Recommended Management Practices for the Removal of Hazardous Materials from Buildings Prior to Demolition

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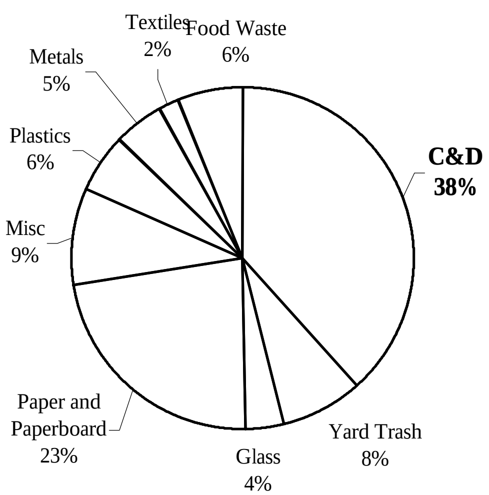
INTRODUCTION

Demolition Waste in the United States

Demolition waste results from the demolition of manmade structures. Demolition waste is often grouped together with construction waste as construction and demolition (C&D) waste. C&D presents a challenge to waste management professionals as a result of the large amount generated and the minimal attention it has received in the past.



Composition of Municipal Solid Waste

The United States Environmental Protection Agency (1998) estimates that C&D waste comprises approximately 38% of the municipal solid waste stream. That excludes waste generated in the construction of roadways or bridges, or in land clearing. The large amount of C&D waste generated and the recognized potential of the environmental impact of C&D waste management have focused attention on this waste stream. New rules require groundwater monitoring of disposal sites, but it is always desirable to *prevent* contamination of groundwater by removing any hazardous materials from the waste before it is landfilled.

Minimizing the environmental risks caused by demolition waste is the focus of this document.

What is in Demolition Waste?

The primary components of demolition waste are the materials that modern society depends on for its homes, offices and other buildings – concrete, wood, metal, and drywall. These items are generally viewed to have minimal impact on the environment upon disposal. Other items found in demolition wastes may present a greater risk to human health and the environment because of chemicals found within them.

Hazardous Materials in Demolition Waste

Some components encountered as part of the demolition waste stream contain hazardous materials and chemicals. Although these building components may be useful and beneficial to modern society, proper care must be taken upon their disposal. Most of these items may be easily removed prior to demolition. Thus with proper planning and foresight, a great majority of the environmental risk associated with the management of waste from a demolition project can be eliminated. Most hazardous building components can also be recycled by specialized processing facilities.

Materials that may result in possible risk to human health and the environment when improperly managed include lamps, thermostats, and light switches containing mercury; batteries from exit signs, emergency lights, and smoke alarms; lighting ballasts which contain polychlorinated biphenyls (PCBs); and lead pipes and roof vent flashings. A summary of these components and their potential risks are presented in the following table.

Hazardous Building Components Covered in Document

Fluorescent Light Bulbs that contain *mercury*. Mercury filled 4 ft, 8 ft, U-tube, circline, and compact fluorescent lamps are the most common types of fluorescent bulbs encountered.

High Intensity Discharge (HID) lamps that contain *mercury*. These lamps are often encountered in security and outdoor lighting applications. HIDs are also found in indoor, high ceiling work areas such as warehouses and supermarkets.

Thermostats that use *mercury* as a switching mechanism. The number of ampoules containing mercury depends on the temperature cycle and type of thermostat.

Mercury-bearing wall switches that use *mercury* as an electrically conductive switching mechanism. These "silent switches" are no longer manufactured but they can still be found in older structures. Numerous industries also use mercury for various types of switches and relays.

Lighting Ballasts for fluorescent light bulbs and HID lamps. These items may contain *Poly-chlorinated Biphenyls* (PCBs) as well as other toxic chemicals such as bis(2-ethylhexyl)ester di(2-ethylhexyl)phthalate (DEHP).

Batteries encountered in emergency lighting, exit signs, security systems, and alarms. These batteries may contain *lead* and *cadmium*.

Lead Roof Flashings used to protect roof vents. Flashings mold easily and often contain pure *lead*.

Other Lead objects such as *lead pipes* and *lead painted surfaces*. Surfaces such a door frames and window sills may be easily removed.

Other hazardous materials such as discarded *paint*, *oil*, *pesticides*, *cleaners* and other chemicals.

Why are Hazardous Building Components a Concern?

When chemicals such as mercury, lead, and cadmium are disposed of as part of hazardous building components, they may enter the environment and contaminate soil and groundwater. They may also pose a risk to workers at C&D recycling facilities and contaminate some of the products produced by recycling of demolition waste.

In most states, many of these materials are prohibited from disposal. Some examples are batteries, thermostats, PCB ballasts, and lamps in large quantities. The demolition contractor may take the next step and remove all such materials from a building prior to demolition.

Objective of Document

The goal of this document is to provide recommended management practices for identifying and extracting easily removable hazardous materials from a building prior to demolition. This document can be used by demolition contractors, environmental regulators, local government, and C&D facility operators. The application of the procedures outlined in this document will result in fewer hazardous chemicals entering the environment. Such practices will help operators of C&D landfills maintain compliance with federal and state requirements for protecting groundwater quality at C&D disposal facilities. The removal of hazardous building components prior to a demolition project helps minimize any long-term contractor and client liability for the disposal of demolition waste.

Organization of Document

This document is designed to provide an overview of the demolition waste components that can present a risk to human health and the environment, as well as specific guidance for the removal of such items. A series of fact sheets are provided describing the various types of hazardous building components commonly encountered. Separate procedures for removal, storage, and disposal are covered as well. The process of conducting a predemolition audit is reviewed and illustrated with two case studies from actual demolition projects. A glossary of terms used throughout the document is also provided.

Since many states have specific regulations addressing the management of items such as batteries and fluorescent lamps, an appendix is provided with contact information for various state environmental protection department solid and hazardous waste programs.

A reference guide for specific sections of the document is presented as follows:

Reference Guide:

MANAGEMENT OF DEMOLITION WASTE

Demolition of Structures

Demolition waste is the waste generated from the dismantling or renovation of buildings, streets, bridges, and other man-made structures. The composition of demolition waste is similar to that of construction waste consisting largely of concrete, metals, drywall, and wood. Unlike typical construction waste, demolition waste may also contain hazardous building components such as mercury thermostats, mercury-lined fluorescent lamps, PCB ballasts, lead acid and nickel-cadmium batteries, and lead flashings. If not removed prior to demolition, these materials become mixed with the other demolition waste components and become very difficult to separate.

Steps to Demolishing a Building

Most demolition waste is generated and disposed of by licensed contractors. In most states, demolition requirements vary by county and municipality. The following list summarizes the typical steps a contractor must follow in order to demolish a structure.

1. A state-licensed contractor or the property owner must perform the demolition.
2. A demolition permit from the city or county building department is required. The permit entails disconnection of utility services and removal of hazardous materials such as asbestos.
3. The building department must approve the permit prior to demolition. This involves a preliminary inspection to verify the permit compliance.
4. After demolition, the contractor must pass a final inspection. This insures the termination of utilities and removal of debris.

These guidelines were developed from a survey of several counties in Florida. With the exception of asbestos, none of the respondents had specific requirements for the removal of hazardous materials. The existing inspection and permit process could easily include other procedures. As a liability matter, local city or county permit agencies should be consulted for specific requirements.

Environmental Impacts of Demolition Waste

Solid waste generated during a demolition project is typically managed by recycling some or all of the demolished structure or by disposal in a landfill. For both of these management strategies, the removal of hazardous materials *before* the demolition of a structure is necessary to protect human health and the environment. The removal of hazardous materials *after* demolition is in most cases not practical or possible.

Disposal by Landfills

Disposal in a sanitary landfill is the most common means of managing demolition waste. Referred to in the past as “dumps,” modern landfills are designed and operated to meet strict regulations for protecting human health and the environment. There are several types of landfills that differ in the types of waste they accept. Landfills that receive household and commercial waste require an elaborate liner system to be installed to protect the groundwater from contamination. Certain types of landfills, those that receive wastes that do not pose a major risk to groundwater contamination, are not required to have liners.

Most C&D landfills are unlined, and demolition waste is usually disposed of in these types of facilities. Private companies operate many of the facilities, but a few government agencies operate C&D as well. One of the requirements of operating a C&D landfill is that waste loads be "spotted" to remove any items that are not C&D waste and may cause some source of pollution. Removing every hazardous component from a mixed waste stream, especially one like demolition waste where the material is typically crushed, is not always possible.

When solid waste is placed in an unlined landfill, the action of rainfall percolating down through the waste creates a liquid known as “leachate.” If a hazardous material is present in the waste stream, it may “leach” from the landfilled material with infiltrating rainfall to form "leachate." The leachate migrates from the landfill and without any liner comes in contact with the underlying soil and groundwater supply.

Once leachate mixes with the groundwater underneath the landfill, it migrates away from the site with the groundwater flow. The result is the possible contamination of nearby drinking water wells.

Recycling of Demolition Waste

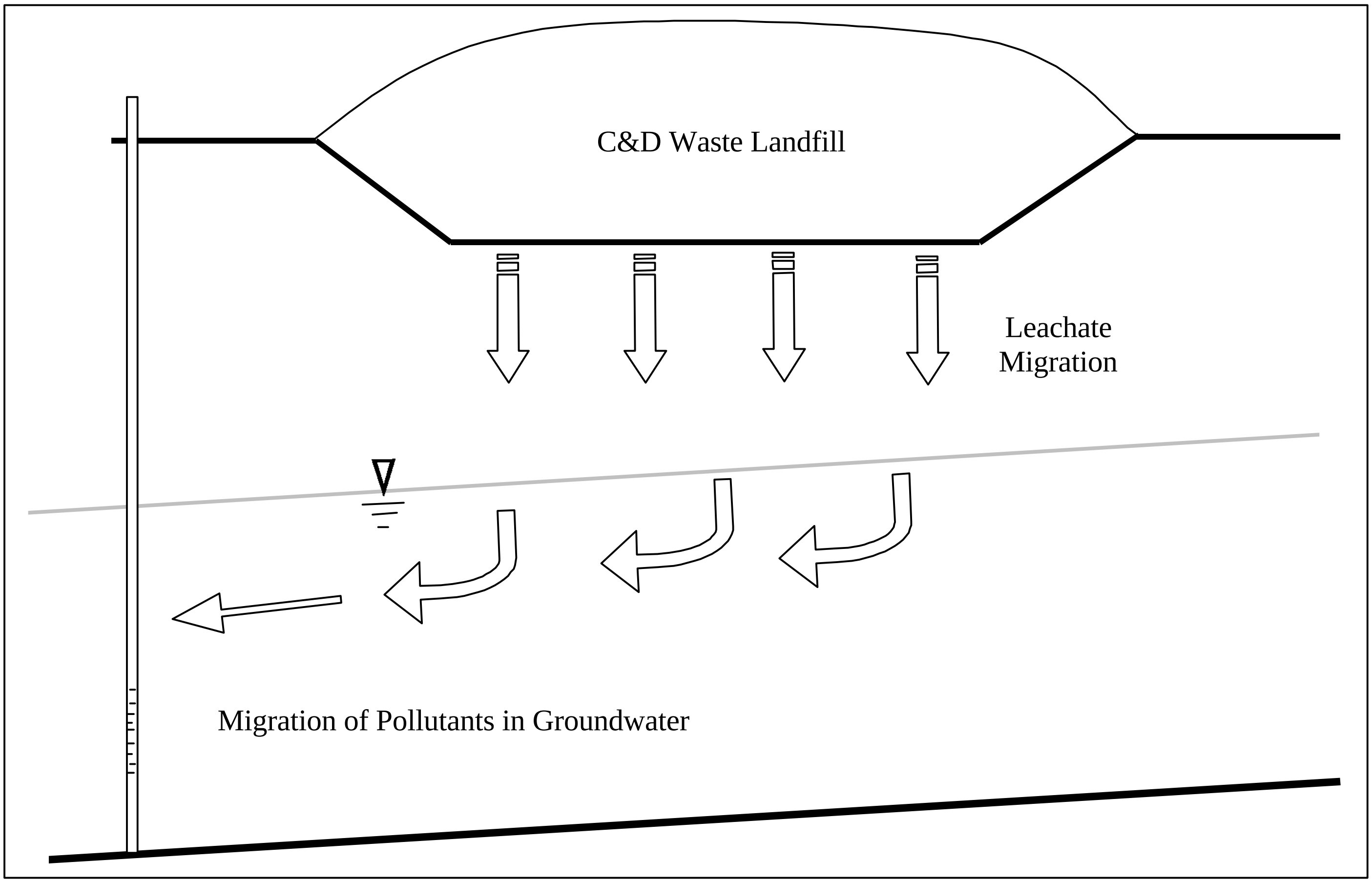
A practice that is becoming more common is the recycling of demolition waste. Demolition recycling ranges from the “deconstruction” of a building with separation of the materials at the demolition site to the processing of mixed demolition waste for recyclable material recovery. With both of these options, the removal of the structure’s hazardous components is a necessary step to ensure worker safety and the value of the recovered product.

The removal of hazardous building components is a good idea for two reasons. First, since much of the separation is performed by manual labor, the removal of hazardous components reduces worker safety risks. Second, purity of the product created by the recycling facilities is adversely affected by the presence of hazardous chemicals.

Recycling of construction and demolition waste has developed into a large industry. For mixed demolition waste, materials recovery facilities (MRFs) have been constructed to separate certain materials from the waste stream. Waste materials are separated by a combination of mechanical and manual separation. The process usually involves crushing the waste in the early stages of the process to aid in the mechanical separation of the material.

Materials such as wood, concrete, and metal have markets ready to accept them. A key to successful recycling is to keep the degree of contamination of the material to a minimum. Purity of the recovered product ensures higher resale value. Removal of hazardous building components is an obvious step to achieve this.

One of the larger products by volume from a typical C&D MRF is a recovered soil fraction. This fraction accounts for 25% or more of the recovered waste stream at some facilities. The recovered soil fraction may be used as clean fill for off-site operations, provided that the material is safe. The presence of hazardous building components increases the likelihood of contamination.



Leachate from Hazardous Building Components Migrating to Groundwater

Recovered Fines Being Produced at a C&D Waste Recycling Facility

HAZARDOUS BUILDING COMPONENTS IN DEMOLISHED STRUCTURES

A number of building components may contain hazardous chemicals

Indoor Lighting Units

Many types of light bulbs are used by modern society. The standard incandescent bulb (or tungsten filament bulb) is the standard light bulb used by most common light fixtures in homes. These bulbs produce light by passing an electric current through a filament. Halogen bulbs produce greater amounts of light by the addition of a halogen gas to the inside of the bulb. Standard incandescent bulbs and halogen bulbs contain relatively inert material and their disposal is not a great concern.

Alternative types of bulbs (gas discharge bulbs) produce light when an electrical current is passed through them. Mercury vapor is extremely efficient in producing low-heat, energy-efficient light. Both fluorescent bulbs and high intensity discharge (HID) lamps utilize mercury vapor. Fluorescent bulbs are used frequently in indoor environments and HID lamps provide bright light for indoor areas such as warehouses and supermarkets.

The United States Environmental Protection Agency encourages the use of efficient power consumption and the use of fluorescent and HID lamps. Mercury, however, is a chemical that can be dangerous to human health and wildlife and thus must be controlled upon disposal.

Indoor fluorescent lighting and HID lighting units may also require the use of a ballast. Ballasts provide an initial starting voltage and current required to excite the gaseous atoms and control the electric current going to the lamp. Ballasts may contain chemicals such as PCBs that are hazardous to human health and the environment.

Outdoor Lighting

Outdoor lighting units typically require brighter light than indoor sources. Examples include streetlights and security lights. High Intensity Discharge (HID) lamps are well suited for energy efficient outdoor applications. These lamps utilize mercury vapor and outdoor lighting units equipped with HID bulbs also require ballasts that possibly contain hazardous chemicals.

Emergency Lighting and Exit Signs

Building safety codes require that emergency lights and exit signs be used in numerous structures. Backup power must be provided in order to operate these devices in the event of a power failure. Such backup power is often provided by rechargeable batteries. Both lead acid and nickel-cadmium batteries are found in use with emergency lighting and exit signs.

Incandescent or halogen bulbs are typically used in emergency lighting. Mercury-containing compact fluorescent bulbs are encountered in some exit sign lighting.

Electrical Switching Mechanisms

The ability of mercury to flow as a liquid at room temperature and its excellent properties for electrical conductance have resulted in this metal’s use in a number of electrical switching mechanisms. Mercury is used in some thermostats, light switches, and electrical relays.

Other Battery Containing Devices

In addition to exit signs and emergency lights, batteries are also encountered in other components. Security alarm systems use batteries as a source of backup power. Smoke detectors and carbon monoxide detectors are powered by small battery sources.

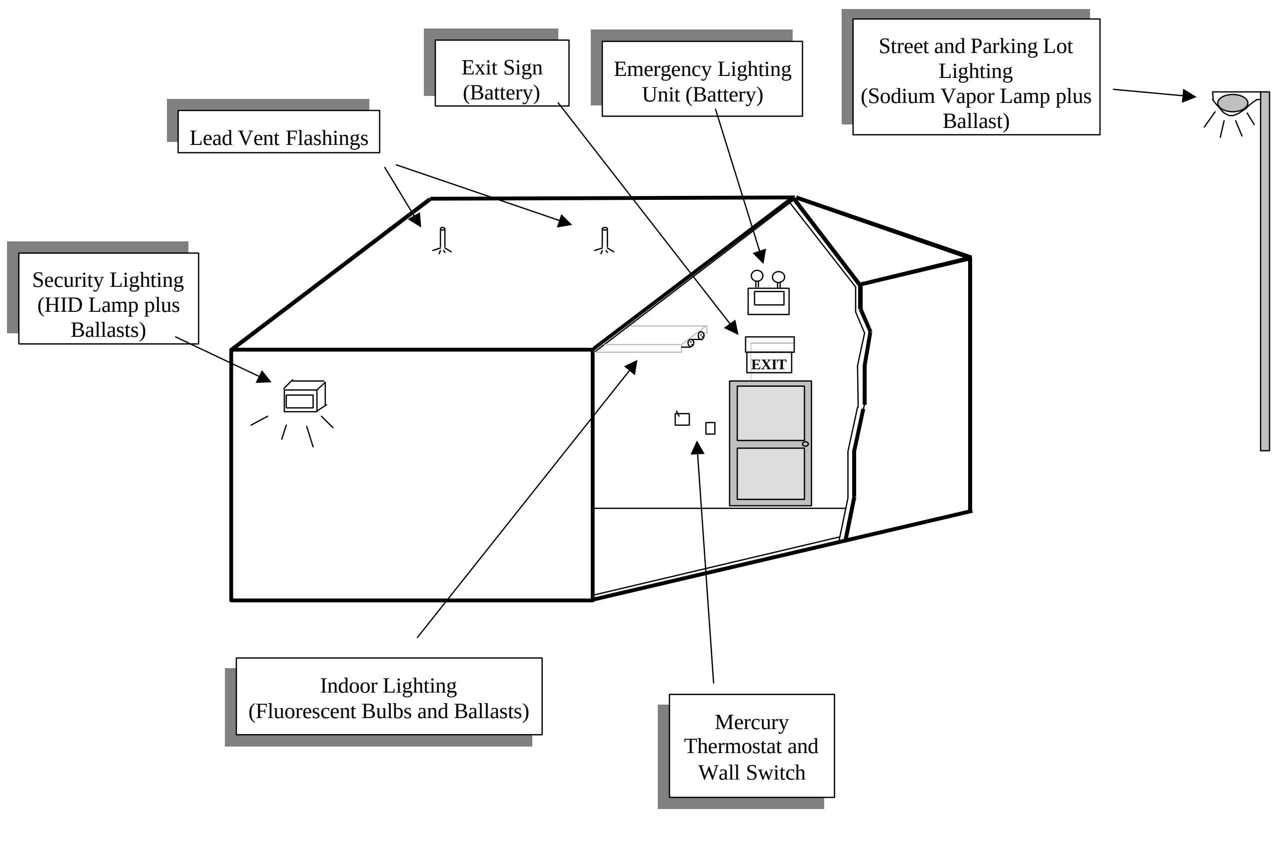
Lead Devices and Objects

Lead is found in a number of areas in manmade structures. Lead is used in roofing applications for flashing because of its structural characteristics and its ability to easily mold around objects. Lead flashing is often used to seal and protect clean-out pipes on the roofs of houses. Older buildings may have large amounts of lead pipe. An object painted with lead paint, such as doorframes or windowsills may be easily removed prior to a building's demolition.

Fact Sheets

The following fact sheets are provided as a reference:

- Fluorescent Light Bulbs
- High Intensity Discharge Lamps
- Mercury Thermostats
- Mercury Switches
- Lighting Ballasts
- Batteries
- Lead Flashings
- Other Lead Objects



Sources of Hazardous Materials in Modern Buildings

FACT SHEET: Fluorescent Light Bulbs

How They Work Fluorescent lamps operate on the principal of exciting mercury atoms enclosed in a glass bulb with an electric current. The excited atoms give off ultraviolet (UV) light upon their return to their natural state. The UV light is converted to visible light by a special phosphor that coats the inside of the fluorescent tube.

Efficient Lighting Fluorescent bulbs have found increasing use in recent years because of their efficiency in regard to energy consumption. The U.S. EPA has established the “Green Lights” program to encourage the use of high-efficiency fluorescent bulbs in indoor lighting applications. Spent bulbs must be managed appropriately because of the mercury content.

Where is the Mercury Located? Most of the mercury associated with a fluorescent bulb is encountered in the phosphor coating on the inside of the bulb as divalent mercury (Hg^{2+}). Only a small fraction of the mercury is found as vapor inside the bulb, but this fraction readily escapes when the bulb is broken.

Types of Bulbs Fluorescent light bulbs take many shapes. Conventional fluorescent bulbs include straight tubes, U-bent, and circline. These fluorescent bulbs require a ballast to provide an initial starting charge needed to excite the gaseous atoms and control the electric current going to the lamp.

Building Component Database: Fluorescent Light Bulbs

Hazardous Chemical: Mercury (Hg)

Average Amount: 30 mg

Mercury Location: Entire tube

Average Life Expectancy: 7,000-20,000 hrs.

Lamp Location: Lamp fixtures in any manmade structure. Indoor or under overhangs.

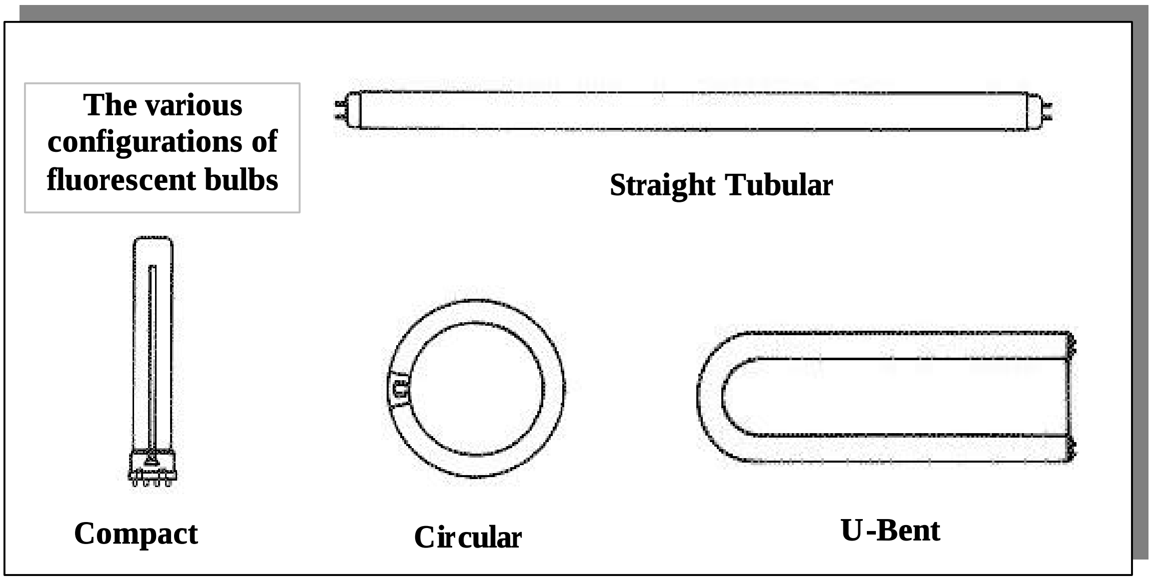
Regulated under: RCRA, various state regulations

Major Manufacturers: General Electric, Philips, Sylvania

Types: 4-foot, 8-foot, compact, u-tube, circline

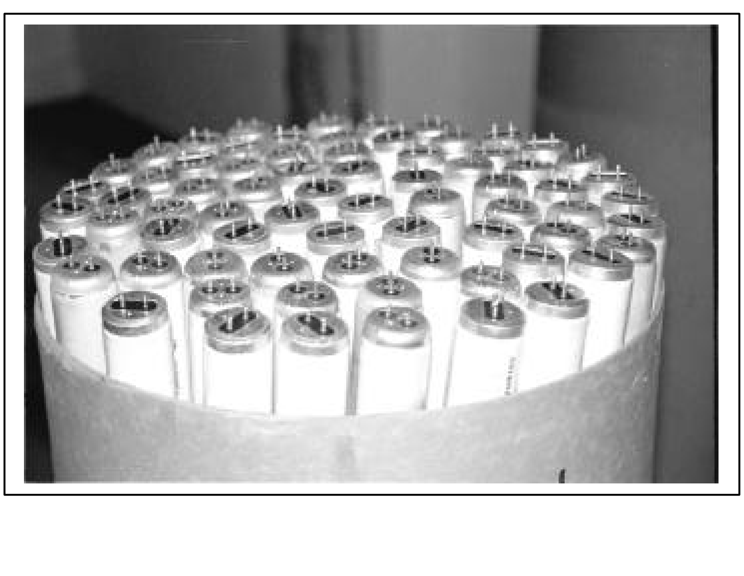
Health Effects: Deterioration of nervous system and brain. Birth defects and death.

Compact Fluorescents One of the fastest growing trends in lighting is the use of compact fluorescent bulbs. Compact fluorescents are a popular choice for retrofitting and new lighting installations because of their extremely high efficiency, long life, and low burn temperature. These bulbs are ideal for retrofitting because they can be used in standard incandescent light sockets. Since they are a type of fluorescent lamp, they require a ballast to operate. Compact fluorescents with a screw base have a ballast attached to the lamp. Some lamps plug into ballast adapters that can screw into an incandescent socket. Otherwise, a separate ballast will be located somewhere near the lamp.



The various configurations of fluorescent bulbs

Mercury in the Environment Mercury-containing lamps are one of the largest sources of mercury in municipal solid waste. Conventional disposal of mercury lamps releases between 700 and 900 kg of mercury into the atmosphere each year. Mercury is released into the atmosphere when lamps are incinerated or broken. Mercury may also be carried to the environment with gas emissions from landfills. Even small emissions are cause for concern because mercury tends to bioaccumulate in the food chain. For example, mercury may bioaccumulate in the tissue of fish, making the fish harmful for human consumption.



Mercury Lamp Recycling A number of businesses have developed to recycle mercury-containing lamps and bulbs. Recycling of fluorescent lamps results in the recovery of glass, metal, and mercury contaminated phosphor powder that can be further processed to reclaim mercury.

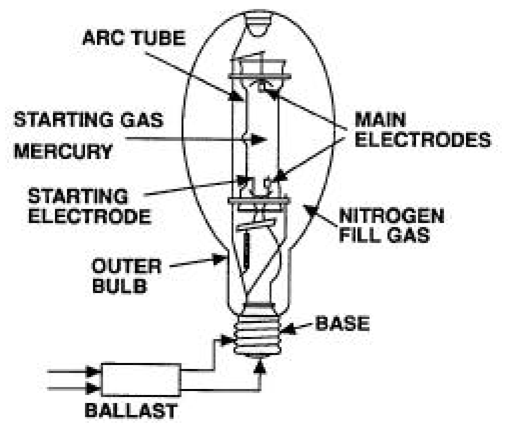
FACT SHEET: High Intensity Discharge Lamps

How They Work
The three major types of high intensity discharge (HID) bulbs are the *mercury vapor*, the *high pressure sodium*, and the *metal halide lamps*. All HID lamps have an inner arc tube contained within an outer tube. The arc tube consists of a starting electrode, a main electrode, a starting gas, and arc metal. When an electric field is passed between the electrodes the starting gas ionizes. The charged starting gas volatalizes the arc metal, decreasing the resistance between the electrodes, and thus creating an arc.

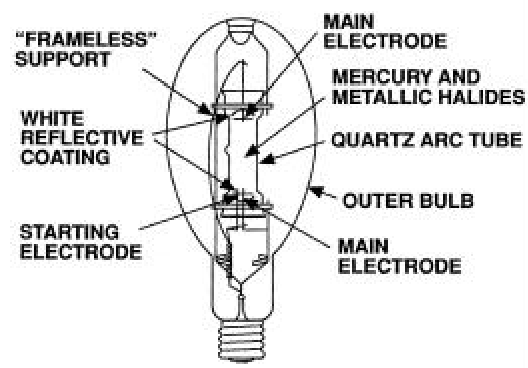
Similar to fluorescent lighting, the charged metal atoms in the arc give off ultraviolet light when excited electrons return to lower orbitals. The outer bulb serves to absorb short wave ultraviolet energy and filter out unnatural light. The outer bulb is made of a heat resistant glass that keeps the arc tube at a constant temperature. Nitrogen gas fills the cavity between the inner and outer tubes and helps prevent oxidation.

Mercury Vapor HID Lamps Mercury vapor lamps contain an all quartz arc tube filled with mercury arc metal and argon as a starting gas. The quartz arc tube emits ultraviolet light that is partially absorbed by the outer tube. Better color for some mercury lamps can be attained if the outer tubes are coated with phosphor. Phosphor converts near ultraviolet energies to visible light. In general, mercury vapor lamps have good efficiency, long life, and can be burned in any position. Applications include security, industrial facilities, and parking lots.

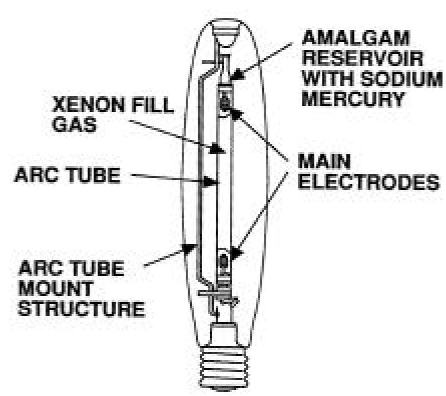
Metal Halide HID Lamps
Metal halide lamps contain fused quartz arc tubes filled with a starting gas and a mixture of mercury and halide salts known as an amalgam. The outer tube of some metal halide lamps can contain a phosphor coat. Typical halide salts include sodium iodide, scandium iodide, thallium iodide, and indium iodide. When the iodides vaporize in the arc they form different colored layers around the mercury arc. Metal halide lamps have a bimetal switch which activates the main electrode once the arc is formed. In general, metal halide lamps have very good efficiency, long life, and superior optical control but



Mercury Vapor Lamp



Metal Halide Lamp



High Pressure Sodium

Figures courtesy of General Electric Lighting

cannot be burned in any position without affecting performance. Applications include floodlights, commercial buildings, and walkways.

High Pressure Sodium HID Lamps High-pressure sodium lamps contain a small ceramic arc tube filled with xenon as a starting gas and a mercury and sodium amalgam. High-pressure sodium lamps produce a high quality light by passing an arc through sodium at high pressures. When starting, these lamps go through several phases in color as excess sodium amalgam stored in a reservoir vaporizes. In general, high-pressure sodium lamps have the best efficiency of any light source, very long life, warm color, and can be burned in any position. Applications include floodlights, industrial facilities, and roadways.

Building Component Database: HID Lamps

***Hazardous Chemical*:** Mercury

***Average Amount*:** 20-250 mg

***Mercury Location*:** Inner ceramic or quartz arc tube

***Average Life Expectancy*:** 8,000-24,000 hrs.

***Lamp Location*:** Parking lots, street lights, and other outdoor applications

***Regulated under*:** RCRA, various state regulations

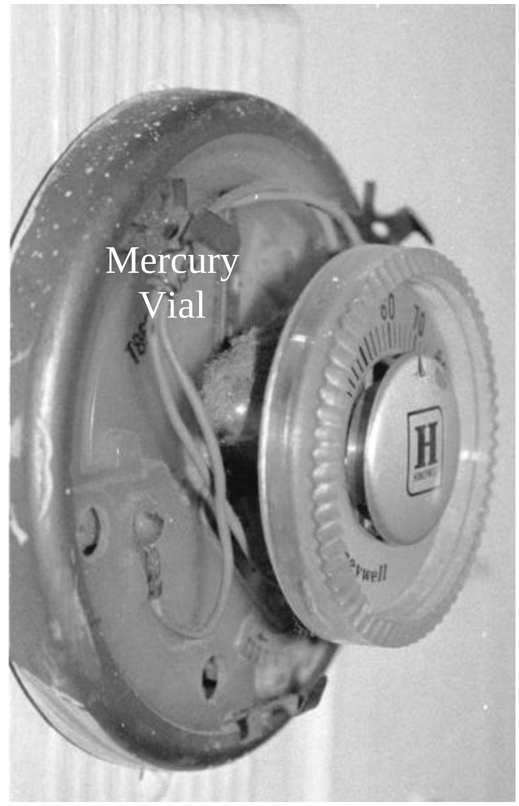
***Major Manufacturers*:** General Electric, Philips, Sylvania

***Types*:** Metal Halide, High-Pressure Sodium, Mercury

***Health Effects*:** Deterioration of nervous system and brain. Birth defects and death .

Various Configurations of High Intensity Discharge Lamps

FACT SHEET: Mercury Thermostats



How They Work Mercury thermostats are used for temperature control and are found in almost any type of building. Thermostats are triggered by a bi-metal element that expands or contracts with changing temperature. When the temperature increases or decreases the bi-metal element moves a glass ampoule filled with mercury. Mercury thermostats are designed such that the ampoules can be aligned in a position corresponding to a given temperature. Depending on the ampoule's orientation, the mercury inside will complete or break a circuit, causing the heating or cooling unit to operate.

Types of Thermostats There are three major types of thermostats. The standard manual thermostat has a manually adjusted set point. The set back thermostat is programmable and will automatically drop the set point for you. The auto changeover thermostat has two temperature settings and will automatically switch from heating to cooling to maintain a temperature range.

The number of ampoules of mercury found in a thermostat depends on the number of stages the thermostat has for heating and cooling. It is common to find thermostats with one, two or four ampoules of mercury. Mercury thermostats are found in the shape of either a rectangle or a circle. While thermostats that do not contain mercury are available today, mercury thermostats are still commonly used because of their relatively low cost and excellent performance and longevity.

Building Component Database: Mercury Thermostats

***Hazardous Chemical*:** Mercury (Hg)

***Average Amount*:** 1.5 to 2 g

***Mercury Location*:** Ampule

***Average Life Expectancy*:** 20 yrs.

***Thermostat Location*:** Mounted on walls of many modern buildings

***Regulated under*:** RCRA, various state regulations

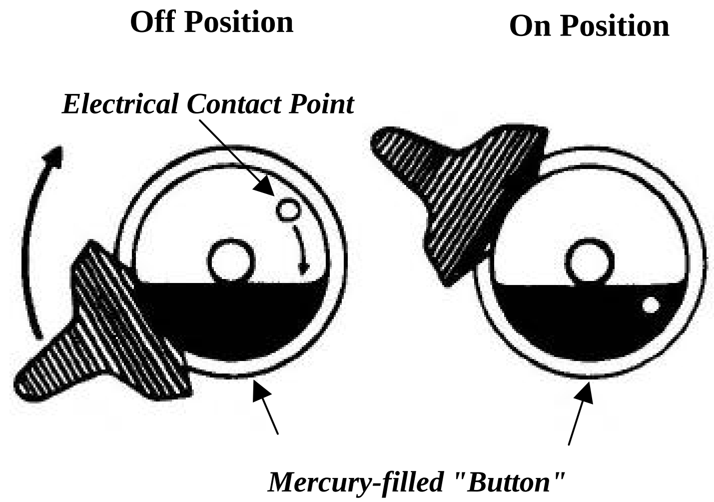
***Major Manufacturers*:** Honeywell, Luxaire, White-Rogers

***Types*:** Set-back, auto-changeover, multiple stage

***Health Effects*:** Deterioration of nervous system and brain. Birth defects and death

FACT SHEET: Mercury Switches

Mercury Light Switches Mercury light switches are sometimes encountered in older buildings. These devices look like typical wall switches, but they do not make the audible "click" sound when activated. They operate on the principal of liquid mercury in a metal encased glass button that completes the electrical circuit when the switch is lifted up, submerging an electrical contact point. These switches are often referred to as "silent switches," although other non-mercury switches on the market today are also sometimes referred to as silent.



Principle of Mercury Wall Switch Operation

General Electric manufactured the buttons for mercury wall switches until the late 1980's. The switches were distributed by Leviton. These switches had the advantage of silent operation and very long operating lifetimes. The mercury-containing buttons can not be broken without the application of excessive force.

Building Component Database: Mercury Wall Switches

***Hazardous Chemical*:** Mercury

***Average Amount*:** 2-3 eyedrops

***Mercury Location*:** Stainless steel cup or "button"

***Average Life Expectancy*:** 50+ yrs.

***Switch Location*:** Mounted on walls near doors and walkways

***Regulated under*:** RCRA, various state regulations

***Major Manufacturers*:** General Electric, Levitan

***Health Effects*:** Deterioration of nervous system and brain. Birth defects and death

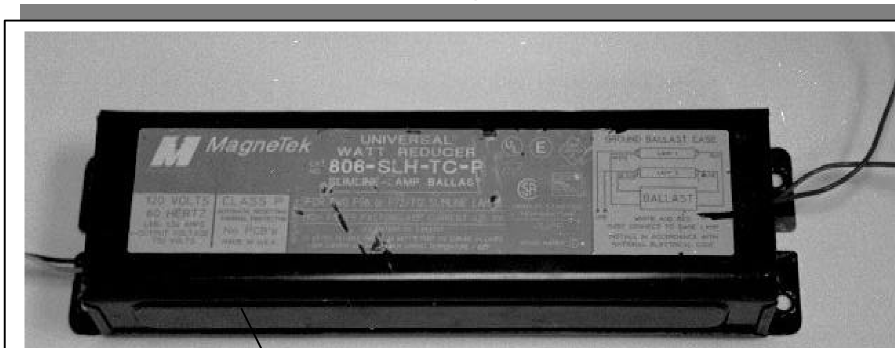
Mercury Displacement Relays and Contacts Some mechanical relays and contacts use mercury as a contacting element. These types of switches are quieter and avoid fatigue better than their non-mercury counterparts. The mercury is found in a hermetically sealed container within the relay or contactor. These devices are typically found in furnace controls, light and traffic controls, lab equipment, high voltage industrial equipment, and motors.

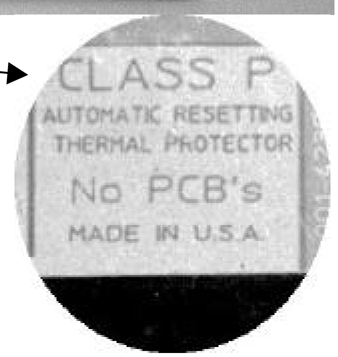
FACT SHEET: Lighting Ballasts

What is a Ballast? Fluorescent and HID lighting requires a special electrical device known as a ballast. The purpose of a ballast is to generate an initial voltage to start the arc on fluorescent and HID lamps and to regulate the amount of current these lamps receive. There are three major types of ballasts; the electromagnetic (magnetic), the electronic, and the high intensity discharge (HID). In addition, an emergency ballast containing nickel-cadmium batteries is often found connected to a single ballast or a series of ballasts. More information about Ni-Cd batteries can be found in another fact sheet.

Components The specific components and configurations differ for each type of ballast. In general, a ballast can contain a capacitor, an igniter, a coil, and potting compounds. The coil is a type of transformer that converts line voltage to usable lamp voltage. The capacitor is used to correct the "dirty" harmonics associated with ballast operation and is either oil filled or dry film. The oil filled capacitor is filled with a dielectric fluid which, before 1979, consisted largely of polychlorinated biphenyls (PCBs). Metal film capacitors contain no dielectric and instead use a polyester or metalized film. Potting compounds are asphalt-based compounds or polyester resins used for noise suppression and heat dissipation. The igniter is used for the initial startup voltage necessary to run the lamps.

Ballasts Containing PCBs Some ballasts contain a mixture of chemicals called polychlorinated biphenyls (PCBs). PCBs are oily fluids that range in color from pale yellow to clear. For 60 years, PCBs were used as dielectric fluids in transistors, capacitors, and heat transfer equipment. They are found in the capacitors of some ballasts and make their way into the environment when these capacitors rupture or degrade. PCBs do not break down in the environment and may bioaccumulate in the food chain. In 1979, the Toxic Substances Control Act officially banned the manufacture of PCBs. However, PCBs still present a threat. In 1971, EPA regulation 40 CFR 761 allowed PCB-containing ballasts already in use to remain in use. Ballasts are replaced only through retrofitting projects such as the EPA's Green Lights Program or when ballast failure occurs. But since ballasts can operate about 30 years before failure, many PCB-ballasts are still in use today.





Fluorescent lighting ballasts manufactured after 1979 were required to be labeled as "No PCB's".

DEHP Current ballasts use a number of chemicals in place of PCBs. The dielectric fluids in today's ballasts are mixtures of vegetable oils or DEHP (bis(2-ethylhexyl)ester di(2-ethylhexyl)phthalate). Research has shown that DEHP has the potential to increase human health risk and is a possible carcinogen. Although several states do not regulate DEHP, some have banned DEHP ballasts from landfills.

Electromagnetic ballasts, also referred to as magnetic ballasts, are the most commonly found ballast for fluorescent light fixtures. Electromagnetics use a dry film or oil filled capacitor and two small coils for initial voltage and current regulation. An asphalt based potting compound covers the inside of the ballast can. The potting compound can be close to fifty percent by weight of the electromagnetic ballast. The ***electronic ballast*** is lighter, quieter, and operates more efficiently than the conventional magnetic ballasts. Electronic ballasts contain a dry film or oil filled capacitor and over one hundred solid state components that are used together for initial voltage generation and current regulation. The inside of an electronic ballast is completely filled with an asphalt based potting compound. Potting compounds of both magnetic and electronic ballasts sometimes contain small amounts of the chemicals found in the capacitor, including PCBs and DEHP.

Ballasts for **High Intensity Discharge** (HID) lamps operate on the same principal as the electromagnetic ballast. In general, HID ballasts use a core and coil, an oil filled or dry film capacitor, and an igniter to produce an initial voltage and to regulate current during operation. There are six major configurations for HID ballasts. HID lighting fixtures are often of the core and coil type. The **core and coil** uses several coils that are vacuum impregnated or dipped with a polyester varnish. The coils are located separately from the capacitor and igniter. The second type of configuration is the **potted core and coil**. A potted core and coil is the same as a standard core and coil except that the coil is placed in a can and potted with polyester resin. The **outdoor weatherproof** HID ballast configuration is used for remote outdoor locations. In the outdoor weatherproof, the core and coil, capacitor, and igniter are placed in an aluminum container and potted with a polyester resin. The **postline** configuration is usually mounted in lighting posts. In this configuration, the igniter and capacitor are located next to a core and coil potted with polyester resin. The fifth type of configuration is the **indoor enclosed** found near the ceilings of factories. In the indoor enclosed, the polyester resin potted core and coil is located in a different compartment than the igniter and capacitor. The last configuration, the **fluorescent can**, looks the same as ballasts encountered with fluorescent lighting units and is found in commercial and institutional buildings. The capacitor, igniter, and core and coil of a fluorescent can are potted with an asphalt-based compound.

Building Component Database: PCB Lighting Ballasts

***Hazardous Chemical*:** Polychlorinated biphenyls (PCBs)

***Average Amount*:** 30 g

***PCB Location*:** Capacitor

***Average Life Expectancy*:** 30 yrs.

***Ballast Location*:** Inside fluorescent and HID lighting fixtures

***Regulated under*:** TSCA, CERCLA

***Major Manufacturers*:** Advance, General Electric, Magnetek, Universal

***Types*:** Magnetic, electronic, HID, emergency lighting

***Health Effects*:** Can harm reproduction and growth and has the potential to cause cancer

FACT SHEET: Batteries in Building Components

Where are batteries encountered? Batteries are encountered in a number of locations in buildings. Exit signs that illuminate in the event of a power failure are required in most buildings for safe evacuation. In buildings not equipped with an emergency power generator, this necessitates the use of a rechargeable battery connected to the exit sign. Under normal conditions, the exit sign will illuminate from the building's power supply, which also keeps the battery charged. The battery supplies the power when the building's power is down. Exit signs are placed in buildings according to building and fire safety codes.

Emergency lights operate in a similar fashion to exit signs except that they are not illuminated during normal operation. Fluorescent lamps have central battery ballasts, which keep the lamps lit in a power failure.

Not all emergency lights and exits signs operate on rechargeable batteries in the event of a power failure. In some cases, a generator will supply the power. One can tell whether batteries provide emergency power for exit signs and lights by simply looking for an attached box that houses the battery and other circuitry, or by looking for a test button. This denotes that it contains a battery. Other devices that contain batteries include alarm systems and smoke alarms.

Types of Batteries A number of different battery types have found use in modern society, including carbon-zinc, mercury, and alkaline. The batteries most often encountered as back up power supplies in building components are small sealed lead-acid (SSLA) batteries and nickel-cadmium (ni-cd) batteries. Each type of battery is described in more detail below.

Nickel-Cadmium Ni-cd batteries are popular and have a number of advantages including their light weight, durability, long life, and low maintenance. They can last from 2 to 4 times longer than lead acid batteries. Ni-cd batteries are typically 5 to 10 times more expensive than lead acid batteries. Sealed ni-cds were first developed in the 1950's from vented or wet ni-cds. Since then, they have gained much popularity, particularly for use in portable devices such as phones and computers.

Ni-cds are a source of particular concern for the health and environment because cadmium is highly carcinogenic. Cadmium can cause kidney damage when contaminated groundwater is ingested. An environmentally friendly substitute for ni-cd batteries is nickel-metal-hydride batteries. These batteries are not always an acceptable substitutes due to performance characteristics and expense. Ni-cd batteries are used in about 30% of emergency lights that use batteries. In 1991, ni-cd batteries only made up 0.1% of the U.S. waste stream by weight, but they represented 54% of the cadmium. Ni-cd's are composed of 13 to 15% of cadmium and 20 to 30% of nickel by weight.

Building Component Database: Nickel Cadmium Batteries

***Hazardous Chemical*:** Cadmium (Cd)

***Average Amount*:** 13 to 15 % by Weight

***Cadmium Location*:** In batteries of exit signs or central alarm boxes.

***Average Life Expectancy*:** 3 to 5 years inactive and 90 minutes discharging.

***Sign Location*:** Stairways, ramps, escalators, and passage ways or closets and utility rooms.

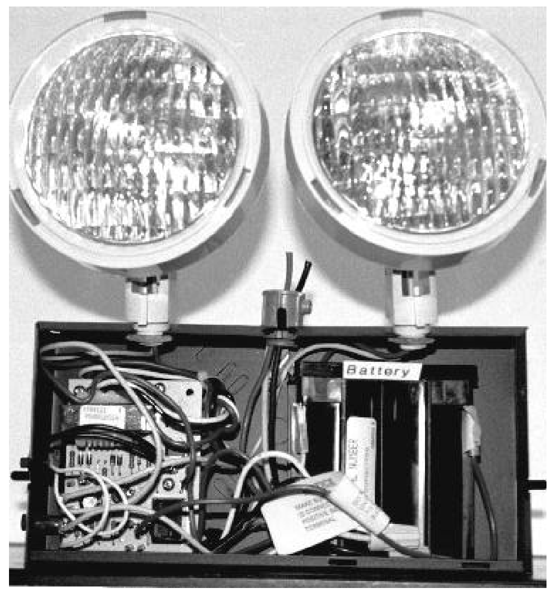
***Regulated under*:** National Electrical Code (NEC) National Fire Protection Association (NFPA).

***Major Manufacturers*:** Alcad, Crucial, Power Sonic, Saft, Panasonic.

Types: Sealed-nickel cadmium and wet nickel cadmium.

***Health Effects*:** Can harm reproduction and growth and has the potential to cause cancer

Lead Acid Batteries Lead acid batteries have been used for over a century. They were first introduced in 1860. Lead acid batteries account for about 60% of the sales of all batteries in the world. The lead acid battery is generally the least-expensive battery for any application with regard to its performance and life characteristics. When compared, both lead acid and ni-cd batteries have the same energy density. However, rechargeable lead acid batteries have a shorter life and poorer cycling service. Because it is inexpensive, the lead acid battery is manufactured in a number of sizes and designs for numerous applications. The type of lead acid battery commonly used for emergency lighting is the portable sealed or non-spill lead acid, otherwise known as small sealed lead acid batteries (SSLA). Lead is used in about 70% of emergency lights that are powered by batteries. Approximately 65% of the battery's weight is lead or lead components. Batteries represent most of the lead use in the world. About 90% of lead batteries sold in the U.S. are recycled.



Emergency Lighting Unit
with SSLA Battery

Building Component Database: Lead Acid Batteries

***Hazardous Chemical*:** Lead (Pb)

***Average Amount*:** 70 % by Weight

***Lead Location*:** In battery of sign or central alarm box.

***Average Life Expectancy*:** 3 to 5 years inactive and 90 minutes discharging.

***Sign Location*:** Stairways, ramps, escalators and passage ways leading to an exit or closets and utility rooms for alarm systems.

***Regulated under*:** National Electrical Code (NEC) National Fire Protection Association (NFPA).

***Major Manufacturers*:** Power Sonic Corp, Saft, Crucial, Panasonic

***Types*:** Seal lead acid and Wet lead acid.

***Health Effects*:** Brain and Nerve damage, stunted growth and kidney damage

FACT SHEET: Lead Roof Flashing

Lead Roof Flashing

The durable and maleable properties of lead make it an excellent material for protecting and sealing pipes and vents on roofs.

Cleanout lines to plumbing systems in modern buildings are typically encountered on the roof. A flashing is typically placed around each pipe to provide a seal and support. The most common type of flashing is composed of lead. Lead flashings have the advantage of being extremely malleable and thus may be installed with ease on sloped surfaces. Lead is also preferred because of its strength and its resistance to atmospheric weathering.

Lead vent flashings are manufactured to fit pipe diameters from 2 to 3 inches and to weigh approximately 5 to 7 pounds. The flashing are composed entirely of lead. The base of the flashing is placed underneath the roof tile or asphalt pitch. The top of the flashing is molded to fit around the opening of the pipe. Roofers prefer the lead "boot" flashing because of its resistance to corrosion and its durability. Other types flashings such as plastic and aluminum are available; however, they cannot compete with lead when durability and efficiency are concerned.

FACT SHEET: Lead Paint and Other Items

As of October 29, 1992, The Lead Exposure Reduction Act provided limits on lead in paint. Paint with less than or equal 1.0 mg/cm^2 or 0.5 % by weight is considered to be lead free. Lead base paint used in older buildings can have a lead content of up to 3.1 %. While the purpose of this document is not to provide guidance for the removal of lead from all painted surfaces, certain components of buildings may contain lead paint and may be easily removed. Such items include doorframes and windowsills.

To determine whether or not easily removable items of a building are coated with lead based paint, test kits may be used. Most large hardware supply stores sell lead paint test kits that are normally located in the safety or paint sections. The average price is about $12.00.

Another item containing lead that may be encountered in older buildings is lead pipe. Often, large amounts of lead pipe in a building make its removal economically valuable, above and beyond the environmental value associated with the removal.

REGULATORY REQUIREMENTS

Since 1965, Congress has passed several laws that establish rules for solid and hazardous waste. The Environmental Protection Agency (EPA) is the federal agency in charge of developing these rules. Some states have the authority to write separate, stricter rules in lieu of EPA rules.

Solid Waste Regulations

The first law to address solid waste was the Solid Waste Disposal Act of 1965. This law authorized guidelines for the disposal of solid waste. In 1970, the Resource Conservation and Recovery Act (RCRA) amended the Solid Waste Disposal Act (SWDA) to emphasize recycling and reuse as solid waste management goals. RCRA is the legal basis for today's solid waste management system. It promulgated rules for solid waste storage, treatment, and disposal. Most of the states' solid waste management plans are based on RCRA principles

Hazardous Waste Regulations

RCRA is the major body of law for hazardous waste management. RCRA defines hazardous waste and addresses its generation, storage, treatment, and disposal. Other laws that deal with hazardous waste are the Toxic Substances Control Act (TSCA) and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), also known as Superfund.

Regulations for Demolition Waste

Almost every demolition project generates hazardous waste. Demolition waste such as fluorescent lamps, PCB ballasts, lead-acid and ni-dd batteries, mercury thermostats, and lead flashings have special case-by-case requirements for generation, storage, transportation, and disposal.

The federal laws that address demolition can be found in RCRA, TSCA, the Universal Waste Rule, and CERCLA.

RCRA

RCRA defines hazardous waste and addresses its generation, storage, treatment, and disposal. Most states have adopted many of RCRA's rules for hazardous waste found in 40 CFR Parts 260-299.

Before disposing of any demolition waste, demolition contractors must determine if their waste is hazardous. A waste can be a characteristic or listed hazardous waste as defined in 40 CFR Part 261. According to RCRA, characteristic hazardous waste is waste that demonstrates at least one of the properties of ignitability, corrosivity, reactivity, or toxicity. A waste can also be a "listed" hazardous waste subject to the full RCRA regulations. The list is found in in 40 CFR Part 261.

Once contractors determine if they are dealing with a hazardous waste, they must determine what type of handler they are. Demolition contractors who remove hazardous materials for disposal are hazardous waste generators. The rules for hazardous waste generators are found in 40 CFR Part 262.

If the demolition contractor ships the waste for disposal the contractor is a hazardous waste transporter. Rules for hazardous waste transporters are found in 40 CFR Part 263.

TSCA

PCB ballasts are regulated by the Toxic Substances Control Act (TSCA) which can be found in 40 CFR Part 261. TSCA addresses the transportation, disposal, and spill clean-up of PCB containing ballasts.

CERCLA

The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) also known as Superfund is the major body of law that addresses clean-up of hazardous waste sites. Under CERCLA, contractors who dispose of hazardous waste may be subject to notification requirements and future liability for hazardous wastes they dispose of.

Universal Waste Rule

The Universal Waste Rule (UWR) was enacted to encourage the collection and recycling of certain hazardous wastes generated in small quantities by a large number of diverse generators. The UWR allows demolition contractors to follow less stringent rules for record keeping, labeling, transporting, and storing hazardous waste batteries, pesticides, and mercury thermostats. Individual states can add other wastes to this list if EPA gives approval.

Conditionally Exempt Small Quantity Generators

It is important for demolition contractors to determine what hazardous waste generator category they fall under. Generators of small amounts of hazardous waste are not subject to the full RCRA hazardous waste regulations. The Conditionally Exempt Small Quantity Generator (CESQG) rule allows generators of l00 kg per month of hazardous waste or less to be exempted from 40 CFR parts 262-266, 268, 270, and 124. It is up to the demolition contractor to determine whether or not they fall under this category.

Responsibility of Demolition Contractor

The responsibility of determining what regulations must be followed falls to the generator of the waste, in this case, the demolition contractor. The hazardous building components discussed in this guide all will likely be hazardous waste if tested by the appropriate regulatory procedure. The most responsible action is therefore to manage all such materials removed from a structure as a hazardous waste.

Every state has a designated regulatory agency responsible for the management of solid and hazardous waste. These programs typically provide guidance in regard to the required management practices. A detailed review of all such requirements is beyond the scope of this guide. A list of state solid and hazardous waste contacts is provided as an appendix, and these organizations should be contacted for additional information.

Identification And Removal Procedures for Fluorescent Light Bulbs

Identification

Fluorescent lights can be found in over-head-light fixtures and exit signs. Please see the fact sheet on fluorescent bulbs for the various types of bulbs encountered.

Removal

Most fluorescent bulbs require one of two techniques for removal:

- With the first technique the bulb is pushed in one direction against a spring located in the socket and then removed.
- With the second technique the bulb must be twisted from the socket.
- In the case of emergency exit signs containing compact-fluorescent bulbs, turn the bulb counter clockwise until fully unthreaded or released.
- Fluorescent bulbs are very delicate. Applying excessive force to the bulb may easily result in injury.
- Leather work gloves and a step ladder are recommended
- Bulbs should immediately be placed in boxes for disposal. Some mercury recyclers rent or provide cylindrical cardboard containers for safe transportation of fluorescent bulbs.
- A 15-inch diameter drum for eight-foot lamps holds between 80-90 fluorescent bulbs, while a 21-inch diameter drum for four-foot lamps holds between 160-170 bulbs.
- Average time to remove individual bulb is 60 seconds.

After removing the cover from the light fixture, straight fluorescent bulbs may be removed by twisting.

Bulbs should be stored in appropriate containers to prevent breakage. A cardboard shipping container may be obtained from lamp recyclers.

Disposal Options Arrange disposal with appropriate recycler. The responsible disposal option for fluorescent bulbs is recycling. Recycling protects human health and the environment and minimizes liability to the contractor.

Identification And Removal Procedures for High Intensity Discharge Lamps

Identification

Most HID lamps are used in security, outdoor, or warehouse applications. Probable locations are parking-lot light poles, warehouse rafters, and the outside walls of buildings.

Removal

HID lamps are usually screwed into a socket. The lamp may be removed by twisting it counterclockwise

- ♦ Leather work gloves and a step- ladder are recommended.
- ♦ Depending on the type of lighting unit and its installation, the removal may require screwdrivers, nutdrivers or wrenches.
- ♦ In many cases, the best way to remove HID lamps is to remove the entire lighting unit.
- ♦ Ballasts and batteries should be separated from the bulbs and placed in their respective containers.
- ♦ HID lamps should be placed in cardboard boxes wrapped in newspaper and/or cushioned with cardboard "peanuts."
- ♦ Designate a space solely for bulb storage to ensure the bulbs are not damaged prior to recycling.
- ♦ Removing the entire unit will also remove any ballasts or batteries, either lead-acid or ni-cd, which are present in the lighting unit.
- ♦ Average time to remove item is 90 seconds.

Disposal Options

Arrange disposal with appropriate recycler. The responsible disposal option for HID lamp bulbs is recycling. Recycling protects human health and the environment and minimizes liability to the contractor.

Remove cover to expose HID lamp

HID Bulb may be removed by unscrewing from fixture.
Note: Outdoor lighting unit will need to be removed to remove ballast.

Identification And Removal Procedures for Mercury Thermostats

Identification

Most thermostats have a removable front plate. This plate should be removed to determine whether or not the thermostat contains mercury.

A thermostat's mercury is contained in a glass vial less than 1 inch in length. While many thermostats contain only 1 of these vials, it is not uncommon to find 2 or 4 in a single thermostat.

Removal

- Once mercury is found in the thermostat, it is necessary to remove the whole thermostat.
- A screwdriver and a pair of wire cutters should be used to remove the thermostat without damaging it.
- Average time for removal is 60 seconds.
- If vials of mercury are removed from the thermostat instead of removing the whole unit (not recommended), these vials should be placed in plastic "ziplock" baggies prior to placing them in a container.

Disposal Options

1. Mercury thermostats and mercury ampoules can not be incinerated or disposed of in a city landfill.
2. Arrange disposal with an appropriate mercury recycler.

Identification And Removal Procedures for Mercury Switches

Identification

Light switches should be flipped to see if they "click." If they do not make a "click" noise, they may be silent switches. The only way to be sure is to remove switch and look at the actual mechanism. Relays and contacts are typically encountered in furnace controls, light and traffic controls, lab equipment, high voltage industrial equipment, and motors.

Removal

- Identify the word "TOP" stamped on the upper end of the silent switch by removing the cover plate. If present, then it is most likely a mercury switch.
- Remove the whole switch with screwdrivers and wire cutters and place in separate container.
- Average time to remove entire unit is 60 seconds.

Disposal Options

1. Mercury silent switches, mechanical switches and relays or contactors can not be incinerated or disposed in a city landfill.
2. Arrange disposal with an appropriate mercury recycler.

Identification And Removal Procedures for Batteries in Emergency Lights and Alarm Systems

Identification Wherever an emergency lighting unit, an exit sign, an alarm system, or a smoke detector is found, a battery is likely contained within.

An emergency light generally consists of two spotlights or lamps that are attached to a box, which houses the circuitry. This box is where the battery is located. Some emergency lights may be powered by a generator and do not contain any batteries.

For an alarm system, it is far more difficult to find the location of the battery. The plans of the building or the owner should be consulted. General locations are closets and utility rooms.

Smoke detectors are primarily found in residential housing or apartments attached to the ceiling or wall.

Removal

- Gloves, wire cutters, ladder, and other appropriate tools (a screwdriver or a wrench) will be required.
- Removal of the entire unit is recommended for safety. After the unit is safely accessible, remove the battery.
- Determine the type of battery.
- Use caution, batteries could be leaking.
- The general approach is to open the panel on the housing box using a screwdriver or wrench. Remove the wires from the battery by disconnecting leads or cutting wires.
- Average time to remove battery is 90 seconds.

Disposal Batteries may not be disposed of in a landfill. Arrangements should be made with an appropriate recycler to accept lead acid and ni-cd batteries.

Remove Panel Door Fasteners

Remove Panel Door

Remove Battery

Identification and Removal Procedures for Batteries in Exit Signs

Identification

The batteries encountered in an exit sign are located in either a housing box or in the sign itself. Note that some exit signs do not have emergency power batteries and typically will not have a box above the sign.

Removal

The exit sign can be removed from the ceiling or the wall in a number of ways.

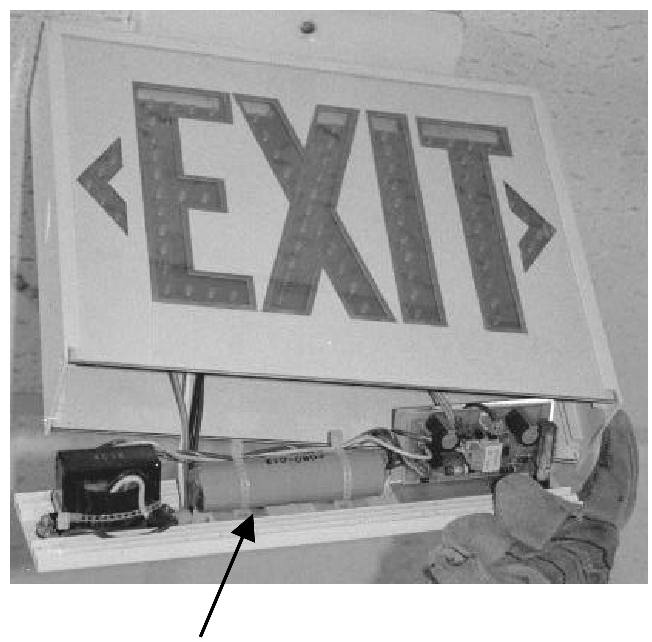
- One way to remove a sign attached to the ceiling, which is probably not so obvious, involves twisting the sign in a counter-clockwise motion—essentially unscrewing the sign from its holding and then clipping the wires.
- Other ways could involve using tools to loosen screws or bolts that hold the sign in place.
- Once the sign is down and wires are clipped, removing the battery is basically the same as for the emergency light.
- Approximate time to remove is 90 seconds.

Other Devices

Removing the face of the unit accesses smoke detector batteries. This is achieved by popping the face plate off or loosening screws. Then the battery can then be removed.

Disposal Options

Batteries may not be disposed of in a landfill. Arrangements should be made with an appropriate recycler to accept lead acid and ni-cd batteries.



Nickel Cadmium Battery Pack in Exit Sign

Identification And Removal Procedures for Lighting Ballasts

Identification Ballasts are rectangular shaped electrical boxes that are usually black in color. Fluorescent ballasts are located above or between the lamps in a fluorescent lighting fixture. Sometimes a metal plate must be removed to access them. HID ballasts can be found in HID lighting fixtures and light posts.

Since 1979, labeling requirements have been developed for ballasts and other PCB containing products. Through general agreement, the following guidelines should be used to determine whether a ballast contains PCBs:

1. All ballasts manufactured through 1979 contain PCBs.

2. Ballasts manufactured after 1979 that do not contain PCBs are labeled "No PCB's."

3. If a ballast is not labeled "No PCB's," assume it contains PCBs.

Removal The steps for removing a ballast include the following:

- Carefully remove the plastic lens from the bottom of the fixture. This can usually be accomplished by removing clips, unscrewing bolts, or unlocking pins. Lenses with hinges or chains can hang from the fixture. Otherwise, place the lens on the ground.

- Carefully remove the fluorescent bulbs and place them in a cardboard container for recycling. With the crowbar or power screwdriver, remove any plates covering the ballasts.

- Once the bulbs and plates are removed, use the power screwdriver to unscrew the ballast from the fixture. With the wire clippers in one hand and the ballast in the other, clip all the wires from the ballast. There are usually 3 wires leading to the ballast.


After removing bulb, remove ballast cover.


Remove restraining bolts.


Cut wires and remove ballast.


Store and dispose of properly.

- To remove HID ballasts, open the HID housing unit. If the HID ballast is composed of one unit, removal is the same as fluorescent ballasts. If the ballast components are separate, only the capacitor needs to be removed.

- Place the recovered ballasts in a 55-gallon steel drum. For disposal purposes separate the ballasts into drums for PCBs and "no PCBs" based on the identification procedure discussed earlier.

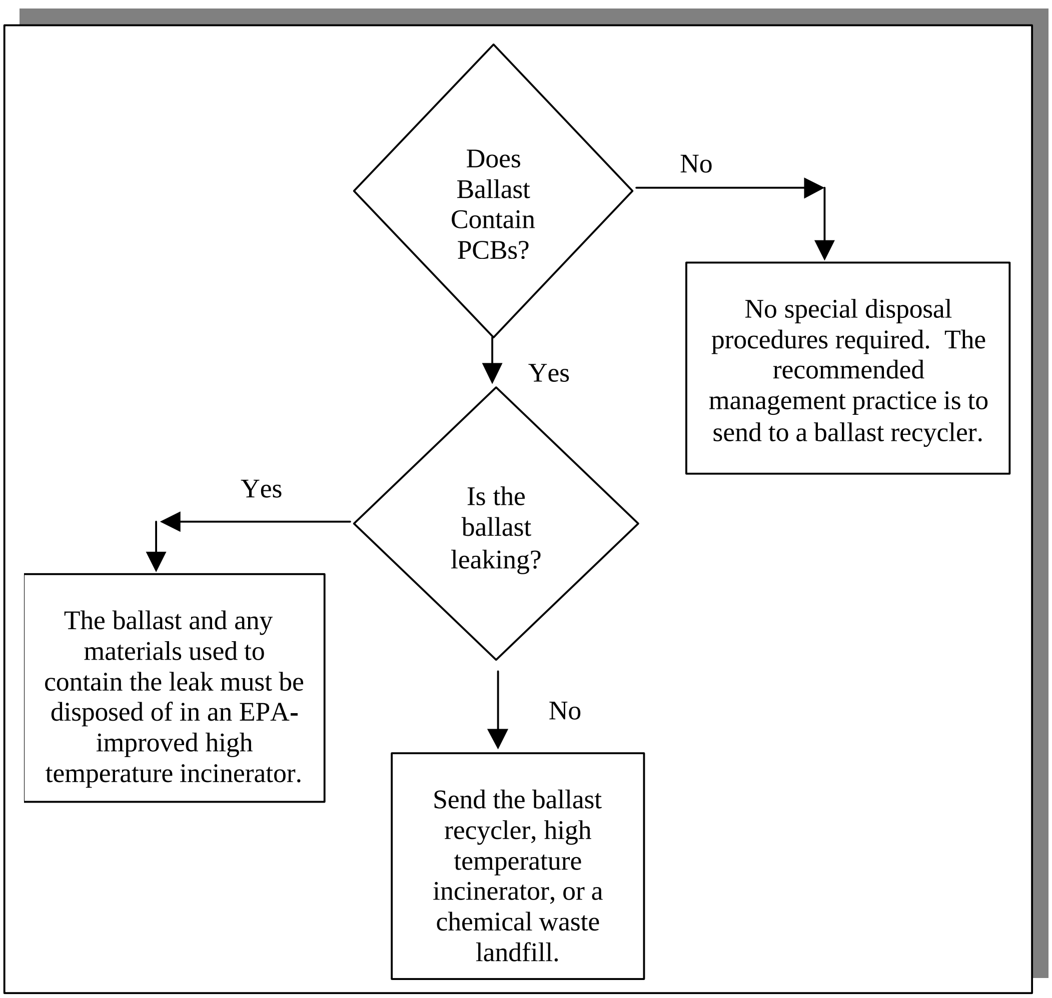
- Leaking PCB ballasts should be placed immediately in a heavy, plastic, zip-lock-type bag and handled as hazardous waste.

- An average of 30 seconds per fixture is required for ballast removal.

- PCBs are very harmful upon contact with skin and mucous membranes. Use caution.

- Safety equipment recommended by OSHA includes gloves made of neoprene, polyvinyl alcohol, FEP Teflon and Viton fluorocarbon rubber. These may be worn inside leather or cloth work gloves to prevent tearing or puncturing.

Disposal Disposal options for ballasts depend on the type, number, and condition of the ballast. Contractors should use the following procedures to determine the proper disposal of ballasts.



Identification And Removal Procedures for Lead Roof Vent Flashing

Identification Lead flashings are found on most roofs. Flashings are used to cover and protect exposed surfaces such as pipes. They look like a dull metal tube jutting vertically up from the roof.

Removal

- Lead flashings on flat, asphalt/gravel roofs require a little more than two minutes each to remove.
- Gravel must be cleared away from the base of the flashing using the claw of a hammer. Once most of the gravel is removed, the claw is used to hack away at the roof several inches away from the pipe.
- After a few hacks, the edge of the flashing base is found and can be pried away from the roof.
- Once the base of the flashing is removed from the roof, the claw of the hammer is used inside the pipe to detach the flashing from the pipe. The flashing can then be removed by hand.
- For the most part, flashings are removed from tiled roofs by the same process. However, tiled roofs require a utility knife to expose the flashing's base, plus a claw hammer to pry the base away from the roof.

Disposal Options Arrange disposal with appropriate lead recycler.

Identification And Removal Procedures for Lead Pipe

Identification Lead pipes can be found in commercial and residential buildings. Lead pipes are usually located behind walls, underneath floors, underneath workspaces, or above ceilings. It may not be possible to access all pipes, but those behind walls, workspaces, or those above ceilings can be accessed once thermostats, switches, lamps, and ballasts are removed.

Removal

- When removing pipes, avoid using a blowtorch or grinding wheel because these tools generate high amounts of dust.
- If these tools must be used, then respirators and eye protection should be worn by the operators and any personal located within the vicinity of the work, especially if the work place is not ventilated.
- Removing pipes normally generates high amounts of dust. This dust can be minimized if the surface can be moisten by a damp sponge or rag.

Disposal Options

Arrange disposal with appropriate recycler. State and local regulatory agencies should maintain lists of qualified recyclers.

Identification And Removal Procedures for Lead Paint

Identification

Lead paint hazards mainly pertain to paint chips and flakes. High amounts of lead paint can be found in homes painted before 1978 (also playgrounds). Major areas of concern are doors, doorframes, windows, window frames, and kick boards.

Lead-paint test kits are available in most hardware stores in the home safety section.

Removal

- Personnel should use eye protection and respirators during the entire paint removal and disposal phase.
- Remove doorframes and windowsills using a crowbar.
- Removable units (doors, window frames) can be removed and temporarily placed on a plastic sheet.
- The waste should stored in a separate container. This container needs to be sheltered from the elements so that rain will not leach out any lead into the ground water.

Disposal Options

Send doorframes and windows containing lead based paint to an appropriate disposal facility.

Conducting A Hazardous Material Removal Process

The aim of this chapter is to outline a procedure that may be used by a demolition contractor or inspector to systematically remove hazardous materials prior to demolition.

Pre-demolition Audit/Hazardous Materials Inventory

A pre-demolition audit is necessary to ensure all hazardous materials in a condemned structure are accounted for. The predemolition audit results in an organized list of hazardous materials, detailing what materials are present and where they may be found.

Walk Through Inspection

The pre-demolition audit begins with a walk through inspection of the building. Every room should be inspected, regardless of whether or not it is similar to another room. Rarely are two rooms exactly the same! Although they may look similar, they may be very different in hazardous material composition. Walk through inspections will vary in terms of the amount of time they require.

Take Good Notes

A sample of a predemolition audit form is included on the following page. The form should include a table that allows the number of each type of material to be recorded. The room these materials are found in should be noted. It is very important to allow additional space for comments. Many demolition sites will have rooms with unique arrangements or items not previously discovered. Sometimes, for example, a material with a unique installation will require special tools or personnel to remove it. Such discoveries should be noted, explicitly, in a predemolition audit. Omission of such information may result in that item not being removed from the waste stream or an improper removal procedure leading to injury or time delays.

Acquire Floor Plans

In addition to using forms to record items, floorplans are an invaluable tool for predemolition audits. Even rough notes on a floor plan can make the forms easier to follow since the plans explicitly detail where items are located. Some materials may be hidden in a location not adequately described by predemolition audit forms.

Take Inventory

As the demolition proceeds, the recovery of items should be noted. At the conclusion of the demolition, the number of uncovered items should be equal to the number of items detailed in the predemolition audit.

Timing is Important

The best way to perform a predemolition audit is to perform it as early as possible in the demolition project. If the building is vacant for any period of time, salvageable items such as thermostats and silent switches may be removed. Delicate items, such as fluorescent bulbs and HID lamps, may be vandalized. If the predemolition audit is performed too far along into the demolition, the chaotic nature of a demolition may prevent an accurate assessment of the materials present.

Removal Methods, Tools, and Removal Times for Hazardous Building Components

Item	Removal Method	Tools Needed	Container	Time per Item (sec)
Thermostats	Remove entire unit	Screwdriver	Small box Newspaper Styrofoam	30 to 60
Silent Switches	Remove entire unit	Screwdriver	Small box Newspaper Styrofoam	60 to 120
Fluorescent Bulbs	Remove bulb	Ladder	Cylindrical box Original package	20 to 30
HID Lamps	Remove entire unit	Ladder Screwdriver or nutdriver	Large box Newspaper Styrofoam	90 to 180
	Remove bulb only	Ladder	Small box Original container	45
Ballasts	Remove ballast	Ladder Nutdriver Wirecutter	55-gallon drum Large cardboard box	60 to 90
Batteries	Remove entire unit	Ladder Screwdriver or nutdriver	Large box Newspaper Styrofoam	90 to 180
	Remove battery only	Ladder Screwdriver or nutdriver Claw hammer or crowbar Wire Cutter	Large box	60
Lead Roof Flashings	Remove flashing	Ladder Claw hammer or crowbar	Large box	120

Impact on the Demolition Contractor

The benefits of removing hazardous building components from structures prior to demolition are many. The demolition contractor and the client greatly minimize future liability as a result of waste disposed from a demolition project. The materials recycled during demolition may retain a higher market value. Worker safety at the demolition and the disposal or recycling site is improved. The removal of chemicals such as lead, mercury, cadmium, and PCBs from demolition prevents their release into the environment.

Removal of hazardous building components is more expensive for the demolition contractor and therefore the client. Costs are incurred by the extra labor time required to remove the components. The previous table can be used to estimate the time for removal. Recyclers of items such as fluorescent lamps and batteries do charge for the items they accept and process. A range of process fees is presented in the following table.

Costs of Recycling Hazardous Building Components
(does not include transportation unless otherwise noted**)**

Item	Cost
Fluorescent Lamps	$0.06 to $0.13 per foot $0.25 to $0.40 per 4-ft lamp $0.50 to $1.00 per 8-ft lamp
HID Lamps	$2.00 to $4.50 per lamp
PCB Ballasts	$0.35 to $1.00 per pound (many companies differentiate PCB and non-PCB ballasts in price)
Mercury Thermostats and Switches	$3.00 to $4.00 per pound
Batteries	$2.50 to $10.00 per pound

Note: Prices vary per the quantity of items

Since the extra cost of removing these components will result in increased costs to the client, education as to the requirements and benefits outlined in this document may be needed. In addition to complying with necessary regulations, perhaps the largest benefit to the client is a greatly reduced liability for the waste that is generated. If demolition waste from a project is sent to a landfill and groundwater contamination results from chemicals in the waste, the demolition contractor *and* the client could be held financially responsible for any cleanup efforts undertaken.

Case Study 1: Lakewood Elementary, St. Petersburg, Florida

A demonstration project was conducted on Wednesday, July 16, 1997, at Lakewood Elementary School in St. Petersburg. The building, which was comprised of 15 classrooms, 4 restrooms and 2 utility/conference rooms, was being demolished by Standard Demolition, Inc., of Tampa. Six workers were needed to complete the job, which began at approximately 11 am and was finished by 5 PM (approximately 36 man-hours).

Walk Through The demonstration began with a walk-through inspection that lasted 30 minutes. Two workers inspected the upstairs while another pair inspected the downstairs. Because a floor plan was not available, both teams sketched a layout of the floor and documented where hazardous materials were located. In the future, it would be beneficial to acquire site plans prior to walk-through inspections, if available.

Removal of Fluorescent Bulbs and Ballasts

Removal of Small Sealed Lead Acid from Emergency Light

Removal Following the initial inspection, the 6 member team was divided into 3 groups of 2. Two teams removed fluorescent light bulbs and ballasts while the third team removed emergency lights and exit signs. The tools necessary to remove the materials were a Phillips head screwdriver, a nutdriver (ratchet attached to a nonmoving handle), a pair of wire cutters and a ladder. The screwdriver was used for the emergency/exit lights, while the nutdriver and wire cutters were used for the lights and ballasts. The team was not permitted to inspect the roof for lead flashings.

Analysis Lights required approximately 30 seconds each to remove, including the time required moving the ladder and become resituated. Ballasts also required about 30 seconds each for removal. Of the 245 ballasts that were removed from the school, only 9 of them contained PCBs. It appeared that the building's lighting had been redesigned in recent years since so few PCB ballasts were found. Furthermore, all PCB ballasts were found in only two rooms, neither of which appeared to be classrooms because of their extremely small size. Twelve of the ballasts were the emergency lighting type.

The following table summarizes the items recovered from Lakewood Elementary. No thermostats were found in the building, nor was any evidence found to suggest they had been removed.

Results of St. Petersburg Case Study

Component	Number Removed	Average Removal Time (sec)
Fluorescent Bulb	468	30
Ballast		
PCB	9	30
Non-PCB	233	30
Batteries		
Exit Signs	7	120
Emergency Lighting	10	120

Fluorescent Lights, Ballasts, and Batteries were Recycled by Quicksilver Environmental (Tampa, Florida)

Case Study 2: Rhines Hall, Gainesville, Florida

Rhines Hall was demolished by Beers Construction on October 7, 1997. The building was comprised of 64 classrooms and 4 restrooms. The removal was performed by two workers and took 6 hours.

Walk Through Floorplans for each of the building's three floors and roof were acquired from University Blueprint in Gainesville. Two workers took three hours to complete the pre-demolition audit. The number of fluorescent bulbs and ballasts in each room was counted and labeled on each floor's blueprint. Likewise, the location and number of batteries, HID lamps, and thermometers were also recorded.

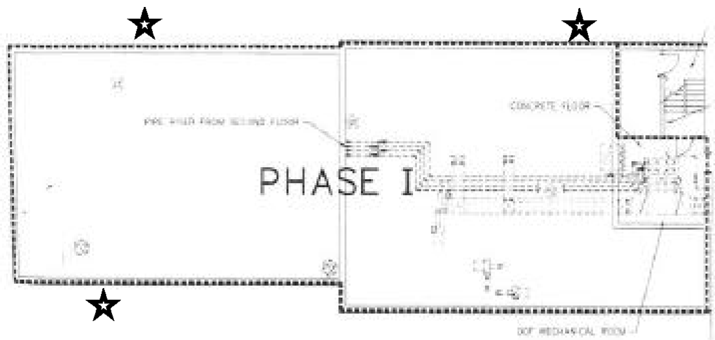
Removal Two workers performed the entire hazardous material removal. Each worker had a power screwdriver, a pair of wire cutters, and a ladder. The screwdriver was used for the emergency/exit lights, while the wire cutters were used for the lights and ballasts. The team did not inspect the roof for lead flashings.

Analysis Lights required approximately 30 seconds each to remove, including the time required to move the ladder and become resituated. Ballasts required about 90 seconds each for removal. Of the 420 ballasts that were removed from the building, only 12 of them contained PCBs. Neither the three HID bulbs nor the lead flashings were removed. The number of estimated fluorescent bulbs and ballasts may be low due to a dropped ceiling in some first floor rooms. Room 113, for example, had a renovated dropped ceiling and light fixtures from the original ceiling were above the tiles of the new ceiling. Some of these fixtures may have contained fluorescent bulbs and ballasts which were not removed at the time of renovation. This may explain the discrepancies between the number expected and the number removed. Further inspection was needed to warrant their inclusion in the pre-demolition audit.

The following table presents the results of the inspection and removal. Average Removal Time is based on data supplied from the demolition crew removing these items.

Hazardous Building Components Encountered and Average Removal Time

Component	Number Removed	Average Removal Time (sec)
Fluorescent Bulb	816	30
HID Lamp	3	180
Thermostat	1	30
Ballast	420	
PCB	12	90
Non-PCB	408	90
Batteries		
Exit Signs	9	90

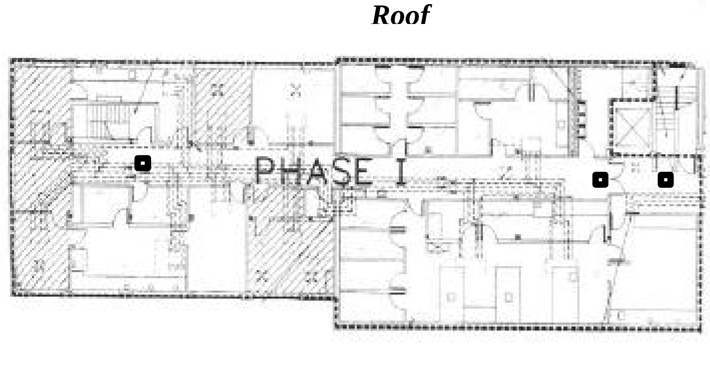


Exit Sign

HID Light Fixture

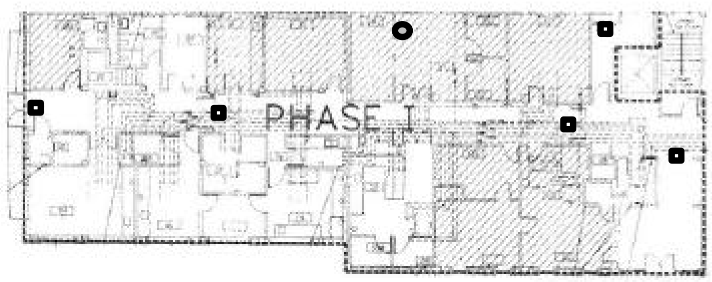
Mercury Thermostat

Roof



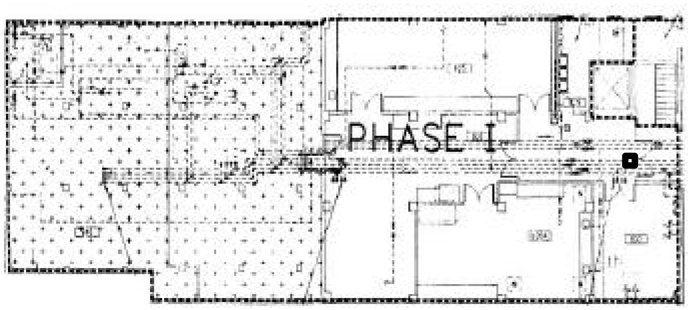
2nd Floor: 150 Light Fixtures
1st Floor: 148 Light Fixtures
Basement: 98 Light Fixtures

Second Floor



First Floor

Ballasts were stored in 55-gallon drums.



Basement

GLOSSARY

The following terms were used throughout this document.

Ballast Electrical device used to provide an initial starting charge required to excite the gaseous atoms and control the electric current going to fluorescent and HID lamps.

Bioaccumulation Process whereby certain chemicals concentrate to dangerous levels as they work their way up the food chain.

Cadmium A bluish white ductile toxic bivalent metallic element used especially in nickel-cadmium batteries which can cause liver damage, kidney failure and pulmonary disease.

Class III Landfill Classification of landfills in some states that can accept yard waste, construction demolition waste, and white goods.

Code of Federal Regulations (CFR) The location of federal regulations, including those relating to the management of solid and hazardous waste. For example, Title 40 of the Code of Federal Regulations Part 262 deals with requirements for generators of hazardous wastes.

Deconstruction Type of demolition that focuses on salvaging certain items for reuse.

Fluorescent Light Bulb Gas discharge bulb which emits light by passing electrical current though gaseous mercury.

High Intensity Discharge Lamp (HID) A dual chambered gas discharge bulb containing mercury which is used for outdoor lighting applications .

High Pressure Sodium Lamp Type of HID lamp with an inner ceramic tube and which uses a sodium/mercury amalgam. Emits a mono-chromatic light ideal for parking lots, bridges and street lights.

Leachate The liquid created as rainfall percolate through a solid waste. It may contain any chemical present in the waste materials. Leachate acts as a transport mechanism for the migration of chemicals from a landfill off-site.

Lead A heavy soft bluish white metallic element used especially in pipes, flashings batteries, and paints which may cause brain and nerve damage, stunted growth, and kidney damage.

Lead Acid Battery Type of battery with lead antimony electrodes and sulfuric acid electrolyte.

Lead Vent Flashing A malleable sheet or tube of lead used to help seal and protect exposed roof surfaces.

Materials Recovery Facility (MRF) A facility operated for the purpose of separating and recovering materials from a solid waste stream for recovery and reuse.

Mercury A heavy silver-white poisonous metallic element that is used in thermostats, switches, fluorescent and HID bulbs which can cause deterioration of the nervous system and brain damage, birth defects, and death.

Mercury Vapor Lamp Type of HID lamp with a mercury filled inner quartz arc tube used for indoor and outdoor lighting applications.

Metal Halide Lamp Type of HID lamp with a mercury filled inner quartz arc tube which emits a considerable amount of ultraviolet radiation.

Municipal Solid Waste All the waste generated from residential, commercial, and institutional facilities.

Nickel Cadmium Battery Type of light – weight, rechargeable, rapid discharge battery that uses nickel and cadmium.

Polychlorinated Biphenyls (PCBs) Oily chemicals used as lubricating fluids in the capacitors of some ballasts which can harm reproduction and growth and has the potential to cause cancer.

Resource Conservation and Recovery Act (**RCRA**) The federal statute that deals with the identification, generation, storage, treatment, and disposal of hazardous solid wastes.

Silent Switch A type of light switch which uses a mercury filled cylinder to make a quiet contact when turned on.

Spotter Municipal waste facility employee who inspects incoming loads of waste for prohibited materials.

Thermostat A temperature control device which uses mercury filled ampoules to trigger heating, ventilation, and air conditioning (HVAC) systems.

Universal Waste Rule Federal rule which allows demolition contractors to follow less stringent rules for record keeping, labeling, transporting, and storing hazardous waste batteries, pesticides, mercury lamps and mercury thermostats.