U. S. Postal Service
Washington, DC

Energy Conservation and Maintenance
Maintenance Handbook MS-49

Transmittal Letter 3
June 1, 1981

A. EXPLANATION

This is a complete revision of Handbook MS-49. It also incorporates material formerly in Handbook MS-50, Guidelines for Energy Conservation and Maintenance Planning in Small Postal Facilities.

B. DISTRIBUTION

1. Initial. This handbook is being distributed to all facilities for which the USPS is responsible for building maintenance and utilities.

2. Additional copies. Order on Form 1286, Request for USPS Publications, from Maintenance Technical Support Center, P.O. Box 1600, Norman, OK 73070-1600. Headquarters offices order through the Document Control Division.

C. RESCISSIONS

Handbook MS-50 and all previous editions of Handbook MS-49 are cancelled.

D. COMMENTS AND QUESTIONS

Recommendations for improving the guidelines and procedures contained in this handbook are solicited from all sources. Anyone wishing to make such recommendations should submit them to:

Director
Maintenance Technical Support Center
P. O. Box 1600
Norman, OK 73070-1600

E. EFFECTIVE DATE

These instructions are effective on receipt.

Peter A. Jacobson
Director
Office of Maintenance Management

TABLE OF CONTENTS

CHAPTER 1

GENERAL

110 INTRODUCTION

110.10 Purpose

This handbook promulgates the energy conservation strategies, developed under and consistent with the USPS energy conservation policy, relating to the operation and maintenance of postal facilities.

110.20 Scope

The instructions and guidelines contained herein apply to all USPS facilities where the USPS is responsible for building maintenance and utilities.

110.30 Background

This handbook was first published in response to the need for the U.S. Postal Service to comply with the Federal Government energy conservation requirements. It is being updated to reflect changes and more definitive statements of requirements. A chronology of some of the significant events is shown below:

The Federal Energy Management Program was established in 1973 to develop energy conservation and management techniques at the federal level. The Energy Policy and Conservation Act, enacted in 1975, formalized the ongoing government activities and established direct requirements for Federal energy conservation programs in the area of transportation, buidings, procurement policies, and standards. Executive Order 12003, issued July 20, 1977, established conservation goals. The National Energy Conservation Policy Act enacted in 1978, reinforced and strengthened Federal energy conservation rules. Presidential proclamation No. 4667 of July 10, 1979, established Emergency Building Temperature Restrictions. On February 19, 1981, Presidential proclamation No. 4820 rescinded the Emergency Building Temperature Restrictions but the Postal Service, in order to restrain energy consumption, voluntarily, continued to maintain the standards contained herein.

120 ORGANIZATION

In July 1979, the Postmaster General established an Energy Committee to direct the USPS Energy Conservation Efforts. The committee consists of the Assistant Postmasters General of Real Estate and Buildings, Engineering and Technical Support, Delivery Services, Mail Processing, and Procurement and Supply; the Executive Director of the Research and Development Laboratory; and the Chairman, Special Assistant to the Deputy Postmaster General for Energy-Conservation. The Energy Committee is responsible for the overall coordination, planning and execution of the USPS energy conservation efforts and the committee reports directly to the Deputy Postmaster General.

Each of the five regions has an Energy Coordinator, who reports to the Regional Postmaster General. The Energy Coordinator's role is to disseminate policies and guidelines established by the Energy Committee and to coordinate energy conservation programs. There are energy coordinators at the District and MSC levels of management primarily in the areas of Mail Processing and Customer Services.

The Engineering and Technical Support Department through the Office of Maintenance Management, the Maintenance Technical Support Center, and the Regional Maintenance Management Divisions are responsible for the planning, implementing and monitoring of facility energy programs.

The Real Estate and Buildings Department is responsible for the execution and administration of energy conservation efforts relating to new construction, renewable and alternate fuels, and the Energy Consumption Reporting System.

At the facility level, local maintenance organizations are involved in the implementation of energy conservation measures, monitoring their effectiveness and the reporting of energy consumption data.

130 RESPONSIBILITIES

Overall responsibility for conservation of energy in postal facilities belongs to the installation head. The installation head, or a designated employee, has the responsibility for ensuring that all applicable guidelines and instructions in this handbook are followed. The management of the energy program also entails the completion of forms and records for energy consumption on a scheduled basis.

These records are mandatory and are the subject of management and Inspection Service audits. Appendix A contains a checklist which is commonly used and is included in this handbook so facilities can easily conduct self-evaluation.

Each employee has a vested responsibility to support the Energy Conservation Program, to achieve goals for controlling energy consumption and to get the maximum benefit from energy used.

140 LEASED FACILITIES

Retrofitting to accomplish energy conservation should be considered relative to the terms of the lease and whether or not it is cost effective to the USPS.

As a general rule, regular maintenance routines shall be carried out in these facilities in accordance with the applicable guidelines and instructions contained herein.

150 GOALS

The Postal Service has established energy conservation goals that meet or exceed those established by Executive Order 12003 and the National Energy Conservation Policy Act which are:

(a) A 20 percent reduction in average energy use per gross square foot of floor area in FY 1985 from the average energy use per gross square foot in FY 1975 for existing owned or leased buildings.

(b) A 45 percent reduction in average energy use per gross square foot of floor area in FY 1985 compared to FY 1975 for new owned or leased buildings.

NOTE: The 20 percent reduction goals for existing buildings and the 45 percent reduction goals for new buildings cover total energy used in operating the facility and mail processing equipment.

(c) The established USPS yearly energy reduction goals.

160 TRAINING

Training seminars have been instituted on a nationwide basis for first-line maintenance and operational supervisors. This training is directed to the application of energy conservation measures in facility operation.

Energy conservation seminars for managers and supervisors are available at the Postal Service Training and Development Insitute in Bethesda, MD. Instructor training, directed to energy seminars, energy audits and building surveys is given at the Technical Center in Norman, OK.

Energy conservation is also incorporated in courses taught to craft employees at the Technical Center, Norman, OK.

170 MAINTENANCE

Proper maintenance is necessary if a facility is to be energy efficient. Maintenance provides whatever support is necessary for proper operation and availability of plant and postal equipment, and sustains a working environment conducive to high morale and productivity by Postal employees.

180 SAFETY AND HEALTH

It is the responsibility of each installation head to provide for the safety and health of employees. Care should be taken to ensure that actions to conserve energy are not so zealous as to create hazardous working conditions. A special word of caution is expressed against over-reduction of illumination of passageways, stairways, catwalks, and ladderways. No employee is to be subjected to unreasonable discomfort; and the individual problems of the handicapped must be given special attention.

190 ENERGY SOURCES AND CONVERSION FACTORS

The following is a list of energy sources, units of measurement and conversion factors to British Thermal Units (BTU's). Two conversion factors are shown for electricity and steam; a source conversion value which reflects generation and transmission losses, and a site conversion value which represents energy available for use.

Energy Source	Unit of Measurement	Conversion Factor (BTU)
Electricity	Kilowatt Hour (KWH)	11,600 (source) 3413 3,412 (site)
Fuel Oil	Gallon (42 Gallons = 1 Barrel)	138,700
Natural Gas	Cubic Feet	103,100 1,030
Liquified Petroleum Gas (LPG)	Gallon	95,500
Coal	Short Ton	24,500,000
Purchased Steam	Pound	1,390 (source) 1,000 (site)

CHAPTER 2

CONSERVATION PRACTICIES AND STANDARDS

210 ELECTRICITY

Approximately 60 percent of all energy consumed by postal facilities is in the form of electricity. Electrical energy requires 3.4 units of raw energy, (gas, coal, oil) at the point of generation, to produce one unit of energy which is usable at the facility. This inefficiency causes electricity to be the most expensive energy source in terms of dollar-cost per million BTU's.

This chapter deals with all systems and equipment which are run by electricty with the exception of heating, ventilation and air conditioning equipment which will be treated in a later chapter.

211 LIGHTING SYSTEM GUIDELINES

Energy Conservation through effective lighting management is achieved by considering the following principal elements of lighting:

1. On-Off Control
2. Lamps
3. Ballasts
4. Fixtures
5. Fixture Arrangement

Obviously, the proper combination of all of these elements will produce the most energy efficient lighting system. Furthermore, because all of the elements, except wiring, have a direct effect on the amount of energy required to operate a lighting system, substantial reductions can be achieved by the adoption of the many techniques now available. Hence a discussion of the appropriate techniques for each of the elements is outlined in the following sections.

211.10 On-Off Control

It is a basic fact that when a lighting system is turned off the greatest possible amount of energy is saved. In view of this, significant savings can be achieved by the prudent use of switches, time clocks, photocells, etc. Accordingly, the following measures should be adopted: Consider installing a master switching system, using low-voltage switching, permitting an operator at one or more stations to turn off all lighting at the end of occupied periods. Seven-day timers can also be used to automatically program the lights.

Provide manual switches or photocells to shut off lights when available daylight is adequate. Install additional switches to permit shutting off lights in unoccupied areas of the building.

Revise switch circuits to permit turning off unused or unnecessary lights.

Install time switches which automatically turn off lights after a preset time in areas where occupancy is intermittent. Require manual switching to energize the lights again after that time.

Use photocell and/or time clock controls for outdoor lighting whenever feasible. Parking areas, building exteriors, identification signs, etc., usually require lighting only for a part of the period of darkness. Such lighting should be turned off automatically during late evening and early morning hours except for security and safety lighting.

Lighting provided for specific tasks will be turned off when those tasks are completed. Room lights will be turned off when leaving. Light switch decals (see Exhibit 2-1) are now available through procurement services (U.S. Postal Service Label 165). These decals are red with white lettering with the phrase, "Going out? Turn it off." They are very effective tools in lighting conservation.

Schedule the custodial force to clean during normal daylight working hours. This is particularly helpful in office areas since the lighting needed while cleaning at night will not be used. It will also enable the maintenance force to shut down the environmental systems when the building is not in use. Cleaners, guards, and other work persons should turn lights on at night only in the immediate space in which they are working, and should turn lights off when they leave the area.

211.20 Lamps

The following chart is a summary of the characteristics of the different types of light sources. The selection of the right type of lamp to the specific task or function will greatly enhance energy savings.

TYPE	EFFICIENCY (LUMENS/WATT)	COLOR	COLOR RENDITION	OPERATING LIFE (HRS)
Incandescent	8-33	Soft White	Excellent	750 - 4,000
Quartz	15-27	White	Excellent	500 - 4,000
Mercury Vapor	23-49	Cool White	Good	12,000 -24,000+
Metal Halide	51-93	White	Excellent	7,000 -20,000
Fluorescent	28-92	Cool and Warm White	Good	6,000 -20,000+
High-Pressure Sodium	59-126	Golden Yellow	Fair	12,000 -24,000
Low-Pressure Sodium	137-183	Yellow	Poor	18,000+

The following techniques concerning both delamping and re-lamping should be adopted.

DE-LAMPING

In most existing buildings, the lighting system is significantly over designed for the new foot-candle standards. One way to correct this overlit condition and bring the area into conformance with the new standards, is to remove lamps on a selected basis. Care should be used to avoid undue dark spots or shadows.

(a) In removing lamps from existing fluorescent fixtures, always disconnect the ballast, observe normal precautions when working on electrical circuits; insure power is disconnected while making wiring changes.

(b) Reduction in light levels should be scheduled at the same time fixtures are cleaned and re-lamped. Any change will be less noticeable due to increased fixture efficiency.

(c) Remove lamps from existing HID fixtures.

(d) Remove lamps from Decorative Lighting Fixtures.

RE-LAMPING

In the past several years the lamp manufacturers have produced a great array of new lamps that are more energy efficient. That is, they put out more usable light while using less electricity.

In order to take advantage of this new technology and realize immediate energy savings, the old standard lamps are to be replaced with the new energy efficient types.

In fluorescent fixtures, standard lamps shall be replaced with energy efficient lamps such as Wattmiser II, Econowatt II, Supersaver II, etc. The GSA commercial items, P-A-1579 and A-A-1582, for 4 and 8 foot lamps cover this type of energy efficient lamp. As additional lamps become available, the life and lumens per watt over the life of the lamp should compare favorably with the types listed above before they are considered for purchase.

Many post office lobbies and corridors have an abundance of recessed incandescent "high hat" fixtures (recessed down lights) which are meant to produce a nonglare downlight. Unfortunately, these fixtures are very inefficient because they trap much of the light from a common floodlight within the fixture itself, thereby reducing much of the useful or effective light.

An excellent opportunity is available to increase this efficiency, while at the same time retaining the high quality incandescent light. Replace the 150-watt floodlight with a 75-watt ER-type elliptical reflector.

Because of the more efficient optics of the elliptical reflector, an equal amount of effective light is produced for one-half the wattage. Since this conversion involves only the simpler replacement of one type of incandescent light for another, without the necessity of replacing the whole fixture, extremely short paybacks of about two month are possible.

RE-LAMPING MERCURY VAPOR

If the Mercury system (typical 400 watt) is less than 10 years old, it is likely that the ballast and fixtures are still in good condition. Accordingly, the lamps should be removed and replaced with 325 watt Metal Halide lamps. In most cases this can be accomplished using the same ballast. This technique will probably result in an overlit condition which will allow for even more savings through removal of some lamps on a selected basis. If the system is more than 10 years old, the entire system should be replaced with HP sodium or Metal Halide.

LOW PRESSURE SODIUM

Low Pressure Sodium vapor lighting should normally be used only for security purposes because of poor color rendition. Uses are exterior lightings, interior lighting where a light is required over a safe during nighttime, etc.

211.30 Ballast Replacement

Maximum efficiency occurs with the new energy efficient fluorescent lamps when they are used with energy efficient ballasts. If the system is less than 10 years old, it is probably not cost effective to replace ballasts on a group basis. If the system is more than 10 years old it is likely that the ballasts are nearing the end of their useful life and therefore it is cost effective to group replace ballasts in conjunction with conversion to the energy efficient tubes. In any event, all failed ballasts are to be replaced with ballasts labeled for use with energy efficient lamps.

211.40 Fixtures

Modify existing fixtures to accomodate higher efficiency lamps. For instance, convert incandescent lamp fixtures to high intensity discharge (HID lamps) or convert existing HID lamps to newer or more efficient ones.

Replace incandescent fixtures with more efficient fluorescent or HID lamps depending upon application.

Some diffusers, particularly the "egg crate" type, cause a reduction of light level when they are dirty or aged. Where light level can be increased by removing diffusers, it should be done and safety clips (GSA 6210-00-930-2819) should be installed to prevent tubes from falling should they come loose. Diffusers should not be removed if doing so would:

(a) Expose tubes to damage by activities normally conducted beneath them such as handling long objects in a stockroom.

(b) Cause visual interference by placing tube in line of sight normally used while performing routine work.

(c) Expose the fixture to grime as would happen if the diffuser is designed to seal the fixture (refractive diffuser).

Procedures of fixture cleaning and group replacement of lamps are described in Maintenance Handbook MS-39, **Fluorescent and Mercury Vapor Lighting - Cleaning and Relamping.**

211.50 *Fixture Arrangement*

In many instances, re-lamping with higher efficiency and higher output lamps will result in an overlit condition which will allow for the permanent removal of or rearrangement of fixtures.

(a) Consider lowering fixtures or individual lights so they will provide recommended illumination levels on the task area at reduced wattage.

(b) Fixture Location . In relation to the fixed desk or work station, fixture location is the major consideration. The most desirable location for fixtures or lamps remaining energized should be directly over, or to the side, of work surfaces where they will not create reflections. Ensure that surroundings seen by the worker do not become dark, producing visual discomfort.

211.51 Task and Zone Lighting

Task and zone lighting permit reduction of General Background lighting levels while still providing sufficient illumination for tasks.

Task lighting is usually provided by mounting a light source on the piece of furniture or equipment at which the task is performed, e.g., desk lamp, case light, LSM console light, etc.

Zone lighting is provided in those areas where a large task or group of tasks is being performed and it is impractical to provide task lighting.

When task or zone lighting is installed, general background lighting will be reduced, if necessary, to the levels specified in 211.52.

211.52 The following tables indicate lighting levels for specific areas or tasks:

TABLE 211.522 Building interior Lighting Levels

Area	Footcandles
Office	
General Background	20-25
Task: Desk	50*
Workroom	
General Background with Task Lighting	20-25
General Background without Task Lighting	50
Task: Case, LSM Console, etc.	50*
Zone: Mark II, Pouching, etc.	50*
Lobby	
General Background	30
Task: Table	50*
Service Counter	80*
Stairway & Corridor	20
Elevator, Freight & Passenger	20
Toilet & Washroom	30
Locker Room	30
Storage Room, Inactive	5
Storage Room, Active; Rough, Bulky Materials	10
Storage Room, Active, Parts Storage	
General Background	20
Desk or Counter	50*
Training Room	70*
Conference Room	50*
Air-Conditioning Equipment Room	20
Tunnel & Gallery	10
Boiler Room	20
Dining	30*
Maintenance Shop & Battery Room	50*

*Measurements taken at work surface.

**When specific workroom areas contain distribution or carrier cases equipped with case lights, General Background lighting shall be reduced to 20-25 fc. Additional switching capability may be required to provide this flexibility for existing facilities. New buildings will be designed to include multiple switching capability (RE&B Bulleting No. DC-81-5).

Exceptions to above standards require the written approval of the installation head.

211.53 Vision Problems

Special consideration will be given to employees who have particular problems related to vision. Localized task lighting shall be provided for this purpose.

211.54 Light Measurement

(a) Light level readings shall be taken with a properly calibrated light meter with an accuracy range of 15% or better.

(b) Task light readings shall be taken on a work surface or where the task is performed, e.g., desk surface, typewriter surface, etc. At cases, light readings shall be taken at the normal position at which mail is held when sorted.

(c) Background or general lighting readings shall be taken at a level of 36-40 inches above the floor surface.

(d) Zone light readings shall be taken at the working level where the task is performed.

211.60 Reflectance of Surroundings:

(a) Paint or apply light-colored finish on interior room surfaces to increase reflectance and improve the performance of both natural and artificial illumination. The table below shows the approximate reflectance of various colors of painted surfaces.

White	.80 to 85%
Pale pink or yellow	.75 to 80%
Ivory	.70 to 80%
Cream	.65 to 75%
Buff	.55 to 65%
Gray	.35 to 50%
Light blue	.35 to 50%
Light green	.30 to 40%
Dark green	.15 to 25%
Red	.15 to 25%
Dark blue	.5 to 15%
Brown	.8 to 12%
Black	.2 to 5%

(b) Finishes. In selecting a light finish for offices and work rooms, for example, the reflectances should be in the following ranges:

Ceiling finishes	.80 to 90%
Walls	.40 to 60%
Furniture	.24 to 45%
Plant equipment	.25 to 45%

To further increase reflectivity, it is recommended that all acoustical ceiling tiles be either cleaned or replaced. Painting these tiles would be the least desirable, since the tile loses its acoustical quality when painted.

212 Motors, Small Postal Equipment and Applicances.

212.10 Motors.

(a) Perform proper maintenance at specified intervals, e.g., tighten belts and pulleys, lubricate, replace worn bearings, check alignment, etc.

(b) When replacing a worn or defective motor, replace with a motor sized as close to load as possible and use highest efficiency motor available.

212.20 Battery Powered Service Equipment.

212.21 Service equipment in this text refers to fork lifts, vertical lifts, personnel carriers, etc.

(a) Use only when properly charged. Use of improperly charged batteries results in a permanent loss of battery capacity resulting in a loss of efficiency. Manufacturer's charging recommendations or procedures must be followed.

(b) Charge battery during off-peak demand periods.

(c) Perform required Preventive Maintenance.

212.22 Electric Delivery Vehicle Charging.

(a) Chargers should be sub-metered so as to be able to accurately determine electrical energy consumption.

(b) Charging should be done during off-peak demand periods.

212.30 Vehicle Engine Pre-Heaters.

These electrical resistance heaters, where used, consume a considerable amount of energy, particularly when used unnecessarily. Use only when conditions specified in Paragraphs 212.31 and 212.32 are expected and then only with automatic timers.

212.31 Diesel Equipment.

(a) Pre-heaters shall be used only when temperature is below 22 °F.

(b) Maximum time pre-heater should be on prior to engine start is three hours.

212.32 Gasoline Equipment

(a) Preheaters shall be used only when temperature is below 10 °F

(b) Maximum-on-time prior to engine start is two hours if the temperature is -20 to 10 °F, or three hours if the temperature is less than -20 °F.

212.33 Electronic Ignition.

Newer equipment supplied with this type ignition will normally start without the aid of preheaters except in extremely cold climates, e.g., Alaska.

213 Mail Processing Equipment.

Mail processing equipment consumes a significant portion of electrical energy which, in many cases, can be reduced without adversely affecting mail processing.

213.10 Scheduling

Multi-position machines or systems should be used only fully manned to the extent practicable. For example, use one sorting machine with all input stations or consoles manned rather than two machines with one half of the input stations manned.

213.20 Utilization.

To the maximum extent possible, equipment should be run at its rated capacity to handle mail. When practical, mail should be batched or backlogged to assure optimum performance.

213.30 Shutdown

213.31 Fixed mechanization shall be shut down when it will be idle for five or more minutes.

213.32 Non-fixed mail processing equipment shall be turned off when not processing mail or being run for maintenance purposes.

(a) MPLSM (Model 120/121/140/141/OCR). The main motor and internal fluorescent lights should be shut off when not needed (by opening main breaker), if expected idle time is 15 minutes or greater.

(b) ZMT/ESP Cabinets. Should be shut down if expected idle time exceeds one hour.

(c) Mark II/Edger-Feeder Systems. Transport motors should be off except when processing mail or running necessary maintenance tests. Electronic circuits should be left on unless expected idle time exceeds one hour. Warm up time for UV lamps and electronics requires at least 30 minutes.

(d) OCR Equipment. All elements of OCR control equipment, except Memory Drum, should be turned off when not required. Drum must be left on continuously to prevent damage and/or excessive start-up time.

(e) ABMPS, SPLSM and all control electronics, except DR-32 Disk Unit, should be turned off if expected idle time is more than 15 minutes. Therefore, the DF-32 Disk Unit must be run continuously.

(f) SPLSM/SPFSM. This equipment should be shut down when expected idle time exceeds 15 minutes.

214 Miscellaneous Building Equipment.

214.10 Reduce Transformer Losses by replacing defective or inadequately sized transformers with high efficiency rating, e.g., dry types with a low temperature rise rating.

214.20 Reduce Elevator Use.

(a) Reduce number of elevators in service during off-peak periods.

(b) Turn off motor-generator set located in elevator machine room when not in use: (nights, weekends, off-peak periods, etc.).

(c) Encourage use of stairs.

(d) Consider shutting off down escalators during periods of light traffic.

214.30 Reduce Use of Electric Appliances.

(a) Limit use of coffee pots.

(b) Turn off unnecessary appliances.

(1) Cosmetic lighting in vending machines.

(2) Office equipment when not in use.

214.40 Add time clock control to electric water heaters to deactivate during periods when facility is not in use.

214.50 Be alert to and repair leaks in high pressure process air plumbing. Compressed air is energy.

220 HEATING, VENTILATING, AND AIR CONDITIONING

221 General Policies.

It is the purpose of this section to provide an outline of the various conservation measures that can be adopted to bring about the most energy efficient operation of the Heating, Ventilating, and Cooling (HVAC) systems while at the same time maintaining a suitable working environment. It is generally recognized that a large amount of energy now required for operating HVAC systems can be saved by prudent and proper operating methods. The HVAC system consists of four major components: heating equipment, cooling equipment, air handling systems, and temperature controls. Each of these major components is supported by auxiliary systems, all of which have important interacting functions. While it is understood that different operating modes and different building characteristics make each building a unique situation, it is generally acknowledged that the application of these conservation techniques will result in a well managed building.

Furthermore, because most of the Postal Facilities were designed and constructed prior to the adoption of new temperature standards, there is now a significant reserve in the capacity of the HVAC system to produce and distribute more energy than is required. Accordingly, the entire operating philosophy of building systems must now consider these new parameters.

221.10 Building Temperature Standards.

In order to properly control the use of energy in postal facilities, temperature standards have been established for the various occupied and unoccupied areas. Chart 221.10 contains these standards for both heating and cooling modes.

It is permissible to allow interim temperatures to float between the Heating and Cooling set points, provided supplemental energy (Boiler and Chiller) is not used to heat above 65 °F or to cool below 78 °F. Internal heat loads may cause temperatures to rise above the heating set point or ventilation air to cause temperature to fall below the cooling set point. Under no circumstances should heating energy be used to meet the cooling set point, nor should cooling energy be used to meet the heating set point. Thermostats should be secured to prevent adjustments by unauthorized personnel.

221.20 Humidification.

221.21 Some postal facilities have humidification systems to reduce discomfort and operating problems caused by dry air. In some instances, humidity control systems are installed to meet equipment operating requirements, e.g., computer rooms, laboratories and printing areas. However, excess humidity above the required level is energy wasteful. It takes approximately 1000 BTU's to vaporize one pound of water for humidification. Therefore, where humidification systems are installed, they shall be carefully maintained and controls accurately calibrated for efficient operation.

221.22 Generally, humidistats shall be set to provide a maximum humidity of 20 percent relative humidity (r.h.) during the heating season. Humidistats in computer rooms and other special areas shall be set to provide only the required humidity level for proper equipment operation. This is usually between 20 and 45 percent r.h.

221.23 Ventilation must be carefully controlled if humidification equipment is to be used. In mail processing areas having dock doors or other uncontrolled ventilation conditions, humidification is not permitted except in areas where sustained periods of zero degrees Fahrenheit weather exist.

221.30 Dehumidification.

Dehumidification for comfort purposes is generally accomplished when cooling is in operation. Temperature Control systems that sub-cool and then re-heat to achieve a certain relative humidity percentage will be rendered inoperable.

Dehumidification for special areas such as computer room will be permitted with the percentage of Relative Humidity governed by the process or the recommendations of the equipment manufacturer.

221.40 Snow Melting System.

Snow melting systems are of two basic types. The first, and most common, is a serpentine or grid piping system buried beneath a paved surface through which a heated antifreeze solution is circulated. The second is an electric grid system buried beneath the paved surface. Both systems use large quantities of energy to heat the large mass of pavement above the freeze point. Furthermore, because they must be in the "on-line energized status" to provide quick response when needed, they are very wasteful. Therefore, any snow melting system should only be used only on steep inclined ramps or in other areas where regular plowing or salting is impossible.

221.50 Portable Heaters and Fans.

Portable heaters or portable fans are not to be used to supplement heating or cooling when interior building temperatures are maintained between 65 and 78 °F by the main HVAC system.

The adoption of the new temperature standards along with other conservation improvements has resulted in most Postal Service HVAC systems being considerably oversized. Consequently, it should not be necessary to use portable equipment to supplement heating or cooling requirements. These requirements are to be satisfied by adjusting and balancing the main system. Furthermore, portable fans, whether wall, pedestal, or floor type, are generally inefficient for cooling purposes in that the heat generated by the fan motor places a greater load on the central cooling system than the small amount of "effective cooling" produced by the portable fan. Also, they are annoying because of high noise level, excessive dust, and rapid air movement.

222 Operating Guidelines for HVAC Systems.

In order to realize the full benefits from the new temperature standards, the traditional methods of operating a building must be greatly modified. The change in standards to 65 and 78 °F along with the other energy conservation efforts such as insulating, storm windows, weather stripping, etc., has resulted in HVAC systems that are significantly oversize. Accordingly, if maximum energy savings are to be achieved the HVAC will require extensive adjustments along with the adoption of the new operating techniques.

In addition to the problems created by the oversize condition, the fact that postal facilities are located in all types of climates with wide variation in seasonal conditions makes it even more important to implement many new methods.

The following paragraphs contain a summary of the new methods that are to be considered.

222.10 Boiler Operation.

222.11 Boiler Operating Temperatures for hot water boilers and operating pressures for steam boilers can be reduced because of the reduced heating requirements. Hot water supply temperature can be lowered from approximately 200 ^{0}F to 170 ^{0}F. Operation below 170 ^{0}F may result in Boiler condensation problems. Likewise, steam pressures can be reduced from the 8 to 10 PSI range to the 3 to 6 PSI range.

For those boilers that do not experience condensation problems it is generally worthwhile to reset boiler output set-points even lower during periods of mild weather. Do not, however, operate a boiler at a temperature lower than that specified by the manufacturer.

222.12 Where fuel is used to generate steam or hot water, a boiler operating log, PS Form 4846, shall be maintained to assure a safe, efficient operation. When the annual heating cost exceeds $15,000 per year, the boiler operating efficiency shall be reviewed at least weekly by comparing steam or hot water produced to fuel used. Other locations should make this comparison monthly. When information reflected on this log discloses a decrease in operating efficiency, necessary maintenance will be performed to restore the boiler to peak efficiency. Annual boiler inspection by qualified postal maintenance personnel is essential for safety and energy conservation by increased efficiency. Care should be taken to check both the fire and the water sides of the boiler to assure efficient operation. Biannual inspections by certified postal boiler inspectors are required and will serve to complement annual inspections. See MS-1, Paragraph 10-6 and Appendix 13-b, Preventive Maintenance Guides.

222.13 Boiler operating procedures shall be posted conspicuously in each boiler room. The names of persons qualified to troubleshoot boiler malfunctions shall be listed with the operating procedures. Basic operating criteria for efficient operations are contained in MS-24, Subchapter 360, and MS-1, Section 10.

Indoor-outdoor reset controls have been used to control the temperature of hot water heating systems in most medium and large postal facilities for many years. These controls monitor the outside temperatures and adjust the hot water temperatures as low as possible while maintaining space heating. The boiler operates less, the heating system piping losses are less, and total fuel can be reduced up to 25 percent.

These devices were not generally used in smaller, owned and leased offices because of the cost and installation requirements. Recent innovations have overcome these disadvantages and the new units are more economical and easier to install. It is advisable to consult the supplier about the application and the usable water temperature range to avoid possible problems with fire box condensation.

222.20 Chiller Operations.

222.21 In many instances Chiller operating temperatures can be raised because of the reduced cooling load. Chilled water outlet temperatures can be increased from the 44 to 46 ^{0}F range to the 49 to 50 ^{0}F range. However, when the high humidity conditions are experienced it may be necessary to operate at the lower range to obtain sufficient dehumidification for employee comfort. In addition to adjusting the outlet temperature of the chilled water, significant savings can be realized by lowering the condenser water temperature.

222.22 Perform maintenance on chillers, air handlers, and cooling towers in accordance with MS-1, Operation and Maintenance of Real Property, to sustain efficiency designed into the equipment.

222.23 Operate environmental systems manually during marginal cooling demands. Manual handling will avoid having the automatic system respond to marginal cooling demands. Upon marginal demand conditions, it would be possible to have the heating and cooling systems operating simultaneously, responding to different zones in the building. Meet cooling requirements without operating chillers whenever possible.

222.24 Monitor chiller operations to maintain an efficient operation of the equipment. Chillers usually operate at maximum efficiency between 70% and 80% of load. Supervisors at each location should review logs and manufacturer's data and prepare written instructions on chiller operation to assure that they are operating in the most efficient load range. If chiller performance curves are unavailable, a review of logs or a controlled test will reveal whether for example, one chiller run at 90% or two chillers run at 45% results in the least electrical load. Before a second chiller is put in service, the first chiller should be throttled back to prevent incurring unnecessary demand costs. When the second unit must come on-line during a peak electrical load, it should be brought on with demand limiters set to reduce peak load requirements.

222.25 The lower the chiller water temperature, the less efficient the chiller operation. Therefore, the chilled water temperature should be set at the maximum that will provide the required comfort in the building.

222.26 The lower the condenser water temperature, the more efficient the chiller will operate. However, chillers have a minimum allowable condenser water temperature specified by the manufacturers. This may range from 55 to 80 °F, and some new units require only that the condenser water temperature be equal to or greater than the return chilled water temperature.

Cooling towers shall be maintained and operated to provide the minimum allowable condensing water temperature. Cycling the tower fan should be the first step in controlling condenser water temperature. Manufacturer's data and operating logs shall be consulted to determine minimum condenser water temperature for each location.

222.27 Keep all filter systems in peak operation and keep filters clean.

222.30 Air Handling Units.

Major energy savings can be achieved by the proper use and control of air handling units as well as building ventilation. Inasmuch as the combined factors of air temperature and air volume dictate the amount of heating or cooling supplied to an area, any change of either of these factors will provide a corresponding change in the amount of heating or cooling. Thus, when in the heating mode, if the system output exceeds the new reduced temperature requirements, both the air temperature and air volume should be reduced. Because the greatest savings can be gained by reducing the air volume, i.e., slowing the fans, this should be done first. A 10% reduction in fan volume will reduce the power consumption of the fan by 35%. Next, reduce the supply temperature. This will not conserve as much energy as accomplished by the air volume reduction, but it will be significant.

During the cooling season, when air volume is reduced, chillers will be operating under different loading conditions. Chiller operating conditions should be evaluated to select operating procedures that will derive maximum efficiency of the chillers.

When slowing down fans, the air system must be balanced for the reduced air volume flow. (See MS-42 for balancing procedures). In large areas where more than one air handling unit is serving, it may be more profitable to turn off selected air handling units than to slow others.

Another major energy user associated with air handling units is the terminal reheat system. Terminal reheat provides close control of summer humidity and also allows each zone to be individually controlled. However, since these systems are very wasteful, and really not required in postal facilities, they should be modified to more efficient type systems.

222.40 Guideline for Building Ventilation.

222.41 In the broad sense, building ventilation can be defined as the total of all air entering a building regardless of where it comes from or how it enters. Essentially, the entering air is from two sources, infiltration, which is undesirable, and controlled ventilation, which is needed for occupant respiration (breathing) and heat control (comfort).

222.42 Infiltration, which is air that leaks into buildings, around doors, windows, and through various cracks and openings, is undesirable because it is not heated, cooled, filtered, or properly distributed. Consequently, infiltration should be held to a minimum by means of caulking, weatherstripping, vestibules, revolving doors, dock seals, etc.

On the other hand, controlled ventilation, which is often referred to as minimum or fixed ventilation, is needed to provide: (1) adequate oxygen, (2) minimum carbon dioxide, and (3) dilution of smoke and odors. In most situations, because the amount of air to supply the oxygen and dilute carbon dioxide is surprisingly small, about 1 CFM per person for oxygen and 4 CFM per person for carbon dioxide dilution, the typical infiltration quantities satisfy this aspect. However, to assure that occupants are supplied with sufficient fresh air not only for respiratory needs, but als to dilute smoke and odors, the ventilation rates shown on Chart 222.50 should be adopted. Ventilation shall meet OSHA and local code requirements. Furthermore, because the ventilation rates specified by the chart only satisfy breathing requirements, it is necessary to supply additional amounts for special exhausts, such as paint spray and welding booths, plus additional amounts to satisfy heat control techniques such as Economizer Control and Enthalphy Control which are fully explained elsewhere in this handbook.

223 GUIDELINES FOR DAILY OPERATION OF HVAC SYSTEMS

The proper day-by-day use and control of the entire HVAC system will achieve significant energy savings. Proper operating procedures, coupled with an intimate knowledge of the building and its unique operating conditions, along with the beneficial use of weather conditions, will not only produce large savings but, at the same time, provide suitable working conditions.

The correct selection and balance of HVAC equipment, properly operated and controlled to satisfy operating schedules and weather conditions will result in a system that is energy efficient. Thus the skill and knowledge to intelligently start, stop, and otherwise control the equipment to attain the optimum use of all components will greatly contribute to energy savings.

The following paragraphs contain several concepts that may be adopted for use in the day-by-day control of HVAC systems.

223.10 HVAC Reduction During Periods of Non-Occupancy.

When a facility or portions of a facility are unoccuppied, the operation of the HVAC system should be reduced to correspond to the reduced levels of activity. In many instances, due to the energy inertia of the building, this reduction can start about one hour before the non-occupancy occurs.

Temperatures are to be set back to those shown on Chart 221.10.

TEMPERATURE STANDARDS
FOR
OWNED AND LEASED BUILDINGS

FUNCTIONAL AREA	HEATING		COOLING	
	OCCUPIED °F Max.	UNOCCUPIED °F Max.	OCCUPIED °F Min.	UNOCCUPIED No Cooling
AREAS WITHIN THE PRINCIPLE BUILDING ENVELOPE				
SPACE REGULARLY OCCUPIED PERFORMING EVERYDAY WORK				
Work Rooms	65	55	78	No Cooling
Private Office				
General Office				
Conference Rooms				
Training Rooms				
Credit Unions				
Swing Rooms				
Food Service Rooms				
Locker Rooms				
Toilet Rooms				
Maintenance Shops				
Stock Rooms				
Active Storage	65	55	78	No Cooling
SPACE NOT REGULARLY OCCUPIED IN PEFORMING EVERYDAY WORK				
Lockbox Lobby	55	55	No Cooling	No Cooling
Entrance Vestibule				
Mailing Vestibule				
Mech-Elect Rooms				
Supply Center Stockrooms (Intermittantly occupied)	55	55	No Cooling	No Cooling
Ground Equipment Storage	45	45	No Cooling	No Cooling
Container Storage				
Mail Bag Storage				
Inactive Storage				
Basements, Unused				
Enclosed Parking	45 NOTE 1	45 NOTE 1	No Cooling	No Cooling

Chart 221.10

TEMPERATURE STANDARDS FOR OWNED AND LEASED BUILDINGS

FUNCTIONAL AREA	HEATING		COOLING	
	OCCUPIED ^{0}F Max.	UNOCCUPIED ^{0}F Max.	OCCUPIED ^{0}F Min.	UNOCCUPIED No Cooling
SPECIAL AREAS				
Medical Areas	72	55	76	No Cooling
Special Temperature Control Areas	NOTE 2	NOTE 2	NOTE 2	NOTE 2
Data Processing Areas	NOTE 2	NOTE 2	NOTE 2	NOTE 2
Tenant Space & Court Rooms	65	55	78	No Cooling
AREAS OUTSIDE THE PRINCIPLE BUILDING ENVELOPE				
SPACE REGULARLY OCCUPIED IN PERFORMING EVERYDAY WORK				
Enclosed Platform				
(with sorting)	55 NOTE 3	55 NOTE 3	No Cooling	No Cooling
(without sorting)	45 NOTE 1	45 NOTE 1	No Cooling	No Cooling
Guard House	65	55	No Cooling	No Cooling
Truck Dispatch Office	65	55	No Cooling	No Cooling
VEHICLE MAINTENANCE FACILITIES AND GARAGES				
Office Areas	65	55	78	No Cooling
Swing Rooms				
Locker Rooms				
Parts Control				
Repair Bay				
Wash Bay				
Paint Rooms	65	55	78	
Inactive Storage and Enclosed Parking	45 NOTE 1	45 NOTE 1	No Cooling	No Cooling

NOTES

NOTE 1 Heat is only required in these areas if necessary to protect plumbing from freeze damage.

NOTE 2 The temperature and humidity of Special Control areas will be governed by the requirements of the operation or the equipment manufacturer. If special conditions are not required, the general office standard will apply.

NOTE 3 These temperature standards only apply where platforms meet climate criteria of publication 37 for enclosed heated platforms.

OUTDOOR AIR REQUIREMENTS FOR OWNED AND LEASED BUILDINGS

FUNCTIONAL AREA	VENTILATION RATE		COMMENTS
	NON-SMOKING AREAS		
	CFM/PERSON		
WORK ROOMS	5		
PLATFORMS	5		
SERVICE COUNTER	5		
CONSOLE TRAINING ROOM	5		
PEDC CLASSROOMS	5	NOTE 1	USED FOR SMALL GROUP INSTRUCTION OR STUDY
COURTROOMS and MEDICAL AREAS	7		
DARK ROOMS	20	NOTE 2	
ELEVATORS	15		
	CFM/SQ. FT.		
MECH-ELECT ROOMS	1.0	NOTE 3	
PAINT ROOMS	1.0	NOTE 3	
TRASH ROOMS	1.0	NOTE 3	
BLDGS & GROUNDS STORAGE	1.0	NOTE 3	
BATTERY ROOMS	1.0	NOTE 3	
FLAMMABLE STORAGE	1.0	NOTE 3	
PRINTING ROOMS	1.0	NOTE 3	

NOTES

1. Used for small group instruction or study.

2. 20 CFM per person or 10 air changes per hour for black and white work. Color processing may require additional make-up air for local exhaust systems.

3. Supply air may be required in addition to this quantity for local exhaust systems, make-up air for boilers, hot water heaters, etc. Printing areas may need additional ventilation for control of solvents and ink diluents.

Chart 222.50

OUTDOOR AIR REQUIREMENTS FOR OWNED AND LEASED BUILDINGS

FUNCTIONAL AREA	VENTILATION RATE	COMMENTS
	SMOKING AREAS	
	CFM/PERSON	
PRIVATE OFFICE	20	
GENERAL OFFICE	20	
DRAFTING ROOMS	20	
CREDIT UNION	20	
TENNANT SPACE	20	
SERVICE LOBBY	20	
CLASSROOMS	25	USED FOR LECTURES, SEMINARS, ETC.
CONFERENCE ROOMS	35	
SWING ROOMS	35	
FOOD SERVICE ROOMS	35	SUPPLY AIR FOR KITCHEN EXHAUST IS IN ADDITION TO THIS QUANTITY.
MAINTENANCE SHOPS	35	SUPPLY AIR FOR WELDING, WOODWORKING, ETC., IS IN ADDITION TO THIS QUANTITY.
	CFM/LOCKER	
LOCKER ROOMS	35	
	CFM/STALL OR URINAL	
RESTROOMS	75	
	CFM/SQ. FT. OF FLOOR	
ENCLOSED PARKING	1.5	OR 6 AIR CHANGES PER HR REF NFPA CODE 88A.

Chart 222.50

OUTDOOR AIR REQUIREMENTS FOR OWNED AND LEASED BUILDINGS

FUNCTIONAL AREA	VENTILATION RATE	COMMENTS
	SMOKING AREAS	
VEHICLE REPAIR SHOPS	1.5	SUPPLY AIR FOR PAINT SPRAY BOOTHS, SOLVENT TANKS AND TAIL PIPE EXHAUST IS IN ADDITION TO THIS QUANTITY.
CORRIDORS, ETC.	.02	
MAIL BAG STORAGE	.02	
CONTAINER STORAGE	.02	
ACTIVE STORAGE	.02	
INACTIVE STORAGE	.02	
UNUSED BASEMENTS	.02	
LOCK BOX LOBBY	0	
ENTRANCE VESTIBULE	0	INFILTRATION IS ADEQUATE TO SATISFY MINIMUM VENTILATION
MAILING VESTIBULE	0	

Chart 222.50

Air handling units should be shut down or used sparingly.

Radiators and registers in vestibules and lobbies should be cut back or shut off. However, use care to avoid possible freeze-up.

Exhaust fans should be shut down or cycled to the minimum extent.

Boilers, chillers, pumps, furnaces, unit heaters, and the like, should be turned down or, if feasible, shut off.

223.20 Optimum Use of Air Handling Units.

The cycling of air handling units, even during periods of heavy occupancy, will save electric power and still maintain adequate ventilation and temperature control. The on-off cycles can be varied from zone to zone, and the on-off time period can be varied to satisfy both time-of-day and season loads.

In addition to systematic duty cycling, those air handling units serving areas of low occupancy can be shut off for extended periods.

Also, during those times of the year when outside ambient temperatures are in the range of desired interior temperatures, air handling units can be shut off for extended periods.

223.30 Optimum Utilization of Heating-Cooling Equipment.

The reduction of equipment "run" time not only saves energy but also extends the useful life of the equipment. Consequently, it is almost always beneficial to delay the start-up as long as possible and perform the shut-down as soon as possible. Equipment should be shut down or set back at least 30 minutes before closing a building.

The successful accomplishment of this concept requires a comprehensive understanding of the entire HVAC system, an intimate knowledge of building operations, and the intelligent use of weather forecasts.

223.40 Start/Stop Heating Equipment.

Boilers, furnaces, unit heaters, pumps, and the like, should not be started until the interior temperature is steadily falling and approaches the 65 °F set point or during the rapid falling of outside temperatures that will soon affect interior building conditions. Conversely, heating equipment should be shut down when interior temperatures steadily rise above the 65 °F set point due to internal gains or when outside temperatures are rapidly rising through 50-60 °F range.

The start/stop shut-down time can be further extended when the stored hot water or steam energy is fully utilized.

223.50 Start/Stop Cooling Equipment.

Chillers, pumps, and cooling towers, and the like, should not be started until the interior temperature is approaching the 78 °F set point and is steadily rising or when rapidly rising outside temperatures will soon affect the interior conditions. On the other hand, dropping outside temperature or extended cloud cover will soon affect a prompt shut-down of the cooling equipment and full utilization of the stored chilled water energy.

In addition to the above, the optimum use of cooling equipment can also be used to avoid the peak electric demand. For instance, if a hot day is anticipated, the building can be sub-cooled during the early morning hours, and then, during that part of the day when the peak occurs, the chiller can be shut off allowing the stored chilled water and building inertia to perform the cooling function. This concept, because of the sub-cooling, will not save significant energy, but will avoid the establishment of a new peak. This same sub-cooling concept will provide "reserve" capacity to supply cooling for a short period and thus eliminate the start-up of another chiller.

223.60 Use of Outside Air.

The design of most HVAC systems incorporates both minimum and maximum outside air dampers. By properly controlling the maximum outside air dampers, outside air can be used as the energy source for cooling, or by keeping the maximum dampers closed, internal heat can be retained to supplement heating season requirements.

There are two types of control systems that govern the use of outside air. One, called the "Economizer Cycle" or "Economizer Control", works strictly on outside dry-bulb temperature. Thus, when the outside dry-bulb temperature is in the proper range to cool the building, the dampers are opened and outside air, instead of mechanical refrigeration, is used for cooling. When the outside temperature becomes too warm or too cool, the dampers are closed. Under this system, the humidity level of the outside air is totally disregarded.

The other system, called "Enthalpy Cycle" or "Enthalpy Control", considers the humidity of the outside air as well as the temperature. When the outside air contains the right combination of temperature and humidity, it can be used effectively for cooling.

This system will prevent the intake of excessive moisture even though the dry-bulb temperature appears to be suitable for cooling. Air with a high moisture content, when brought into a warm building, places a high latent load on the HVAC system and, even worse, causes employee discomfort.

Outside air may be used for cooling both day and night, but because nighttime temperatures are usually cooler, it is especailly effective for night cooling. Furthermore, it may be possible to use outside air to sub-cool, i.e., cool the building well below normal, during the night and early morning hours in order to delay the start-up of the cooling equipment as the following day gets progressively warmer.

230 WATER CONSERVATION

Water is our most precious natural resource. The following suggestions will reduce cost as well as conserve this resource:

Approximately five percent of the total utility cost in a building is for water and sewage. Since this is such a small percentage, the control of water is often overlooked, and waste results. Water used for air conditioning and for irrigating lawn areas is often subject to waste and misuse.

230.10 Control.

Water consumption should be recorded to disclose any increase in usage. The justifiable, seasonal variations can be verified by comparing the cooling tower make-up water usage which is determined to reduce sewage charge as discussed in paragraph 337.

230.20 Temperature Restrictions.

(a) When equipment manufacturers' specifications permit, lower heat settings on water heaters so that the temperature of running water at the fixture does not exceed 105 °F.

(b) 180 °F water is required for sanitation in kitchen and cafeteria areas. This can be accomplished by the use of a mixing valve to send the 180 °F water to the kitchen area and 105 °F water to all other fixtures.

(c) Hot water shall not be used to wash vehicles without written approval from the Regional Headquarters Vehicle Services Branch.

230.30 Water Treatment.

Maintenance Handbook MS-24, "Heating, Cooling, and Ventilating," Chapter 6, describes water treatment and provides policy and safety guidelines.

230.40 Water Conservation Measures.

(a) Be alert to observe and stop leaks. A leak 1/8" in diameter can waste 120,000 gallons of water per month.

(b) Tighten pump packing glands to allow only a few drops per minute. This is all that is needed for lubrication and cooling. Excess leakage wastes water treatment as well as water.

(c) Do not use water-cooled air conditioning condenser systems that operate without cooling towers. This type of system, where domestic water is used in a condenser one time and wasted to drain, is illegal in some locations.

(d) Control cooling tower bleed-off to prevent unnecessary loss of water. The amount of bleed should be set as indicated by water analysis report. See MS-24, Chapter 6.

(e) Do not over water lawns and shrubbery areas. The best procedure will vary from location to location, but daily watering is seldom needed. Watering should be accomplished during the night where practical to derive maximum benefit from moisture.

(f) Record water usage, compare with like periods to disclose excess usage, and take corrective action.

(g) Reduce water flow rate in restroom flush valves by adjustment or modification to minimum amount necessary.

(h) If experience indicates they are needed, replace faucets with self-closing types.

(i) Small (3 to 5 gallon) water heaters may be installed to provide hot water in isolated areas and to prevent long plumbing runs.

240 BUILDING ENVELOPE.

A major factor in the annual quantity of energy consumed (and wasted) is the energy efficiency of the building shell or envelope. The building envelope typically is comprised of such components as roof, exposed floors, exterior walls, windows, and doors. The relative efficiency of a building envelope is the ability of the envelope to resist undesirable or untimely losses and gains of indoor heat due to conduction, convection, infiltration and isolation (solar radiation). Additionally, relative efficiency of the building envelope is affected by its orientation with the elements and protection by surrounding structures.

240.10 Transmissions of Heat Through Walls.

Heat transmission through a wall is a function of its resistance to heat flow, modified by the effects of solar radiation and wind velocity on the outside surfaces. Heat loss through walls is greatest in colder climates, but it varies everywhere according to wall orientation, with the highest losses occurring through north walls and the lowest through south walls, due to the beneficial effects of the sun. The overall "U" value (thermal transmittance) of a wall may be decreased by adding insulation material to the inside or the outside surface, or by filling the cavities within the wall structure.

240.20 Transmission of Heat Through Windows and Skylights.

Heat transfer through glass is affected by many environmental factors. The most significant are: solar radiation, outdoor/indoor temperature difference (thermal conduction), and the velocity and direction of air flow across interior and exterior glass surfaces.

Heat loss through windows is highest in climates of high degree days, is modified by orientation, and is greater through windows of northern exposure than of southern exposure, due to the absence of direct north sunlight. Direct and diffuse solar radiation through windows is the largest single component in heat gains through glass. Heat gain in the cooling season due to conduction, by comparison, is relatively insignificant. It is rarely worthwhile to convert single glazing to double glazing for the sole purpose of reducing conductive heat gain. It is often worthwhile, however, to convert single to double glazing for the benefits obtained in the heating season, and this in turn will reduce conduction gains in the summer.

The following methods are the most commonly used to reduce heat loss or gain:

240.21 Storm Windows. May be applied either to the outside or inside of existing windows. If existing windows and frames are of poor construction and allow high rate of infiltration, storm windows should be fitted on the outside where possible. If storm windows are added to existing windows, consider the use of reflective or tinted glass to reduce solar gain and glare in summer.

240.22 Double-glazed Windows. Existing single-glazed windows may be converted permanently to double-glazed windows by the addition of a new glazed frame to accept the additional pane of glass. Where the existing window frame is in good condition and the glazing system permits, a single sheet of glass may be replaced by a sealed, double-glazing unit. Where the existing window frame is in poor condition and is scheduled for renovation and replacement, a double-glazed window frame should be considered.

240.23 Thermal barriers. During the night hours, windows can be covered with thermally insulated barriers or shutters to reduce heat transmission losses.

240.24 Solar Control Devices.

A variety of these are available for installation outside the window, inside the window or on the window surface itself to reduce solar gain.

(a) External sun screens which prevent direct sunlight from falling upon the glass surface are the most effective methods of controlling solar heat gain. External shading may be achieved by fitting eyebrows over the tops of windows or fins at the sides, of windows. Eyebrows are most effective over windows with a southern orientation and can be designed to provide total shading from high altitude sun during the middle of the day. They are not as effective as vertical side fins for east and west orientations.

External louvered sun screens may be fitted close to the outside surface of the windows. The louvered sun screens may be made removable so as to admit solar radiation in winter.

(b) Internal shading devices are least effective, as sunlight has already entered the building and only a portion can be reflected back through the window. Internal shades of various types, i.e., venetian blinds, roller shades, draperies, etc., may be fitted to the inside of the window. If draperies are used, they must be fire resistant and preferably of woven fiberglass which has a higher reflectance. Although internal shades are not as effective as other methods of solar control, they are relatively inexpensive and easily adjustable, permitting full visibility through the window and maximum use of natural light when solar radiation has been reduced.

(c) Tinted or reflective glass may be added to existing glazing to convert it from single to double or may be used to replace the existing glazing. Reflective polyester films may also be applied directly to the inside surface of the glass. These films are self-adhesive and require careful application to avoid bubbles or trapped air. The film is easily abraded, which reduces performance and appearance. Film on the inside of the building subjected to normal wear and tear will have a reduced useful life.

240.30 Transmission of Heat Through Roof.

Heat transfer through a roof/ceiling is a function of the roof's resistance to heat flow, modified by the effect of solar radiation (reduces heat loss) and wind (increases heat loss) on the outside surface. Conduction and solar gains through roofs can form a considerable part of the heat loss or gain.

240.31 Insulation.

The most effective means of reducing heat transfer through a roof is to lower the "U" value of the roof by adding insulation. For buildings located in high degree day climate zones, with large roof areas in proportion to floor area, consideration should be given both to insulating the roof and to reducing its absorption coefficient.

(a) Where the existing roof is sound and directly accessible from an attic space or ceiling void, mineral fiber may be sprayed on the undersurface, with rigid batt or other applicable insulation for the inside surface. Any of the above materials could be laid on the top of a ceiling in an attic space, but attention should be paid to uninsulated ducts or pipes in attics, where reduced temperatures due to ceiling insulation could result in excessive heat losses and/or freezeups. It is suggested that these ducts or piping also be insulated. If application of insulation to underside of roof is considered, also consider effect of possible condensation of moisture on underside of roof membrane in winter. Install vapor barrier beneath insulation if necessary.

(b) Where a roof has deteriorated and is scheduled for extensive repair, deteriorated insulation may be replaced and certain rigid foam insulations may be applied to the top of the roof, not only reducing the "U" factor but also the thermal stress on the repaired membrane. Where roofing must be replaced, new rigid insulation may be added to reduce the "U" factor. Such "rigid" insulation may be fiberglass, fiberboard, cellular glass, perlite boards, and other materials embedded in a solid mopping of hot asphalt and protected with the new roof membrane.

(c) Soffits of roof overhangs and roof facias, often left uninsulated, can result in excessive heat loss, and they should be insulated at the same time as the main roof.

240.32 Solar Radiation.

The effect of solar radiation is influenced by the absorption coefficient of the outside surfaces; dark colors (high absorption coefficient) will reduce the heat loss in winter more than light colors (low absorption coefficient), at the expense of higher heat gain in the summer.

(a) Any paint or reflective finish applied to reduce absorption must be compatible with the existing roof and capable of withstanding abrasion. The absorption coefficient of roofs may also be reduced by adding a surface layer of white pebbles or gravel.

(b) If insulation is added to the surface of the roof for the purpose of reducing heat loss and/or gain, select the most desirable absorption coefficient.

(c) The use of roof sprays is advisable when solar heat on the roof is excessive, generally under the following conditions:

(1) On buildings with a large roof-to-floor area ratio, i.e., one or two story office buildings with large roof areas where heat gains through the roof constitute a major portion of the cooling load.

(2) Where there is more than 70% possible sunshine during the cooling season.

(3) High dry-bulb conditions accompany the solar conditions.

(4) Low wet-bulb conditions coincident with high dry-bulb conditions and sunshine.

240.33 The mass of the roof, with its thermal interia, will mitigate heat loss by delaying the impact of outdoor temperature changes on conditioned spaces indoors.

240.40 Transmission of Heat Through Floors.

Heat transfer through slab-on-grade floors occurs mainly around the perimeter. Heat loss and gain through suspended floors over unheated spaces, however, occur evenly across the entire floor area. Transmission loss through floors can be especially significant when floors are located over unheated crawl spaces or where they project out from the building below. In existing buildings, it is generally impractical to add insulation to the tops of floors. A suspended floor above an unheated space (garage, crawlway, etc.) may be insulated on the underside by applying spray foam or rigid insulation as described for roofs. Uninsulated slab-on-grade floors should be insulated around the perimeter. Insulation materials should be placed vertically along the outside end of the floor and should extend down at least two feet below the floor surface.

240.50 Heating/Cooling Due to Infiltration.

Infiltration of cold outside air into a building through cracks, openings, gaps around windows and doors, etc., increases the building load to such an extent that it is often responsible for as much as 25 percent of the building's heat loss or gain.

240.51 Caulking.

(a) Inspect the building exterior and interior surfaces and caulk all cracks that allow outdoor air to penetrate the building skin.

(b) Caulk around all pipes, louvers, or other openings that penetrate the building skin.

(c) Caulk cracks around window air-conditioning units or through-the-wall units which remain permanently installed year-round, and cover window air-conditioning units with plastic covers outside.

240.52 Weatherstrip Doors and Windows.

Weatherstrip all doors with a copper interlocking-type weatherstrip. In buildings where carpeting extends to the doors, use a compression-type weatherstrip attached to the bottom of the door to clear the carpeting.

240.53 Vestibules and Revolving Doors.

(a) **Vestibules.** In buildings that experience heavy and continuous traffic through external doors, infiltration may be reduced by building vestibules for each external door to form an "air-lock". Depending on the particular characterisitcs of the building, the vestibule may be constructed either inside or outside the building.

(b) **Revolving Doors.** Another solution here is to replace single-swing doors with revolving doors. Although more effective when used in conjunction with vestibules, revolving doors may also be used alone.

240.54 Where wall construction is particularly porous, e.g., cinder block walls or other similar porous materials, cover the exterior surface with a suitable sealing treatment.

240.55 Vertical Shafts and Stairs. To reduce the effect of heated air rising in vertical shafts and stairs, these areas should be sealed from the rest of the building. Open stairwells that connect with circulation spaces at each floor level should be provided with walls and self-closing doors to isolate them. Access holes into vertical service shafts should be provided with gasketed ceiling covers. Holes at the shaft wall, to allow the passage of pipes and ducts at each floor level, should be sealed, and sleeves around the pipes and ducts packed with suitable material.

240.56 (Reduce temperature in stairwells. (But protect pipes from freezing.)

240.57 Elevator Shafts. Elevator shafts are usually provided with a vent at the top into the equipment room or building exterior. This vent is necessary as a smoke release and, if vented into the machine room, the machine room must be vented to the outside. The required area of the vent is three and one-half (3½) percent of the hoistway area or three (3) square feet for each car, whichever is greater. Care shall be taken that this required venting is not obstructed; however, excess venting shall be avoided.

240.58 Install automatic closers on all dock and other exterior doors.

240.60 Increasing Beneficial Solar Heat Gain.

(a) Clean windows to permit maximum sunlight transmission.

(b) Operate draperies and blinds to permit sunlight (when available) to enter windows during the winter; move desks or work stations out of the direct path of sunlight to avoid occupant discomfort.

(c) A percentage of direct solar radiation is stored in the structure and furnishings where it will help to offset the heat load at night. Permit the space temperature to rise so that excess heat can be stored in the structure and be available for heating at night or in cloudy periods. Even on cloudy days diffuse radiation is considerable; allow it to be transmitted into the occupied spaces.

(d) If windows are not fitted with blinds, draperies, or shutters, consider installing them to control the rate of heat flow into and out of the building.

(e) During heavily clouded weather, and at night, reduce the heat loss through windows by drawing shades and draperies or closing shutters.

(f) Trim all foliage shading the southern, eastern or western face of the building in winter. Reduce any evergreen foliage grossly blocking the winter sun.

(g) Where possible, remove shading devices and any other objects casting shadows on the building surfaces during winter.

240.70 Controlling Solar Heat Gain.

The cooling load can be reduced by proper use of shading devices. In southern climates, the north-facing glass can receive a surprising amount of diffuse solar radiation. If heat gain from north windows is excessive, treat them similarly to the other exposures.

(a) In hot weather, adjust existing blinds, draperies, shutters or other shading devices on windows to prevent penetration of solar radiation into the building.

(b) Install blinds, draperies, shutters, or other shading devices on the inside of all southeast and west-facing windows that are subject to direct sunlight in hot weather or exposed to a large expanse of sky.

CHAPTER 3

ENERGY AND COST CONTROL

310 GENERAL

Familiarity with the utility installation and distribution systems by the designated building manager is essential to carry out an effective energy and cost control program. The information in this chapter will assist in understanding utility measurement, cost determination, and USPS orientation procedures required for monitoring energy usage and their costs.

320 UTILITY MEASUREMENT

Utility billings are in part based on a measured use of that energy source. It is, therefore, necessary to understand the utility measurement in order to properly calculate the bill and monitor usage.

321 Electricity

(a) The quantity of electricity used is measured by a recording meter in kilowatt hours (kWh).

(b) Demand is usually determined by one of two methods: a recording graph which plots 15 to 30 minute intervals, or a peak recording meter which records the highest 15 to 30 minute demand during the period between meter readings.

(c) Power Factor is usually determined by comparison of the readings from the kilowatt (kW) meter and a kilovolt-ampere (kVA) meter. The ratio of the readings from these two meters is the Power Factor.

322 Gas

Standard use is measured by a recording meter in cubic feet.

323 Oil

Quantity is measured by a pump in gallons as delivered.

324 Steam

Standard use is measured by a condensate meter which is calibrated to read equivalent thousands of pounds of steam or by a steam flow meter.

325 Liquified Petroleum Gas (e.g., propane).

Quantity is measured by a pump in gallons or pounds, as delivered.

326 Coal.

Quantity is delivered in pre-weighed tons, as ordered.

330 UTILITY CHARGES

The cost of utility service, electricity, steam, oil, gas, etc., represents a significant portion of a facility's operating expense.

331 Electricity.

331.10 Energy.

Most electric utilities use a sliding block approach for energy charge, that is, so much per kWh for the first 100 kWh, so much per kWh for the second thousand, and so on.

331.20 Demand.

The consumer's actual demand is computed as the average amount of energy consumed in a predetermined demand measurement interval, usually 15 minutes (other intervals also are used by the utilities, particularly 30 minutes and 60 minutes). Regardless of the interval, the highest demand recorded during a month becomes the actual demand for the month.

Many utilities also employ a special clause which states that no matter what your actual demand may be in any given month, the demand for which you are billed may be no less than a certain percentage of a peak demand, recorded typically during the previous 12 month period.

331.30 Power Factor.

Power factor is a means of expressing how much of the current flowing in a circuit is in phase with the voltage. Sometimes a penalty is assessed for low power factor. This penalty is usually incurred for power factors below 85% or 90%.

331.40 Load Factor.

Load factor has to do with the relationship between the average and the maximum demands. The load factor will usually affect the energy charge as a discount or a penalty. Each utility company defines load factor differently; therefore, a review of the rate schedule should be made to determine how the load factor affects the bill.

331.50 Fuel Adjustment.

Many electric utilities have imposed an additional energy cost called a fuel adjustment which reflects the increased cost of fuel. It can be a substantial charge.

332 Gas.

Most utilities use therms for billing. The number of therms is obtained by converting from the cubic foot readings on the meter. A therm, which is 100,000 BTU, is equal to approximately 100 cubic feet of gas. As with electric rates, the utilities use a sliding block approach, so much for the first 1000 units and so much for each additional block.

333 Oil.

Most suppliers charge a fixed price per gallon regardless of quantity ordered. The rate charged is dependent on the grade of oil used.

334 Steam.

Most utilities use a sliding block approach with each block in thousands of pounds of steam used.

335 Liquified Petroleum Gas (e.g., propane).

Suppliers charge a fixed price per gallon or pound.

336 Coal.

Suppliers charge a fixed price per ton delivered. The rate per ton is dependent on the grade of coal used.

3375 Water Cost.

The cost of water may vary from $.20 per 1,000 gallons in one location to over $.75 in another. A sewage charge is usually assessed based on the amount of water used. Since large air-conditioning cooling towers evaporate approximately 84 percent of the water they require, the sewage charges can often be reduced by metering the cooling tower make-up water and subtracting make-up from total usage. Sewage charge will be paid based on the difference. Sewage charges can also often be reduced by subtracting a percentage agreed to by the supplier to determine the sewage charge. Special arrangement should be made for this allowance.

338 Basic Billing Information Needed.

338.10 Familiarization with the utilities' installation and distribution systems, by the responsible employee at each facility, is essential. To efficiently carry out a successful and effective utilities management and conservation program, obtain and maintain the following:

(a) Contracts and Rate Schedules. Copies of all current contracts for the purchase of utilities, and all applicable rate schedules, rules and regulations available for reference.

(b) Bills. Copies of all utilities' bills for each billing period.

(c) Location of Meters. A scale map, site plan, or sketch of the layout for each utility showing meter locations.

(d) Areas Served by Meters. Knowledge of what loads, buildings, remote equipment units, and areas are served through each meter.

(e) Meter Readings. Since types of meters vary, request the utility supplier to instruct selected USPS personnel in reading the meters. This will insure that one or more employees at each facility will be capable of reading meters.

(f) Historical Cost Data. Information as to the budgeted utility costs, and past expenditures for utilities.

338.20 Review of Bills.

Electrical rates are highly variable. All factors involved in the total electric bill must be examined to insure that the most economical rates are realized. Review the electric bills and have copies of the appropriate rate schedules, and understand the billing factors. Do not take the utility companies' information for granted. Check to see that all the factors leading to the total dollar amount are correct. Demand charges should be renegotiated for any improvement which reduces demand.

338.30 Change in Rate.

Rate schedules for all utilities must be reviewed at least annually to insure that the most economical rate is being used. The finance organization and the maintenance organization should collaborate to review rate structures. Additional reviews must be made if utility rate structures are changed. Usually rate structures can be obtained from state regulatory bodies (where they exist). If there is any question on how to interpret the rate schedule, forward all of the required information to the General Manager, Maintenance Management Division in the Regional Office.

340 RECORDING, ANALYZING, AND CONTROLLING ENERGY USE

In order to measure progress toward meeting USPS goals for energy reduction, a system for recording, analyzing, and controlling energy use has been developed.

341 Controlled operation of energy systems means intelligent operation. Automatic features alone do not assure proper or economical equipment operation. Only good local management, using cost figures and consumption records, can effectively reduce energy usage. This section lists forms and procedures for monitoring utility costs and usage — involving electricity, fuel, steam, and water.

342 During the 1950's, several forms were used by approximately 3,000 of the larger facilities. These forms have been revised, and all offices for which utility bills are paid by the USPS are now required to use them as an aid to recording, analyzing, and conserving energy. The energy control forms and graphs for all offices, regardless of net interior size, are listed in Table 3-1.

TABLE 3-1

FORMS & GRAPHS USED FOR CONTROL & REPORTING

	Number/Title	Requirement	Reference*
a.	Form 4841, Fuel and Utilities Record. 1977.	Required year-round for all offices regardless of net interior size, for which USPS pays utility bills.	Exhibit 3-1, (2 pages).
b.	Form 4846, Low Pressure Heating Boiler Operating Log.	Required daily and weekly during Heating Season.	MS-24, Exhibit 3-1.
c.	Form 4853, Heating and Cooling Chart.	Use this chart if required by Regional Maintenance Divisions.	Exhibit 3-2, (2 pages).
d.	Graph, kWh and kW vs. Month.	Required during Cooling Season for offices that do not prepare Form 4853.	Exhibit 3-3.
e.	Form 4994, Operating Log for Centrifugal Refrigeration Plants.	Required during Cooling Season.	MS-24, Exhibit 2-2.
f.	Form 4990, Operating Log for Reciprocating Type Refrigeration Machines.	Required during Cooling Season.	MS-24, Exhibit 2-1.
g.	Absorption Operating Log.	Required during Cooling Season.	MS-24, Exhibit 2-3.
h.	Management Instruction AS-540-80-11, Energy Consumption System Operating Procedures.	Contains Form 2216, required quarterly.	
i.	Energy Consumption System, Large Facility Sub-System (ECS-LFS) Report.	Monthly.	

* Exhibits in this handbook are located following paragraph 371.

350 PREPARING FORMS AND GRAPHS

351 Form 4841, Fuel and Utilities Record (Exhibit 3-1)

351.10 General

This form must be prepared, during both the heating and cooling seasons, by all facilities for which USPS pays utility bills. Follow instructions on the reverse of the form.

351.20 Heating Season.

Energy consumption information is obtained from fuel and utility bills, meter readings and recording demand meter information. Obtain assistance from fuel suppliers and utility companies if necessary.

351.30 Cooling Season.

In those offices that have a separate kWh meter on the central chiller, the kWh used by the central chillers should be recorded monthly and used to compute the kWh per degree-day in Column 23.

352 Form 4846, Low Pressure Heating Boiler Operating Log (see Par. 22.12 and MS-24, Exhibit 3-1)

352.10 General.

This form must be prepared by all facilities having a low pressure heating boiler, either hot water or steam.

352.20 Procedure.

The necessary information for completing the form appears on the reverse.

353 Form 4853, Heating and Cooling Chart (Exhibit 3-2)

The necessary instructions for completing the form appear on the reverse side. Information concerning degree-days is available from the U.S. Weather Service or local newspaper.

353.20 Heating Season.

353.21 Requirement.

Form 4853 is generally required only for those facilities having over 25,000 sq. ft. in which fuel costs are paid by the Postal Service and in which there is full maintenance capability.

Regional Maintenance Management Divisions will specify to what extent this form will be used.

353.22 Procedure.

Consumption information is available from Form 4841. Heating Targets for Column 1 of Form 4853 will be developed by each facility following Regional, District, and MSC instructions based on established national goals.

353.30 Cooling Season.

353.31 Requirement.

The preparation of Form 4853 during the cooling season may also be required by the Regional Maintenance Management Division. If this form is required, it will be necessary to make special provisions to get usable ton-hour figures from the chiller operating log.

353.32 Procedure.

Facilities which prepare Form 4853 during the cooling season should establish the Cooling Target as specified by the Maintenance Division.

354 GRAPH, kWh AND kW VS. MONTH (Exhibit 3-3)

All offices for which USPS pays utility bills are required to prepare this graph. Prepare it on a large sheet of graph paper at least 15" x 20" and post prominently to be seen by as many employees as possible. The same chart may be used for succeeding years and color-coded to distinguish between the years.

355 FORM 4990, FORM 4994, and ABSORPTION OPERATING LOG

355.10 General.

The appropriate Operating Log for the type of Refrigeration Plant in use must be prepared by all facilities having refrigeration equipment. It shall be reviewed daily by the supervisor to assure that equipment is being operated efficiently.

355.20 Procedure.

Instructions for completing these forms appear on the reverse of the forms and in MS-24, Chapter 2.

356 Instructions for the ECS Form 2216 and ECS-LFS are outlined in Section 370 and *Management Instruction AS-540-90-11.*

360 USE OF THE FORMS

361 After all information has been recorded on the necessary forms and the instructions contained in preceding parts have been implemented, the responsible official at the local office will review the data. Power and fuel consumption can be analyzed to determine utilization trends, and it can be measured against consumption figures from the same period in the preceding year to determine whether the individual facility is meeting Postal Service energy conservation goals. Information reflected on the forms can also be of value in identifying problem areas in the facility's energy conservation program — allowing specific action to be taken by management.

These forms should also be used for equipment performance analysis. Deteriorating system efficiencies and potential machine problems can be properly resolved by consistent monitoring of these important energy and maintenance tools.

362 The data recorded on Form 4841 or direct meter readings will be the source of information to be placed on the data base on the automated consumption measurement system (ECS). This form will be made available to Headquarters and Regional Maintenance Organization, on request.

370 ENERGY REPORTING

371 In support of the U.S. Postal Service attainment of the energy conservation goals, a national system for tracking and reporting energy conservation in USPS facilities has been implemented. The Energy Consumption (ECS) is described in Management Instruction AS-540-80-11, which delineates facilities concerned, reporting requirements, and completion of energy consumption reports and ECS reports.

CHAPTER 4

CONSERVATION PRACTICES, SMALL FACILITIES

410 GENERAL

Energy conservation is just as important in small facilities as it is in large facilities. The potential savings in a single facility may not be large, but because of the quantity of facilities involved, aggregate energy and cost savings potential is significant. All facilities are responsible for compliance with instructions in this handbook, but operators of small facilities must be particularly aware of the following:

420 LIGHTING

421 Proper lighting conservation and supervision can save significant amounts of electricty. Task lighting should be used wherever possible to provide lighting levels specified in 211.30 for various areas. Fixtures and lamps should be kept clean. Cleaning standards for USPS personnel and normal cleaning contracts always provide for lamp cleaning. Managers of small facilities should assure themselves that this is being done.

422 Lamps that are not needed must be turned off. All personnel should be reminded of their responsibility to manage lighting waste.

423 Exterior lights should only provide levels specified in 211.30 and should be controlled with photocells or timeclocks.

424 Existing lamps should be replaced with the most energy efficient type when the change is cost effective.

430 TEMPERATURE AND HVAC MAINTENANCE

431 Interior temperatures should be maintained in accordance with 221.10. Basically, in occupied areas, thermostats should be set at 65 °F when heating and 78 °F when cooling. If the thermostats are badly out of calibration, or defective, the MSC or lessor should be advised of need for correction.

432 When leaving the facility for the day, thermostats should be set back to 55 °F in the heating season, and air, conditioning should be turned off during the cooling season. At the beginning of the heating season, either the MSC or the lessor should be advised that it is time to do the annual flue-gas analysis on the heating equipment per MS-1, Appendix 13-B, Guide Numbers A-7 and A-8. At the beginning of the cooling season, the air-conditioning filters should be cleaned or replaced, and the equipment inspected per MS-1, Appendix 13-B, Guide Numbers A-1 and A-2.

440 BUILDING OPERATION

441 Proper attention to windows and doors, their condition and their proper operation, can result in a significant energy savings. Seals, glazing, or caulking which are in poor condition can cause significant energy waste. Doors and windows should be kept closed except when the ventilation they provide would be beneficial and heating and cooling equipment is not in use. Blinds and draperies should be opened to allow heat and light in during the winter and closed to keep heat out during the summer.

442 Plumbing must be kept in good repair to prevent water waste. Additionally, wasted hot water means wasted fuel. Hot water tanks should have a flue-gas analysis once a year per MS-1, Appendix 13-B, Guide Number P-31. The thermostats should be set at minimum or set to provide 105 °F water to the faucets in restrooms.

450 ENERGY REPORTING

451 Small facilities will report data for the *Energy Consumption System by following procedures* in Section 370.

CHAPTER 5

ENERGY SHORTAGE MAINTENANCE CONTINGENCY PLANNING

510 GENERAL

Due to the extreme swings in energy supply and demand, there is a possibility that many facilities will experience some form of an energy shortage. This chapter is intended to direct and assist facility managers in developing and documenting emergency procedures. These instructions are mandatory for all facilities which have an assigned maintenance force. Postmasters/officers-in-charge of other facilities (which do not have an assigned maintenance force) should request Sectional Center assistance to accomplish the procedures set forth herein, if necessary. The installation head at the Sectional Center will review conservation and contingency plans of associate offices every six months.

520 DOCUMENTATION

521 Requirement.

Each postal facility is required to prepare a document setting forth maintenance procedures to follow in the event of a power or fuel shortage. These procedures are not to be considered as conservation measures or alternatives to processing the mail. Rather, they are procedures to be followed by the maintenance organization in the event of a power failure, a severe reduction in voltage, or a loss of heat due to a fuel shortage. The document is to be reviewed and, if necessary, updated at least once every six months (ref. Subchapter 560, Building Shutdown).

522 Format.

This document is to be entitled, Energy Shortage Emergency Procedures, and should be prepared according to the following outline:

I Power Failure
II Power Reduction
III Heating Fuel Shortage

For each part, include assignments and equipment (See 530).

Also, add addendum on planning (See section 550).

523 Guidelines.

Sections 530, 540, 560 and 570 prescribe guidelines and requirements to assist each office in preparing each section of the document. However, each of the guidelines is general and therefore, may not pertain to every office.

524 Addendum.

All areas of planning, including steps taken, persons contacted, sources of alternate energy supply, establishment of preventive maintenance route sheets on appropriate equipment, etc., shall also be documented and included as an addendum to the Emergency Procedures (see section 550).

530 PERSONNEL AND EQUIPMENT

531 Personnel Assignments.

The Emergency Procedures shall include personnel assignments for each of the necessary tasks. Make assignments for each tour; also make provisions for alternates and standbys (if necessary). Persons assigned tasks under contingency documents should be fully briefed on their duties and responsibilities and provided with a list of step-by-step procedures.

532 Equipment.

In addition, the Emergency Procedures shall itemize all tools and equipment required for each type of emergency task. Such equipment may include flashlight, rope, ladders, candles, space heaters, lanterns, emergency fuel, etc. Assure that:

(a) the equipment is labeled and stored separately in easily accessible areas,
(b) Necessary persons know where the equipment is located, and
(c) Persons assigned to dispense equipment are briefed.

Frequent inspections are necessary to assure that the equipment is secure and in optimum condition. Conduct inspections as necessary — at least semiannually.

540 EMERGENCY PROCEDURES

541 POWER FAILURE

541.1 Elevator Rescue.

Make personnel and equipment available to assist anyone trapped in an elevator. Plan for portable lighting equipment, hoists, and/or ladders (as applicable). Follow procedures specified in MS-1, Appendix 8A.

541.2 Equipment Shutdown.

While most electrical equipment within a post office will require a manual reset, it is necessary to properly secure each piece of equipment after a power failure. Therefore, each piece of equipment will be turned off and properly secured following a power failure. This includes all mail processing equipment, power tools, pumps, elevators, air handling equipment, etc. For each piece of equipment, prepare a list of detailed procedures to follow during shutdown.

541.3 Building Plumbing.

Inspect all building plumbing to assure that all faucets, toilets, drains, etc. are shut off. Plan a method of evacuating accumulated sewage and water in basement (if applicable). If power in the building remains off for 24 hours, take steps to evacuate all water from pipes to prevent freezing during severe cold weather conditions.

541.4 Building Security.

Following the steps in 541.1-541.3, inspect the entire building to assure that

(a) All unauthorized personnel have been evacuated and
(b) no hazardous conditions beyond those caused by the power failure are evident.

541.5 Boiler Room.

All fuel lines to the boilers should be turned off, since the boiler controls are electric and the absolute safety of the building must be assured.

541.6 *Standby Equipment.*

If standby equipment is available, start using it immediately. If not, contact the utility company to determine the extent and possible duration of the power outage. If necessary, obtain and hook up auxiliary equipment. Obtain fuel if none is on hand. Implement applicable procedures for management and operation of the auxiliary power equipment.

542 SEVERE POWER REDUCTION

Severe power reduction is defined as a reduction of voltage greater than 10% in the section of town in which the building is located. As a minimum, and as applicable, the following items must be covered in Part II (Severe Energy Reduction) of the Emergency Procedures document.

(a) **Elevator Service.** During a power reduction, the drop may be sufficient to overload the circuits and cause a stoppage of the elevator. If so, implement rescue as described in section 541.1.

(b) **Equipment Shutdown.** Although most equipment with electric motors includes overload protective devices; nevertheless, shut down all equipment to preclude the possibility of an overload device malfunction. Furthermore, this will protect the main circuits from going off-line and causing complete building power failure. Therefore, implement procedures outlined in section 541.2.

(c) **Building Plumbing.** Same as section 541.3.

(d) **Standby Equipment.** Same as 541.6.

543 HEATING FUEL SHORTAGE-ALTERNATE FUEL REQUIREMENT

Contingencies should be planned well in advance of any actual shortage (see Subchapters 550, 560, 570). Normally, a fuel shortage is not sudden. Therefore, when it is imminent, implement procedures documented in Part III (Fuel Heating Shortage) of Emergency Procedures. As a minimum, Part III should include the following as required procedures:

(a) Determine from the prime fuel contractor the extent of the shortage expected.

(b) Immediately contact all alternate sources of fuel and arrange for delivery during the expected interval of the fuel shortage.

(c) If alternate sources are not available, arrange for one of the following options:

(1) Heating piped in from neighboring buildings or plants.
(2) Contracted mobile steam or heat generating equipment.
(3) Convert heating equipment to alternate fuel source, if applicable.
(4) Distribute alternate (portable) heat sources such as electric and gas space heaters or woodburning stoves to strategic work areas.

550 RECOMMENDED PLANNING

551 POWER FAILURES AND REDUCTIONS

551.1 Locate the source of auxiliary or emergency power supplies. Determine the availability of equipment with output capacity required for your building and equipment, and, if appropriate, contract for it. It may be possible to obtain generating equipment sufficient to handle only limited functions such as lighting. In this event, it will be necessary to implement strict procedures to ensure that the auxiliary power equipment will not overload during its use. If a contract for backup power supplies is executed, specify if the contractor will provide fuel and connect the equipment. If this is not a contractor's responsibility, establish and document the necessary methods and procedures for connecting and operating the equipment. Also, provide for the fuel that will be necessary to power the equipment, and ensure that enough personnel have been trained for its hook-up and operation.

551.2 Coordinate the auxiliary power equipment planning with postal operations to ensure that necessary mail processing contingency plans are developed with the knowledge of what equipment will be available for use during each type of emergency.

551.3 Determine feasibility of permanent standby power supply. It may be feasible, in areas of low power reliability, if you have:

(1) high mail volume;
(2) high competition for portable auxiliary power supplies,
(3) equipment that cannot remain without power for any length of time; or
(4) auxiliary power equipment with required capacity is not available for emergencies.

551.4 Contact local utility company to determine status of fuel for area power generation and the probability of power outages. This will assist in the decision for or against procurement of an emergency standby power supply. Also, ask the utility company for assistance in establishing emergency procedures for power outages.

551.5 If permanent standby power supplies are within the building, implement preventive maintenance per MS-1, Section 9.

551.6 All facilities should have battery powered emergency lighting equipment. Preventive Maintenance Checklists have been published in MS-1. Assure that these criteria have been implemented. If criteria has not been implemented, it must be at once. Assure that the lighting is in all hallways, control rooms, boiler rooms, exit stairs and work areas where natural light is not adequate. The emergency lights must be located so that all hazardous areas can be navigated in safety by personnel exiting the building from all work areas.

552 FUEL SHORTAGES

552.1 *Contact fuel supplier to determine* availability of primary heating fuel (e.g., heating oil, propane, natural gas, etc.) and probability of adequate supplies through winter. Based on this, establish alternate sources of primary fuel supply in case of shortage. When it is possible that there may not be adequate supplies of the primary heating fuel available through winter, determine types and sources of alternate fuels and take necessary steps to ensure availability of alternative heating methods in the event of fuel shortages. Establish methods and procedures for conversion from scarce fuels to more abundant fuels when necessary.

552.2 Locate sources of alternate heating supplies such as mobile steam generating equipment (These are boilers mounted on trucks and vary from 15 horsepower to 100 horsepower). Determine if the building's heating system must be supplied with the same type heating unit. If an auxiliary heating unit must come from the manufacturer, determine its availability and shipping time, and contract for it if necessary. Determine what methods of alternate heating are available and contract or procure (e.g., wood-burning stoves, electric, and gas space heaters, etc.).

552.3 Determine if heating coverage can be secured from neighboring plants or buildings, the time required to adopt the system, and establish required procedures for implementation, if feasible.

553 EMERGENCY EQUIPMENT

Determine all tools and emergency equipment that will be required for each case. Also assign personnel to handle the equipment (see subchapter 530). Refer to MS-1, Section 17, for damage control requirements.

560 BUILDING SHUTDOWN

561 Purpose.

This section contains guidelines, in narrative and *checklist form to prepare a building for curtailed* or discontinued fuel supply. Two levels of preparation are provided for: short term outage with systems held at "maintenance level"; and longer term, at extreme low temperatures, with all systems operation ceased. It is assumed that mail processing has ceased. These procedures are applicable to both USPS owned and leased facilities.

562 Background.

Most larger facilities have staff fully capable of making necessary preparations. Handbook MS-1, Section 17 requires damage control teams be identified to plan for emergencies. This information is to assist those teams in planning and executing closure of a facility. Offices with small or no maintenance staffs have to have certain precautions taken to prevent unnecessary damage. Maintenance capable sectional centers may be required to assist non-maintenance capable associate offices.

563 Instructions.

563.1 Safety.

563.11 All equipment deactivated will be locked and tagged in accordance with USPS procedures in MS Handbooks and maintenance bulletins.

563.12 If fuel supply is turned off, the main gas valve and gas valves at all equipment, i.e., boiler, domestic water heating, unit heaters, etc., shall also be turned off.

563.13 The local fire department shall be notified of the condition of the buildings, i.e., water off, sprinkler system, fire alarm, etc.

563.14 If the water is off in a building, it is highly vulnerable to fire, therefore, strict fire prevention measures will be enforced including:

(a) No smoking or open flame.
(b) Unplug all electrical appliances.
(c) Remove all combustible trash and flammable liquids.
(d) Exercise extra care in the use of electric heaters or lights to prevent circuit overload.

563.15 When deactivating building make a list of critical valves and switches that may present a safety hazard on reactivation.

563.16 Post signs at each entrance advising that the post office is closed due to fuel shortage.

563.2 Information in the following areas shall be obtained to aid in determining the course of action.

(a) Expected duration of the fuel shortage or curtailment.

(b) The availability and expected reliability of electrical power.

(c) If heating equipment is dual fired, can standby fuel be used? If so, how long will standby fuel last at Plant Protection level of usage? (Plant Protection temperature is 35 to 40 °F.)

(d) Possibility of obtaining additional standby fuel.

(e) Outside temperature and weather forecast.

(f) Road conditions and access to the building.

Based on the above information, determine whether the interior of the building will be subjected to freezing temperatures.

563.3 Reduction to Plant Protection level.

It may be possible to maintain the interior of the building slightly above freezing (appoximately 35 to 40 °F) by the following actions.

(a) Close and seal all outside air dampers, using tape and plastic sheets if necessary to assure that all air leakage is stopped (especially the upper portions of the buildings).

(b) Seal exhaust fans and/or outlets. (Roof top fans can be covered with plastic bags).

(c) Maintain circulation (operate pumps) on all hot and chill water circuits unless ethylene glycol is in system. Automatic valves will be blocked open if necessary, to assure circulation through every coil.

(d) Make sure all doors (dock doors, elevator penthouse doors, vestibule doors and dock dump-hole doors) are sealed and all air leakage stopped.

(e) Open interior doors where necessary to provide heat distribution to specific areas in building to prevent damage from freezing.

(f) Maintain building temperatures by keeping lighting turned on, especially incandescent lighting. Consider operating other electrical equipment if practical.

(g) Use electrical space heaters or large incandescent lamps in areas such as restrooms, equipment rooms and other strategic areas.

(h) Schedule maintenance personnel to monitor conditions in the building.

(i) If fuel is only curtailed, fire boiler or other heating systems to maintain 35 to 40 °F. Boiler will have to be operated in intermittent schedule.

563.4 Prepare for freezing — complete shutdown.

When it is determined that the building temperature cannot be maintained above freezing, the following action must be considered:

563.41 Chill Water and Hot Water Closed Circuits (One of the following).

(a) Ethylene glycol (antifreeze) should be considered for use in these systems to provide freeze protection. Ethylene glycol in bulk is normally available from chemical suppliers. Use an automotive-type antifreeze hydrometer to adjust the solution level to prevent freezing at the expected temperature.

(b) Systems should be totally drained. Individual coils should be drained and blown out to assure they are dry.

(c) When coils cannot be drained or blown out, a solution of ethylene glycol should be injected to fill the individual coils.

563.42 Condenser Water Circuits.

These systems will be totally drained including tower sumps, piping and pumps. Sump heaters should be disconnected. Condenser piping, heat tracing should be maintained, if possible. Drain condensers on all small units throughout the building.

563.43 Pneumatic Systems.

Drain compressed air system including tanks, drains, traps and water legs and turn system off.

563.44 Steam Heating Systems.

Drain boilers, condensate return system and steam traps on steam heating coils. Where radiators are used the water in each radiator trap will be subject to freezing. Therefore, each trap will have to be opened and water removed (suggest using a wet-dry vacuum to remove the water).

563.45 Sewage Systems.

For systems that drain directly to the central sewage system, put an antifreeze solution in the traps to prevent water from freezing. (Remove water and replace with 50 percent solution of ethylene glycol and water).

NOTE. If water is removed from these traps, sewage gases will enter the building and create a hazardous condition. Traps are found in toilets, urinals, sinks and slop sinks, all floor drains, branch sewer lines, water coolers, etc.

For sewage systems that drain to sewage ejectors within the building, the water can be blown out or vacuumed from the traps, and the ejector or pumps protected from freezing with antifreeze or local heating.

563.46 Domestic Water System.

CAUTION. Before domestic water is cut off, precaution should be taken to prevent false fire alarm or operation of fire pumps. It should also be noted that when all these systems have been drained, the building has no fire protection capabilities. therefore, stringent fire prevention procedures must be enforced. **NOTE.** Prior to turning off water system and air compressors, shut down dry-pipe sprinkler system control units according to manufacturer's instructions.

(a) Turn water supply off at meter or service entrance to prevent freezing.

(b) Open all valves and completely drain system, including domestic hot water system. Check for low spots in pipes and areas where water may be trapped and blow or vacuum water from those areas.

CAUTION. DO NOT USE ANTIFREEZE IN DOMESTIC WATER SYSTEMS

(c) Drain fire protection standpipe and sprinkler system.

(d) Drain fire protection storage tanks if they cannot be heated.

563.47 All Exterior Buildings or Facilities.

These will be treated as individual building systems subject to all above items.

563.48 **Electric Systems.**

It is normally not necessary to turn off electric power. However, if electric power is turned off to reduce fire hazard, or in the event of power failure, the following precautions shall be taken .

(a) Disable battery powered emergency lights so that batteries will not be discharged.

(b) Disable emergency generators to prevent needless operation.

(c) Check battery powered fire alarm system and maintain it in operation.

563.5 **Small Buildings.**

If temperatures are expected to go below freezing inside the structure .

(a) Turn off all burners and associated pilot lights on heating units and water heaters.

(b) Turn off water supply at service entrance and open all faucets, draining system as completely as possible from lowest faucet in system. Open drain on hot water tank and flush all toilets.

(c) Pour ethylene glycol (antifreeze) in toilet bowls. Use sufficient quantity to lower freezing point to below temperature expected. Similarly treat other traps located in sink drains and floor drains. Do not drain traps because sewage gas will be allowed into building.

563.6 These procedures are advisory and not all-inclusive. Local authorities should be given full cooperation and coordination. Maintenance Technical Support Center (405) 329-8920 (or FTS 743-8251) is available to provide technical support on a 24-hour basis as described in current Maintenance Bulletins. Regional Maintenance Management Divisons should also be contacted to be informed and provide assistance, if necessary.

570 BUILDING START-UP AFTER FUEL SHUT-OFF OR CURTAILMENT

571 Purpose.

This section contains step-by-step procedures to reactivate a building after partial or complete shutdown caused by curtailed or discontinued fuel supply.

572 Instructions.

572.1 Plant Protection Level.

572.11 If a building has been maintained at Plant Protection Level, 35 to 40 °F, building temperature should be raised slowly to 65 °F. Temporary material and equipment used to seal air dampers, exhaust fans, doors, etc., must be removed and properly stored for possible future use.

572.12 During heat-up period, a thorough inspection must be made of the entire building to determine that equipment and systems are operating properly. It is possible that piping or water-coils may be leaking as a result of freezing. Equipment rooms, penthouses, attics, steam radiators, baseboard heating, etc., should receive special attention.

572.2 Start-Up After Building Interior Exposed to Subfreezing Conditions

572. 21 Domestic water supply must be restored, vented and checked for freeze-ups and leaks. This will include filling and venting of water main, sprinkler system, hot water heaters, etc. If any part of the system does not fill, it is probably caused by ice in the piping. A check of the piping should be made to determine if valves are closed or if there is visible damage to the piping. If no damage is apparent and if blockage does not affect other systems, determine a procedure for quickly cutting off water supply to affected area and continue filling the system.

572.22 Steam Boiler.

(a) Fill boiler, vent and check for leaks.

(b) Before firing steam boiler, add boiler water treatment and check entire heating system for burst or open steam traps.

(c) Boiler must be fired on low fire or manual firing valve, so that the boiler will be allowed to heat slowly. Fast firing may damage the boiler by creating extreme expansion stresses in the boiler metal.

(d) The main steam stop should be open, and steam pressure allowed to build slowly throughout the system. Fast firing the boiler or opening the system to full boiler pressure may damage steam piping throughout the building by creating severe water hammer.

(e) As soon as the boiler has steam pressure, start checking the system for leaks or damage.

(f) Check boiler controls, safety controls, safety valves, condensate pumps, etc., for proper operation.

572.23 Hot Water Boiler.

(a) Fill system, vent high spots, make sure that expansion tank has an adequate air cushion, pressurize system so that highest water line in a system has 2 psi while system is cold and pumps are off.

(b) Start pumps and vent high points. Check vents every few hours during first twenty-four (24) hours of operation. Check for leaks throughout system after pumps are operating. Water treatment should be added as soon as possible.

(c) If hot water heating system was filled with ethylene glycol (antifreeze) mixture prior to building shutdown, do not drain .operate system as usual.

(d) If glycol mixture was not used in individual coils, do not drain unless the water treatment that will be used is not compatible with ethylene glycol. Most closed loop treatment chemicals such as nitrate can be used with glycol. Glycol is not compatible with any type of chromate material.

(e) Boiler must be filled until water temperature is at least 100 °F or until boiler has fired for one hour.

(f) Pressure gauges should be watched clearly throughout system for indication of frozen or stopped-up lines.

(g) If it is necessary to thaw out a frozen line, electric strip heaters or thermostatic controlled heating cable should be used.

572.24 Chilled Water System.

The same procedure as that used for filling, venting, and checking a hot water heating system should be followed on a chilled water system.

572.25 Sewage System.

The only requirements are to make sure drain plugs, openings, etc., are closed or replaced, and to check for freeze damage and leaks.

572.26 Pneumatic System.

Same requirements as sewage system. Check for leaks after air compressors are started.

572.27 Condenser Water System.

Check for damage and leave drained until freeze season is over. System should be filled, treated and tested before cooling season begins to assure that any damage has been found and corrected.

572.28 Electrical.

(a) Return systems to normal.

(b) Check wet cell batteries for cracked cases. Investigate any unusual electrolyte loss.

572.29 Air Handler Units.

(a) Do not remove damper seals, exhaust fan covers, etc. until heating system is operating and heating coils are hot.

(b) Exhaust fans should be left off and uncovered until the building is ready for occupancy.

(c) Some AHU's can be started and run by manual control to warm up the building.

(d) Equipment should be operating in normal condition before the building is occupied.

572.3 Small Buildings.

572.31 If heat is supplied by gas or oil fired hot air furnaces, such furnaces will be started by following manufacturer's instructions and the building temperature raised above 35 °F before domestic water is turned on.

572.32 If heat is supplied by a steam or hot water boiler, some method of heating the boiler room or building to above 30 °F should be used, if possible, before domestic water is turned on to fill boiler or system. The heat source might be one or more of the following . electric heater, gasoline camp/type heater, kerosene space heater, or a wood or coal stove with temporary flue pipe extending through a window.

Caution - When using any of the above, extreme care must be taken to assure there is no fire hazard involved with the operation. This type of heating should be watched constantly and removed as soon as possible.

572.33 Follow all instructions in 572.1 an 572.2 that pertain to the building or equipment being activated.

573 Safety.

573.1 The main problem in building start-up after exposure to freezing temperatures is detecting and correcting water leaks from ruptures caused by freezing of water pockets that remained in various water systems. Unless extreme care is taken during shutdown and start-up procedures, portions of the building can be flooded by drain valves, plugs, etc. that were left open after draining systems. Water leaks or flooding can damage expensive equipment and create electrical hazards or fires by short-circuiting electrical wiring.

573.2 It is essential that one person direct the start-up procedures and that only persons who are part of the start-up team be allowed in the building until systems have been returned to normal and the building inspected. It is possible that ruptured lines may not be evident for several hours after start-up. Therefore, building and equipment inspections will continue to be made for at least eight hours after the building is at normal temperature. Employees and tenants should be cautioned to report any unusual sighting or disturbance during the first twenty-four (24) hours after returning to work.

573.3 When a steam or hot water boiler is fired after freezing conditions, electrical safety control shall be checked for proper operation before the boiler is left unattended. Low water cutoffs and water level controllers will be blown down to determine proper operation, and safety or relief valves will be manually tested to assure proper opening and closing.

573.4 When using natural gas or liquified petroleum gas (LPG) as fuel, be extremely careful when starting burners. Vent all areas and equipment where a gas leak might have caused pockets of gas to accumulate. Natural gas is lighter than air and will rise making dissipation easy. LPG, however, is heavier than air and requires forced ventilation to be removed from low/lying areas. If free natural gas or LPG is discovered, find the source and correct it as soon as possible. A burner control, which otherwise functions normally, may have had a failure of the pilot light safety system.