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GUIDE FOR SELECTION AND OPERATION OF MEDICAL WASTE INCINERATORS

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This Technical Guide provides information to Department of the Army (DA) personnel responsible for selection and operation of incinerators used to dispose of solid waste generated by DA medical facilities.

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GUIDE FOR SELECTION AND OPERATION OF MEDICAL WASTE INCINERATORS

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CHAPTER 1

GENERAL

1-1. REFERENCES. See Appendix A for a list of references used for this Technical Guide.

1-2. PURPOSE. This Technical Guide provides information to the Department of the Army (DA) personnel responsible for selection and operation of incinerators used to dispose of solid waste generated by DA medical facilities.

1-3. SCOPE. This Technical Guide provides guidance on selection of incinerators to be used for the destruction of medical waste, discusses operational practices which affect proper combustion of the waste, provides site selection considerations, addresses safety and health considerations, and identifies air pollution control equipment which may be required for compliance with air pollution control regulations.

1-4. BACKGROUND.

a. Incineration is defined as the disposal of waste materials by burning in an enclosed structure. The process reduces the weight, volume and volatile content of refuse, producing gases and a noncombustible residue (ash). Product gases are vented to the atmosphere through the stack; and the ash, if not hazardous, may be disposed of in a sanitary landfill. An incinerator used to treat medical waste must properly incinerate the waste by killing any pathogens and destroying any biologically active material in the waste, reducing the waste to a nonhazardous ash which may be landfilled, and meeting applicable air pollution emission standards.

b. A common problem with medical waste incinerators has been the procurement of incinerators which were not designed for incineration of the types of waste generated at the facility. Personnel specifying and procuring incinerators to incinerate hospital wastes have frequently procured pathological incinerators with the mistaken idea that these types of incinerators are designed for all hospital wastes. Confusion arises in definitions and in the term pathological. Some people identify the term pathological as referring to all types of contaminated, infectious, or other wastes generated by a health care facility. However, the manufacturers of incinerators have a different meaning when referring to a pathological incinerator. A pathological incinerator is one designed specifically to burn a Type 4 waste (pathological waste) which is defined as human and animal remains consisting of up to 85-percent moisture, 5-percent incombustible solids, and having a heating value of 1,000 British thermal units (Btu's) per pound. (Refer to Appendices B and C for classifications of general waste and infectious waste, respectively.) However, the wastes generated at Army medical facilities normally contain only a small amount of Type 4 waste and are composed primarily of a variable mixture of Types 0, 1, 2, 3, and 4 wastes and small amounts of Type 5 waste.

c. Waste incinerated in pathological incinerators should be limited to Type 4 waste only. Pathological incinerators require solid hearths, rather than grates, due to the release of fluids that are not immediately evaporated as carcasses/body parts are incinerated. Solid hearths eliminate the use of underfire air in the combustion process and result in a decreased burning rate and the formation of substantial amounts of carbon monoxide and particulates through the incomplete oxidation of carbon. Use of pathological incinerators should be limited to facilities such as veterinary clinics, where the waste generated consists primarily of Type 4 waste.

d. The infectious waste in medical facility waste must be exposed to a sufficiently high temperature for an adequate period of time to ensure destruction of all pathogenic organisms. This is difficult to achieve with a single chamber incinerator. The use of hospital incinerators to destroy general wastes with very high destruction efficiency requirements and the appearance of plastics in the wastes has led to the use of multiple chamber incinerators which are more effective than single chamber incinerators. Solids are burned in the primary chamber, and the combustion gases are heated to an adequate temperature to ensure good combustion in the secondary chamber by supplementary firing. Older model multiple chamber incinerators operate at high excess air levels. In the past 10-15 years, the predominant incinerator technology has become the "controlled air" type incinerator. These incinerators operate at significantly lower excess air levels and, therefore, have lower combustion gas velocities through the combustion chambers. Because of this, the particulate emission levels are lower, and these type incinerators have become the preferred and most commonly installed incinerator today. Controlled air incinerators are also referred to as "starved air," "pyrolytic combustion," or "modular" incinerators.

e. The preferred incinerator type, controlled air (starved air) incinerators, burn Types 0 through 4 waste (Appendix B) in capacities of 100 to 1,000 pounds per hour with volume reductions ranging from 10:1 to greater than 100:1, depending on waste composition. The "starved air" or "controlled air" incineration systems control burning in a process that produces combustible carbon monoxide rather than carbon dioxide. Waste is fed into the primary combustion chamber and ignited. Gases from the primary chamber pass to the secondary combustion chamber where they are mixed with preheated air and ignited by a gas jet. The mixture burns at temperatures of 2,000 °F to 2,400 °F (Appendix A, reference A-6). A blower introduces air to the bottom of the primary combustion chamber through headers. The air supply is proportional to the amount needed in the combustion chamber; as the fire becomes hotter, the concentration of oxygen decreases, automatically reducing the rate of burning.

CHAPTER 2

INCINERATOR SELECTION

2-1. GENERAL. The principles of combustion that generally apply to incinerator combustion efficiency include the following: air and fuel must be in proper proportion and adequately mixed, temperatures must be sufficient for ignition of both fuel and gaseous components, the furnace volume must be sufficient to provide the retention time necessary for complete combustion, and furnace proportions must ensure that ignition temperatures are maintained and fly ash entrainment is minimized. This section discusses features which enable these principles of combustion to be adequately designed into an incinerator and the factors which must be considered when selecting an incinerator.

a. One specific medical waste incinerator cannot be recommended to meet the needs of all installations since compositions of wastes and air pollution regulations vary significantly by locale. Each facility must be analyzed with regard to type and quantity of waste to be incinerated.

b. Incinerator configuration will depend upon the physical form of the waste, performance requirements (standards, including air pollution), and the combustibility of the waste. Dry combustibles can be burned on a grate with cold air blown up through it. If the solids are wet, this combustion air must be hot. These differences illustrate the difficulty in designing one incinerator to burn all types of waste and indicate that changing the purpose of an existing incinerator (for example, from burning pathological waste to burning general wastes) is often impractical.

2-2. INCINERATOR DESIGN. Medical waste incinerators should be of multiple-chamber design, preferably of the "starved air" or "controlled air" type. Emissions from single-chamber incinerators are about an order of magnitude greater than those from multiple-chamber incinerators for particulate and about two orders of magnitude greater for carbon monoxide (Appendix A, reference A-5). Design considerations for medical waste incinerators include, but are not limited to, the following:

a. Air Pollution Standards.

(1) The design of medical waste incinerators and the modification or conversion of existing units must comply with State and local standards, as well as general design standards for incinerators specified by air pollution control agencies. Depending on locale, standards may be established for particulate emissions, gaseous emissions, opacity (visible emissions), and fugitive emissions. Rated capacities of medical waste incinerators should be determined with consideration given to the increased particulate and opacity problems resulting from the trend of higher plastic content in medical wastes. A list of selected State air pollution standards for particulate and opacity is provided at Appendix D.

(2) Some States maintain lists of incinerators by manufacturer and model number which are recommended for the destruction of medical waste without a requirement for individual testing to determine compliance with air pollution standards. Procurement of an incinerator from such a list saves the expense of testing for compliance with emissions and indicates that the listed incinerators previously have demonstrated compliance with air pollution standards. However, the installation is still responsible for operation of the incinerator in such a manner as to minimize emissions and comply with State and local air pollution standards.

b. Waste Composition.

(1) The quantity and type of waste to be incinerated are the primary criteria for selecting an incinerator. The diversified character of waste generated at each facility precludes the generalization of a typical waste for system design. When a requirement for a medical waste incinerator is established, a study must be performed to determine the type and size of incinerator appropriate for the facility. This requirement must be submitted to HQDA for coordination with the Office of the Surgeon General (OTSG) for review and approval before the design is authorized (Appendix A, reference A-2). The Waste Disposal Engineering Division of this Agency can provide guidance and assistance in conducting the study to characterize the amount and types of waste generated [AV 584-2953, (301) 671-2953].

(2) The type of waste and its heating value must be adequately determined. The heating value of the waste will determine the thermal input required to incinerate the waste. Thermal input is more critical to incinerator design than the amount of waste to be incinerated, although the quantity of waste must also be considered. It is the rate of heat release which primarily determines the size of the unit rather than the rate of waste feed, which is determined by the amount of heat released or absorbed and not on a simple pounds per hour basis. However, knowledge of actual (not typical) waste heating values and actual waste disposal rates are necessary since the rate of waste feed will govern the hours of incinerator operation each day.

(3) The plastic content of the waste to be incinerated is of concern and must be considered, particularly the content of chlorinated plastics, such as polyvinyl chloride. In addition to the problem of hydrogen chloride production from the combustion of chlorinated plastics, all plastics burn rapidly and release large amounts of high temperature combustion gases which increase the velocity through the incinerator and decrease the retention time. Because of this, some incinerator manufacturers may not guarantee the particulate emission rate of an incinerator if the plastic content in the waste is too high. Plastic content of 10-15 percent of the waste can generally be burned in most incinerators without adversely affecting the performance of the incinerator. High plastic content in incinerated waste can also lead to over pressure in the primary combustion chamber, producing fugitive smoke and/or aerosol in the breathing zones of incinerator operating personnel.

c. Refractory. Material must be super-duty, sufficient in thickness to preclude premature refractory failure and to protect the integrity of the structure that supports them. The use of acid-resistant mortar is required. High quality materials are necessary if a reasonable and satisfactory service life is to be expected. Manufacturers must be experienced in high-temperature furnace fabrication and refractory installation, since faulty construction may offset the benefits of a good design.

d. Charging Doors. Double charging doors must be provided for maximum protection from flame blowback, exploding cans and bottles, and infectious micro-organisms. Guillotine charging doors used in recommended designs should be lined with refractory material with a minimum service temperature of 2,600 °F. The following guidelines should be followed for door linings based on capacity in pounds per hour (Appendix A, reference A-5):

(1) 2 inches for less than 100 lb/hr.

(2) 3 inches for 100-350 lb/hr.

(3) 4 inches for 350-1,000 lb/hr.

(4) 6 inches for 1,000 lb/hr and larger.

e. Sampling Ports. In order to test for compliance with air pollution standards, incinerator stacks should have two sampling ports, 3 1/2 inches in diameter, located at right angles to each other. They should be located, whenever possible, 8 to 10 stack diameters downstream from any bend or disturbance of gas flow, and two stack diameters upstream of the exit of the stack. The ports should be provided with removable, replaceable caps. Assistance in determining the best location of sampling ports can be obtained from the Air Pollution Engineering Division of this Agency [AV 584-3500, (301) 671-3500].

f. Gas Burners. The burner assembly should consist of the main burner, pilot burner, automatic valve, the necessary manual valves, and accessory equipment with provision for rigid mounting. When a complete automatic pilot system is not provided, a readily accessible, manually operated valve should be provided to shut off or turn on the gas supply to the main burner manifold. This valve should be located upstream from all controls except the pilot control valve. Clearly defined and complete instructions for lighting and shutting down the burner should be provided in durable, weather-proof material for posting in a position where they can be easily read. Combustion safety controls, such as a burner flame monitor, air and fuel pressure switches, an oven temperature switch, and automatic safety shut-off valves, should be provided to ensure safe burner operation.

g. Air Inlets. All combustion air inlets should provide positive control, and air inlet structures should be of cast iron. Sliding rectangular dampers become inoperative and should not be used.

h. Operational Controls. The incinerator must have sufficient operational controls to adequately monitor and control operation of the incinerator. These should include temperature monitors in both the primary and secondary chambers, air and fuel flow monitors and controls, and draft gauges. Automatic temperature-controlled interlocks should be provided for charging door and burner system operation and combustion air supply. An automatic time/temperature-controlled interlock system should be provided on the induced draft fan system to prevent refractory damage and protect air pollution control equipment.

i. Mixing and Gas Residence Times. Enough time must be provided to complete the chemical reactions and enough turbulence provided to mix the oxygen and volatilized components. The necessary retention times can be assured by designing the combustion system to provide an adequate volume. Turbulent mixing is achieved in multiple-chamber incinerators by use of restricted flow areas and abrupt changes in flow direction.

j. Length of Work Day. Incinerator capacity must be based on a 6-hour maximum burning period to allow sufficient startup and cool-down time during one 8-hour shift.

CHAPTER 3

INCINERATOR OPERATION

3-1. GENERAL. This section discusses operational practices which affect proper combustion of the waste and, as a result, the air pollution emissions. These operational practices are general in nature and are considered good operating procedure for any incinerator. The practices discussed below are not intended to replace the incinerator manufacturer's specific operating instructions for a designated model.

3-2. MANUFACTURER'S OPERATING INSTRUCTIONS. A copy of the Incinerator Manufacturer's Operating Instructions should be posted at the incinerator location. The operator must be thoroughly familiar with and operate the incinerator in accordance with these instructions.

3-3. INCINERATOR STANDING OPERATING PROCEDURES (SOP's). Acceptable operating practices should be included in an incinerator SOP which should be developed based on type and quantity of waste to be incinerated and posted near the incinerator so that they will be available to operators at all times. The following practices should be included in SOP's for medical waste incinerators:

a. Operating limits for charging, temperature, air flow, and fuel feed should be carefully observed while feeding and combusting waste.

b. The incinerator and associated equipment should be inspected to detect leaks and check operation of shut-down controls; the incinerator should be ventilated with combustion air prior to starting the burns to prevent an explosion from leakage of combustion fuel.

c. The incinerator should be airtight or operated under negative pressure for control of fugitive emissions.

d. Waste should not be fed during startup and shut-down to prevent incineration of waste at improper combustion temperatures.

e. The primary chamber should not be ignited until the secondary chamber is heated to proper operating temperature.

f. Waste should not be fed until the previous batch has completely burned out in order to prevent surges of incomplete combustion products, possibly including microorganisms, up the stack.

3-4. OPERATING LIMITS. Acceptable operating limits must be set for the following parameters affecting operation of any incinerator used for disposal of infectious waste: variations in waste composition, waste feed rate, combustion temperature, and air/fuel feed rates.

a. Waste Composition. The waste feed composition affects combustion since different types of waste vary in characteristics such as moisture content and heating value. The effect of each type of waste or combination of wastes on the combustion process must be understood to determine adjustments to be made in operating variables to maintain proper incinerator operation.

(1) Inorganic materials, such as metals and glass, should be minimized in the waste feed due to slag formation which can damage the refractory.

(2) The quantity of plastics in the waste feed should be minimized as much as possible, especially chlorinated plastics, such as polyvinyl chloride, whose combustion products include hydrogen chloride which is corrosive to the incinerator. Chlorinated plastic items should be eliminated by substituting other types of plastic, such as polyethylene or polypropylene, for disposable items and trash bags, and by using other types of containers to hold waste.

(3) Since all plastics burn rapidly, particulate emissions are increased due to incomplete combustion and particle entrainment. Rapid temperature fluctuations may also damage the incinerator refractory. Accordingly, plastic wastes which must be incinerated should be mixed with other wastes prior to charging, with the resulting plastic content of the charge not to exceed 20 percent. The plastic content may have to be lowered to 10-15 percent in order for the incinerator emissions to meet air pollution standards. Use of clear trash bags versus opaque trash bags for collection and incineration of medical waste will enable incinerator operating personnel to monitor plastic content in batch waste feed operations.

b. Waste Feed Rate. The rate at which waste is fed to the incinerator affects combustion and incinerator efficiency. Overcharging the incinerator will result in incomplete combustion; the optimal feed rate should be determined for each waste feed composition. Scales for weighing the waste charge should be provided at the incinerator to ensure that a consistent charge is maintained. In general, it is recommended to charge one-quarter of the hourly rate every 15 minutes. For example, if the optimal feed rate for a certain waste composition has been determined to be 100 lb/hr, 25 pounds should be charged every 15 minutes. Compacting the waste prior to incineration may result in incomplete combustion of the waste and should be avoided.

c. Combustion Temperature. The proper combustion temperature can be maintained by adjusting the combustion air feed and the amount of fuel. Preheating the secondary combustion chamber to operating temperature (1,800-2,000 °F) should be accomplished prior to charging or ignition of the primary chamber burners to preclude products of incomplete combustion exiting the stack and to ensure the destruction of pathogens.

d. COMBUSTION AIR. The quantity of combustion air introduced into the incinerator is fundamental to proper combustion. Air and fuel feed rates can be adjusted with variations in waste feed rate and composition to maintain the necessary combustion temperature. The air required to supply the necessary oxygen for complete combustion is defined as stoichiometric or theoretical air. Due to incomplete mixing, not all of the oxygen will be consumed and additional air must be provided. This additional required air is known as excess air and is expressed as a percentage of stoichiometric air. If insufficient excess air is supplied to an incinerator, incomplete combustion will occur and result in increased particulate emissions and a black smoke plume from the stack. An overabundance of excess air will also promote incomplete combustion by increasing the velocity of gases through the incinerator, thereby lowering the retention time and temperature, resulting in the release of a white smoke plume from the stack. Excess air requirements generally range from 50 to 200 percent of stoichiometric air; consult the manufacturer for excess air requirements for a particular incinerator.

3-5. INCINERATOR MAINTENANCE. Adequate space must be provided at the incinerator to permit easy transfer of waste to the incinerator charging gate, removal of ash, and maintenance and repair of the incinerator.

a. The hearth should be cleaned frequently to prevent a buildup of ash residue. The frequency of cleaning the combustion chamber is dependent upon incinerator usage. Deposits in the combustion chamber should be removed to avoid reentrainment in the exit gases with further use of the incinerator.

b. Incinerator refractory linings are easily damaged and must be treated with care, especially when cleaning out the ash from the incinerator. A new refractory will soon crack after being put in service due to the temperature-dependent coefficient of expansion, resulting in cracks 1/32 to 3/16 of an inch in width. At normal operating temperatures, the refractory bricks will expand and eliminate these cracks. Larger cracks or chips will result if the refractory is damaged; damaged refractories often can be repaired with refractory filler material, but the incinerator manufacturer should be consulted prior to undertaking any refractory repairs.

c. All monitors and controls should be checked periodically and recalibrated when necessary. Improperly operating monitors and controls may result in incomplete combustion and increased air pollution emissions.

3-6. ASH HANDLING. The ash residue after incineration is not considered to be infectious if the incinerator is operated properly and in accordance with the manufacturer's specifications. Accordingly, the ash may be landfilled in any permitted sanitary landfill.

3-7. TRAINING. The best incinerator design and SOP's will be worthless without proper operation. Operation of the incinerator must be restricted to persons trained in the correct operation of the incinerator. Training must include impressing upon the operators the importance of following the manufacturer's operating procedures for the incinerator. When a new incinerator is being installed at an installation, the contract should include a provision for the manufacturer to provide training in the proper operation of the incinerator to those persons designated to operate the incinerator.

CHAPTER 4

ADDITIONAL CONSIDERATIONS

4-1. SITING. The following factors must be taken into consideration when determining the best location for the incinerator. The importance and feasibility of each will vary with the installation, but safety and health considerations must take precedence over convenience and aesthetics.

a. The direction and velocity of the prevailing winds.

b. The proximity to the health care facility.

c. The proximity to nearby buildings.

d. The type and use of nearby buildings.

e. The location of air intake vents in the hospital and nearby buildings.

f. The height of the hospital and other nearby buildings.

g. Accessibility of the incinerator site.

h. Incinerator stack height.

4-2. SAFETY AND HEALTH.

a. Medical waste may constitute a health hazard if not handled properly. Incinerator operators should wear appropriate personal protective equipment, including gloves, coveralls, and safety glasses. Gloves and coveralls should be changed daily. Operators should also wear a transparent face shield when stoking and charging waste. Depending on the type of waste to be incinerated and existing engineering controls, approved respiratory protection may be necessary, as determined by an industrial hygienist. If respirators are used, a respiratory protection program meeting the minimum requirements of 29 CFR 1910.134 and TB MED 502 must be in force.

b. Operators of medical waste incinerators and others handling medical waste should be immunized against organisms to which they may be exposed. Determination of necessary immunizations are the responsibility of the hospital commander with staff assistance from the Preventive Medicine Service.

c. The following safety procedures should be followed at all times:

(1) Do not charge highly flammable materials into the incinerator or permit delivery or storage of gasoline, ammunition, or other explosive materials in the room where the incinerator is located.

(2) Do not stand directly in front of the fire door when opening it or when charging the incinerator. The influx of cold air may cause bottles in the waste to explode.

(3) Ventilate the incinerator well before lighting burners to avoid explosion of accumulated vapors.

(4) Provide a Halon or dry chemical fire extinguisher in good working order in the incinerator room at all times. Ensure that all workers expected to respond to an incipient stage fire have been trained in accordance with 29 CFR 1910.157(g).

4-3. AIR POLLUTION CONTROL EQUIPMENT. A characteristic of multiple-chamber incinerators is that control of air-pollution emissions is built in, if the incinerator is operated with reasonable care. The discharge of combustion contaminants is almost entirely a function of ignition chamber design and the actions of the operator. Control of smoke is attained by proper admission of combustion air and use of secondary burners. If applicable air pollution regulations require a further reduction in air pollution emissions, a wet scrubber system may be added to the incinerator.

a. Wet scrubbers can control both particulate and gaseous pollutants and are probably the only type of control equipment suitable for use where the incineration of chlorinated plastics results in hydrogen chloride production. Venturi scrubbers and turbulent bed scrubbers can provide a particulate collection efficiency in excess of 90 percent.

b. Fabric filters and electrostatic precipitators both are able to provide the necessary particulate collection efficiency, but neither have the ability to provide a sufficient reduction in gaseous emissions. Additionally, fabric filters are generally not applied to small incinerators because of the difficulty in removing the collected ash from the fabric and the danger of fires due to the high temperatures and carry over of combustible material; and electrostatic precipitators are not normally applicable to the size of incinerators in use at Army medical facilities.

4-4. STORAGE. An easily cleanable storage area should be provided as close to the incinerator site as feasible. All access doors to infectious waste storage and treatment areas should be posted with appropriate infectious waste warning signs, including the universal biohazard symbol. The storage area should be provided with a lock and a faucet which will allow connection of a hose and should be capable of providing storage for at least 1 day's generation of waste. The floor, ceiling, and wall surfaces should be of an impervious washable material. The floor should slope to a drain to facilitate removal of cleaning/disinfectant wastes. The storage facility should be sized to accommodate weekend storage of waste, peak period waste production, and waste accumulation while the incinerator is out of operations for repair or maintenance. A ventilation or refrigeration system may be required to prevent temperatures from exceeding 77 °F for one day of storage, 45 °F for 3 days of storage, and 14 °F for 90 days of storage.

4-5. SECURITY. Adequate measures to ensure the security of the waste being stored and the incinerator facility need to be determined and addressed in the design of the incinerator facility.

4-6. TECHNICAL ASSISTANCE. Technical assistance can be obtained from the US Army Environmental Hygiene Agency through MACOM's from the Commander, Health Services Command, ATTN: HSPA-P, Fort Sam Houston, TX 78234-6000. Specific services available include:

a. Determination of pollutant emission data, operating criteria, and performance standards for air pollution abatement equipment.

b. Consultation on current air quality regulations, standards and monitoring instruments.

c. Source evaluations to show compliance of existing sources with air quality regulations or standards.

d. Collection and interpretation of data to develop permit applications.

e. Review of designs for air pollution controls to be installed for new, modified, or existing sources.

f. Assistance in determining the type and amount of waste generated at the medical facility.

APPENDIX A

REFERENCES

A-1. AR 40-5, 1 June 1985, Preventive Medicine.

A-2. AR 200-1, 15 June 1982, Environmental Protection and Enhancement.

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A-4. Incinerator Institute of America, I.I.A. Incinerator Standards (1968).

A-5. US Environmental Protection Agency, Office of Air and Water Programs, August 1982, "Field Operations and Enforcement Manual for Air Pollution Control, Volume II: Control Technology and General Source Inspection."

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A-7. US Environmental Protection Agency, Office of Air and Water Programs, June 1973, "Field Surveillance and Enforcement Guide: Combustion and Incineration Sources."

A-8. US Department of Health, Education, and Welfare, Public Health Service, "Incinerator Guidelines-1969" (1969).

A-9. Brian W. Doyle, Donald A. Drum, Jack D. Lauber, "The Smoldering Question of Hospital Wastes," Pollution Engineering (July 1985).

APPENDIX B

CLASSIFICATION OF WASTES TO BE INCINERATED[a]

Type of waste: Type	Type of waste: Description	Principal components	Approximate composition, % by weight	Moisture content, %	Incombustible solids, %	BTU value/lb of refuse as fired	BTU of aux. fuel per lb of waste to be included in combustion calculations	Recommended minimum BTU/hr burner input per lb waste
0		Combustible trash, paper, cardboard, wood, rags, etc.		10	5	8,500	0	0
1	Rubbish	Combustible waste, paper, cartons, rags, wood scraps, floor sweepings, foodscraps, domestic, commercial, industrial sources	Rubbish 100% (Garbage up to 20%)	25	10	6,500	0	0
2	Refuse	Rubbish and garbage; residential sources	Rubbish 50% Garbage 50%	50	7	4,300	0	1,500
3	Garbage	Animal & vegetable wastes, restaurants, hotels, markets; institutional, commercial, and club sources	Garbage 100% (Rubbish up to 35%)	70	5	2,500	1,500	3,000
4	Animal solids and organic wastes	Carcasses, organs, solid organic wastes, hospital, laboratory, abattoirs, animal pound, and similar sources	100% animal and human Tissue	85	5	1,000	3,000	8,000 (5000 primary) (3000 secondary)
5	Gaseous, liquid or semi-liquid wastes	Industrial process wastes	Variable	Dependent on predominant components	Variable according to wastes survey	Variable according to wastes survey	Variable according to wastes survey	Variable according to wastes survey
6	Semi-solid and solid wastes	Combustibles requiring hearth, retort, or grate burning equipment	"	"	"	"	"	"

[a] As defined by the Incineration Institute of America.

APPENDIX C

TYPES OF INFECTIOUS WASTE

C-1. Infectious Waste - Any waste from patients in strict or respiratory isolation, or with wound and skin precautions; wastes from the microbiology laboratory; surgical waste at the discretion of the operating room supervisor.

C-2. Isolation Wastes - Generated by patients who are isolated to protect others from their communicable diseases. These wastes contain pathogens transferred from the patients.

C-3. Blood and Blood Products - Hazardous due to pathogens of diseases in which the etiologic agent circulates in the blood, with the hepatitis agent as the principal concern. The Centers for Disease Control recommends that precautions be taken with these patients to prevent acquisition of infection from contact with blood or items contaminated with blood.

C-4. Pathological Wastes - Any wastes which include anatomical parts of humans and animals, excluding human corpses and animal carcasses, e.g., tissues, organs, body parts, blood and body fluids that are removed during surgery and autopsy.

C-5. Surgery and Autopsy Wastes - Dressings, sponges, lavage tubes, surgical gloves, etc. The American Hospital Association recommends that all surgical dressings be regarded as contaminated.

C-6. Contaminated Laboratory Wastes - Wastes that have come in contact with pathogens in any type of laboratory work. Wastes from medical and pathological laboratories generated by culturing specimens are of special concern due to the prevalence of resistant strains of microorganisms. NOTE: Some contaminated laboratory wastes are classified as hazardous waste under the Resource Conservation and Recovery Act and, as such, may not be incinerated in a medical waste incinerator.

C-7. Dialysis Wastes - Tubing, filters, sheets, towels, gloves, lab coats, and any wastes that have come in contact with the blood of dialysis patients.

C-8. Animal Carcasses and Body Parts - Due to the prevalence of zoonotic diseases, all laboratory animal carcasses, secretions, excretions and bedding should be regarded as infectious waste.

C-9. Discarded Biologicals - Due to the possible presence of etiologic agents.

APPENDIX D

SELECTED STATE AIR POLLUTION EMISSION STANDARDS FOR PARTICULATE AND OPACITY

STATE	PARTICULATE	OPACITY
Alaska	0.15 grains/dscf (1000-2000 lb/hr capacity) none for < 1,000 lb/hr capacity	20%
Arizona	0.1 grains/dscf	20%
Colorado	0.10 grains/dscf (nonattainment areas) 0.15 grains/dscf (attainment areas)	20%
Washington, D.C.	No new incinerators, multiple-chamber only incinerators in use prior to 7 July 1972: max capacity = 400 lb/hr, 0.08 grains/dscf incinerators put in use after 7 July 1972: 0.03 grains/dscf	
Georgia	1.0 lb/hr, multiple-chamber only	20%
Hawaii	0.2 lb/100 lb charged	
Indiana	Multiple-chamber only 0.5 lb/1000 lb (<200 lb/hr capacity) 0.3 lb/1000 lb (>200 lb/hr capacity)	40% (attainment areas) 30% (nonattainment areas)
Kansas	Multiple-chamber only 0.3 grains/dscf (<200 lb/hr capacity) 0.2 grains/dscf (200-20,000 lb/hr capacity)	20%
Louisiana	Multiple-chamber only, 0.2 grains/dscf	
Maryland	0.10 grains/dscf	20%
Massachusetts	No particles greater than 100 microns	
New Jersey	0.1 grains/dscf	20%
New York	0.5 lb/hr per 100 lb/hr charged	20%
North Carolina	0.2 lb/hr per 100 lb/hr charged	40% (existing 1 Jul 71) 20% (established after 1 Jul 71)
South Carolina	0.5 lb per million Btu of heat input	20%
Virginia	0.14 grains/dscf	20%
Washington	0.23 grams/dscf	