greater than 1.65 when used alone;

(b). an effective size of 0.8 mm - 1.2 mm with a uniformity coefficient not greater than 1.7 when used as a cap; and

(c). an effective size for anthracite used as a single media on potable groundwater for iron and manganese removal only shall be a maximum of 0.8 mm (effective sizes greater than 0.8 mm may be approved based upon onsite pilot plant studies or other demonstration acceptable to the state health officer).

ii. Sand shall have:

(a). an effective size of 0.45 mm to 0.55 mm; and

(b). a uniformity coefficient of not greater than 1.65.

iii. High density sand shall have:

(a). an effective size of 0.2 to 0.3 mm;

(b). a uniformity coefficient of not greater than 1.65.

iv. Granular activated carbon (GAC) shall be in accordance with AWWA B604 and the design of shall meet the following:

(a). The media must meet the basic specifications for filter media as given in §177.A.6.a through §177.A.6.c of this Part.

(b). There shall be provisions for a free chlorine residual and adequate contact time in the water following the filters and prior to distribution (See §177.C and §177.D).

(c). There shall be means for periodic treatment of filter material for control of bacterial and other growth.

(d). Provisions shall be made for frequent replacement or regeneration. Regeneration of GAC shall be in accordance with AWWA B604.

v. Other media. Other media will be considered based on experimental data and operating experience.

d. Characteristics of support media shall include the following.

i. Torpedo sand. A three-inch layer of torpedo sand shall be used as a supporting media for filter sand where supporting gravel is used, and shall have:

(a). effective size of 0.8 mm to 2.0 mm; and

(b). uniformity coefficient not greater than 1.7.

ii. Gravel, when used as the supporting media shall consist of cleaned and washed, hard, durable, rounded silica particles and shall not include flat or elongated particles. The coarsest gravel shall be 2.5 inches in size when the gravel rests directly on a lateral system, and shall extend above the top of the perforated laterals. Not less than four layers of gravel shall be provided in accordance with the following size and depth distribution:

Table 175.A.6.e	
Size	**Depth**

3/32 to 3/16 inches	2 to 3 inches
3/16 to 1/2 inches	2 to 3 inches
1/2 to 3/4 inches	3 to 5 inches
3/4 to 1 ½ inches	3 to 5 inches
1 ½ to 2 ½ inches	5 to 8 inches

Reduction of gravel depths and other size gradations may be considered upon justification to the state health officer.

7. Filter bottoms and strainer systems. Departures from these standards may be acceptable for high rate filters and for proprietary bottoms. Porous plate bottoms shall not be used where iron or manganese may clog them or with waters softened by lime. The design of manifold-type collection systems shall:

a. ensure even distribution of washwater and even rate of filtration over the entire area of the filter;

b. provide the ratio of the area of the final openings of the strainer systems to the area of the filter at 0.003;

c. provide the total cross-sectional area of the laterals at twice the total area of the final openings;

d. provide the cross-sectional area of the manifold at 1.5 to 2 times the total area of the laterals;

e. lateral perforations without strainers shall be directed downward.

8. Filter media wash facilities are required except for filters used exclusively for iron, radionuclides, arsenic or manganese removal. Wash water systems shall be designed with:

a. water pressure per manufacturer's requirements;

b. a properly installed vacuum breaker or other approved device to prevent back siphonage if connected to the filtered or finished water system;

c. rate of flow of 2.0 gallons per minute per square foot of filter area (4.9 m/hr) with fixed nozzles or 0.5 gallons per minute per square foot (1.2 m/hr) with revolving arms if provided.

d. Air scouring. When provided, general design criteria for air scouring is as follows.

i. Air flow for air scouring the filter shall be 3-5 standard cubic feet per minute square foot of filter area (0.9 - 1.5 m3/min/m2) when the air is introduced in the underdrain; a lower air rate shall be used when the air scour distribution system is placed above the underdrains.

ii. When employing concurrent air scour and water back wash a method for avoiding excessive loss of the filter media during backwashing shall be provided.

iii. Air scouring shall be followed by a fluidization wash sufficient to re-stratify the media.

iv. Air shall be free from contamination.

v. Air scour distribution systems should be placed below the media and supporting bed interface; if placed at the interface the air scour nozzles shall be designed to prevent media from clogging the nozzles or entering the air distribution system.

vi. Piping for the air distribution system shall not be flexible hose which will collapse when not under air pressure and shall not be a relatively soft material which may erode at the orifice opening with the passage of air at high velocity.

vii. Air delivery piping shall not pass down through the filter media nor shall there be any arrangement in the filter design which would allow short circuiting between the applied unfiltered water and the filtered water.

viii. The backwash water delivery system must be capable of 15 gallons per minute per square foot of filter surface area (37 m/hr); however, when air scour is provided the backwash water rate must be variable and should not exceed 8 gallons per minute per square foot (20 m/hr) unless operating experience shows that a higher rate is necessary to remove scoured particles from filter media surfaces.

ix. The filter underdrains shall be designed to accommodate air scour piping when the piping is installed in the underdrain.

9. Appurtenances. The following shall be provided for every filter:

a. a means of sampling influent and effluent water sampling taps;

b. a meter indicating the instantaneous effluent rate of flow;

c. where used for surface water, provisions for filtering to waste with appropriate measures for cross connection control;

d. a flow rate controller capable of providing gradual rate increases when placing the filters back into operation; and

e. for surface water or systems using ground water under the direct influence of surface water with three or more filters, on-line turbidimeters shall be installed on the effluent line from each filter. All turbidimeters shall consistently determine and indicate the turbidity of the water in NTUs. Each turbidimeter shall report to a recorder that is designed and operated to allow the operator to accurately determine the turbidity at least once every 15 minutes. Turbidimeters on individual filters should be designed to accurately measure low-range turbidities and have an alarm that will sound when the effluent level exceeds regulatory turbidity limits. It is recommended that turbidimeters be placed in a location that also allows measurement of turbidity during filter to waste.

10. Backwash. Provisions shall be made for washing filters as follows.

a. a minimum rate necessary to provide for a 50 percent expansion of the filter bed shall be provided with a minimum of 15 gpm/sqft. A reduced rate of 10 gallons per minute per square foot (24 m/hr) may be acceptable for full depth anthracite or granular activated carbon filters;

b. filtered water shall be used for backwashing filters;

c. washwater pumps shall be in duplicate unless an alternate means of obtaining washwater is available;

d. a washwater regulator or valve on the main washwater line to obtain the desired rate of filter wash with the washwater valves on the individual filters open wide;

e. a flow meter, preferably with a totalizer, on the main washwater line located so that it can be easily read by the operator during the washing process;

f. design to prevent rapid changes in backwash water flow;

g. automated systems shall be adjustable; and

h. appropriate measures for cross-connection control.

B. Rapid rate pressure filters. The normal use of these filters is for iron and manganese removal. For raw water with iron concentration of 2 mg/L or greater consideration should be given to pretreatment prior to filtration. Pressure filters shall not be used in the filtration of surface or other polluted waters or following lime-soda softening.

1. Minimum criteria relative to rate of filtration, structural details and hydraulics, filter media, etc., provided for rapid rate gravity filters also apply to pressure filters where appropriate. At least two filter units shall be provided. The filters shall be capable of meeting the average daily flow of the maximum month with one filter unit removed from service.

2. Rate of filtration. The rate shall not exceed six gallons per minute per square foot of filter area except where manufacturer's performance studies of the unit have demonstrated to the satisfaction of the state health officer that higher filtration rates are achievable. Consideration shall be given to backwash frequency and deteriorating water quality when selecting the filtration rate.

3. The filters shall be designed to provide for:

a. loss of head gauges on the inlet and outlet pipes of each filter;

b. an easily readable meter or flow indicator on each battery of filters;

c. filtration and backwashing of each filter individually;

d. minimum side wall shell height of five feet for vertical filters. A corresponding reduction in side wall height is acceptable where proprietary bottoms permit reduction of the gravel depth;

e. the top of the washwater collectors to be at least 18 inches above the surface of the media;

f. the underdrain system to efficiently collect the filtered water and to uniformly distribute the backwash water at a rate not less than 15 gallons per minute per square foot of filter area;

g. backwash flow indicators and controls that are easily readable while operating the control valves;

h. an air release valve on the highest point of each filter;

i. an accessible manhole of adequate size to facilitate inspection and repairs for filters 36 inches or more in diameter. Manholes should be at least 24 inches in diameter where feasible;

j. means to observe the wastewater during backwashing; and

k. construction to prevent cross-connection.

C. Diatomaceous earth filtration. The use of these filters may be considered for application to surface waters with low turbidity and low bacterial contamination.

1. Conditions of use. Diatomaceous earth filters are expressly excluded from consideration for the following conditions:

a. bacteria removal;

b. color removal;

c. turbidity removal where either the gross quantity of turbidity is high or the turbidity exhibits poor filterability characteristics; and

d. filtration of waters with high algae counts.

2. Pilot plant study. Installation of a diatomaceous earth filtration system shall be preceded by a pilot plant study on the water to be treated.

a. Conditions of the study such as duration, filter rates, head loss accumulation, slurry feed rates, turbidity removal, bacteria removal, etc., must be approved by the state health officer prior to the study.

b. Satisfactory pilot plant results must be obtained prior to preparation of final construction plans and specifications.

c. The pilot plant study must demonstrate the ability of the system to meet applicable drinking water standards at all times.

3. Types of filters. Pressure or vacuum diatomaceous earth filtration units will be considered for approval. However, the vacuum type is preferred for its ability to accommodate a design which permits observation of the filter surfaces to determine proper cleaning, damage to a filter element, and adequate coating over the entire filter area.

4. Treated water storage capacity in excess of normal requirements shall be provided to:

a. allow operation of the filters at a uniform rate during all conditions of system demand at or below the approved filtration rate, and

b. guarantee continuity of service during adverse raw water conditions without by-passing the system.

5. Number of units. At least two units shall be provided. Where only two units are provided, each shall be capable of meeting the plant design capacity (normally the projected maximum daily demand) at the approved filtration rate. Where more than two filter units are provided, the filters shall be capable of meeting the plant design capacity at the approved filtration rate with one filter removed from service.

6. Pre-coating criteria includes the following.

a. Application. A uniform precoat shall be applied hydraulically to each septum by introducing a slurry to the tank influent line and employing a filter-to-waste or recirculation system.

b. Quantity. Diatomaceous earth in the amount of 0.2 pounds per square foot of filter area (0.98 kg/m2) or an amount sufficient to apply a 1/8 inch coating should be used with recirculation.

7. A body feed system to apply additional amounts of diatomaceous earth slurry during the filter run is required to avoid short filter runs or excessive head losses.

a. Rate of body feed is dependent on raw water quality and characteristics and shall be determined in the pilot plant study.

b. Operation and maintenance can be simplified by providing accessibility to the feed system and slurry lines.

c. Continuous mixing of the body feed slurry is required.

8. Filtration criteria includes the following.

a. Rate of filtration. The recommended nominal rate is 1.0 gallon per minute per square foot of filter area (2.4 m/hr) with a recommended maximum of 1.5 gallons per minute per square foot (3.7 m/hr). The filtration rate shall be controlled by a positive means.

b. Head loss. The head loss shall not exceed 30 psi (210 kPa) for pressure diatomaceous earth filters, or a vacuum of 15 inches of mercury (-51 kPa) for a vacuum system.

c. Recirculation. A recirculation or holding pump shall be employed to maintain differential pressure across the filter when the unit is not in operation in order to prevent the filter cake from dropping off the filter elements. A minimum recirculation rate of 0.1 gallon per minute per square foot of filter area (0.24 m/hr) shall be provided.

d. Septum or filter element. The filter elements shall be structurally capable of withstanding maximum pressure and velocity variations during filtration and backwash cycles, and shall be spaced such that no less than one inch is provided between elements or between any element and a wall.

e. Inlet design. The filter influent shall be designed to prevent scour of the diatomaceous earth from the filter element.

9. Backwash. A satisfactory method to thoroughly remove and dispose of spent filter cake shall be provided (see Subchapter F. §§257-275 of this Part).

10. The following appurtenances shall be provided for every filter:

a. a means of sampling for raw and filtered water;

b. loss of head or differential pressure gauge;

c. rate-of-flow indicator, preferably with totalizer;

d. a throttling valve used to reduce rates below normal during adverse raw water conditions;

e. evaluation of the need for body feed, recirculation, and any other pumps, in accordance with §217 of this Part; and

f. provisions for filtering to waste with appropriate measures for backflow prevention.

D. Slow Sand Filters. The use of these filters shall require prior engineering studies to demonstrate the adequacy and suitability of this method of filtration for the specific raw water supply.

1. Quality of raw water. Slow rate gravity filtration shall be limited to waters having maximum turbidities of 10 units and maximum color of 15 units; such turbidity shall not be attributable to colloidal clay. Microscopic examination of the raw water shall be made to determine the nature and extent of algae growths and their potential adverse impact on filter operations.

2. Number. At least two units shall be provided. Where only two units are provided, each shall be capable of meeting the plant design capacity (normally the projected maximum daily demand) at the approved filtration rate. Where more than two filter units are provided, the filters shall be capable of meeting the plant design capacity at the approved filtration rate with one filter removed from service.

3. Structural details and hydraulics. Slow rate gravity filters shall be so designed as to provide:

a. headroom to permit normal movement by operating personnel for scraping and sand removal operations;

b. adequate access hatches and access ports for handling of sand and for ventilation; and

c. an overflow at the maximum filter water level.

4. Rates of filtration. The permissible rates of filtration shall be determined by the quality of the raw water and shall be on the basis of experimental data derived from the water to be treated. The nominal rate may be 45 to 150 gallons per day per square foot of sand area (1.8 - 6.1 m/day), with somewhat higher rates acceptable when demonstrated to the satisfaction of the approving authority.

5. Underdrains. Each filter unit shall be equipped with a main drain and an adequate number of lateral underdrains to collect the filtered water. The underdrains shall be placed as close to the floor as possible and spaced so that the maximum velocity of the water flow in the underdrain will not exceed 0.75 feet per second. The maximum spacing of laterals shall not exceed 3 feet if pipe laterals are used.

6. Filter material criteria shall be as follows.

a. Filter sand shall be placed on graded gravel layers for a minimum depth of 30 inches.

b. The effective size shall be between 0.15 mm and 0.30 mm. Larger sizes may be considered by the state health officer.

c. The uniformity coefficient shall not exceed 2.5.

d. The sand shall be cleaned and washed free from foreign matter.

e. The sand shall be rebedded when scraping has reduced the bed depth to no less than 19 inches. Where sand is to be reused in order to provide biological seeding and shortening of the ripening process, rebedding shall utilize a "throw over" technique whereby new sand is placed on the support gravel and existing sand is replaced on top of the new sand.

7. Filter gravel. The supporting gravel should be similar to the size and depth distribution provided for rapid rate gravity filters (see §177.A.6.d.ii of this Part).

8. Depth of water on filter beds. Design shall provide a depth of at least three to six feet of water over the sand. Influent water shall not scour the sand surface.

9. Control appurtenances. Each filter shall be equipped with:

a. means of sampling influent and effluent water;

b. an indicating loss of head gauge or other means to measure head loss;

c. an indicating rate-of-flow meter. A means of controlling the rate of filtration and limiting the rate of filtration to a maximum rate shall be provided;

d. provisions for filtering to waste with appropriate measures for cross connection control; and

e. an effluent pipe designed to maintain the water level above the top of the filter sand.

10. [Ripening] Slow sand filters shall be operated to waste after scraping or rebedding during a ripening period until the filter effluent turbidity falls to consistently below the regulated drinking water standard established for the system.

E. Direct Filtration. Direct filtration, as used herein, refers to the filtration of a surface water following chemical coagulation and possibly flocculation but without prior settling. The nature of the treatment process will depend upon the raw water quality. A full scale direct filtration plant shall not be constructed without prior pilot studies which are acceptable to the state health officer. In-plant demonstration studies may be appropriate where conventional treatment plants are converted to direct filtration. Where direct filtration is proposed, an engineering report shall be submitted prior to conducting pilot plant or in-plant demonstration studies.

1. Engineering report. In addition to the items considered in §113 of this Part, "Engineering Report", the report shall include a historical summary of meteorological conditions and of raw water quality with special reference to fluctuations in quality, and possible sources of contamination. The following raw water parameters shall be evaluated in the report:

a. color;

b. turbidity;

c. bacterial concentration;

d. microscopic biological organisms;

e. temperature;

f. total solids;

g. general inorganic chemical characteristics; and

h. additional parameters as required by the state health officer.

The report shall also include a description of methods and work to be done during a pilot plant study or, where appropriate, an in-plant demonstration study.

2. Pilot plant studies. After approval of the engineering report and pilot plant protocol, a pilot study or in-plant demonstration study shall be conducted. The study must be conducted

over a sufficient time to treat all expected raw water conditions throughout the year. The pilot plant filter must be of a similar type and operated in the same manner as proposed for full scale operation. The pilot study must determine the contact time necessary for optimum filtration for each coagulant proposed. The study shall emphasize but not be limited to, the following items:

a. chemical mixing conditions including shear gradients and detention periods;

b. chemical feed rates;

c. use of various coagulants and coagulant aids;

d. flocculation conditions;

e. filtration rates;

f. filter gradation, types of media and depth of media;

g. filter breakthrough conditions;

h. adverse impact of recycling backwash water due to solids, algae, trihalomethane formation and similar problems;

i. length of filter runs;

j. length of backwash cycles;

k. quantities and make-up of the wastewater.

Prior to the initiation of design plans and specifications, a final report including the engineer's design recommendations shall be submitted to the state health officer.

3. Pretreatment. The final coagulation and flocculation basin design should be based on the pilot plant or in-plant demonstration studies augmented with applicable portions of §175.D, "Coagulation" and §175.E, "Flocculation" of this Part.

4. Filtration. Filters shall be rapid rate gravity filters with dual or mixed media. The final filter design shall be based on the pilot plant or in-plant demonstration studies and all portions of§177.A "Rapid rate gravity filters" of this Part. Pressure filters or single media sand filters shall not be used.

5. Appurtenances. The following shall be provided for every filter:

a. influent and effluent sampling taps;

b. an indicating loss of head gauge;

c. a meter indicating instantaneous rate of flow;

d. where used for surface water, provisions for filtering to waste with appropriate measures for cross connection control;

e. measures for providing gradual rate increases when placing the filters back into operation; and

f. for systems with three or more filters, on-line turbidimeters shall be installed on the effluent line from each filter. All turbidimeters shall consistently determine and indicate the turbidity of the water in NTUs. Each turbidimeter shall report to a recorder that is designed and operated to allow the operator to accurately determine the turbidity at least once every 15 minutes. Turbidimeters on individual filters should be designed to accurately measure low-range turbidities and have an alarm that will sound when the effluent level exceeds 0.3 NTU.

F. Deep bed rapid rate gravity filters. Deep bed rapid rate gravity filters, as used herein, generally refers to rapid rate gravity filters with filter material depths equal to or greater than 48 inches. Filter media sizes are typically larger than those listed in §177.A.6.d of this Part.

1. Deep bed rapid rate filters may be considered based on pilot studies pre-approved by the state health officer.

2. The final filter design shall be based on the pilot plant studies and shall comply with all applicable portions of §177.A. of this Part. Careful attention shall be paid to the design of the backwash system which usually includes simultaneous air scour and water backwash at subfluidization velocities.

G. Biologically active filters. Biologically active filtration, as used herein, refers to the filtration of surface water (or a ground water with iron, manganese, ammonia or significant natural organic material) which includes the establishment and maintenance of biological activity within the filter media.

1. Objectives of biologically active filtration may include control of disinfection byproduct precursors, increased disinfectant stability, reduction of substrates for microbial regrowth, breakdown of small quantities of synthetic organic chemicals, reduction of ammonia-nitrogen, and oxidation of iron and manganese. Biological activity can have an adverse impact on turbidity, particle and microbial pathogen removal, disinfection practices; head loss development; filter run times and distribution system corrosion. Design and operation should ensure that aerobic conditions are maintained at all times. Biologically active filtration often includes the use of ozone as a pre-oxidant/disinfectant which breaks down natural organic materials into biodegradable organic matter and granular activated carbon filter media which may promote denser biofilms.

2. Biologically active filters may be considered based on pilot studies pre-approved by the state health officer. The study objectives must be clearly defined and must ensure the microbial quality of the filtered water under all anticipated conditions of operation.

a. The pilot study shall be of sufficient duration to ensure establishment of full biological activity. The pilot study shall establish empty bed contact time, biomass loading, and/or other parameters necessary for successful operation as required by the state health officer.

3. The final filter design shall be based on the pilot plant studies and shall comply with all applicable portions of §177.A. of this Part.

AUTHORITY NOTE: Promulgated in accordance with the provisions of R.S. 40:4.A.(8), 40:4.13.D.(1)(2) and 40:5.A.(2)(3)(5)(6)(7)(17).

HISTORICAL NOTE: Promulgated by the Department of Health, Office of Public Health, LR 44:

§179. Disinfection

A. Disinfection may be accomplished with gas and liquid chlorine, calcium or sodium hypochlorites, chlorine dioxide, chloramines, ozone, or ultraviolet light. Other disinfecting agents will be considered, providing reliable application equipment is available and testing procedures for a residual are recognized in "Standard Methods for the Examination of Water and Wastewater,". Disinfection is required for all water systems in accordance with §355 and §357 of this Part.

B. Chlorination. Design criteria for chlorination shall be as follows.

1. Chlorination equipment type. Solution-feed gas chlorinators or hypochlorite feeders of the positive displacement type shall be provided. (see §§201-209 "Chemical Application" of this Part).

2. Capacity. The chlorinator capacity shall be sufficient to comply with minimum chlorine residuals required in §355 and §357 of this Part. The equipment shall be of such design that it will operate accurately over the desired feeding range.

3. Standby equipment. Standby equipment shall be available to replace/repair a critical unit unless an alternative is approved by the state health officer. Spare parts shall be readily available to replace parts subject to wear and breakage. If there is a large difference in feed rates between routine and emergency dosages, a gas metering tube should be provided for each dose range to ensure accurate control of the chlorine feed.

4. Automatic switch-over. Automatic switch-over of chlorine cylinders shall be provided to assure continuous disinfection.

5. Eductor. Each eductor shall be selected for the point of application with particular attention given to the quantity of chlorine to be added, the maximum injector water flow, the total discharge back pressure, the injector operating pressure, and the size of the chlorine solution line. Gauges for measuring water pressure and vacuum at the inlet and outlet of each eductor should be provided.

6. Injector/diffuser. The chlorine solution injector/diffuser shall be compatible with the point of application to provide a rapid and thorough mix with all the water being treated.

C. Criteria for contact time and point of application.

1. Due consideration shall be given to the contact time of the disinfectant in water with relation to pH, ammonia, taste-producing substances, temperature, bacterial quality, disinfection byproduct formation potential and other applicable factors. The disinfectant should be applied at a point which will provide adequate contact time (CT). All basins used for disinfection shall be designed to minimize short circuiting.

2. For treating surface waters and groundwaters under the direct influence of surface water, the system shall be designed to meet the CT standards set in Chapter 11 of this Part.

D. Residual chlorine. Systems shall be designed to meet the minimum disinfectant residual per §355 and §357 of this Part.

E. Testing equipment. Testing equipment used for compliance monitoring shall comply with approved analytical methods set forth in this Part.

F. Chlorinator piping. Design criteria for chlorinator pipping shall be as follows.

1. Cross-connection protection. The chlorinator water supply piping shall be designed to prevent contamination of the treated water supply in accordance with the backflow prevention requirements set forth in §§344 and 346 of this Part.

2. Pipe material. The pipes carrying elemental liquid or dry gaseous chlorine under pressure shall be Schedule 80 seamless steel tubing or other materials recommended by the Chlorine Institute. PVC is not acceptable upstream of the vacuum regulator. Vacuum piping for gaseous chlorine shall be polyethylene tubing or Schedule 80 PVC pipe. Rubber, Schedule 80 PVC, or

polyethylene shall be used for chlorine solution piping and fittings.

G. Chloramination. Chloramination is an application of ammonia and chlorine at a proper mass ratio of chlorine to ammonia to produce a combined chlorine residual predominantly in form of monochloramine. Proper chlorine to ammonia ratio shall be maintained to prevent the formation of dichloramine and trichloramine which create taste and odor in drinking water.

1. Type. The chlorine system shall comply with the applicable requirements of §179.B. Ammonia systems shall supply either anhydrous ammonia, ammonium sulfate or aqua ammonia in compliance with the requirements of §§201-209 "Chemical Application" of this Part.

2. Capacity. The ammonia supply system shall have sufficient capacity to comply with minimum disinfectant residuals required in §355 and §357 of this Part. The equipment shall be of such design that it will operate accurately over the desired feeding range.

3. Standby equipment. Standby equipment shall be available to replace/repair a critical unit. Spare parts shall be made available to replace parts subject to wear and breakage.

4. Injector/diffuser. The ammonia injector/diffuser shall be compatible with the point of application to provide a rapid and thorough mix with all the water being treated. If injectors are used, provisions for scale formation shall be considered.

a. Ammonia solution shall be fed through injectors/diffusers made of appropriate material installed per manufacturer's recommendations for even distribution of the solution. Materials containing copper shall not be used in contact with the ammonia.

5. Cross-connection protection. The aqua ammonia water supply piping shall be designed to prevent contamination of the treated water supply in accordance with the backflow prevention requirements set forth in §§344 and 346 of this Part.

6. Pipe material. The pipes carrying anhydrous ammonia shall be black iron or stainless steel. Aqua (Aqueous) ammonia or ammonium sulfate piping shall be stainless steel, polyethylene tubing or schedule 80 PVC. Stainless steel, rubber, polyethylene tubing or PVC shall be used for aqueous ammonia solution piping and fittings.

H. Ozone. Design considerations include the following.

a. Ozonation systems are generally used for the purpose of disinfection, oxidation and microflocculation.

b. Bench scale studies shall be conducted to determine minimum and maximum ozone dosages for disinfection "CT" compliance and oxidation reactions. More involved pilot studies shall be conducted when necessary to document benefits and DBP precursor removal effectiveness. Consideration shall be given to multiple points of ozone addition. Pilot studies shall be conducted for all surface waters. Particularly sensitive measurements include gas flow rate, water flow rate, and ozone concentration.

c. Following the use of ozone, the application of a disinfectant which maintains a measurable residual will be required in order to ensure bacteriologically safe water is carried throughout the distribution system.

d. Furthermore, because of the more sophisticated nature of the ozone process a higher degree of operator maintenance skills and training is required. The ability to obtain qualified operators must be evaluated in selection of the treatment process. The necessary operator training shall be provided prior to plant startup. An operation and maintenance manual shall be provided and maintained onsite while the ozone unit is in operation.

2. Feed Gas Preparation. General design criteria for feed gas preparation shall be as follows.

a. Feed gas can be air, oxygen enriched air, or high purity oxygen. Sources of high purity oxygen include purchased liquid oxygen; on site generation using cryogenic air separation; or temperature, pressure or vacuum swing (adsorptive separation) technology. For high purity oxygen-feed systems, dryers typically are not required.

i. Air handling equipment on conventional low pressure air feed systems shall consist of an air compressor, water/air separator, refrigerant dryer, heat reactivated desiccant dryer, and particulate filters. Some "package" ozonation systems for small plants may work effectively operating at high pressure without the refrigerant dryer and with a "heat-less" desiccant dryer. The maximum dew point of -76°F (-60°C) will not be exceeded at any time.

b. Air compression. Design criteria for air compression shall be as follows.

i. Air compressors shall be of the liquid-ring or rotary lobe, oil-less, positive displacement type for smaller systems or dry rotary screw compressors for larger systems.

ii. The air compressors shall have the capacity to simultaneously provide for maximum ozone demand, provide the air flow required for purging the desiccant dryers (where required) and allow for standby capacity.

iii. Air feed for the compressor shall be drawn from a point protected from rain, condensation, mist, fog and contaminated air sources to minimize moisture and hydrocarbon content of the air supply.

iv. A compressed air after-cooler and/or entrainment separator with automatic drain shall be provided prior to the dryers to reduce the water vapor.

v. A back-up air compressor must be provided so that ozone generation is not interrupted in the event of a break-down.

c. Air drying. Design criteria for air drying shall be as follows.

i. Dry, dust-free and oil-free feed gas must be provided to the ozone generator. Dry gas is essential to prevent formation of nitric acid, to increase the efficiency of ozone generation and to prevent damage to the generator dielectrics. Sufficient drying to a maximum dew point of -76°F (-60°C) shall be provided at the end of the drying cycle.

ii. Drying for high pressure systems may be accomplished using heatless desiccant dryers only. For low pressure systems, a refrigeration air dryer in series with heat-reactivated desiccant dryers shall be used.

iii. A refrigeration dryer capable of reducing inlet air temperature to 40°F (4°C) shall be provided for low pressure air preparation systems.

iv. For heat-reactivated desiccant dryers, the unit shall contain two desiccant filled towers complete with pressure relief valves, two four-way valves and a heater. External type dryers shall have a cooler unit and blowers. The size of the unit shall be such that the specified dew point will be achieved during a minimum adsorption cycle time of 16 hours while operating at the maximum expected moisture loading conditions.

v. Multiple air dryers shall be provided so that the ozone generation is not interrupted in the event of dryer breakdown.

vi. Each dryer shall be capable of venting "dry" gas to the atmosphere, prior to the ozone generator, to allow start-up when other dryers are "on-line".

d. Air filters. Design criteria for air filters shall be as follows.

i. Air filters shall be provided on the suction side of the air compressors, between the air compressors and the dryers and between the dryers and the ozone generators.

ii. The filter before the desiccant dryers shall be of the coalescing type and be capable of removing aerosol and particulates larger than 0.3 microns in diameter. The filter after the desiccant dryer shall be of the particulate type and be capable of removing all particulates greater than 0.1 microns in diameter, or smaller if specified by the generator manufacturer.

e. Preparation piping. Piping in the air preparation system can be common grade steel, seamless copper, stainless steel or galvanized steel. The piping must be designed to withstand the maximum pressures in the air preparation system.

3. Ozone Generator. Design criteria for ozone generators shall be as follows.

a. Capacity. Design criteria for ozone generator capacity shall be as follows.

i. The production rating of the ozone generators shall be stated in pounds per day and kWhr per pound at a maximum cooling water temperature and maximum ozone concentration.

ii. The design shall ensure that the minimum concentration of ozone in the generator exit gas will not be less than 1 percent (by weight).

iii. Generators shall be sized to have sufficient reserve capacity so that the system does not operate at peak capacity for extended periods of time.

iv. The production rate of ozone generators will decrease as the temperature of the coolant increases. If there is to be a variation in the supply temperature of the coolant throughout the year, then applicable data shall be used to determine production changes due to the temperature change of the supplied coolant. The design shall ensure that the generators can produce the required ozone at maximum coolant temperature.

v. Appropriate ozone generator backup equipment must be provided.

b. Electrical. The generators can be low, medium or high frequency type. Specifications shall require that the transformers, electronic circuitry and other electrical hardware be proven, high quality components designed for ozone service.

c. Cooling. Adequate cooling shall be provided. The cooling water must be properly treated to minimize corrosion, scaling and microbiological fouling of the water side of the tubes. Where cooling water is treated, cross connection control shall be provided to prevent contamination of the potable water supply in accordance with the backflow prevention requirements in §§344 and 346 of this Part.

d. Materials. The ozone generator shell and tubes shall be constructed of Type 316L stainless steel.

4. Ozone Contactors. The selection or design of the contactor and method of ozone application depends on the purpose for which the ozone is being used.

a. Bubble diffusers. Design criteria for bubble diffusers shall be as follows.

i. Where disinfection is the primary application a minimum of two contact chambers each equipped with baffles to prevent short circuiting and induce countercurrent flow shall be provided. Ozone shall be applied using porous-tube or dome diffusers.

ii. The minimum contact time shall be 10 minutes. A shorter contact time may be approved by state health officer.

iii. The contactor must be kept under negative pressure and sufficient ozone monitors shall be provided to protect worker safety. The secondary enclosure for the ozone contactor shall be open to the atmosphere.

iv. Large contact vessels made of reinforced concrete shall comply with ACI 350. All reinforcement bars shall be covered with a minimum of 2.0 inches of concrete. Smaller contact vessels can be made of stainless steel, fiberglass or other material which will be stable in the presence of residual ozone and ozone in the gas phase above the water level.

v. Where necessary a system shall be provided between the contactor and the off-gas destruct unit to remove froth from the air and return the other to the contactor or other location acceptable to the state health officer. If foaming is expected to be excessive, then a potable water spray system shall be placed in the contactor head space.

vi. All openings into the contactor for pipe connections, hatchways, etc. shall be properly sealed using welds or ozone resistant gaskets such as Teflon or Hypalon.

vii. Multiple sampling ports shall be provided to enable sampling of each compartment's effluent water and to confirm "CT" calculations.

viii. A pressure/vacuum relief valve shall be provided in the contactor and piped to a location where there will be no damage to the destruction unit.

ix. The diffusion system shall work on a countercurrent basis such that the ozone is fed at the bottom of the vessel and water is fed at the top of the vessel.

x. The depth of water in bubble diffuser contactors shall be a minimum of 18 feet. The contactor should also have a minimum of 3 feet of freeboard to allow for foaming.

xi. All contactors shall have provisions for cleaning, maintenance and drainage of the contactor. Each contactor compartment shall also be equipped with an access hatchway.

xii. Aeration diffusers shall be fully serviceable by either cleaning or replacement.

b. Other contactors. Other contactors, such as the venturi or aspirating turbine mixer contactor, may be approved by the state health officer provided adequate ozone transfer is achieved and the required contact times and residuals can be met and verified.

5. Ozone Destruction Unit. Design criteria for ozone destruction unit shall be as follows.

a. A system for treating the final off-gas from each contactor shall be provided in order to meet safety and air quality standards. Acceptable systems include thermal destruction and thermal/catalytic destruction units.

b. The maximum allowable ozone concentration in the discharge is 0.1 ppm (by volume).

c. At least two units shall be provided which are each capable of handling the entire gas flow.

d. Exhaust blowers shall be provided in order to draw off-gas from the contactor into the destruct unit.

e. Catalysts shall be protected from froth, moisture and other impurities which may harm the catalyst.

f. The catalyst and heating elements shall be located where they can easily be reached for maintenance.

6. Piping Materials. Only low carbon 304L and 316L stainless steels shall be used for ozone service.

7. Joints and Connections. Design criteria for ozone joints and connections shall be as follows.

a. Connections on piping used for ozone service are to be welded where possible.

b. Connections with meters, valves or other equipment are to be made with flanged joints with ozone resistant gaskets, such as Teflon of Hypalon.

c. A positive closing plug or butterfly valve plus a leak-proof check valve shall be provided in the piping between the generator and the contactor to prevent moisture reaching the generator.

8. Instrumentation. Design criteria for ozone instrumentation shall be as follows.

a. Pressure gauges shall be provided at the discharge from the air compressor, at the inlet to the refrigeration dryers, at the inlet and outlet of the desiccant dryers, at the inlet to the ozone generators and contactors and at the inlet to the ozone destruction unit.

b. Electric power meters shall be provided for measuring the electric power supplied to the ozone generators. Each generator shall have a trip which shuts down the generator when the wattage exceeds a certain preset level.

c. Dew point monitors shall be provided for measuring the moisture of the feed gas from the desiccant dryers. Because it is critical to maintain the specified dew point, it is recommended that continuous recording charts be used for dew point monitoring which will allow for proper adjustment of the dryer cycle. Where there is potential for moisture entering the ozone generator from downstream of the unit or where moisture accumulation can occur in the generator during shutdown, post-generator dew point monitors shall be used.

d. Air flow meters shall be provided for measuring air flow from the desiccant dryers to each of other ozone generators, air flow to each contactor and purge air flow to the desiccant dryers.

e. Temperature gauges shall be provided for the inlet and outlet of the ozone cooling water and the inlet and outlet of the ozone generator feed gas, and, if necessary, for the inlet and outlet of the ozone power supply cooling water.

f. Water flow meters shall be installed to monitor the flow of cooling water to the ozone generators and, if necessary, to the ozone power supply.

g. Ozone monitors shall be installed to measure zone concentration in both the feed-gas and off-gas from the contactor and in the off-gas from the destruct unit. For disinfection systems, monitors shall also be provided for monitoring ozone residuals in the water. The number and location of ozone residual monitors shall be such that the amount of time that the water is in contact with the ozone residual can be determined.

h. A minimum of one ambient ozone monitor shall be installed in the vicinity of the contactor and a minimum of one shall be installed in the vicinity of the generator. Ozone monitors shall also be installed in any areas where ozone gas may accumulate.

9. Alarms. The following alarm/shutdown systems shall be considered at each installation:

a. dew point shutdown/alarm. This system should shut down the generator in the event the system dew point exceeds -76°F (-60°C);

b. ozone generator cooling water flow shutdown/alarm. This system should shut down the generator in the event that cooling water flows decrease to the point that generator damage could occur;

c. ozone power supply cooling water flow shutdown/alarm. This system should shut down the power supply in the event that cooling water flow decreases to the point that damage could occur to the power supply;

d. ozone generator cooling water temperature shutdown/alarm. This system should shutdown the generator if either the inlet or outlet cooling water exceeds a certain preset temperature;

e. ozone power supply cooling water temperature shutdown/alarm. This system should shutdown the power supply if either the inlet or outlet cooling water exceeds a certain preset temperature;

f. ozone generator inlet feed-gas temperature shutdown/alarm. This system should shutdown the generator if the feed-gas temperature is above a preset value;

g. ambient ozone concentration shutdown/alarm. The alarm should sound when the ozone level in the ambient air exceeds 0.1 ppm or a lower value chosen by the water supplier. Ozone generator shutdown should occur when ambient ozone levels exceed 0.3 ppm (or a lower value) in either the vicinity of the ozone generator or the contactor; and

h. ozone destruct temperature alarm. The alarm should sound when temperature exceeds a preset value.

10. Safety. Design criteria for ozone safety shall be as follows.

a. The maximum allowable ozone concentration in the air to which workers may be exposed must not exceed 0.1 ppm (by volume).

b. Emergency exhaust fans shall be provided in the rooms containing the ozone generators to remove ozone gas if leakage occurs.

c. A sign shall be posted indicating "No smoking, oxygen in use" at all entrances to the treatment plant. In addition, no flammable or combustible materials shall be stored within the oxygen generator areas.

I. Chlorine dioxide. When choosing chlorine dioxide, consideration must be given to formation of the regulated byproducts and chlorite.

1. Chlorine dioxide generators. Chlorine dioxide generation equipment shall be factory assembled pre-engineered units with a minimum efficiency of 95 percent. The excess free chlorine shall not exceed five percent of the theoretical stoichiometric concentration required. Generators designed or intended to operate outside of this criteria shall require justification and be considered on a case-by-case basis. Generator yield shall be defined as the ratio of chlorine dioxide generated to the theoretical stoichiometric maximum, as presented in EPA's Alternative Disinfectants and Oxidants Guidance Manual, Section 4.2.2 (EPA 815-R-99-014, April 1999).

a. Generators shall be designed, built and certified in compliance to NSF 61.

b. Bench scale testing shall be conducted to determine chlorine dioxide demand and decay kinetics for the specific water being treated in order to establish the correct design dose for required log inactivation compliance (if required), oxidation reactions, and chlorite generation.

c. An operation and maintenance manual (O&M) shall be provided. The O&M shall cover, at a minimum, operating instructions, identification and location of components, maintenance information and checklists; manufacturer's product information (including trouble shooting information, a parts list and parts order form, special tools, spare parts list, etc.) and a chlorine dioxide and chlorite residual monitoring action plan (RMAP). The RMAP shall identify actions to be taken by properly trained certified operators in the event that the chlorine dioxide residual or chlorite level meet or exceed specified maximum levels at specified testing locations (e.g., generator effluent, treatment units, point-of-entry).

d. Certified operators charged with handling and/or conducting chlorine dioxide and chlorite testing shall be properly trained on the production and testing equipment, the generator O&M manual, and the RMAP. Documentation of training shall be signed by the individual having responsible authority over the operators. Training documentation shall be provided to the OPH District Office and maintained on-site for review during sanitary surveys.

2. Feed and storage facilities. When chlorine gas and sodium chlorite are used feed and storage facilities shall comply with §209.A and §209.C of this Part, respectively. Sodium hypochlorite feed and storage facilities shall comply with §209.D of this Part. All chlorine dioxide feed and storage facilities shall comply with §179.I.5 and §179.I.6 of this Part.

3. Other design requirements shall include the following.

a. The design shall comply with all applicable portions of §179.B, §179.C, and §179.F of this Part.

b. Alarms shall be provided to indicate a lack of chemical (chlorine and sodium chlorite) or motive water flow.

4. Public notification. Notification of a change in disinfection practices and the schedule for the changes shall be made known to the public; particularly to hospitals, kidney dialysis facilities, and fish breeders, as chlorine dioxide and its byproducts may have similar effects as chloramines.

5. Chlorine dioxide feed system. Design criteria for chlorine dioxide feed system shall be as follows.

a. Use fiberglass reinforced vinyl ester plastic (FRP) or high density linear polyethylene (HDLPE) tanks with no insulation.

b. If centrifugal pumps are used, provide Teflon packing material. Pump motors must be totally enclosed, fan-cooled, equipped with permanently sealed bearings, and equipped with double mechanical seals or other means to prevent leakage.

c. Provide chlorinated PVC, vinyl ester or Teflon piping material. Do not use carbon steel or stainless steel piping systems.

d. Provide glass view ports for the reactor if it is not made of transparent material.

e. All chlorite solutions shall have concentrations less than 30%. Higher strength solutions are susceptible to crystallization and stratification.

6. Chlorine dioxide storage requirements. Design criteria for chlorine dioxide storage shall be as follows.

a. Chlorine Dioxide Storage and Operating Area shall conform to the following.

i. The chlorine dioxide facility shall be physically located in a separate room from other water treatment plant operating areas.

ii. The chlorine dioxide area shall have a ventilation system separate from other operating areas.

iii. Provision shall be made to ventilate the chlorine dioxide facility area and maintain the ambient air chlorine dioxide concentrations below the Permissible Exposure Limit (PEL).

(a) The ventilating fan(s) take suction near the floor, as far as practical from the door and air inlet, with the point of discharge so located as not to contaminate air inlets of any rooms or structures.

(b). Air inlets are provided near the ceiling.

(c). Air inlets and outlets shall be louvered.

(d). Separate switches for the fans are outside and near the entrance of the facility.

iv. There shall be observation windows through which the operating area can be observed from outside the room to ensure operator safety.

v. Manual switches to the light in the operating area shall be located outside the door to the room.

vi. An emergency shutoff control to shut flows to the generator shall be located outside the operating area.

vii. Gaseous chlorine feed to the chlorine dioxide generator shall enter the chlorine dioxide facility area through lines which can only feed to vacuum.

viii. There shall not be any open drains in the chlorine dioxide operating area.

H. Ultraviolet Light. Any Ultraviolet unit installed for treatment of cryptosporidium is required to meet the requirements of the USEPA's 2006 Ultraviolet Disinfection Guidance Manual.

J. Other disinfecting agents. Use of disinfecting agents other than those listed shall be approved by the state health officer prior to preparation of final plans and specifications.

§181. Softening

A. Lime or lime-soda process. Design standards for rapid mix, flocculation and sedimentation are in Section 4.2. Additional consideration must be given to the following process elements.

1. Hydraulics. When split treatment is used, the bypass line should be sized to carry total plant flow, and an accurate means of measuring and splitting the flow shall be provided.

2. Rapid mix. Rapid mix detention times should be instantaneous, but not longer than 30 seconds with adequate velocity gradients to keep the lime particles dispersed.

3. Stabilization. Equipment for stabilization of water softened by the lime or lime-soda process is required. (see §189 of this Part).

4. Sludge collection. A means for sludge removal shall be provided in the sedimentation basin.

5. Sludge disposal. Provisions shall be included for proper disposal of softening sludges. (see Subchapter F. §§257-275 of this Part).

B. Cation exchange process. Design criteria for cation exchange process shall be as follows.

1. Pre-treatment requirements. Iron, manganese, or a combination of the two, should not exceed 0.3 mg/L in the water as applied to the ion exchange resin. Pre-treatment is required when the content of iron, manganese, or a combination of the two, is one milligram per liter or more (see §187 of this Part). Waters having 5 units or more turbidity should not be applied directly to the cation exchange softener.

2. Design. The units may be of pressure or gravity type, of either an upflow or downflow design. Automatic regeneration based on volume of water softened shall be used unless manual regeneration is justified and is approved by the state health officer. A manual override shall be provided on all automatic controls.

3. Exchange capacity. The design capacity shall be in accordance with the manufacturer's specifications for hardness removal.

4. Depth of resin. The depth of the exchange resin shall not be less than three feet.

5. Flow rates. The rate of softening shall not exceed seven gallons per minute per square foot of bed area and the backwash rate shall be between six and eight gallons per minute per square foot of bed area. Rate-of-flow controllers or the equivalent shall be installed for the above purposes.

6. Freeboard. The freeboard will depend upon the size and specific gravity of the resin and the direction of water flow. Adequate freeboard shall be provided to prevent loss of media during backwashing.

7. Underdrains and supporting gravel. The bottoms, strainer systems and support for the exchange resin shall conform to criteria provided for rapid rate gravity filters (see §177.A.6 and §177.A.7 of this Part).

8. Brine distribution. Facilities should be included for even distribution of the brine over the entire surface of both upflow and downflow units.

9. Cross-connection control. Backwash, rinse and air relief discharge pipes shall be installed in such a manner as to prevent any possibility of back-siphonage.

10. Bypass piping and equipment. Bypass shall must be provided around softening units to produce a blended water of desirable hardness. Totalizing meters shall be installed on the bypass line and on each softener unit. The bypass line shall have a shutoff valve and should have an automatic proportioning or regulating device.

11. Additional limitations. When the applied water contains a chlorine residual, the cation exchange resin shall be a type that is not damaged by residual chlorine.

12. Sampling taps. A means of collecting samples shall be provided for the collection of representative samples. If sample taps are provided, they shall be Smooth-nose type. The taps sampling locations shall be located to provide for sampling of the softener influent, effluent and blended water. The sampling locations for the blended water shall be at least 20 feet downstream from the point of blending.

13. Brine and salt storage tanks. Design criteria for brine and salt storage tanks shall be as follows.

a. Salt dissolving or brine tanks and wet salt storage tanks shall be covered and must be corrosion-resistant.

b. The make-up water inlet shall be protected from back-siphonage.

c. Wet salt storage basins shall be equipped with manholes or hatchways for access and for direct dumping of salt from truck or railcar. Openings shall be provided with raised curbs and watertight covers having overlapping edges. Each cover shall be hinged on one side, and shall have locking device.

d. Overflows, where provided, shall be protected with corrosion resistant screens and must terminate with either a turned downed bend having a proper free fall discharge or a self-closing flap valve.

e. The salt shall be supported on graduated layers of gravel placed over a brine collection system.

14. Stabilization. Refer to §189 of this Part.

15. Waste disposal. Suitable disposal shall be provided for brine waste (see Subchapter F. §§257-275 of this Part).

16. Construction materials. Pipes and contact materials shall be resistant to the aggressiveness of salt. Steel and concrete must be coated with a non-leaching protective coating which is compatible with salt and brine.

17. Housing. Bagged salt and dry bulk salt storage shall be enclosed and separated from other operating areas in order to prevent damage to equipment.

§183. Anion Exchange Treatment

A. Pre-treatment requirements. Iron, manganese or a combination of the two, should not exceed 0.3 mg/L in the water as applied to the ion exchange resin. Pre-treatment is required when a combination of iron and manganese exceeds 0.5 mg/L.

B. Design criteria for anion exchange treatment is as follows.

1. Anion exchange units are typically of the pressure type, down flow design. Automatic regeneration based on volume of water treated shall be used unless manual regeneration is justified

and is approved by the state health officer. A manual override shall be provided on all automatic controls.

2. If a portion of the water is bypassed around the units and blended with treated water, the maximum blend ratio allowable must be determined based on the highest anticipated raw water contaminant level. If bypassing is provided, a totalizing meter and a proportioning or regulating device or flow regulating valves shall be provided on the bypass line.

C. Number of Units. At least two units shall be provided. The treatment capacity shall be capable of producing the water at the average daily flow at the maximum month of the plant at a level below the MCL of the contaminant being removed, with one exchange unit out of service.

D. Type of Media. The anion exchange media shall be of the type required to for the contaminant being removed.

E. Flow Rates. The treatment flow rate should not exceed 5 gallons per minute per square foot of bed area (20 cm/minute down flow rate). The backwash flow rate should be approximately 4.0 to 6.0 gallons per minute per square foot of bed area (16 to 24 cm/minute rise rate). The regeneration rate should be approximately 1.0 gallon per minute per square foot of bed area (4 cm/minute rise rate) with a fast rinse approximately equal to the service flow rate.

F. Freeboard. Adequate freeboard shall be provided to accommodate the backwash flow rate of the unit.

G. Miscellaneous Appurtenances. Miscellaneous appurtenances shall include the following.

1. The system shall be designed to include an adequate under drain and supporting gravel system and brine distribution equipment.

2. Sample taps, and brine and salt storage shall be as required in §181.B.12 and §181.B.13 of this Part.

H. Cross Connection Control. Backwash, rinse and air relief discharge pipes shall be installed in such a manner as to prevent any possibility of back-siphonage.

I. Construction materials. Pipes and contact materials must be resistant to the aggressiveness of salt. Plastic and red brass are acceptable materials. Steel and concrete shall be coated with a non-leaching protective coating which is compatible with salt and brine.

J. Housing. Bagged salt and dry bulk salt storage shall be enclosed and separated from other operating areas in order to prevent damage to equipment.

K. Preconditioning of the media. Prior to startup of the equipment, the media shall be regenerated with no less than two bed volumes of water containing sodium chloride followed by an adequate rinse.

L. Waste Disposal. Suitable disposal must be provided for brine waste (see Subchapter F. §§257-275 of this Part).

§185. Aeration

A. Aeration processes generally are used in two types of treatment applications. One is the transfer of a gas to water (e.g., adding oxygen to assist in iron and/or manganese removal) and is called gas absorption, or aeration. The second is the removal of gas from water (reduce or remove objectionable amounts of carbon dioxide, hydrogen sulfide, etc. or reduce the concentration of taste and odor-causing substances or removal of volatile organic compounds) and is classified as desorption or air stripping. The materials used in the construction of the aerator(s) shall meet NSF/ANSI 61 or be approved by the state health officer.

1. Natural draft aeration. Design shall provide:

a. perforations in the distribution pan 3/16 to 1/2 inches in diameter, spaced 1 to 3 inches on centers to maintain a six inch water depth;

b. for distribution of water uniformly over the top tray;

c. discharge through a series of three or more trays with separation of trays not less than 12 inches;

d. loading at a rate of 1 to 5 gallons per minute for each square foot of total tray area (2.5 - 12.5 m/hr);

e. trays with slotted, heavy wire (1/2 inch openings) mesh or perforated bottoms;

f. construction of durable material resistant to aggressiveness of the water and dissolved gases; and

g. protection from insects by 24-mesh screen when used in applications where the water will not be subject to open vessels in downstream treatment processes.

2. Forced or induced draft aeration. Devices shall be designed to:

a. insure adequate counter current of air through the enclosed aerator column;

b. exhaust air directly to the outside atmosphere;

c. include a down-turned air outlet and inlet. Protection from insects by 24-mesh screen when used in applications where the water will not be subject to open vessels in downstream treatment processes;

d. be such that air introduced in the column shall be as free from obnoxious fumes, dust, and dirt as possible;

e. be such that sections of the aerator can be easily reached or removed for maintenance of the interior or installed in a separate aerator room;

f. provide loading at a rate of 1 to 5 gallons per minute for each square foot of total tray area (2.5 - 12.5 m/hr);

g. insure that the water outlet is adequately sealed to prevent unwarranted loss of air;

h. when trays are used, discharge through a series of five or more trays with separation of trays not less than six inches or as approved by the state health officer;

i. provide distribution of water uniformly over the top tray; and

j. be of durable material resistant to the aggressiveness of the water and dissolved gases.

3. Spray aeration. Design shall provide:

a. a hydraulic head of between 5 - 25 feet;

b. nozzles, with the size, number, and spacing of the nozzles being dependent on the flowrate, space, and the amount of head available;

c. nozzle diameters in the range of 1 to 1.5 inches to minimize clogging; and

d. an enclosed basin to contain the spray. Any openings for ventilation, etc. shall be protected from insects by 24-mesh screen when used in applications where the water will not be subject to open vessels in downstream treatment processes.

4. Pressure aeration. Pressure aeration shall be used for oxidation and biological filtration purposes only. Filters following pressure aeration must have adequate exhaust devices for release of air. Pressure aeration devices shall be designed to:

a. give thorough mixing of compressed air with water being treated; and

b. provide screened and filtered air, free of obnoxious fumes, dust, dirt and other contaminants.

5. Packed tower aeration. Packed tower aeration (PTA) which is also known as air stripping involves passing water down through a column of packing material while pumping air counter-currently up through the packing. PTA is used for the removal of volatile organic chemicals, trihalomethanes, carbon dioxide, and radon.

a. Process design for PTA includes the following.

i. The tower shall be designed to reduce contaminants to below the maximum contaminant level (MCL).

ii. The ratio of the packing height to column diameter should be at least 7:1 for the pilot unit and at least 10:1 for the full scale tower. The type and size of the packing used in the full scale unit shall be the same as that used in the pilot work.

iii. The minimum volumetric air to water ratio at peak water flow should be 25:1 and the maximum should be 80:1. Air to water ratios outside these ranges should not be used without prior approval from the state health officer.

iv. The design shall consider potential fouling problems from calcium carbonate and iron precipitation and from bacterial growth

b. Materials of construction. The tower shall be constructed of a material that is suitable for contact with the water being treated. Packing materials shall be resistant to the aggressiveness of the water, dissolved gases and cleaning materials and shall be suitable for contact with potable water.

c. Water flow system. Design of the water flow system includes the following.

i. Water should be distributed uniformly at the top of the tower using spray nozzles or orifice-type distributor trays that prevent short circuiting.

ii. A mist eliminator shall be provided above the water distributor system.

iii. A side wiper redistribution ring shall be provided at least every 10 feet in order to prevent water channeling along the tower wall and short circuiting.

iv. Sample taps shall be provided in the influent and effluent piping.

v. The effluent sump, if provided, shall have easy access for cleaning purposes and be equipped with a drain valve. The drain shall not be connected directly to any storm or sanitary sewer.

vi. A blow-off line should be provided in the effluent piping to allow for discharge of water/chemicals used to clean the tower.

vii. A means of measuring the water flow to each tower shall be provided.

viii. An overflow line shall be provided which discharges 12 to 14 inches above a splash pad or drainage inlet. Proper drainage shall be provided to prevent flooding of the area.

ix. Means shall be provided to prevent flooding of the air blower.

x. The water influent pipe should be supported separately from the tower's main structural support.

d. Air flow system. Design of the air flow system includes the following.

i. The air inlet to the blower and the tower discharge vent shall be downturned and protected with a non-corrodible 24-mesh screen to prevent contamination from extraneous matter.

ii. The air inlet shall be in a protected location.

iii. A means of ensuring that air is being provided when water is being delivered to the air strippers shall be provided.

e. The following features shall be provided.

i. A sufficient number of access ports with a minimum diameter of 24 inches to facilitate inspection, media replacement, media cleaning and maintenance of the interior.

ii. A method of cleaning the packing material when fouling may occur.

iii. An acceptable alternative treatment shall be available during periods of maintenance and operation interruptions when used for treatment of a primary contaminant. No bypass shall be provided unless specifically approved by the state health officer.

iv. Disinfection application points ahead of the tower to control biological growth.

v. Adequate packing support to allow free flow of water and to prevent deformation with deep packing heights..

6. Other methods of aeration. Other methods of aeration may be used if applicable to the treatment needs. Such methods include but are not restricted to spraying, diffused air, cascades and mechanical aeration. The treatment processes shall be designed to meet the particular needs of the water to be treated and are subject to the approval of the state health officer.

7. Protection of aerators. All aerators except those discharging to lime softening or clarification plants shall be protected from contamination by birds, insects, wind borne debris, rainfall and water draining off the exterior of the aerator.

8. Bypass. A bypass should be provided for all aeration units except those installed to comply with maximum contaminant levels.

9. Redundancy. Redundant equipment shall be provided for units installed to comply with the Safe Drinking Water Act primary contaminants, unless otherwise approved by the state health officer.

§187. Iron and Manganese Control

A. Iron and manganese control, as used herein, refers solely to treatment processes designed specifically for this purpose. The treatment process used will depend upon the character of the raw water. The selection of one or more treatment processes must meet specific local conditions as determined by engineering investigations, including chemical analyses of representative samples of water to be treated, and receive the approval of the state health officer. It may be necessary to operate a pilot plant in order to gather all information applicable to the design. Consideration should be given to adjusting pH of the raw water to optimize the chemical reaction.

1. Design elements for removal by oxidation, detention and filtration are as follows.

a. Oxidation. Oxidation may be by aeration, as indicated in §185 of this Part, or by chemical oxidation with chlorine, potassium permanganate, sodium permanganate, ozone or chlorine dioxide.

b. Reaction. A detention time shall be provided following aeration to insure that the oxidation reactions are as complete as possible. The reaction tank/detention basin shall be designed to prevent short circuiting. If a reaction tank/detention basin is provided, it shall be provided with an overflow, vent and access hatch in accordance with §225.I, §225.J, and §225.K of this Part.

c. Sedimentation. Sedimentation basins shall be provided when treating water with high iron and/or manganese (≥ 7*SMCL) content, or where chemical coagulation is used to reduce the load on the filters. Provisions for sludge removal shall be made.

b. Filtration. Filters shall be provided and shall conform to §177 of this Part.

2. For removal by the lime-soda softening process, see §181.A of this Part.

3. Removal by manganese coated media filtration. This process consists of a continuous or batch feed of potassium permanganate to the influent of a manganese coated media filter.

a. Provisions should be made to apply the permanganate as far ahead of the filter as practical and to a point immediately before the filter.

c. An anthracite media cap of at least six inches or more as required by the state health officer shall be provided over manganese coated media.

d. Normal filtration rate shall be based on the manufacturer's performance studies.

e. Sample taps shall be provided:

i. for the raw water;

ii. immediately ahead of filtration; and

iii. at the filter effluent.

4. Removal by ion exchange. This process of iron and manganese removal should not be used for water containing more than 0.3 milligrams per liter of iron, manganese or combination thereof. This process is not acceptable where either the raw water or wash water contains dissolved oxygen or other oxidants.

5. Sequestration by polyphosphates. The total phosphate applied shall not exceed 10 mg/L as phosphate (PO_4). Possible adverse effects on corrosion must be addressed when phosphate

addition is proposed for iron sequestering.

a. Feeding equipment shall conform to the requirements of Subchapter A "Chemical Application" §201-§209 of this Part.

b. Polyphosphates shall not be applied ahead of iron and manganese removal treatment.

c. The phosphate feed point shall be located at least five feet ahead of the oxidant feed point.

6. Sequestration by sodium silicates. Sodium silicate sequestration of iron and manganese is appropriate only for groundwater supplies prior to air contact. On-site pilot tests are required to determine the suitability of sodium silicate for the particular water and the minimum feed needed. Rapid oxidation of the metal ions such as by chlorine or chlorine dioxide must accompany or closely precede the sodium silicate addition. Injection of sodium silicate more than 15 seconds after oxidation may cause detectable loss of chemical efficiency. Dilution of feed solutions much below five per cent silica as $SiO2$ should also be avoided for the same reason. Sodium silicate treatment may be less effective for sequestering manganese than for iron.

a. Sodium silicate addition is applicable to waters containing up to 2 mg/L of iron, manganese or combination thereof.

b. Chlorine residuals shall be maintained throughout the distribution system to prevent biological breakdown of the sequestered iron.

c. The amount of silicate added shall be limited to 20 mg/L as $SiO2$, but the amount of added and naturally occurring silicate shall not exceed 60 mg/L as $SiO2$.

d. Feeding equipment shall conform to the requirements of Subchapter A "Chemical Application" §201-§209 of this Part.

e. Sodium silicate shall not be applied ahead of iron or manganese removal treatment.

7. Sampling taps. Smooth-nosed sampling taps shall be provided for control purposes. A means of collecting samples shall be provided for each raw water source, each treatment unit influent and each treatment unit effluent.

8. Testing equipment shall be provided for all plants. Where polyphosphate sequestration is practiced, appropriate phosphate testing equipment shall be provided that meets the requirements of §137.G of this Part.

§189. Stabilization

A. Carbon dioxide addition. Where liquid carbon dioxide is used, adequate precautions shall be taken to prevent carbon dioxide from entering the plant from the recarbonation process.

1. Consideration shall be given to the installation of a carbon dioxide alarm system with light and audio warning, especially in low areas.

2. Recarbonation tanks shall be located outside or be sealed and vented to the outside with adequate seals and adequate purge flow of air to ensure workers safety.

a. Provisions shall be made for draining the recarbonation basin and removing sludge.

B. Acid addition. Design elements for acid addition include the following.

1. Feed equipment shall conform to Subchapter A "Chemical Application" §201-§209 of this Part.

2. Adequate precautions shall be taken for operator safety, such as not adding water to the concentrated acid. (see §207 and §209 of this Part).

C. Phosphates. The feeding of phosphates may be applicable for sequestering calcium, for corrosion control, and in conjunction with alkali feed following ion exchange softening.

1. Feed equipment shall conform to Subchapter A "Chemical Application" §201-§209 of this Part.

2. Stock phosphate solution shall be kept covered and disinfected by carrying approximately 10 mg/L free chlorine residual unless the phosphate is not able to support bacterial growth. Phosphate solutions having a pH of 2.0 or less may also be exempted from this requirement by the state health officer.

§191. Taste and Odor Control

A. Powdered activated carbon. Design elements for powered activated carbon (PAC) include the following.

1. Continuous agitation or resuspension equipment shall be provided to keep the carbon from depositing in the slurry storage tank.

2. Provision shall be made for adequate dust control.

3. The required rate of feed of carbon in a water treatment plant depends upon the tastes and/or odors involved, but provision should be made for adding from 0.1 milligrams per liter to at least 40 milligrams per liter.

4. Powdered activated carbon shall be handled as a potentially combustible material.

B. Granular activated carbon. Replacement of anthracite with granular activated carbon (GAC) may be considered as a control measure for geosmin and methyl isoborneol (MIB) taste and odors from algae blooms. Demonstration studies may be required by the state health officer. See §177.A.6.iv of this Part for application within filters.

C. Copper sulfate and other copper compounds. Continuous or periodic treatment of water with copper compounds to kill algae or other growths shall be controlled to prevent copper in excess of 1.0 milligrams per liter as copper in the plant effluent or distribution system. Care shall be taken to assure an even distribution of the chemical within the treatment area.

D. For Aeration, see §185 of this Part.

E. Ozone. Ozonation can be used as a means of taste and odor control. Adequate contact time shall be provided to complete the chemical reactions involved. Ozone is generally more desirable for treating water with high threshold odors. (See §179.H of this Part)

§193. Reserved.

§195. Reserved.

§197. Reserved.

§199. Reserved.

Chapter 2. Public Water System Construction, Operation and Maintenance

Subchapter A. Chemical Application

§201. General Requirements

A. General. Chemicals applied to treat potable drinking water shall meet the requirements of NSF/ANSI Standard 60 as certified by an ANSI-accredited testing agency.

B. Plans and specifications. Plans and specifications shall be submitted for review and approval, as provided for in Chapter 1, Subchapter B of this Part, and shall include:

1. descriptions of feed equipment, including maximum and minimum feed ranges;
2. location of feeders, piping layout and points of application;
3. storage and handling facilities;
4. operating and control procedures including proposed application rates;
5. description of testing equipment; and
6. description of system including all tanks with capacities, (with drains, overflows, and vents), feeders, transfer pumps, connecting piping, valves, points of application, backflow prevention devices, air gaps, secondary containment, and safety eye washes and showers.

C. Chemical Application. Chemicals shall be applied to the water at such points and by such means as to:

1. assure maximum efficiency of treatment;
2. assure maximum safety to consumer;
3. provide maximum safety to operators;
4. assure satisfactory mixing of the chemicals with the water;
5. provide maximum flexibility of operation through various points of application, when appropriate; and
6. prevent backflow or back-siphonage between multiple points of feed through common manifolds.

D. General equipment design shall be such that:

1. feeders will be able to supply, at all times, the necessary amounts of chemicals at an accurate rate, throughout the range of feed;
2. chemical-contact materials and surfaces are resistant to the aggressiveness of the chemical solution;
3. corrosive chemicals are introduced in such a manner as to minimize potential for corrosion;

4. chemicals that are incompatible are not stored or handled together;

5. all chemicals are conducted from the feeder to the point of application in separate conduits;

6. chemical feeders are as near as practical to the feed point;

7. chemical feeders and pumps shall operate at no lower than 20 per cent of the feed range unless two fully independent adjustment mechanisms such as pump pulse rate and stroke length are fitted then the pump shall operate at no lower than 10 percent of the rated maximum; and

8. gravity may be used where practical.

E. For each chemical the information submitted shall include:

1. documentation that the chemical is certified to NSF/ANSI Standard 60;

2. specifications for the chemical to be used;

3. purpose of the chemical;

4. proposed minimum non-zero, average and maximum dosages, solution strength or purity (as applicable), and specific gravity or bulk density;

5. method for independent calculation of amount fed daily; and

6. Safety Data Sheet (SDS).

AUTHORITY NOTE: Promulgated in accordance with the provisions of R.S. 40:4.A.(8), 40:4.13.D.(1)(2) and 40:5.A.(2)(3)(5)(6)(7)(17).

HISTORICAL NOTE: Promulgated by the Department of Health, Office of Public Health, LR 44:

§203. Feed Equipment

A. Feeder redundancy. Where a chemical feed and booster pump is necessary for the protection of the supply, such as chlorination, coagulation or other essential processes, a standby unit or a combination of units of sufficient size to meet capacity shall be provided to replace the largest unit when out of service.

1. A separate feeder shall be used for each chemical applied.

2. Spare parts shall be available on site for each type of feeder and chemical booster pump to replace parts which are subject to wear and damage.

B. Control. Feeders may be manually or automatically controlled.

1. Automatic controls shall be designed so as to allow override by manual controls.

2. Chemical feed rates shall be proportional to the flow stream being dosed.

3. A means to measure the flow stream being dosed shall be provided in order to determine chemical feed rates.

4. Provisions shall be made for measuring the quantities of chemicals used.

5. Weighing scales:

a. shall be provided for weighing cylinders at all plants utilizing chlorine gas;

b. shall be required for fluoride solution fed from supply drums or carboys;

c. should be provided for volumetric dry chemical feeders;

d. shall be capable of providing reasonable precision in relation to average daily dose; and

e. shall not be required for chlorine gas cylinders when used as a backup or standby source of chlorine gas.

6. Where conditions warrant, for example with rapidly fluctuating intake turbidity, coagulant and coagulant aid addition may be made according to turbidity, streaming current or other sensed parameter.

C. Dry chemical feeders. Dry chemical feeders shall:

1. measure chemicals volumetrically (see §203.B.5.c) or gravimetrically;

2. provide adequate solution/slurry water and agitation of the chemical at the point of placing in solution/slurry; and

3. completely enclose chemicals to reduce emission of dust to the operating room.

D. Positive displacement solution feed pumps. Positive displacement type solution feed pumps should be used to feed liquid chemicals.

1. Pumps shall be capable of operating at the required maximum rate against the maximum head conditions found at the point of injection.

2. Equipment utilized to readily measure feed rates in the pumped liquid shall be designed to handle the liquid being measured and shall be provided.

3. A pressure relief valve should be provided on the pump discharge line.

E. Siphon control for liquid chemical feeders. Liquid chemical feeders shall be such that chemical solutions cannot be siphoned or overfed into the water supply, by:

1. assuring discharge at a point of positive pressure;

2. providing vacuum relief;

3. providing a suitable air gap, or anti-siphon device; or

4. providing other suitable means or combinations as necessary.

F. Cross-connection control shall be provided to assure that:

1. the service water lines discharging to liquid storage tanks shall be properly protected from backflow as required by the state health officer;

2. chemical solutions or slurries cannot be siphoned through liquid chemical feeders into the water supply as required in §203.E of this Part;

3. no direct connection exists between any sewer and a drain or overflow from the liquid chemical feeder, liquid storage chamber or tank by providing that all drains terminate at least six inches or two pipe diameters, whichever is greater, above the overflow rim of a receiving sump, conduit or waste receptacle;

4. in the absence of other cross connection control measures, separate feeders shall be provided for chemical feed systems that have feed points at both unfiltered and filtered water locations such that all unfiltered water feed points are fed from one feeder, and that all filtered water feed points are fed from another feeder.

G. Location. Chemical feed equipment:

1. shall be readily accessible for servicing, repair, and observation of operation;

2. should be located in a separate room where hazards and dust problems may exist; and

3. should be conveniently located near points of application to minimize length of feed lines.

H. In-plant water supply shall be:

1. ample in quantity and adequate in pressure;

2. provided with means for measurement when preparing specific solution concentrations by dilution;

3. properly treated for hardness, when necessary;

4. properly protected against backflow; and

5. obtained from the finished water supply, or from a location sufficiently downstream of any chemical feed point to assure adequate mixing.

I. Supply and storage of chemicals. A minimum of 10 days of chemical supply shall be on site at all times that will allow the facility to satisfy a maximum average day demand for all ten days. Additional supply of chemicals that will not degrade is recommended. Chemicals for which the EPA has established a Threshold Quantity for Risk Management Plan purposes need not be stored on site provided the system has a plan in place for effective timely deliveries of such chemicals.

1. Storage space shall:

a. be convenient and provide for efficient handling of chemicals;

b. have dry storage conditions; and

c. provide a minimum storage volume of 1.5 truck loads where purchase can only be made by truck load lots.

2. Storage tanks and pipelines for liquid chemicals shall be specified for use with individual chemicals and not used for different chemicals. Offloading areas shall be clearly labeled to prevent accidental cross-contamination.

3. Chemicals shall be stored in covered or unopened shipping containers, unless the chemical is transferred into an approved storage unit.

4. Liquid chemical storage tanks shall:

a. have a means to readily determine the volume of liquid retained in the storage tank; and,

b. have an overflow and a receiving basin capable of receiving accidental spills or overflows without uncontrolled discharge; a common receiving basin may be provided for each group of compatible chemicals, which provides sufficient containment volume to prevent accidental discharge in the event of failure of the largest tank.

J. Bulk liquid storage tanks. Bulk liquid storage tanks shall comply with the following requirements:

1. A means which is consistent with the nature of the chemical stored shall be provided in a liquid storage tank to maintain a uniform chemical strength. Continuous agitation shall be provided to maintain slurries in suspension.

2. A means to assure continuity of chemicals to treat the water to comply with federal primary drinking water standards and state drinking water regulations shall be provided while servicing a liquid storage tank.

3. A means shall be provided to readily measure the liquid level in the liquid storage tank.

4. Liquid storage tanks shall have a lid. Large liquid storage tanks with access openings shall have such openings curbed and fitted with overhanging covers or, bolted and gasketed manways.

5. Subsurface locations for liquid storage tanks shall:

a. be free from sources of possible contamination; and

b. assure positive drainage away from the area for ground waters, accumulated water, chemical spills and overflows.

6. Overflow pipes, when provided, shall:

a. be turned downward, with the end screened;

b. have a free fall discharge; and

c. be located where noticeable.

7. Liquid storage tanks must be vented, but not through vents in common with other chemicals or day tanks. Acid storage tanks shall be vented to the outside atmosphere.

8. Each liquid storage tank shall be provided with a method to be drained.

9. Each liquid storage tank shall be protected against contamination by cross-connections.

10. Liquid storage tanks shall be located and secondary containment provided so that chemicals from equipment failure, spillage or accidental drainage shall not enter the water in conduits, treatment or storage basins. Secondary containment volumes shall be able to hold the volume of the largest storage tank. Piping shall be designed to minimize or contain chemical spills in the event of pipe ruptures.

K. Overfeed Protection. Overfeed protection shall be provided and comply with the following requirements.

1. A LDH-approved overfeed process control and/or procedure shall be provided for liquid chemical feeds. The process control and/or procedure must be in addition to the requirements of §203.E (siphon control) of this Part. When day tanks are used for overfeed protection, day tanks shall meet requirements of §203.K.3 of this Part.

2. Day tanks shall be provided when bulk storage of fluoride is used.

3. When day tanks are used, all day tanks shall meet all of the following requirements and requirements of §203.J of this Part, except that shipping containers do not require §203.J.6 (overflow pipes) and §203.J.8. (drain method) and day tanks do not require secondary containment.

a. Day tanks should hold no more than a 30 hour supply.

b. Day tanks shall be scale-mounted, or have a calibrated gauge painted or mounted on the side if liquid level can be observed in a gauge tube or through translucent sidewalls of the tank. In opaque tanks, a gauge rod may be used.

c. Except for fluorosilicic acid, hand pumps may be provided for transfer from a shipping container. A tip rack may be used to permit withdrawal into a bucket from a spigot.

d. A means which is consistent with the nature of the chemical solution shall be provided to maintain uniform chemical strength in a day tank. Continuous agitation shall be provided to maintain chemical slurries in suspension.

e. Tanks and tank refilling line entry points shall be clearly labeled with the name of the chemical contained.

f. Filling of day tanks shall not be automated, unless redundancy of controls is provided.

g. Where motor-driven transfer pumps are provided, an automated means to prevent an overflow shall be provided.

L. Feed lines. Feed lines:

1. should be as short as possible;
2. should be of durable, corrosion-resistant material;
3. be easily accessible throughout the entire length;
4. be readily cleanable;
5. shall be protected from freezing;
6. should slope upward from the chemical source to the feeder when conveying gases;
7. shall be designed consistent with scale-forming or solids depositing properties of the water, chemical, solution or mixtures conveyed; and
8. should be color coded and labeled.

M. Handling. Carts, elevators and other appropriate means shall be provided for lifting chemical containers to minimize excessive lifting by operators.

1. Provisions shall be made for disposing of empty bags, drums, carboys, or barrels by an approved procedure which will minimize exposure to dusts.

2. Provisions shall be made for the proper transfer of dry chemicals from shipping containers to storage bins or hoppers, in such a way as to minimize the quantity of dust which may enter the room in which the equipment is installed. Control should be provided by use of:

a. vacuum pneumatic equipment or closed conveyor systems;

b. facilities for emptying shipping containers in special enclosures, and/or;

c. exhaust fans and dust filters.

3. Provision shall be made for measuring quantities of chemicals used to prepare feed solutions.

N. Housing. Housing of feed equipment shall comply with the following.

1. Floor surfaces shall be smooth and impervious, slip-proof and well drained.

2. Vents from feeders, storage facilities and equipment exhaust shall discharge to the outside atmosphere above grade and remote from air intakes.

AUTHORITY NOTE: Promulgated in accordance with the provisions of R.S. 40:4.A.(8), 40:4.13.D.(1)(2) and 40:5.A.(2)(3)(5)(6)(7)(17).

HISTORICAL NOTE: Promulgated by the Department of Health, Office of Public Health, LR 44:

§205. Chemicals

A. Chemical shipping containers shall be fully labeled to include:

1. chemical name, purity and concentration; and

2. supplier name and address.

B. Chemicals shall meet the appropriate ANSI/AWWA standards and/or be certified to NSF/ANSI Standard 60.

C. The state health officer may require assay of chemicals.

AUTHORITY NOTE: Promulgated in accordance with the provisions of R.S. 40:4.A.(8), 40:4.13.D.(1)(2) and 40:5.A.(2)(3)(5)(6)(7)(17).

HISTORICAL NOTE: Promulgated by the Department of Health, Office of Public Health, LR 44:

§207. Operator Safety

A. Special provisions shall be made for ventilation of chlorine feed and storage rooms.

B. Respiratory protection equipment shall:

1. meet the requirements of the National Institute for Occupational Safety and Health (NIOSH);

2. be available where chlorine gas is handled;

3. shall be stored at a convenient heated location, but not be stored inside any room where chlorine is used or stored; and

4. if compressed air is used shall have at least a 30 minute capacity.

C. Leak detection for chlorine gas. A bottle of concentrated ammonium hydroxide (56 per cent ammonia solution) shall be available for chlorine leak detection; where ton containers are used, a leak repair kit approved by the Chlorine Institute shall be provided. Where pressurized chlorine gas is present, continuous chlorine leak detection equipment is required and shall be equipped with both an audible alarm and a warning light.

D. Other protective equipment shall be provided as follows.

1. At least one pair of rubber gloves, a dust respirator of a type certified by NIOSH for toxic dusts, an apron or other protective clothing and goggles or face mask shall be provided for each operator on duty.

2. An appropriate deluge shower and eye washing device shall be installed where strong acids and alkalis are used or stored.

3. Other protective equipment should be provided as necessary.

AUTHORITY NOTE: Promulgated in accordance with the provisions of R.S. 40:4.A.(8), 40:4.13.D.(1)(2) and 40:5.A.(2)(3)(5)(6)(7)(17).

HISTORICAL NOTE: Promulgated by the Department of Health, Office of Public Health, LR 44:

§209. Specific Chemicals

A. Chlorine gas. Chlorinators should be housed in a room separate from but adjacent to the chlorine storage room.

1. Chlorinator rooms should be heated to 60°F, and be protected from excessive heat. Cylinders and gas lines should be protected from temperatures above that of the feed equipment.

2. Both the chlorine gas feed and storage rooms should be located in a corner of the building on the prevailing downwind side of the building and be away from entrances, windows, louvers, walkways, etc.

3. If chlorine gas feed and storage is enclosed, the chlorine gas shall be separated from other operating areas. Both the feed and storage rooms shall be constructed so as to meet the following requirements:

a. a shatter resistant inspection window shall be installed in an interior wall unless secondary containment is provided for chlorine gas;

b. all openings between the rooms and the remainder of the plant shall be sealed;

c. doors shall be equipped with panic hardware, assuring ready means of exit and opening outward only to the building exterior;

d. a ventilating fan with a capacity to complete one air change per minute when the room is occupied; where this is not appropriate due to the size of the room, a lesser rate may be considered;

e. the ventilating fan shall take suction near the floor and as great a distance as is practical from the door and air inlet, with the point of discharge located so as not to contaminate air inlets to any rooms or structures;

f. air inlets with corrosion resistant louvers shall be installed near the ceiling;

g. air intake and exhaust louvers shall facilitate airtight closure;

h. separate switches for the ventilating fan and for the lights shall be located outside and at the inspection window. Outside switches must be protected from vandalism. A signal light indicating ventilating fan operation shall be provided at each entrance when the fan can be controlled from more than one point;

i. vents from chlorinator and storage areas must be screened and discharge to the outside atmosphere, above grade;

j. floor drains are discouraged. Where provided, the floor drains must discharge to the outside of the building and not be connected to other internal or external drainage systems; and

k. provisions should be made to chemically neutralize chlorine gas where feed and/or storage is located near residential or developed areas in the event of any measured chlorine release. The equipment must be sized to treat the entire contents of the largest storage container on site.

4. Chlorine gas not stored in a room shall be:

a. protected from direct sunlight and windblown debris;

b. shielded from public view;

c. located inside a fenced and secure area;

d. secured in a fixed position, and

e. all chlorine pipelines are under vacuum with no pressure chlorine lines allowed.

5. Chlorine gas feed systems shall be of the vacuum type and include the following.

a. vacuum regulators on all individual cylinders in service; and

b. service water to injectors/eductors shall be of adequate supply and pressure to operate feed equipment within the needed chlorine dosage range for the proposed system.

6. Pressurized chlorine feed lines shall not carry chlorine gas beyond the chlorinator room.

7. Full and empty cylinders of chlorine gas shall meet the following requirements:

a. housed only in the chlorine storage room or designated area conforming with §209.A.4 of this Part;

b. isolated from operating areas;

c. restrained in position;

d. stored in locked and/or secure rooms separate from ammonia storage; and

e. protected from direct sunlight or exposure to excessive heat.

B. Acids and caustics. Acids and caustics shall:

1. be kept in closed corrosion-resistant shipping containers or bulk liquid storage tanks; and

2. not be handled in open vessels, but should be pumped in undiluted form to and from bulk liquid storage tanks and covered day tanks or from shipping containers through suitable hoses, to the point of treatment.

C. Sodium chlorite for chlorine dioxide generation. Proposals for the storage and use of sodium chlorite shall be approved by the state health officer prior to the preparation of final plans and specifications. Provisions shall be made for proper storage and handling of sodium chlorite to eliminate any danger of fire or explosion associated with its powerful oxidizing nature.

1. Storage. The storage of sodium chlorite shall comply with the following.

a. Sodium chlorite shall be stored by itself in a separate room and preferably shall be stored in an outside building detached from the water treatment facility. It shall be stored away from organic materials because many materials will catch fire and burn violently when in contact with sodium chlorite.

b. The storage structures shall be constructed of noncombustible materials.

c. If the storage structure shall be located in an area where a fire may occur, water shall be available to keep the sodium chlorite area cool enough to prevent heat induced explosive decomposition of the sodium chlorite.

2. Handling. The criteria for handling of sodium chlorite is as follows.

a. Care should be taken to prevent spillage.

b. An emergency plan of operation should be available for the clean-up of any spillage.

c. Storage drums shall be thoroughly flushed to an acceptable drain prior to recycling or disposal.

3. Feeders. Feeders shall comply with the following requirements.

a. Positive displacement feeders shall be provided.

b. Tubing for conveying sodium chlorite or chlorine dioxide solutions shall be Type 1 PVC, polyethylene or materials recommended by the manufacturer.

c. Chemical feeders may be installed in chlorine rooms if sufficient space is provided or in separate rooms meeting the requirements of §209.A.3 of this Part.

d. Feed lines shall be installed in a manner to prevent formation of gas pockets and shall terminate at a point of positive pressure.

e. Check valves shall be provided to prevent the backflow of chlorine into the sodium chlorite line.

D. Sodium hypochlorite. Sodium hypochlorite storage and handling procedures should be arranged to minimize the slow natural decomposition process of sodium hypochlorite either by contamination or by exposure to more extreme storage conditions. In addition, feed rates should be regularly adjusted to compensate for this progressive loss in chlorine content.

1. Storage. The storage of sodium hypochlorite shall comply with the following.

a. Sodium hypochlorite shall be stored in the original shipping containers or in sodium hypochlorite compatible bulk liquid storage tanks.

b. Storage containers or tanks shall be located out of the sunlight in a cool area and shall be vented to the outside of the building when enclosed.

c. Wherever reasonably feasible, stored sodium hypochlorite shall be pumped undiluted to the point of addition. Where dilution is utilized, deionized or softened water should be used.

d. Storage areas, tanks, and pipe work shall be designed to avoid the possibility of uncontrolled discharges.

e. Reusable sodium hypochlorite storage containers shall be reserved for use with sodium hypochlorite only and shall not be exposed to contamination.

2. Feeders. Sodium hypochlorite feeders shall comply with the following.

a. Positive displacement pumps with sodium hypochlorite compatible materials for wetted surfaces shall be used.

b. To avoid air locking in smaller installations, small diameter suction lines shall be used with foot valves and degassing pump heads as required.

c. In larger installations flooded suction shall be used with pipe work arranged to ease escape of gas bubbles.

d. Calibration tubes or mass flow monitors which allow for direct physical checking of actual feed rates shall be provided.

e. Injectors shall be made removable for regular cleaning where hard water is to be treated.

E. Ammonia. Ammonia for chloramine formation may be added to water either as a water solution of ammonium sulfate, or as aqua ammonia, or as anhydrous ammonia (purified 100% ammonia in liquid or gaseous form). Special provisions required for each form of ammonia are listed below.

1. Ammonium sulfate. A water solution is made by addition of ammonium sulfate solid to water with agitation. The tank and dosing equipment contact surfaces should be made of corrosion resistant non-metallic materials. Provision should be made for removal of the agitator after dissolving the solid. The tank should be fitted with an air-tight lid and vented outdoors. The application point should be at the center of treated water flow at a location where there is high velocity movement.

2. Aqua ammonia (ammonium hydroxide). When the exception criteria in §209.E.2.i of this Part is not met, Aqua ammonia feed pumps and storage shall be enclosed and separated from other operating areas. The aqua ammonia room shall conform to §209.A.3 of this Part and to the following:

a. Corrosion resistant, closed, pressurized tank shall be used for bulk liquid storage and day tanks, vented through inert liquid traps to a high point outside.

b. An incompatible connector or lockout provisions shall be provided to prevent accidental addition of other chemicals to the bulk liquid storage tank(s).

c. The bulk liquid storage tank(s) should be designed to avoid conditions where temperature increases cause the ammonia vapor pressure over the aqua ammonia to exceed atmospheric pressure. Such provisions shall include either:

i. refrigeration or other means of external cooling, and/or;

ii. dilution and mixing of the contents with water without opening the bulk liquid storage tank.

d. An exhaust fan shall be installed to withdraw air from high points in the room and makeup air shall be allowed to enter at a low point.

e. The aqua ammonia feed pump, regulators, and lines shall be fitted with pressure relief vents discharging outside the building away from any air intake and with water purge lines leading back to the headspace of the bulk storage tank.

f. The application point should be placed in a region of rapid, preferably turbulent, water flow.

g. Provisions should be made for easy access for removal of calcium scale deposits from the injector.

h. Provision of a modestly-sized scrubber capable of handling occasional minor emissions should be considered.

i. An exception to the requirement for enclosing aqua ammonia shall be made when aqua ammonia is stored in a manner which satisfies all of the following criteria:

i. protection is provided from direct sunlight and windblown debris;

ii. shielded from public view;

iii. located inside a fenced and secured area, and

iv. secured in a fixed position.

3. Anhydrous ammonia. Anhydrous ammonia is readily available as a pure liquefied gas under moderate pressure in cylinders or as a cryogenic liquid boiling at $^-15°$ Celsius at atmospheric pressure. The liquid causes severe burns on skin contact.

a. When the exception criteria in §209.E.3.i of this Part is not met, anhydrous ammonia storage and feed systems (including heaters where required) shall be enclosed and separated from other works areas and constructed of corrosion resistant materials. Bulk anhydrous ammonia storage tanks holding more than 500 gallons shall not be located in an enclosed area.

b. An emergency air exhaust system, as in §209.A.3 of this Part but with an elevated intake, shall be provided in the ammonia storage room.

c. Leak detection systems shall be provided in all areas through which ammonia is piped.

d. Special vacuum breaker/regulator provisions must be made to avoid potentially violent results of backflow of water into cylinders or storage tanks.

e. Carrier water systems of soft or pre-softened water may be used to transport ammonia to the application point and to assist in mixing.

f. The ammonia injector should use a vacuum eductor or should consist of a perforated tube fitted with a closely fitting flexible rubber tubing seal punctured with a number of small slits to delay fouling by lime or other scale deposits.

g. Provision should be made for the periodic removal of lime or other scale deposits from injectors and carrier piping.

h. Consideration should be given to the provision of an emergency gas scrubber capable of absorbing the entire contents of the largest anhydrous ammonia storage unit whenever there is a risk to the public as a result of potential ammonia leaks.

i. Anhydrous ammonia storage not enclosed in a room shall be stored per the following criteria:

i. protection is provided from direct sunlight and windblown debris;

ii. shielded from public view;

iii. located inside a fenced and secured area, and

iv. secured in a fixed position.

F. Potassium permanganate. Design criteria for potassium permanganate is as follows.

1. A source of heated water should be available for dissolving potassium permanganate, and

2. mechanical mixers shall be provided.

G. Fluoride. Sodium fluoride, sodium silicofluoride and fluorosilicic acid shall conform to the applicable AWWA Standards and be certified to NSF/ANSI Standard 60. Other fluoride compounds which may be available shall be approved by the state health officer.

1. Storage. Design criteria for storage of fluoride compounds is as follows.

a. Fluoride chemicals should be isolated from other chemicals to prevent contamination.

b. Compounds shall be stored in covered or unopened shipping containers and should be stored inside a building.

c. Unsealed storage units for fluorosilicic acid should be vented to the atmosphere at a point outside any building. The vents to atmosphere shall be provided with a corrosion resistant 24 mesh screen.

d. Bags, fiber drums and steel drums should be stored on pallets.

2. Chemical feed equipment and methods. Design criteria for chemical feed and methods for fluoride compounds is as follows.

a. At least two diaphragm operated anti-siphon devices shall be provided on all fluoride saturator or fluorosilicic acid feed systems.

i. one diaphragm operated anti-siphon device shall be located on the discharge side of the feed pump; and

ii. a second diaphragm operated anti-siphon device shall be located at the point of application unless a suitable air gap is provided.

b. A physical break box may be required in high hazard situations where the application point is substantially lower than the metering pump. In this situation, either a dual head feed pump or two separate pumps are required and the anti-siphon device at the discharge side of the pump may be omitted.

c. Scales, loss-of-weight recorders or liquid level indicators, as appropriate, accurate to within five percent of the average daily change in reading shall be provided for chemical feeds.

d. Feeders shall be accurate to within five percent of any desired feed rate.

e. Fluoride compound shall not be added before lime-soda softening or ion exchange softening.

f. The point of application if into a horizontal pipe, shall be in the lower half of the pipe, preferably at a 45 degree angle from the bottom of the pipe and protrude into the pipe one third of the pipe diameter.

g. Except for constant flow systems, a device to measure the flow of water to be treated is required.