

SUBTITLE F

TITLE 35: ENVIRONMENTAL PROTECTION
SUBTITLE F: PUBLIC WATER SUPPLIES
CHAPTER I: POLLUTION CONTROL BOARD

PART 604
DESIGN, OPERATION AND MAINTENANCE CRITERIA

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AUTHORITY: Implementing Section 14-19 and authorized by Section 27 of the Illinois Environmental Protection Act [415 ILCS 5].

SOURCE: Adopted in R18-17 at 43 Ill. Reg. _____, effective July 26, 2019.

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SUBPART A: GENERAL PROVISIONS

Section 604.100 Purpose

This Part includes the design, operational, and maintenance criteria for owners, operators and official custodians of community water supplies.

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Section 604.105 General Requirements

- a) The community water supply must be designed to produce at least 20 percent greater than the maximum average daily demand, as defined in 35 Ill. Adm. Code 601.105.
- b) The criteria for design of community water supply facilities must be the standards under this Part or other criteria under 35 Ill. Adm. Code 602 that the applicant demonstrates will produce a finished water that meets the requirements of 35 Ill. Adm. Code 611 under all operating conditions.
- c) Water must be treated to meet the national primary drinking water standards in 35 Ill. Adm. Code 611.
- d) Duplicate units for water treatment facilities must be provided in the following situations:
 - 1) The treatment is installed to comply with any microbial requirements in 35 Ill. Adm. Code 611;
 - 2) The treatment unit is installed to comply with the maximum contaminant level for nitrite or nitrate in 35 Ill. Adm. Code 611.301; and
 - 3) The treatment unit is installed to comply with Section 17.10 of the Act regarding the removal of carcinogenic volatile organic compounds.
- e) Duplicate units are not required under subsection (d) if an adequate supply of finished water can be provided to meet the maximum daily demand to the community water supply and comply with the requirements of 35 Ill. Adm. Code 611 with the water treatment facility out of service for any period of time.
- f) Unless otherwise approved by the Agency under Section 604.145(b), products that come in contact with water, including protective barrier materials, joining and sealing materials, mechanical devices, pipes and related products, plumbing devices, process media and non-metallic potable water materials, or components that comprise chemical feed systems in a community water supply, must be certified to comply with NSF/ANSI Standard 61 and NSF/ANSI Standard 372, incorporated by reference in 35 Ill. Adm. Code 601.115.
- g) Water treatment chemicals must be certified to comply with NSF/ANSI Standard 60, incorporated by reference in 35 Ill. Adm. Code 601.115.

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Section 604.110 Location

- a) All community water supplies must select construction sites after completing an evaluation of risk from earthquakes, land subsidence, floods, fires or other disasters that could result in breakdown of any part of the system. If a site is subject to an identified risk, the community water supply must submit a complete statement describing reasons for site selection and identify construction measures that will be taken to protect the community water supply.
- b) All community water supply facilities must be located outside the flood plain or must be at least two feet above the 100-year flood elevation or maximum flood of record, whichever is higher.
- c) All access roads, except roads to wells, must be protected to at least the 100-year flood elevation or maximum flood of record.

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Section 604.115 Usage

- a) Average daily usage must be based on finished water pumpage records. When records are not available or when a new supply is proposed, average daily usage must be based on at least 75 gallons per person per day based on the current or projected population to be served.
- b) The average daily usage estimate must be increased when large uses such as irrigation, filling swimming pools, and service to commercial or industrial establishments are known or anticipated.
- c) When records are not available, maximum demand must be calculated as 1.5 times the average daily usage.
- d) For Sections 604.1345 and 604.1350, peak hourly flow must be calculated using six times the average daily usage and converted into units of gallons per minute.

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Section 604.120 Piping Identification

- a) Piping in a community water supply treatment facility must be identified clearly by legends or the use of nametag labels identifying the contents of individual pipes, spaced at intervals to allow convenient identification of individual pipes. A consistent standard must be used throughout the system.
- b) The following color scheme or a similar consistent scheme must be used to identify piping in plants and pumping stations:
 - 1) Water Lines
 - A) Raw or Recycle: Olive Green
 - B) Settled or Clarified: Aqua
 - C) Finished or Potable: Dark Blue
 - 2) Chemical Lines
 - A) Alum or Primary Coagulant: Orange
 - B) Ammonia: White
 - C) Carbon Slurry: Black
 - D) Caustic: Yellow with Green Band
 - E) Chlorine (Gas and Solution): Yellow
 - F) Chlorine Dioxide: Yellow with Violet Band
 - G) Fluoride: Light Blue with Red Band
 - H) Lime Slurry: Light Green
 - I) Ozone: Yellow with Orange Band
 - J) Phosphate Compounds: Light Green with Red Band
 - K) Polymers or Coagulant Aids: Orange with Green Band
 - L) Potassium Permanganate: Violet

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- M) Soda Ash: Light Green with Orange Band
 - N) Sulfuric Acid: Yellow with Red Band
 - O) Sulfur Dioxide: Light Green with Yellow Band
- 3) Waste Lines
- A) Backwash waste: Light Brown
 - B) Sludge: Dark Brown
 - C) Sewer (sanitary or other): Dark Grey
- 4) Other Lines
- A) Compressed Air: Dark Green
 - B) Gas: Red
 - C) Other line: Light Grey
- c) Potable water lines must be clearly and permanently identified where dual water lines or pressure sewer systems exist.

SUBTITLE F**Section 604.125 Automatic Equipment**

- a) Equipment that will automatically shut down a water treatment process is acceptable, provided restart procedures are manual.
- b) Automatic startup must be allowed for treatment plants that treat only groundwater and have only unit processes not exposed to contamination. Examples include iron removal by protected aeration, enclosed retention and pressure sand filtration or ion exchange softening in a pressure vessel operated in a downflow mode.

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Section 604.130 Operational Testing Equipment

- a) Monitoring Equipment. Community water supplies must have equipment to monitor the water as follows:
 - 1) Plants treating surface water and groundwater under the direct influence of surface water must have the capability to monitor and record the following:
 - A) chlorine residual, water temperature and pH at locations necessary to evaluate adequate CT disinfection; and
 - B) turbidity.
 - 2) Plants treating groundwater using iron removal or ion exchange softening must have the capability to monitor and record chlorine residual.
 - 3) Ion exchange plants for nitrate removal must continuously monitor and record the finished water nitrate level.
- b) Sampling Taps
 - 1) Smooth-nosed sampling taps must be provided for collecting representative samples of treated and untreated water.
 - 2) When fluoride is added, the sample tap for the finished water must be located after the fluoride solution is added and has thoroughly mixed with the water being fluoridated.
 - 3) Smooth-nosed sample taps for untreated water must be provided at each well or source.
- c) For measuring chlorine residual, DPD test equipment or other means approved in "Standard Methods for the Examination of Water and Wastewater", incorporated by reference in 35 Ill. Adm. Code 611.102, must be used.
- d) Testing equipment must be available to plants with specific treatment processes, which include:
 - 1) fluoride adjustment - test equipment for measuring levels of fluoride ion;
 - 2) iron removal - test equipment for measuring ferrous and total iron levels;

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- 3) cation exchange softening - equipment for measuring hardness, and chloride concentration;
- 4) coagulation and filtration - jar testing equipment for determining chemical dosages and equipment for measuring pH, hardness, total and phenolphthalein ("P") alkalinity, nitrate, and nitrite;
- 5) lime softening - equipment for measuring pH, hardness, and total and phenolphthalein alkalinity forms;
- 6) reverse osmosis - equipment for measuring total dissolved solids, chlorides and monitoring sulfates;
- 7) phosphate addition - equipment for measuring both orthophosphates and total phosphates;
- 8) anion exchange - equipment for continuous monitoring of nitrate concentration must be provided for treated water and finished water after blending;
- 9) stabilization - equipment for determining the effectiveness of stabilization treatment for parameters that may include temperature, pH, alkalinity, total dissolved solids, chloride, sulfate, calcium hardness and total hardness, expressed as calcium carbonate;
- 10) chloramination - equipment to measure free chlorine residual, total chlorine residual, monochloramine residual, and free ammonia-N;
- 11) coagulation using coagulants that contain aluminum – in addition to the equipment described in subsection (d)(4), equipment to measure total and insoluble aluminum;
- 12) manganese removal - equipment for measuring the concentration of total manganese and soluble manganese; and
- 13) chlorine dioxide treatment - equipment for measuring chlorine dioxide residual and chlorite ion concentration.

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Section 604.135 Repair Work and Emergency Operation

- a) The community water supply must be protected from contamination when any part of the system is out of service for repair, construction, alteration or replacement.
- b) Disinfection Following Repair
 - 1) Any part of a community water system that has direct contact with finished water and has been out of service for repair, alteration or replacement must be disinfected and sampled as required by 35 Ill. Adm. Code 602.310 before being returned to service.
 - 2) Equipment that does not come in contact with finished water, such as raw surface water pumps, raw surface water transmission lines, chemical mixing tanks and clarifiers, need only be flushed before being returned to service.
 - 3) Filters must be disinfected.
 - 4) Wells, water storage tanks, water treatment plants, and water mains must be disinfected in accordance with AWWA C651, C652, C653 or C654, incorporated by reference in 35 Ill. Adm. Code 601.115.
- c) Emergency Operation
 - 1) Boil Order
 - A) Whenever microbiological contamination is determined to persist in a community water supply, as demonstrated by microbiological analysis results, the owners or official custodians of the supply must notify all consumers as required by subsection (c)(2) to boil for five minutes all water used for consumption or culinary purposes.
 - B) This boil order will remain in effect until appropriate corrective action approved by the Agency is taken and microbiological samples demonstrate that the water is safe for domestic use.
 - C) If the owner or official custodian of the supply fails to take the required action, the Agency may issue a boil order directly to the consumers affected.

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- D) Issuance of a boil order does not relieve the water supply from making public notification in accordance with 35 Ill. Adm. Code 611.Subpart V.
- 2) Required Notification
- A) Owners and operators of community water supplies must immediately notify the Agency at the appropriate Regional Office, in accordance with 35 Ill. Adm. Code 602.104(f), when there is knowledge or suspicion that a water supply has become contaminated or the community water supply's finished water quality is negatively impacted due to water treatment equipment malfunction.
 - B) Whenever the safety of a supply is endangered for any reason, including spillage of hazardous substances, the community water supply owner, official custodian, or Responsible Operator in Charge must take appropriate action to protect the community water supply, and immediately notify the Agency.
 - C) The Agency will require the community water supply to notify all consumers of appropriate actions to protect themselves if the water supply has become contaminated or the consumers' safety may be endangered. If the community water supply fails to make these notifications, the Agency must notify directly the consumers affected.
 - D) On weekends, holidays and after office hours, the Agency must be notified through the Illinois Emergency Management Agency at 1-800-782-7860.
- 3) When the water pressure falls below 20 pounds per square inch on any portion of the distribution system for any amount of time, the owner or official custodian of the community water supply must issue a boil order as required by subsection (c)(2) to those consumers affected unless the Agency has issued a SEP and:
- A) There is a historical record of adequate chlorine residual as required by Section 604.725(a) and approved turbidity levels in the general area affected covering at least 12 monthly readings;
 - B) Samples for bacteriological examination are taken in the affected area immediately and approximately 12 hours later; and

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- C) Tests for residual chlorine and turbidity taken at not more than hourly intervals in the affected area for several hours do not vary significantly from the historical record. If significant decrease in chlorine residual or increase in turbidity occurs, a boil order as required by subsection (c)(2) must be issued.
- d) Emergency Operations Plan
- 1) Each community water supply must develop an emergency operations plan for the provision of water under emergency circumstances, including earthquakes, floods, tornados, and other disasters. The emergency operations plan must include a review of the methods and means by which alternative supplies of drinking water could be provided in the event of destruction, impairment or contamination of community water supply.
 - 2) The community water supply must review its emergency operations plan at least every three years and revise the plan as necessary. The community water supply must maintain the emergency operations plan on site and make it available to the Agency, upon request.

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Section 604.140 Nitrification Action Plan

Any community water supply distributing water without a free chlorine residual must create a Nitrification Action Plan (NAP). The NAP must:

- a) contain a plan for monitoring total ammonia-N, free ammonia-N, nitrite-N, nitrate-N, monochloramine residual, dichloramine residual, and total chlorine residual;
- b) contain system specific levels of the chemicals in subsection (a) when action must be taken;
- c) contain specific corrective actions to be taken if the levels in subsection (b) are exceeded; and
- d) be maintained on site and made available to the Agency, upon request.

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Section 604.145 Exceptions for Community Water Supplies

- a) A community water supply operating before July 26, 2019 is not required to modify or replace components to meet the requirements of this Part if:
 - 1) the requirements of 35 Ill. Adm. Code 611 are met;
 - 2) the requirements of Sections 604.205, 604.230 and 604.1210 are met;
 - 3) water pressure meets the standards of Section 604.1415(a)(1); and
 - 4) the components were permitted or no permits were required at the time of construction.

- b) Alternate Design, Maintenance and Operation Requirements
 - 1) As specified in this Part, the Agency may approve design, maintenance, or operation requirements different from those contained in this Part so long as the alternative produces water meeting the requirements of 35 Ill. Adm. Code 601.101 and 35 Ill. Adm. Code 611.
 - 2) When approving alternate design, maintenance or operation requirements, the Agency must issue a construction permit, operating permit or special exception permit.
 - 3) The Agency must approve alternate design, maintenance or operation requirements when the community water supply demonstrates that compliance with this Part is economically unreasonable or technically impossible.

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Section 604.150 Protection of Community Water Supply Structures

- a) Each community water supply must protect its wells, clear water reservoirs, suction lines, gravity filters, iron removal, chlorine reaction and wet salt storage basins from sources of contamination by maintaining the following minimum distances:

Source of Contamination	Distance for Clay or Loam Soils	Distances for Soils with Higher Permeability than Clay or Loam
Cesspools, leaching sewage disposal pits	150'	300'
Privies	150'	300'
Septic tanks and subsurface septic tanks effluent disposal tile	75'	150'
Livestock, grazing areas or feedlots	50'	100'
Sewers (non-watertight)	50'	50'
Sewers (cast iron pipe, with leaded or mechanical joints)	25'	25'
Sewers (extra-heavy cast iron pipe, asbestos-cement pressure pipe, prestressed concrete pipe, or PVC (polyvinyl chloride) pipe meeting water main standards, with pressure tested, leaded, mechanical or slip-on joints)	10'	10'
Washwater sumps of reinforced concrete construction	10'	10'
Flood waters – A horizontal distance must be maintained by natural earth or fill. In addition, wells must meet the	15'*	15'*

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requirements of Section 604.240(k).		
Flood waters – A vertical distance must be maintained to which structure and earth protection must be carried above maximum high water elevation. In addition, wells must meet the requirements of Section 604.240(k).	2'	2'
Fuel storage tanks above ground	25'**	25'**
*The Agency must consider special structural arrangements equivalent to earthen construction for protection of the well when horizontal earth protection is impractical.		
** unless otherwise approved by the Agency under Section 604.145(b)		

- b) Wells must meet the setback requirements of the Act.
- c) Fuel storage tanks located at a community water supply facility must be above ground and must have secondary containment.

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Section 604.155 Electrical Controls and Standby Power

- a) Electrical controls must be located above grade, in areas not subject to flooding.
- b) Each community water supply must provide on site, dedicated standby power capable of maintaining continued operation of its water system during power outages to meet the average daily usage determined under Section 604.115.

SUBTITLE F**Section 604.160 Safety**

- a) All community water supplies whose treatment involves chemical application must have and maintain a chemical safety plan.
- b) All community water supply personnel involved in the use and maintenance of chemicals must have periodic safety training.

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Section 604.165 Monthly Operating Report

- a) The community water supply must prepare an operating report on a form approved by the Agency as specified in a construction, operating or special exception permit.
- b) An individual set of operating reports must be maintained for each installation when more than one source of water with separate chemical addition equipment is used.
- c) The operating report must be signed by the Responsible Operator in Charge and submitted to the Agency within 30 days after the last day of the month.
- d) A copy of the operating report records must be maintained by the official custodian of the community water supply.

SUBTITLE F**Section 604.170 Security**

- a) Each community water supply well, well house, raw water intake structure, pumping stations, treatment plant buildings, and treated water storage reservoirs must be protected to prevent vandalism and entrance by animals or unauthorized persons.
- b) Fencing, locks on tank access hatches, or other necessary precautions must be provided to prevent trespassing, vandalism, and sabotage.

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SUBPART B: SOURCE DEVELOPMENT

Section 604.200 General Requirements

- a) Each water supply must take its raw water from the best available source that is economically reasonable and technically possible.
- b) In selecting the source of water to be developed, the community water supply must prove the following:
 - 1) an adequate quantity of water will be available; and
 - 2) the water that is to be delivered to the consumers will meet the current requirements of the Board and Act with respect to microbiological, physical, chemical and radiological qualities.
- c) A surface water source includes tributary streams and drainage basins, natural lakes and artificial reservoirs or impoundments above the point of water supply intake.
- d) A groundwater source includes all water obtained from wells.
- e) The Agency will approve surface water, groundwater under the direct influence of surface water, or groundwater as a community water supply source only if treatment produces water that meets the primary drinking water standards of 35 Ill. Adm. Code 611 and the following conditions are met:
 - 1) The design of the water treatment plant must consider the worst conditions that may exist during the life of the system.
 - 2) Sampling must be performed to determine treatment requirements. The Agency may require samples be taken at least once a month over a 12-consecutive month period. Representative samples must be submitted to the Agency to determine raw water quality.
 - 3) More frequent sampling must be required to obtain a true representation of raw water quality. Raw water characteristics must be determined after heavy rainfall and runoff, ~~or after~~ after low stream flow, and at other times when unusual factors pertaining to physical and chemical quality, treatability, tastes and odors exist.
 - 4) Auxiliary treatment must be provided for waters when the geometric mean of fecal coliform exceeds 2000 per 100 ml. Examples of auxiliary

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treatment are presedimentation, prechlorination and storage of raw water for 30 days or more.

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Section 604.205 Surface Water Quantity

The quantity of surface water at the source must:

- a) be adequate to meet the maximum projected water demand of the service area as shown by calculations based on a one in 50-year drought or the extreme drought of record, and should include consideration of multiple year droughts;
- b) provide a 20% surplus unless otherwise approved by the Agency under Section 604.145(b); and
- c) be adequate to compensate for all losses, including silting, evaporation, seepage and required water releases.

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Section 604.210 Surface Water Quality

- a) For all surface water, community water supplies must provide conventional filtration treatment or filtration treatment using technologies approved by the Agency under 35 Ill. Adm. Code 611.250(d) and disinfection.
- b) For all groundwater under the direct influence of surface water, community water supplies must provide filtration treatment using technologies approved by the Agency under 35 Ill. Adm. Code 611.250 and disinfection.
- c) A source water assessment under Section 604.315 must be completed, considering factors, both natural and manmade, that may affect water quality in the water supply stream, river, lake or reservoir, or groundwater under direct influence of surface water.

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Section 604.215 Surface Water Structures

- a) Design of intake structures must provide for:
 - 1) withdrawal of water from more than one level if quality varies with depth;
 - 2) separate facilities for release of less desirable water held in storage;
 - 3) where frazil ice may be a problem, holding the velocity of flow into the intake structure to a minimum, generally not to exceed 0.5 feet per second;
 - 4) inspection manholes every 1000 feet for pipe sizes large enough to permit visual inspection;
 - 5) cleaning of the inlet line;
 - 6) protection against rupture by dragging anchors, ice and other factors;
 - 7) ports located above the bottom of the stream, lake or impoundment, but at sufficient depth to be kept submerged at low water levels;
 - 8) where shore wells are not provided, a diversion device capable of keeping large quantities of fish or debris from entering an intake structure; and
 - 9) when buried surface water collectors are used, sufficient intake opening area must be provided to minimize inlet head loss. Particular attention should be given to the selection of backfill material in relation to the collector pipe slot size and gradation of the native material over the collector system.

- b) Raw water pumping station must:
 - 1) be protected from flooding and, when feasible, located above grade;
 - 2) be accessible;
 - 3) be designed against flotation;
 - 4) be equipped with a screen before the pump suction well;
 - 5) provide for introduction of chlorine or other chemicals in the raw water transmission line if necessary for quality control;

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- 6) have intake valves and provisions for backflushing or cleaning by a mechanical device and testing for leaks, where practical;
 - 7) have provisions for withstanding surges when necessary; and
 - 8) be constructed to prevent intrusion of contaminants.
- c) Side Channel Raw Water Storage Reservoir
- 1) A side channel water storage reservoir is a facility into which water is pumped during periods of good quality and high stream flow for future release to treatment facilities.
 - 2) Side channel raw water storage reservoirs must be constructed to assure that:
 - A) water quality is protected by controlling runoff into the reservoir;
 - B) dikes are structurally sound and protected against wave action and erosion;
 - C) intake structures and devices meet requirements of subsection (a);
 - D) point of influent flow is separated from the point of withdrawal;
 - E) separate pipes are provided for influent to and effluent from the reservoir; and
 - F) a bypass line is provided around the reservoir to allow direct pumping to the treatment facilities.

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Section 604.220 Invasive Mussel Control

- a) When chemical treatment for the control of invasive mussels is permitted by the Agency:
 - 1) chemical treatment must be in accordance with Subpart K;
 - 2) plant safety items, including ventilation, operator protective equipment, eyewashes/showers, and cross connection control must be provided;
 - 3) solution piping and diffusers must be installed within the intake pipe or in a suitable carrier pipe. Provisions must be made to prevent dispersal of chemicals into the water environment outside the intake. Diffusers must be located and designed to protect all intake structure components; and
 - 4) The chemicals feeder must be interlocked with plant system controls to shut down automatically when the raw water flow stops.
- b) When alternative control methods are proposed for the control of invasive mussels, appropriate piloting or demonstration studies must be provided to the Agency for approval.

SUBTITLE F**Section 604.225 Reservoirs**

Reservoirs must provide, where applicable, for:

- a) removal of brush and trees to high water elevation;
- b) protection from floods during construction; and
- c) abandonment of all wells that will be inundated.

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Section 604.230 Groundwater Quantity

- a) A community water supply must determine groundwater source adequacy by the amount of water produced by each well pumping within its calculated safe yield.
- b) Multiple Well Systems: When multiple wells are used, the combined delivery must equal or exceed the maximum average daily demand under Section 604.105(a) with the largest producing well out of service.
- c) Single Well Systems: No community water supply, the construction or modification of which commences after July 26, 2019, may rely only on a single well for its water source. A community water supply, the construction of which commenced before and that is not modified after July 26, 2019, may rely on a single well for its water source, but must be placed on the critical review list under 35 Ill. Adm. Code 602.107. For the purposes of this subsection, "modified" means when the fixed capital costs of the new components constructed within a 2-year period exceed 50% of the fixed capital cost of a comparable entirely new facility.
- d) The well location must be selected to minimize the impact on other wells and other water resources.

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Section 604.235 Groundwater Quality

- a) Each community water supply using groundwater must collect and analyze one sample per well per month for total coliform bacteria. The analysis must be performed by a certified laboratory.
 - 1) If a routine sample result is total coliform-positive, the community water supply must collect and analyze another sample within 24 hours after being notified of the positive result. The analysis must be performed by a certified laboratory.
 - 2) Results that show the presence of coliform and have been confirmed by a sample taken under subsection (a)(1) must be reported to the Agency within 24 hours after being notified of the positive result of the sample taken under subsection (a)(1).
- b) The Agency must require multiple barrier treatment to achieve at least 99.99 percent (4-log) removal or inactivation of viruses for all groundwater sources subject to bacteriological contamination.
- c) When maintenance or equipment replacement on a well occurs that does not require a construction or operating permit under 35 Ill. Adm. Code 602, one sample from the well must be submitted to a certified laboratory for analysis for total coliform bacteria.
 - 1) If the sample result is satisfactory, the well may be placed into service.
 - 2) If the sample result is unsatisfactory, the well may not be placed into service until samples collected from the well on two consecutive days and tested by a certified laboratory have satisfactory results.
- d) A source water assessment under Section 604.315 must be completed considering factors, both natural and manmade, that may affect water quality in the groundwater.

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Section 604.240 General Well Construction

- a) Drilling fluids and additives must not impart any toxic substance to the water or promote bacterial contamination.
- b) Minimum protected depths of drilled wells must provide watertight construction to exclude contamination and seal off formations that are, or may be, contaminated or yield undesirable water.
- c) Surface or temporary steel casing used for construction must be capable of withstanding the structural load imposed during its installation and removal. Surface or temporary casing must be removed during or prior to grouting or it must be grouted in place when set according to subsection (i).
- d) The well casing material must be steel. Permanent steel casing pipe must:
 - 1) be new single steel casing pipe meeting AWWA A100, incorporated by reference in 35 Ill. Adm. Code 601.115, for water well construction;
 - 2) have a minimum weight and thickness indicated in Table A;
 - 3) be equipped with a drive shoe when driven; and
 - 4) have full circumferential welds or threaded coupling joints.
- e) All wells during construction must be protected against the entrance of water, contaminants and tampering. Methods for capping a well include a welded metal plate and a threaded cap.
- f) Packers must be of material that will not impart taste, odor, toxic substances or bacterial contamination to the well water. Lead packers must not be used.
- g) Screens must:
 - 1) be constructed of materials resistant to damage by chemical action of groundwater or cleaning operations;
 - 2) have size of openings based on sieve analysis of formation and/or gravel pack materials;
 - 3) have sufficient length and diameter to provide adequate specific capacity and low aperture entrance velocity;

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- 4) be installed so that pumping water level remains above the screen under all operating conditions; and
 - 5) be provided with a bottom plate or washdown bottom fitting of the same material as the screen.
- h) Grouting Requirements. The annulus of all permanent well casings must be grouted from the original ground surface or pitless unit to a minimum depth of 10 feet utilizing a minimum thickness of 1½ inches of grout.
- 1) Neat Cement Grout. Cement conforming to AWWA A100 and water, with not more than six gallons of water per 94 pounds of cement, must be used for 1½ inch openings.
 - 2) Concrete Grout. Equal parts of cement conforming to AWWA A100 and sand, with not more than six gallons of water per 94 pounds of cement, may be used for annular openings larger than 1½ inches. For annular openings greater than four inches, gravel added to the concrete must not exceed ½ inch.
 - 3) Application
 - A) A minimum thickness of 1½ inches of grout around permanent casings, including couplings, must be provided.
 - B) Prior to grouting through creviced or fractured formations, bentonite or similar materials may be added to the annular opening, in the manner indicated for grouting.
 - C) When the annular opening is less than four inches, grout must be installed under pressure by means of a grout pump from the bottom of the annular opening upward in one continuous operation until the annular opening is filled.
 - D) When the annular opening is four inches or greater and extends less than 100 feet, and concrete grout is used, it may be placed by gravity through a grout pipe installed to the bottom of the annular opening in one continuous operation until the annular opening is filled.
 - E) Grout must be allowed to overflow from the annular opening until the proper density or percent solids has been achieved.

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- F) Standby grouting equipment for grouting annular openings, including a backup grout pump and tremie pipe, must be on site during the grouting of all wells.
 - G) The conductor pipe must be completely withdrawn from the well prior to flushing excess grout from the conductor pipe when grouting down the annular space or must be disconnected from the grout shoe or street elbow prior to flushing excess grout when grouting within the casing.
 - H) After cement grouting is applied, work on the well must be discontinued until the cement or concrete grout has properly set.
 - I) Grout placement must be sufficient to achieve proper density or percent solids throughout the annular space.
- 4) Guides. The casing must be provided with sufficient guides welded to the casing to center the casing in the drill hole, prevent displacement of the casing and still permit unobstructed flow and uniform thickness of grout.
- i) Upper Terminal Well Construction
- 1) Permanent casing for all groundwater sources must project at least 12 inches above the pumphouse, well platform floor or concrete apron surface and at least 18 inches above final ground surface.
 - 2) Where a well house is constructed, the floor surface must be at least six inches above the final ground elevation.
 - 3) Protection from physical damage must be provided.
 - 4) The upper terminal must be constructed to prevent contamination from entering the well.
 - 5) Where well appurtenances protrude through the upper terminal, the connections to the upper terminus must be mechanical or welded connections that are watertight.
- j) Upper Terminal Well Construction in the Flood Plain of a 100-year Flood or Flood of Record
- 1) Sites subject to flooding must be provided with an earth mound to raise the well house floor to an elevation at least two feet above the highest

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known flood elevation, or other suitable protection as determined by the Agency. A 15-foot horizontal distance must be maintained.

- 2) The top of the well casing at sites subject to flooding must terminate at least three feet above the 100-year flood level or the highest known flood elevation, whichever is higher, or as otherwise approved by the Agency under Section 604.145(b).
 - 3) Wells must have a six-inch concrete envelope completely surrounding the regular casing and extending at least 10 feet below original ground surface.
- k) Development
- 1) Every well must be developed to remove the native silts and clays, drilling mud or finer fraction of the gravel pack.
 - 2) Development must continue until the maximum specific capacity is obtained from the completed well.
 - 3) Where chemical conditioning is required, specifications submitted to the Agency under 35 Ill. Adm. Code 602 must include provisions for the method, equipment, chemicals, testing for residual chemicals, and disposal of waste.
 - 4) Where blasting procedures are used, specifications submitted to the Agency under 35 Ill. Adm. Code 602 must include the provisions for blasting and cleaning. The grouting and casing must not be damaged by the blasting.
- l) When an operating permit is not required under 35 Ill. Adm. Code 602, disinfection of modified or reconditioned wells must be provided, and a record of microbiological sample results must be maintained for five years.
- m) Test wells and groundwater sources that are not in use must be sealed in accordance with 77 Ill. Adm. Code 920.120. The sealing form specified in 77 Ill. Adm. Code 920.120(e)(2) must be submitted to the Agency not more than 30 days after the well is sealed.

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Section 604.245 Well Testing and Records

- a) The specific capacity of the production well must be determined by a drawdown test before the well is placed in service.
- b) Aquifer property data must be:
 - 1) determined by using published values of transmissivity and hydraulic conductivity;
 - 2) estimated by using specific capacity; or
 - 3) determined by using a pump test with an observation well.
- c) Pump Test
 - 1) A pump test must be performed on every production well after construction and prior to placement of the permanent pump.
 - 2) A pump test must have a capacity of at least 1.5 times the flow anticipated at the maximum anticipated drawdown.
 - 3) The test must provide, as a minimum, for continuous pumping for at least 24 hours at the design pumping rate or until stabilized drawdown has continued for at least six hours when test pumped at 1.5 times the design pumping rate.
- d) The following information must be submitted to the Agency before the Agency will issue an operating permit:
 - 1) pump test data:
 - A) the latitude and longitude of the observation well;
 - B) test pump capacity head characteristics;
 - C) static water level;
 - D) depth of test pump settings; and
 - E) time of starting and ending each test cycle;
 - 2) static water level in the production well and observation wells;

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- 3) pumping water level in the production well;
- 4) transmissivity in gallons per day per foot of drawdown (GPD/ft);
- 5) hydraulic conductivity in gallons per day per square foot (GPD/ft²) or feet per day (ft/day);
- 6) saturated thickness of the aquifer;
- 7) storage coefficient or specific yield (dimensionless); and
- 8) lateral area of influence calculated under 35 Ill. Adm. Code 671.
- 9) recording and graphic evaluation of the following, at one-hour intervals or less:
 - A) pumping rate;
 - B) pumping water level;
 - C) drawdown;
 - D) water recovery rate and levels; and
 - E) specific capacity, measured in gallons per minute per foot (GPM/ft) of drawdown.
- 10) a determination of the regional groundwater gradient and flow direction:
 - A) if the groundwater gradient and flow direction was estimated, provide the data and the source of the data;
 - B) if the groundwater gradient and flow direction was not estimated, provide the longitude and latitude of the wells used, well logs and the water elevations observed in the wells during the pump test;
 - C) provide the compass direction clockwise from north in degrees; and
 - D) provide the gradient.
- 11) geological data:

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- A) a driller's log determined from samples collected at 5-foot intervals and at each pronounced change in formation;
 - B) accurate geographical location, such as latitude and longitude or GIS coordinates;
 - C) records of drill hole diameters and depths;
 - D) order of size and length of casing, screens and liners;
 - E) grouting depths;
 - F) formations penetrated;
 - G) water levels; and
 - H) location of any blast charges.
- e) Every well must be tested in accordance with AWWA A100, incorporated by reference in 35 Ill. Adm. Code 601.115, for plumbness and alignment. The test method and allowable tolerance must be clearly stated in the specifications submitted to the Agency.
- f) The owner of each well must retain all records pertaining to each well's construction, maintenance and operation.

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Section 604.250 Aquifer Types and Construction Methods

- a) Sand or Gravel Wells
 - 1) Unless otherwise approved by the Agency under Section 604.145(b), the permanent casing and grout must extend at least 25 feet below the original ground elevation.
 - 2) If a temporary or a surface casing is used, it must be completely withdrawn.
- b) Gravel Pack Material
 - 1) Gravel pack materials must:
 - A) be sized based on sieve analysis of the formation; and
 - B) be well-rounded particles of 95 percent siliceous material that are smooth and uniform, free of foreign material, properly sized, and washed and then disinfected immediately prior to or during placement.
 - 2) Gravel Pack
 - A) Gravel pack must be placed in one continuous operation.
 - B) Gravel pack must be placed in a manner that prevents segregation and gradation during placement.
 - C) The annular space between the well screen and the hole must allow for proper placement of gravel pack.
 - D) Gravel pack must extend above the highest well screen with an allowance for settling.
 - E) Protection from leakage of grout into the gravel pack or screen must be provided.
 - F) Permanent inner casing and outer casings must meet the requirements of Section 604.240(d).

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- 3) Unless otherwise approved by the Agency under Section 604.145(b), minimum permanent casing and grouted depth must be at least 25 feet below the original ground elevation.
- c) Radial Water Collector
- 1) Locations of all caisson construction joints and porthole assemblies must be indicated on plans submitted to the Agency.
 - 2) Provisions must be made to assure that radial collectors are essentially horizontal.
 - 3) Caisson Construction
 - A) The caisson wall must be reinforced to withstand the forces to which it will be subjected.
 - B) The top of the caisson must be extended at least above the flood plain of a 100-year flood or flood of record and covered with a watertight floor.
 - C) All openings in the floor must be curbed and protected from entrance of foreign material.
 - D) The pump discharge piping must not be placed through the caisson walls.
- d) Fractured or Highly Permeable Bedrock Aquifer Wells
- 1) Where the depth of unconsolidated formations is more than 50 feet over fractured or highly permeable bedrock, the permanent casing must be firmly seated in rock.
 - 2) Where the depth of unconsolidated formations is less than 50 feet, the depth of casing and grout must be at least 50 feet.

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Section 604.255 Well Pumps, Discharge Piping and Appurtenances

- a) Where line shaft pumps are used:
 - 1) the casing must be firmly connected to the pump structure or have the casing inserted into a recess extending at least one-half inch into the pump base;
 - 2) the pump foundation and base must be at least six inches above the finished floor elevation; and
 - 3) lubricants must comply with Section 604.105(f).
- b) Where a submersible pump is used:
 - 1) the top of the casing must be effectively sealed to prohibit the entrance of water under all conditions of vibration or movement of conductors or cables;
 - 2) the electrical cable must be firmly attached to the riser pipe at 20-foot intervals or less; and
 - 3) mercury seals must not be used when an existing submersible pump is replaced or a new submersible pump is installed.
- c) Discharge Piping
 - 1) The discharge piping for each well must:
 - A) be designed to minimize friction loss;
 - B) be equipped with a check valve in or at the well, a shutoff valve, a pressure gauge, and a means of measuring flow;
 - C) be protected from the entrance of contamination;
 - D) have control valves and appurtenances located above the pumphouse floor when an above-ground discharge is provided;
 - E) be equipped with a smooth nosed sampling tap at least 18-inches above the floor to facilitate sample collection, located at a point where positive pressure is maintained, but before any treatment chemicals are applied;

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- F) when necessary to remove entrapped air from the well, be equipped with an air release-vacuum relief valve located upstream from the check valve, with exhaust/relief piping terminating in a down-turned position at least 18 inches above the floor and covered with a 24 mesh, corrosion resistant screen;
 - G) be valved to permit test pumping and control of each well;
 - H) have all exposed piping, valves and appurtenances protected against physical damage and freezing;
 - I) be anchored to prevent movement and be supported to prevent excessive bending forces;
 - J) be protected against surge or water hammer; and
 - K) be constructed so that it can be disconnected from the well or well pump to allow the well pump to be pulled.
- 2) The well must have a means of pumping to waste that is not directly connected to a sewer.
- 3) The discharge, drop or column piping inside the well for submersible, submersible jet and submersible line shaft pumps must:
- A) be capable of supporting the weight of the submersible pump, piping, water and appurtenances and of withstanding the thrust, torque, torque fatigue and other reaction loads created during pumping; and
 - B) use lubricants, fittings, brackets, tape or other appurtenances that comply with Section 604.105(f).
- d) Pitless Well Units
- 1) Pitless units must:
 - A) be shop-fabricated from the point of connection with the well casing to the unit cap or cover;
 - B) be threaded or welded to the well casing;

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- C) be of watertight construction throughout;
 - D) be of materials and weight at least equivalent and compatible to the casing;
 - E) have field connection to the lateral discharge from the pitless unit of threaded, flanged or mechanical joint connection; and
 - F) terminate at least 18 inches above final ground elevation or three feet above the 100-year flood level or the highest known flood elevation, whichever is higher.
- 2) The design of the pitless unit must make provision for:
- A) access to disinfect the well;
 - B) a properly constructed casing vent meeting the requirements of subsection (e);
 - C) facilities to measure water levels in the well, under subsection (f);
 - D) a cover at the upper terminal of the well that will prevent the entrance of contamination;
 - E) a contamination-proof entrance connection for electrical cable;
 - F) an inside diameter as great as that of the well casing to facilitate work and repair on the well, pump, or well screen; and
 - G) at least one check valve within the well casing.
- 3) If the connection to the casing is by field weld, the shop-assembled unit must be designed specifically for field welding to the casing. The only field welding permitted will be that needed to connect a pitless unit to the casing.
- e) Casing Vent
- 1) Well casing must be vented to the atmosphere.
 - 2) The vent must terminate in a downturned position, at or above the top of the casing or pitless unit, no less than 12 inches above grade or floor, in a

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minimum 1½ inch diameter opening covered with a 24 mesh, corrosion resistant screen.

- 3) The pipe connecting the casing to the vent must be of adequate size to provide rapid venting of the casing.
 - 4) Where vertical turbine pumps are used, vents may be placed into the side of the casing.
- f) Water Level Measurement
- 1) Each well must be equipped with a means for taking water level measurements.
 - 2) Where pneumatic water level measuring equipment is used, it must be made using corrosion-resistant materials attached firmly to the drop pipe or pump column to prevent entrance of foreign materials.
- g) Observation wells must meet the requirements in 77 Ill. Adm. Code 920.170.

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SUBPART C: SOURCE WATER PROTECTION PLAN

Section 604.300 Purpose

The purpose of the following requirements is to facilitate protection of source water quality and quantity.

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Section 604.305 Source Water Protection Plan Requirement and Contents

Each community water supply that treats surface or groundwater as a primary or emergency supply of water must develop a source water protection plan that contains the following minimum elements:

- a) a vision statement as set forth in Section 604.310;
- b) a source water assessment as set forth in Section 604.315;
- c) the objectives set forth in Section 604.320; and
- d) an action plan as set forth in Section 604.325.

SUBTITLE F**Section 604.310 Vision Statement**

The vision statement must include the following:

- a) the community water supply's policy and commitment to protecting source water;
- b) an explanation of the community water supply's resources to protect source water;
- c) an explanation of the barriers to protecting source water; and
- d) the names of the individuals who developed the vision statement.

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Section 604.315 Source Water Assessment

- a) The source water assessment must contain the following information:
 - 1) statement of the importance of the source water;
 - 2) a list of water supplies that obtain water from this community water supply;
 - 3) delineation of all sources of water used by the community water supply, including:
 - A) for surface water, description of the watershed, map of the watershed, and intake locations;
 - B) for groundwater, the well identification number, well description, well status and well depth; a description of setback zones, and a description of the aquifer for each well;
 - 4) a report on the quality of the source water for all sources of water delineated in subsection (a)(3), including:
 - A) when and where samples used to determine the quality of the source water were taken. These samples must be tested by a certified laboratory; and
 - B) the certified laboratory's results;
 - 5) a report on the quality of the finished water;
 - 6) identification of potential sources of contamination to the source water;
 - 7) analysis of the source water's susceptibility to contamination; and
 - 8) explanation of the community water supply's efforts to protect its source water.
- b) Upon request, the Agency will provide technical assistance to a community water supply in conducting the source water assessment.
- c) A community water supply may use a Source Water Assessment Program Fact Sheet prepared by the Agency to fulfill the requirements of this Section.

SUBTITLE F**Section 604.320 Source Water Protection Plan Objectives**

The source water protection plan must contain a list of the community water supply's objectives for protecting source water. These objectives can include meeting the requirements of any of the Sections in this Subpart, including developing a vision statement or performing a source water assessment. Objectives may also address the specific problems or issues identified in the source water assessment and should consider current and potential future issues.

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Section 604.325 Action Plan

In the action plan, the community water supply must identify the actions needed to achieve the community water supply's objectives determined under Section 604.320. The action plan must include the following:

- a) descriptions of all projects, programs, and activities developed by the community water supply to meet the objectives listed in Section 604.320;
- b) the community water supply's schedule for implementing projects, programs and activities;
- c) an identification of the necessary resources to implement the plan; and
- d) an identification of the potential problems with and obstacles to implementing the plan.

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Section 604.330 Submission

- a) A community water supply that first commenced construction after July 26, 2019, must develop and submit a source water protection plan simultaneously with the construction permit application.
- b) A community water supply in existence as of July 26, 2019, must develop and submit to the Agency for approval a source water protection plan within the following time frame after July 26, 2019:
 - 1) within 3 years, for a community water supply serving a population greater than 50,000 persons;
 - 2) within 4 years, for a community water supply serving a population of greater than 3,000 but less than or equal to 49,999 persons; or
 - 3) within 5 years, for a community water supply serving a population of less than or equal to 2,999 persons.
- c) An existing community water supply that anticipates using a new source of water for its supply must develop and submit a revised source water protection plan simultaneously with the construction permit application.

SUBTITLE F**Section 604.335 Agency Approval**

The Agency, not later than 45 days after the receipt of the source water protection plan, will either approve or disapprove the plan. If the Agency takes no action within the 45 days, the community water supply may deem the plan approved. A community water supply may waive the requirement that the Agency take an action within the 45 days by so advising the Agency in writing.

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Section 604.340 Evaluation and Revision

The community water supply must review, and revise as necessary, its source water protection plan no less frequently than every five years. If the community water supply revises its source water protection plan, it must submit the plan to the Agency for approval under Section 604.335.

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SUBPART D: AERATION

Section 604.400 General Requirements for Aeration

- a) All aerators, except those discharging to lime softening or clarification plants, must be protected from contamination by birds, insects, wind borne debris, rainfall and water draining off the exterior of the aerator. Screens must be 24 mesh.
- b) A bypass must be provided when a single aeration unit is installed.
- c) The stability of the water after aeration must be evaluated to determine the need for additional treatment under Subpart I.

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Section 604.405 Forced or Induced Draft Aeration

Forced or induced draft aeration devices must be designed to:

- a) include a blower with a weatherproof motor in a tight housing and screened enclosure;
- b) insure adequate counter current of air through the enclosed aerator column;
- c) exhaust air directly to the outside atmosphere;
- d) include a down turned and 24 mesh screened air outlet and inlet;
- e) be such that air introduced in the column must be as free from obnoxious fumes, dust, and dirt as possible;
- f) be such that sections of the aerator can be reached or removed for maintenance of the interior or installed in a separate aerator room;
- g) provide loading at a rate of 1 to 5 gallons per minute for each square foot of total tray area (2.5 to 12.5 m/hr);
- h) ensure that the water outlet is sealed;
- i) discharge through a series of five or more trays with separation of trays not less than six inches;
- j) provide distribution of water uniformly over the top tray; and
- k) be of durable material resistant to the aggressiveness of the water and dissolved gases.

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Section 604.410 Spray Aeration

Spray aeration design must provide:

- a) a hydraulic head of between 5 and 25 feet;
- b) nozzles, with the size, number, and spacing of the nozzles being dependent on the flow rate, the space, and 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, with any openings protected by a 24-mesh screen.

SUBTITLE F**Section 604.415 Pressure Aeration**

- a) Pressure aeration may be used for oxidation purposes only. This process is not acceptable for the removal of dissolved gases.
- b) Filters following pressure aeration must allow for the release of air.
- c) Pressure aeration must be designed to
 - 1) thoroughly mix compressed air with water being treated; and
 - 2) provide air free of obnoxious fumes, dust, dirt and other contaminants.

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Section 604.420 Packed Tower Aeration

- a) Packed tower aeration (PTA) may be used for removing compounds with a Henry's Constant greater than 100 atm mol/mol at 120°C. Compounds with a Henry's Constant less than 10 may not be removed by PTA. For Henry's Constant values between 10 and 100, PTA may be used upon completion of a pilot study and approval by the Agency.
- b) Process Design
 - 1) Construction Permit Applications and Pilot Study
 - A) Before installing PTA, the community water supply must submit a construction permit application that includes Henry's Constant for the contaminant, the mass transfer coefficient, air pressure drop and stripping factor, height and diameter of unit, air to water ratio, packing depth, and surface loading rate.
 - B) Pilot testing is required for PTA used for compounds with Henry's Constant greater than 100 unless there is considerable past performance data on the contaminant to be treated, there is a concentration level similar to previous projects, and the Agency has approved the process design based on use of appropriate calculations without pilot testing. Proposals of this type must be discussed with the Agency prior to submission of any construction permit applications.
 - C) When a pilot test is required, the pilot test must:
 - i) evaluate a variety of loading rates and air to water ratios at the peak contaminant concentration; and
 - ii) give special consideration to removal efficiencies when multiple contaminations occur.
 - 2) The tower must be designed to reduce contaminants to below the maximum contaminant level (MCL) and to the lowest practical level.
 - 3) The water loading rates are typically in the range from 15 gpm/ft² to 30 gpm/ft².
 - 4) The ratio of the column diameter to packing diameter must be at least 10:1 for the full-scale tower. The pilot test can have a ratio of 7:1. The type

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and size of the packing used in the full-scale unit must be the same as that used in the pilot unit.

- 5) The minimum volumetric air to water ratio at peak water flow must be in the range of 25:1 and to 80:1, unless otherwise demonstrated by a pilot study and approved by the Agency under Section 604.145(b).
 - 6) The design must consider providing pretreatment if potential fouling problems are likely to occur. Fouling problems can occur from calcium carbonate and iron precipitation and from bacterial growth.
 - 7) Disinfection capability must be provided prior to and after PTA.
 - 8) The effects of temperature must be considered since a drop in water temperature can result in a drop in contaminant removal efficiency.
- c) Materials of Construction
- 1) The tower may be constructed of stainless steel, concrete, aluminum, fiberglass, or plastic, but the tower must not be constructed of uncoated carbon steel.
 - 2) Towers must be protected against damage from wind.
 - 3) Towers must have adequate structural support.
- d) Water Flow System
- 1) Water must be distributed uniformly at the top of the tower when using spray nozzles or orifice type distributor trays that prevent short-circuiting.
 - 2) A mist eliminator must be provided above the water distributor system.
 - 3) A side wiper redistribution ring must be provided at least every 10 feet to prevent water channeling along the tower wall and short-circuiting.
 - 4) Sample taps must be provided in the influent and effluent piping.
 - 5) If an effluent sump is provided, it must be accessible to allow for cleaning and must be equipped with a drain valve in compliance with Section 604.1500.
 - 6) The effluent piping must have a means to discharge to waste.

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- 7) The design must prevent freezing of the influent riser and effluent piping when the unit is not operating.
 - 8) If piping is buried, it must be maintained under positive pressure.
 - 9) An overflow line must be provided that discharges 12 to 24 inches above the ground surface.
- e) Air Flow System
- 1) The air inlet to the blower and the tower discharge vent must be down turned and protected with a noncorrodible 24 mesh screen to prevent contamination from extraneous matter.
 - 2) A positive airflow sensing device and a pressure gauge must be installed on the air influent line. The positive airflow-sensing device must be a part of an automatic control system that will turn off the influent water if positive airflow is not detected. The pressure gauge will serve as an indicator of fouling buildup.
- f) Other Required Features
- 1) Access ports with a minimum diameter of 24 inches to facilitate inspection, media replacement, media cleaning and maintenance of the interior must be provided.
 - 2) Disinfection application points ahead of the tower must be provided.
 - 3) Adequate packing support to allow free flow of water and to prevent deformation of the media with deep packing heights must be provided.
 - 4) An access ladder must be provided.
 - 5) The blower, disinfectant feeder and well pump must have an electrical interconnection.

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Section 604.425 Other Methods of Aeration

Other methods of aeration may be used if applicable to the treatment needs. The treatment processes must be designed to meet the particular needs of the water to be treated and must be approved by the Agency. Such methods include:

- a) spraying;
- b) diffused air;
- c) cascades;
- d) mechanical aeration; or
- e) natural draft aeration.

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SUBPART E: CLARIFICATION

Section 604.500 General Clarification Requirements

- a) All community water supplies designed to treat surface water must have a minimum of two clarification units. The clarifiers must be capable of meeting the plant design capacity with one clarifier removed from service.
- b) For community water supplies treating groundwater under the direct influence of surface water, the community water supply must have a minimum of two clarification units if clarification is provided.
- c) Community water supplies designed to treat groundwater will be required to have a minimum of two clarification units if clarification is provided.
- d) Design of the clarification process must:
 - 1) allow units to be taken out of service without disrupting operation;
 - 2) start manually following shutdown;
 - 3) minimize hydraulic head losses between units to allow future changes in processes without the need for repumping; and
 - 4) if flow is split, provide a means of measuring and modifying the flow to each train or unit unless flow paths are equivalent and hydraulic controls are provided.

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Section 604.505 Coagulation

- a) For purposes of this Section, coagulation is a process using coagulant chemicals and mixing by which colloidal and suspended material are destabilized and agglomerated into settleable or filterable flocs, or both.
- b) For community water supplies treating surface water using direct or conventional filtration, the use of a primary coagulant is required at all times.
- c) The community water supply must submit with the construction permit application the design basis for the velocity gradient (G value) selected, considering the chemicals to be added and water temperature, color and other related water quality parameters.
- d) Mixing – Mixing must be adequate to disperse chemicals in the basin. The detention period should be instantaneous, but not longer than 30 seconds, with mixing equipment capable of imparting a minimum velocity gradient (G) of at least 750 fps/ft.
- e) Equipment - Basins must be designed or equipped to produce adequate mixing for all treatment flow rates. Static mixing may be considered where the flow is relatively constant and will be high enough to maintain the necessary turbulence for complete chemical reactions.
- f) Location - the coagulation and flocculation basin must be as close together as possible.

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Section 604.510 Flocculation

- a) For purposes of this Section, flocculation is a process to enhance agglomeration or collection of smaller floc particles into larger, more easily settleable or filterable particles through gentle stirring by hydraulic or mechanical means.
- b) Basin Design - Inlet and outlet design must minimize short-circuiting and destruction of floc. Series compartments are recommended to further minimize short-circuiting and to provide decreasing mixing energy with time. Basins must be designed so that individual basins may be isolated without disrupting plant operation. A drain and/or pumps must be provided to handle dewatering and sludge removal.
- c) Detention – The detention time must be adequate for floc formation. A detention time of at least 30 minutes with consideration to using tapered (*i.e.*, diminishing velocity gradient) flocculation is recommended. The flow-through velocity should be not less than 0.5 nor greater than 1.5 feet per minute.
- d) Equipment - Agitators must be driven by variable speed drives, with the peripheral speed of paddles ranging from 0.5 to 3.0 feet per second. External, non-submerged motors are preferred.
- e) Other Designs - Baffling may be used to provide for flocculation in small plants only after Agency approval. The design should be such that the velocities and flows recommended in subsection (c) will be maintained.
- f) Superstructure - A superstructure over the flocculation basins may be required.
- g) Piping - Flocculation and sedimentation basins must be as close together as possible. The velocity of flocculated water through pipes or conduits to settling basins must be no less than 0.5 nor greater than 1.5 feet per second. Allowances must be made to minimize turbulence at bends and changes in direction.
- h) Consideration should be given to the need for additional chemical feed in the future.

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Section 604.515 Sedimentation

For purposes of this Section, sedimentation is a process that allows particles to settle by gravity and typically precedes filtration. The detention time for effective clarification is dependent upon a number of factors related to basin design and the nature of the raw water. The following criteria apply to conventional sedimentation units:

- a) A minimum of four hours of settling time must be provided. This may be reduced to two hours for lime-soda softening facilities treating only groundwater. The Agency may approve reduced detention time when equivalent effective settling is demonstrated or when the overflow rate is not more than 0.5 gpm per square foot.
- b) Inlet Devices - Inlets must be designed to distribute the water equally and at uniform velocities by using open ports, submerged ports, and similar entrance arrangements. A baffle should be constructed across the basin close to the inlet end and should project several feet below the water surface to dissipate inlet velocities and provide uniform flows across the basin.
- c) Velocity - The velocity through a sedimentation basin must not exceed 0.5 feet per minute. The basins must be designed to minimize short-circuiting. Fixed or adjustable baffles must be provided as necessary to achieve the maximum potential for clarification.
- d) Outlet Devices - Outlet weirs or submerged orifices must maintain velocities suitable for settling in the basin and minimize short-circuiting. Submerged orifices must be used if necessary to provide a volume above the orifices for storage when there are fluctuations in flow. Outlet weirs and submerged orifices must be designed as follows:
 - 1) The rate of flow over the outlet weirs or through the submerged orifices must not exceed 20,000 gallons per day per foot of the outlet launder or orifice circumference;
 - 2) Submerged orifices should not be located lower than 3 feet below the flow line; and
 - 3) The entrance velocity through the submerged orifices must not exceed 0.5 feet per second.
- e) Overflow - An overflow weir or pipe designed to establish the maximum water level desired on top of the filters should be provided. The overflow must discharge by gravity with a free fall at a location where the discharge can be observed.

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- f) Drainage – Sedimentation basins must be provided with a means for dewatering. Basin bottoms should slope toward the drain not less than one foot in 12 feet where mechanical sludge collection equipment is not required.
- g) Flushing lines - Flushing lines or hydrants must be provided and must be equipped with backflow prevention devices approved by the Agency.
- h) Mechanical sludge removal equipment must be provided in the sedimentation basin.
- i) Sludge removal design must provide that:
 - 1) sludge pipes will not be less than 3 inches in diameter and so arranged as to facilitate cleaning;
 - 2) entrance to sludge withdrawal piping must prevent clogging;
 - 3) valves must be located outside the tank for accessibility; and
 - 4) the operator may observe and sample sludge being withdrawn from the unit.

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Section 604.520 Solids Contact Unit

- a) Adequate piping with sampling taps must be provided to allow for the collection of samples from various depths of the units.
- b) Chemical Feed. Chemicals must be satisfactorily mixed in accordance with Section 604.1100(b).
- c) The Agency may require a rapid mix device or chamber ahead of solids contact units to assure proper mixing of the chemicals applied. If required by the Agency, the mixing devices must be constructed to:
 - 1) provide good mixing of the raw water with previously formed sludge particles; and
 - 2) prevent deposition of solids in the mixing zone.
- d) Flocculation equipment:
 - 1) must be adjustable (speed and/or pitch);
 - 2) must provide for coagulation in a separate chamber or baffled zone within the unit; and
 - 3) should provide that the flocculation and mixing period will not be less than 30 minutes.
- e) Sludge removal design must:
 - 1) require sludge pipes be not less than 3 inches in diameter and arranged to facilitate cleaning;
 - 2) prevent clogging at the entrance to sludge withdrawal piping;
 - 3) locate valves outside the tank for accessibility; and
 - 4) allow the operator to observe and sample sludge being withdrawn from the unit.
- f) Cross Connections
 - 1) Blow-off outlets and drains must terminate in a location with an air gap of 6 inches for backflow protection.

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- 2) Cross connection control must be included for the potable water lines used to back flush sludge lines.
- g) Detention Period. Detention period must be established on the basis of the raw water characteristics and other local conditions that affect the operation of the unit.
- 1) When treating surface water with upflow clarifiers using mechanical mixing, detention times must be based on design flow rates and should be two to four hours;
 - 2) When softening groundwater with upflow clarifiers using mechanical mixing, detention times must be based on design flow rates and should be one to two hours;
 - 3) When treating surface water using cone shaped, helical upflow, solids contact clarifiers or softeners, the detention time must be a minimum of 60 minutes; and
 - 4) When treating groundwater using cone shaped, helical upflow, solids contact softeners, the detention time must be a minimum of 45 minutes.
- h) Water Losses
- 1) Solids contact units must be provided with controls to allow adjusting the rate or frequency of sludge withdrawal.
 - 2) Total water losses must not exceed:
 - A) five percent for clarifiers; and
 - B) three percent for softening units.
 - 3) Solids concentration of wasted sludge to waste must be:
 - A) three percent by weight for clarifiers; and
 - B) five percent by weight for softeners.
- i) Weirs or Orifices
- 1) Upflow Clarifiers Using Mechanical Mixing

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- A) The units must be equipped with either overflow weirs or orifices constructed so that water at the surface of the unit does not travel over 10 feet horizontally to the collection trough.
 - B) Weirs must be adjustable, at least equivalent in length to the perimeter of the tank.
 - C) Weir loading must not exceed:
 - i) 10 gpm per foot of weir length for units used as clarifiers; and
 - ii) 20 gpm per foot of weir length for units used as softeners.
 - D) Where orifices are used, the loading rates per foot of launder rates should be equivalent to weir loadings. Either must produce uniform rising rates over the entire area of the tank.
- 2) Cone Shaped, Helical Upflow, Solids Contact Clarifiers or Softeners
- A) Weir loadings on cone shaped, helical upflow, solids contact units that utilize reversing flow weirs must not exceed:
 - i) 100 gpm per lineal foot of weir length for cone shaped, helical upflow, solids contact units; or
 - ii) 200 gpm per foot of weir length for units used as softeners.
 - B) Where orifices are used, the loading rates per foot of launder rates should be equivalent to weir loadings. Either must produce uniform rising rates over the entire area of the tank.
- j) Upflow Rates. Unless otherwise approved by the Agency under Section 604.145(b), the upflow rates must not exceed:
- 1) 1.0 gpm per square foot of area at the sludge separation line for units used as clarifiers; and
 - 2) 1.75 gpm per square foot of area at the slurry separation line, for units used as softeners.

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- k) Cone shaped, helical upflow, solids contact units must be equipped with one or more tangentially oriented inlets that introduce flow into the bottom cylindrical section of the unit. The inlets must be equipped with a means for controlling the velocity of the water flowing into the unit.

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Section 604.525 Tube or Plate Settlers

- a) Settler units consisting of variously shaped tubes or plates installed in multiple layers and at an angle to the flow may be used for sedimentation, following flocculation.
- b) Tube or plate settlers must meet the following requirements:
 - 1) Inlet and outlet design must maintain velocities suitable for settling in the basin and to minimize short-circuiting;
 - 2) Plate units must be designed to minimize maldistribution across the units;
 - 3) Drain piping from settler units must be sized to facilitate a quick flush of the settlers units and to prevent flooding of other portions of the plant;
 - 4) Outdoor installations must be protected against freezing, including sufficient freeboard above the top of the settlers;
 - 5) Tubes must have a maximum application rate of 2 gpm per square foot of cross-sectional area, unless higher rates are shown through pilot plant or in-plant demonstration studies;
 - 6) Plates must have a maximum application rate of 0.5 gpm per square foot, based on 80 percent of the projected horizontal plate area;
 - 7) Flushing lines must be provided to facilitate maintenance and must be properly protected against backflow or back siphonage;
 - 8) Inlets and outlets must conform with Section 604.515(b) and (d);
 - 9) The units' support system must be able to carry the weight of the settler units when the basin is drained plus any additional weight to support maintenance; and
 - 10) Settler units must accommodate
 - A) A water or air jet system for cleaning their tubes or plates; and
 - B) Dropping their water level to allow cleaning with the system identified in subsection (b)(10)(A).

SUBTITLE F**Section 604.530 Other High Rate Clarification Processes**

The Agency may approve high rate clarification processes upon a demonstration of satisfactory performance under on site pilot plant conditions or documentation of full-scale plant operation with similar raw water quality conditions. The demonstration of documentation must include justification for any reductions in detention times and/or increases in weir loading rates. High rate clarification processes may include dissolved air flotation, ballasted flocculation, and contact flocculation/clarification.

SUBTITLE F

SUBPART F: FILTRATION

Section 604.600 Filtration

- a) Application of any one type of filter must be supported by water quality data representing a reasonable period of time to characterize the variations in water quality. The Agency may require pilot treatment studies to demonstrate the applicability of the method of filtration proposed.
- b) Acceptable filters include the following types:
 - 1) rapid rate gravity filters;
 - 2) rapid rate pressure filters;
 - 3) deep bed rapid rate gravity filters; and
 - 4) biologically active filters.

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Section 604.605 Rapid Rate Gravity Filters

- a) The use of rapid rate gravity filters requires pretreatment.
- b) For community water supplies treating surface water, groundwater under the direct influence of surface water, or using lime soda softening treatment, unless otherwise approved by the Agency under Section 604.145(b), the nominal filtration rates must not exceed 3 gal/min/ft² of filter area for single media filters and 5 gal/min/ft² for multi-media filters. Filtration rates must be reduced when treated water turbidity exceeds the standards in 35 Ill. Adm. Code 611.
- c) For community water supplies treating groundwater and not using lime soda softening treatment, unless otherwise approved by the Agency under Section 604.145(b), the rate of filtration must not exceed 4 gal/min/ft² of filter area.
- d) Number of Filter Units.
 - 1) A minimum of two units must be provided. Each unit must be capable of meeting the plant design capacity or the projected maximum daily demand at the approved filtration rate.
 - 2) Where more than two filter units are provided, the filters must be capable of meeting the plant design capacity at the approved filtration rate with one filter removed from service.
 - 3) Where declining rate filtration is provided, the variable aspect of filtration rates and the number of filters must be considered when determining the design capacity for the filters.
- e) Structural Details and Hydraulics. The filter structure must be designed to provide for the following:
 - 1) vertical walls within the filter;
 - 2) no protrusion of the filter walls into the filter media;
 - 3) cover by superstructure;
 - 4) head and walking room to permit normal inspection and operation;
 - 5) minimum depth of filter box of 8.5 feet;
 - 6) minimum water depth over the surface of the filter media of 3 feet;

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- 7) trapped effluent to prevent backflow of air to the bottom of the filters;
 - 8) prevention of floor drainage to the filter with a minimum 4-inch curb around the filters;
 - 9) prevention of flooding by providing overflow;
 - 10) maximum velocity of treated water in pipe and conduits to filters of 2 ft/sec;
 - 11) cleanouts and straight alignment for influent pipes or conduits where solids loading is heavy, or following lime soda softening;
 - 12) construction to prevent cross connections, short-circuiting, or common walls between potable and non-potable water; and
 - 13) wash water drain capacity to carry maximum flow.
- f) Wash water troughs must be constructed such that:
- 1) the bottom elevation is above the maximum level of expanded media during washing;
 - 2) a 2-inch freeboard is provided at the maximum rate of wash;
 - 3) the top edge is level and is all at the same elevation;
 - 4) troughs are spaced so that each trough serves the same number of square feet of filter area; and
 - 5) the maximum horizontal travel of suspended particles to reach the trough does not exceed 3 feet.
- g) The filter media must be composed of clean silica sand or other natural or synthetic media free from detrimental chemical or bacterial contaminants and must meet the following requirements:
- 1) a total depth of not less than 24 inches;
 - 2) a uniformity coefficient of the smallest material not greater than 1.65;

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- 3) a minimum of 12 inches of media with an effective size range of 0.45 mm to 0.55 mm;
- 4) filter media specifications:
 - A) Filter anthracite must consist of hard, durable anthracite coal particles of various sizes. Blending of non-anthracite material is not acceptable. Anthracite must have:
 - i) an effective size of 0.45 mm to 0.55 mm with uniformity coefficient not greater than 1.65 when used alone;
 - ii) an effective size of 0.8 mm to 1.2 mm with a uniformity coefficient not greater than 1.7 when used as a cap;
 - iii) an effective size less than 0.8 mm for anthracite used as a single media on potable groundwater for iron and manganese removal only (effective sizes greater than 0.8 mm may be approved based upon on site pilot plant studies);
 - iv) a specific gravity greater than 1.4;
 - v) an acid solubility less than 5 percent; and
 - vi) a Moh's scale of hardness greater than 2.7.
 - B) Sand must have:
 - i) an effective size of 0.45 mm to 0.55 mm;
 - ii) a uniformity coefficient of not greater than 1.65;
 - iii) a specific gravity greater than 2.5; and
 - iv) an acid solubility less than 5 percent.
 - C) High density sand must consist of hard, durable, and dense grain garnet, ilmenite, hematite or magnetite, or associated minerals of those ores that will resist degradation during handling and use, and must:

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- i) contain at least 95 percent of the associated material with a specific gravity of 3.8 or higher;
 - ii) have an effective size of 0.2 to 0.3 mm;
 - iii) have a uniformity coefficient of not greater than 1.65; and
 - iv) have an acid solubility less than 5 percent.
 - D) Granular activated carbon as a single media may be considered for filtration only after pilot or full-scale testing and with prior approval of the Agency. The design must include the following:
 - i) The media must meet the basic specifications for filter media in subsections (g)(1) through (g)(3).
 - ii) There must be provisions for a free chlorine residual and adequate contact time in the water following the filters and prior to distribution.
 - iii) Provisions must be made for frequent replacement or regeneration.
 - E) Other media types or characteristics must be approved by the Agency;
- 5) supporting media designed as follows based on the type of filter material:
- A) A three-inch layer of torpedo sand must be used as a supporting media for filter sand where supporting gravel is used, and must have:
 - i) an effective size of 0.8 mm to 2.0 mm; and
 - ii) a uniformity coefficient not greater than 1.7.
 - B) Gravel
 - i) When gravel is used as the supporting media, it must consist of cleaned and washed, hard, durable, rounded silica particles and must not include flat or elongated particles.

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- ii) The coarsest gravel must be 2.5 inches in size when the gravel rests directly on a lateral system, and must extend above the top of the perforated laterals.
- iii) Not less than four layers of gravel must be provided in accordance with the following size and depth distribution:

Size	Depth
2½ to 1½ inches	5 to 8 inches
1½ to ¾ inches	3 to 5 inches
¾ to ½ inches	3 to 5 inches
½ to 3/16 inches	2 to 3 inches
3/16 to 3/32 inches	2 to 3 inches

- iv) Reduction of gravel depths and other size gradations may be approved by the Agency upon justification for slow sand filtration or when proprietary filter bottoms are specified.

h) Filter Bottoms and Strainer Systems

- 1) Water quality must be reviewed prior to the use of porous plate bottoms to prevent clogging and failure of the underdrain system.
- 2) The design of manifold type collection systems must:
 - A) minimize loss of head in the manifold and laterals;
 - B) ensure even distribution of washwater and even rate of filtration over the entire area of the filter;
 - C) provide the ratio of the area of the strainer systems' final openings to the area of the filter at about 0.003;
 - D) provide the total cross-sectional area of the laterals at about twice the total area of the final openings;
 - E) provide the cross-sectional area of the manifold at 1.5 to 2 times the total area of the laterals; and
 - F) direct lateral perforations without strainers downward.
- 3) The Agency may approve departures from these standards for high rate filters and for propriety bottoms.

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- i) The following appurtenances must be provided for every filter:
 - 1) influent and effluent sampling taps;
 - 2) a gauge indicating loss of head;
 - 3) a meter indicating the instantaneous rate of flow;
 - 4) a pipe for filtering to waste that has a six inch or larger air gap, or other Agency approved cross connection control measure;
 - 5) a continuously recording Nephelometer capable of measuring and recording filter effluent turbidity at maximum 15-minute intervals, and with alarm capability to notify the operator if filtered water turbidity exceeds 0.3 NTU (Nephelometric Units);
 - 6) an adjustable rate valve to allow the operator to gradually control the flow rate increase when placing the filters back into operation; and
 - 7) a hose and storage rack for washing filter walls.
- j) Backwash. Provisions must be made for washing filters as prescribed in this subsection.
 - 1) The community water supply must use filtered water provided at the required rate by washwater tanks or a dedicated washwater pump to wash the filters.
 - 2) Backwash rate must meet the following requirements:
 - A) a minimum rate of 15 gal/min/ft², consistent with water temperatures and specific gravity of the filter media;
 - B) a rate sufficient to provide for a 50 percent expansion of the filter bed; and
 - C) a reduced rate of 10 gal/min/ft² for full depth anthracite or granular activated carbon filters, upon approval by the Agency.
 - 3) Washwater pumps in duplicate must be provided unless an alternate means of obtaining washwater is available.

SUBTITLE F

- 4) The main washwater line must have a regulator or valve to obtain the desired rate of filter wash with the washwater valves on the individual filters open wide.
 - 5) The main washwater line or backwash waste line must have a rate of flow indicator, preferably with a totalizer, located so that it can be easily read by the operator during the washing process.
 - 6) Rapid changes in backwash water flow must be prevented.
 - 7) Backwash must be completed with an operator in attendance to initiate the backwash cycle and to control the return-to-service procedure to assure that the effluent turbidity is less than 0.3 NTU when the filter is placed back into operation for discharge to the clearwell.
 - 8) Appropriate measures for cross connection control must be provided.
- k) Surface or subsurface wash facilities are required except for filters used exclusively for iron, radionuclides, arsenic or manganese removal. Wash facilities may include a system of fixed nozzles or a revolving-type apparatus. All devices must be designed:
- 1) to provide water pressures of at least 45 psi;
 - 2) if connected to the treated water system, to prevent back siphonage by properly installing a vacuum breaker or other approved device; and
 - 3) to provide a rate of flow of 2.0 gpm/ft² of filter area with fixed nozzles or 0.5 gpm/ft² with revolving arms.
- l) Air scouring can be used in place of surface wash if the air scouring meets the following requirements:
- 1) Air flow for air scouring the filter must be 3 to 5 f³/min/ft² of filter area when the air is introduced in the underdrain; a lower air rate must be used when the air scour distribution system is placed above the underdrains;
 - 2) A method to avoid filter media loss during backwashing must be provided;
 - 3) Air scouring must be followed by a fluidization wash sufficient to restratify the media;
 - 4) Air must be free from contamination;

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- 5) If air scour distribution systems are placed at the media and supporting bed interface, the air scour nozzles must be designed to prevent media from clogging the nozzles or the air entering the air distribution system;
- 6) Piping for the air distribution system must not be flexible hose or other soft material;
- 7) Air delivery piping must not:
 - A) pass down through the filter media; and
 - B) have any arrangement in the filter design that would allow short-circuiting between the applied unfiltered water and the filtered water;
- 8) When air scouring is being utilized, the backwash rate must be variable and must not exceed 8 gal/min, unless a higher rate is necessary to remove scoured particles from filter media surfaces; and
- 9) Air scouring piping must not be installed in the underdrain unless the underdrain was designed to accommodate the piping.

SUBTITLE F

Section 604.610 Rapid Rate Pressure Filters

- a) Pressure filters must not be used in the filtration of surface water, groundwater under the direct influence of surface water, or water treated by lime soda softening.
- b) The rate of filtration must not exceed 4 gal/min/ft² of filter area unless otherwise approved by the Agency under Section 604.145(b).
- c) Minimum criteria at Section 604.605(e) and (g) relative to structural details, hydraulics, and filter media provided for rapid rate gravity filters also apply to pressure filters when appropriate.
- d) Number
 - 1) A minimum of two units must be provided. Each unit must be capable of meeting the plant design capacity or the projected maximum daily demand at the approved filtration rate.
 - 2) When more than two filter units are provided, the filters must be capable of meeting the plant design capacity at the approved filtration rate with one filter removed from service.
- e) Rapid rate pressure filters must be designed to provide for the following:
 - 1) loss of head gauges on the inlet and outlet pipes of each battery of filters;
 - 2) an easily readable meter or flow indicator on each battery of filters;
 - 3) filtration and backwashing of each filter individually;
 - 4) minimum sidewall shell height of 5 feet, unless otherwise approved by the Agency under Section 604.145(b);
 - 5) the top of the washwater collectors at least 18 inches above the surface of the media;
 - 6) an underdrain system to collect the filtered water and to uniformly distribute the backwash water at a rate not less than 15 gal/min/ft² of filter area;
 - 7) backwash flow indicators and controls that are readable while operating the control valves;

SUBTITLE F

- 8) an air release valve on the highest point of each filter;
 - 9) when the filter exceeds 36 inches in diameter, a manhole at least 24 inches in diameter;
 - 10) means of observing backwash discharge water; and
 - 11) a six inch or larger air gap, or other Agency approved cross connection control measure.
- f) Rapid rate pressure filters should have a flow indicator on each filtering unit.

SUBTITLE F

Section 604.615 Deep Bed Rapid Rate Gravity Filters

Deep bed rapid rate gravity filters 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 Section 604.605(f)(4).

- a) Before a community water supply may use deep bed rapid rate filters, a pilot study must be completed and approved by the Agency.
- b) The final filter design must be based on the pilot plant studies and must comply with all applicable portions of Section 604.605.

SUBTITLE F

Section 604.620 Biologically Active Filtration

Biologically active filtration refers to the filtration of surface water or a groundwater with iron, manganese or significant natural organic material, which includes the establishment and maintenance of biological activity within the filtration media. The 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; and oxidation of ammonia-nitrogen, iron and manganese. Biological activity can have an adverse impact on turbidity, particle and microbial pathogen removal, disinfection practices, head loss development, and filter run times and distribution system corrosion.

- a) Before use of biologically active filters, the community water supply must conduct a pilot study and obtain Agency approval. Pilot study objectives must be clearly defined and must ensure the microbial quality of the filtered water under all anticipated conditions of operation.
 - 1) The pilot study must be of sufficient duration to ensure establishment of full biological activity; often greater than three months is required.
 - 2) The pilot study must establish empty bed contact time, surface filtration hydraulic loading rate, substrate loading rate per unit filter media volume, and treatment efficiency for removal or reduction of concentration of parameters targeted for the pilot study.
- b) The final filter design must be based on the pilot plant studies and must comply with Section 604.605.

SUBTITLE F

SUBPART G: DISINFECTION

Section 604.700 Disinfection Requirement

- a) Disinfection, in addition to continuous chlorination, is required for all sources utilizing surface water, groundwater under the direct influence of surface water, groundwater obtained from unconfined fractured bedrock, groundwater with a total coliform presence, and groundwater treated in basins open to the atmosphere to meet the inactivation of pathogens treatment objectives as provided in Section 604.720 and 35 Ill. Adm. Code 611.
- b) Disinfection may be accomplished with chlorine, chloramines, chlorine dioxide, ozone, or ultraviolet light. Chloramines must not be used as a primary disinfectant, unless otherwise approved by the Agency under Section 604.145(b).
- c) Continuous chlorination is required for all community water supplies unless the chlorine residual requirements of Section 604.725 are met or the community water supply is exempt under Section 17(b) of the Act.
- d) Notification of a change in disinfection practices and the schedule for the changes must 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.

SUBTITLE F

Section 604.705 Chlorination Equipment

- a) Procedure for Submitting Plans and Specifications - Design documents for chlorination must be prepared and submitted in accordance with 35 Ill. Adm. Code 602.
- b) Chlorination equipment must:
 - 1) be large enough to satisfy the immediate chlorine demand and give a measurable residual of at least 2.0 mg/L of total chlorine under all operating conditions after contact;
 - 2) be capable of feeding chlorine to the water being treated at a dosage rate of at least 5.0 mg/L, except when the water has a high chlorine demand. Factors in determining chlorine demand are:
 - A) pH;
 - B) water temperature;
 - C) contact time;
 - D) presence in the water of substances having chlorine demand such as hydrogen sulfide, iron, manganese and nitrogenous compounds including ammonia; and
 - E) supplemental treatment such as aeration that reduces chlorine demand;
 - 3) be provided in duplicate when operating conditions do not allow repair of the chlorinator during off-pumping periods;
 - 4) be provided in duplicate, installed and operational, at community water supplies treating surface water, groundwater under the direct influence of surface water, and groundwater with a history of total coliform positive results; and
 - 5) include spare parts for emergency repairs consisting of at least the commonly expendable parts such as glassware, fittings, hose clamps, and gaskets.

SUBTITLE F

Section 604.710 Points of Application

Provisions must be made for the capability to add a disinfectant into or prior to any aeration, settling, or filtration process, unless the process involves biological treatment, in which case the disinfectant must be added after the biological treatment.

SUBTITLE F

Section 604.715 Contact Time

- a) Unless otherwise approved by the Agency under Section 604.145(b), a minimum chlorine contact time of 60 minutes must be provided at all plants treating surface water, groundwater under the direct influence of surface water, groundwater with basins open to the atmosphere, and groundwater obtained from unconfined, fractured bedrock. The equivalent baffling factor must be greater than or equal to 0.3 to prevent short-circuiting. The 60-minute contact time must be calculated based on the following formula:

$$\frac{\text{maximum pumping rate out of basin, gpm}}{\text{actual basin operating water volume, gallons}} = \text{minimum 60 minutes}$$

- b) For the purposes of this Section, contact time is measured as follows:
- 1) When the treatment process includes filtration, contact time is measured as the time following filtration of the water until the water reaches the first user.
 - 2) When the treatment process does not include filtration, contact time is measured as the time following chlorination of water until the water reaches the first user.

SUBTITLE F

Section 604.720 Inactivation of Pathogens

- a) At plants treating surface water or groundwater under the direct influence of surface water, a disinfectant must be added to provide:
 - 1) a minimum 0.5-log inactivation of *Giardia lamblia* cysts; and
 - 2) a minimum 2-log inactivation of viruses.
- b) At plants treating groundwater obtained from unconfined fractured bedrock, groundwater with a total coliform presence, or groundwater treated in basins open to the atmosphere:
 - 1) A 4-log virus inactivation is required; and
 - 2) A second method of inactivation is required in addition to continuous chlorination. Additional methods of inactivation must be approved by the Agency, and may include chlorine dioxide, ozone, ultraviolet light, gravity filtration and membrane filtration.
- c) The methodology to determine inactivation of pathogens must be done in accordance with the Disinfection Profiling and Benchmark Guidance Manual, August 1999, USEPA reference for methodology and C x T tables, incorporated by reference in 35 Ill. Adm. Code 601.115.
- d) Factors to be considered in determining inactivation include: pH, temperature, form of disinfectant residual, disinfectant residual concentration, flow rate, volume of basins/piping and baffling factors. Baffling factor must be determined according to "Improving Clearwell Design for CT Compliance", incorporated by reference in 35 Ill. Adm. Code 601.115, or a tracer study approved by the Agency.

SUBTITLE F

Section 604.725 Residual Chlorine

- a) A minimum free chlorine residual of 0.5 mg/L or a minimum combined chlorine residual of 1.0 mg/L must be maintained in all active parts of the distribution system at all times.
- b) Community water supplies must monitor chlorine residual to determine the amount and type of residuals existing at different points in the distribution system.
- c) Community water supplies must not mix water sources with free chlorine and combined chlorine residual.

SUBTITLE F

Section 604.730 Continuous Chlorine Analyzers

Community water supplies that rely on chlorination for disinfection under Section 604.700(a) must have continuous chlorine residual analyzers with alarm capability that alerts the community water supply if chlorine residuals at the entry point to the distribution system are below the limits established in Section 604.725.

SUBTITLE F

Section 604.735 Chlorinator Piping

- a) Cross Connection Protection.
 - 1) The chlorinator piping must be designed to prevent contamination of the treated water.
 - 2) For all systems required to disinfect under Section 604.700, piping must be arranged to prevent back flow or back siphonage between multiple points of chlorine application.
 - 3) The water supply to each eductor must have a separate shutoff valve.
- b) Pipe Material
 - 1) The pipes carrying elemental liquid or dry gaseous chlorine under pressure must be Schedule 80 seamless steel tubing or other materials recommended by The Chlorine Institute in Pamphlet 6, Piping Systems for Dry Chlorine, incorporated by reference in 35 Ill. Adm. Code 601.115. These pipes must not be PVC.
 - 2) Rubber, PVC, polyethylene (PE), or other materials recommended by The Chlorine Institute must be used for chlorine solution piping and fittings.
 - 3) Nylon products are not acceptable for any part of the chlorine solution piping system.

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SUBPART H: SOFTENING

Section 604.800 Lime or Lime-soda Process

- a) Design standards for rapid mix, flocculation and sedimentation are in Subpart E.
- b) When split treatment is used, an accurate means of measuring and splitting the flow must be provided.
- c) Before installation of lime or lime-soda processes, the community water supply must determine the carbon dioxide content of the raw water to evaluate the efficacy of installing aeration treatment.
- d) Lime must be fed directly into the rapid mix basin or mixing chamber.
- e) Rapid mix detention time must be no longer than 30 seconds, with adequate velocity gradients to keep the lime particles dispersed.
- f) The softening process must include equipment for stabilization of water softened by the lime or lime-soda.
- g) The use of excess lime is not an acceptable substitute for disinfection.
- h) The plant processes must be manually started following shut down.

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Section 604.805 Cation Exchange Process

- a) Pre-treatment under Section 604.1010(b) or (c) is required when the content of iron, manganese, or a combination of the two is 1 mg/L or more.
- b) Design requirements must provide:
 - 1) automatic regeneration based on volume of water softened; and
 - 2) a manual override on all automatic controls.
- c) The design capacity for hardness removal must not exceed 20,000 grains per cubic foot when resin is regenerated with 0.3 pounds of salt per 1000 grains of hardness removed.
- d) The depth of the exchange resin must not be less than 3 feet.
- e) Flow Rates
 - 1) The rate of softening must not exceed 7 gal/min/ft² of bed area.
 - 2) The backwash rate must be 6 to 8 gal/min/ft² of bed area.
 - 3) Rate of flow controllers or the equivalent must be installed.
- f) The freeboard must be calculated based on the size and specific gravity of the resin and the direction of water flow. Unless otherwise approved by the Agency under Section 604.145(b), the washwater collector must be 24 inches above the top of the resin on down flow units.
- g) The bottoms, strainer systems and support for the exchange resin must conform to criteria provided for rapid rate gravity filters in Section 604.605(f) and (g).
- h) Brine must be evenly distributed over the entire surface of both upflow and downflow units.
- i) Backwash, rinse and air relief discharge pipes must be installed to prevent any possibility of back siphonage.
- j) Bypass Piping and Equipment
 - 1) Bypass must be provided around softening units to produce a blended water of desirable hardness.

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- 2) Totalizing meters must be installed on the bypass line and on each softener unit.
 - 3) The bypass line must have a shutoff valve. An automatic proportioning or regulating device is recommended.
- k) When the applied water contains a chlorine residual, the cation exchange resin must be a type that is not damaged by residual chlorine.
- l) Sampling Taps
- 1) Smooth-nosed sampling taps must be provided for the collection of representative samples.
 - 2) The taps must be located to provide for sampling of the softener influent, effluent and blended water.
 - 3) The sampling taps for the blended water must be at least 20 feet downstream from the point of blending.
 - 4) Petcocks are not acceptable as sampling taps.
- m) Brine and Salt Storage Tanks:
- 1) Salt dissolving or brine tanks and wet salt storage tanks must be covered and must be corrosion resistant.
 - 2) The make-up water inlet must be protected from back siphonage. Water for filling the tank must be distributed over the entire surface by pipes above the maximum brine level in the tank. An automatic declining level control system on the make-up water line is recommended.
 - 3) Wet salt storage basins must be equipped with manholes or hatchways for access and for direct dumping of salt from truck or railcar. Openings must be provided with raised curbs and watertight covers having overlapping edges similar to those required for finished water reservoirs.
 - 4) Overflows, where provided, must be protected with corrosion resistant screens and must terminate with either a turned down bend having a proper free fall discharge or a self-closing flap valve.

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- 5) The salt must be supported on graduated layers of gravel placed over a brine collection system.
 - 6) Alternative designs that are conducive to frequent cleaning of the wet salt storage tank may be approved by the Agency.
 - 7) Total salt storage must provide for at least 30 days of operation.
- n) Corrosion control must be provided under Subpart I.
 - o) Suitable disposal must be provided for brine waste.
 - p) Pipes and contact materials must be resistant to the aggressiveness of salt. Plastic and red brass are acceptable piping materials. Steel and concrete must be coated with a non-leaching protective coating that is compatible with salt and brine.
 - q) Dry bulk salt storage must be enclosed and separated from other operating areas to prevent damage to equipment.

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SUBPART I: STABILIZATION

Section 604.900 General Stabilization Requirements

- a) Water distributed by community water supplies must be stable so as to not cause a violation of 35 Ill. Adm. Code 601.101(a).
- b) The following water quality parameters of finished water must be evaluated to ensure that water quality parameters minimize corrosion and minimize deposition of excess calcium carbonate (CaCO_3) scale throughout the distribution system of the community water supply:
 - 1) alkalinity (as CaCO_3);
 - 2) total hardness (as CaCO_3);
 - 3) calcium hardness (as CaCO_3);
 - 4) temperature;
 - 5) pH;
 - 6) chloride;
 - 7) sulfate;
 - 8) total dissolved solids;
 - 9) oxidation reduction potential;
 - 10) conductivity;
 - 11) iron;
 - 12) manganese;
 - 13) orthophosphate, if applicable; and
 - 14) silica, if applicable.
- c) The following may be used to determine the corrosivity of water distributed by a community water supply:

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- 1) Lead and Copper
 - A) Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems, USEPA (March 2016); Office of Water (4606M); EPA 816-B-16-003, incorporated by reference at 35 Ill. Adm. Code 601.115;
 - B) Chloride Sulfate Mass Ratio (CSMR), calculated as follows:
$$\text{CMSR} = \frac{\text{Cl}^-, \text{ expressed as mg/L}}{\text{SO}_4^-, \text{ expressed as mg/L}}$$
 - C) Coupon and pipe loop studies.

- 2) Iron and Steel

Larson-Skold Index (L-SI), calculated as follows:

$$\text{L-SI} = (\text{Cl} + \text{SO}_4) / \text{alkalinity}$$

(All parameters expressed as mg/L of equivalent CaCO₃)

BOARD NOTE: The following equation provides a simplified procedure for calculating L-SI:

$$\text{LS-I} = \frac{(1.41)(\text{mg/L Cl}^-) + (1.04)(\text{mg/L SO}_4^{2-})}{\text{mg/L alkalinity (as CaCO}_3)}$$

Cl⁻ expressed as mg/L chloride
SO₄⁻² expressed as mg/L sulfate

- 3) Iron Steel and Concrete

- A) Calcium Carbonate Precipitation Potential (CCPP) as referenced in Method 2330 C Standard Methods for Examination of Water and Wastewater, 22nd edition, incorporated by reference in 35 Ill. Adm. Code 611.102.
- B) For water containing phosphates:
 - i) The Alkalinity Difference Technique, as described in Method 2330 B.3.b and 2330 C.2.b Standard Methods for

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Examination of Water and Wastewater, 22nd edition, incorporated by reference in 35 Ill. Adm. Code 611.102. The CCPP is the difference between the initial and equilibrated water's alkalinity (or calcium) values, when expressed as CaCO_3 .

- ii) The Marble Test, as described in Method 2330 C.2.c Standard Methods for Examination of Water and Wastewater, 22nd edition, incorporated by reference in 35 Ill. Adm. Code 611.102. The Marble Test is similar to the Alkalinity Difference Technique. The CCPP equals the change in alkalinity (or calcium) values during equilibration, when expressed as CaCO_3 .
- d) The following may be used to determine deposition of excess CaCO_3 scale:
- 1) CCPP, as referenced in Method 2330 B Standard Methods for Examination of Water and Wastewater, 22nd edition, incorporated by reference in 35 Ill. Adm. Code 611.102.
 - 2) For water containing phosphates:
 - A) The Alkalinity Difference Technique, as described in Method 2330 B.3.b and 2330 C.2.b Standard Methods for Examination of Water and Wastewater, 22nd edition, incorporated by reference in Section 611.102. The CCPP is the difference between the initial and equilibrated water's alkalinity (or calcium) values, when expressed as CaCO_3 .
 - B) The Marble Test as described in Method 2330 C.2.c Standard Methods for Examination of Water and Wastewater, 22nd edition, incorporated by reference in Section 611.102. The Marble Test is similar to the Alkalinity Difference Technique. The CCPP equals the change in alkalinity (or calcium) values during equilibration, when expressed as CaCO_3 .

BOARD NOTE: Calcium Carbonate Precipitation Potential (CCPP) can be calculated using Trussell Technologies software: www.trusselltech.com/downloads?category=6.

CCPP does not apply to protection or corrosion of lead and copper plumbing materials or to water containing phosphates. See "Internal Corrosion and Deposition Control", Water Quality & Treatment, A Handbook on Drinking Water, 6th ed. (2011), American Water Works Association.

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BOARD NOTE: Estimating Calcium Carbonate Precipitation Potential (CCPP) using the Alkalinity Difference Technique or the Marble Test, both referenced in Standard Methods for Examination of Water and Wastewater, 22nd edition, incorporated by reference at 35 Ill. Adm. Code 611.102, is described as "Calcium Carbonate Saturation". Simplified Procedures for Water Examination, Manual of Water Supply Practices M12 (5th ed. 2002), American Water Works Association.

Based on results of the "Calcium Carbonate Saturation" test, CCPP can be calculated as:

$$\text{CCPP} = \text{Final mg/L alkalinity (as CaCO}_3\text{)} - \text{Initial mg/L alkalinity (as CaCO}_3\text{)}$$

Water is unsaturated with respect to calcium carbonate and may be corrosive if final alkalinity is greater than initial alkalinity, a positive value in the equation above. If there is alkalinity gain in the final alkalinity test, it indicates tendency to dissolve calcium carbonate scale.

Water is oversaturated with calcium carbonate scale and may deposit calcium carbonate coating in the water mains if final alkalinity is less than initial alkalinity, a negative value in the equation above. If there is alkalinity loss in the final alkalinity test, it indicates tendency to precipitate calcium carbonate scale. If final and initial alkalinity are the same, the water is stable and in equilibrium with calcium carbonate.

CCPP is not applicable to protection or corrosion of lead and copper plumbing materials.

Verifying the alkalinity titration endpoint by using a pH meter to verify the pH of the titrated alkalinity sample is recommended, since titration endpoint visual color change may be individually variable. If pH of the sample is not certain, consider using pH of 4.50 to represent the endpoint. See "Alkalinity Test", Standard Methods for Examination of Water and Wastewater, 22nd edition, incorporated by reference in 35 Ill. Adm. Code 611.102.

e) Acceptable stability treatments include:

- 1) carbon dioxide addition;
- 2) acid addition;
- 3) phosphate addition;
- 4) split treatment;
- 5) alkali chemical:

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- A) hydrated lime
 - B) sodium carbonate
 - C) sodium bicarbonate
 - D) sodium hydroxide;
- 6) carbon dioxide reduced by aeration;
 - 7) calcium hydroxide; and
 - 8) sodium silicate addition.
- f) When chemical addition is used for stabilization, the community water supply must comply with requirements of Subpart K.

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Section 604.905 Carbon Dioxide Addition

- a) Unless carbon dioxide addition is provided in the form of a carbonic acid and water solution under pressure, recarbonation basin design must provide:
 - 1) a total detention time of 20 minutes; and
 - 2) a depth that will provide a diffuser submergence of not less than 7.5 feet nor greater submergence than recommended by the manufacturer.
- b) When liquid carbon dioxide is used, carbon dioxide must be prevented from entering the atmosphere within the plant from the recarbonation process.
- c) Recarbonation tanks must be located outside or be sealed and vented to the outside with adequate seals and adequate purge flow of air.
- d) The recarbonation basin must be designed to allow for draining and sludge removal.

SUBTITLE F**Section 604.910 Phosphates**

Phosphate solution must be kept covered and disinfected by carrying approximately 10 mg/L free chlorine residual unless the phosphate is not able to support bacterial growth and the phosphate is being fed from the covered shipping container. Phosphate solutions having a pH of 2.0 or less may also be exempted from this requirement by the Agency.

SUBTITLE F**Section 604.915 Split Treatment**

A lime softening water treatment plant can be designed using "split treatment" in which raw water is blended with lime softened water to partially stabilize the water prior to secondary clarification and filtration. Treatment plants designed to utilize "split treatment" should also contain facilities for further stabilization by other methods.

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SUBPART J: OTHER TREATMENT

Section 604.1000 Presedimentation

- a) Basin Design: presedimentation basins must have the capability for dewatering. These basins may include hopper bottoms or a continuous mechanical sludge removal apparatus;
- b) Inlet: short-circuiting must be prevented;
- c) Bypass: provisions for bypassing presedimentation basins must be included; and
- d) Detention time must be adequate. Unless otherwise approved by the Agency under Section 604.145(b), three hours detention is the minimum period.

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Section 604.1005 Anion Exchange

- a) Pre-treatment Requirements. Pre-treatment under Section 604.1010 is required when a combination of iron and manganese exceeds 0.5 mg/L.
- b) Anion Exchange Treatment Design
 - 1) Automatic regeneration based on volume of water treated must be used unless manual regeneration is justified and is approved by the Agency.
 - 2) If a portion of the water is bypassed around the units and blended with treated water, the following requirements must be met:
 - A) the maximum blend ratio allowable must be determined based on the highest anticipated raw water nitrate level; and
 - B) a totalizing meter and a proportioning or regulating device or flow regulating valves must be provided on the bypass line.
 - 3) A manual override must be provided on all automatic controls.
 - 4) Adequate freeboard must be provided to accommodate the backwash flow rate of the unit, ensuring the resin will not overflow. The freeboard must be calculated based on the size and specific gravity of the resin.
 - 5) The system must be designed to include an adequate under drain and supporting gravel system and brine distribution equipment.
 - 6) Sampling Taps
 - A) Smooth-nosed sampling taps must be provided for the collection of representative samples.
 - B) The taps must be located to provide for sampling of the softener influent, effluent and blended water.
 - C) The sampling taps for the blended water must be at least 20 feet downstream from the point of blending.
 - D) Petcocks are not acceptable as sampling taps.
 - 7) Brine and Salt Storage Tanks:

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- A) Salt dissolving or brine tanks and wet salt storage tanks must be covered and must be corrosion resistant.
 - B) The make-up water inlet must be protected from back siphonage. Water for filling the tank must be distributed over the entire surface by pipes above the maximum brine level in the tank. An automatic declining level control system on the make-up water line is recommended.
 - C) Wet salt storage basins must be equipped with manholes or hatchways for access and for direct dumping of salt from truck or railcar. Openings must be provided with raised curbs and watertight covers having overlapping edges similar to those required for finished water reservoirs.
 - D) Overflows, where provided, must be protected with corrosion resistant screens and must terminate with either a turned downward bend having a proper free fall discharge or a self-closing flap valve.
 - E) The salt must be supported on graduated layers of gravel placed over a brine collection system.
 - F) Alternative designs that are conducive to frequent cleaning of the wet salt storage tank may be approved by the Agency.
 - G) Total salt storage must provide for at least 30 days of operation.
- c) Exchange Capacity. The design capacity for nitrate removal must not exceed 10,000 grains per cubic foot when the resin is regenerated at 15 pounds of salt per cubic foot of resin.
 - d) Number of Units. At least two units must be provided. The treatment capacity must be capable of producing the maximum average daily demand at a level below the nitrate/nitrite MCL, with one exchange unit out of service.
 - e) Type of Media. The anion exchange media must be of the nitrate selective type.
 - f) Flow Rates. Unless otherwise approved by the Agency under Section 604.145(b), the following flow rates apply:
 - 1) The treatment flow rate must not exceed 5 gal/min/ft² of bed area.

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- 2) The backwash flow rate must be between 4.0 and 6.0 gal/min/ft² of bed area.
 - 3) The regeneration rate must be approximately 1.0 gal/min/ft² of bed area with a fast rinse approximately equal to the service flow rate.
- g) Cross Connection Control. Backwash, rinse and air relief discharge pipes must be installed to prevent any possibility of back-siphonage.
 - h) Construction Materials. Pipes and contact materials must be resistant to the aggressiveness of salt. Plastic and red brass are acceptable materials. Steel and concrete must be coated with a non-leaching protective coating that is compatible with salt and brine.
 - i) Housing. Dry bulk salt storage must be enclosed and separated from other operating areas to prevent damage to equipment.
 - j) Preconditioning of the Media. Prior to startup of the equipment, the media must be regenerated with no less than two bed volumes of water containing sodium chloride followed by an adequate rinse.

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Section 604.1010 Iron and Manganese Control

- a) Except as provided in 35 Ill. Adm. Code 611.300(e), treatment is required to meet the iron and manganese MCL as stated in Section 611.300(b).
- b) Removal of Iron and Manganese by Oxidation, Detention and Filtration
 - 1) Oxidation must be by aeration, as indicated in Subpart D, unless the community water supply demonstrates chemical oxidation provides equivalent results to aeration. Chemicals that may be used for oxidation include chlorine, sodium permanganate, potassium permanganate, ozone or chlorine dioxide.
 - 2) Detention
 - A) A minimum detention time of 30 minutes must be provided following aeration to ensure that the oxidation reactions are complete prior to filtration. This minimum detention time may be modified only when a pilot plant study indicates completion of oxidation reactions in less time.
 - B) The reaction tank/detention basin must be provided with an overflow, vent and access hatch in accordance with Subpart M.
 - 3) Filtration. Filters must conform to Subpart F.
- c) Removal by Manganese Greensand or Manganese Coated Media Filtration.
 - 1) Permanganate or chlorine must be added to the water upstream of the filter, per manufacturer's recommendation.
 - 2) An anthracite media cap of at least six inches must be provided over manganese greensand.
 - 3) Normal backwash rate is 8 gal/min/ft² with filters containing manganese greensand and 15 gal/min with manganese coated media.
 - 4) Sample taps must be provided:
 - A) prior to application of permanganate;
 - B) immediately ahead of filtration;

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- C) at points between the anthracite media and the manganese greensand;
 - D) halfway down the manganese greensand; and
 - E) at the filter effluent.
- d) Sequestration of Iron and/or Manganese by Polyphosphates
- 1) Sequestration by polyphosphates must not be used when the combination of iron and manganese exceeds 1 mg/L.
 - 2) Phosphate solution must be kept covered and disinfected by carrying approximately 10 mg/L free chlorine residual unless the phosphate is not able to support bacterial growth and the phosphate is being fed from the covered shipping container. Phosphate solutions having a pH of 2.0 or less may also be exempted from this requirement by the Agency.
 - 3) Polyphosphates must not be applied ahead of iron and manganese removal treatment. The point of application must be prior to aeration, oxidation or disinfection.
 - 4) The phosphate feed point must be located as far ahead of the oxidant feed point as possible.
- e) Sequestration of Iron and/or Manganese by Sodium Silicates:
- 1) Sequestration by sodium silicate must not be used when iron, manganese or a combination of iron and manganese exceeds 2 mg/L.
 - 2) A full-scale demonstration will be required to determine the suitability of sodium silicate for the particular water and the minimum feed needed.
 - 3) Chlorine or chlorine dioxide addition must accompany the sodium silicate addition.
 - 4) Sodium silicate must not be applied ahead of iron or manganese removal treatment.

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Section 604.1015 Taste and Odor Control

- a) Control of taste and odor is required when necessary to meet the requirements of 35 Ill. Adm. Code 601.101(b).
- b) Acceptable taste and odor control treatments include:
 - 1) chlorination;
 - 2) chlorine dioxide;
 - 3) powdered activated carbon;
 - 4) granular activated carbon;
 - 5) copper sulfate or other copper compounds;
 - 6) aeration;
 - 7) potassium permanganate;
 - 8) ozonation; or
 - 9) ultraviolet with hydrogen peroxide.

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Section 604.1020 Powdered Activated Carbon

- a) Powdered activated carbon must be added as early as possible in the treatment process to provide maximum contact time to allow the effective and economical use of the chemical.
- b) Activated carbon must not be applied near the point of chlorine or other oxidant application.
- c) The carbon may be added as a pre-mixed slurry or by means of a dry feed machine as long as the carbon is properly wetted.
- d) Continuous agitation or resuspension equipment must be provided to keep the carbon from depositing in the slurry storage tank.
- e) Provisions must be made for adequate dust control.
- f) When feeding powdered activated carbon for taste and odor control, provisions must be made for adding at least 40 mg/L.
- g) Powdered activated carbon must be handled as a potentially combustible material.
 - 1) A separate room must be provided for carbon feed equipment, including a door to allow isolation of the room.
 - 2) The separate room must be as nearly fireproof as possible.
 - 3) Other chemicals must not be stored in the same room as powdered activated carbon.
 - 4) Carbon feeder rooms must be equipped with explosion-proof electrical outlets, lights and motors.

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SUBPART K: CHEMICAL APPLICATION

Section 604.1100 General Chemical Application Requirements

- a) Permit Requirement. No chemicals may be applied to treat drinking water unless specifically permitted by the Agency.
- b) Chemical must 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 consumers;
 - 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.
- c) General equipment design must 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 to minimize potential for corrosion;
 - 4) chemicals that are incompatible are not stored or handled together;
 - 5) all chemicals are delivered from the feeder to the point of application in separate conduits; and
 - 6) chemical feeders and pumps operate at no lower than 20 percent of the feed range unless two fully independent adjustment mechanisms, such as pump pulse rate and stroke length, are fitted when the pump must operate at no lower than 10 percent of the rated maximum.

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- d) All chemical containers must bear the name, address and telephone number of the supplier, along with a functional name or identification and strength of the chemical.
- e) Storage containers must be reserved for use of one chemical only.
- f) Chemicals must not be fed in excess of the maximum dosage stated in the NSF/ANSI Standard 60, incorporated by reference in Section 601.115.

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Section 604.1105 Feed Equipment and Chemical Storage

- a) Solution Feed Equipment.
 - 1) Corrosion resistant containers must be provided for solution feeders.
 - 2) Containers must have non-corrodible covers with overhanging edges. Openings must be constructed to prevent contamination.
 - 3) Scales or a volumetric measuring device must be provided for determining the amount of solution fed.
- b) Feeder Redundancy
 - 1) When chemical feed is necessary for the protection of the supply, such as chlorination, coagulation or other essential processes:
 - A) a minimum of two feeders must be provided with each having adequate capacity to provide the maximum dosage necessary; and
 - B) the standby unit or a combination of units of sufficient size to meet capacity must be provided to replace the largest unit when out of service.
 - 2) A separate feeder must be used for each chemical applied.
 - 3) Each chemical feeder and day tank must be identified with its content.
 - 4) Spare parts must be available on site for all feeders and chemical booster pumps to replace parts that are subject to wear and damage.
- c) Control
 - 1) At automatically operated facilities:
 - A) The automatic controls must be designed to allow override by manual controls.
 - B) Chemical feeders must be electrically interconnected with the well or service pump so that they will not operate if the well or service pump is not operating.

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- 2) Chemical feed rates must be proportional to the flow stream to achieve the appropriate dose of chemical application.
 - 3) A means to measure water flow stream being dosed must be provided to determine chemical feed rates.
 - 4) Provisions must be made for measuring the quantities of chemicals used.
 - 5) Weighing Scales
 - A) Weighing scales must be capable of providing reasonable precision in relation to average daily dose.
 - B) Unless otherwise approved by the Agency under Section 604.145(b), treatment chemicals in gaseous state must be weighed;
 - C) Fluoride solution fed from supply drums or carboys must be weighed; and
 - D) Volumetric dry chemical feeders must be weighed unless otherwise approved by the Agency under Section 604.145(b).
- d) Dry chemical feeders must:
- 1) measure chemicals volumetrically or gravimetrically;
 - 2) provide adequate water and agitation of the chemical within the slurry tank; and
 - 3) completely enclose chemicals to prevent emission of dust to the operating room.
- e) Positive Displacement Solution Pumps
- 1) Positive displacement type solution feed pumps may be used to feed liquid chemicals, but must not be used to feed chemical slurries.
 - 2) Pumps must be capable of operating at the required maximum rate against the maximum head conditions found at the point of injection.
 - 3) Calibration tubes or mass flow monitors that allow for direct physical measurement of actual feed rates must be provided.

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- f) To ensure that chemical solutions cannot be siphoned or overfed into the water supply, liquid chemical feeders must:
- 1) assure discharge at a point of positive pressure;
 - 2) provide vacuum relief; or
 - 3) provide a suitable air gap or anti-siphon device.
- g) Cross connection control must be provided to assure that:
- 1) the make-up water lines discharging to liquid storage tanks must be properly protected from backflow;
 - 2) no direct connection exists between any sewer and a drain or overflow from a chemical feed system; and
 - 3) all overflows and drains from a chemical feed system must have an airgap above the sewer or overflow rim of a receiving sump.
- h) Chemical feed equipment location must be readily accessible for servicing, repair and observation of operation.
- i) Make-up water ~~lines~~supply must be:
- 1) obtained from the finished water supply, or from a location sufficiently downstream of any chemical feed point to assure adequate mixing; and
 - 2) ample in quantity and adequate in pressure.
- j) Storage of Chemicals
- 1) Space must be provided for:
 - A) at least 30 days of chemical supply;
 - B) convenient and efficient handling of chemicals;
 - C) dry storage conditions; and
 - D) a minimum storage volume of 1.5 times the gross shipping volume.

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- 2) Offloading areas must be clearly labeled to prevent accidental cross-contamination.
 - 3) Chemicals must not be stored in confined spaces.
 - 4) Chemicals must be stored in covered or unopened shipping containers, unless the chemical is transferred into an approved storage unit.
 - 5) Feed equipment and storage chemicals must be stored inside a building unless otherwise approved by the Agency under Section 604.145(b).
 - 6) Liquid chemical storage tanks must have a liquid level indicator.
 - 7) Secondary Containment
 - A) Liquid chemical storage tanks must have secondary containment consisting of an overflow and a receiving basin capable of receiving accidental spills or overflows without uncontrolled discharge.
 - B) A common receiving basin may be provided for each group of compatible chemicals that provides sufficient containment volume to prevent accidental discharge in the event of failure of the largest tank. Groups of compatible chemicals are as follows: acids, bases, salts and polymers, absorption powders, oxidizing powders and compressed gases.
 - 8) Vents from storage tanks must have a corrosion resistant 24 mesh screen.
- k) Bulk Liquid Storage Tanks
- 1) A uniform strength of chemical solution must be maintained. Continuous agitation must be provided to maintain slurries in suspension.
 - 2) A means to assure continuity of chemical supply must be provided.
 - 3) Means must be provided to measure the liquid level in the tank.
 - 4) Liquid storage tanks including any access openings must be kept securely covered.
 - 5) Overflow pipes, when provided, must:

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- A) be turned downward, with the end screened;
 - B) have a free fall discharge; and
 - C) be located where noticeable.
- 6) Liquid storage tanks must be vented, but not through vents in common with other chemicals or day tanks.
 - 7) Each liquid storage tank must be provided with a valved drain in accordance with subsection (g).
 - 8) Solution tanks must be located, and protective curbing provided, so that chemicals from equipment failure, spillage or accidental drainage do not enter the water in conduits, treatment or storage basins. Chemicals must be stored as required by subsection (j)(5).
- l) Day Tanks
 - 1) Day tanks must be provided where bulk storage of liquid chemical is provided.
 - 2) Day tanks must meet all the requirements of subsection (k), except that shipping containers do not require overflow pipes and subsection drains.
 - 3) Day tanks must 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. The ratio of the area of the tank to its height must be such that unit readings are meaningful in relation to the total amount of chemical fed during a day.
 - 4) Except for fluosilicic acid, hand pumps may be provided for transfer from a shipping container. When motor-driven transfer pumps are provided, a liquid level limit switch must be provided.
 - 5) Tanks and tank refilling line entry points must be clearly labeled with the name of the chemical contained.
 - 6) Filling of day tanks must not be automated.
 - m) Feed lines must be:

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- 1) of durable, corrosion-resistant material;
 - 2) protected against freezing;
 - 3) designed to prevent clogging; and
 - 4) color coded and labeled in accordance with Section 604.120.
- n) Handling. Provision must 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 that may enter the room.
- o) Housing
- 1) Floor surfaces must be smooth and impervious, slip-proof and well drained.
 - 2) Vents from feeders, storage facilities and equipment exhaust must discharge to the outside atmosphere above grade and remote from air intakes.

SUBTITLE F**Section 604.1110 Protective Equipment**

- a) Personal protective equipment must be provided consistent with the requirements of the CWS safety plan developed under Section 604.160.
- b) A deluge shower and eyewashing device must be installed where strong acids and alkalis are used or stored. The deluge shower and eyewashing device, and the water supply to these devices, must comply with applicable provisions of 77 Ill. Adm. Code 890 (the Illinois Plumbing Code).

SUBTITLE F

Section 604.1115 Chlorine Gas

- a) Chlorinators that are housed separately from the chlorine storage must be in an adjacent room.
- b) Chlorinator rooms must be heated to 60°F, and be protected from excessive heat. Cylinders and gas lines must be protected from excessive temperatures.
- c) Chlorine gas feed and storage must be enclosed and separated from other operating areas. Both the feed and storage rooms must be constructed so as to meet the following requirements:
 - 1) a shatter resistant inspection window must be installed in an interior wall;
 - 2) all openings between the rooms and the remainder of the plant must be sealed;
 - 3) doors must be equipped with panic hardware, assuring ready means of exit and opening outward only to the building exterior;
 - 4) a ventilating fan with a capacity to complete one air change per minute when the room is occupied, unless otherwise approved by the Agency under Section 604.145(b);
 - 5) the ventilating fan must take suction near the floor and at 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;
 - 6) air inlets with corrosion resistant louvers must be installed near the ceiling;
 - 7) air intake and exhaust louvers must facilitate airtight closure;
 - 8) separate switches for the ventilating fan and for the lights must be located outside and at the inspection window.
 - A) Outside switches must be protected from vandalism.
 - B) A signal light indicating ventilating fan operation must be provided at each entrance when the fan can be controlled from more than one point;

SUBTITLE F

- 9) vents from chlorinator and storage areas must be screened and must discharge to the outside atmosphere, above grade;
 - 10) where floor drains are provided, the floor drains must discharge to the outside of the building and not be connected to other internal or external drainage systems; and
 - 11) provisions must be made to chemically neutralize chlorine gas 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.
- d) Chlorine gas feed systems must be of the vacuum type and include the following:
- 1) vacuum regulators on all individual cylinders in service;
 - 2) service water to eductors must be of adequate supply and pressure to operate feed equipment within the needed chlorine dosage range for the proposed system.
- e) All chlorine gas feed lines located outside the chlorinator or storage rooms must be installed in air tight conduit pipe.
- f) Full and empty cylinders of chlorine gas must meet the following requirements:
- 1) housed only in the chlorine storage room;
 - 2) isolated from operating areas; and
 - 3) restrained in position;
- g) Continuous chlorine leak detection equipment equipped with both an audible alarm and a warning light is required.

SUBTITLE F**Section 604.1120 Acids and Caustics**

- a) Acids and caustics must be kept in closed corrosion-resistant shipping containers or bulk liquid storage tanks.
- b) Acids and caustics must not be handled in open vessels.
- c) Acids storage tanks must be vented to the outside atmosphere.

SUBTITLE F

Section 604.1125 Chlorine Dioxide

- a) Chlorine dioxide generation equipment must be factory assembled pre-engineered units with a minimum efficiency of 95 percent. The excess free chlorine must not exceed three percent of the theoretical stoichiometric concentration required.
- b) Chlorine gas and sodium chlorite feed and storage facilities must comply with Sections 604.1115 and 604.1130, respectively. Sodium hypochlorite feed and storage facilities must comply with Section 604.1135.
- c) The design must comply with all applicable portions of Sections 604.130(c), 604.705, 604.710, 604.715, 604.720 and 604.735.

SUBTITLE F

Section 604.1130 Sodium Chlorite

- a) Storage
 - 1) Sodium chlorite must be stored by itself in a separate room and preferably must be stored in an outside building detached from the water treatment facility.
 - 2) The storage structures must be constructed of noncombustible materials.
 - 3) The storage room must be available to keep the sodium chlorite area cool enough to prevent heat induced explosive decomposition of the chlorite.
- b) Provisions for the clean-up of any sodium chlorite release must be included in the facility's emergency operation plan specified in Section 604.150.
- c) Feeders
 - 1) Positive displacement feeders must be provided.
 - 2) Tubing for conveying sodium chlorite or chlorine dioxide solutions must be Type 1 PVC, polyethylene or materials recommended by the manufacturer.
 - 3) Check valves must be provided to prevent the backflow of chlorine into the sodium chlorite line.

Section 604.1135 Sodium Hypochlorite

Storage of sodium hypochlorite must be:

- a) protected from excess temperatures;
- b) sited out of the sunlight in a cool area; and
- c) vented to the outside of the building.

SUBTITLE F

Section 604.1140 Ammonia

- a) Ammonia for chloramine formation may be added to water either as a water solution of ammonium sulfate, or as aqua ammonia (ammonia gas in water solution), or as anhydrous ammonia (purified 100% ammonia in liquid or gaseous form). Special provisions required for each form of ammonia are listed in subsections (b) through (d).
- b) Ammonium Sulfate
 - 1) The water solution made by addition of ammonium sulfate solid to water must include-agitation.
 - 2) The tank and dosing equipment contact surfaces must be made of corrosion resistant non-metallic materials.
 - 3) The submerged portion of the mixer shaft and propeller must be made of 304 or 316 stainless steel that is resistant to corrosion by ammonium sulfate solution.
- c) Aqua Ammonia (ammonium hydroxide)
 - 1) Aqua ammonia feed pumps and storage must be enclosed and separated from other operating areas.
 - 2) The aqua ammonia room must be equipped as required in Section 604.1115, with the following changes:
 - A) A corrosion resistant, closed, unpressurized tank must be used for bulk storage, vented through an inert liquid trap to a high point outside.
 - B) The bulk liquid storage tank must be protected from excessive heat to prevent ammonia vaporization.
 - C) An exhaust fan must be installed to withdraw air from high points in the room and make-up air must be allowed to enter at a low point.
 - D) The aqua ammonia feed pump, regulators, and lines must 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.

SUBTITLE F

- E) The aqua ammonia must be conveyed directly from storage to the treated water stream injector without the use of a carrier water stream unless the carrier stream is softened.
- d) Anhydrous Ammonia
- 1) Anhydrous ammonia and storage feed systems (including heaters where provided) must be enclosed and separated from other work areas and constructed of corrosion resistant materials.
 - 2) Any pressurized ammonia feed lines outside the ammonia room must be installed in air tight conduit.
 - 3) An exhaust fan must be installed to withdraw air from high points in the room and make-up air must be allowed to enter at a low point.
 - 4) Leak detection systems must be installed, operated and maintained in each area through which ammonia is piped.
 - 5) Special vacuum breaker/regulator provisions must be installed to prevent backflow of water into cylinders or storage tanks.
 - 6) Carrier water systems, where provided to convey anhydrous ammonia to the injection point, must use softened water.
 - 7) Provisions must be made to chemically neutralize anhydrous ammonia, in the event of any anhydrous ammonia release.

SUBTITLE F**Section 604.1145 Potassium Permanganate**

Potassium permanganate may be fed with gravimetric feeders or from batched solution fed from day tanks. For batched solutions:

- a) the potassium permanganate added cannot exceed the solubility limits based on temperature; and
- b) mechanical mixers must be provided.

SUBTITLE F

Section 604.1150 Fluoride

- a) Basis of Design. Equipment must have the capacity to maintain the fluoride content in the finished water at 0.7 mg/L.
- b) Chemical Feed Equipment
 - 1) A free chlorine residual of 10 mg/L must be maintained in solutions prepared from dry chemicals. This chlorine residual must not replace the chlorination requirement of Section 604.725.
 - 2) Chlorine must not be added to hydrofluosilicic or fluorosilicic acid solutions.
 - 3) Diaphragm operated anti-siphon devices must be provided on all fluoride saturator or fluorosilicic acid feed systems as follows:
 - A) one diaphragm operated anti-siphon device must be located on the discharge side of the feed pump; and
 - B) a second diaphragm operated anti-siphon device must be located at the point of application unless a suitable air gap is provided.
- c) Chemical Feed Methods
 - 1) Fluoride compound must not be added prior to filters at plants that lime soften or coagulate for turbidity removal, and must not be added prior to ion exchange softeners.
 - 2) The point of application, if into a horizontal pipe, must 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.
 - 3) Water used for sodium fluoride dissolution must be softened if hardness exceeds 75 mg/L as calcium carbonate.
 - 4) Saturators must be provided with a meter and backflow protection on the make-up water line.
- d) Secondary Controls. Secondary control systems for fluoride chemical feed devices must be provided as a means of reducing the possibility for overfeed. These may include flow or pressure switches, break boxes, or other devices.

SUBTITLE F

- e) Samples must be submitted monthly to a certified laboratory to determine compliance with 35 Ill. Adm. Code 611.125.

SUBTITLE F

SUBPART L: PUMPING FACILITIES

Section 604.1200 General

Pumping facilities must be designed to maintain the quality of pumped water.

SUBTITLE F

Section 604.1205 Pumping Stations

- a) Both raw and finished water-pumping stations must:
 - 1) have adequate space for the installation of additional units if needed, and for the safe servicing of all equipment;
 - 2) be of durable construction, fire and weather resistant, and with outward opening doors;
 - 3) not create a confined space;
 - 4) have floors that slope to a suitable drain; and
 - 5) provide a suitable outlet for drainage from pump glands without discharging onto the floor.
- b) Suction wells must:
 - 1) be watertight;
 - 2) have floors sloped to permit removal of water and settled solids;
 - 3) be covered or otherwise protected against contamination; and
 - 4) have two pumping compartments or other means to allow the suction well to be taken out of service for inspection maintenance or repair.
- c) Equipment Servicing. Pump stations must be provided with:
 - 1) crane-ways, hoist beams, eyebolts, or other adequate facilities for servicing or removal of pumps, motors or other heavy equipment; and
 - 2) openings in floors, roofs or wherever else needed for removal of heavy or bulky equipment.
- d) Provisions must be made for adequate heating for the safe and efficient operation of the equipment.
- e) Ventilation
 - 1) Adequate ventilation must be provided for all pumping stations.

SUBTITLE F

- 2) Forced ventilation of at least six changes of air per hour must be provided for:
 - A) all rooms, compartments, pits and other enclosures below ground floor; or
 - B) any area where unsafe atmosphere may develop or where excessive heat may be built up.

- f) Dehumidification must be provided in areas where excess moisture could cause hazards for operator safety or damage to equipment.

SUBTITLE F

Section 604.1210 Pumps

- a) At least two pumping units must be provided for all pump stations.
- b) With any pump out of service, the remaining pump or pumps must be capable of providing the maximum demand of the community water supply.
- c) The pumping units must be provided with readily available spare parts and tools.
- d) Suction Lifts
 - 1) Suction lifts must be avoided if possible;
 - 2) Suction lifts must be less than 15 feet; and
 - 3) If suction lift is necessary, provisions must be made for priming the pumps, as follows:
 - A) prime water must not be of lesser sanitary quality than that of the water being pumped;
 - B) means must be provided to prevent either backsiphonage or backflow; and
 - C) vacuum priming may be used.
- e) Pumps taking suction from ground storage tanks must be provided adequate net positive suction head, but the minimum distribution pressure of 20 psi is not required. The pumps must be equipped with automatic shutoffs or low-pressure controllers, as recommended by the pump manufacturer.

SUBTITLE F

Section 604.1215 Booster Pumps

- a) Each booster pumping station must contain no fewer than two pumps with capacities such that maximum demand can be satisfied with the largest pump out of service.
- b) Construction must conform to Section 604.150.
- c) Automatic control equipment must be installed to prevent the pump from causing a vacuum and/or lowering water pressure in any part of the distribution system to less than 20 psi as measured at ground surface.
- d) Automatic or remote-control devices must have a range between the start and cutoff pressure that will prevent excessive cycling.
- e) Booster pumps must have the ability to be bypassed.
- f) Pressure for portions of a distribution system served by a booster pump station, as required by Section 604.1415, must be provided during periods when the booster station is not in operation.
- g) One of the following must be installed if adequate pressure will not be available in any part of the system:
 - 1) hydropneumatic storage designed in accordance with Section 604.1345 on the discharge side of the booster pump station; or
 - 2) elevated storage.
- h) All booster pumping stations must be fitted with a flow rate indicator and totalizer meter.

SUBTITLE F**Section 604.1220 Automatic and Remote-Controlled Stations**

- a) All remote-controlled pumping facilities must be electrically operated and controlled and must have signaling apparatus of proven performance.
- b) All automatic pumping facilities must be provided with automatic signaling apparatus that will report when the station is out of service, unless otherwise approved by the Agency under Section 604.145(b).

SUBTITLE F

Section 604.1225 Appurtenances

- a) Valves
 - 1) Each pump must have an isolation valve on the inlet and discharge side of the pump to permit satisfactory operation, maintenance and repair of the equipment.
 - 2) Each pump must have a positive acting check valve on the discharge side between the pump and the shutoff valve.
 - 3) Surge relief valves or slow acting check valves must be designed to minimize hydraulic transients.
- b) Piping must:
 - 1) be designed to minimize friction losses;
 - 2) have watertight joints;
 - 3) be protected against surge or water hammer and provided with suitable restraints where necessary; and
 - 4) be designed such that each pump has an individual suction line or the lines must be so manifolded that they will ensure similar hydraulic and operating conditions.
- c) Gauges and Meters
 - 1) Each pump must have the following gauges and meters:
 - A) a standard pressure gauge on its discharge line;
 - B) a compound gauge on its suction line; and
 - C) a meter for measuring the flow rate.
 - 2) The station must have the following:
 - A) a flow rate indicator and totalizing meter; and
 - B) a method of recording the total water pumped.

SUBTITLE F

- d) Water Seals
 - 1) Water seals must not be supplied with water of a lesser sanitary quality than that of the water being pumped.
 - 2) The seal must:
 - A) when pumps are sealed with potable water and are pumping water of lesser sanitary quality, be provided with either an approved reduced pressure principle backflow preventer or a break tank open to atmospheric pressure; and
 - B) when a break tank is provided, have an air gap as defined in 35 Ill. Adm. Code 601.105 between the feeder line and the flood rim of the tank.
- e) Controls
 - 1) Pumps, their prime movers and accessories, must be controlled in such a manner that they will operate at rated capacity without overload.
 - 2) Provisions must be made to prevent energizing the motor in the event of a backspin cycle.
 - 3) Electrical controls must be located above grade.
 - 4) Equipment must be provided or other arrangements made to prevent surge pressures from activating controls that switch on pumps or activate other equipment outside the normal design cycle of operation.
- f) Lubrication
 - 1) When automatic pre-lubrication of pump bearings is necessary and an auxiliary power supply is provided, design must assure that pre-lubrication is provided when auxiliary power is in use, or that bearings can be lubricated manually before the pump is started.
 - 2) All lubricants that come into contact with the potable water must comply with Section 604.105(f).

SUBTITLE F

SUBPART M: STORAGE

Section 604.1300 General Storage Requirements

- a) Storage facilities must have sufficient capacity to meet domestic demands and, where fire protection is provided, fire flow demands.
- b) Excessive storage capacity must be avoided to prevent potential water quality deterioration problems and freezing.
- c) The material used in the construction of water storage structures must be approved by the Agency under 35 Ill. Adm. Code 602.105. Porous materials, including wood and concrete block, are not acceptable.
- d) Storage Structure Drainage
 - 1) Storage structures must be designed so they can be isolated to prevent loss of pressure in the distribution system when maintenance or cleaning occurs.
 - 2) Each elevated storage tank must have a hydrant or other means to drain for repair, maintenance or cleaning.
 - 3) The storage structure drain must discharge to the ground surface with no direct connection to a sewer or storm drain.
- e) The bottom of a water storage structure must be placed above the groundwater table, preferably above grade. At least 50 percent of the water depth must be above grade.
- f) Finished water storage must be designed to facilitate turnover of water to avoid stagnation.
- g) Freezing
 - 1) Finished water storage structures and their appurtenances, including the riser pipes, overflows, and vents, must be designed to prevent freezing.
 - 2) Equipment used for freeze protection that will come into contact with the potable water must comply with Section 604.105(f).
- h) The discharge pipes from water storage structures must be located to prevent the flow of sediment into the distribution system.

SUBTITLE F

- i) The area surrounding a ground level structure must be graded to prevent surface water from standing within 50 feet.
- j) Minimum distances from sources of contamination for below ground storage reservoirs must be maintained as specified in Section 604.150(a).
- k) A smooth-nosed sampling tap must be provided to facilitate collection of water samples for both bacteriological and chemical analyses.

SUBTITLE F

Section 604.1305 Overflow

- a) All water storage structures must be provided with an overflow that is brought down to an elevation between 12 and 24 inches above the ground surface and that discharges over a drainage inlet structure or a splash plate.
- b) No overflow may be connected directly to a sewer or a storm drain.
- c) All overflow pipes must be located so that any discharge is visible.
- d) Overflow for a ground level storage reservoir must meet the following requirements:
 - 1) open downward and be screened with 24 mesh non-corrodible screen; and
 - 2) when a flapper or duckbill valve is used, a screen must be provided inside the pipe.
- e) Overflow for an elevated tank must:
 - 1) open downward and be screened with a 4 mesh, non-corrodible screen or mechanical device; and
 - 2) when a flapper or duckbill valve is used, a screen must be provided inside the pipe.
- f) The overflow pipe must be of sufficient diameter to permit waste of water in excess of the filling rate.

SUBTITLE F

Section 604.1310 Access to Water Storage Structures

- a) Finished water storage structures must be designed with access to the interior for cleaning and maintenance.
- b) At least two manholes must be provided above the waterline at each water compartment where space permits.
- c) For elevated storage structures:
 - 1) at least one of the access manholes must be framed at least four inches above the surface of the roof at the opening, must be fitted with a solid watertight cover that overlaps the framed opening and extends down around the frame at least two inches, must be hinged on one side, and must have a locking device; and
 - 2) all other manholes or access ways not conforming to subsection (c)(1) must be bolted and gasketed so that they are watertight.
- d) For ground level structures or flat roof structures:
 - 1) each manhole must be elevated at least 24 inches above the top of the tank or covering sod, whichever is higher;
 - 2) each manhole must be fitted with a solid watertight cover that overlaps a framed opening and extends down around the frame at least two inches;
 - 3) the frame must be at least four inches high; and
 - 4) each cover must be hinged on one side, and must have a locking device.

SUBTITLE F

Section 604.1315 Vents

- a) Finished water storage structures must be vented as follows:
 - 1) the overflow pipe must not be considered a vent; and
 - 2) open construction between the sidewall and roof is not permissible.
- b) Vents must:
 - 1) prevent the entrance of surface water and rainwater;
 - 2) exclude birds and animals;
 - 3) exclude insects and dust to the extent practicable;
 - 4) on ground level structures, open downward with the opening at least 24 inches above the roof or sod and be covered with 24 mesh non-corrodible screen; and
 - 5) on elevated tanks and standpipes:
 - A) open downward; and
 - B) be fitted with either four mesh non-corrodible screen, or with finer mesh non-corrodible screen in combination with an automatically resetting pressure-vacuum relief mechanism, as required by the Agency.

SUBTITLE F**Section 604.1320 Level Controls**

Storage structures must provide:

- a) adequate controls, including telemetering equipment, to maintain water levels within the operating range of distribution system storage structures;
- b) level indicating devices; and
- c) overflow and low-level warnings or alarms.

SUBTITLE F

Section 604.1325 Roof and Sidewalls

- a) The roof and sidewalls of all water storage structures must be watertight with no openings except properly constructed vents, manholes, overflows, risers, drains, pump mountings, control ports, or piping for inflow and outflow.
- b) Any pipes running through the roof or sidewall of a metal storage structure must be welded or gasketed to prevent leaks.
- c) Any pipes running through the roof or sidewall of a concrete tank must be connected to standard wall castings that were poured in place during the forming of the concrete.
- d) Openings in the roof of a storage structure designed to accommodate control apparatus or pump columns must be curbed and sleeved with proper additional shielding to prevent contamination from surface or floor drainage.
- e) The roof of the storage structure must be well drained.
 - 1) Downspout pipes must not enter or pass through the reservoir.
 - 2) Parapets, or similar construction that would tend to hold water and snow on the roof, must have adequate waterproofing and drainage.
- f) The roof of concrete reservoirs with earthen cover must be sloped to facilitate drainage and must have an impermeable membrane roof covering.
- g) Reservoirs with pre-cast concrete roof structures must be made watertight with the use of a waterproof membrane or similar product.
- h) The installation of appurtenances, such as antenna, must be done in a manner that ensures no damage to the tank, coatings or water quality, or corrects any damage that occurred.

SUBTITLE F

Section 604.1330 Painting and Cathodic Protection

- a) Metal surfaces must be protected by paints or other protective coatings, by cathodic protective devices, or by both.
- b) Paint Systems
 - 1) Paint systems must comply with Section 604.105(f); and
 - 2) Interior paint must be applied and cured in a manner that does not transfer to the water any substance that will be toxic or cause taste or odor problems.
- c) Cathodic protection must be designed, installed and maintained by trained technical personnel and must comply with Section 604.105(f).

SUBTITLE F

Section 604.1335 Treatment Plant Storage

Treatment plant storage must meet the following requirements.

- a) Clearwell storage must:
 - 1) provide contact time, when required, under Section 604.715;
 - 2) ensure adequate disinfectant contact time by sizing the clearwell to include extra volume to accommodate depletion of storage during the nighttime for intermittently operated filtration plants with automatic high service pumping from the clearwell during non-treatment hours;
 - 3) be sized in conjunction with distribution system storage, to relieve the filters from having to follow fluctuations in water use;
 - 4) provide an overflow and vent; and
 - 5) provide a minimum of two clearwells or clearwell compartments.
- b) Single wall separation of raw and treated water is prohibited.
- c) Other treatment plant storage tanks/basins, including detention basins, backwash reclaim tanks, receiving basins and pump wet wells for treated water, must be designed as finished water storage structures, unless otherwise approved by the Agency under Section 604.145(b).
- d) When provided, filter washwater tanks must be sized to provide adequate treated water for the duration of the backwash cycle, including the sequential backwash of several filters.

SUBTITLE F

Section 604.1340 Elevated Storage

- a) The minimum storage capacity must:
 - 1) be equal to the average daily usage or be based on an engineering study of the distribution system hydraulic conditions, anticipated domestic water demands of the system, and, where fire protection is provided, fire flow demands; and
 - 2) be capable of maintaining adequate pressures as described in Section 604.1415(a).
- b) Elevated tanks with riser pipes over eight inches in diameter must have protective bars over the riser openings inside the tank.

SUBTITLE F

Section 604.1345 Hydropneumatic Storage

- a) Hydropneumatic tanks, when provided as the only water storage, are not acceptable in community water supplies with over 150 service connections.
- b) Hydropneumatic tank storage is not to be permitted for fire protection purposes.
- c) Hydropneumatic tanks must meet the ASME BPVC – VIII – 1-2015, incorporated by reference in 35 Ill. Adm. Code 601.115.
- d) The tank must be located above normal ground surface and be completely housed.
- e) Gross volume must equal or exceed 80 gallons per service connection-when only hydropneumatic storage is provided.
- f) An air compressor must be provided to maintain an air cushion in the hydropneumatic tanks.
- g) Finished water must be delivered at a rate greater than the peak hourly flow provided in Section 604.115(d).
- h) Actual capacity of the well pump or high service pump used to deliver water to the distribution system through the hydropneumatic tank must be greater than the peak hourly flow provided in Section 604.115(d).
- i) Actual capacities of multiple well pumps or high service pumps used to deliver water to the distribution system through the hydropneumatic tank must be greater than the peak hourly flow provided in Section 604.115(d) with the largest well pump or high service pump out of operation.
- j) All hydropneumatic tanks must have bypass piping to permit operation of the system while the tank is being repaired or painted, and each tank must have:
 - 1) an access manhole and, where practical, the access manhole should be 24 inches in diameter;
 - 2) a drain; and
 - 3) control equipment consisting of the following:
 - A) a pressure gauge;
 - B) water sight glass placed to show the water/air interface;

SUBTITLE F

- C) automatic or manual air blow off;
- D) means for adding air; and
- E) pressure operated start stop controls for the pumps.

SUBTITLE F

Section 604.1350 Combination Pressure Tanks and Ground Storage

A combination of ground storage, hydropneumatic storage and pumps may be considered in water systems for maintaining pressure on the distribution system. Design of such a system must include:

- a) a minimum ground storage volume equivalent to 1.5 times the average daily usage;
- b) a minimum of two pumps, each capable of meeting the peak hourly flow provided in Section 604.115(d). If more than two pumps are proposed, the peak hourly flow must be met when any pump is out of service;
- c) an electric generator with automatic start capable of providing power to pumps that can produce the peak hourly flow as provided in Section 604.115(d), plus sufficient power to operate all chemical feeders, appurtenances and equipment essential to plant operation. Consideration must be given to sizing the generator to provide power for at least one well; and
- d) a hydropneumatic tank sized to provide service for a minimum of 10 minutes under the peak hourly flow provided in Section 604.115(d).

SUBTITLE F

SUBPART N: DISTRIBUTION

Section 604.1400 General Distribution System Requirements

- a) Water distribution systems must be designed to maintain finished water quality.
- b) The community water supply must have a record keeping system to document the nature and frequency of water main breaks.
- c) The system must be designed to meet existing demands on the distribution system. Future distribution system demands must be taken into account.

SUBTITLE F

Section 604.1405 Installation of Water Mains

- a) Except as provided in 35 Ill. Adm. Code 602.200, a permit from the Agency is required before the installation of a water main.
- b) Bedding
 - 1) A continuous and uniform bedding must be provided in the trench for all buried pipe.
 - 2) Backfill material must be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe.
 - 3) Stones found in the trench must be removed for a depth of at least six inches below the bottom of the pipe.
- c) Water mains must be placed at a sufficient depth, or covered with sufficient earth or other insulation, to prevent freezing.
- d) All tees, bends, plugs and hydrants must be provided with reaction blocking (thrust blocks), tie rods or joints designed to prevent pipe failure.
- e) Installed pipe must be pressure and leak tested.
- f) New, cleaned and repaired water mains must be disinfected in accordance with 35 Ill. Adm. Code 602.310 and AWWA C651, incorporated by reference in 35 Ill. Adm. Code 601.115.
- g) External Corrosion
 - 1) In areas where aggressive soil conditions are suspected, the community water supply must perform analyses to determine the actual aggressiveness of the soil unless protections in subsection (g)(2) are provided.
 - 2) If soils are found or known to be aggressive, the community water supply must protect the water main, by methods including encasement of the water main in polyethylene, provision of cathodic protection (in very severe instances), or using corrosion resistant water main materials.

SUBTITLE F

Section 604.1410 Materials

- a) All materials, including ductile iron pipe, steel pipe, concrete pipe, plastic pipe, pipe liners, joints, fittings, valves and fire hydrants, must conform to the AWWA, ASTM, ANSI or NSF standards incorporated by reference at 35 Ill. Adm. Code 601.115.
- b) Plastic Pipe
 - 1) Plastic Pipe Specifications. Polyvinyl Chloride (PVC), Chlorinated Polyvinyl Chloride (CPVC), Molecularly Oriented Polyvinyl Chloride (PVCO) and Polyethylene (PE) must conform to NSF Standard 14, incorporated by reference in 35 Ill. Adm. Code 601.115.
 - 2) PVC, CPVC, PVCO and PE pipe may be used for water mains in accordance with this Section.
 - A) PVC may be used for water mains in accordance with the following standards, incorporated by reference in 35 Ill. Adm. Code 601.115:
 - i) AWWA C900-07;
 - ii) ASTM D 1784-11;
 - iii) ASTM D 1785-15;
 - iv) ASTM D 2241-09.
 - B) PE pipe may be used for water mains in accordance with AWWA C906, incorporated by reference in 35 Ill. Adm. Code 601.115.
 - C) PVCO pipe may be used for water mains in accordance with AWWA C909, incorporated by reference in 35 Ill. Adm. Code 601.115.
 - D) CPVC pipe may be used for water mains in accordance with the following standards, incorporated by reference in 35 Ill. Adm. Code 601.115:
 - i) ASTM F441/F 441M;
 - ii) ASTM F 442/F 442M;

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- iii) ASTM D 1784.
- 3) Jointing
- A) Jointing must be pressure slip jointed, solvent welded, heat welded, flange or threaded joint.
 - B) Clean, dry contact surfaces are required when making solvent or heat welded joints. Adequate setting time must be allowed for maximum strength.
 - C) Elastomeric seals (gaskets) used for push-on joints must comply with ASTM F 477 and must be pressure rated in accordance with ASTM D 3139.
 - D) Solvent cement must be specific for the piping material and must comply with ASTM D 2564 for PVC and ASTM F 493 for CPVC and must comply with Section 604.105(f).
- 4) Plastic Pipe Fittings
- A) PVC fabricated fittings, 4-inch through 60-inch, must conform to AWWA C900.
 - B) Polyethylene pressure pipe fitting, 4-inch through 63-inch, must conform to AWWA C906.
 - C) Injection-molded PVC pressure fittings, 4-inch through 12-inch, must conform to AWWA C907.
 - D) Schedule 40 or 80 PVC and CPVC pipe fittings must be of the same material as the pipe and must comply with ASTM Standards as follows:
 - i) ASTM D 2466 for PVC Schedule 40;
 - ii) ASTM D 2467 for PVC Schedule 80;
 - iii) ASTM D 2464 for threaded Schedule 80;
 - iv) ASTM F 438 for Socket-Type CPVC Schedule 40;

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- v) ASTM F 439 for CPVC Schedule 80; and
 - vi) ASTM F 437 for threaded CPVC Schedule 80.
 - E) Plastic fitting material must conform to ANSI/NSF Standard 14 and comply with Section 604.105(f).
 - F) All fittings must bear the NSF seal of approval.
- c) Protection from Organic Compounds
- 1) When distribution systems are installed in areas contaminated by organic compounds:
 - A) pipe and joint materials must be protected; and
 - B) protection must extend at least 25 feet laterally from the areas contaminated by organic compounds.
 - 2) Where distribution systems are installed within 25 feet of potential sources of organic compound contamination, including any unit at a facility or a site that stores or accumulates petroleum at any time above ground or below ground, pipe and joint materials must be protected from organic compounds.
 - 3) Protection from organic compounds may include the following:
 - A) use of ductile iron pipe with a Viton® or nitrile gaskets, unless otherwise approved by the Agency under Section 604.145(b);
 - B) remediation;
 - C) use of steel pipe;
 - D) encasement of the pipe; and
 - E) secondary containment of the source.

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Section 604.1415 System Design

- a) Pressure
 - 1) The system must be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow.
 - 2) The normal working pressure on all transmission mains for finished water must be at least 20 psi. All other water mains must have a normal working pressure of at least 35 psi.
 - 3) When static pressures exceed 100 psi, pressure reducing devices must be provided on water mains or on individual service lines.
 - 4) All water mains, including those not designed to provide fire protection, must be sized after a hydraulic analysis based on flow demands and pressure requirements.
- b) Diameter of Water Mains
 - 1) The minimum size of water main that provides for fire protection and serving fire hydrants must be of 6-inch diameter. Larger size mains will be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure specified in subsection (a).
 - 2) The minimum size of water main must be 4-inch nominal diameter in distribution systems serving incorporated areas, subdivisions or other closely situated housing or commercial units.
 - 3) The minimum size of water main must be 3-inch nominal diameter in distribution systems serving rural areas where service connections are widely spaced, water usage per service is low, and rates of flow are slow.
- c) Dead Ends
 - 1) Dead ends must be minimized.
 - 2) Dead end mains must be equipped with a means to provide adequate flushing as provided in Section 604.1425(b)(1).

SUBTITLE F**Section 604.1420 Valves**

- a) A sufficient number of valves must be provided to isolate portions of the distribution system during repairs and maintenance and to facilitate unidirectional flushing.
- b) Location. Unless otherwise approved by the Agency under Section 604.145(b), valves must be located:
 - 1) at not more than 500-foot intervals in commercial districts;
 - 2) at not more than two blocks or 1200-foot intervals in other districts.

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Section 604.1425 Hydrants

- a) Only water mains designed to carry fire flows may have fire hydrants connected to them.
 - 1) The fire hydrant lead must be a minimum of six inches in diameter.
 - 2) Auxiliary valves must be installed on all fire hydrant leads.
- b) Unless otherwise approved by the Agency under Section 604.145(b), water mains not designed to carry fire flows must have flushing hydrants.
 - 1) Flushing hydrants must be sized to provide flows that will give a velocity of at least 2.5 feet per second in the water main being flushed.
 - 2) No flushing device may be directly connected to any sewer.
- c) Each community water supply must develop and maintain a systematic flushing program.
- d) Hydrant Drainage
 - 1) When hydrant drains are plugged, the barrels must be pumped dry after use during freezing weather.
 - 2) When hydrant drains are not plugged, a gravel pocket or dry well must be provided unless the natural soils will provide adequate drainage.
 - 3) Hydrant drains must not be connected to or located within 10 feet of sanitary sewers, storm sewers, or storm drains.
 - 4) Hydrant drains must be above the seasonal groundwater table.

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Section 604.1430 Air Relief Valves

- a) Air relief valves must be installed at high points in water mains where air can accumulate.
- b) Automatic air relief valves must not be used in situations where flooding of the manhole or chamber may occur.
- c) Air Relief Valve Piping
 - 1) The open end of an air relief pipe from a manually operated valve must extend to the top of the pit and be provided with a screened, downward-facing elbow if drainage is provided for the manhole.
 - 2) The open end of an air relief pipe from automatic valves must be extended to at least one foot above grade and provided with a screened, downward-facing elbow.
 - 3) Discharge piping from air relief valves must not connect directly to any storm drain, storm sewer, or sanitary sewer.

SUBTITLE F**Section 604.1435 Valve, Meter and Blow Off Chambers**

- a) Valves, blow offs, meters or other such appurtenances to a distribution system must be protected from standing water in the chambers, pits or manholes.
- b) Chambers, pits or manholes containing valves, blow offs, meters, or other appurtenances to a distribution system must be drained or be equipped with other means to remove standing water.
- c) The chambers, pits and manholes containing valves, blow offs, meters, or other appurtenances to a distribution system must not connect directly to any storm drain or sanitary sewer.

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Section 604.1440 Sanitary Separation for Finished Water Mains

Water mains must be protected from sanitary sewers, storm sewers, combined sewers, house sewer service connections and drains as follows:

- a) Horizontal Separation
 - 1) Water mains must be laid at least 10 feet horizontally from any existing or proposed drain, storm sewer, sanitary sewer, combined sewer or sewer service connection. The distance must be measured edge to edge.
 - 2) Water mains may be laid closer than 10 feet to a sewer line when:
 - A) local conditions prevent a lateral separation of 10 feet;
 - B) the water main invert is at least 18 inches above the crown of the sewer; and
 - C) the water main is either in a separate trench or in the same trench on an undisturbed earth shelf located to one side of the sewer.
 - 3) When it is impossible to meet subsection (a)(1) or (a)(2), the following requirements must be met:
 - A) Required Materials
 - i) Both the water main and drain or sewer must be constructed of materials specified in Section 604.1410; or
 - ii) The sewer has a structural lining meeting ASTM F1216. The Agency may approve an alternate structural lining under Section 604.145(b).
 - B) The drain or sewer must be pressure tested to the maximum expected surcharge head before backfilling.
 - 4) Water mains must be laid at least 25 feet horizontally from any existing or proposed sanitary lift station, unless otherwise approved by the Agency under Section 604.145(b).
- b) Vertical Separation
 - 1) When possible, the water main must be placed above the sewer.

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- A) A water main must be laid so that its invert is 18 inches above the crown of the drain or sewer whenever water mains cross storm sewers, sanitary sewers, or sewer service connections.
 - B) The vertical separation must be maintained for that portion of the water main located within 10 feet horizontally of the outer edge of any sewer or drain crossed.
 - C) A length of water main pipe must be centered over the sewer to be crossed with joints equidistant from the sewer or drain.
 - D) When it is impossible to maintain the 18-inch separation specified in subsection (b)(1)(A), the Agency may approve an alternate construction method that reduces the risk of sanitary contamination, including:
 - i) Both the water main and sewer are constructed of water main materials specified in Section 604.1410, extending on each side of the crossing until at least 10 feet separates the two pipes;
 - ii) The sewer has a structural lining meeting ASTM F1216 or an alternate structural lining approved by the Agency under Section 604.145(b);
 - iii) The water main or the sewer is encased in a carrier pipe equivalent to water main materials specified in Section 604.1410, extending on each side of the crossing until at least 10 feet separate the two pipes; or
 - iv) When the water main crosses a storm sewer, the storm sewer is constructed with reinforced concrete pipe conforming to ASTM C76 with ASTM C443 flat gasket joints or ASTM C361 "O-ring" joints within 10 feet of the water main.
- 2) When it is impossible to place the water main above the storm sewers, sanitary sewers or sewer service connections, the water main may be placed below the sewer if:

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- A) The water main is laid so that it is at least 18 inches below the invert of the drain or sewer wherever water mains cross storm sewers, sanitary sewers or sewer service connections.
 - B) Construction
 - i) Both the water main and sewer are constructed of water main materials specified in Section 604.1410, extending on each side of the crossing until at least 10 feet separates the two pipes;
 - ii) The sewer has a structural lining meeting ASTM F1216 or an alternate structural lining approved by the Agency under Section 604.145(b);
 - iii) The water main or the sewer is encased in a carrier pipe equivalent to water main materials specified in Section 604.1410, extending on each side of the crossing until at least 10 feet separate the two pipes; or
 - iv) when the water main crosses a storm sewer, the storm sewer is constructed with reinforced concrete pipe conforming to ASTM C76 with ASTM C443 flat gasket joints or ASTM C361 "O-ring" joints within 10 feet of the water main.
 - C) The sewer or drain lines must be supported to prevent settling and breaking the water main.
- c) Water mains must be separated from sewage disposal systems, disposal fields and seepage beds by a minimum of 25 feet.
 - d) Notwithstanding subsection (a) or (b), a sanitary sewer force main must have at least the following minimum separation:
 - 1) When the sanitary sewer force main and the water main are parallel, a 10-foot horizontal separation from water mains; and
 - 2) When the sanitary sewer force main and the water main cross, an 18-inch vertical separation, with the water main above the sanitary sewer force main.

SUBTITLE F**Section 604.1445 Sanitary Separation for Raw Water Mains**

- a) Raw water mains from groundwater sources must have the same sanitary separation as provided in Section 604.1440 for finished water mains.
- b) Raw water mains from surface water sources must have the same sanitary separation between the sanitary sewer, combined sewer, house sewer service connections and drains as provided in Section 604.1440 for finished water mains.

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Section 604.1450 Surface Water Crossings

- a) For above-water crossings, the pipe must be adequately supported and anchored, protected from damage and freezing, and accessible for repair or replacement.
- b) Underwater Crossings
 - 1) A minimum cover of five feet must be provided over the pipe.
 - 2) When crossing water courses that are greater than 15 feet in width, the following apply:
 - A) the pipe must be of special construction, having flexible, restrained or welded watertight joints;
 - B) valves must be provided at both ends of water crossings so that the section can be isolated for testing or repair;
 - C) the valves must be easily accessible and not subject to flooding; and
 - D) permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples must be made on each side of the valve closest to the supply source.

SUBTITLE F**Section 604.1455 Water Service Line**

- a) A community water supply must not supply water through a water service line to more than a single property, dwelling or rental unit.
- b) If a pipe from the water main or source of potable water supply is accessible to more than one property, dwelling or rental unit, the pipe will be considered a water main subject to all permitting requirements of 35 Ill. Adm. Code 602.
- c) A pipe is accessible when it crosses the property boundary of another landowner to reach the property, dwelling or rental unit being served.

SUBTITLE F**Section 604.1460 Water Loading Stations**

To prevent contamination of both the public supply and potable water vessels being filled, the following principles must be met in the design of water loading stations:

- a) a six inch or larger air gap or other Agency approved cross connection control measure must be included for all water loading stations;
- b) the piping arrangement must prevent potential contaminants from being transferred between hauling vessels; and
- c) hoses must not be allowed to contact the ground.

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SUBPART O: CROSS CONNECTIONS

Section 604.1500 Cross Connections

- a) No cross connection is allowed between water plant piping and any drain or sewer. Backflow prevention installed within the water treatment facility must comply with the Illinois Plumbing Code (77 Ill. Adm. Code 890).
- b) No cross connection is allowed whereby an unsafe substance may enter a community water supply.
- c) No cross connection is allowed between any portion of a community water supply distribution system and any other water supply that is not a community water supply.

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Section 604.1505 Cross Connection Control Program

- a) All community water supplies, including those that meet the criteria in Section 17(b) of the Act and any exempt community water supply as defined in Section 9.1 of the Public Water Supply Operations Act [415 ILCS 45], must have a cross connection control program to educate and inform water supply consumers regarding prevention of the entry of contaminants into the distribution system.
- b) The cross connection control program must include the following:
 - 1) For any new service connection, the community water supply must evaluate the risk of cross connection whereby an unsafe substance may enter a community water supply.
 - 2) A community water supply must conduct a cross connection control survey of the distribution system at least every three years. The survey must be conducted by the owner, official custodian or an authorized delegate. The survey must evaluate the risk of an unsafe substance entering a community water supply through each service connection to the distribution system of the community water supply. This survey is not intended to include an actual visual inspection of piping or plumbing systems.
 - 3) From each completed survey, the community water supply must develop an inventory of the following:
 - A) all customers surveyed;
 - B) the number of customers who responded to the survey;
 - C) identification of service connections not required to have a backflow preventer installed under 77 Ill. Adm. Code 890.1130;
 - D) identification of service connections required to have a backflow preventer installed under 77 Ill. Adm. Code 890.1130;
 - E) backflow preventers installed;
 - F) service connections that require further risk evaluation; and
 - G) corrective actions to mitigate cross connections.

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- 4) An ordinance, tariff, or required condition for service, whichever is applicable, that meets the Illinois Plumbing Code (77 Ill. Adm. Code 890), must be adopted and enforced.
- 5) The community water supply must maintain records of all backflow preventers that require annual testing under 77 Ill. Adm. Code 890 and identified in subsections (b)(2) and (b)(3).

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Section 604.1510 Cross Connection Control Device Inspectors

- a) Except as provided in subsection (c), cross connection control devices must be inspected at least annually by a person approved by the Agency or its designee as a cross connection control device inspector (CCCDI). The inspection of mechanical devices must include physical testing in accordance with the manufacturer's instructions.
 - 1) Records of the annual inspection must be submitted to the community water supply.
 - 2) Each device inspected must have a tag attached listing the date of the most recent test, name of CCCDI, and type and date of repairs.
 - 3) A maintenance log must be maintained at the site of installation and must include:
 - A) make, model and serial number of the backflow preventer, and its location at the site;
 - B) date of each test;
 - C) name and approval number of person performing the test;
 - D) type of test kit used and date of its most recent calibration;
 - E) test results and a brief statement indicating whether the results pass or fail the test;
 - F) repairs or servicing required;
 - G) repairs and date completed; and
 - H) servicing performed and date completed.
- b) Requirements for Cross Connection Control Device Inspector Approval
 - 1) Each applicant for CCCDI Approval must:
 - A) be a person authorized to perform plumbing as described in the Illinois Plumbing License Law [225 ILCS 320/3(1)].

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- B) complete a training course offered by the Environmental Resources Training Center (see 110 ILCS 530) or the Agency's delegate on cross connection control device that includes hands on practice testing of different types of backflow devices and proper maintenance and repair.
 - C) complete and submit an application for CCCDI Approval.
 - D) successfully complete both written and performance examinations demonstrating competency in the following: the principles of backflow and back-siphonage; the hazard presented to a potable water system; locations that require installation of cross connection control devices; identifying, locating, inspecting, testing, maintaining and repairing cross-connection control methods and devices in-line, as located throughout each system that connects to a community public water supply. The applicant must successfully complete:
 - i) the written examination with a minimum score of 75%; and
 - ii) a performance-based examination by demonstrating competency in testing device procedures on all types of devices at the examination center.
- 2) CCCDIs must-renew the CCCDI Approval each year between May 1 and June 30. An application for CCCDI renewal will be sent by the Agency or its designee, and must be completed and returned by June 30 of the renewal year. CCCDIs must complete an eight-hour recertification course every three years from the date of the original issuance of the CCCDI license. The course must be offered by the Environmental Resources Training Center or the Agency's delegate and include a written and practical exam demonstrating competency in backflow prevention testing.
- 3) A CCCDI Approval or admission to examination for CCCDI Approval must be suspended, revoked or not issued by the Agency for any one or more of the following causes:
- A) Practice of any fraud or deceit in obtaining or attempting to obtain a CCCDI Approval, including misrepresentation of approval;
 - B) Any repeated, flagrant or willful negligence or misconduct in the inspection, testing or maintenance of cross connection control devices;

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- C) Falsification of reports required by this Part;
 - D) Willful violation of the Environmental Protection Act or any rules adopted under it.
- 4) Suspension and Revocation Procedures
- A) Any person may file with the Agency a written complaint regarding the conduct of a CCCDI approved under this Part. The complaint must state the name and address of the complainant, the name of the CCCDI, and all information that supports the complaint.
 - B) The Agency may initiate the suspension or revocation procedure on the basis of any written complaint or on its own motion. The Agency's decision to institute suspension or revocation proceedings will be based on the seriousness of the violation and its potential deleterious impact upon public health and safety.
 - C) When the suspension or revocation procedure is initiated, the Agency must notify the CCCDI by certified mail that suspension or revocation is being sought. The notice must specify the cause upon which suspension or revocation is sought and include the procedures for requesting a hearing before the Agency. Request for hearing must be made in writing within 14 days after receipt of the Agency's certified notification. If no hearing is requested, the Agency will suspend or revoke the CCCDI Approval.
 - D) Should a hearing be requested, the Director must appoint one or more Agency employees to chair the proceedings. The hearing must be conducted according to the hearing requirements of 35 Ill. Adm. Code 168.
 - E) The Director must make a decision within 30 days after receiving the hearing transcript. The Director must give written notice of that decision and reasons for the decision to the CCCDI by certified mail.
 - F) Within 30 days after receiving a notice of suspension or revocation from the Agency, the CCCDI may appeal the suspension or revocation to the Pollution Control Board. The suspension or

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revocation of the CCCDI's Approval must be stayed pending a final decision on the appeal by the Board.

- c) Backflow preventers located in the treatment plant, wellhouse or booster station of a community public water supply facility must be inspected at least annually by either an approved CCCDI or by a certified water supply operator who has completed the qualifications listed in subsections (b)(1)(B) and (D).
 - 1) When the inspection is conducted by a certified water supply operator who has completed the necessary qualifications, records must be kept as required by subsection (a)(3).
 - 2) Each device inspected must have a tag attached listing the date of the most recent test, name of the CCCDI, and type and date of repairs.

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Section 604.1515 Agency Approved Cross Connection Control Measures

- a) For all mains, pipes, structures through which water is obtained and distributed to the public, including wells and well structures, intakes and cribs, pumping stations, treatment plants, reservoirs, storage tanks and appurtenances, collectively or severally, actually used or intended for use for the purpose of furnishing water for drinking or domestic use, cross connection devices must be used as set forth in this Section.
- b) Except as provided in this Section, a fixed air gap must be used.
- c) Atmospheric vacuum breakers may be installed subject to the following conditions:
 - 1) the location is not subject to back pressure;
 - 2) the substance in the container receiving water is not toxic; and
 - 3) an atmospheric vacuum breaker is installed at the highest point in the waterline and after the last control valve before the point of discharge and a minimum of six inches above the flood level rim of the receptacle.
- d) Examples of acceptable installations of atmospheric vacuum breakers include:
 - 1) surface wash piping for a gravity filter;
 - 2) solution tanks of gravimetric dry chemical feeders;
 - 3) faucet with hose attachments; and
 - 4) receptacles with a low-level inlet where the substance contained is nontoxic, such as food or beverages.
- e) Reduced pressure principle backflow preventers may be installed subject to the following conditions:
 - 1) Installation
 - A) Units must be accessible for maintenance and testing.
 - B) Minimum clearances recommended by the manufacturer must be used.

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- C) Units must be protected against flooding and freezing.
 - D) Relief ports must not be plugged. A drain that will remain free flowing under all conditions must be provided.
 - E) No reduction must be made in the size of the relief port drain.
- 2) Bypass lines without reduced pressure principle backflow preventers must not be installed.
 - 3) Reduced pressure principle backflow preventers must be used for installations where a fixed air gap is not possible, and an atmospheric vacuum breaker is not allowed under subsection (c).

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Section 604.TABLE A Steel Pipe**Table A
STEEL PIPE**

SIZE	DIAMETER (inches)		THICKNESS (inches)	WEIGHT PER FOOT (pounds)	
	EXTERNAL	INTERNAL		PLAIN ENDS (calculated)	WITH THREADS AND COUPLINGS (nominal)
6 id.	6.625	6.065	0.280	18.97	19.18
8	8.625	7.981	0.322	28.55	29.35
10	10.750	10.020	0.365	40.48	41.85
12	12.750	12.000	0.375	49.56	51.15
14 od.	14.000	13.250	0.375	54.57	57.00
16	16.000	15.250	0.375	62.58	
18	18.000	17.250	0.375	70.59	
20	20.000	19.250	0.375	78.60	
22	22.000	21.000	0.500	114.81	
24	24.000	23.000	0.500	125.49	
26	26.000	25.000	0.500	136.17	
28	28.000	27.000	0.500	146.85	
30	30.000	29.000	0.500	157.53	
32	32.000	31.000	0.500	168.21	
34	34.000	33.000	0.500	178.89	
36	36.000	35.000	0.500	189.57	