[](http://vsbit.org/)

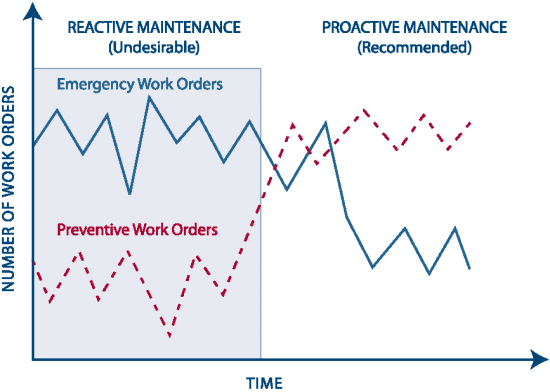
**FACILITIES MAINTENANCE PROGRAM**

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**PREVENTIVE MAINTENANCE PLAN**

Essential Need:

Without a reliable routine planned maintenance program and a scheduled preventive maintenance plan a school district cannot effectively maintain its facilities. This program is not a short term commitment but an ongoing continued work task, assessment of conditions, and developing and implementing preventive and corrective measures. The results of such a program can affect the District’s facilities by reduction of overall costs, lessening impacts on the educational process, providing stable conditions, increased years of reliable service, and the ability to adequately budget.



Communication:

The prime uses of such a program are the development of adequate communication to assess each school and the condition of facilities. A well-developed program brings the schools staff and the district’s maintenance department together to find and resolve maintenance problems and to have a record of what has happened and needs to happen. It is very important that schools staff and new employees understanding of how the system works and what part they play.

Exceptional:

Schools are unique and exceptional from other building types due to their intense use and abuse, young occupants, and special design requirements. Rigid standards and extra precautions must be taken to ensure life safety. Buildings are seasonal with long periods of use and shot periods of limited occupancy. All of these factors make maintenance difficult to do without interfering with the educational process and therefore maintenance must be done after school hours or during vacations periods.

Training and Development:

Building maintenance has become a sophisticated process with new equipment, materials, and maintenance personnel required to have more technical skills to keep the electrical, mechanical, and special systems in operation. To do this formal career path training must be presented and selected individuals must attend courses for continued education on the latest and evolving technical problems.

***A good maintenance program is built on a foundation of preventive maintenance. It begins with an audit of the buildings, grounds, and equipment. Once facilities data have been assembled, structural items and pieces of equipment can be selected for preventive maintenance.***

Facility / Equipment Audit

To assist in the formulation of the preventative maintenance program, a detailed equipment audit needs to be completed. A facility audit (or inventory) is a comprehensive review of a facility's assets. Facility audits are a standard method for establishing baseline information about the components, policies, and procedures of a new or existing facility. An audit is a way of determining the "status" of the facility at a given time-that is, it provides a snapshot of how the various systems and components are operating. A primary objective of a facility audit is to measure the value of an aging asset relative to the cost of replacing that asset. Thus, facilities audits are a tool for projecting future maintenance costs.

The facility / equipment audit will include data on all facilities, infrastructure, grounds, maintenance staff (e.g., specialized training courses attended), and equipment (including boilers, HVAC systems), floor finishes, plumbing fixtures, electrical distribution systems, heating and air conditioning controls, roof types, flooring, furniture, lighting, ceilings, fire alarms, doors and hardware, windows, applicable technology, parking lots, athletic fields/structures, playground equipment and landscaping, and the building envelope. Other issues considered during an audit include accessibility (does a facility meet the requirements of the Americans with Disabilities Act, or ADA?), clean air, asbestos, fire, occupant safety, energy efficiency, susceptibility to vandalism, and instructional efficiency (e.g., alignment with state and local classroom standards).

The facility / equipment audit will include the following data collection:

• Inventory item (brand name, model numbers, serial numbers, etc.)

• quantity and product size(e.g., size 4 or "medium")

• location

• age

• condition

• working as purchased/designed?

• working as it should be?

• working as it needs to be to meet the needs of the users?

• repair history

• specialized upkeep requirements (e.g., oil and filter types)

• evidence of future needs

• recommended service

• estimated remaining useful life

Data collected should have a hard copy filed and/or entered into the software component of the district’s automated work order processing system.

**Reactive / Emergency Maintenance Projects**

Reactive or Emergency Maintenance Projects will continue. Although “breakdown” maintenance is necessary, the objective of the Facilities Maintenance Plan will focus on Preventative Maintenance Programs in an effort to reduce such reactive or emergency type projects translating to an organized reduction in maintenance expenses.



**Maintenance and Operations Issues**

A number of specific maintenance topics are addressed in the following paragraphs. Every school organization in the nation may not encounter every one of these issues since school facilities and circumstances facing school districts vary enormously. Additional information about relevant environmental topics can be found at the U.S. Environmental Protection Agency's Web index page at [http://www.epa.gov/ebtpages/alphabet.html](http://nces.ed.gov/transfer.asp?location=www.epa.gov/ebtpages/alphabet.html).

*Access Controls* - Keys and key control are a major concern for all districts. For example, who has the authority to issue keys? A great grand master keying system - a pyramid system that allows several doors to be opened by one master key - is well worth the investment. (All major manufacturers of lock systems produce great grand master keys.) Also, the concept of a "key" has changed rather dramatically over the past decade or so. Electronic locks that open by card, code, or password are now being used in many schools. Some systems record the time and identification number of each person who opens a door. Whether traditional metal keys or electronic "keys" are used, top-level school managers and the school board should establish a clear and concise "key policy."

*Boilers* - Boilers, which can be used to generate hot water for domestic use (e.g., kitchens, showers, and bathrooms) or for heating buildings, should definitely be included in an organization's preventive maintenance program. Most large boilers are subject to state or local inspection laws, which typically require that the boiler be maintained on a regular basis (at least annually) and that maintenance records be kept on-site. Records of hours of operation and fuel use must also be maintained on-site and made available to inspectors. Moreover, permits may be required for boilers that generate more than 10,000,000 btu/hour. Energy-saving techniques include equipping boilers with hot-water temperature resets (which adjust the temperature of the hot water being produced based on the outside temperature) and using boiler economizers to capture and recycle heat that would otherwise be lost in the stacks.

*Electrical Systems* - Electrical equipment must be maintained like any other piece of equipment, whether it is a distribution pole with transformers or a breaker box for controlling a classroom's electrical power. Professional engineers and electricians should help to determine preventive maintenance tasks and schedules for electrical components. Thermographic scanning, which identifies overheating in connections, motors, bearings, and other electrical switchgear, can be an important tool for determining the condition of electrical gear (the principle behind the test is that a loose connection, bad bearing, or bad breaker bars will produce more heat than a proper connection). Thermographic scanning devices are not expensive and should be part of every district's standard maintenance toolkit. Another new technology, motor current analysis, checks the line current going to a motor and can be used to identify unacceptably high resistance and other defective parts in a motor before it fails. With the widespread use of computers, the proper maintenance of electrical systems is more important than ever in 21st-century schools. Reliance upon extension cords and an excessive number of power poles is an indication that permanent upgrades to the electrical system are needed. However, upgrading existing electrical systems in old buildings must be carefully managed. Building codes vary by locality, but whatever procedures, standards, and inspection requirements exist are designed for standardization and safety and must be carefully followed by school personnel.

**Focus on Energy Efficiency**

Direct Digital Controls (DDCs): DDCs are a state-of-the-art method of controlling temperature with sensors and computers. Thermostats are replaced by a sensor that transmits the current room temperature to a computer, which has been   
programmed with a desired "target" temperature and signals the controller to raise or lower the room temperature as needed to reach the target. DDCs are not yet standard with most Energy Management Systems, but they can be purchased as an upgrade or retrofitted to existing systems.

Two-Pipe and Four-Pipe HVAC Systems: HVAC water systems heat and cool buildings by transferring hot or cold water through a system of pipes. One method of moving the water through a building uses a " two-pipe" system, in which one pipe is used to supply the water to the point of use and the other is used to return the water to its source. Because only two pipes need to be installed, it is initially less expensive than a "four-pipe" system. The drawback is that chilled and hot water can't both be supplied at the same time. In other words, a building is either being heated or being cooled in its entirety at any given time. If, for example, the south face of a building heats up faster than the shaded north face, there is no way to heat one part of the building while another part is being cooled.

In contrast, a four-pipe system (which is basically a dual two-pipe system) allows both chilled and hot water to be sent to different parts of a building at the same time. Because four-pipe systems minimize the need for unnecessary heating or cooling, they are recommended in all new building construction and renovation. Although they cost more to install, their operational savings will quickly recoup the costs and lead to substantial energy savings over a building's life.

*Energy Management* - The cost of energy is a major item in any school budget. Thus, school planners should embrace ideas that can lead to reduced energy costs. Energy Management Systems are computer-controlled systems that operate HVAC units. They can automatically turn on and off air conditioning, lights, and boilers according to pre-programmed instructions entered by facilities staff. Investment in Energy Management Systems will generally be recouped within a few years. The following guidelines will help a school district to accomplish more efficient energy management:

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|  | Graphic of Checkmark | Establish an energy policy with specific goals and objectives. |
|  | Graphic of Checkmark | Assign someone to be responsible for the district's energy management program, and give this energy manager access to top-level administrators. |
|  | Graphic of Checkmark | Monitor each building's energy use. |
|  | Graphic of Checkmark | Conduct energy audits in all buildings to identify energy-inefficient units. |
|  | Graphic of Checkmark | Institute performance contracting (i.e., contracts requiring desired results rather than simply a list of needed products) when replacing older, energy-inefficient equipment. |
|  | Graphic of Checkmark | Reward schools that decrease their energy use. |
|  | Graphic of Checkmark | Install energy-efficient equipment, including power factor correction units, electronic ballast, high-efficient lamps, night setbacks, and variable-speed drives for large motors and pumps. |
|  | Graphic of Checkmark | Install motion detectors that turn lights on when a room is occupied (and off when the room is unoccupied). |

For more information about energy management, visit the National Clearinghouse for Educational Facilities' Energy Page at [http://www.edfacilities.org/rl/energy.cfm](http://nces.ed.gov/transfer.asp?location=www.edfacilities.org/rl/energy.cfm), which provides list of links, books, and journal articles on various methods of heating, cooling, and maintaining new and retrofitted K-12 school buildings and grounds.

Image of Keys*Fire Alarms* - Fire drills should be held on a monthly basis both to test fire alarms and practice occupant response to fire emergencies. During school breaks when buildings are not occupied, detailed inspections of all fire alarms should be performed. This includes testing all pull stations, smoke detectors, and heat detectors located in building ductwork. (Note that the installation of smoke and heat detectors in HVAC ducts is a recent, but important, revision to many building codes.) Some states require that a licensed contractor perform fire alarm inspections.

*Floor Coverings* - Selecting appropriate floor coverings for a school is an important issue that planners must address during renovation and new construction. Often lunchrooms, main halls, and secondary halls are covered in terrazzo, vinyl composition tile (VCT), or quarry tile. These coverings have hard surfaces that are easily cleaned and do not collect dirt. In classrooms where noise control is important, carpets with an impermeable backing, which prevents the passage of water or dirt and are easily cleaned, may be used. Carpets can also be purchased with adhesives already attached to the backing, which helps to ensure complete adhesion without the emission of volatile organic compounds (VOCs). Some primary schools use area rugs rather than carpets because they can be easily removed and cleaned at the end of the school year or as needed. Periodic cleaning of both carpets and rugs is necessary to minimize the likelihood of dirt and other contaminants causing indoor air quality problems. Ceramic floor tile is an excellent surface material for bathrooms or other areas with high exposure to water. Good specifications for a high-performance, soft-surface floor covering include:

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|  | Graphic of Checkmark | nylon type 6.6 |
|  | Graphic of Checkmark | face weight no greater than 20 ounces |
|  | Graphic of Checkmark | 100 stitches per square inch |
|  | Graphic of Checkmark | vinyl pre-coated as primary backing |
|  | Graphic of Checkmark | close-cell vinyl cushion |
|  | Graphic of Checkmark | permanently fused to tufting blanket |
|  | Graphic of Checkmark | no moisture penetration after 10,000 impacts |
|  | Graphic of Checkmark | no backing or seam degradation after 50,000 cycles from Phillips Chair Caster Test |
|  | Graphic of Checkmark | factory-applied non-wet, low-VOC adhesive with no off-gassing (required) |
|  | Graphic of Checkmark | permanent chemically welded seams |
|  | Graphic of Checkmark | warranty non-prorated for 20 years against zippering, delamination, edge ravel, excessive surface wear, and loss of resiliency |

For more information about floor care, visit the National Clearinghouse for Educational Facilities' Floor Care Page at [http://www.edfacilities.org/rl/floor\_care.cfm](http://nces.ed.gov/transfer.asp?location=www.edfacilities.org/rl/floor_care.cfm), which provides list of links, books, and journal articles on the maintenance of a variety of floor coverings in K-12 school classrooms, gymnasiums, science labs, hallways and stairs.

**Focus on Floors: A Common Custodial Task**

A large part of custodial responsibilities in a school building involves the cleaning of various types of flooring.   
In heavy-traffic areas such as corridors, classrooms, and cafeterias, an effective cleaning regimen might be:

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| **Carpets**   |  |  |  | | --- | --- | --- | |  | Graphic of Checkmark | Shake floor mats in entryways | |  | Graphic of Checkmark | Vacuum daily | |  | Graphic of Checkmark | Apply spot remover as needed | |  | Graphic of Checkmark | Deep-clean prior to start of school year | |  | Graphic of Checkmark | Deep-clean during holiday break | |  | Graphic of Checkmark | Scrub-clean twice yearly | | **Hard Surfaces**   |  |  |  | | --- | --- | --- | |  | Graphic of Checkmark | Shake floor mats in entryways | |  | Graphic of Checkmark | Dry-mop daily | |  | Graphic of Checkmark | Apply spot remover as needed | |  | Graphic of Checkmark | Wet-mop three times/week | |  | Graphic of Checkmark | Spray-burnish every other week | |  | Graphic of Checkmark | Strip and finish yearly | |

Although carpets help to protect floors, they are difficult to keep clean. They collect dirt and pesticides, and incubate fungi and bacteria when moisture gets trapped. Adhesive backing can also give off harmful fumes. (Some new school buildings are being constructed without carpets to alleviate these health concerns.) If, however, the floor-covering inventory includes carpet, then provisions must be made for proper cleaning. A hot-water extractor should be available at each school and used weekly to remove stains and dirt. Carpets should be steam-cleaned annually with a professional-quality steam cleaner that generates water at least 140°F and an extraction capability of 60 pounds per square inch. Note, however, that carpets must be dried within 24 hours of wet-cleaning to prevent mold from growing. Carpet bonnets, which attach over a buffer wheel, should never be used because they damage carpets. Larger districts should have in-house staff who are capable of repairing buffers, vacuum cleaners, and other types of carpet-cleaning equipment. Equipment manufacturers will advise customers about training repair people and obtaining replacement parts.

For more information about recommended carpet and rug care, visit the Carpet and Rug Institute (CRI) at [http://www.carpet-rug.com/](http://nces.ed.gov/transfer.asp?location=www.carpet-rug.com/). The CRI also has a site that focuses on carpet use in schools, including such topics as indoor air quality, allergies, and carpet selection, installation, and care at [http://www.carpet-schools.com/](http://nces.ed.gov/transfer.asp?location=www.carpet-schools.com/).

*Gym Floors* - Gym floors are generally constructed with vinyl composition tile (VCT), one of several grades of maple flooring, sheet rubber, or other synthetic materials. Regardless, all floor types must be kept clean and properly maintained. VCT floors must be periodically stripped and re-waxed to ensure a safe surface. Wood floors require annual screening and resealing with a water-based sealant. They should also be sanded, re-marked, and resealed in their entirety every 10 years. Synthetic floors (including sheet rubber but excluding asbestos tile) require monthly cleaning and scrubbing with buffers.

*Heating, Ventilation, and Air Conditioning (HVAC) Systems* - All schools require HVAC systems to control indoor climate if they are to provide an environment that is conducive to learning. In fact, oftentimes a district's ability to convene classes depends on acceptable climate control. If the air conditioning is broken on a 90ºF day or the heating system is malfunctioning on a 30ºF day, school gets canceled. It’s as simple as that. Different regions of the country may place emphasis on different elements of the HVAC system, but the bottom line is the same: HVAC components must be maintained on a timely and routine basis. This preventive maintenance will ensure reliability, reduce operating costs, and increase the life expectancy of the equipment.

Two effective ways to improve HVAC performance are through air balancing and water balancing. Air balancing ensures that the desired amount of air reaches each space in the building, as specified in the mechanical plans. Water balancing ensures that the flow of water from the chiller and boiler is in accordance with the mechanical plans. Water balancing is normally performed before air balancing. Balancing is usually conducted upon installation of new equipment and at 5- to 8-year intervals. Balancing should also be conducted when building space is substantially modified or room use is changed dramatically.

For more information about HVAC systems, visit the National Clearinghouse for Educational Facilities' HVAC Page at [http://www.edfacilities.org/rl/hvac.cfm](http://nces.ed.gov/transfer.asp?location=www.edfacilities.org/rl/hvac.cfm), which provides list of links, books, and journal articles on HVAC systems, including geothermal heating systems, in school buildings.

*Hot Water Heaters* - Hot water heaters in schools range in size from small 10-gallon heaters to the larger 100- to 300-gallon units. Preventive maintenance programs must be established for each hot water heater. At a minimum, maintenance should include inspection for failing safety devices and leaks (especially if fired by natural gas).

*Kitchens* - Kitchens present special problems for school districts: not only must equipment be maintained properly to ensure reliability, but 1) a high state of cleanliness must be maintained in all food preparation areas; 2) the use of certain cleaning agents may be discouraged in food preparation areas; and 3) ovens and stoves pose special fire safety concerns. Floor surfaces are also of particular concern in kitchens since they must be easy to clean yet slip-resistant. Recommended floor surfaces for kitchens include terrazzo, vinyl composition tile (VCT), quarry tile, and sealed concrete. Kitchen equipment is a prime candidate for inclusion in a preventive maintenance program.

*Painting* - Painting should be done on a regular schedule that is published well in advance of work dates to minimize inconvenience to building occupants. Painting needs will be determined largely by the type of surface, the type of paint applied previously, and surface use (e.g., a window pane may be expected to receive less wear than a chair rail). A wall constructed of concrete masonry units (CMU) and painted with a two-part epoxy can last 8 or 10 years whereas drywall will require painting every 5 or 6 years. Bathrooms, special education areas, and other high-traffic areas will require painting on a more frequent schedule. A durable, cleanable (i.e., able to be cleaned by the custodial staff with their standard tools), paint from a major manufacturer should be used for indoor areas. Water-based latex paints are a good choice because they are low in volatile organic compounds (VOCs) and do not produce noticeable odors. Surfaces must be properly prepared for painting, which may require the use of a primer to cover stains and discolored patches.

*Plumbing* - Like other major building components, plumbing should be included in the preventive maintenance program. Sprinkler systems, water fountains, sump pumps, lift pumps, steam traps, expansion joints, and drains are likely targets for preventive maintenance. Standing water must be avoided at all costs since it damages building materials and can lead to mold concerns that affect indoor air quality.

*Public Address Systems and Intercoms* - These communications tools are vital to the management of school buildings and, in an emergency, the safety of building occupants. Public address (PA) systems must be connected to the emergency power system to ensure uninterrupted communications in the event of a power failure. Public address systems and intercoms should be tested on a daily basis during the broadcast of a school's morning announcements. If broadcast systems fail to perform properly, they must be repaired immediately.

*Roof Repairs* - Roofs should be included in a preventive maintenance program and inspected on a regular schedule. The key to maintaining good roofs is the timely removal of water from the surface and substructure of the roof. Thus, all leaks and damaged tiles must be repaired as soon as possible to prevent water damage and mold growth. On composition built-up roofs, hot tar is the only appropriate repair method. Single-ply and modified roofs should be repaired in accordance with the manufacturer's instructions. Staff should read carefully all warranties issued with new roofs to ensure that required maintenance is conducted according to specification so as to avoid invalidating the warranty protections. For example, failing to inspect or repair a roof on an annual basis (and document such efforts) may be considered justification for a manufacturer invalidating a warranty.

The facility manager must verify the annual assessment of each roof within the district, recording the date of installation, type of roof, type and thickness of insulation, type of drainage, and type and frequency of repair work. Detailed drawings or photographs that show the location of repairs should be maintained, as should contact information for the installing contractor. This information is extremely important in the event of a major roofing problem or an insurance or warranty claim. Whatever type of roof is selected, it should be installed by a reputable (and bonded) roofer and should include a non-prorated warranty.

For more information about roof repairs, visit the National Clearinghouse for Educational Facilities' Roof Repair Page at [http://www.edfacilities.org/rl/roof\_maintenance.cfm](http://nces.ed.gov/transfer.asp?location=www.edfacilities.org/rl/roof_maintenance.cfm), which provides list of links, books, and journal articles discussing maximizing the life cycle performance of school roofs, as well as roof inspection strategies, scheduling, documentation, and repair resources.

*Water Softeners* - Water softeners are often used in hot water lines in those regions of the country where the water has a high concentrate of calcium. Water softeners remove the calcium from the water, which prolongs the life of dishwashers and other kitchen equipment.

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| Schools are subject to federal regulations, state law, local law, district policy and, hopefully, good, old-fashioned common sense. While these guidelines cite relevant federal regulations they cannot fully describe the wide range of individual state, local, and district-level regulations, many of which vary considerably between jurisdictions. For more information about federal and state regulations, visit the U.S. Environmental Protection Agency's Links to EPA Regional Office and State Environmental Departments web page at [http://www.epa.gov/epapages/statelocal/envrolst.htm](http://nces.ed.gov/transfer.asp?location=www.epa.gov/epapages/statelocal/envrolst.htm). |

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| **Establishing Expectations for Custodial Efforts**  Planners, administrators, and community members must agree on what constitutes "cleanliness." While there is not a nationwide standard for describing standards of cleanliness, a five-tiered system of expectations is emerging to help guide decision-making:  Level 1 cleaning results in a "spotless" building, as might normally be found in a hospital environment or corporate suite. At this level, a custodian with proper supplies and tools can clean approximately 10,000 to 11,000 square feet in an 8-hour period.  Level 2 cleaning is the uppermost standard for most school cleaning, and is generally reserved for restrooms, special education areas, kindergarten areas, or food service areas. A custodian can clean approximately 18,000 to 20,000 square feet in an 8-hour shift.  Level 3 cleaning is the norm for most school facilities. It is acceptable to most stakeholders and does not pose any health issues. A custodian can clean approximately 28,000 to 31,000 square feet in 8 hours.  Level 4 cleaning is not normally acceptable in a school environment. Classrooms would be cleaned every other day, carpets would be vacuumed every third day, and dusting would occur once a month. At this level, a custodian can clean 45,000 to 50,000 square feet in 8 hours.  Level 5 cleaning can very rapidly lead to an unhealthy situation. Trash cans might be emptied and carpets vacuumed on a weekly basis. One custodian can clean 85,000 to 90,000 square feet in an 8-hour period.  The figures above are estimates. The actual number of square feet per shift a custodian can clean will depend on additional variables, including the type of flooring, wall covers, and number of windows, all of which must be taken  into account when determining workload expectations. |