Department of Health

Adopted Permanent Rules Relating to Public Water Supplies

Rules as Adopted

4720.0200 JUSTIFICATION.

Parts 4720.0200 to 4720.3970 are adopted pursuant to the Safe Drinking Water Act, Minnesota Statutes, sections 144.381 to 144.388, which requires that the commissioner of health adopt for all public water supplies rules which are at least as stringent as the federal regulations dealing with public water supplies adopted by the United States Environmental Protection Agency, in order for the commissioner to be able to assume the primary responsibility for enforcing the federal act.

4720.0300 SCOPE AND COVERAGE.

Parts 4720.0200 to 4720.3970 prescribe standards for water supply siting and construction, set maximum contaminant levels for turbidity, microbiological constituents, organic and inorganic chemicals, and radioactivity, prescribe a frequency for monitoring the levels of these constituents and sodium and corrosivity, and prescribe the procedures for reporting results, notifying the public and for maintaining records.

The standards and procedures adopted in parts 4720.0200 to 4720.3970 inclusive shall apply to all public drinking water supplies, pursuant to authority granted by existing statutes and amendments thereto, notwithstanding any other water quality standards or regulations.

A water supply which meets all of the following requirements shall not be a public supply for the purpose of parts 4720.0200 to 4720.3970:

A. consists only of distribution and storage facilities and does not have any collection and treatment facilities;

B. obtains all of its water from, but is not owned or operated by a public water supply to which the regulations

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apply;

C. does not sell water to any person; and

D. is not a carrier which conveys passengers in interstate commerce.

4720.0350 RULES AND STANDARDS ADOPTED BY REFERENCE.

The National Primary Drinking Water Regulations in Code of Federal Regulations, title 40, parts 141, and 142.40 to 142.64 as amended through June 29, 1989, are incorporated by reference in parts 4720.0200 to 4720.3970 and are subject to the alterations and amendments contained in parts 4720.0200 to 4720.3970.

4720.0450 DEFINITIONS; SECTION 141.2 OF THE NATIONAL PRIMARY DRINKING WATER REGULATIONS.

Subpart 1. **Central water treatment defined.** In section 141.2 of the National Primary Drinking Water Regulations, the following definition is added:

"Central water treatment" means providing treatment at a common location or facility and subsequently delivering it to the consumer of the public water supply.

Subp. 2. **Commissioner of health defined.** In section 141.2 of the National Primary Drinking Water Regulations, the following definition is added:

"Commissioner of health" means the authority established by Minnesota Statutes, sections 144.381 to 144.388, for enforcement in the state of the National Primary Drinking Water Regulations and parts 4720.0200 to 4720.3970. For purposes of enforcing the National Primary Drinking Water Regulations, title 40, part 141, the term "state" contained in those regulations means the commissioner of health.

Subp. 3. **Composite defined.** In section 141.2 of the National Primary Drinking Water Regulations, the following definition is added:

"Composite" means a sampling technique in which two or more samples are combined before an analysis is performed.

Subp. 4. **Distribution system defined.** In section 141.2 of

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the National Primary Drinking Water Regulations, the following definition is added:

"Distribution system" means a network of pipes, valves, storage reservoirs, and pumping stations that delivers water to homes, businesses, and industries for drinking and other uses.

Subp. 5. **Entry point samples defined.** In section 141.2 of the National Primary Drinking Water Regulations, the following definition is added:

"Entry point samples" means water samples collected at a location after any application of treatment but before the water is delivered to any consumer.

Subp. 6. **Environmental Protection Agency methods defined.** In section 141.2 of the National Primary Drinking Water Regulations, the following definition is added:

"Environmental Protection Agency methods" means methods contained in Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water, September 1986. These methods are issued by the Environmental Monitoring and Support Laboratory (EMSL) of the United States Environmental Protection Agency, Cincinnati, Ohio 45268. These methods are incorporated by reference and are not subject to frequent change. The methods are available through the Minitex interlibrary loan system.

Subp. 7. **Federal act defined.** In section 141.2 of the National Primary Drinking Water Regulations, the following definition is added:

"Federal act" means the Safe Drinking Water Act of 1974, Public Law Number 93-523, title 42, United States Code, section 300f to 300j-11.

Subp. 8. **Federal regulations defined.** In section 141.2 of the National Primary Drinking Water Regulations, the following definition is added:

"Federal regulations" means regulations dealing with public water supplies and drinking water quality, adopted by the Administrator of the United States Environmental Protection Agency pursuant to the federal act.

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Subp. 9. **Groundwater defined.** In section 141.2 of the National Primary Drinking Water Regulations, the following definition is added:

"Groundwater" means the water in the zone of saturation in which all of the pore spaces of the subsurface material are filled with water. The water that supplies a well is groundwater.

Subp. 10. **Turbidity unit defined.** In section 141.2 of the National Primary Drinking Water Regulations, the following definition is added:

"Turbidity unit" means an amount of turbidity equivalent to that in a solution composed of 0.000125 percent hydrazine sulfate and 0.00125 percent hexamethylenetetramine in distilled and filtered (100 µ pore size membrane) water, as measured by a nephelometric turbidimeter.

Subp. 11. **Year round resident defined.** In section 141.2 of the National Primary Drinking Water Regulations, the following definition is added:

"Year round resident" means a person who resides in the area served by the public water supply for more than six months of the year.

4720.0550 MICROBIOLOGICAL CONTAMINANT SAMPLING AND ANALYTICAL REQUIREMENTS; SECTION 141.21 OF THE NATIONAL PRIMARY DRINKING WATER REGULATIONS.

Section 141.21, paragraph (b), clause (1), of the National Primary Drinking Water Regulations is amended to read:

If a routine sample is total coliform-positive, the public water supplier must collect a set of repeat samples within 24 hours of being notified of the positive result. A supplier must collect no fewer than four repeat samples for each total coliform-positive sample found. The commissioner of health may extend the 24-hour limit on a case-by-case basis if the supplier has a logistical problem in collecting the repeat samples within 24 hours and the problem is beyond the supplier's control. In the case of an extension, the commissioner of health shall

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specify how much time the supplier has to collect the repeat samples.

4720.2300 ADDITIONAL MONITORING REQUIREMENTS.

The commissioner may impose additional monitoring requirements if the results of a sanitary survey indicate that a public health risk may exist. The commissioner may impose a requirement for more frequent sampling if the analytical results of water tests show that a previously measured contaminant is approaching a maximum contaminant level prescribed in Code of Federal Regulations, title 40, part 141, as amended through June 29, 1989.

4720.3920 GENERAL REQUIREMENTS FOR CONSTRUCTION OF SURFACE WATER TREATMENT FACILITIES.

The source of surface water selected for a public water supply must provide the highest quality water reasonably available which, with appropriate treatment and adequate safeguards, meets the requirements specified in Code of Federal Regulations, title 40, parts 141.72(b) and 141.73, as amended through June 29, 1989. The design of the treatment processes, equipment, and structures shall depend on an evaluation of the nature and quality of the particular water to be treated. Variations from the design criteria may be approved by the commissioner in cases where experimental, pilot, or full scale studies have demonstrated that acceptable results can be obtained.

4720.3922 INTAKES.

Intake structures must provide:

A. a velocity of flow 0.25 to 0.50 feet per second through the inlet structure so frazil ice is held to a minimum;

B. for the withdrawal of water from the depth of the best water quality;

C. inspection manholes every 1,000 feet for pipe sizes large enough to permit visual inspection;

D. protection against rupture by dragging anchors,

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ice, and other activity; and

E. permanent monuments to reference locations.

4720.3925 SHORE WELLS.

Shore well structures must:

A. have motors and electrical controls located above grade and flood level;

B. be accessible for operation and service;

C. be designed to prevent flotation;

D. be equipped with removable or traveling screens before the pump suction well;

E. provide chlorination or other chemical addition facilities for raw water transmission mains;

F. have the intake valved with provisions for backflushing and testing for leaks; and

G. have provisions for controlling surges.

4720.3927 PUMPING STATIONS; DESIGN REQUIREMENTS.

Subpart 1. **General.** Pumping stations must be designed to maintain the sanitary quality of the water being pumped. All raw or finished water pump stations must:

A. provide space to access and service all equipment;

B. have outward opening doors;

C. have a floor elevation at least six inches above the finished grade and at least 24 inches above the regional flood level. Below grade installations shall be permitted only if the terrain at the site is such that a gravity drain system can be provided;

D. have all floors drained without impairing the quality of water being handled; and

E. provide a suitable outlet for drainage from pump glands without discharging onto the floor.

Subp. 2. **Pumping station suction well.** Suction wells, including installations where the pumps are installed on top of a reservoir, must:

A. be watertight;

B. have bottoms sloped to permit removal of water and

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entrained solids;

C. be vented by means of a pipe or other device terminating in a screened U-bend at least 24 inches above the floor; and

D. have curbs a minimum of four inches around all access openings, pipes, and other equipment which extend through the top of the suction well. Access openings must have covers which overlap at least two inches.

Subp. 3. **Pumping station pumps.** Pumping stations must:

A. have at least two pumping units except where additional pumping stations which can meet the peak demand are available or where the commissioner determines that ample time will be available between pumping periods for necessary repairs. If only two units are provided, each must be capable of carrying the peak demand. If more than two units are installed, each must have sufficient capacity so that any one pump can be taken out of service with the remaining pump capable of carrying the peak demand.

B. have controls for proper alternation where two or more pumps are installed. Provision must be made to prevent operation of the pump during the backspin cycle. All electrical controls must be located above grade.

C. provide a power supply from at least two independent sources or from a standby, auxiliary power source.

D. provide a prelubrication line with a valved bypass around the automatic control and backflow protection where required, whenever automatic prelubrication of pump bearings is necessary and an auxiliary power supply is provided.

Subp. 4. **Pumping station suction lift.** A suction lift shall be allowed only for distances of less than 15 feet and where provision is made for priming the pumps. A suction lift shall not be permitted if used with buried piping carrying finished water.

Subp. 5. **Pumping station priming.** Prime water must not be of lesser sanitary quality than that of the water being pumped. Means must be provided to prevent backflow. When an

air-operated ejector is used, the screened intake must draw clean air from a point at least ten feet above the ground or other source of contamination, unless the air is filtered by apparatus approved by the commissioner. Vacuum priming may be used.

4720.3930 WATER CLARIFICATION PROCEDURES.

Subpart 1. **Duplicate systems.** Facilities designed to process surface water must provide duplicate systems for flocculation and sedimentation and be constructed to permit a system to be taken out of service without disrupting operation.

Subp. 2. **Pretreatment.** Water containing high turbidity or having unusual treatment requirements shall be pretreated, usually by sedimentation or detention either with or without the addition of chemicals.

A. Sedimentation basins must have a means for sludge removal.

B. Inlets for incoming water must disperse water across the full width of the line of travel as quickly as possible; short circuiting must be prevented.

C. Means for bypassing sedimentation basins must be provided.

D. Three hours detention is the minimum period required for sedimentation. In individual cases where chemical pretreatment is required because of unusual water quality characteristics, a greater detention time shall be required.

Subp. 3. **Flash or rapid mixing.** Mixing means the rapid dispersion of chemicals throughout the water to be treated, usually by vigorous agitation.

A. Basins must be equipped with mechanical mixing devices unless other methods, such as baffling or injection of chemicals at a point of high velocity, are approved by the commissioner after determining that the other requirements of this chapter are met.

B. The detention period for mechanical mixing must be as short as possible depending on the velocity gradient provided

by the mixing units.

4720.3932 FLOCCULATION (SLOW MIXING).

Subpart 1. **Basin design.** Inlet and outlet design must prevent short circuiting and destruction of floc. A drain must be provided.

Subp. 2. **Detention.** Minimum flow-through velocity must be not less than 0.5 feet or greater than 1.5 feet per minute with a detention time for floc formation of at least 30 minutes.

Subp. 3. **Equipment.** Agitators must be driven by variable speed drives or other means which vary the peripheral speed of paddles in the range of 0.5 to 3.0 feet per second. Uniform mixing must be provided to prevent settling in the flocculation basin.

Subp. 4. **Piping.** Flocculation and sedimentation basins must be as close together as possible to avoid settling out. The velocity of flocculated water through pipes or conduits to settling basins must be no less than 0.5 feet nor greater than 1.5 feet per second.

Subp. 5. **Baffling; other designs.** Baffling may be used to provide flocculation only after the supplier consults with the commissioner and receives the commissioner's approval. The design must maintain the velocities and flows set forth in this subpart.

4720.3935 SEDIMENTATION.

Subpart 1. **General.** Sedimentation must follow flocculation. The detention time for effective water clarification shall depend on basin design and the nature of the raw water, such as turbidity, color, colloidal matter, taste, and odor causing compounds.

Subp. 2. **Detention time.** Facilities with a conventional sedimentation system must provide a minimum of four hours of settling time.

Subp. 3. **Inlet devices.** Inlets must be designed to distribute the water equally and at uniform velocities. A baffle must be constructed across the basin, close to the inlet

end. The baffle must project far enough below the water surface to dissipate inlet velocities and provide uniform flow across the basin.

Subp. 4. **Outlet devices.** Outlet devices must maintain velocities suitable for settling in the basin and must minimize short circuiting.

Subp. 5. **Weir overflow rate.** The rate of flow over the outlet weir must not exceed 20,000 gallons a day per foot of weir length. If submerged ports are used as an alternate for overflow weirs, they must not be lower than three feet below the flow line.

Subp. 6. **Drainage.** Basins must be provided with a means for dewatering. Basin bottoms must slope toward the drain.

Subp. 7. **Covers.** Covers or superstructures are required at all facilities. Where covers are used, manholes must be provided, as well as drop light connections, so the flow can be observed at the inlet midpoint and outlet of the basin.

Subp. 8. **Velocity.** The velocity through settling basins must not exceed one foot a minute. The basins must be designed to minimize short circuiting. Baffles must be provided if the commissioner determines the flow through time cannot be met.

Subp. 9. **Overflow.** An overflow weir or pipe must be installed which establishes the maximum water level on top of the filters. The overflow weir must discharge with a free fall at a location where the discharge is visible.

Subp. 10. **Safety.** Guard rails must be installed around openings hazardous to maintenance personnel.

Subp. 11. **Sludge disposal.** A facility must provide for sludge disposal. Provisions must be made for the operator to observe and sample sludge being withdrawn from the unit.

Subp. 12. **Cross connection control.** Protection must be provided for all potable water lines used to backflush sludge lines and basins or for other purposes if potable water could become contaminated by nonpotable water.

4720.3940 SOLIDS CONTACT UNIT.

Subpart 1. **General.** A unit designed for combined water softening and sedimentation shall be permitted only if the unit is:

A. designed for the maximum uniform flow rate;

B. adjustable to changes in flow which are less than the design rate; and

C. designed for changes in water quality characteristics.

Subp. 2. **Installation supervision.** Supervision by a representative of the manufacturer must be provided whenever mechanical equipment is installed at the facility and, also, at the time of initial operation.

Subp. 3. **Sampling taps.** Sampling taps must be located to permit the collection of water samples from the solids contact unit.

Subp. 4. **Chemical feed.** Chemicals must be applied at points and by means which ensure satisfactory mixing of the chemicals with the water.

Subp. 5. **Mixing devices.** Mixing devices must be constructed to adequately mix raw water with previously formed sludge particles, and to prevent the deposit of solids in the mixing zone.

Subp. 6. **Flocculation.** Flocculation equipment must be adjustable so that coagulation occurs in a separate chamber or baffled zone within the unit and so that there is a flocculation and mixing period of not less than 30 minutes.

Subp. 7. **Sludge concentrators.** The solids contact unit must provide either internal or external concentrators which concentrate sludge and minimize wastewater.

Subp. 8. **Sludge removal.** Design of the sludge removal system must provide:

A. sludge pipes not less than three inches in diameter, arranged to facilitate cleaning;

B. an entrance to sludge withdrawal piping to prevent clogging;

C. accessible valves located outside the tank; and

D. a means for an operator to observe or sample sludge being withdrawn from the solids contact unit.

Subp. 9. **Cross connections.** Blow-off outlets and drains must terminate and discharge at places so backflow is prevented. Cross connection control must be included for all potable water lines including those used to backflush sludge lines and flush basins if potable water could become contaminated by nonpotable water.

Subp. 10. **Detention period.** The detention time must be established on the basis of the raw water characteristics and local conditions that affect the operation of the unit. Based on design flow rates, the minimum detention time must be two hours for suspended solids contact clarifiers, and one hour for the suspended solids contact softeners.

Subp. 11. **Suspended slurry concentrate.** Softening units must be designed so continuous slurry concentrates of one percent or more, by weight, are maintained.

Subp. 12. **Weirs or orifices.** Units must be equipped with either overflow weirs or orifices. Weirs must be adjustable, must be at least equivalent in length to the perimeter of the tank, and must be constructed so surface water does not travel over ten feet horizontally to the collection trough.

Subp. 13. **Weir; orifice loading.** Weir loading must not exceed 20 gallons a minute per foot of weir length for units used for softeners, or ten gallons a minute per foot of weir length for units used for clarifiers. Orifices must produce uniform rising rates over the entire area of the tank.

Subp. 14. **Upflow rates.** The upflow rates in the solid contact unit must not exceed:

A. 1.75 gallons a minute per square foot of area at the slurry separation line if units are used for softeners; and

B. 1.0 gallon a minute per square foot of area at the sludge separation line if units are used for clarifiers.

4720.3942 FILTRATION.

The application of any type of filter and media must be

supported by water quality data for the period of use sufficient to characterize any variation in water quality. Filtration systems must meet the requirements in parts 4720.3945 to 4720.3955.

4720.3945 RAPID RATE GRAVITY FILTERS.

Subpart 1. **Pretreatment.** Rapid rate gravity filters must only be used after coagulation, flocculation, and sedimentation.

Subp. 2. **Number.** At least two filter units must be provided. Provisions must be made to meet the maximum day demand at the approved filtration rate if one filter is out of service.

Subp. 3. **Rate of filtration.** The permissible rate of filtration shall be determined after consideration of factors such as raw water quality, the degree of pretreatment provided, the filter media, and water quality control parameters. In all cases the filtration rate must be reviewed and approved by a registered engineer and approved by the commissioner before the preparation of final plans.

Subp. 4. **Structural details and hydraulics.** The filter structure must be designed to:

A. provide vertical walls within the filter;

B. prevent protrusion of the filter walls or other structures into the filter media or the area between the top of the media and the high water line during backwashing;

C. provide cover by superstructure;

D. provide head room to permit normal inspection and operation;

E. provide a minimum filter depth of 8-1/2 feet;

F. provide a minimum water depth three feet over the surface of the media;

G. provide a trap on the effluent pipe or conduit to prevent backflow of air to the bottom of the filter;

H. prevent drainage from the floor to the filter with a minimum four-inch curb around the filter;

I. prevent flooding by providing overflow if this is

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not provided in a pretreatment unit;

J. provide a maximum velocity of treated water in the pipe and conduits to the filter of two feet per second;

K. provide cleanouts and straight alignment for influent pipes or conduits where solids loading is heavy or following lime-soda softening;

L. provide wash water drain capacity to carry maximum backwash flow;

M. provide walkways around filters not less than 24 inches wide; and

N. provide safety handrails or walls around the filter areas adjacent to the walkways.

Subp. 5. **Wash water troughs.** Wash water troughs must be designed to provide:

A. a bottom elevation above the maximum level of expanded media during washing;

B. a top elevation not exceeding 30 inches above the filter surface;

C. a two-inch freeboard at the maximum rate of wash;

D. a top or edge which is level;

E. spacing so each trough serves the same number of square feet of filter area; and

F. a maximum horizontal travel of suspended particles not exceeding three feet in reaching the trough.

Subp. 6. **Filter media.** Filter media must meet the standards specified in this subpart.

A. Sand must be:

(1) clean silica sand having a depth no less than 24 inches and no more than 30 inches;

(2) an effective size from 0.45 millimeter to 0.55 millimeter, depending upon the quality of the raw water; and

(3) have a uniformity coefficient no greater than 1.65 millimeters.

B. Clean crushed anthracite, or sand and anthracite may be used as a filter media if supported by experimental data

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obtained from the project. Anthracite used as the only media must have an effective size from 0.45 millimeter to 0.8 millimeter and a uniformity coefficient no greater than 1.6 millimeters. Anthracite used to cap sand filters must have an effective size from 0.7 millimeter to 1.2 millimeters and a uniformity coefficient no greater than 1.85 millimeters.

C. Granular activated carbon may be used as a filter material only if approved by the commissioner. A request for approval must:

(1) include a report from a registered engineer detailing raw water quality, the results of pilot plant studies, proposed flow rates, process controls to be provided, proposed operational adjustments, and justification for the project proposals;

(2) specify criteria for the media;

(3) provide for a chlorine residual in the water following filtering and before distribution;

(4) provide for periodic treatment of the filter bed to control possible bacterial and other growths; and

(5) include plans showing any proposed modification of facilities.

D. Other media may be approved by the commissioner, but only on the basis of pilot tests and experience which demonstrate that the requirements of this part will be met.

E. Except as provided in item F, sand and gravel must be provided as supporting media according to subitems (1) and (2).

(1) A three-inch layer of sand must be used as a supporting media for the filter sand. The sand must have an effective size from 0.8 millimeter to 2.0 millimeters, and a uniformity coefficient no greater than 1.7 millimeters.

(2) Gravel, when used as the supporting media, must consist of hard, rounded particles and must not include flat or elongated particles. The coarsest gravel shall be no more than 2-1/2 inches in diameter in any direction when the gravel rests directly on the strainer system, and must extend

above the top of the perforated laterals or strainer nozzles. No less than four layers of gravel shall be provided according to the following size and depth distribution when used with perforated laterals or strainer nozzles:

(a) 2-1/2 to 1-1/2 inches, five to eight inches deep;

(b) 1-1/2 to 1/4 inches, three to five inches deep;

(c) 1/4 to 1/2 inches; three to five inches deep;

(d) 1/2 to 3/16 inches, two to three inches deep; and

(e) 3/16 to 3/32 inches, two to three inches deep.

F. If the supplier submits subtantiation to the commissioner that proprietary filter bottoms are used, the commissioner may allow elimination of certain layers of supporting media or a reduction in the depth of the layers of supporting media that are required in item E.

Subp. 7. **Filter bottoms and strainer systems.** Departures from the standards in this subpart by using proprietary bottoms may be approved by the commissioner on a case-by-case basis if the effectiveness of the method is demonstrated by the supplier. Porous plate bottoms must not be used where iron or manganese may clog them or with water softened with lime. The design of a manifold-type collection system must:

A. minimize loss of head in the manifold and laterals;

B. assure even distribution of wash water and an even rate of filtration over the entire area of the filter;

C. provide a ratio of the area of the final openings of the strainer system to the area of the filter of not more than 0.003;

D. provide a total cross-sectional area of the laterals at least twice the total area of the final openings of the strainer system; and

E. provide a cross-sectional area of the manifold at 1-1/2 to two times the total cross-sectional area of the laterals.

Subp. 8. **Surface wash.** Surface wash facilities consisting of either fixed nozzles or a revolving mechanism are required. All devices must be designed for:

A. water pressures of at least 45 pounds per square inch;

B. a volume of flow of 2.0 gallons per minute per square foot of filter area with fixed nozzles and 0.5 gallons per minute per square foot with revolving arms; and

C. a vacuum breaker installed above the high water elevation in the filter or other device approved by the commissioner to prevent back siphonage.

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

A. a sampling tap on the effluent line;

B. a loss-of-head gauge;

C. controls to indicate flow rate;

D. a drain to waste with appropriate measures for backflow prevention;

E. a means of monitoring the effluent from each filter for turbidity on a continuous basis or on a selective basis where one turbidimeter would monitor more than one filter on a rotating cycle. The turbidimeter must have a recorder. Access to the filter interior through wall sleeves must be provided in several locations to allow the installation of sampling lines, pressure sensors, and other devices, at different depths in the filter media; and

F. a one to 1-1/2 inch pressure hose and rack at the operating floor for washing the filter walls.

Subp. 10. **Backwash.** Facilities must provide for the washing of filters as follows:

A. by filtered water at a rate no less than 15 gallons per square foot per minute from wash water tanks, a wash water pump from a reservoir, or a high service main, or a

combination of these;

B. by wash water pumps in duplicate unless an alternate means of obtaining wash water is available;

C. by no less than 15 minutes wash of one filter at the design rate of wash;

D. by a wash water regulator or valve on the wash water line to obtain the desired rate of filter wash;

E. by a rate-of-flow indicator and totalizer on the main wash water line, located for convenient reading by the operator during the washing process; and

F. by a method which prevents rapid changes in the backwash water flow.

Subp. 11. **Roof drains.** Roof drains must not discharge into the filters and basins or the conduits preceding the filters.

4720.3947 SLOW RATE GRAVITY FILTERS.

Subpart 1. **Demonstration study.** The use of slow rate gravity filters shall require an engineering study to demonstrate the adequacy and suitability of this filtration method for a specific raw water supply. The standards in this part shall be applied to determine the adequacy and suitability of this filtration method.

Subp. 2. **Quality of raw water.** Slow rate gravity filtration must be limited to water with a maximum turbidity of 50 units and maximum color of 30 units. The turbidity must not be attributable to colloidal clay. Raw water quality data must include an examination for algae.

Subp. 3. **Structural details and hydraulics.** A slow rate gravity filter must be designed to provide:

A. no less than two filter units;

B. a cover or superstructure;

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

D. manholes and access ports for handling sand; and

E. filtration to waste and overflow at the maximum

filter water levels.

Subp. 4. **Rates of filtration.** The permissible rates of filtration must be based on the quality of the raw water as determined from experimental data. Proposed rates must be submitted to the commissioner for approval. The design rate shall be 45 to 150 gallons a day per square foot of sand area. However, rates of 150 to 230 gallons a day per square foot shall be approved when effectiveness is demonstrated by the supplier to the satisfaction of the commissioner.

Subp. 5. **Under drains.** Each filter unit must be equipped with a main drain and lateral drains under the filter media to collect the filtered water. The under drains must be spaced so the maximum velocity of the water flow in a lateral under drain does not exceed 0.75 feet per second. The maximum spacing of lateral under drains shall not exceed 12 feet.

Subp. 6. **Filtering material.** A minimum depth of 30 inches of filter sand, clean and free of foreign matter, must be placed on graded gravel layers. The effective size of the filter media must be between 0.35 and 0.50 millimeter, and the uniformity coefficient must not exceed 2.5.

Subp. 7. **Filter gravel.** The supporting gravel must conform to the size and depth distribution provided for rapid rate gravity filters.

Subp. 8. **Depth of water on filter beds.** The design must provide a depth of at least three feet of water over the sand. Influent water must be distributed in a manner which does not scour the sand surfaces.

Subp. 9. **Control appurtenances.** Each filter must be equipped with:

A. a loss-of-head gauge;

B. an orifice, Venturi meter, or other suitable metering device installed on each filter to enable control of the rate of filtration; and

C. an effluent pipe located at an elevation which maintains the water level in the filter above the top of the sand.

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4720.3950 DIATOMACEOUS EARTH FILTRATION.

Subpart 1. **Applicability.** The use of diatomaceous earth filters may be considered for application to surface water with low turbidity and low bacterial contamination. Diatomaceous earth filters must not be used for bacterial removal, color removal, or turbidity removal where either the gross quantity of turbidity exceeds 40 turbidity units or the turbidity exhibits poor filterability characteristics.

Subp. 2. **Pilot plant study.** Installation of a diatomaceous earth filtration system must 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, and bacteria removal, must be approved by the commissioner before the study.

B. The pilot plant study must demonstrate the ability of the system to meet the requirements of Code of Federal Regulations, title 40, part 141.73(c), as amended through June 29, 1989.

Subp. 3. **Treated water storage capacity.** Treated water storage capacity in excess of normal requirements must be provided to allow operation of the filters at a uniform rate during all conditions of system demand at or below the approved filtration rate, and to guarantee continuity of service during adverse raw water conditions without bypassing the system.

Subp. 4. **Number of filters.** There must be at least two filters provided. Where only two filters are provided, they must each be capable of meeting the plant's design capacity at the approved filtration rate.

Subp. 5. **Precoat.** A uniform precoat of diatomaceous earth must be applied hydraulically to each septum by introducing a slurry to the tank influent line and employing a filter-to-waste or recirculation system. Diatomaceous earth in the amount of 0.1 pound per square foot of filter area or an amount sufficient to apply a 1/16 inch coating must be used with recirculation.

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When precoating is accomplished with a filter-to-waste system, 0.15 to 0.2 of a pound per square foot of filter area must be provided.

Subp. 6. **Body feed.** A body feed system must apply additional amounts of diatomaceous earth slurry during the filter run to avoid short filter runs or excessive head loss.

A. The rate of body feed shall depend on raw water quality and characteristics and must be determined in the pilot plant study in subpart 2.

B. The feed systems and slurry lines must be accessible.

C. The body feed slurry must be continuously mixed.

Subp. 7. **Rate of filtration.** The minimum rate of filtration is 1.0 gallon a minute per square foot of filter area with a maximum of 1.5 gallons a minute per square foot. The filtration rate must be mechanically controlled.

Subp. 8. **Recirculation.** A recirculation or holding pump must be used to maintain differential pressure across the filter when the unit is not in operation to prevent the filter cake from dropping off the filter elements. A minimum recirculation rate of 0.1 gallon a minute per square foot of filter area must be provided.

Subp. 9. **Septum or filter element.** The filter elements must be structurally capable of withstanding maximum pressure and velocity variations during filtration and backwash cycles, and must be spaced so no less than one inch is provided between elements or between any element and a wall.

Subp. 10. **Inlet design.** The filter influent must be designed to prevent scour of the diatomaceous earth from the filter element.

Subp. 11. **Backwash.** A satisfactory method to thoroughly remove and dispose of spent filter cake must be provided.

Subp. 12. **Appurtenances.** The following must be provided for every filter:

A. sampling taps for raw and filtered water;

B. a loss of head or differential pressure gauge;

C. rate-of-flow indicator, preferable with totalizer; and

D. a throttling valve to reduce rates below normal during adverse raw water conditions.

Subp. 13. **Monitoring turbidimeter.** A continuous monitoring turbidimeter with recorder is required on the filter effluent for plants treating surface water.

4720.3955 DIRECT FILTRATION PLANTS.

Subpart 1. **Studies.** A full scale direct filtration plant must not be constructed without a pilot study acceptable to the commissioner. An in-plant demonstration study shall be appropriate where conventional treatment plants are converted to direct filtration. Where direct filtration is proposed, the supplier must submit an engineering report to the commissioner. The commissioner must approve the report before the supplier conducts a pilot plant or in-plant demonstration study.

Subp. 2. **Engineering report.** The engineering report must 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 must 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 reviewing authority.

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

Subp. 3. **Pilot plant or in-plant demonstration studies.** After approval of the engineering report, a pilot study or, for

existing plants where conventional treatment is being converted to direct filtration, an 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 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; and

H. a description of the adverse impact of recycling backwash water due to solids, algae, trihalomethane formation and similar problems.

Before initiation of design plans and specifications, the supplier shall submit a final report including the engineer's design recommendations. The study must demonstrate the minimum contact time necessary for optimum filtration for each coagulant proposed.

Subp. 4. **Pretreatment - rapid mix and flocculation.** The final rapid mix and flocculation basin design shall be based on the pilot plant or in-plant demonstration studies augmented with applicable portions of parts 4720.3930, subpart 3, and 4720.3932.

Subp. 5. **Filtration.** Filters must be rapid rate gravity filters, with dual or mixed media. The final filter design must be based on the pilot plant or in-plant demonstration studies augmented by applicable portions of part 4720.3945, subparts 1 to 7. Pressure filters or single media sand filters must not be used.

A. Surface wash, subsurface wash, or air scour must be provided for the filters according to part 4720.3945, subpart

8.

B. Provisions for filtration to waste must be provided with measures for backflow prevention according to chapter 4715.

Subp. 6. **Siting requirements.** The plant design and land ownership surrounding the plant must allow for the installation of conventional sedimentation basins should the commissioner find that the installation of the direct filtration methods specified in this part do not achieve the water quality standard indicated in Code of Federal Regulations, title 40, part 141.73(a)(1), as amended through June 29, 1989.

4720.3957 CHEMICAL ADDITION.

Subpart 1. **Feed equipment required.** If chemical feed such as chlorination, coagulation, or other processes are necessary for the protection of the water supply, a minimum of two feeders must be provided so a standby unit or combination of units is available to replace the largest unit during shutdowns. Spare parts must be available for all feeders to replace parts subject to wear and damage.

Subp. 2. **Design and capacity.** The design of the facility must ensure that:

A. a separate feed system is provided for each chemical;

B. feeders supply, at all times, the necessary amounts of chemical at an accurate rate, throughout the range of feed. To allow for changes in pumping or application rates, the feeder must be designed to operate between 30 and 70 percent of the feeder range on initial start-up. If this is not possible with stock chemical solution, the chemical must be diluted;

C. proportioning of chemical feed to rate of flow is provided;

D. positive displacement-type solution feeders are used to feed liquid chemicals;

E. chemical solutions are prevented from being siphoned into the water supply by assuring discharge at points

of positive pressure and by providing anti-siphon devices, or through a suitable air gap or other effective means approved by the commissioner;

F. the service water supply is protected from contamination by chemical solutions either by equipping the supply line with backflow or backsiphonage prevention devices, or by providing an air gap of two pipe diameters, but not less than three inches, between the supply line and top of the solution tank;

G. materials and surfaces in contact with chemicals are resistant to the chemical solution;

H. dry chemical feeders:

(1) measure chemicals volumetrically or gravimetrically;

(2) effectively dissolve the chemical in the solution pot;

(3) provide gravity feed from solution pots, if possible; and

(4) completely enclose chemicals to prevent emission of dust to the operating room; and

I. no direct connection exists between any sewer and a drain or overflow from the feeder or solution chamber or tank.

Subp. 3. **Location of feed equipment.** Chemical feed equipment must be:

A. readily accessible for servicing, repair, and observation of operation;

B. located and have protective curbings to prevent chemicals from equipment failure, spillage, or accidental drainage from entering the water in conduits, and treatment or storage basins; and

C. located above grade.

Subp. 4. **Controls.** Feeders must be manually or automatically controlled if the water supply pumps are manually controlled. Where pumps are automatically controlled, the feeders must be automatically controlled. In all cases, automatic control shall be capable of reverting to manual

control when necessary.

A. Feeders must be designed and controlled to provide rates proportional to flow.

B. Automatic chemical feed rate control may be used in combination with residual analyzers which have alarms for critical values and recording charts.

Subp. 5. **Weighing scales.** Weighing scales:

A. must be provided to weigh cylinders at all plants using chlorine gas;

B. are required for solution feed unless a comparable means for determining use is approved by the commissioner;

C. are required for volumetric dry chemical feeders; and

D. must be accurate enough to measure increments of 0.5 percent of load.

Subp. 6. **Feed lines.** Feed lines must:

A. be as short as possible in length of run; of durable, corrosion resistant material; easily accessible throughout entire length; protected against freezing; and readily cleanable;

B. slope upward from chemical source to feeder when conveying gases;

C. introduce corrosive chemicals so as to minimize the potential for corrosion;

D. be designed consistent with the scale-forming or solids-depositing properties of the water, chemical, solution, or mixture conveyed;

E. not carry chlorine gas under pressure beyond the chlorine feeder room; and

F. include an injection nozzle when application is into a pipeline.

Subp. 7. **Service water supply.** Water used for dissolving dry chemicals, diluting liquid chemicals, or operating chemical feeders must be from a safe, approved source with appropriate backflow prevention provided. The commissioner may grant an exception in cases where the finished water quality is not

affected by addition of the chemical mixed with untreated water.

4720.3960 CHEMICAL STORAGE.

Subpart 1. **Storage space.** Storage space must provide for:

A. storage of at least 30 days of chemical supply;

B. convenient and efficient handling of chemicals;

C. dry storage conditions; and

D. a minimum of 1-1/2 truckloads storage volume where purchase is by truckload.

Subp. 2. **Containers.** Covered or unopened shipping containers must be provided for storage unless the chemical is transferred into an approved covered storage unit. Solution tanks must have overlapping covers.

Subp. 3. **Capacity.** Solution storage or day tanks supplying feeders directly must have sufficient capacity for one day of operation. When the chemical solution is prepared from a powder or slurry, two solution tanks are required to assure continuity of feed.

Subp. 4. **Storage containers.** Storage must be constructed of or lined with materials compatible with the chemical being handled.

Subp. 5. **Mixing equipment.** Mixing equipment must be provided where necessary to assure a uniform chemical solution strength.

Subp. 6. **Measurements.** Means must be provided to accurately determine the amount of chemical applied either by measurement of the solution level in the tank or by weighing scales. A meter must be provided on the water fill line to a fluoride saturator. Liquid chemical storage tanks must have a liquid level indicator.

Subp. 7. **Drainage.** Means to drain tanks must be provided in the storage space, but there must be no direct connection between any drain piping and a sewer. Drain piping must terminate at least two pipe diameters, but not less than three inches, above the overflow rim of a receiving sump, conduit, or waste receptacle.

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Subp. 8. **Overflow pipes.** Overflow pipes must be turned downward, be screened, have a free discharge, and be in a conspicuous location.

Subp. 9. **Subsurface storage.** Where subsurface locations for solution or storage tanks are provided, the tanks must be free from sources of possible contamination and located to assure drainage for groundwater, accumulated water, chemical spills, and overflows.

Subp. 10. **Compatibility of chemicals.** Incompatible chemicals must not be stored or handled in common areas.

Subp. 11. **Venting.** Gases from feeders, storage, and equipment exhausts must be conveyed to the outside atmosphere above grade and remote from air intakes. Acid storage tanks must be vented to the outside but not through vents in common with day tanks.

4720.3962 CHEMICAL HANDLING.

Subpart 1. **Measuring equipment.** Equipment must be provided in the handling facility to measure the chemicals used to prepare feed solutions.

Subp. 2. **Piping.** Piping for chemicals must be compatible with the chemical being conveyed.

Subp. 3. **Dust control.** Provision must be made for the transfer of dry chemicals from shipping containers to storage bins or hoppers in a way that minimizes dust. Control must be provided by use of one of the following:

A. vacuum pneumatic equipment or closed conveyor systems;

B. facilities for emptying shipping containers in special containers; or

C. exhaust fans and dust filters which place the hoppers or bins under negative pressure.

Subp. 4. **Acids.** Acids must be kept in closed, acid-resistant shipping containers or storage units. Transfer from shipping containers to solution or day tanks must be through suitable hose or pipe by means of a transfer pump.

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4720.3965 DISINFECTION.

Subpart 1. **Chlorine.** Chlorine must be the principal agent used to disinfect the water supply. Other agents may be approved by the commissioner on a case-by-case basis provided reliable feeding equipment is available and testing procedures for a residual are recognized in the 16th edition of Standard Methods for the Examination of Water and Wastewater (1985). This edition is incorporated by reference, is not subject to frequent change, and is available through the Minitex interlibrary loan system.

Subp. 2. **Equipment.** A gas chlorinator or a positive displacement hypochlorite feeder must be provided by the supplier.

Subp. 3. **Capacity.** The chlorinator capacity must provide that a free chlorine residual of at least two mg/l is attained in the water after a contact time of at least 30 minutes when maximum flow rates coincide with anticipated maximum chlorine demands. The equipment must be designed to operate accurately over the desired feed range.

Subp. 4. **Standby equipment.** Where chlorination is needed to protect the water supply, standby equipment of sufficient capacity must be available to replace the largest unit during shutdowns.

Subp. 5. **Automatic proportioning.** Automatic proportioning chlorinators are required where the rate of flow is not reasonably constant or where the rate of flow of the water is not manually controlled.

Subp. 6. **Contact time and point of application.** To determine the contact time of the chlorine in water, ammonia, taste-producing substances, temperature, bacterial quality, trihalomethane formation potential and other pertinent factors must be considered. All basins used for disinfection must be designed to minimize short circuiting.

A. At plants treating surface water, provisions must be made for applying chlorine to the raw water, settled water,

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filtered water, and water entering the distribution system. The contact time required in item B must be provided after filtration.

B. Surface water supplies using free residual chlorination must provide a minimum contact time of two hours. When combined residual chlorination is used for surface water supplies, a minimum of three hours contact time must be provided.

Subp. 7. **Residual testing equipment.** Residual testing equipment must measure residuals to the nearest 0.1 mg/l in the range below 0.5 mg/l and to the nearest 0.2 mg/l between 0.5 mg/l to 2.0 mg/l.

Subp. 8. **Chlorinator piping.** The water supply piping must be designed to prevent contamination of the treated water supply by water sources of impure or unknown quality.

Subp. 9. **Housing.** Chlorine gas feed and storage must be:

A. separated from other operating areas by gas-tight enclosures to prevent injury to personnel and damage to equipment;

B. provided with an inspection window installed in an interior wall or exterior door to permit viewing of the interior of the room and the equipment;

C. provided with doors having emergency or panic hardware and opening outward to the building exterior;

D. heated to prevent freezing and insure proper operation of the equipment;

E. provided with restraints to prevent movement of the chlorine cylinders; and

F. designed so the ejector for mixing chlorine gas and water is located in the chlorine room <u>where chlorine gas under pressure is used</u>.

Subp. 10. **Ventilation of chlorine rooms.** One complete air change a minute must be provided when the chlorine room is occupied. In addition:

A. the exhaust fan suction must be near the floor with the point of discharge located to avoid contamination of air inlets to other rooms and structures or blockage by snow or

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other obstructions;

B. air inlets must be located near the ceiling and controlled to prevent adverse temperature variation;

C. the exhaust fan switch must be located at the entrance to the chlorine room with a signal light indicating fan operation when the fan is controlled from more than one point; and

D. vents from feeder and storage units must discharge to the outside atmosphere, above grade as indicated in item A.

Subp. 11. **Ammoniation.** Housing and ventilation for ammoniation must be provided as specified in subparts 9 and 10. Ammonia storage and feed facilities must be separate from chlorine facilities because of the combustion hazard. A plastic bottle of hydrochloric acid must be available and used for leak detection.

4720.3970 VARIANCE PROCEDURES AND CRITERIA FOR SURFACE WATER CONSTRUCTION STANDARDS.

The commissioner of health shall grant a variance to parts 4720.3920 to 4720.3965 according to the procedures and criteria in parts 4717.7000 to 4717.7050~~, as proposed at 15 State Register 985, October 29, 1990, and as later adopted~~.

REPEALER. Minnesota Rules, parts 4717.6000 to 4717.6900, 4720.0020, 4720.0100, 4720.0400, 4720.0500, 4720.0600, 4720.0700, 4720.0800, 4720.0900, 4720.1000, 4720.1100, 4720.1200, 4720.1300, 4720.1400, 4720.1500, 4720.1510, 4720.1600, 4720.1700, 4720.1800, 4720.1900, 4720.2000, 4720.2100, 4720.2200, 4720.2400, 4720.2500, 4720.2600, 4720.3100, 4720.3200, 4720.3300, 4720.3400, 4720.3500, 4720.3510, 4720.3600, 4720.3700, and 4720.3900 are repealed.

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