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# NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities 1995 Edition

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An International Standards-Making Organization

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### Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.



### Statement on NFPA Procedures

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Errata

# NFPA 820

## Fire Protection in Wastewater Treatment and Collection Facilities

1995 Edition

**Reference: Table 7-3**

The Committee on Wastewater Treatment Plants notes the following errors in the 1995 edition of NFPA 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities.* In the printing of the 1995 edition, an error inadvertently occurred.

*1. In Table 7-3, Row 2(b), relocate the requirements of Class I, Div. 1 to Class I, Div. 2.*

*2. In Table 7-3, Row 2(b), relocate the requirements of Class I, Div. 2 to Unclassified.*

**Issue Date: April 15, 1996**

Errata

# NFPA 820

## Fire Protection in Wastewater Treatment and Collection Facilities

1995 Edition

**Reference: Table 4(b), Table 7-3**

The Committee on Wastewater Treatment Plants notes the following errors in the 1995 edition of NFPA 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities.* In the printing of the 1995 edition, an error inadvertently occurred.

1. In Table 4(b) Column E, heading, replace:

   "Class I, Group D" with "Class II, Group G"

2. In Table 7-3, correct metric conversions as follows:

   a. In Row 1 replace "12 ft/min (4 m/min)" with "12 air changes per hour" in two places.
   b. In Row 2(a) replace "12 ft/min (4 m/min)" with "12 air changes per hour" in two places.
   c. In Row 2(b) replace "6 ft/min (2 m/min)" with "6 air changes per hour" in two places.
   d. In Row 2(c) replace "6 ft/min (2 m/min)" with "6 air changes per hour" in two places.
   e. In Row 3(a) replace "12 ft/min (4 m/min)" with "12 air changes per hour" in two places.
   f. In Row 3(b) replace "6 ft/min (2 m/min)" with "6 air changes per hour" in two places.

**Issue Date: March 1, 1996**

**NFPA 820**

**Standard for**

# Fire Protection in Wastewater Treatment and Collection Facilities

**1995 Edition**

This edition of NFPA 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities*, was prepared by the Technical Committee on Wastewater Treatment Plants and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held May 22-25, 1995, in Denver, CO. It was issued by the Standards Council on July 21, 1995, with an effective date of August 11, 1995, and supersedes all previous editions.

This edition of NFPA 820 was approved as an American National Standard on August 11, 1995.

## Origin and Development of NFPA 820

The Committee on Wastewater Treatment Plants was organized in 1983 to have primary responsibility for documents on safeguarding against the fire and explosion hazards specific to wastewater treatment plants and associated collection systems. This includes the hazard classification of specific areas and processes. The need to develop NFPA 820 was based on fire or explosion incidents that, while infrequent, are relatively severe when they do occur. Initial work on the document was begun early in 1985 and resulted in the first edition being issued in 1990. Extensive changes were made between the first edition and the 1992 edition, with the most notable revision being the document title, which was changed from Recommended Practice for Fire Protection in Wastewater Treatment Plants to Recommended Practice for Fire Protection in Wastewater Treatment and Collection Facilities. In addition, the document scope was revised to include storm sewer systems and their appurtenances.

In 1995 the document was changed from a recommended practice to a standard, which contains mandatory requirements. This was done because NFPA 820 was widely referenced by various jurisdictions.

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*This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.*

NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

**Committee Scope:** This Committee shall have primary responsibility for documents on criteria for safeguarding against the fire and explosion hazards specific to wastewater treatment plants and associated collection systems, including the hazard classification of specific areas and processes.

## Contents

# NFPA 820

## Standard for

# Fire Protection in Wastewater Treatment and Collection Facilities

## 1995 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A.

Information on referenced publications can be found in Chapter 9 and Appendix F.

## Chapter 1 Introduction

### 1-1 Scope.

#### 1-1.1 General.

**1-1.1.1*** This standard provides the minimum requirements for protection against fire and explosion hazards in wastewater treatment plants and associated collection systems, including the hazard classification of specific areas and processes.

**1-1.1.2** This standard covers the following:

(a) Collection sewers,
(b) Trunk sewers,
(c) Intercepting sewers,
(d) Combined sewers,
(e) Storm sewers,
(f) Pumping stations,
(g) Wastewater treatment plants,
(h) Sludge-handling facilities,
(i) Chemical-handling facilities,
(j) Treatment facilities, or
(k) Ancillary structures (*see definition*).

**1-1.1.3** This standard does not cover the following:

(a) Collection, treatment, or disposal of industrial wastes or manufactured by-products that are treated on-site and not discharged to a public or privately operated municipal facility;

(b) On-site treatment systems (*see definition*);

(c) Pressure sewer systems (*see definition*);

(d) Building drain systems and appurtenances (*see definition*);

(e) Industrial sewer systems and appurtenances (*see definition*);

(f) Personnel safety from toxic and hazardous materials or products of combustion; or

(g) Separate nonprocess related structures (*see definitions*).

**1-1.2 Alternative Methods.** Nothing in this standard is intended to prevent or discourage the use of alternative methods, materials, practices, or devices, provided that sufficient technical data are submitted to the authority having jurisdiction to demonstrate that the alternative method, material, practice, or device is equivalent to or superior to the requirements of this standard.

**1-1.3** A fire risk evaluation shall be initiated early in the facility design or alteration to integrate the fire prevention and fire protection requirements as described in this document.

### 1-2 Purpose.

**1-2.1 General.** The purpose of this standard is to provide a reasonable degree of fire and explosion protection for life, property, continuity of mission, and protection of the environment. This standard intends to reduce or eliminate effects of fire or explosion by maintaining structural integrity, controlling flame spread and smoke generation, preventing the release of toxic products of combustion, and maintaining serviceability and operation of the facility.

**1-2.2 Toxicity and Biological Hazards.** This standard addresses the fire and explosion hazards of various substances associated with wastewater treatment and conveyance. This standard does not cover toxicity and biological hazards.

> **CAUTION:** It is recognized that, from a personnel safety standpoint, these hazards can be present in life-threatening concentrations while no threat of fire or explosion exists.

**1-2.3 Ventilation Practices.** Ventilation rates required by this standard are intended to minimize fire and explosion hazards but might be insufficient to protect personnel from exposure to toxic and biological hazards.

**1-2.4 Materials Selection.** The fire risk evaluation shall include consideration for flame spread, smoke generation, and the impact that a fire or explosion will have on the structural integrity of the facility when conditions or applications warrant the selection of materials that are combustible, limited combustible, or low flame spread.

> **CAUTION:** Since many of the corrosion-resistant materials and coatings are combustible or limited-combustible and might represent a considerable fuel load during fire events, the design and fire risk evaluation shall consider any additional hazards imposed by the use of these materials.

### 1-3 Application.

**1-3.1*** The requirements of this standard are intended for new installations. When additions or modifications are made to existing facilities, the modifications shall reflect the requirements of this document. In any event, the requirements of this standard shall be used by owners in a risk assessment to identify areas of a treatment plant that are vulnerable to fire or other loss.

**1-3.2** This document is divided into 9 chapters. Chapters 1, 5, 6, 7, 8, and 9 apply generally. Chapters 2, 3, and 4 apply to specific processes and functions. The appendixes provide explanatory information, and the paragraph designations used in Appendix A coincide with the paragraph numbers used in Chapters 1 through 8 to which the clarification is provided. Appendix B provides a general overview and layout of the unit processes found at a typical wastewater treatment plant, although the arrangement of the unit processes will vary from plant to plant.

**1-3.3* National Electrical Code® Criteria.** This standard is based on the criteria established by Article 500 of NFPA 70, *National Electrical Code*, but is not intended to supersede or conflict with the requirements therein. Once an area is properly classified, the *National Electrical Code* specifies the types of equipment and the wiring methods that shall be used.

**1-4 Metric Units of Measurement Guidance.** Metric units of measurement used within this standard are in accordance with the modernized metric system known as the International System of Units (SI). Values of measurement are followed by an approximate equivalent value in SI units. For metric conversion practices, see ANSI/IEEE 268, *Metric Practices*.

**1-5 Definitions.**

**Activated Carbon.** Adsorptive carbon particles or granules usually obtained by heating carbonaceous material in the absence of air or in steam and possessing a high capacity to selectively remove trace and soluble components from solution.

**Activated Sludge.** A microbial mass grown in aeration tanks, subsequently separated from treated wastewater by sedimentation, and wasted or returned to the process as needed.

**Adjacent.** Adjacent, as used in this document, means sharing a common wall, partition, or barrier.

**Advanced (Tertiary) Wastewater Treatment.** Any physical, chemical, or biological treatment process used to accomplish a degree of treatment greater than that achieved by secondary treatment. (*See Secondary Wastewater Treatment.*)

**Anaerobic Digestion.** A unit process designed to biologically convert organic matter (sludge) through the action of microorganisms in the absence of elemental oxygen. Process by-products include a gas containing methane, carbon dioxide, and small quantities of hydrogen sulfide. The digestion tank can have a fixed or floating roof system.

**Anaerobic Waste Treatment.** A unit process providing treatment of the liquid stream by action of microorganisms in the absence of elemental oxygen. Process by-products include a gas containing methane, carbon dioxide, and small quantities of hydrogen sulfide.

**Ancillary Structure.** A structure that is an integral part of the wastewater treatment or collection process.

**Approved.*** Acceptable to the authority having jurisdiction.

**Authority Having Jurisdiction.*** The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

**Belt Filter.** A sludge dewatering or concentrating device having continuous bands or belts of filtering media that pass around rollers and from which the material caught on the media is usually removed by gravity and pressure.

**Building.** A structure used or intended for supporting or sheltering any use or occupancy. Personnel might occupy buildings continuously or intermittently.

**Building Drain.** In plumbing, the part of the lowest horizontal piping of a drainage system that receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer (house connection or lateral).

**Centrifuge.** A mechanical device in which centrifugal force is used to separate solids from liquids or to separate liquids of different densities.

**Combustible.** Any material that does not comply with the definition of either noncombustible or limited-combustible.

**Combustible Gas Detectors.** Devices used to detect the presence of flammable vapors and gases and warn when concentrations in air approach the explosive range.

**Combustible Liquid.** A liquid having a flash point at or above 100°F (37.8°C). (*See NFPA 30, Flammable and Combustible Liquids Code.*)

**Combustible or Explosive Dust.** A dust capable of spontaneous combustion or of exploding or burning when subjected to a source of ignition.

**Compost.** The product of thermophilic biological oxidation of sludge or other organic materials.

**Digester Gas.** See Sludge Gas.

**Dissolved Air Flotation.** A separation process in which air bubbles emerging from a supersaturated solution become attached to suspended solids in the liquid undergoing treatment and float them up to the surface.

**Domestic Wastewater.** Wastewater derived principally from dwellings, commercial establishments, institutions, and the like. It might or might not contain small amounts of ground water, surface water, or storm water.

**Dry Well.** That portion of a pumping station designed to provide isolation and shelter or accommodations for controls or equipment associated with pumping of wastewater. Dry wells are designed to completely and permanently exclude wastewater or wastewater-derived atmospheres. Dry wells can contain accidental leakage of wastewater from shaft seals or occasional spills. A dry well might contain equipment such as pumps, motors, fans, wiring, controls, lights and associated wiring devices, and other accessories.

**Drying Beds.** Confined, underdrained, shallow layers of sand or gravel on which digested sludge is distributed for draining and air drying. Also applied to underdrained, shallow, diked earthen structures used for drying sludge.

**Enclosed.** The interior of any tank or unit process that is closed to the atmosphere (excluding vents or pressure relief), or the area around any open tank or unit process surrounded by a building or other structure constructed with a roof and solid walls.

**Equipment.** A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like used as part of, or in connection with, a mechanical, instrumentation, or electrical installation.

**Equipment Enclosure.** The housing that covers, protects, or guards a piece of equipment and is not intended for personnel occupancy, but can provide for access to the equipment.

**Explosionproof Apparatus.** Apparatus, enclosed in a case, that is capable of withstanding an explosion of a specified gas or vapor that might occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby.

**Explosive Limits.** The minimum concentration of a gas-air or vapor-air mixture that supports flame, if ignited, is known as the lower explosive limit (LEL). The maximum concentration of a gas-air or vapor-air mixture that, if ignited, supports flame is known as the upper explosive limit (UEL). Above the UEL and below the LEL, ignition cannot take place. (These values might change in oxygen-enriched atmospheres.)

**Filter (Pressure or Gravity).** A device used to pass liquid through a medium to remove suspended solids.

**Filter Press.** A unit process using a plate and frame press, that is operated hydraulically and mechanically, to produce a semisolid sludge cake from a slurry.

**Fire Barrier.** A continuous membrane, either vertical or horizontal, such as a wall or floor assembly, that is designed and constructed with a specified fire resistance rating to limit the spread of fire and that will also restrict the movement of smoke. Such barriers might have protected openings.

**Fire Loading.** The amount of combustibles present in a given area, expressed in Btu/ft$^2$ (kJ/m$^2$).

**Fire Prevention.** Measures directed toward avoiding the inception of fire.

**Fire Protection.** Methods of providing for fire control or fire extinguishment.

**Fire-Rated Penetration Seal.** An opening in a fire barrier for the passage of pipe, cable, duct, etc., that has been sealed so as to maintain a barrier rating.

**Fire Resistance Rating.** The time, in minutes or hours, that materials or assemblies have withstood a fire exposure as established in accordance with the test procedures of NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*. This definition applies to the materials used in the construction of buildings but does not apply to furnishings or the contents of buildings or to the fire hazard evaluation of materials.

**Fire Stop.** A through-penetration fire stop is a specific construction consisting of the materials that fill the opening around penetrating items such as cables, cable trays, conduits, ducts, and pipes and their means of support through the wall or floor opening to prevent spread of fire. Its rating is established in accordance with test procedures in ASTM E 814, *Standard Method of Fire Tests of Through-Penetration Fire Stops*.

**Flammable Liquid.** Any liquid having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psia (276 kPa) absolute pressure at 100°F (37.8°C). (*See NFPA 30, Flammable and Combustible Liquids Code*.)

**Flash Dryer.** A device for vaporizing water from partly dewatered and finely divided sludge through contact with a current of hot gas or superheated vapor. It includes a squirrel-cage mill for separating the sludge cake into fine particles.

**Flash Mixer.** A device for quickly dispersing chemicals uniformly throughout a liquid or semisolid.

**Flocculator.** A unit process for the formation of floc in wastewater.

**Fluidized Bed Reactor.** A pressure vessel or tank that is designed for liquid-solid or gas-solid reaction; the liquid or gas moves upward through the solids particles at a velocity sufficient to suspend the individual particles in the fluid. Applications include ionexchange, granular activated carbon adsorbers, and some types of furnaces, kilns, and biological contactors.

**Force Main (Pressure Main).** A pressure pipe connecting the pump discharge of a wastewater pumping station under pressure to a point of discharge.

**Fuel Gases.** Any gas used as a fuel source including natural gas, manufactured gas, sludge gas, liquefied petroleum gas-air mixtures, liquefied petroleum gas in the vapor phase, and mixtures of these gases. (*See NFPA 54, National Fuel Gas Code*.)

**Galleries.** Long tunnels or walkways connecting separate buildings or structures. Galleries are generally underground, without windows, and with limited entrances and exits. Galleries frequently contain gas, water, wastewater, sludge piping, electrical wiring, and mechanical or electrical equipment.

**Gas-Handling Equipment.** Gas-handling equipment includes equipment for removal of gas evolved from the anaerobic digestion process and the compression, conditioning, or treatment of this gas. This equipment includes gas compressors, sediment traps, drip traps, gas scrubbers, and pressure regulating and control valves. Gas-handling equipment does not include equipment or devices for the utilization of the gas, such as boilers, engines, and waste gas burners.

**Grit Chamber.** A detention chamber or an enlargement of a sewer designed to reduce the velocity of flow of the liquid to permit the separation of mineral from organic solids by differential sedimentation.

**Hazardous (Classified) Location.** Locations are classified depending on the properties of the flammable vapors, liquids, or gases or combustible dusts or fibers that might be present and the likelihood that a flammable or combustible concentration or quantity is present. Each room, section, or area is considered individually in determining its classification.

**Hazardous Waste.** Any waste that is potentially damaging to the environment or human health because of toxicity, ignitibility, corrosivity, chemical reactivity, or other reason.

**Heat Treatment.** A sludge-conditioning process combining high temperature, time, and pressure to improve the dewaterability of organic sludge.

**Hydrogen Sulfide ($H_2S$).** A toxic and lethal gas produced in sewers and digesters by anaerobic decomposition of wastewater solids or other anaerobic wastewater or sludge treatment processes.

**Identified (as applied to equipment).** Recognizable as suitable for the specific purpose, function, use, environment, application, etc., where described in a particular code requirement. Suitability of equipment for a specific purpose, environment, or application can be determined by a qualified testing laboratory, inspection agency, or other organization concerned with product evaluation. Such identification can include labeling or listing. (*See Labeled and Listed.*)

**Imhoff Tank.** A deep, two-story wastewater treatment tank. It consists of an upper continuous-flow sedimentation chamber and a lower sludge-digestion chamber. The upper chamber floor slopes steeply to trapped slots through which solids can slide into the lower chamber. The lower chamber receives no fresh wastewater directly but is provided with gas vents and with means for drawing digested sludge from near the bottom.

**Incineration.** Combustion or controlled burning of volatile organic matter in sludge and solid waste that reduces the volume of the material while producing heat, dry inorganic ash, and gaseous emissions.

**Industrial Waste.** Generally liquid, solid, or gaseous wastes originating from the manufacture of specific products. Such wastes are usually more concentrated, are more variable in content and rate, and require more extensive or different treatment than municipal waste.

**Inspection.** A visual examination of a system or portion thereof to verify that it appears to be in operating condition and is free of physical damage.

**Intrinsically Safe.** Intrinsically safe equipment and wiring are not capable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific flammable or combustible atmospheric mixture in its most easily ignitable concentration. Abnormal conditions include accidental damage to any field-installed wiring, failure of electrical components, application of overvoltage, adjustment and maintenance operations, and other similar conditions. (*See ANSI/ISA RP 12.67, Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations.*)

**Labeled.** Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**Limited-Combustible.** As applied to a building construction material, a material not complying with the definition of noncombustible material that in the form in which it is used has a potential heat value not exceeding 3500 Btu/lb (8.14 × 106 J/kg) (*see NFPA 259, Standard Test Method for Potential Heat of Building Materials*) and complies with one of the following paragraphs (a) or (b):

(a) Materials having a structural base of noncombustible material with a surfacing not exceeding a thickness of $\frac{1}{8}$ in. (3.175 mm) that has a flame spread rating not greater than 50.

(b) Materials, in the form and thickness used, other than as described in (a), having neither a flame spread rating greater than 25 nor evidence of continued progressive combustion and of such composition that surfaces that would be exposed by cutting through a material on any plane would have neither a flame spread rating greater than 25 nor evidence of continued progressive combustion as tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials.*

NOTE: Materials subject to increase in combustibility or flame spread rating beyond the limits herein established through the effects of age, moisture, or other atmospheric condition should be considered combustible. This definition applies to the materials used in the construction of buildings but does not apply to furnishings or the contents of buildings or to the fire hazard evaluation of materials.

**Listed.*** Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

**Low Flame Spread.** A material with a flame spread rating of 25 or less when classified in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials.*

**Maintenance.** Work performed to keep equipment operable or to make repairs.

**Maintenance Hole.** A structure atop an opening in a gravity sewer to permit personnel entry, or an opening in the top or side of an enclosed vessel to permit personnel entry. Also referred to as manhole or manway.

**Methane ($CH_4$).** A colorless, odorless, flammable gaseous hydrocarbon present in natural gas and formed by the anaerobic decomposition of organic matter. (*See also Anaerobic Digestion.*)

**Nitrification Tank.** A unit process for the oxidation of ammonia and nitrogen into nitrates through biochemical actions.

**Noncombustible.** A material that in the form in which it is used and under the conditions anticipated will not aid combustion or add appreciable heat to an ambient fire. Materials when tested in accordance with ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C (1382°F)*, and conforming to the criteria contained in Section 7 of the referenced standard shall be considered as noncombustible. This definition applies to the materials used in the construction of buildings but does not apply to furnishings or the contents of buildings or to the fire hazard evaluation of materials.

**Nonenclosed.** Any tank or unit process open to the atmosphere, or the area around any open tank or unit process housed in a building or other structure constructed with a roof and having at least 50 percent of the wall area open to the atmosphere. Fixed open louvered panels with effective openings greater than 50 percent of the wall area and evenly distributed over the wall area are considered open to the atmosphere.

**On-Site Treatment System.** A self-contained system, including pumping equipment, that provides both treatment and disposal of wastewater on or immediately adjacent to a single residence or group of residences or small commercial establishments.

**Oxygen-Enriched Atmosphere.** Any atmosphere with an oxygen concentration greater than ambient by volume at normal atmospheric pressure, for example in oxygen-activated sludge systems, ozonation units, or high-pressure oxidation units.

**Ozonation.** The process of contacting wastewater or air with ozone for the purpose of disinfection, oxidation, or odor control.

**Physically Separated.** Physically separated, as used in this document, means a gastight partition between two adjacent spaces, or two nonadjacent spaces, with no means of gas communication between the spaces. Personnel entry to the separate spaces is by individual, grade-level exterior access ports with no physical connection between the two.

**Primary Wastewater Treatment.** The first major treatment in a wastewater treatment plant, generally consisting of one or more of the following unit processes: screening, comminution or grinding, grit removal, sedimentation, and skimming.

**Pumping Station.** A structure that contains pumps and appurtenant piping, valves, and other mechanical and electrical equipment for pumping wastewater or other liquid. Also called lift station.

**Pyrolysis.** The destructive distillation of organic compounds in an oxygen-free environment that converts the organic matter into gases, liquids, and char.

**Residential Wastewater.** Wastewater derived from areas consisting of single- and multiple-family residences.

**Rotating Biological Contactor (RBC).** A unit process for wastewater treatment that is composed of large, closely spaced plastic discs that are rotated about a horizontal shaft (usually a secondary biological treatment process).

**Screening Chamber.** A chamber or enlargement of a sewer where large suspended or floating solids or material is removed from raw wastewater by a screen.

**Scum or Skimmings.** Grease, solids, liquids, and other floatable material removed from settling tanks.

**Secondary Wastewater Treatment.** Wastewater treatment unit processes usually consisting of primary treatment and biological oxidation using activated sludge or trickling filtration, followed by clarification.

**Sedimentation.** The unit process of subsidence of suspended matter carried by water, wastewater, or other liquids, by gravity. It is usually accomplished by reducing the velocity of the liquid below the point at which it can transport the suspended material. Also called settling, it can be enhanced by chemical addition, coagulation, and flocculation.

**Separate Nonprocess-Related Structures.** Structures that are physically separated and do not contain any process-related equipment associated with the collection and treatment of wastewaters and solids derived from wastewater treatment processes.

**Sewer.** A single pipe or system of pipes or conduits that carries wastewater or drainage water. See definitions below for different types of sewers.

*Branch.* A sewer that receives wastewater from a relatively small area and discharges into a main sewer serving more than one branch-sewer area.

*Building.* In plumbing, the extension from the building drain to the public sewer or other place of disposal (also called house connection or lateral).

*Collector.* A pipe or conduit that receives wastewater from a relatively small area from two or more lateral sewers and that subsequently discharges into a trunk sewer.

*Combined.* A sewer intended to receive both wastewater and storm or surface water.

*Industrial.* A sewer intended to receive only industrial wastewater or other liquid or water-carried wastes (also see sanitary sewer, storm sewer, and combined sewer).

*Interceptor.* A sewer that receives dry-weather flow and frequently additional predetermined quantities of storm water (if from a combined system) from a number of transverse sewers or outlets and conducts such waters to a point for treatment or disposal (also called main sewer).

*Outfall.* A sewer that receives wastewater from a collecting system or from a treatment plant and carries it to a point of final discharge.

*Pressure.* A collection sewer that incorporates a wastewater grinder pump or septic tank effluent pump to convey wastewater from a single residence or group of residences or small commercial establishments to a private or public sewer system or on-site disposal system.

*Private.* A sewer privately owned and used by one or more properties or owners.

*Relief.* A sewer built to carry the flows in excess of the capacity of an existing sewer. Also a sewer intended to carry a portion of the flow from a district in which the existing sewers are of insufficient capacity.

*Residential.* A sewer intended to receive only residential wastewater (also see combined sewer, sanitary sewer, and storm sewer).

*Sanitary.* A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions together with minor quantities of storm, surface, and ground waters that are not admitted intentionally.

*Storm.* A pipe or conduit that carries storm water and surface water, street wash, and other wash water, or drainage, but excludes domestic wastewater and industrial wastes (also called storm drain).

*Trunk.* The principal pipe or conduit to which one or more collector sewers or branch sewers are tributaries (also called main sewer).

**Sewer Gas.** Gas resulting from decomposition of organic matter in wastewater in sewers. Also, gas resulting from the incidental uncontrolled release of hydrocarbons or decomposition of organic matter in stagnant liquid and septic sludge in wastewater treatment plants. The gas

might contain trace quantities of methane and hydrogen sulfide and might be low in oxygen. It might be both a fire and life safety hazard.

**Shall.** Indicates a mandatory requirement.

**Sludge.** A semiliquid mass of accumulated settled solids deposited from wastewater, raw or treated, in tanks or basins. Also referred to as biosolids.

**Sludge Cake.** A semisolid product of a sludge dewatering process.

**Sludge Dewatering.** The process of removing a part of the water in sludge by any physical or mechanical method without heat, such as draining, pressing, vacuum filtration, centrifuging, or passing between rollers.

**Sludge Drying Systems.** Sludge processes using physical or mechanical evaporation techniques with or without the application of heat to achieve solids concentrations greater than 85 percent.

**Sludge Gas.** Gas obtained as a by-product of the anaerobic sludge digestion unit process from the decomposition of organic matter. It has a high content of methane, varying amounts of carbon dioxide and hydrogen sulfide, and a small amount of nitrogen. It can be both a fire and life safety hazard.

**Sludge Gas Vent.** A passage to permit the controlled release of gases from anaerobic treatment processes or gas storage facilities.

**Sludge Thickening.** A sludge treatment process designed to concentrate wastewater sludges by gravity, mechanical means, or air flotation.

**Sludge Treatment.** The processing of wastewater sludges to render them stable. This can be done by aerobic or anaerobic digestion followed by drying on sand beds, filtering and incineration, filtering and drying, or wet air oxidation.

**Standard.** A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements, which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an Appendix, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

**Structure.** Structure, as used in this document, includes all construction designed to carry gravity loads and intended to contain wastewater, sludge, sludge gas, piping, or equipment. Structures can provide access but are not intended for continuous personnel occupancy.

**Trickling Filter.** A treatment unit process consisting of stone, plastic, redwood, or similar media over which wastewater is distributed and through which wastewater trickles to the underdrains and is treated by the microbial slimes formed on the surface of the media.

**Utilization Equipment.** Equipment that utilizes electric energy for mechanical, chemical, heating, lighting, or similar purposes.

**Vacuum Filter.** A unit process used to dewater wastewater sludge and consisting of a cylindrical drum mounted on a horizontal axis, covered with a media, and subjected to an internal vacuum.

**Vault.** An enclosed structure, usually underground, used to permit personnel access to various types of equipment and instrumentation.

**Ventilation Rate.** Ventilation rate, as used in this document, is based on air changes per hour and is calculated by the use of 100 percent outside air for the supply air that is exhausted. Air change per hour is calculated on the basis of the maximum aggregate volume (under normal operating conditions) of the space to be ventilated.

**Volatile Liquid.** A liquid that evaporates readily at normal temperature and pressure.

**Wastewater.** The spent water of a community. Combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any ground water, surface water, and storm water that might be present.

**Wet Well.** That portion of the pumping station that receives and temporarily stores wastewater for the purpose of pumping. A wet well might or might not contain electrical equipment such as pumps, motors, fans, wiring and wiring devices, controls, lights, and other accessories.

## Chapter 2 Collection Systems

**2-1* General.** This chapter provides minimum criteria for protection against fire and explosion hazards in the collection and transportation of municipal wastewater. This chapter does not address on-site systems, force mains, or those sewers that convey principally industrial wastes. Table 2 summarizes the various components associated with wastewater collection and transport systems.

**2-2* Design and Construction.** The design and construction of collection system facilities shall conform to Table 2.

**Table 2 Collection Systems**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 1 | | MATERIALS USED IN REHABILITATION, RECONSTRUCTION, OR SLIP-LINING OF SEWERS | NA | NA | NA | NA | In accordance with 6-3.1 | NA |
| 2 | | INDUSTRIAL SEWER Sewer transporting industrial wastewater only. (No sanitary wastewater.) | Not included within the scope of this document | | | | | |
| 3 | | STORM SEWER Sewer transporting storm water only. (No sanitary wastewater.) | Possible ignition of flammable gases and floating flammable liquids | NNV | Inside of sewer | Division 2 | In accordance with 6-3.1 | NR |
| 4 | | STORM WATER PUMPING STATION WET WELLS Liquid side of pumping station serving only a storm sewer system. | Possible ignition of flammable gases and floating flammable liquids | NNV | Entire room or space | Division 2 | NC, LC, or LFS | CGD if enclosed |
| 5 | a | STORM WATER PUMPING STATION DRY WELLS Dry side of a pumping station serving only a storm sewer system and physically separated from wet well. | Buildup of vapors from flammable or combustible liquids | D | Entire dry well | Division 2, or unclassified, if space provided with pressurization in accordance with NFPA 496 | NC, LC, or LFS | FE |
| | b | | | C | | Unclassified | | |
| 6 | | PRESSURE SEWER-(Force main) Sewer under pressure. (Flooded discharge pipe from pump or tank.) | Not included within the scope of this document | | | | | |
| 7 | | BUILDING SEWER (Lateral sewer or drain) Sewer serving a house or single building (plumbing). | Not included within the scope of this document | | | | | |
| 8 | | INDIVIDUAL RESIDENTIAL SEWER Sewer serving one but not more than five dwellings. | NA | NNV | Within enclosed space | Unclassified | NR | NR |
| 9 | | INDIVIDUAL RESIDENTIAL PUMPING UNITS Pumping units serving one but not more than five dwellings (e.g., grinder pumps, septic tank effluent pumps, ejector pumps). | NA | NNV | Within enclosed space | Unclassified | NR | NR |

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code®*
NNV — Not normally ventilated
NR — No requirement

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**Table 2 (continued)**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 10 | a | RESIDENTIAL SEWER Sewer transporting primarily residential wastewater. | Possible ignition of flammable gases and floating flammable liquids | NNV | Within enclosed space | Division 2 | In accordance with 6-3.1 | NR |
| | b | | | B | | Unclassified | | |
| 11 | a | RESIDENTIAL WASTEWATER PUMPING STATION WET WELL Pumping station transporting primarily residential wastewater. | Possible ignition of flammable gases and floating flammable liquids | A | Entire room or space | Division 2 | NC, LC, or LFS | CGD |
| | b | | | B | | Unclassified | | |
| 12 | a | RESIDENTIAL WASTEWATER PUMPING STATION DRY WELL Dry side of a pumping station transporting primarily residential wastewater. | Buildup of vapors from flammable or combustible liquids | D | Entire room or space | Division 2 | NC, LC, or LFS | FE |
| | b | | | C | | Unclassified | | |
| 13 | | OUTFALL SEWER Final discharge pipe, from a treatment plant, transporting treated wastewater. | NA | NNV | NA | Unclassified | NR | NR |
| 14 | a | SANITARY SEWER Sewer transporting domestic, commercial, and industrial wastewater. | Possible ignition of flammable gases and floating flammable liquids | NNV | Inside of sewer | Division 1 | In accordance with 6-3.1 | NR |
| | b | | | B | | Division 2 | | |
| 15 | a | COMBINED SEWER Sewer transporting domestic, commercial, and industrial wastewater and storm water. | Possible ignition of flammable gases and floating flammable liquids | NNV | Inside of sewer | Division 1 | In accordance with 6-3.1 | NR |
| | b | | | B | | Division 2 | | |
| 16 | a | WASTEWATER PUMPING STATION WET WELLS Liquid side of a pumping station serving a sanitary sewer or combined system. | Possible ignition of flammable gases and floating flammable liquids | A | Entire room or space | Division 1 | NC, LC, or LFS | CGD |
| | b | | | B | | Division 2 | | |
| 17 | a | BELOW- OR PARTIALLY BELOW-GRADE WASTEWATER PUMPING STATION DRY WELL Pump room physically separated from wet well. Pumping of wastewater from a sanitary or combined sewer system through closed pumps and pipes. | Buildup of vapors from flammable or combustible liquids | C | Entire space or room | Unclassified | NC, LC, or LFS | FE |
| | b | | | D | | Division 2, or unclassified, if space provided with pressurization in accordance with NFPA 496 | | |

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

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**Table 2 (continued)**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 18 | | ABOVE-GRADE WASTEWATER PUMPING STATION<br>Pump room physically separated with no personnel access to wet well. Pumping of wastewater from a sanitary or combined sewer system through closed pumps and pipes. | NA | NR | NA | Unclassified | NC, LC, or LFS | FE |
| 19 | a | ABOVE-GRADE WASTEWATER PUMPING STATION<br>Pump room not physically separated from wet well. Pumping of wastewater from a sanitary or combined sewer system through closed pumps and pipes. | Possible ignition of flammable gases and floating flammable liquids | A | Entire space or room | Division 1 | NC | FE |
| | | | | B | | Division 2 | NC, LC, or LFS | |
| 20 | a | ODOR CONTROL SYSTEM AREAS<br>Areas physically separated from wet well that house systems handling wet well gases | Leakage and ignition of sewage gases | D | Entire area if enclosed | Division 2 | NC, LC, or LFS | CGD and FDS |
| | b | | | C, or outdoors | Areas within 3 ft (0.9 m) of leakage sources such as fans, dampers, flexible connections, flanges, pressurized unwelded ductwork, and odor control vessels | Division 2 | | |
| | c | | | | Areas beyond 3 ft (0.9 m) | Unclassified | | |
| 21 | a | MAINTENANCE HOLES<br>Access to sewer for personnel entry. | Possible ignition of flammable gases and floating flammable liquids | NNV | Inside | Division 1 | In accordance with 6-3.1 | NR |
| | b | | | B | | Division 2 | | |
| 22 | a | JUNCTION CHAMBERS<br>Structure where sewers intersect. | Buildup of vapors from flammable or combustible liquids | NNV | Inside | Division 1 | In accordance with 6-3.1 | NR |
| | b | | | B | Open and above grade or inside and ventilated | Division 2 | | |
| 23 | | INVERTED SIPHONS<br>Depressed section of gravity sewer. | Possible ignition of flammable gases and floating flammable liquids | NNV | Interior of inlet and outlet structures | Division 1 | NC | NR |

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C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

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**Table 2 (continued)**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 24 | | CATCH BASINS (Curb inlet) Inlet where street water enters a storm or combined sewer. | Buildup of vapors from flammable or combustible liquids | NNV | Enclosed space | Division 1 | In accordance with 6-3.1 | NR |
| 25 | a | RESIDENTIAL DIVERSION STRUCTURES Enclosed structures where residential wastewater can be diverted. | Buildup of vapors from flammable or combustible liquids | NNV | Enclosed space | Division 2 | In accordance with Chapter 6 | NR |
| | b | | | B | | Unclassified | | |
| 26 | a | RESIDENTIAL BELOW-GRADE VALVE VAULT With an exposed residential wastewater surface. | Possible ignition of gases and floating flammable liquids | NNV | Enclosed space | Division 2 | In accordance with 6-3.1 | NR |
| | b | | | B | | Unclassified | | |
| 27 | a | RESIDENTIAL CONTROL STRUCTURES Enclosed structures where residential wastewater flow is regulated. | Buildup of vapors from flammable or combustible liquids | A | Enclosed space | Division 2 | In accordance with Chapter 6 | NR |
| | b | | | B | | Unclassified | | |
| 28 | a | RESIDENTIAL BELOW-GRADE METERING VAULT With an exposed residential wastewater surface. | Possible ignition of flammable gases and floating flammable liquids | NNV | Enclosed space | Division 2 | In accordance with 6-3.1 | NR |
| | b | | | B | | Unclassified | | |
| 29 | a | DIVERSION STRUCTURES Enclosed structures where wastewater can be diverted. | Buildup of vapors from flammable or combustible liquids | NNV | Enclosed space | Division 1 | In accordance with Chapter 6 | NR |
| | b | | | B | | Division 2 | | |
| 30 | | ABOVE-GRADE VALVE VAULT Physically separated from the wet well. Valves in vault in closed piping system. | NA | NR | NA | Unclassified | NC, LC, or LFS | NR |
| 31 | a | BELOW-GRADE VALVE VAULT Physically separated from the wet well and with closed piping system. | Buildup of vapors from flammable or combustible liquids | NNV | Enclosed space | Division 2 | NC, LC, or LFS | NR |
| | b | | | C | | Unclassified | | |
| 32 | a | BELOW-GRADE VALVE VAULT With an exposed wastewater surface. | Possible ignition of gases and floating flammable liquids | NNV | Enclosed space | Division 1 | NC | NR |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| 33 | a | CONTROL STRUCTURES Enclosed structures where wastewater or storm water flow is regulated. | Buildup of vapors from flammable or combustible liquids | A | Enclosed space | Division 1 | In accordance with Chapter 6 | NR |
| | b | | | B | | Division 2 | | |

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

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**Table 2 (continued)**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 34 | a | WASTEWATER HOLDING BASINS Enclosed structures holding untreated or partially treated wastewater temporarily. | Possible ignition of flammable gases and floating flammable liquids | A | Enclosed space | Division 1 | NC | NR |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| 35 | | WASTEWATER HOLDING BASINS, LINED OR UNLINED Open structures holding storm water, combined wastewater, untreated or partially treated wastewater. | NR | NR | NR | NR | NR | NR |
| 36 | a | BELOW-GRADE METERING VAULT Physically separated from the wet well and with closed piping system. | Buildup of vapors from flammable or combustible liquids | NNV | Enclosed space | Division 2 | NC, LC, or LFS | NR |
| | b | | | C | | Unclassified | | |
| 37 | a | BELOW-GRADE METERING VAULT With an exposed wastewater surface. | Possible ignition of flammable gases and floating flammable liquids | NNV | Enclosed space | Division 1 | NC | NR |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| 38 | | COARSE AND FINE SCREEN FACILITIES (*See Coarse and Fine Screen Facilities, Table 3.*) | | | | | | |

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

## Chapter 3 Liquid Stream Treatment Processes

**3-1* General.** This chapter provides minimum criteria for protection against fire and explosion hazards associated with liquid stream treatment processes. This chapter does not address treatment systems serving individual structures or treatment systems that treat principally industrial wastes. Table 3 summarizes the various components associated with liquid stream treatment processes.

**3-2* Design and Construction.** The design and construction of liquid stream treatment processes shall conform to Table 3.

**Table 3 Liquid Stream Treatment Processes**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area[3]** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 1 | a | COARSE AND FINE SCREEN FACILITIES Removal of screenings from raw wastewater. | Possible ignition of flammable gases and floating flammable liquids | A | Enclosed — entire space | Division 1 | NC | FE, H, and CGD if enclosed |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | Not enclosed, open to atmosphere | Within 10 ft (3 m) envelope around equipment and open channel[1, 2] | | | |
| 2 | | PUMPING STATIONS (*See Collection Systems, Table 2.*) | | | | | | |
| 3 | a | FLOW EQUALIZATION TANKS Storage of raw or partially treated wastewater. | Possible ignition of flammable gases and floating flammable liquids | A | Enclosed — entire space | Division 1 | NC | FE, H, and CGD if enclosed |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | Not enclosed, open to atmosphere | Within 10 ft (3 m) envelope around equipment and open channel[1, 2] | | | |
| 4 | a | GRIT REMOVAL TANKS Separation of grit from raw wastewater. | Possible ignition of flammable gases and floating flammable liquids | A | Enclosed — entire space | Division 1 | NC | FE, H, and CGD if enclosed |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | Not enclosed, open to atmosphere | Within 10 ft (3 m) envelope around equipment and open channel[1, 2] | | | |
| 5 | a | PRE-AERATION TANKS Conditioning of wastewater prior to further treatment. | Possible ignition of flammable gases and floating flammable liquids | A | Enclosed — entire space | Division 1 | NC | H and CGD if enclosed |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | Not enclosed, open to atmosphere | Within 10 ft (3 m) envelope around equipment and open channel[1] | | | |
| 6 | a | PRIMARY SEDIMENTATION TANKS Separation of floating or settleable solids from raw wastewater. | Possible ignition of flammable gases and floating flammable liquids | A | Enclosed — entire space | Division 1 | NC | H and CGD if enclosed |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | Not enclosed, open to atmosphere | Interior of the tank from the minimum operating water surface to the top of the tank wall. Envelope 18 in. (0.46 m) above the top of the tank and extending 18 in. (0.46 m) beyond the exterior wall. Envelope 18 in. (0.46 m) above grade extending 10 ft (3 m) horizontally from the exterior tank walls. | | | |
| 7 | | AERATION BASIN, POND, LAGOON, OXIDATION DITCH, AEROBIC SUSPENDED GROWTH SYSTEMS, SEQUENCING BATCH REACTORS Aerobic treatment of wastewater open to the atmosphere. | | NA | | Unclassified (If process is not preceded by primary sedimentation, refer to primary sedimentation in Table 3 for classification.) | NR | H |

NOTE 1: Area beyond envelope is unclassified.
NOTE 2: Where liquid turbulence is not induced by aeration or other factors, the following criteria apply: interior of the tank from the minimum operating water surface to the top of the tank wall; envelope 18 in. (0.46 m) above the top of the tank and extending 18 in. (0.46 m) beyond the exterior wall; and envelope 18 in. (0.46 m) above grade extending 10 ft (3 m) horizontally from the exterior tank walls.
NOTE 3: Open channels and open structures upstream from the unit processes are to be classified the same as the downstream process they supply.

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

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**Table 3 (continued)**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area[3]** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 8 | a | ENCLOSED AERATION BASIN OR AEROBIC SUSPENDED GROWTH SYSTEMS Aerobic treatment of wastewater not preceded by primary treatment. | Possible ignition of flammable gases or floating flammable liquids | A | Entire enclosed space not routinely entered by personnel | Division 1 | NC | NR |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| 9 | | ENCLOSED AERATION BASIN OR AEROBIC SUSPENDED GROWTH SYSTEMS Aerobic treatment of wastewater preceded by primary treatment. | NA | NR | Entire enclosed space | Unclassified | NC, LC, or LFS | NR |
| 10 | | TRICKLING FILTER, BIO-TOWER, AEROBIC FIXED FILM SYSTEMS Aerobic biological treatment of wastewater. | Not normally a significant hazard; however, these processes might contain materials that are combustible under certain conditions | NA | | Unclassified (If unit process is not preceeded by primary sedimentation, refer to primary sedimentation in Table 3 for classification.) | NR | H |
| 11 | a | ANAEROBIC TOWERS, ANAEROBIC FIXED FILM SYSTEM Anaerobic biological treatment if sealed from atmosphere. | Normally produces combustible gas as treatment process by-product | NA | Tank interior | Division 1 | NC | FE and H |
| | b | | | NA | 10-ft (3-m) envelope around tank | Division 2 | NC, LC, or LFS | |
| 12 | a | GAS-HANDLING SYSTEMS FOR LIQUID TREATMENT PROCESSES | Combustible gas, often under pressure | A | Enclosed — entire space | Division 1 | NC | FE and H |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | Not enclosed, open to atmosphere | Within 10-ft (3-m) envelope around equipment[1] | | | |
| 13 | | OXYGEN AERATION TANKS Tanks for aerobic treatment of wastewater using high purity oxygen rather than air. | Ignition of flammable gases and floating flammable liquids in an oxygen-enriched environment | NA | Enclosed space | Division 2 (If unit process is not preceded by primary sedimentation, refer to primary sedimentation in Table 3 for classification.) | Any equipment or material within the reactor space should be safe for exposure to volatile hydrocarbons in an oxygen-enriched atmosphere | Special provision for LEL monitoring and automatic isolation of equipment and oxygen supply |
| 14 | | INTERMEDIATE, SECONDARY, OR TERTIARY SEDIMENTATION TANKS Separate floating and settleable solids from wastewater at various treatment stages. | | NA | NA | Unclassified (If unit process is not preceded by primary sedimentation, refer to primary sedimentation in Table 3 for classification.) | NR | H |

NOTE 1: Area beyond envelope is unclassified.
NOTE 2: Where liquid turbulence is not induced by aeration or other factors, the following criteria apply: interior of the tank from the minimum operating water surface to the top of the tank wall; envelope 18 in. (0.46 m) above the top of the tank and extending 18 in. (0.46 m) beyond the exterior wall; and envelope 18 in. (0.46 m) above grade extending 10 ft (3 m) horizontally from the exterior tank walls.
NOTE 3: Open channels and open structures upstream from the unit processes are to be classified the same as the downstream process they supply.

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

*Continued on next page*

**Table 3 (continued)**

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area[3]** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 15 | FLASH MIXER OR FLOCCULATION TANKS Tanks for mixing various treatment chemicals with wastewater. | | NA | NA | Unclassified (If unit process is not preceded by primary sedimentation, refer to primary sedimentation in Table 3 for classification.) | NR | H |
| 16 | NITRIFICATION AND DENTRIFICATION TANKS Tertiary treatment of wastewater to reduce or remove nitrogen. | | NA | NA | Unclassified (If unit process is not preceded by primary sedimentation, refer to primary sedimentation in Table 3 for classification.) | NR | H |
| 17 | BREAKPOINT CHLORINATION TANKS AND CHLORINE CONTACT TANKS Application of chlorine in aqueous solution to wastewater. | | NA | NA | Unclassified | NR (These unit processes use corrosive chemicals that require the use of specific materials of construction. Special consideration shall be given to these materials of construction.) | H |
| 18 | AMMONIA STRIPPING TOWERS | (*See trickling filter in Table 3.*) | NA | NA | Unclassified | NR (These unit processes use corrosive chemicals. Special consideration shall be given to these materials of construction.) | H |
| 19 | INTERMEDIATE OR FINAL PUMPING STATIONS Pump(s) at intermediate stage or end of the treatment process. | | NA | NA | Unclassified | NR | H |
| 20 | GRAVITY AND PRESSURE FILTERS Filtering of treated wastewater through sand or other media. | | NA | NA | Unclassified | NR | H |
| 21 | CARBON COLUMN OR TANKS Vessels containing carbon for tertiary treatment of wastewater. | Significant hazard from combustible carbon material | NA | NA | Unclassified | NR | H |
| 22 | ON-SITE OZONE GENERATION SYSTEM AND OZONE CONTACT TANKS Ozone generation and purification for disinfection of wastewater. | Similar to oxygen generation with addition of being highly corrosive (*See Table D-1.*) | NA | NA | Not covered in this document | NR | NR |

NOTE 1: Area beyond envelope is unclassified.
NOTE 2: Where liquid turbulence is not induced by aeration or other factors, the following criteria apply: interior of the tank from the minimum operating water surface to the top of the tank wall; envelope 18 in. (0.46 m) above the top of the tank and extending 18 in. (0.46 m) beyond the exterior wall; and envelope 18 in. (0.46 m) above grade extending 10 ft (3 m) horizontally from the exterior tank walls.
NOTE 3: Open channels and open structures upstream from the unit processes are to be classified the same as the downstream process they supply.

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

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**Table 3 (continued)**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area[3]** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 23 | | BACKWASH WATER AND WASTE BACKWASH WATER HOLDING TANKS Tanks for temporary storage of backwash water. | NA | NA | NA | Unclassified | NR | H |
| 24 | | ULTRAVIOLET DISINFECTION UNIT Disinfection of wastewater by ultraviolet radiation. | | NA | NA | Unclassified | NR | H |
| 25 | | EFFLUENT STRUCTURES Various structures conveying treated wastewater away from treatment processes. | | NA | NA | Unclassified | NR | H |
| 26 | a | ODOR CONTROL SYSTEM AREAS Areas physically separated from processes that house systems handling flammable gases. | Leakage and ignition of flammable gases | D | Entire area if enclosed | Division 2 | | |
| | b | | | C | Areas within 3 ft (0.9 m) of leakage sources such as fans, dampers, flexible connections, flanges, pressurized unwelded ductwork, and odor control vessels | Division 2 | NC, LC, or LFS | CGD, FDS, and FE |
| | c | | | | Areas beyond 3 ft (0.9 m) | Unclassified | | |

NOTE 1: Area beyond envelope is unclassified.
NOTE 2: Where liquid turbulence is not induced by aeration or other factors, the following criteria apply: interior of the tank from the minimum operating water surface to the top of the tank wall; envelope 18 in. (0.46 m) above the top of the tank and extending 18 in. (0.46 m) beyond the exterior wall; and envelope 18 in. (0.46 m) above grade extending 10 ft (3 m) horizontally from the exterior tank walls.
NOTE 3: Open channels and open structures upstream from the unit processes are to be classified the same as the downstream process they supply.

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

## Chapter 4 Solids Treatment Processes

**4-1* General.** This chapter provides minimum criteria for protection against fire and explosion hazards associated with solids treatment processes. This chapter does not address treatment of solids from industrial waste treatment processes. Tables 4(a) and 4(b) summarize the various components associated with solids treatment processes.

**4-2* Design and Construction.** The design and construction of solids treatment processes shall conform to Table 4(a) and Table 4(b).

**Table 4(a) Solids Treatment Processes**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 1 | | COARSE AND FINE SCREENINGS HANDLING BUILDINGS Storage, conveying, or dewatering of screenings. (No exposed flow of wastewater through this building or area.) | NA | NR | NA | Unclassified | NC, LC, or LFS | H, FE, and FAS |
| 2 | | GRIT-HANDLING BUILDING Storage, conveying, and dewatering of heavy small screenings and grit. (No exposed flow of wastewater through this building or area.) | NA | NR | NA | Unclassified | NC, LC, or LFS | H, FE, and FAS |
| 3 | a | SCUM-HANDLING BUILDING OR AREA Holding, dewatering, or storage. | Possible grease or flammable liquids carryover | A | Enclosed space | Division 2 | NC, LC, or LFS | H, FE, and CGD if enclosed |
| | b | | | B | | Unclassified | | |
| | c | | | Not enclosed, open to atmosphere | NA | | | |
| 4 | a | SCUM PITS | Buildup of vapors from flammable or combustible liquids | A | Enclosed—entire space | Division 1 | NC | H, FE, and CGD if enclosed |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | Not enclosed, open to atmosphere | Within 10 ft (3 m) envelope around equipment and open channel[1] | | | |
| 5 | a | SCUM-PUMPING AREAS Pumping of scum, wet side of pumping station. | Carryover of floating flammable liquids | A | Enclosed—entire space | Division 1 | NC | H, FE, and CGD if enclosed |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | Not enclosed, open to atmosphere | Within 10 ft (3 m) envelope around equipment and open channel[1] | | | |
| 6 | a | SCUM-PUMPING AREAS Pumping of scum, dry side of pumping station. | Not significant | D | Enclosed space | Division 2, or unclassified if adequate positive pressure ventilation from clean air is provided with effective safeguards against ventilation failure | NC, LC, or LFS | FE |
| | b | | | C | | Unclassified | | |
| | c | | | Not enclosed, open to atmosphere | NA | | | |
| 7 | | SCUM INCINERATORS[2] Elimination of scum through burning. | Firebox explosion from possible carryover of flammable scum | NR | Incinerator area if separated from scum storage | Unclassified | NC, LC, or LFS | FSS (if indoors), H, and FE |

NOTE 1: Area beyond envelope is unclassified.
NOTE 2: See NFPA 54, NFPA 82, NFPA 8501, and NFPA 8502.

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

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**Table 4(a) (continued)**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 8 | a | SLUDGE THICKENER (CLARIFIER) Sludge concentration and removal, gravity or dissolved air flotation. | Possible generation of methane from sludge; carryover of floating flammable liquids | A | Enclosed—entire space | Division 1 | NC | |
| | b | | | B | | Division 2 | NC, LC, or LFS | H, FE, and CGD if enclosed |
| | c | | | Not enclosed, open to atmosphere | Envelope 18 in. (0.46 m) above water surface and 10 ft (3 m) horizontally from wetted walls[1] | | | |
| 9 | a | SLUDGE PUMPING STATION DRY WELLS Dry side of a sludge pumping station. | Buildup of methane gas or flammable vapors | D | Entire dry well when physically separated from a wet well or separate structures | Division 2, or unclassified if adequate positive pressure ventilation from clean air is provided with effective safeguards against ventilation failure | NC, LC, or LFS | H and FE |
| | b | | | C | Entire dry well when physically separated from a wet well or separate structures | Unclassified | | |
| 10 | a | SLUDGE STORAGE WET WELLS, PITS, AND HOLDING TANKS Retaining of sludge. | Possible generation of methane gas in explosive concentrations; carryover of floating flammable liquids | A | Enclosed—entire space | Division 1 | NC | CGD, H, and FE if tank enclosed in structure |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | Not enclosed, open to atmosphere | Envelope 18 in. (0.46 m) above water surface and 10 ft (3 m) horizontally from wetted walls[1] | | | NR |
| 11 | a | SLUDGE BLENDING TANKS AND HOLDING WELLS Retaining of sludge with some agitation. | Possible generation of methane gas in explosive concentrations; carryover of floating flammable liquids | A | Enclosed—entire space | Division 1 | NC | H, FE, and CGD if tank enclosed in structure |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | Not enclosed, open to atmosphere | Envelope 18 in. (0.46 m) above water surface and 10 ft (3 m) horizontally from wetted walls[1] | | | NR |
| 12 | | DEWATERING BUILDINGS CONTAINING CENTRIFUGES, GRAVITY BELT THICKENERS, BELT AND VACUUM FILTERS, AND FILTER PRESSES Removal of water from sludge and the conveyance of sludge or sludge cake. | NA | NR | NA | Unclassified | NC, LC, or LFS | FE, FDS, and FAS |

NOTE 1: Area beyond envelope is unclassified
NOTE 2: See NFPA 54, NFPA 82, NFPA 8501, and NFPA 8502.

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

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**Table 4(a) (continued)**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 13 | | INCINERATORS[2] AND INCINERATOR BUILDINGS Conveying and burning of sludge cake. | Firebox explosion | NR | NA | Unclassified | NC, LC, or LFS | FSS (if indoors), H, and FE |
| 14 | | HEAT TREATMENT UNITS, LOW- OR HIGH-PRESSURE OXIDATION UNITS Closed oxidation of sludge. | None, other than in high pressure systems | NR | NA | Unclassified | NC, LC, or LFS | H and FE |
| 15 | a | ANAEROBIC DIGESTERS, BOTH FIXED ROOF AND FLOATING COVER Generation of sludge gas from digesting sludge. | Leakage of gas from cover, piping, emergency relief valves, and appurtenances | Not enclosed, open to atmosphere | Tank interior. Areas above and around the digester cover. Envelope 10 ft (3 m) above the highest point of the cover, when the cover is at its maximum elevation, and 5 ft (1.5 m) from any wall. | Division 1 | NC | H and FE |
| | b | | | | Envelope 15 ft (4.6 m) above the Division 1 area over the cover and 5 ft (1.5 m) beyond the Division 1 area around the tank walls. | Division 2 | | |
| | c | | | A | For digester tanks enclosed in a building: Tank interior. Entire area inside building. | Division 1 | NC | CGD if enclosed |
| | d | | | B | For digester tanks enclosed in a building: Tank interior. Areas above and around the digester cover. Envelope 10 ft (3 m) above the highest point of the cover, when the cover is at its maximum elevation, and 5 ft (1.5 m) from any wall of the digester tank. | Division 1 | NC | CGD if enclosed |
| | e | | | | Remaining space in enclosed area | Division 2 | NC, LC, or LFS | |
| 16 | a | ANAEROBIC DIGESTER CONTROL BUILDING Storage, handling, or burning of sludge gas. | Leaking and ignition of sludge gas | A | Entire building | Division 1 | NC | CGD, H, and FE |
| | b | | | B | Enclosed areas that contain gas handling equipment | Division 2 | NC, LC, or LFS | |
| | c | | | C | Physically separated from above | Unclassified | | |

NOTE 1: Area beyond envelope is unclassified.
NOTE 2: See NFPA 54, NFPA 82, NFPA 8501, and NFPA 8502.

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

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**Table 4(a) (continued)**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 17 | a | DIGESTER GAS PROCESSING ROOMS Gas compression, handling, and processing. | Sludge gas ignition | A | Entire room | Division 1 | NC | CGD, H, and FE |
| | b | | | B | | Division 2 | NC, LC, or LFS | |
| | c | | | B | Within 5 ft (1.5 m) of equipment | Division 1 | NC, LC, or LFS | |
| 18 | | ANAEROBIC DIGESTER GAS STORAGE Storage of sludge gas. | Gas storage piping and handling | NNV | (*See NFPA 54.*) | (*See NFPA 54.*) | NC, LC, or LFS | H, FE, and CGD |
| 19 | | CHLORINE OXIDATION UNITS Chlorine reaction with sludge. | Chlorine is a very strong oxidizing agent | NR | NA | Unclassified | NR (These unit processes use corrosive chemicals that require the use of specific materials of construction. Special consideration shall be given to these materials of construction.) | H and FE |
| 20 | a | UNDERGROUND (PIPING) TUNNELS CONTAINING NATURAL OR SLUDGE GAS PIPING Transmission of gas, sludge, water, air, and steam via piping, and also might contain power cable and conduit. | Ignition of natural or sludge gases | D | Within 10 ft (3 m) of valves and appurtenances. | Division 1 | | |
| | b | | | D | Entire tunnel | Division 2 | NC, LC, or LFS | CGD, FDS, and FE |
| | c | | | C | Areas within 10 ft (3 m) of valves, meters, gas check valves, condensate traps, and other piping appurtenances | Division 2 | | |
| | d | | | C | Areas beyond 10 ft (3 m) | Unclassified | | |
| 21 | | UNDERGROUND (PIPING) TUNNELS NOT CONTAINING NATURAL OR SLUDGE GAS PIPING Transmission of sludge, water, air, and steam piping, and also might contain power cable and conduit. | NA | NR | NA | Unclassified | NC, LC, or LFS | FDS and FE |
| 22 | a | COMPOSTING PILES Aerobic sludge reduction. | Liberation of ammonia and toxic gas (composting materials can self-ignite) | D | Enclosed area | Division 2 | NC, LC, or LFS | H and FDS |
| | b | | | C | | Unclassified | | |
| 23 | a | IN-VESSEL COMPOSTING Aerobic sludge reduction. | Liberation of ammonia and toxic gas (composting materials can self-ignite) | As required by process | If enclosed, the interior of the reactor vessel plus a 10-ft (3-m) envelope around the reactor vessel | Division 2 | NC | H and FDS |
| | b | | | | Areas beyond 10 ft (3 m) | Unclassified | | |

NOTE 1: Area beyond envelope is unclassified.
NOTE 2: See NFPA 54, NFPA 82, NFPA 8501, and NFPA 8502.

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

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**Table 4(a) (continued)**

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| | | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 24 | a | ODOR CONTROL SYSTEM AREAS Areas physically separated from processes that house systems handling flammable gases. | Leakage and ignition of flammable gases | D | Entire area if enclosed | Division 2 | NC, LC, or LFS | CGD, FDS, and FE |
| | b | | | C | Areas within 3 ft (1.5 m) of leakage sources such as fans, dampers, flexible connections, flanges, pressurized unwelded ductwork, and odor control vessels | Division 2 | | |
| | c | | | | Areas beyond 3 ft (1.5 m) | Unclassified | | |
| 25 | | PUMPING OF DRAINAGE FROM DIGESTED SLUDGE DEWATERING PROCESSES Pumping of centrate, filtrate, leachate, drying beds, etc. | NA | NR | NA | Unclassified | NC, LC, or LFS | H |

NOTE 1: Area beyond envelope is unclassified.
NOTE 2: See NFPA 54, NFPA 82, NFPA 8501, and NFPA 8502.

A — No ventilation, or ventilated at less than 12 air changes per hour
B — Continuously ventilated at 12 air changes per hour or in accordance with Chapter 7
C — Continuously ventilated at 6 air changes per hour or in accordance with Chapter 7
CGD — Combustible gas detection system
D — No ventilation, or ventilated at less than 6 air changes per hour
FAS — Fire alarm system
FDS — Fire detection system
FE — Portable fire extinguisher
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
LC — Limited-combustible material
LFS — Low flame spread material
NA — Not applicable
NC — Noncombustible material
NEC — In accordance with NFPA 70, *National Electrical Code*
NNV — Not normally ventilated
NR — No requirement

**Table 4(b) Solids Treatment Processes**

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| | **Location and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 1 | SLUDGE-DRYING PROCESSES[2] | Potential for ignition of dust | NR | Entire room[1] | Division 1[3] | NC Construction in accordance with NFPA 69 | H, FAS, and FSS See NFPA 61 and NFPA 69 |

NOTE 1: Area beyond envelope is unclassified.
NOTE 2: See NFPA 54, NFPA 82, NFPA 8501, and NFPA 8502.
NOTE 3: If acceptable to the authority having jurisdiction, it shall be permitted to determine the classification using the provisions in NFPA 497B.
FAS — Fire alarm system
FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection in accordance with 5-2.4
NC — Noncombustible material
NR — No requirement

## Chapter 5 Fire and Explosion Prevention and Protection

**5-1* Scope.** This chapter establishes minimum requirements for overall protection against fire and explosion hazards in wastewater facilities and associated collection systems. The conditions created by the existence of gases, liquids, and solids can be grouped into two categories: flammable/combustible and injurious to life. While this standard deals primarily with the flammability aspects of a particular substance, process, or area within a plant, additional requirements to protect against other safety and health hazards are contained in NFPA *101®, Life Safety Code®*, and NFPA 70E, *Standard for Electrical Safety Requirements for Employee Workplaces*, and shall be considered part of NFPA 820.

### 5-2 Fire Protection Measures.

#### 5-2.1 General.

**5-2.1.1** Collection systems, liquid stream treatment processes, and solids handling processes shall be provided with fire protection appropriate to the fire hazard as described in Tables 2 through 4(a) and (b).

**5-2.1.2** In addition to the fire protection specified in Chapter 6, buildings, structures, and process elements under some conditions shall be provided with automatic extinguishing systems in accordance with Chapter 5.

#### 5-2.2 Automatic Sprinkler Systems.

**5-2.2.1** An automatic sprinkler system where required by this standard or by referenced publications shall conform to NFPA 13, *Standard for the Installation of Sprinkler Systems*, and shall be approved by the authority having jurisdiction.

*Exception: In certain areas of the wastewater treatment plant, such as chemical storage, underground tunnels or structures, areas where electrical hazard is a principal concern, or where water damage would seriously impair the integrity of the treatment plant, other automatic extinguishing systems shall be permitted.*

**5-2.3 Other Automatic Extinguishing Systems.** Where required or used in place of automatic sprinkler systems, special hazard extinguishing systems and nonwater automatic extinguishing systems shall be designed, installed, and maintained in accordance with the following standards, as applicable:

(a) NFPA 11, *Standard for Low-Expansion Foam*;

(b) NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*;

(c) NFPA 11C, *Standard for Mobile Foam Apparatus*;

(d) NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*;

(e) NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*;

(f) NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*;

(g) NFPA 16, *Standard on the Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems*;

(h) NFPA 17, *Standard for Dry Chemical Extinguishing Systems*; and

(i) NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*.

#### 5-2.4 Water Supplies, Standpipes, Hose Systems, and Hydrants.

**5-2.4.1** Water supplies shall be capable of delivering the total demand of sprinklers, hose streams, and foam systems. In areas where there is no public water supply or where the supply is inadequate, treatment plant effluent shall be permitted for fire protection use. Where connections are made from public water supplies, it might be necessary to guard against possible contamination of the public supply. The requirements of the public health authority having jurisdiction shall be determined and followed.

**5-2.4.2** Water supplies and hydrants shall be installed in accordance with the following standards, as applicable:

(a) NFPA 22, *Standard for Water Tanks for Private Fire Protection*;

(b) NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*; and

(c) NFPA 1231, *Standard on Water Supplies for Suburban and Rural Fire Fighting*.

**5-2.4.3** Standpipes and hose systems, where provided, shall be installed and inspected in accordance with NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*.

**5-2.4.4** Where fire pumps are used as a separate and sole source of supply, the system shall provide sufficient capacity to meet fire water flow requirements and shall be equipped with a standby power supply. Pumps shall be automatic starting and manual shutdown. Pumps shall be installed in accordance with NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*.

**5-2.5 Portable Fire Extinguishers.** Portable fire extinguishers shall be installed, located, and maintained in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*.

*Exception: In areas of the treatment plant not commonly occupied, such as basement and underground pipe galleries connecting buildings, the requirement for the permanent installation of portable fire extinguishers might not be appropriate. In these cases, the provision of portable fire extinguishers adequate for the hazards involved and acceptable to the authority having jurisdiction during all times the areas are occupied shall meet the intent of this standard.*

### 5-3 Fire Detection and Alarm Systems.

**5-3.1** Fire detection and alarm systems of a type appropriate to each treatment plant area shall be provided as identified in Tables 2, 3, and 4(a) and (b) or by referenced publications.

**5-3.2** Fire detection and alarm systems, where required, shall be installed and maintained in accordance with the NFPA 72, *National Fire Alarm Code*.

### 5-4 Combustible Gas Detection.

**5-4.1*** Combustible gas detectors shall be located in accordance with Tables 2, 3, and 4(a).

**5-4.2*** The selection of combustible gas detector types and their placement shall be determined by a qualified person.

**5-4.3** Combustible gas detectors shall be listed. The installation of combustible gas detectors shall be in accordance with their listing requirements and the manufacturer's instructions.

**5-4.4** Combustible gas detection equipment located in hazardous (classified) locations, as defined in accordance with NFPA 70, *National Electrical Code*, shall be listed for use in such atmospheres. The detectors shall be set at 10 percent of the lower explosive limit in accordance with the manufacturer's calibration instructions and shall be connected to alarm signaling systems.

*Exception: Alarm limits shall be permitted to be set at a higher percentage of the explosive limit where experience indicates ambient levels are too high and spurious alarms might be the result.*

**5-5 Ventilation Monitoring and Signaling Systems.**

**5-5.1** All continuous ventilation systems shall be fitted with flow detection devices connected to alarm signaling systems to indicate ventilation system failure.

**5-5.2** Local and remote alarms for both ventilation system failure and combustible gas detection shall be provided for all hazardous areas classified in accordance with the following:

(a) Article 500 of NFPA 70, *National Electrical Code*;

(b) Any space pressurized in accordance with Chapters 2, 3, and 4; or

(c) Chapter 7 and NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment.*

**5-5.3*** The alarms required in 5-5.2 shall be displayed in accordance with Table 5-5.3.

**5-5.4** Signaling systems shall be in accordance with the requirements for supervised signaling systems as set forth in NFPA 72, *National Fire Alarm Code.*

**5-6 Laboratories.** Fire protection for laboratories shall be in accordance with NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals.*

**5-7 Special Fire Protection Measures.**

**5-7.1 Fire Protection During Construction.** Fire protection measures during construction at both new and existing wastewater facilities shall be provided in accordance with NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, and NFPA 395, *Standard for the Storage of Flammable and Combustible Liquids at Farms and Isolated Sites.*

**5-7.2 Lightning Protection.** Lightning protection shall be provided in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems.*

**Table 5-5.3 Ventilation System Alarm Devices for Areas Indicated in 5-5.2**

| Location/Supervision | Alarm Devices and Supervision |
|---|---|
| 1. Entrance(s) to such spaces[1] | Visual and audible alarm or equivalent |
| 2. Within such spaces | Visual and audible alarm |
| 3. Local (within treatment plant or building) | Visual and audible alarm |
| 4. Remote (for distant supervision)[2] | Visual and audible alarm |

[1]Where locations are not constantly attended, the use of a nonaudible signal is permissible if a dual light system or equivalent is used. A dual light system shall include a "go"/"no go" or green light/red light type of warning system instead of the audible alarm.
[2]In appropriate situations and where this is impractical, a telephone dialer shall be considered to meet the intent of this portion of the table.

**5-7.3 Drainage.**

**5-7.3.1** Provisions shall be made in all fire areas of the plant for removal of all liquids directly to safe areas or for containment in the fire area without flooding of equipment and without endangering other areas. Caution shall be taken to avoid washing hazardous or toxic products of combustion into the drainage system.

**5-7.3.2** The provisions for drainage and any associated drainage facilities shall be sized to accommodate all three of the following simultaneously:

(a) The spill of the largest single container of any flammable or combustible liquids in the area,

(b) The maximum expected number of fire hose lines [500 gal/min (31.5 L/sec) minimum] operating for a minimum of 10 min, and

(c) The maximum design discharge of fixed fire suppression systems operating for a minimum of 10 min.

## Chapter 6 Materials of Construction

**6-1 General.**

**6-1.1** This chapter provides minimum criteria for selecting materials of construction for buildings, structures, and process elements for protection against fire and explosion in wastewater treatment plants and associated collection systems. In general, materials of construction and interior coatings and finishes shall provide a maximum degree of fire resistance with the minimum amount of flame spread and smoke generation for a particular application.

**6-1.2** Materials shall be selected that reduce or eliminate the effects of fire and explosion by maintaining structural integrity, controlling flame spread and smoke generation, minimizing the release of toxic products of combustion, and maintaining serviceability and operation of critical processes. The criteria for selecting materials of construction is not intended to provide sufficient protection of personnel from the risk of exposure to an asphyxiating or toxic atmosphere generated during a fire event.

*Exception: In general, criteria for selecting materials of construction do not apply to nonprocess contents of the building, structure, or assembly where such contents are not a part of the building, structure, or assembly, including, but not limited to, equipment or equipment enclosures, grating, walkways, ladders, railings, weirs, process piping and appurtenances, process media, aeration devices, slide and sluice gates, pump packing and seal material, electrical conduit, hardware, liners for basins that are open to the atmosphere, or materials used in rehabilitation or for lining existing sewer pipes.*

**6-1.3** In areas where corrosive environments are present, including classified areas, special attention shall be given to mitigation of corrosion problems in the selection and use of materials for nonstructural assemblies, including the use of corrosion-resistant metallic or nonmetallic grating, railings, steps and stairs, conduit, and electric equipment enclosures.

**6-1.4** Other local approving authorities and governing codes shall dictate more stringent material selection requirements, when appropriate.

**6-2 Materials Selection.**

**6-2.1** Materials shall be selected based on criteria for a particular application. Selection criteria shall include:

(a) Structural requirements,
(b) Location and operating environment,
(c) Fire rating,
(d) Flame spread value,
(e) Smoke density generation factors,
(f) Products of combustion, and
(g) Corrosion resistance.

**6-2.2** For the purpose of this document, materials of construction are divided into four basic categories: (a) combustible, (b) noncombustible, (c) limited-combustible, and (d) low flame spread.

**6-2.3** Materials of construction being considered for unit processes located in areas with an electrical classification of Class I, Division 1 or Division 2, and Class II shall be selected based on an overall evaluation including fire risk of the material attributes, the economic impacts of replacing the unit process, and the potential environmental dangers caused by having the unit process out of service for an extended period of time due to fire or explosion.

**6-3 Applications.**

**6-3.1* Sewers and Appurtenances.** Materials of construction for sewers and appurtenances such as maintenance holes, junction chambers, and catch basins shall be based on the results of a written materials risk assessment.

**6-3.2 Pumping Facilities.** Materials selected for wastewater pumping facilities shall be in accordance with Table 2.

*Exception No. 1: When conditions or applications warrant the selection of combustible materials for pumping facilities, consideration to flame spread, smoke generation, corrosion resistance, products of combustion, and the impact that a fire or explosion will have on the structural integrity, operability of the pumping facility, and the economic and environmental consequences of having the pumping facility out of service shall be included in the fire risk evaluation.*

*Exception No. 2: Small aboveground pumping facilities with a floor area of 100 ft$^2$ (9.3 m$^2$) or less and physically separated from the wet well and that do not present a fire hazard to other buildings or structures shall be permitted to be constructed of any appropriate materials.*

**6-3.3 Buildings and Structures.**

**6-3.3.1 General.** Buildings and structures, including domes and covers, shall be constructed of materials in accordance with Tables 2, 3, and 4(a) and (b).

*Exception No. 1: When conditions or applications warrant the selection of combustible materials for buildings and structures, consideration to flame spread, smoke generation, corrosion resistance, products of combustion, and the impact that a fire or explosion will have on the structural integrity, operability of the facility, and the economic and environmental consequences of having the facility out of service shall be included in the fire risk evaluation.*

*Exception No. 2: Small aboveground buildings and structures, including domes and covers, with a floor or surface area of 100 ft$^2$ (9.3 m$^2$) or less and physically separated from other buildings or structures and that do not present a fire hazard to other buildings or structures shall be permitted to be constructed of any appropriate materials.*

*Exception No. 3: Materials other than those required by Tables 2, 3, and 4(a) and (b) shall be permitted in buildings or structures that are fully sprinklered in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems.*

**6-3.3.2 Critical Unit Processes.**

**6-3.3.2.1** Buildings and structures, including domes and covers, containing unit processes that are considered critical to maintaining the integrity of the treatment plant (e.g., headworks, main pumping facility, primary clarifiers, etc.), and that if out of service for even a few hours could permanently or unacceptably damage the environment or endanger public health by allowing the release of raw wastewater or sludge, shall be constructed of materials meeting the definition of noncombustible.

*Exception: Except as indicated by the Exceptions to 6-3.3.1.*

**6-3.3.2.2** Where structural assemblies and partitions are required in these areas for fire separation in accordance with the fire risk evaluation, they shall have a minimum 3-hr fire rating.

**6-3.3.2.3** Nonstructural assemblies such as ventilation ducts and piping shall be constructed of noncombustible, limited-combustible, or low flame spread materials.

**6-3.3.3 Essential Unit Processes.**

**6-3.3.3.1** Buildings or structures, including domes and covers, containing unit processes that are considered essential to maintain the integrity of the treatment plant (e.g., secondary biological treatment, secondary clarifiers, disinfection facilities, etc.), and that if out of service for short periods of time would not permanently or unacceptably damage the environment or endanger public health but would become critical if continued for several days, shall be constructed of materials meeting the definition of noncombustible, limited-combustible, or low flame spread.

*Exception: Except as indicated by the Exceptions to 6-3.3.1.*

**6-3.3.3.2** Where structural assemblies and partitions are used in these areas for fire separation, they shall have a minimum 2-hr fire rating.

**6-3.3.3.3*** Nonstructural assemblies such as ventilation ducts and piping shall be constructed of noncombustible, limited-combustible, or low flame spread materials.

**6-3.3.4 Other Unit Processes.**

**6-3.3.4.1** Buildings and structures containing unit processes, including most sludge processing operations, that are not considered to be critical or essential to maintaining the integrity of the treatment plant, and where being out of service for long periods of time (a week or more) would not permanently or unacceptably damage the environment or endanger public health, shall be constructed of materials considered applicable by the authority having jurisdiction.

*Exception: Except as indicated by the Exceptions to 6-3.3.1.*

**6-3.3.4.2** Where structural assemblies and partitions are used in these areas for fire separation, they shall have a minimum fire rating of 1 hr.

**6-3.3.4.3** Nonstructural assemblies such as ventilation ducts and piping shall be constructed of materials meeting the definition of noncombustible, limited-combustible, or low flame spread.

**6-3.3.5 Combustible Gas Generation and Combustion Processes.** Buildings and structures containing unit processes that generate, process, or utilize combustible gases (e.g., anaerobic wastewater treatment processes, anaerobic digesters, compressors, storage spheres, piping, waste gas burners, gas-fired equipment including sludge incinerators, etc.) shall be constructed of materials meeting the definition of noncombustible.

*Exception: Except as indicated by the Exceptions to 6-3.3.1.*

**6-3.3.6 Air Supply and Exhaust.** Noncombustible, limited-combustible, or low flame spread materials shall be used for air supply and exhaust systems. Systems supplying or exhausting air at a rate greater than 2000 $ft^3$/min (56.6 $m^3$/min) shall include listed smoke dampers, listed fire dampers, and smoke detection and shall cause the ventilation system to shut down upon detection of smoke. Separate smoke ventilation systems shall be used where applicable.

*Exception: Smoke venting shall be permitted to be integrated into normal ventilation systems using automatic or manually positioned dampers and motor speed control in accordance with NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems. (Also see NFPA 204M, Guide for Smoke and Heat Venting. Smoke venting also can be accomplished through the use of portable smoke ejectors.)*

**6-3.3.7 Miscellaneous Materials.** Cellular or foamed plastic materials shall only be used in accordance with NFPA *101, Life Safety Code*. Roof covering shall be Class A in accordance with NFPA 256, *Standard Methods of Fire Tests of Roof Coverings*. Metal roof deck construction, where used, shall be Class I or fire classified.

*Exception: Class II metal roof deck construction shall be permitted in buildings or structures that are fully sprinklered in accordance with Chapter 5.*

## Chapter 7 Ventilation

### 7-1 General.

#### 7-1.1 Scope.

**7-1.1.1** Minimum criteria for adequate ventilation for protection against fire and explosion of wastewater treatment and pumping facilities shall be in accordance with Chapters 2, 3, and 4 for the designated electrical classifications.

**7-1.1.2** Ventilation criteria not addressed by Chapters 2, 3, and 4 shall meet the requirements of Table 7-3.

**7-1.1.3** An "NR" designation in column C of Tables 2, 3, and 4(a) and (b) indicates that no ventilation requirements are established for the space and, therefore, Table 7-3 also has no requirements.

**7-1.2** Where this standard requires certain ventilation practices, they are intended to minimize fire and explosion hazards; these ventilation standards might be insufficient to protect personnel from the toxic effects of exposure to gases present.

**7-1.3** This chapter is limited to ventilation of enclosed wastewater pumping and process-related areas. It does not establish criteria applicable to spaces devoted to administrative areas, laboratories, or other ancillary spaces.

**7-1.4** This chapter does not apply to at- or above-grade unroofed structures less than 2 ft (0.6 m) deep or 2 ft (0.6 m) to the normal water line or to at- or above-grade roofed structures where (a) the roof is at least 10 ft (3 m) above surrounding finished grade, and (b) the structure is open on at least three sides.

**7-1.5** Because of the unpredictable nature of materials and events that can be encountered in the operation of wastewater systems, ventilation criteria established in this standard might not be adequate for protection against all hazards that might be encountered.

**7-1.6** Hazardous classifications as established in Tables 2, 3, and 4(a) and (b) shall be permitted to be reduced to a lower classification (including unclassified) with positive pressurization as provided under Article 500 of NFPA 70, *National Electrical Code*. Positive pressurization shall be as described in NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*.

### 7-2 Installation.

**7-2.1** Ventilation systems serving spaces governed by this standard shall be designed in accordance with NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, unless superseded by more restrictive provisions of this standard.

**7-2.2** Ventilation systems serving hazardous areas classified under the provisions of Article 500 of NFPA 70, *National Electrical Code*, shall incorporate fans fabricated in accordance with AMCA Type A or B spark-resistant construction.

**7-2.3** All mechanically ventilated spaces shall be served by both supply and exhaust fans.

*Exception No. 1: For covered process facilities that are not routinely entered by personnel and where mechanically ventilated, the space is permitted to be ventilated by exhaust fans only. In determining the area classification, the induced supply (outside) air shall meet the ventilation rate specified in the applicable chapter.*

*Exception No. 2: Above-grade spaces with floor areas of 100 $ft^2$ (9.3 $m^2$) or less meeting the requirements of Exception No. 2 to 6-3.3.1 shall be permitted to be ventilated by a supply fan only.*

**7-2.4** Ventilation systems serving unclassified areas adjacent to classified areas shall maintain a differential pressure relative to ambient air pressure of 0.1 in. water column (25 Pa) under all operating conditions.

**7-2.5** Ventilation systems serving classified areas shall maintain a differential pressure relative to ambient air pressure of –0.1 in. water column (–25 Pa) under all operating conditions.

**7-2.6** Ventilation systems for hazardous areas designed to operate intermittently or only when the space is occupied are not considered adequate for the purpose of downgrading the electrical classification of areas. (*See Chapters 2, 3, and 4.*)

**7-2.7** Air shall be introduced into and exhausted from such spaces in a manner that will encourage scavenging of all portions of the spaces to avoid short-circuiting and to promote the effective removal of both heavier- and lighter-than-air gases and vapors.

**7-2.8** Ventilation systems shall not transfer air between unclassified interior spaces and classified interior spaces.

**7-2.9** Ventilation systems serving areas governed by this standard shall receive power from electrical equipment that receives power from a primary power source and that also has the means to accept power from alternate power sources. Minimum requirements for the means to accept the alternate source of power include connectors that are designed to connect to devices such as standby generators, portable generators, uninterruptible power supplies, etc. Automatic or manual switching to a permanent alternate source of power is also acceptable. Power failure of the primary source shall be alarmed so that appropriate emergency procedures can be started.

### 7-3 Ventilation Criteria.

**7-3.1** Ventilation rates are based on air changes per hour and shall be calculated on the basis of the maximum aggregate volume (under normal operating conditions) of the space to be ventilated. Air changes per hour shall be based upon 100 percent outside supply air, which shall be exhausted. Ventilation rates shall conform to those listed in Table 7-3 in order to obtain the lowest area electrical classification possible in accordance with NFPA 70, *National Electrical Code*.

**7-3.2** Dual ventilation rates for Class I, Division 1 and Division 2 areas shall be permitted under the provisions of this document, provided (a) the low ventilation rate is not less than 50 percent of that specified in Table 7-3, (b) the low ventilation rate is in operation only if the supply air temperature is 50°F (10°C) or less, (c) the high ventilation rate is not less than that specified in Table 7-3, and (d) the high ventilation rate is in operation whenever the supply air temperature is above 50°F (10°C), whenever the ventilated space is occupied, or whenever activated by approved combustible gas detectors set to function at 10 percent of the lower explosive limit.

**7-3.3*** Recirculation of up to 75 percent of the exhaust air flow rate for unclassified areas shall be permitted provided

(a) The recirculated air and outside air flow rate total is not less than 6 air changes per hour,

(b) Recirculation does not occur during occupancy, and

(c) Recirculation does not occur whenever a combustible gas detector senses a lower explosive limit of 10 percent or greater.

**7-3.4** Ventilation system designs shall consider the effects of cold weather operation and the probable presence of corrosive agents.

**Table 7-3 Minimum Ventilation Rates**

| | | Ventilation Rate, Air Changes per Hour, or Velocity as Noted | | |
|---|---|---|---|---|
| | **Description** | **Class I, Div. 1** | **Class I, Div. 2** | **Unclassified** |
| 1 | Wet wells, screen rooms, and other enclosed spaces with wastewater exposed to the room atmosphere. | < 12 ft/min (4 m/min) | ≥ 12 ft/min (4 m/min) | |
| 2 | Below-grade spaces (such as dry wells, equipment rooms, tunnels, or galleries) | | | |
| (a) | With equipment using or processing flammable gas; or | < 12 ft/min (4 m/min), or < 74 ft/min (22.2 m/min) velocity in tunnels or galleries | ≥ 12 ft/min (4 m/min), or ≥ 74 ft/min (22.2 m/min) velocity in tunnels or galleries | |
| (b) | With gas piping; or | < 6 ft/min (2 m/min), or < 37 ft/min (11 m/min) velocity in tunnels or galleries | ≥ 6 ft/min (2 m/min), or ≥ 37 ft/min (11 m/min) velocity in tunnels or galleries | |
| (c) | Without gas piping. | | < 6 ft/min (2 m/min) for dry wells | ≥ 6 ft/min (2 m/min) for dry wells |
| | | | NR for tunnels and galleries | |
| 3 | Above-grade spaces (such as equipment rooms and galleries) | | | |
| (a) | With equipment using or processing flammable gas; or | < 12 ft/min (4 m/min), or < 74 ft/min (22.2 m/min) velocity for galleries | ≥ 12 ft/min (4 m/min), or ≥ 74 ft/min (22.2 m/min) velocity in galleries | |
| (b) | With gas piping; or | | < 6 ft/min (2 m/min), < 37 ft/min (11 m/min) velocity in galleries | > 6 ft/min, or > 37 ft/min (11 m/min) velocity in galleries |
| (c) | Without gas piping. | | NR for galleries | |

NR = No requirement

## Chapter 8 Administrative Controls

**8-1 General.** This chapter establishes procedures and controls necessary for the execution of the fire prevention and fire protection activities and practices for wastewater interceptor systems, pumping stations, and treatment plants.

**8-2 Management Policy and Direction.**

**8-2.1*** Management shall establish a policy and institute a fire prevention and protection program at each facility.

**8-2.2** Combustible materials shall not be stored in areas used for the storage of toxic or reactive chemicals.

**8-3* Fire Risk Evaluation.** A complete fire risk evaluation shall be performed during the initial design process.

**8-4 Fire Prevention Program.** Each plant shall establish a fire prevention program. This program shall include all of the following:

(a) Fire safety information for all employees and contractors. This information shall include, as a minimum, familiarization with fire protection equipment and procedures, plant emergency alarms and procedures, and how to report a fire;

(b) Documented plant inspections including provisions for handling remedial actions to correct conditions that increase fire hazards;

(c) A description of the general housekeeping practices and the control of transient combustibles, including control of such materials stored in areas containing toxic or reactive chemicals;

(d) Control of flammable and combustible liquids and gases in accordance with NFPA 30, *Flammable and Combustible Liquids Code*, and NFPA 54, *National Fuel Gas Code*;

(e) Control of ignition sources to include smoking, grinding, welding, and cutting in accordance with NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*;

(f) Fire prevention surveillance in accordance with NFPA 601, *Standard on Guard Service in Fire Loss Prevention*; and

(g)* Fire report, including an investigation and a statement on the corrective action to be taken.

**8-5 Water-Based Fire Protection Systems.**

**8-5.1** These systems include fire sprinkler systems, standpipe and hose systems, water spray fixed systems, and foam-water sprinkler systems. Included are the water supplies that are part of these systems such as private fire service mains and appurtenances, fire pumps and water storage tanks, and valves controlling system flow.

**8-5.2** All water-based fire protection systems shall be installed in accordance with the manufacturer's specifications and the NFPA standards referenced throughout this document, as summarized in Chapter 9.

**8-5.3** All water-based fire protection systems shall be inspected, tested, and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*

**8-6 Other Fire Protection and Detection Systems.**

**8-6.1** All other fire protection and detection systems shall be installed in accordance with the manufacturer's specifications and the NFPA standards referenced throughout this document, as summarized in Chapter 9.

**8-6.2*** All other fire protection and detection systems shall be periodically inspected, tested, and maintained in accordance with the NFPA standards referenced throughout this document, as summarized in Chapter 9.

**8-6.3** Other fire protection system equipment not addressed by an NFPA standard as referenced in Chapter 9 (e.g., combustible gas detectors, radio communications equipment, and flame arrestors or flame checks) shall be inspected, tested, and maintained in accordance with the manufacturer's specifications.

**8-7* Impairments.**

**8-7.1** A written procedure in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, shall be established to address impairments of all water-based fire protection systems.

**8-7.2** A written procedure shall be established to address impairments to other fire protection systems and plant systems that have an impact on the level of fire hazard (dust collection systems, HVAC systems, etc.). These procedures shall include the following:

(a) Identify equipment not available for service,

(b) Identify personnel to be notified (plant fire brigade chief, public fire department, etc.), and

(c) Increase fire surveillance as needed. [*See 8-4(g).*]

**8-7.3** Following repairs, tests shall be conducted on all affected systems to ensure proper operation.

**8-7.4** Following restoration, all parties previously notified of the impairment shall be notified of the completion of repairs.

**8-8 Fire Emergency Plan.** A written fire emergency plan shall be developed. This plan shall include the following:

(a) Response to fire alarms and fire system supervisory alarms,

(b) Notification of personnel identified in the plan,

(c) Evacuation of employees not directly involved in firefighting activities from the fire area,

(d) Coordination with security forces or other designated personnel to admit the public fire department and control traffic and personnel,

(e) Fire extinguishment activities, and

(f) In critical areas, operators' activities during fire emergencies. Approved breathing apparatus shall be readily available in critical areas.

**8-9* Fire Brigades.**

**8-9.1*** If a fire brigade is provided, its organization and training shall be identified in written procedures.

**8-9.2** Arrangements shall be made to permit rapid entry into the plant by the municipal fire department, police department, or other authorized personnel in the case of fire or other emergency. The Plant Emergency Organizations, where provided, shall be instructed and trained in accordance with NFPA 600, *Standard on Industrial Fire Brigades.*

**8-10* Polychlorinated Biphenyls.** If polychlorinated biphenyls (PCBs) are contained within the wastewater treatment plant, the owner and the local fire officials shall prepare a contingency plan to protect the plant and the collection system from possible contamination in the event that the PCBs or combustion products are leaked or washed into the drains during a fire.

**8-11 Fire and Explosion Prevention.** The principal control procedures used to minimize potential fire and explosion incidents at wastewater treatment plants shall include:

(a) Ventilation (*see Chapter 7*),

(b) Education (*see NFPA 1, Fire Prevention Code*),

(c) Risk management and property conservation programs,

(d) Procedures for permitting hot work,

(e) Selection of appropriate materials of construction (*see Chapter 6*), and

(f) Selection of appropriate equipment.

**8-11.1 Control of Hazardous Source.** In-house training programs [Plant Emergency Organizations (PEO) and housekeeping or maintenance] that will provide information to understand, identify, prevent, and handle hazardous sources and situations related to potential fire, explosion, and toxicity problems shall be established for all personnel. Close liaison shall be implemented between the local fire department (including other authorized emergency personnel) and wastewater treatment plant safety personnel so that mutually approved emergency procedures (including familiarity with the plant) can be established.

**8-11.2 Control of Ignition Sources.**

**8-11.2.1** Personnel involved shall be made familiar with the conditions for and sources of ignition of special hazards and shall be trained for the safe operation of processes. [*See 8-4(e).*]

**8-11.2.2** All personnel shall be trained to report faulty equipment, worn static bonding lines, improperly stored chemicals, and other items needing correction.

**8-11.3 Hot Work Permits.** Welding, cutting, and similar spark-producing operations shall not be permitted until a written permit authorizing such work has been issued. The permit shall be issued by a person in authority following his or her inspection of the area to ensure that the proper precautions have been taken and will be followed until the job is completed. (*See NFPA 51B, Standard for Fire Prevention in Use of Cutting and Welding Processes.*)

## Chapter 9 Referenced Publications

**9-1** The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**9-1.1 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 10, *Standard for Portable Fire Extinguishers*, 1994 edition.

NFPA 11, *Standard for Low-Expansion Foam*, 1994 edition.

NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*, 1994 edition.

NFPA 11C, *Standard for Mobile Foam Apparatus*, 1995 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 1993 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 1992 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1994 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 1993 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 1990 edition.

NFPA 16, *Standard on the Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems*, 1995 edition.

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, 1994 edition.

NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*, 1993 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 1993 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 1995 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 1995 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 1993 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 1991 edition.

NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*, 1994 edition.

NFPA 54, *National Fuel Gas Code*, 1992 edition.

NFPA 70, *National Electrical Code*, 1996 edition.

NFPA 70E, *Standard for Electrical Safety Requirements for Employee Workplaces*, 1995 edition.

NFPA 72, *National Fire Alarm Code*, 1993 edition.

NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, 1993 edition.

NFPA *101, Life Safety Code*, 1994 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, 1993 edition.

NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*, 1995 edition.

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, 1990 edition.

NFPA 256, *Standard Methods of Fire Tests of Roof Coverings*, 1993 edition.

NFPA 395, *Standard for the Storage of Flammable and Combustible Liquids at Farms and Isolated Sites*, 1993 edition.

NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, 1993 edition.

NFPA 600, *Standard on Industrial Fire Brigades*, 1992 edition.

NFPA 601, *Standard on Guard Service in Fire Loss Prevention*, 1992 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 1995 edition.

NFPA 1231, *Standard on Water Supplies for Suburban and Rural Fire Fighting*, 1993 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 1994 edition.

**9-1.2 Other Publications.**

**9-1.2.1 ASTM Publications.** American Society for Testing and Materials, 1916 Race Street, Philadelphia PA 19103.

ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C*, 1994.

ASTM E 814, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops*, 1988 (Rev. B-94).

## Appendix A Explanatory Material

*This Appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.*

**A-1-1.1.1** Consult other NFPA standards for additional requirements relating to wastewater treatment and collection facilities.

**A-1-3.1** In existing facilities, it is not always practical to strictly apply the provisions of this standard. Physical limitations might necessitate disproportionate effort or expense with little increase in fire protection. In such cases, the authority having jurisdiction should be satisfied that reasonable fire protection is ensured.

In existing facilities, it is intended that any condition that represents a serious threat to fire protection be mitigated by application of appropriate safeguards. It is not intended to require modification for conditions that do not represent a significant threat to fire protection, even though such conditions are not literally in conformance with these fire protection requirements.

**A-1-3.3** For additional information see NFPA 497A, *Recommended Practice for Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, and NFPA 497B, *Recommended Practice for the Classification of Class II Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*. While some of this information is not applicable to wastewater treatment facilities, both documents provide useful information.

**A-1-5 Approved.** The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations that is in a position to determine compliance with appropriate standards for the current production of listed items.

**A-1-5 Authority Having Jurisdiction.** The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

**A-1-5 Listed.** The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

**A-2-1** Additional information on sources of hazards, sources of ignition, and mitigation measures associated with collection and transmission of municipal wastewater is contained in Appendix D.

**A-2-2** See Figures A-2-2(a) through (g), which provide examples for Table 2.

**A-3-1** Additional information on sources of ignition, sources of hazards, and mitigation measures associated with liquid stream treatment processes is contained in Appendix D.

**A-3-2** See Figure A-3-2, which provides an example for Table 3.

**A-4-1** Additional information on sources of hazards, sources of ignition, and mitigation measures associated with solids treatment processes is contained in Appendix D.

**A-4-2** See Figures A-4-2(a) through A-4-2(g), which provide examples for Table 4(a).

**A-5-1** Additional information is contained in Appendix D.

**A-5-4.1** For further information, refer to NFPA 328, *Recommended Practice for the Control of Flammable and Combustible Liquids and Gases in Manholes, Sewers, and Similar Underground Structures*.

**A-5-4.2** Other types of detectors, such as heat and smoke detectors, have standards recommending spacing usually based on a certain area per detector. There are no known recognized standards or guidelines for the locating or spacing of combustible gas detectors.

Whether natural or mechanical, air movement is a very important consideration in installing combustible gas detectors. This aspect should be carefully investigated, including the effect of doors, windows, vents, and other openings. It might be necessary to conduct a ventilation study that could involve a nontoxic smoke movement analysis.

Dispersion characteristics can also affect detector placement. Vapors and gases will disperse inversely proportional to their specific density in a quiescent environment. Vapors and gases with densities less than that of air will diffuse quickly at first until the vapor or gas becomes diluted. Heavier-than-air vapors and gases will tend to settle at a low area and not diffuse into the atmosphere unless dispersed by ventilation or temperature currents. Vapors with densities close to that of air will exhibit little mixing effect and will be transported largely by air currents.

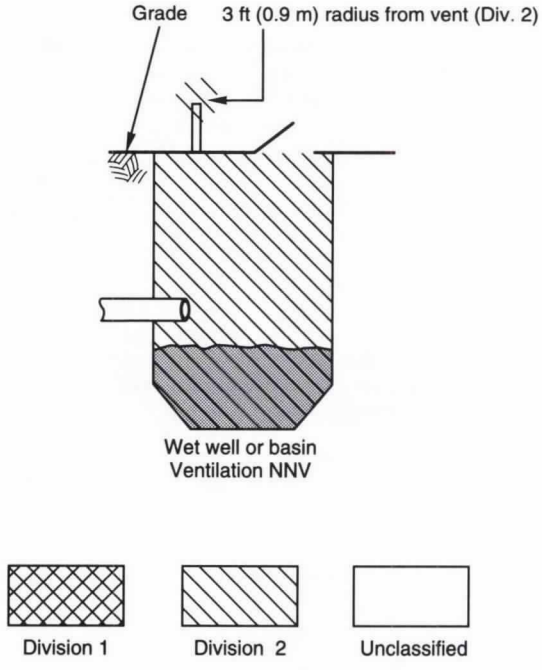


Figure A-2-2(a) Wet well or basin serving a storm sewer. Illustration of Table 2, row 4.

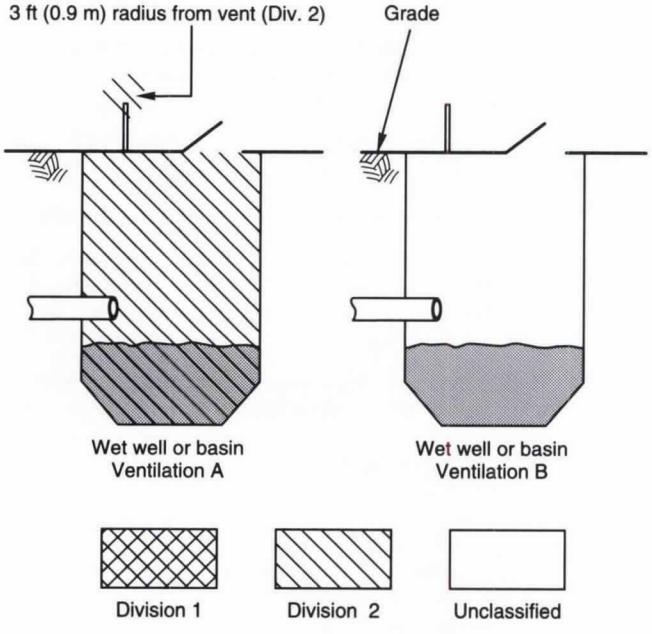


Figure A-2-2(b) Wet well or basin serving a residential sewer. Illustration of Table 2, row 11.

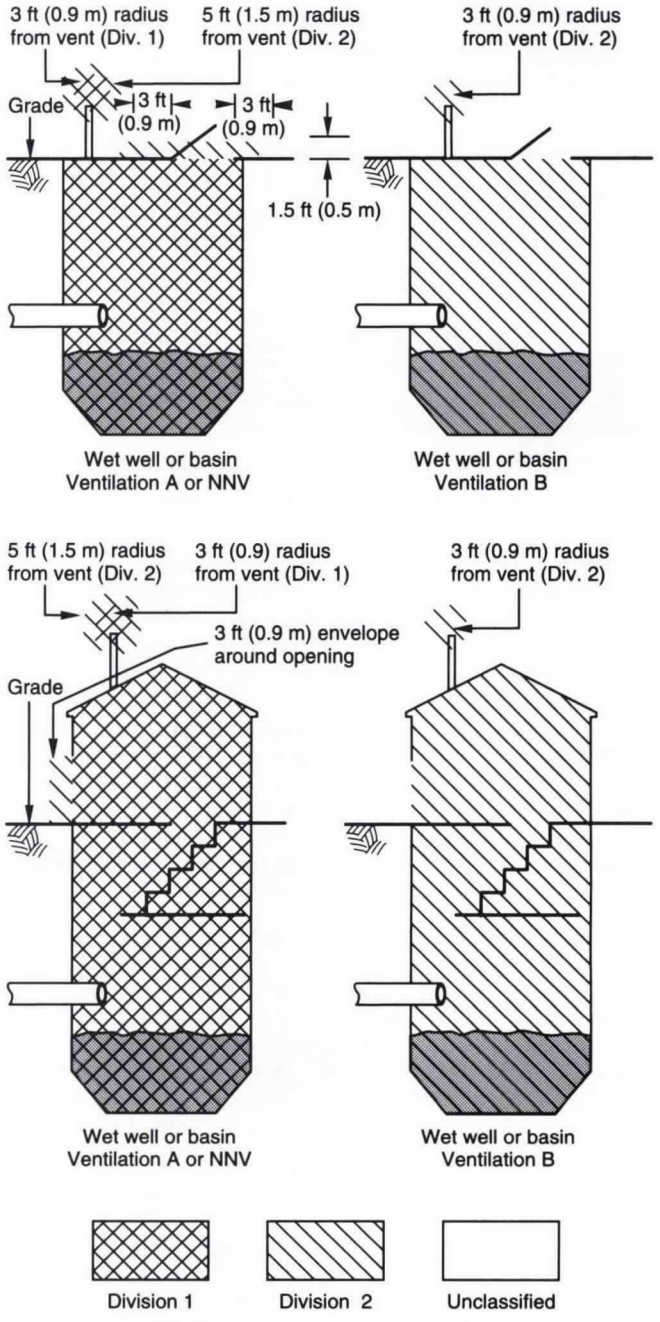


Figure A-2-2(c) Wet well or basin serving separate or combined sanitary sewer. Illustration of Table 2, rows 16 and 34.

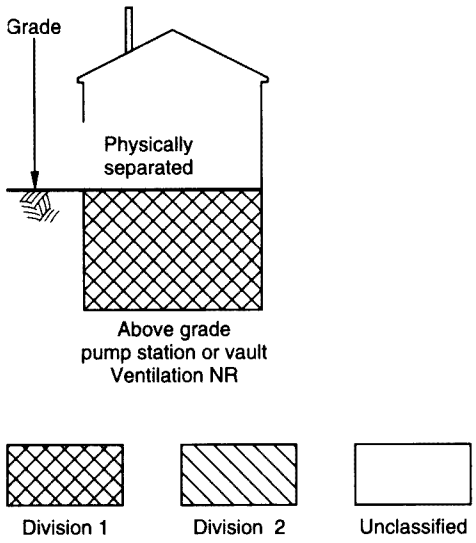


Figure A-2-2(d) Above-grade equipment housing or vault physically separated from the wet well or basin. Illustration of Table 2, rows 18 and 30.

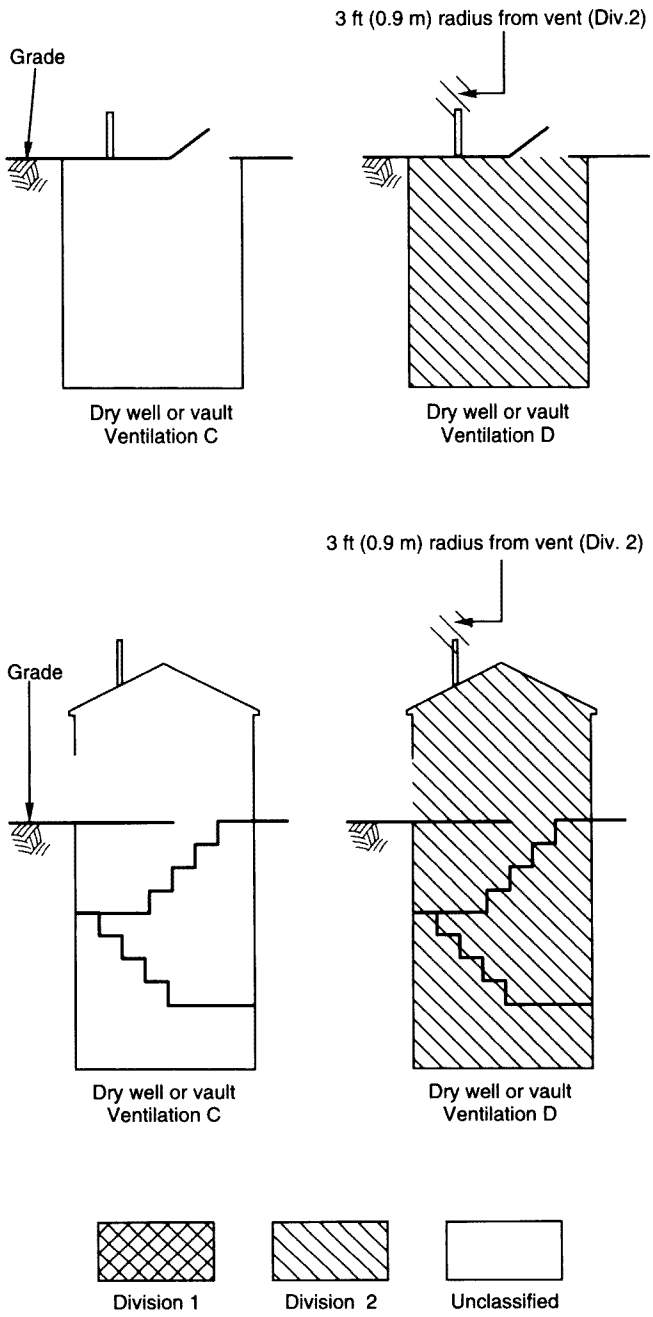


Figure A-2-2(e) Below- or partially below-grade equipment housing or vault physically separated from the wet well or basin. Illustration of Table 2, rows 5, 12, 17, 31, and 36.

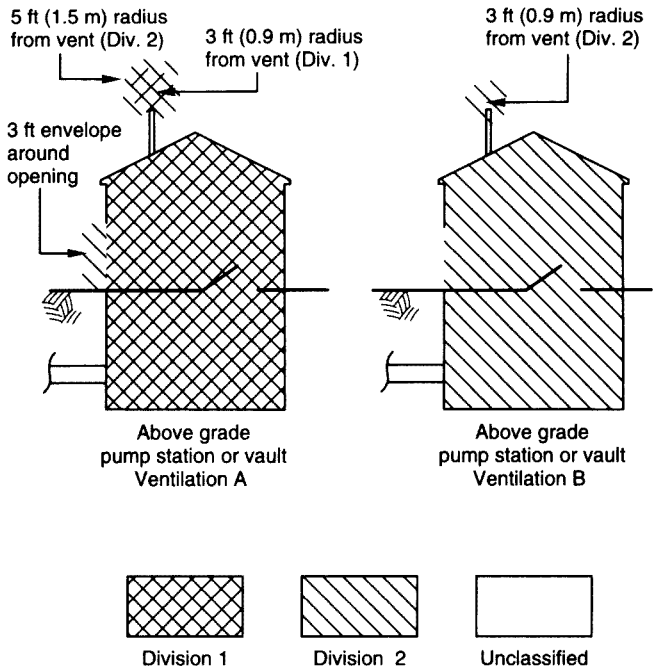


**Figure A-2-2(f) Above-grade equipment housing or vault not physically separated from the wet well or basin. Illustration of Table 2, row 19.**

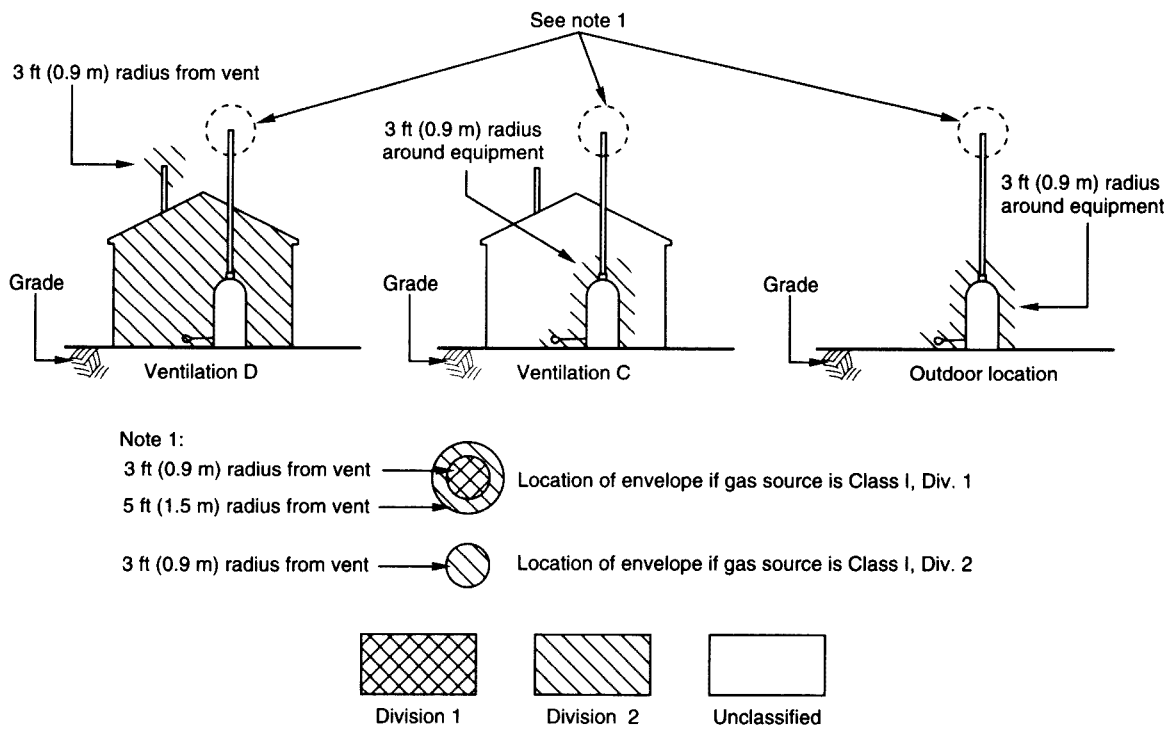


**Figure A-2-2(g) Odor control system location physically separated from wet well. Illustration of Table 2, row 20.**

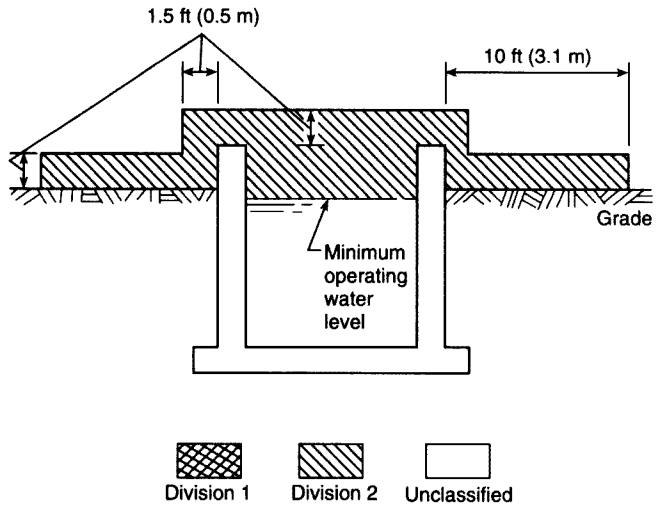


Figure A-3-2 Primary sedimentation tank. Illustration of Table 3, row 6.

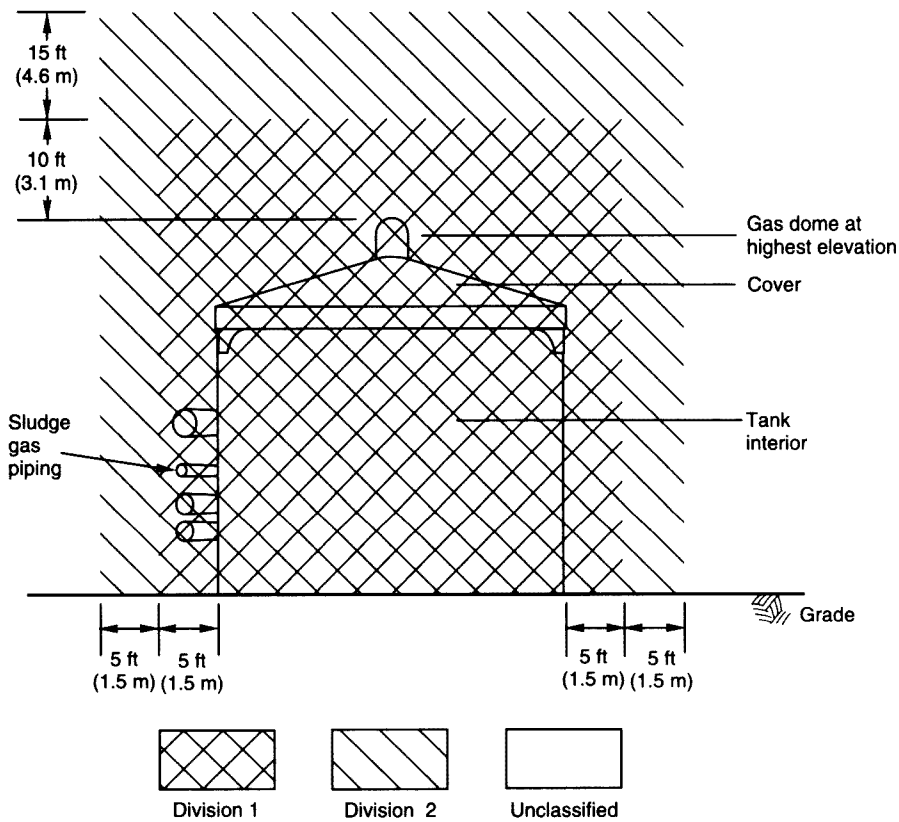


Figure A-4-2(a) Anaerobic digester with fixed or floating cover above grade not enclosed in a building. Illustration of Table 4(a), rows 15a and b.

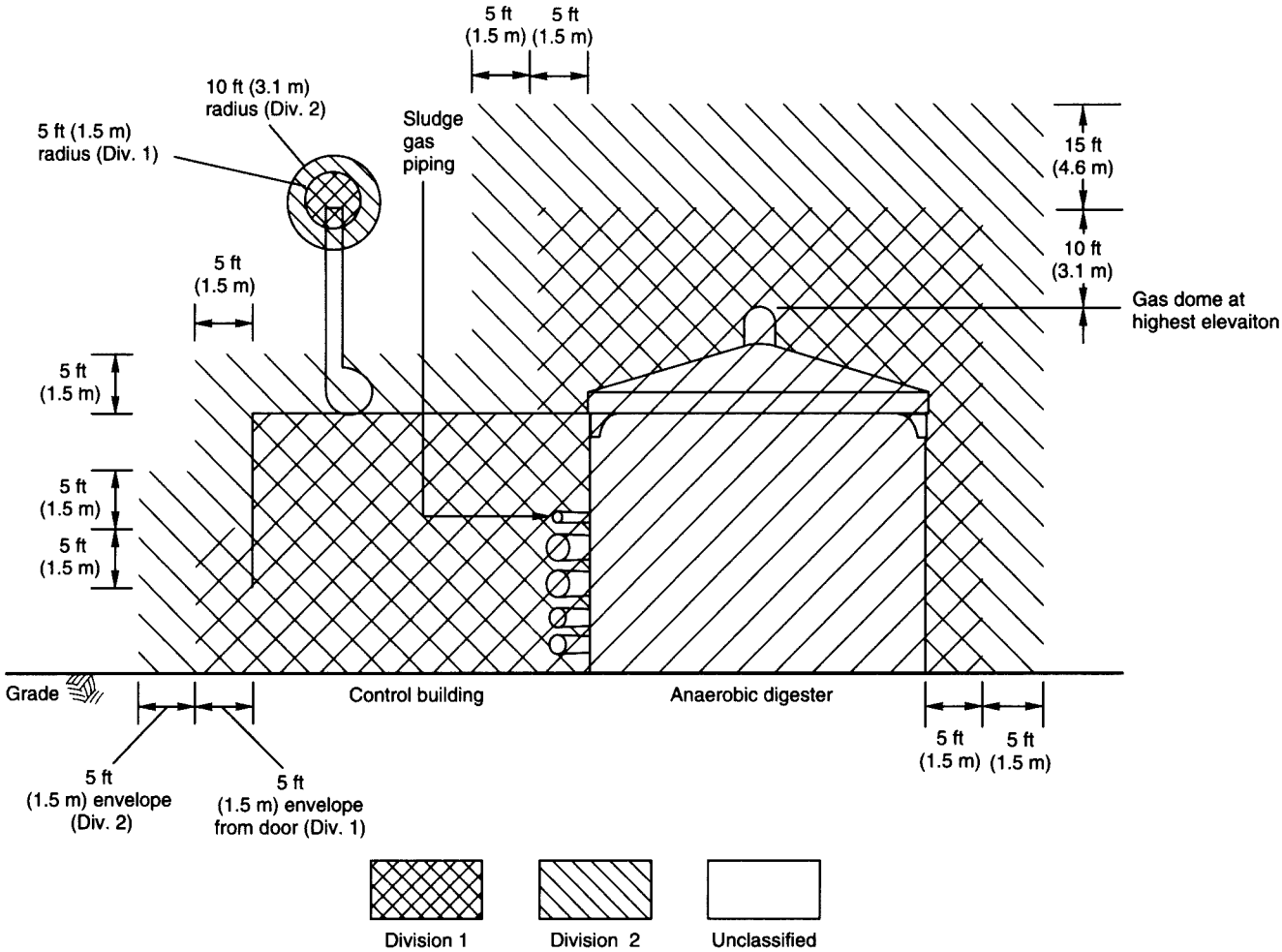


**Figure A-4-2(b) Anaerobic digester control building containing sludge gas piping and with ventilation A. Illustration of Table 4(a), row 16a.**

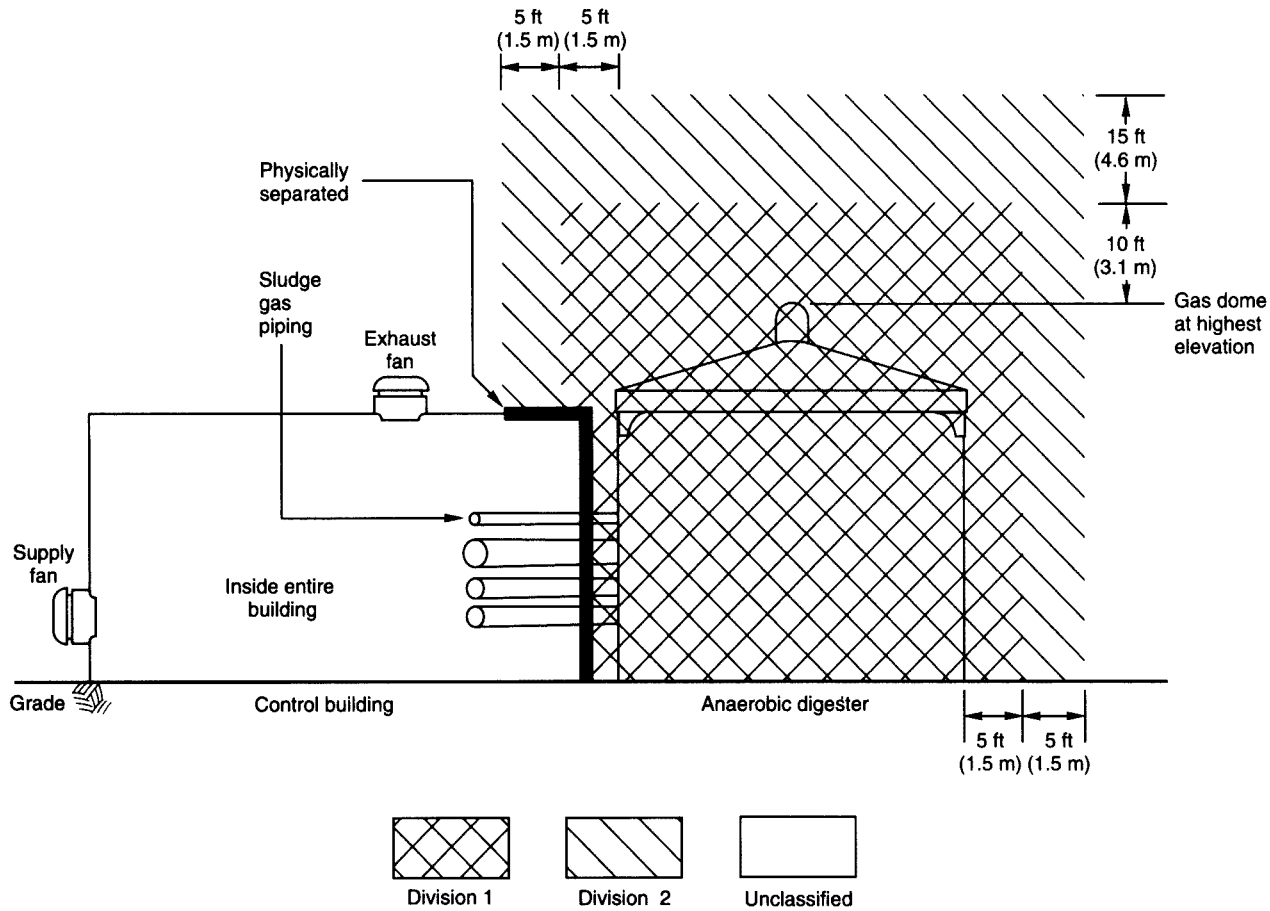


**Figure A-4-2(c) Anaerobic digester control building containing sludge gas piping and with ventilation C. Illustration of Table 4(a), row 16c.**

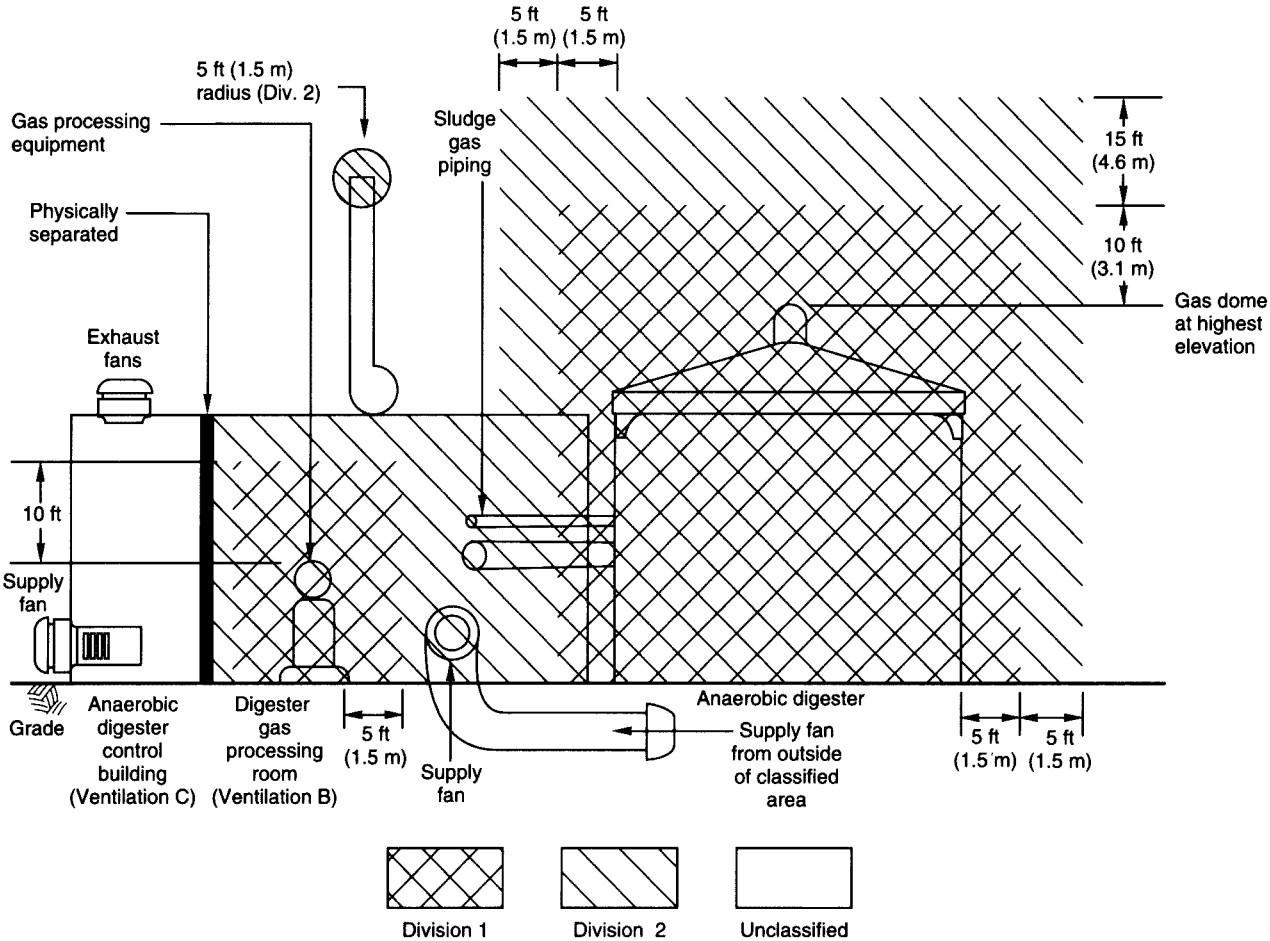


**Figure A-4-2(d) Anaerobic digester control building containing sludge gas processing equipment physically separated and with ventilation B for the processing room, and ventilation C for the control building. Illustration of Table 4(a), rows 16c and 17b.**

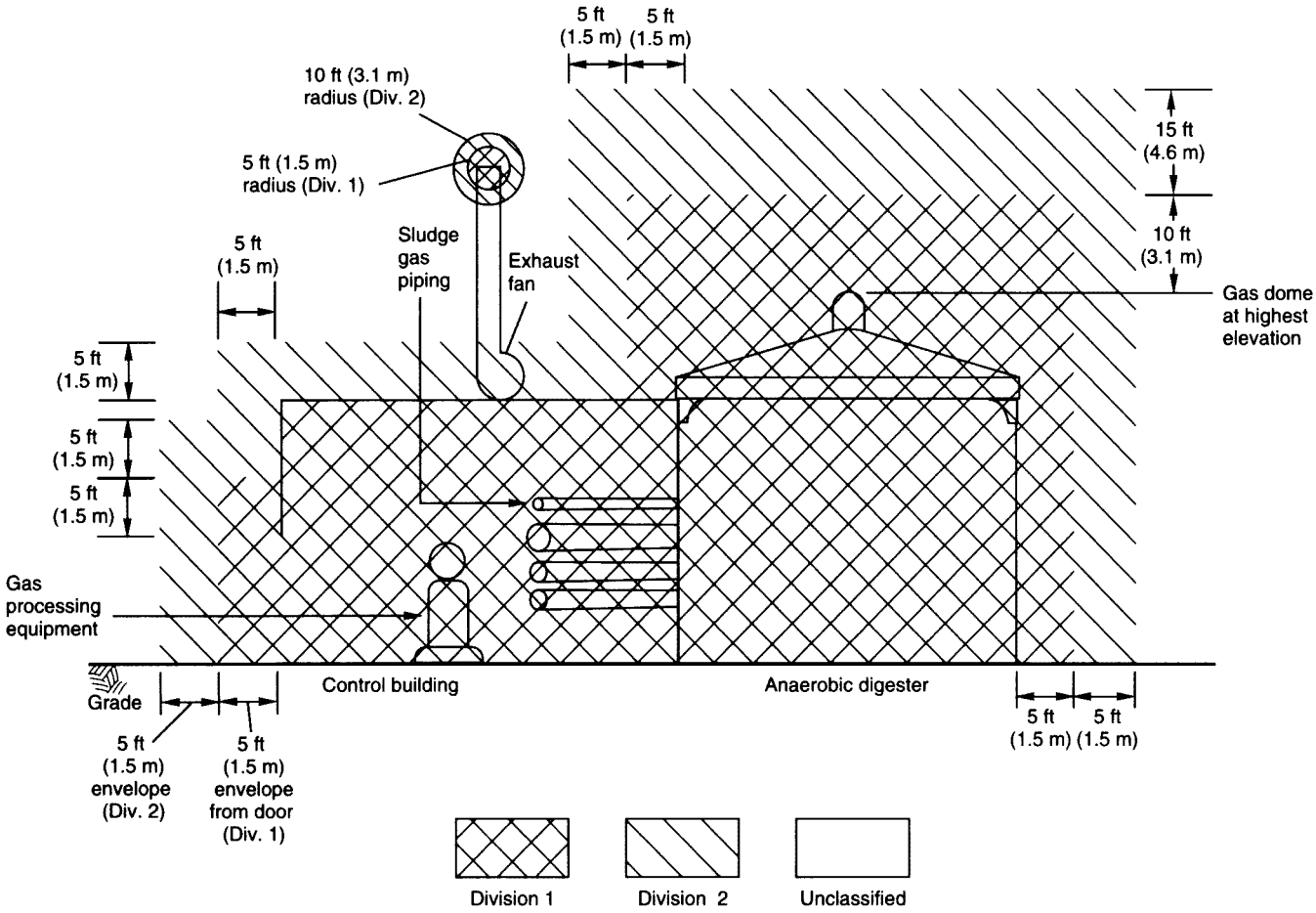


**Figure A-4-2(e) Anaerobic digester control building containing sludge gas processing equipment not physically separated and with ventilation A. Illustration of Table 4(a), row 16.**

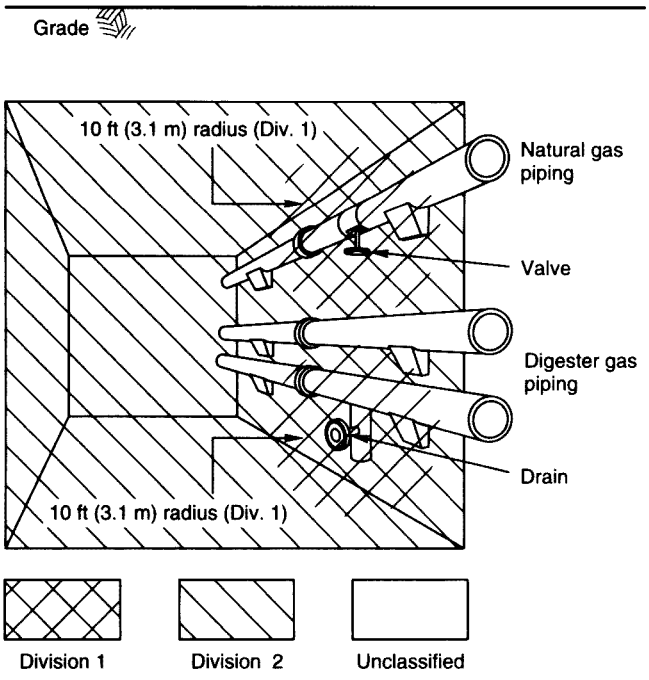


**Figure A-4-2(f) Underground tunnel containing natural gas or sludge gas piping with ventilation D. Illustration of Table 4(a), rows 20a and 20b.**

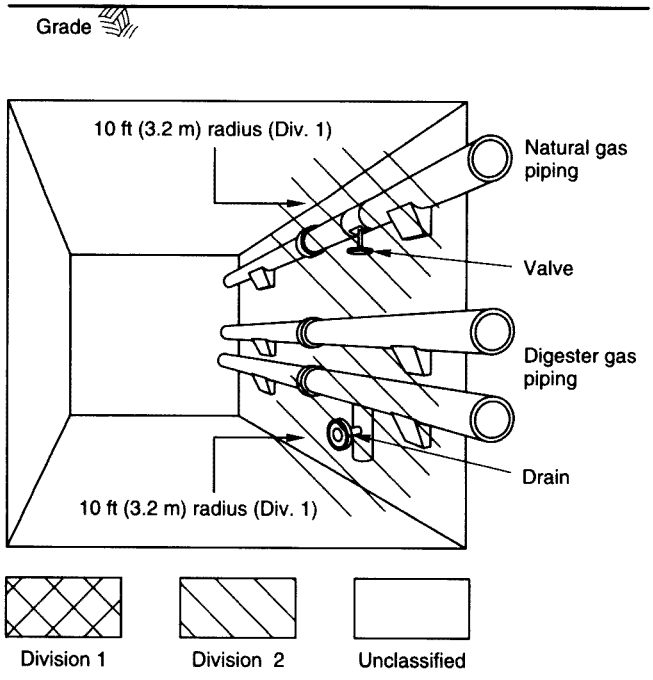


**Figure A-4-2(g) Underground tunnel containing natural gas or sludge gas piping with ventilation C. Illustration of Table 4(a), rows 20c and 20d.**

There are various types of sensing devices. It is important to select the proper sensing device for each application and for the environment in which it will be placed. Most organic and inorganic compounds can be safely monitored with a catalytic-combustion-type sensor. However, organic and metallic solvents containing lead, silicones, plasticizers, or halogens can poison the catalytic element.

**A-5-5.3** In all cases, standard "Danger" signs identifying the purpose of the lights and audible alarms and warning against entry when there is an alarm condition should be posted as near as practical to the warning devices.

**A-6-3.1** See Appendix C of this document and NFPA 328, *Recommended Practice for the Control of Flammable and Combustible Liquids and Gases in Manholes, Sewers, and Similar Underground Structures.*

**A-6-3.3.3.3** Plastic or fiberglass-reinforced plastic products are often used as materials of construction in unit processes such as rotating biological contactors (RBC), biotowers, trickling filters, inclined plate (tube) settlers, ventilation ducts, and other equipment that might be subject to corrosion. Under normal operating conditions, these plastic or fiberglass-reinforced plastic materials might be submerged; however, during maintenance or repair they can become exposed. During maintenance and repair operation, extreme care should be taken with open flame such as cutting torches, as these exposed plastic or fiberglass-reinforced plastic materials might present a considerable fuel load if ignited.

**A-7-3.3** Ventilation rates and procedures established by this standard might not be sufficient to protect personnel from exposure to toxic gases that might be present in enclosed spaces.

**A-8-2.1** Proper preventive maintenance of operating and fire protection equipment, as well as operator training, are important aspects of a viable fire prevention program.

**A-8-3** A fire risk evaluation should result in recommendations to integrate the fire prevention and fire protection required in this document into the plant-specific considerations regarding design, layout, and anticipated operating requirements. The evaluation should result in a list of recommended fire prevention features to be provided based on acceptable means for separation or control of common and special hazards, the control or elimination of ignition sources, and the suppression of fires.

This evaluation should focus on materials of construction in ventilation systems and in processes that normally operate in a wet condition (examples: plastic media trickling filters, bio-towers, and rotating biological contactors). These systems and process units can represent a considerable fuel load if ignition occurs during operation. Maintenance, fire spread, and smoke production should be considered in the selection of materials.

Consideration should also be given to locating process areas (examples: screen room, areas containing gas management equipment, etc.) that represent a significant explosion hazard remote from other process areas to reduce the risk of consequent damage should an explosion occur.

**A-8-4(g)** (*See Sample Fire Report.*)

**A-8-6.2 Maintenance.** Once a detection system is installed, a preventive maintenance program is essential. A detection system is only as good as the care and maintenance it receives. This is especially true in harsh environments. When installing instruments, ease of calibration and maintenance should be considered. Periodic calibration, checks, and adjustments are necessary for detection to remain accurate. If instruments are inaccessible, it is more likely that maintenance procedures will not be followed. Detectors should be located so as not to be exposed to physical damage from normal activities in the area.

Consideration should be given to the scope and limitations of the listing for combustible gas detectors. For example, Underwriters Laboratories Inc., in its *Hazardous Location Equipment Directory*, offers some guidance in maintaining and using combustible gas detectors. The following is extracted from that directory's product category guide for listed gas detectors (JTPX):

> Gas or vapor detectors should be calibrated and inspected by the operator in compliance with the manufacturer's instructions, as performance of the instruments will depend on proper maintenance. The instruments should be calibrated with known gas- or vapor-air mixtures at intervals and particularly after replaceable sensors incorporated in the detecting unit are replaced. Certain gases or vapors can adversely affect (poison) the sensors and limit the use of the instruments. Sampling atmospheres containing gases or vapors for which they have not been previously calibrated should, therefore, be avoided.

**A-8-7** Impairments to fire protection systems should be as short in duration as practical. If the impairment is planned, all necessary parts and manpower should be assembled prior to removing the protection system from service. When an impairment is not planned, the repair work should be expedited until the repairs are completed.

**A-8-9 Fire Brigades.** The size of the plant and its staff, the complexity of fire-fighting problems, and the availability of a public fire department should determine the requirements for a fire brigade. The organization of a fire brigade is encouraged for wastewater treatment facilities located in remote areas.

If a fire brigade is provided, its organization and training should be identified in written procedures. Recommendations contained in NFPA 600, *Standard on Industrial Fire Brigades*, and OSHA 29 CFR, 1910.156, should be consulted for additional information.

The following items discuss special fire-fighting conditions unique to wastewater facilities. This information might be useful in fire brigade training and fire preplanning.

(a) Cable tray fires should be handled like any fire involving energized electrical equipment. It might not be practical or desirable to de-energize the cables involved in the fire. Water is the most effective extinguishing agent for cable insulation fires, but it should be applied with an electrically safe nozzle. Some cable insulations [polyvinyl chloride (PVC), neoprene, or Hypalon™] can produce dense smoke in a very short time. In addition, PVC liberates hydrogen chloride (HCl) gas. Self-contained breathing apparatus should be used by personnel attempting to extinguish cable tray fires.

**Sample Fire Report**

Name of company: _____

Date of fire: _____ Time of fire: _____ Operating facility: _____

Under construction: _____

Plant or location where fire occurred: _____

Description of facility, fire area, or equipment (include nameplate rating) involved: _____

_____

Cause of fire, such as probable ignition source, initial contributing fuel, equipment failure causing ignition, etc.: _____

_____

_____

Description of fire and events and conditions preceding, during, and after the fire: _____

_____

_____

Types and approximate quantities of portable extinguishing equipment used: _____

_____

_____

Was fire extinguished with portable equipment only? _____ Public fire department called? _____

Employee fire brigade at this location? _____ Qualified for incipient fires? _____

For interior structural fires? _____

Was fixed fire extinguishing equipment installed? _____

Type of fixed extinguishing system: _____

Automatic operation: _____, manually actuated: _____, or both: _____

Specific type of detection devices: _____

Did fixed extinguishing system control fire? _____, extinguish fire _____, both control and extinguish fire? _____

Did detection devices and extinguishing system function properly? _____

If not, why not? _____

_____

Estimated direct damage due to fire: $ _____, or between $ _____ and $ _____

Estimated additional (consequential) loss: $ _____. Nature of additional loss: _____

_____

_____

Estimated time to complete repairs/replacement of damaged equipment/structure: _____

Number of persons injured: _____ Number of fatalities: _____

What corrective or preventive suggestions would you offer to other utilities who might have similar equipment, structures, or extinguishing systems? _____

_____

_____

Submitted by: _____ Title: _____

(b) Some sludge drying and composting processes (especially solvent extraction drying, sludge drying kilns, and in-vessel composting systems) might produce a product that might be subject to spontaneous combustion. Generally, water will be the most effective fire-fighting agent in these areas. However, fires might be deep-seated in stockpiled products, which might have to be dispersed with front-end loaders or similar equipment to fully extinguish smoldering and burning material.

(c) Some chlorinated hydrocarbon products commonly used as foam suppressants or flocculation agents in wastewater treatment might cause spontaneous combustion when in contact with powdered disinfectants. These chemicals should be stored separately, and care should be exercised in their use.

(d) Plastic or fiberglass-reinforced plastic materials used in process units or ventilation systems might represent a considerable fuel load if ignited during operation or maintenance and might necessitate special response techniques.

**A-8-9.1** NFPA 600, *Standard on Industrial Fire Brigades*, and OSHA 29 CFR 1910.156 should be consulted.

**A-8-10** Federal regulations (40 CFR, 761.30) specify that the local fire department should be notified of the location of all PCB-filled transformers and other electrical equipment.

## Appendix B Wastewater Treatment Processes

*This Appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.*

### B-1 General.

**B-1.1 Wastewater.** Wastewater is principally the spent water supply of the community. It is used to flush and transport human wastes and the liquid wastes of commerce, industry, and institutions. Ground water, surface water, and storm water might also be present. The primary purposes of wastewater treatment are to protect the health and well-being of the community and the quality of the receiving waterway. The extent or completeness of wastewater treatment to accomplish these purposes is governed by legislation and regulations and will vary from jurisdiction to jurisdiction.

**B-1.2 Elements of Wastewater Treatment.** The principal elements of wastewater treatment are:

(a) Preliminary treatment,
(b) Primary treatment,
(c) Secondary treatment,
(d) Tertiary treatment,
(e) Disinfection, and
(f) Sludge treatment.

A typical schematic flow and process diagram for a wastewater treatment plant is shown in Figure B-1.

**B-2 Preliminary Treatment.** Preliminary treatment comprises the conditioning of wastewater as it enters the wastewater treatment plant. Preliminary treatment removes materials that might be harmful to or might adversely affect the operation of the treatment plant. Such material might include lumber, cardboard, rags, stones, sand, plastic, grease, and scum. Methods and equipment used to remove these materials include bar racks, bar screens, and gravity or aerated grit chambers.

**B-3 Primary Treatment.** Primary treatment is first-stage sedimentation, in which settleable, suspended, and floating material is removed from the wastewater following preliminary treatment. Well-operated primary treatment facilities can remove as much as 60 percent of the influent suspended solids and 30 percent of the influent biochemical oxygen demand. However, primary treatment does not remove colloidal or dissolved solids.

**B-4 Secondary Treatment.** Secondary treatment is intended to reduce the concentrations of the remaining suspended solids and the dissolved and colloidal organic matter in the wastewater. Such material is not removed to any significant degree in primary treatment. A wastewater treatment plant having secondary treatment following primary treatment commonly can achieve removal of a total of 90 percent of the influent suspended solids and biochemical oxygen demand of the raw wastewater. Secondary treatment processes can be either biological or physical-chemical.

**B-4.1 Biological Treatment.** Most municipal secondary treatment processes are biological. These processes can be classified as fixed film or suspended growth. In each process, a mixed population of microorganisms is established in the presence of oxygen. These microorganisms metabolize the dissolved organic matter in the wastewater and form a biological mass. The effluent from fixed film or suspended growth processes contains suspensions of biological solids. These solids are removed from the treated wastewater in a secondary sedimentation tank.

**B-4.2 Physical-Chemical Treatment.** Physical-chemical treatment includes one or more physical-chemical unit processes to treat primary effluent. Such processes might include chemical coagulation, precipitation, and filtration to remove suspended matter and activated carbon adsorption to remove soluble organics.

**B-5 Tertiary Treatment.** Tertiary treatment is used as necessary to reduce the concentration of inorganic and organic constituents below the concentrations achievable through secondary treatment. Tertiary treatment also includes the removal of nitrogen and phosphorus by additional process unit operations. Tertiary treatment processes can be physical, chemical, biological, or a combination.

**B-6 Disinfection.** Disinfection is necessary to destroy pathogenic bacteria, viruses, and amoebic cysts commonly found in wastewater. Disinfection processes can be chemical (ozonation or chlorination) or physical (ultraviolet irradiation). Chemical disinfection using chlorine and, infrequently, ozone are the most widely used means of wastewater disinfection.

### B-7 Sludge Treatment.

**B-7.1 Sludge Stabilization.** Sludge is the settled solids accumulated and subsequently separated from the liquid during various wastewater treatment processes. Sludge handling and disposal is the most difficult, important, and costly part of the wastewater treatment process. Sludge treatment typically comprises stabilization followed by dewatering prior to disposal. Sludge can be stabilized under

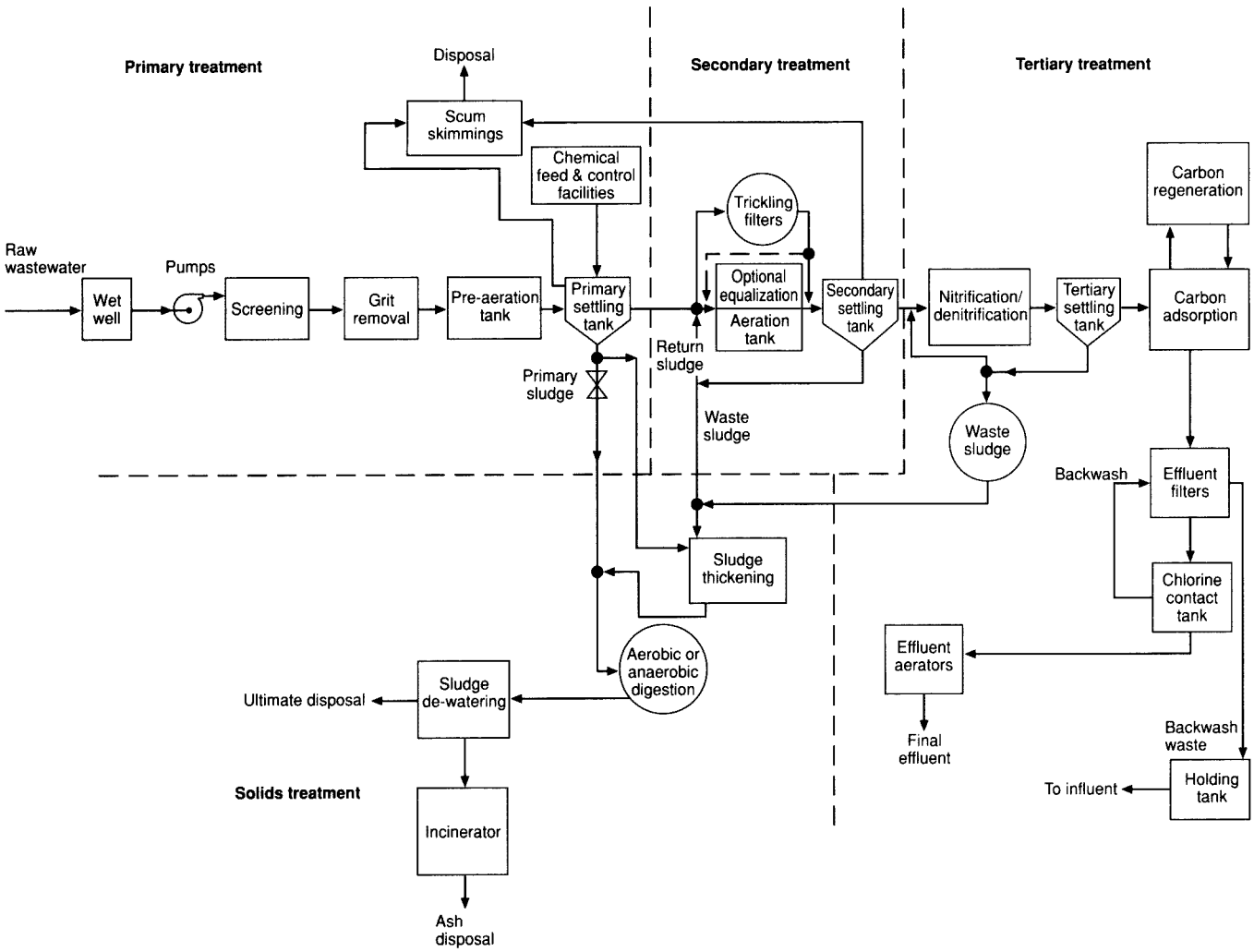


**Figure B-1 Typical schematic flow and process diagram.**

either anaerobic or aerobic conditions. Anaerobic sludge digestion takes place in the absence of free oxygen. The solid end product of anaerobic digestion is relatively nonputrescible and inoffensive. The off-gas produced in anaerobic sludge digestion contains about 65 percent methane and can be collected and burned as a fuel.

**B-7.2 Sludge Dewatering.** Both anaerobic and aerobic digestion results in a reduction in the total volume and weight of the excess organic matter. It is often desirable, before final disposal, to reduce further the volume and weight of sludge and to change it from a liquid that is more than 95 percent water to a semisolid form. Dewatering can be accomplished by using drying beds, vacuum filters, centrifuges, filter presses, or mechanical gravity units. The dewatering operation often is enhanced by chemically conditioning the sludge before dewatering. The conditioning can include a thickening step that could be gravity or air flotation. Thermal conditioning can also be used to prepare sludge for dewatering.

**B-7.3 Sludge Cake Disposal.** After sludge has been dewatered, it is identified as sludge cake. This material is disposed of by several different methods. It can be incinerated to reduce the volume to ash (approximately 10 percent of the original cake). The heat of this combustion can be utilized to produce steam for process and building heat. The cake can be composted to produce a soil conditioner. Cake can be spread directly on land for agricultural use, or it can be landfilled as a waste material.

## Appendix C Selection of Collection System Materials

*This Appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.*

**C-1 General.** Wastewater collection systems might or might not be vulnerable to the introduction of flammable liquids into the wastewater. These liquids, if lighter than water, will float and collect on the surface. The presence of these materials can present a threat to the integrity of the collection system should ignition occur.

**C-2 Materials of Construction.**

**C-2.1** Some materials commonly used in sewer construction are vulnerable to attack from environmental conditions commonly found in collection systems, but might

provide resistance to damage from fire. Other materials might be vulnerable to structural damage from fire but provide protection against long-term structural failure from corrosion.

**C-2.2** For additional information on corrosion control, refer to National Association of Corrosion Engineers Recommended Practices RP01 series and the appropriate Water Environment Federation publications.

**C-3 Materials Risk Assessment.**

**C-3.1** The materials risk assessment should include an evaluation of all factors that could potentially affect the safety and long-term functioning of the collection system. Factors to be considered should include both of the following:

(a) The potential that flammable liquids can enter the system from identifiable sources. As an example, a system serving a combined system or a system serving commercial and industrial dischargers might be more vulnerable to exposure to floating flammable materials than separate systems serving residential communities.

(b) The potential for development of conditions that might promote corrosive attack to materials vulnerable to these agents. Experience with existing conditions within the community and with existing systems with similar characteristics should be taken into full account.

**C-3.2** The materials risk assessment should consider the long-term threat that these agents present to the community and to the system's ability to serve the community before a final selection is made. It is recommended that the materials risk assessment be presented to local authorities for review and comment before final selection of materials of construction is completed.

**C-4 Examples.**

**C-4.1** Storm sewers serving locations such as residential areas and areas where significant quantities of flammable or combustible materials are not expected to enter the sewer system, sewers, and appurtenant structures could be constructed of any appropriate material.

**C-4.2** Storm sewers serving locations such as commercial and industrial areas or areas where there is a possibility that significant quantities of flammable or combustible materials could enter the sewer system through illicit discharges, curb inlets, leaking underground storage tanks, or broken pipes, sewers, and associated structures might be exposed to considerable risk of fire. Materials meeting the definitions of noncombustible, limited-combustible, or low flame spread might be appropriate.

**C-4.3** Where conditions or applications warrant selection of other materials for storm sewer piping and appurtenant structures, consideration to flame spread, smoke generation, and the impact that fire or explosion will have on the structural integrity and operability of the sewer system and the economic and environmental consequences of having the sewer system out of service should be included in the materials risk assessment.

**C-4.4** Separate sanitary sewers serving locations such as residential areas and areas where significant quantities of flammable or combustible materials are not expected to enter the sewer system, sewers, and appurtenant structures can be constructed of any appropriate material.

**C-4.5** Separate sanitary sewers serving locations such as commercial and industrial areas or areas where there is some possibility that significant quantities of flammable or combustible materials could enter the sewer system from illicit discharges, leaking underground storage tanks, or broken pipes, sewers, and appurtenant structures might be exposed to some risk of fire. Materials meeting the definitions of noncombustible, limited combustible, or low flame spread might be appropriate.

**C-4.6** Where applications warrant selection of other materials for separate sanitary sewer piping and appurtenant structures, consideration to flame spread, smoke generation, and the impact that a fire or explosion will have on the structural integrity and operability of the sewer system and the economic and environmental consequences of having the sewer system out of service should be included in the materials risk assessment.

**C-4.7** Where combined sewers are designed to collect both wastewater and storm water or where there is a possibility that significant quantities of flammable or combustible materials could enter the sewer system by means of curb inlets, illicit discharges, leaking underground storage tanks, or broken pipes, all sewers and other appurtenant structures can be exposed to considerable risk of fire. Materials meeting the definitions of noncombustible, limited combustible, or low flame spread might be appropriate.

**C-4.8** Where conditions or applications warrant selection of other materials for combined sewer piping and appurtenant structures, consideration to flame spread, smoke generation, and the impact that a fire or explosion will have on the structural integrity and operability of the sewer system and the economic and environmental consequences of having the sewer system out of service should be included in the materials risk assessment.

## Appendix D Chemical and Fuel Fire/Explosion Hazards

*This Appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.*

**D-1 General Information.**

**D-1.1** This appendix provides guidelines for protection against fire and explosion in the chemical and fuel storage and handling facilities. This appendix does not include gas utilization equipment, vehicle maintenance areas, or laboratories. Table D-1 summarizes the various hazards associated with chemical and fuel storage and handling facilities.

**D-1.2** This appendix also contains additional information on specific areas or unit operations associated with storage and handling of chemicals and fuels commonly used in municipal wastewater treatment plants.

**D-2 Sources of Hazards.** (*See Table D-2.*)

**D-2.1 Fuel Gases.** Fuel gases include natural gas, manufactured gas, sewer gas, liquefied petroleum gas—air mixtures, liquefied petroleum gas in the vapor phase, mixtures of these gases, and floating flammable liquids. Some of these gases have specific gravities lower than that of air so that, when released, they will rapidly rise and diffuse above

**Table D-1 Chemical and Fuel Fire/Explosion Hazards**

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| | **Materials and Function** | **Fire and Explosion Hazard** | **Ventilation** | **Extent of Classified Area** | **NEC-Area Electrical Classification (All Class I, Group D)** | **Material of Construction for Buildings or Structures** | **Fire Protection Measures** |
| 1 | ALCOHOL Used in some teritary treatment. | Flammable vapors | See NFPA 30. | | | | |
| 2 | CHLORINE (Gas) Chlorination of water. | Aids combustion; oxidizer, toxic | NR | NR | Refer to Chlorine Institute. | NR (This equipment handles a corrosive chemical that necessitates the use of specific materials of construction. Special consideration should be given to these materials of construction.) | NR |
| 3 | OXYGEN (Used in aeration basins; see Chapter 3) | Aids combustion; oxidizer | See NFPA 50 and NFPA 53. | | | NR | NR |
| 4 | DIESEL FUEL, GASOLINE, AND MOTOR OILS Fuels for equipment. | Various | See NFPA 30 and NFPA 513. | | | NR | Indoor FSS and FE; Outdoor FE |
| 5 | LP-GAS | Flammable gas | NR (stored outdoors) | | See NFPA 58. | NR | FE |
| 6 | OXYGEN GENERATION AND STORAGE | Aids combustion; oxidizer, oxygen-enriched areas | See NFPA 50 and NFPA 53. | | | NR | FSS (if indoors), H, and FE |
| 7 | OZONE GENERATION | Aids combustion; oxidizer, toxic | See NFPA 50 and NFPA 53. | | | NR | FSS (if indoors), H, and FE |
| 8 | ACTIVATED CARBON (Powdered or pulverized) | Combustible | NR | NR | NR | NR | NR |

FE — Portable fire extinguisher FSS — Fire suppression system (automatic sprinkler, water spray, foam, gaseous, or dry chemical)
H — Hydrant protection (*see 5-2.4*) NEC — (*See NFPA 70, National Electrical Code*)
NR — No requirement

the point of leakage. Flammable mixtures are produced when these gases are mixed with air within certain limits. They can be considered as suffocating gases.

**D-2.2 Sludge Gases.** These flammable gases result from the fermentation or anaerobic decomposition of organic matter. Explosive conditions (especially concerning compression and storage) can result when these gases are mixed with air.

**D-2.3 Sewer Gases.** These flammable gases result from the fermentation or decomposition of organic matter. Explosive conditions (especially concerning the screening, degritting, and primary clarification processes) might result when these gases are mixed with air.

**D-2.4 Unit Processes.** Special consideration should be given to the following unit processes associated with solids treatment:

(a) Scum pits collect scum, grease, and other floating flammable liquids from the surface of sedimentation tanks. Special consideration should be given to equipment located in these areas because of potential explosion and fire hazards.

(b) Sumps and tanks that collect drainage from anaerobic sludge treatment processes or that store, mix, and blend sludge might also collect significant volumes of sludge gas. Special consideration should be given to equipment located in these areas because of the potential for explosion.

(c) Anaerobic digesters are unit processes specifically designed to produce sludge gas from the fermentation or anaerobic decomposition of organic matter. The sludge gas normally contains significant volumes of methane as a by-product of the anaerobic digestion process. Special consideration should be given to equipment located in and around anaerobic digesters because of the potential for explosion.

(d) Solvent extraction and dehydration processes can produce a very dry organic dust as a by-product. Special consideration should be given to equipment located in dust-handling areas because of the potential for explosion.

(e) Incinerators used to burn scum or sludge cake are ignition sources when in operation. Special consideration should be given in construction of incineration buildings and in storage of combustible materials in incineration areas.

(f) Sludge dewatering and sludge cake conveyance equipment generate sludge cake and convey it to its final destination (incineration, landfill, etc.). Dried cake can be a combustible material. Special consideration should be given in construction, operation, maintenance, and housekeeping of the equipment and surrounding areas.

(g) Pumping stations that handle raw wastewater should be classified in the same manner as wastewater pumping stations (*see Chapter 2*). In-plant pumping stations should be classified depending upon their location in the process train and the type of material handled. Restrictive classifications are generally not necessary for pumping stations that handle fully treated wastewater.

(h) Grit chambers or screening equipment that is housed in a building or in below-grade pits might be subject to the same fire and explosion hazards as pumping station wet wells.

(i) Imhoff tanks and other similar processes can combine the wastewater liquids and solids treatment streams in a single vessel. Special consideration should be given to equipment located in or around Imhoff tanks or similar processes because of the generation of methane gas from anaerobic solids digestion processes within the vessel and the possibility of volatile substances being released from the wastewater.

(j) The primary sedimentation tank might collect and concentrate floating flammable liquids.

(k) Secondary and tertiary sedimentation tanks and aeration tanks not preceded by primary sedimentation can be subject to the same fire and explosion hazards as primary sedimentation tanks because of the potential of floating flammable liquids collecting on the surface. Where bypassing of primary sedimentation is possible, although not normally utilized, secondary and tertiary sedimentation tanks and aeration tanks might not be subject to the same fire and explosion potential as primary sedimentation.

(l) Unit processes employing oxygen-enriched atmospheres necessitate special consideration. Covered facilities might be unclassified above the covering deck; however, any equipment or instrumentation housed under the cover within the reactor space should be suitable for exposure to volatile hydrocarbons in an oxygen-enriched atmosphere. Oxygen is not itself flammable; however, increased concentrations of oxygen greatly increase the fire hazard. Oxygen aeration tanks and other similar processes should be equipped with continuously operating hydrocarbon LEL monitoring devices that will automatically cut off oxygen supply and purge reactor gases with atmospheric air when 10 percent LEL conditions are registered.

(m) Galleries and other connecting structures that contain pipes transporting flammable gases or liquids necessitate special consideration in design and fire protection.

(n) Plastic media or wood for trickling filters, rotating biological contactors, bio-towers, and other fixed film systems are not a significant hazard in normal operations; however, these materials are normally classified as combustible and can contribute a considerable fuel load if ignited under certain conditions, such as during maintenance and construction. Some fixed film treatment systems are anaerobic and produce a combustible gas by-product, which aggravates the hazard for such enclosures containing these materials.

**D-2.5 Chemicals.** Wastewater treatment plants use a variety of gaseous, solid, and liquid chemicals that by themselves or when mixed with oxygen or other chemicals can be a potential source of fire or explosion, or both. Additional information can be found in NFPA 49, *Hazardous Chemicals Data*; NFPA 497A, *Recommended Practice for Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*; and NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*. Chemicals should be handled, processed, and stored in a manner that eliminates or significantly reduces the hazard to the wastewater treatment facility and personnel and is acceptable to the authority having jurisdiction. Chemicals should be properly labeled to identify the materials and hazards, and material safety data sheets should be made available to all personnel.

**D-2.6 Hazardous Gases.** Sewer and sludge gas are flammable gases generated by the fermentation or decomposition of organic matter. Explosive conditions (especially concerning screening, degritting, primary clarification, and the anaerobic digestion process) can result when these gases are mixed with air. Specialty gases utilized for (a) laboratory analysis and instrumentation calibration (hydrogen, methane, etc.), (b) wastewater treatment plant unit processes (chlorine, ozone, etc.), and (c) welding operations (acetylene, oxygen, etc.) can form flammable/explosive conditions when either acting alone or mixed with other gaseous organic substances. Fuel gases including natural gas, manufactured gas, and liquefied petroleum gas used as fuels for wastewater treatment plant equipment can cause flammable/explosive conditions when improperly used, handled, or stored. Appropriate measures should be taken to prevent the accumulation of hazardous gases, including ventilation, proper storage, and safe handling/distribution systems. For additional guidance, see NFPA 55, *Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders*, and NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*. In processes where explosive mixtures cannot be prevented, explosion venting or protection systems should be provided. See NFPA 68, *Guide for Venting of Deflagrations*, and NFPA 69, *Standard on Explosion Prevention Systems*, for additional guidance.

**D-2.7 Liquids.** Disposal of waste chemical products through sewers and into wastewater treatment plants and disposal of waste chemical products and scum skimmed from sedimentation tanks can be potential sources or contributing causes of fire and explosive conditions. Hydrocarbon liquids such as gasoline, kerosene, oils, and various chemicals either sent to sewers and drains or used for various applications at wastewater treatment plants can also provide flammable vapor concentrations at certain locations. For additional information, see NFPA 321, *Standard on Basic Classification of Flammable and Combustible Liquids*, and NFPA 329, *Recommended Practice for Handling Underground Releases of Flammable and Combustible Liquids*. Areas of wastewater treatment plants as identified and classified in Tables 2 through 4 (especially areas of primary treatment) should be protected as flammable liquid hazards.

**D-2.8 Finely Divided Solids and Dusts.** Finely divided solids used in various wastewater treatment processes (especially sludge dehydration processing) or dust by-products produced by such processes can be combustible or cause potential flammable and explosive conditions. Process areas should be cleaned on a regular schedule to prevent the accumulation of hazardous concentrations of dust. Equipment

handling finely divided solids should be designed and installed in a manner that protects against the hazards of fire and explosion. Additional information can be found in NFPA 61, *Standard for the Prevention of Fire and Dust Explosions in Agricultural and Food Products Facilities;* NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials;* and NFPA 8503, *Standard for Pulverized Fuel Systems.*

**D-2.9 Materials.** Materials used in wastewater treatment plants due to humid or corrosive atmospheres, including wood, plastic, fiberglass-reinforced plastics (FRPs), paints and coatings, insulating material, and furnishings, can be combustible, limited combustible, or low flame spread under certain conditions. Some of these materials can present a considerable fuel load if ignited. Buildings and structures should be provided with fire protection in accordance with Chapter 6 of this document. Areas where materials are stored should be provided with appropriate fire protection approved by the authority having jurisdiction. For additional guidance, see NFPA 13, *Standard for the Installation of Sprinkler Systems;* NFPA 231, *Standard for General Storage;* and NFPA 231C, *Standard for Rack Storage of Materials.*

**D-3 Conditions for and Sources of Ignition.** The potential ignition of flammable gases, liquids, and solids (including dusts) that can be found at a wastewater treatment plant is limited by certain fundamental conditions. Gases and generated vapors need to be mixed with air or an oxidizer to form a flammable mixture that needs heat of sufficient intensity for ignition. The ignition temperature of a combustible solid is influenced by the rates of airflow and heating as well as the geometry of the rates of airflow and heating and the geometry of the solid. Ignition can result from one or more of the following causes: (a) open flames or hot surfaces, (b) electrical arc, (c) sparks, or (d) chemical reaction.

**D-3.1 Open Flames and Hot Surfaces.** Open flames and hot surfaces might be encountered during normal operation, repair and maintenance operations, or with malfunctioning equipment and appliances within a wastewater treatment plant. Sources of ignition might include welding tasks, boilers, incinerators, kerosene-type lanterns, internal combustion engines, and smoking by personnel. Equipment producing open flames or hot surfaces capable of producing ignition should be properly installed, maintained, and isolated from potential hazards. For additional guidance, see NFPA 31, *Standard for the Installation of Oil-Burning Equipment;* NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines;* NFPA 82, *Standard on Incinerators and Waste and Linen Handling Systems and Equipment;* NFPA 8501, *Standard for Single Burner Boiler Operation;* and NFPA 8502, *Standard for the Prevention of Furnace Explosions/Implosions in Multiple Burner Boiler-Furnaces.* Smoking should be prohibited in all hazardous areas.

**D-3.2 Electrical Arc.** Sustained arcing faults can cause extensive damage to electrical switchgear and motor control centers. This might provide sufficient heat to ignite flammable gases or vapors present or generated as a result of the arc (pyrolysis of insulating material). Electrical equipment should be properly maintained in good operating condition. Faulty equipment should be removed from service. See NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*, for additional guidance.

**Table D-2 Gases Commonly Found in Wastewater Treatment**

| Name (chemical formula) | Explosive Limits (% vol.) LEL | UEL | Density[1] Heavier/Lighter than Air | Sources |
|---|---|---|---|---|
| Ammonia[5] ($NH_3$) | 16 | 25 | L | — Storage tank leaks |
| Chlorine[2] ($Cl_2$) | nonflammable | | H | — Disinfection processes<br>— Storage tanks |
| Gasoline[5] ($C_3H_{12}$ - $C_9H_{20}$) | 1.3 | 7.1 | H | — Storage tanks<br>— Tank truck spills |
| Hydrogen Chloride (HCl) | nonflammable | | H | — Storage tank leaks<br>— Ceramic diffuser cleaning |
| Hydrogen Sulfide[5, 6] ($H_2S$) | 4.0 | 44 | H | — Sewer gas<br>— Sludge gas |
| Natural Gas[5] | 3.8–6.5 | 13–17 | L | — Gas piping leaks |
| Nitrogen ($N_2$) | nonflammable | | L | — Storage tanks<br>— Oxygen generation processes<br>— Denitrification processes |
| Oxygen[2] ($O_2$) | nonflammable | | H | — Generation of oxygen on-site<br>— Activated sludge processes<br>— Storage tanks<br>— Sludge processes |
| Ozone[2] ($O_3$) | nonflammable | | H | — Disinfection processes<br>— On-site generation processes |
| Sewer Gas[3] | 5.3 | 19.3 | H | — Sewer systems |
| Sludge Gas[4] | 5 | 15 | L | — Sludge digestion processes |
| Sulfur Dioxide ($SO_2$) | nonflammable | | H | — Dechlorination processes<br>— Storage tanks |

NOTE 1: The table lists the physical properties at standard temperature and pressure. Due to actual field conditions, these gases might disperse and might be present throughout the structure.
NOTE 2: These gases accelerate combustion.
NOTE 3: Contains approximately 70 percent carbon dioxide, 5 percent methane, and 25 percent other gases (source: U.S. E.P.A).
NOTE 4: Contains approximately 65 percent methane, 30 percent carbon dioxide, and 5 percent other gases (source: U.S. E.P.A).
NOTE 5: Source: NFPA 325, *Guide to Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids.*
NOTE 6: Rarely reaches explosive concentration in wastewater treatment plants.