SUBCHAPTER G: FIXED FILM AND FILTRATION UNITS
§§217.181 - 217.194
Effective December 4, 2015

§217.181. Applicability.

This subchapter establishes the requirements for trickling filters, rotating biological contactors, submerged biological contactors, and filtration systems.

Adopted August 6, 2008 Effective August 28, 2008

§217.182. Trickling Filters--General Requirements.

(a) Trickling filters are classified according to applied hydraulic loading, including recirculation, in million gallons per day per acre of filter media surface area and influent organic loadings in pounds of five-day biochemical oxygen demand (BOD_5) per day per 1,000 cubic feet of filter media. The following factors must be used as the basis for the selection of the design hydraulic and influent organic loadings:

(1) BOD_5 concentration of the influent wastewater;

(2) effectiveness of pretreatment;

(3) type of filter media; and

(4) treatment efficiency required.

(b) A trickling filter may be classified as:

(1) a roughing filter, which provides at least 50%, but not more than 75% removal of soluble BOD_5;

(2) a secondary treatment filter, which provides the removal of pollutants required to meet the effluent limits for BOD_5 and total suspended solids (TSS) of effluent set 1 or 2 in §309.4 of this title (relating to Table 1, Effluent Limitations for Domestic Wastewater Plants);

(3) a combined BOD_5 and nitrifying filter, which provides the removal of pollutants required to meet the effluent limits for BOD_5, ammonia-nitrogen (NH_3-N), and TSS of effluent set 2N or 2N1 in §309.4 of this title; or

(4) a tertiary nitrifying filter, which provides removal of NH_3-N, if the influent to the trickling filter is a clarified secondary effluent.

(c) The following table lists the hydraulic and organic loadings for different classes of trickling filters.

Figure: 30 TAC §217.182(c)

Table G.1. - Typical Design Loadings

	Standard Rate	**Intermediate Rate**	**High Rate**	**High Rate**	**Roughing**
Media	***Rock***	***Rock***	***Rock***	***Manufactured***	***Either***
Hydraulic Loading: mgd/acre	1-4	4-10	10-40	15-90	60-180
Hydraulic Loading: gpd/sf	25-90	90-230	230-900	350-1000	1400-4200
*Organic Loading: lb BOD_5/acre-feet/day	200-1000	700-1400	1000-1300	--	--
*Organic Loading: lb BOD_5/day/1000cf	5-25	15-30	30-150	up to 300	≥100
[H]BOD_5 Removal (%)	80-85	0-70	40-80	65-85	40-85

*Does not include recirculation
[H]Includes subsequent settling

(d) Pretreatment.

(1) A trickling filter must have upstream preliminary treatment units that:

(A) remove grit, debris, suspended solids, oil, and grease;

(B) remove particles with a diameter greater than three millimeters; and

(C) control the release of hydrogen sulfide.

(2) A primary clarifier equipped with scum and grease removal devices must precede a rock media trickling filter.

(e) Rock Filter Media.

(1) Materials.

(A) Rock filter media composed of crushed rock, slag, or similar material is prohibited if more than 5% of the media, by weight, consists of pieces with their longest dimension measuring more than three times greater than their shortest dimension.

(B) Rock filter media must conform to the following size distribution and grading. Mechanical grading over a vibrating screen with square openings must meet the following:

(i) passing 5.0 inch sieve - 100% by weight;

(ii) retained on 3.0 inch sieve - 95 to 100% by weight;

(iii) passing 2.0 inch sieve - 0.2% by weight;

(iv) passing 1.0 inch sieve - 0.1% by weight; and

(v) the loss of weight by the 20-cycle test, as described in American Society of Civil Engineers' *Manual of Engineering and Engineering Practice No. 13*, must be less than 10%.

(2) Placement.

(A) Rock filter media must be at least 4.0 feet deep at the shallowest point.

(B) Dumping rock filter media directly on a trickling filter is prohibited. Rock media must be placed by hand to a depth of 12 inches above the underdrains. The remainder of the rock filter media may be placed by belt conveyor or an equivalent mechanical method.

(C) Crushed rock, slag, and other similar media must be washed and screened or forked to remove clay, organic material, and other fine particles prior to placement.

(D) The placement of any material must not damage the underdrains.

(E) Vehicles and equipment are prohibited from driving over the rock filter media.

(f) Synthetic (Manufactured or Prefabricated) Media Materials.

(1) Any synthetic media material must be used in accordance with all of the manufacturer's recommendations.

(2) Synthetic media material may be considered innovative or non-conforming technology and may be subject to §217.7(b)(2) of this title (relating to Types of Plans and Specifications Approvals), and requires executive director approval in writing.

(A) Suitability. The suitability of synthetic media material must be evaluated based on performance data from a wastewater treatment facility with similar media operating under similar hydraulic and organic loading conditions. The engineering report must include a relevant case history involving the use of the synthetic media.

(B) Durability. A synthetic media must be insoluble in wastewater and resistant to flaking, spalling, ultraviolet degradation, disintegration, erosion, aging, common acids and alkalis, organic compounds, and biological attack.

(C) Structural Integrity.

(i) The structural design of synthetic filter media must support the synthetic media, water flowing through or trapped in voids, and the maximum anticipated thickness of the wetted biofilm.

(ii) The synthetic filter media must support the weight of an individual, unless a separate provision is made for maintenance access to the entire top of the trickling filter media and to the distributor.

(D) Placing of Synthetic Filter Media. Modular synthetic filter media must be installed with the edges of the modules matched as closely as possible to provide consistent hydraulic conditions within the trickling filter.

(g) Trickling Filter Dosing.

(1) Dosing rates to a trickling filter must be within the design dosing rate range, even if the trickling filter receives flow from a siphon, pump, or gravity discharge from a preceding treatment unit.

(2) A trickling filter must be designed to control instantaneous dosing rates under both normal operating conditions and filter-flushing conditions.

(3) The distributor speed and the recirculation rate of a trickling filter must be adjusted for the dosing intensity as a compensatory measure under low-flow conditions. The following table provides design ranges of dosing intensity for both normal usage periods and for flushing periods:

Figure: 30 TAC §217.182(g)(3)

Table G.2 - Trickling Filter Dosing Intensity Ranges (SK)

BOD_5 loading ***kilogram (kg)/m³/day***	**Design SK** ***mm/pass***	**Flushing SK** ***mm/pass***
0.25	10-100	≥200
0.50	15-150	≥200
1.00	30-200	≥300
2.00	40-250	≥400
3.00	60-300	≥600
4.00	80-400	≥800

(4) A design may be based on instantaneous dosing intensity for rotary distributors using Equation G.1. in Figure: 30 TAC §217.182(g)(4).

Figure: 30 TAC §217.182(g)(4)

Equation G.1.

$$SK = \frac{(q + r) \times (1000mm/m)}{(a) \times (n) \times (60)}$$

Where:
SK = dosing intensity, millimeter (mm)/pass of an arm
q = influent flow/filter top surface area, in cubic meters (m^3)/square meter (m^2)/hour

r = recycle flow/filter top surface area, m^3/m^2/hour
a = number of arms
n = revolutions per minute

(h) Distribution Equipment.

(1) The design of a trickling filter must include a rotary, horizontal, or traveling wastewater distribution system that distributes wastewater uniformly over the entire surface of a filter at the design and flushing dosing intensities.

(2) A design must include filter distributors that operate properly at all anticipated flow rates.

(3) A design must not deviate from the design dosing intensity by more than 10%.

(4) A new trickling filter or an upgrade of an existing trickling filter must include an electrically driven, variable speed filter distributor to allow operation at optimum dosing intensity independent of recirculation pumping.

(5) If an existing rectangular trickling filter is retrofitted with rotary distributors, any filter media that will not be fully wetted must not be considered part of the required effective treatment area.

(6) The center column of a rotary trickling filter distributor must have emergency overflow ports that are sized to prevent water from reaching the bearings in the center column.

(7) A filter distributor must include cleanout gates on the ends of the distributor arms and an end spray nozzle to wet the edges of the trickling filter media.

(8) The trickling filter walls must extend at least 12.0 inches above the top of the ends of the distributor arms.

(9) The use of a mercury seal in a distributor of a trickling filter is prohibited in a new wastewater treatment facility. If an existing wastewater treatment facility is materially altered, any mercury seal in a trickling filter must be replaced with an oil or mechanical seal.

(10) The minimum clearance between the top of the trickling filter media and the distributing nozzles is 6.0 inches.

(11) Rotary distributors must be capable of operating at speeds as low as one revolution per 30 minutes.

(12) A trickling filter with a height or diameter that does not allow distributors to be removed and replaced by a crane must provide jacking columns and pads at the distributor column.

(i) Recirculation.

(1) Low Flow Conditions.

(A) The design of a trickling filter must include a mechanism to maintain minimum recirculation during periods of low flow to ensure that the biological growth on the filter media remains active at all times.

(B) For all trickling filters with continuous recirculation, the design must include the minimum recirculation rate in the evaluation of the efficiency of the filter.

(C) Minimum flow to the filters must be equal to or greater than 1.0 million gallons per day per acre of filter aerial surface and must ensure the proper operation of the distribution nozzles.

(D) The minimum flow rate for a trickling filter design using hydraulically driven distributors must keep rotary distributors turning at the minimum design rotational velocity.

(E) For a wastewater treatment facility designed with a design flow equal to or greater than 0.4 million gallons per day and recirculation for BOD_5 removal, the recirculation system must include variable speed pumps and a method of conveniently measuring the recycle flow rate.

(2) Compensatory Recirculation.

(A) The design of a trickling filter must provide compensatory recirculation to supplement influent flow if design and flushing dosing intensities are not achieved solely by the control of distributor operation.

(B) Controls for the distributor speed and recycle pumping rate must provide optimum dosing intensity under all anticipated influent flow conditions.

(3) Process Calculations. The engineering report must:

(A) provide design details about removal of the remaining organic matter by recirculation;

(B) identify the effect of dilution of the influent on the rate of diffusion of dissolved organic substrates into the biofilm; and

(C) identify the effect of reduced influent concentrations on reaction rates in each section of a filter having first order kinetics.

(4) Recirculation Rate. A recirculation rate may exceed four times the design flow if calculations to justify the higher rate are included in the engineering report.

(5) Configuration.

(A) In a wastewater treatment facility with influent that has constant organic loadings, direct recirculation of unsettled trickling filter effluent must be used.

(B) A design must ensure that the distributor nozzles can handle the recirculated sloughed biofilm.

(C) In a wastewater treatment facility with variable influent organic loadings, effluent must recirculate from a final clarifier to either a primary clarifier or a trickling filter to equalize organic loading.

(j) Average Hydraulic Surface Loading.

(1) The engineering report must include calculations of the maximum, design, and minimum surface loadings on the trickling filters in terms of million gallons per acre of filter area per day for the flow expected in the initial year and at full capacity.

(2) The average hydraulic surface loadings of a trickling filter with crushed rock, slag, or similar media:

(A) must not exceed 40 million gallons per day per acre based on design flow, except in roughing applications;

(B) must not be less than 1.0 million gallons per day per acre; and

(C) must be within the ranges specified by the manufacturer.

(k) Underdrain System Design.

(1) A trickling filter must include an underdrain with semicircular inverts that cover the entire floor of the trickling filter.

(2) An underdrain must be constructed of vitrified clay or pre-cast reinforced concrete.

(3) An underdrain constructed of half tile is prohibited.

(4) Underdrain inlet openings must have a gross cross-sectional area greater than 15% of a trickling filter's surface area.

(5) A modular synthetic media design must be supported above a trickling filter floor by beams and grating with support and clearances in accordance with the trickling filter media manufacturer's recommendations. The manufacturer's recommendations must be included in the engineering report.

(l) Underdrain Slopes.

(1) An underdrain and trickling filter effluent channel floor must have a minimum slope of 1%.

(2) An effluent channel must produce a minimum velocity of 2.0 feet per second at the design flow rate to a trickling filter.

(3) The floor of a new trickling filter using stackable modular or synthetic media must slope toward a drainage channel at a slope of at least 1% and not more than 5%, based on filter size and hydraulic loading.

(m) Passive Ventilation.

(1) The effluent channels and effluent pipes of an underdrain system or a synthetic media support structure must permit free passage of air.

(2) Any drain, channel, or effluent pipe must have a cross-sectional area with not more than 50% of the area submerged at peak flow plus recirculation.

(3) The effluent channels must accommodate the specified flushing hydraulic dosing intensity and allow the possibility of increased hydraulic loading.

(4) A passive ventilation system may include an extension of an underdrain through a trickling filter sidewall, a ventilation opening through a sidewall,

or an effluent discharge conduit designed as a partially full flow pipe or an open channel.

(5) A vent opening through a trickling filter wall must include hydraulic closure to allow flooding of a trickling filter for nuisance organism control.

(6) A passive ventilation design must provide at least 2.5 square feet of ventilating area per 1,000 pounds of primary effluent BOD_5 per day.

(7) An underdrain system for a rock media filter must provide at least 1.0 square foot of ventilating area for every 250 square feet of the trickling filter basin surface area.

(8) The minimum required ventilating area for a synthetic media underdrain is the area recommended by the manufacturer. The manufacturer's recommendations must be included in the engineering report.

(9) The ventilating area must be equal to the greater of 1.0 square foot per 175 square feet of synthetic media area or 2.6 square feet per 1,000 cubic feet of media volume.

(n) Forced Ventilation.

(1) Forced ventilation is required for a trickling filter designed for:

(A) nitrification;

(B) a trickling filter design with a media depth in excess of 6.0 feet; and

(C) a location where seasonal or diurnal temperatures do not provide sufficient difference between the ambient air and wastewater temperatures to sustain passive ventilation of one cubic foot of air per square foot of trickling filter area per minute.

(2) A design must specify the minimum airflow for forced ventilation and optimized process performance, and the engineering report must include all calculations associated with this determination.

(3) The design of a down-flow forced ventilation system must include a provision for:

(A) the removal of entrained droplets; or

(B) the return of air containing entrained moisture to the top of a trickling filter; and

(C) a reversible fan or other mechanism to reverse the airflow when a wide temperature difference between the ambient air and wastewater creates strong updrafts.

(4) A ventilation fan and the associated controls must withstand flooding of a trickling filter without sustaining damage.

(5) The following equation and the values in Table G.3. in Figure: 30 TAC §217.182(n)(5) determine the minimum airflow rate for forced ventilation.

Figure: 30 TAC §217.182(n)(5)

Equation G.2.

$$MAFR = \frac{(R_A) \times (L) \times (P_F)}{1440 \text{min}/day}$$

Where:
MAFR = Minimum airflow rate, scfm
R_A = Aeration rate, scf/lb, Table G.3.
L = Loading rate, lb/day, Table G.3.
P_F = Loading peaking factor

Table G.3. - Aeration Rate and Loading Rate Factors		
Filter Application	**R_A (scf/lb BOD_5)**	**L (lb BOD_5/1000 cf/day) Loading on the filter**
Roughing Filter at 75-200 lb BOD_5/1000 cf/day	1080	BOD_5
Secondary Treatment Filter at 25-50 lb BOD_5/1000 cf/day	1200	BOD_5
Combined or Tertiary Filter	2400	1.25 * BOD_5 + 4.6 * total Kjeldahl nitrogen (TKN)

(o) Maintenance.

(1) Cleaning and Sloughing.

(A) A flow distribution device, an underdrain, a channel, and a pipe must allow for maintenance, flushing, and drainage.

(B) A trickling filter system must hydraulically accommodate the specified flushing hydraulic dosing intensity and must facilitate cleaning and rodding of the distributor arms.

(C) A trickling filter system must prevent recirculation of sloughed biomass in pieces larger than the distributor nozzle openings or the filter media voids.

(2) Nuisance Organism Control. A trickling filter system must control nuisance organisms by operation of trickling filters at proper design dosing intensities, with periodic flushing at higher dosing intensities.

(A) Filter Flies.

(i) The structural and hydraulic design of a trickling filter must enable flooding of the trickling filter for fly control.

(ii) The executive director may approve an alternate method of fly control for a trickling filter that exceeds 6.0 feet in height if the effectiveness of the alternate method is verified at a full-scale installation and documented in the engineering report.

(B) Snails. A trickling filter system must be designed to prevent sludge accumulation that attracts snails. A trickling filter system must include a low-velocity, open channel between a trickling filter and final clarifier for manual removal of snails.

(3) Corrosion Protection. A trickling filter must be designed to prevent corrosion. Corrosion-resistant materials must be used for all equipment and for construction of a trickling filter, including ventilation equipment and covers.

(p) Flow Measurements. A trickling filter system must include a means to measure the flow to each trickling filter and the recirculation flow of each trickling filter.

(q) Odor Control. A trickling filter system must use ventilation and periodic flushing at a higher dosing intensity to minimize potential odor.

(1) Covers.

(A) The executive director may require an owner of a wastewater treatment facility with prior odor complaints to install a cover over a new or altered trickling filter.

(B) A cover must allow access to the entire top of the trickling filter media and to the distributor for maintenance and removal.

(C) A covered trickling filter must have a forced ventilation system with a scrubber or an adsorption column for odor control.

(2) Stripping. A trickling filter with an influent organic strength of BOD_5 greater than 200 milligrams per liter must have forced ventilation in a down-flow mode to minimize odor. Odorous off-gases may be:

(A) recycled through a trickling filter;

(B) used to ventilate a tertiary nitrifying trickling filter in an up-flow mode;

(C) diffused into an aeration basin; or

(D) treated separately for odor control using a scrubber or an adsorption column.

(r) Final Clarifiers. The size of the final clarifiers for a wastewater treatment facility with a trickling filter must ensure the required effluent total suspended solids removal at the peak flow with all recirculation pumps in operation.

(s) Report Requirements.

(1) The engineering report must specify the trickling filter efficiency formula used in the design calculations.

(2) The engineering report must include the operating data from any existing trickling filter of similar construction and operation to justify the projected treatment efficiency, kinetic coefficients, and other design parameters as required in this subchapter.

(3) The engineering report may include more than one set of applicable design equations to allow crosschecking of predicted treatment efficiency.

§217.183. Nitrifying Trickling Filters--Additional Requirements.

(a) Ventilation. A nitrifying trickling filter must include forced ventilation to distribute airflow throughout the underdrain area. The minimum design airflow rate must be the greater of:

(1) 50 pounds of oxygen provided per pound of oxygen required at average organic loading, based on stoichiometry; or

(2) 30 pounds of oxygen provided per pound of oxygen required at peak organic loading, based on stoichiometry.

(b) Temperature. The engineering report must justify the temperature used in the design equations. A design may include deep towers or other means to minimize recirculation while providing a design hydraulic dosing intensity that lessens the effects of temperature on removal efficiency.

(c) pH. The engineering report must document that the design recirculation rates are appropriate for dealing with the effects of pH.

(d) Predation. A nitrifying trickling filter must include a means for control of biomass predators, such as snails.

(e) Hydraulic Application Rates. A nitrifying trickling filter must operate at a design dosing intensity of at least 1.47 gallons per minute per square foot and provide operational control of dosing intensity.

(f) Media. Cross-flow synthetic media is required for a new tertiary nitrification filter or for the nitrifying section of a new combined nitrification filter.

(g) Tertiary Nitrification Filters. A trickling filter treating influent that has a five-day biochemical oxygen demand (BOD_5) to total Kjeldahl nitrogen (TKN) ratio of equal to or greater than 1.0 and soluble BOD_5 of less than or equal to 12 milligrams per liter (mg/l) is a tertiary nitrification filter.

(1) Design Justification. The engineering report must include process design calculations and selection criteria of kinetic coefficients for a tertiary nitrification trickling filter. The design calculations and selection criteria must be justified by operating data from an existing trickling filter of similar construction and operation.

(2) Media biotowers. A tertiary nitrification trickling filter design must minimize pH depression due to recirculation. A tertiary nitrification trickling filter must use either:

(A) a single tower at least 20 feet tall; or

(B) a series of towers less than 20 feet tall. The design must include provisions to readily switch the operating sequence of the trickling filters if multiple towers are operated in series.

(h) Combined BOD_5 and Nitrification Filters. A trickling filter intended to perform nitrification and treating influent having a BOD_5 to TKN ratio of less than 1.0 or soluble BOD_5 of less than 12 mg/l is a combined BOD_5 and nitrification filter.

(1) Design Justification. The engineering report must justify the projected treatment efficiency and other design parameters of a combined BOD_5 and nitrification trickling filter by including operating data from any existing trickling filter of similar construction and operation.

(2) BOD_5 Removal Requirements. A combined BOD_5 and nitrification filter must achieve effluent total BOD_5 of less than 15 mg/l.

(3) Recirculation. A combined BOD_5 and nitrification filter design must enable a high recirculation rate with turndown capability.

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§217.184. Dual Treatment Using Trickling Filters.

(a) Classification. A trickling filter or other attached-growth treatment unit in series with a suspended-growth process is considered a dual treatment process that is classified as an Activated Biological Filter (ABF) System, a Trickling Filter/Solids Contact (TF/SC) System, a Roughing Filter/Activated Sludge (RF/AS) System, an Activated Biological Filter/Activated Sludge (ABF/AS) System, or a Trickling Filter/Activated Sludge (TF/AS) System.

(1) ABF System. An ABF system consists of a tricking filter and a final clarifier. An ABF system recirculates settled solids from the final clarifier through the trickling filter with no separate aeration basin or solids contact basin.

(2) TF/SC System. A TF/SC system consists of a trickling filter sized to remove the majority of the soluble five-day biochemical oxygen demand (BOD_5), followed by an aerated solids contact basin sized to provide polishing and improved

sludge settleability, followed by a final clarifier. A TF/SC system recirculates activated sludge to a solids contact basin. The design of a TF/SC system may include a sludge re-aeration basin.

(3) RF/AS System. An RF/AS system consists of a trickling filter sized to perform primary treatment, followed by an aeration basin sized to remove the majority of the soluble BOD_5, followed by a final clarifier. An RF/AS system circulates activated sludge to the aeration basin.

(4) ABF/AS System. An ABF/AS system consists of a trickling filter sized to perform primary treatment, followed by an aeration basin sized to remove the majority of the soluble BOD_5, followed by a final clarifier. An ABF/AS system recirculates activated sludge to the trickling filter.

(5) TF/AS System. A TF/AS system consists of a trickling filter sized to perform roughing and concentration dampening, followed by an intermediate clarifier, followed by an aeration basin sized to remove the majority of the soluble BOD_5, followed by a final clarifier. A TF/AS system circulates activated sludge to the aeration basin.

(b) Process Design.

(1) Attached and suspended growth sub-processes in a dual treatment system must be designed through an integrated process that includes the effluent quality from the first stage in determining the design basis of the second stage.

(2) The design of a dual treatment system must include an estimate of the performance of the second stage of a dual system using data from existing similar installations or applicable pilot studies.

(3) For a dual treatment system design in which activated sludge is recycled to first-stage trickling filters, the design must not include the reduction of oxygen demand to the second-stage aeration basin because of sludge recirculation to the trickling filters.

(4) The design of a dual treatment system may include estimates of the applicable design equations and methodology used for a single stage process.

(c) Treatment Unit Design. The design of a suspended and attached growth system must include all of the features and operational capabilities required for the same treatment unit used for single-process treatment. The design of a suspended and attached growth system must also include the design for pretreatment, snail control, return sludge, aeration, sludge age, hydraulic residence time, and nitrification design.

(1) Pretreatment. Pretreatment for a dual treatment system must conform to the requirements for a first-stage process.

(2) Snail Control. A dual treatment system must include a low-velocity channel between the first-stage and second-stage treatment units for control of snails.

(3) Return sludge.

(A) A dual treatment system that includes recirculation of activated sludge or sloughing to trickling filters must prevent recirculation of pieces too large to pass through the distributor nozzles or the trickling filter media voids.

(B) The trickling filters in a dual treatment system that recirculates sludge to the trickling filters must be of a high-rate, vertical flow design that uses fully corrugated media.

(C) Sludge must be incorporated into the influent prior to application to trickling filters, and must be incorporated into the effluent from first-stage processes prior to being introduced into second-stage aeration basins.

(4) Aeration. An aeration system for second-stage treatment units in a dual system not designed for nitrification must transfer at least 1.2 pounds of oxygen per pound of first stage effluent BOD_5 per day. An aeration system for second-stage treatment units in systems designed for nitrification must transfer sufficient oxygen to meet stoichiometric requirements for:

(A) biomass growth;

(B) respiration for both carbonaceous material oxidation and nitrification; and

(C) oxygen demand due to biomass sloughing events from the first-stage.

(5) Sludge Age.

(A) A second-stage suspended growth process must operate in a way that varies the age of the sludge.

(B) The mean cell residence time must be:

(i) at least 1.5 days for the suspended growth process for TF/SC systems; or

(ii) at least 3.0 days if the second process is an activated sludge aeration basin.

(C) A nitrifying dual treatment system must maintain a total combined mean cell residence time in the attached and suspended growth systems of at least 10.0 days with capability to provide at least 6.0 days mean cell residence time in the suspended growth process alone.

(6) Hydraulic Residence Time. A design of second-stage processes must have a minimum hydraulic residence time of:

(A) 0.5 hour if the second process is an aerated solids contact basin; or

(B) 3.0 hours if the second process is an activated sludge aeration basin.

(7) Nitrification Design. A wastewater treatment facility designed for nitrification using a dual treatment system must include:

(A) a sludge re-aeration basin if the second process is an aerated solids contact basin; or

(B) an intermediate clarifier if the second process is an activated sludge aeration basin.

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§217.185. Rotating Biological Contactors.

(a) Pretreatment.

(1) Pretreatment to remove grit, debris, and excess oil and grease must precede a rotating biological contactor (RBC). Grit, debris, and excess oil and grease must be handled and disposed of in accordance with §217.123 and §217.126 of this title (relating to Screenings and Debris Handling; and Grit Handling).

(2) The executive director may require primary clarifiers, fine screens, or grit removal chambers prior to an RBC to control high levels of grease, oil, grit, or other debris in the influent waste stream.

(3) Hydrogen sulfide concentration must be considered to determine whether an RBC system requires pre-aeration.

(b) Enclosures and Ventilation.

(1) An RBC must be covered and must provide at least six complete air exchanges per hour.

(2) A cover must have working clearance of at least 30 inches above an RBC, unless the cover can be removed with on-site equipment.

(3) Enclosures must be constructed of a corrosion-resistant material.

(4) An RBC must include:

(A) access doors on each end; and

(B) observation ports with covers at 3.0 foot intervals along the RBC.

(c) Media Design.

(1) An RBC must provide self-cleaning action for the media.

(2) RBC media must be compatible with the wastewater to be treated.

(3) An RBC design using multiple stages must use low-density media material for the first stage.

(d) Design Flexibility. If included in the design of an RBC, the engineering report must include descriptions of the following:

(1) controlled flow to multiple first stages;

(2) alternate flow and staging arrangements;

(3) removable baffles between stages; and

(4) provisions for step feed and supplemental aeration.

(e) Tank Configuration. The design of an RBC must ensure that each RBC tank:

(1) minimizes the zones in which solids will settle out; and

(2) includes tank drains to facilitate removal of any accumulated solids.

(f) Control of Unwanted Growth in the Initial Stages. Chlorine may be added upstream of an RBC system to control the growth of filamentous bacteria that oxidize sulfur compounds (e.g., *Beggiatoa* species).

(g) Maintenance Provisions.

(1) An RBC system with a design flow of 1.0 million gallons per day or greater must have two or more process trains, each consisting of three or more stages in series.

(2) An RBC system must be able to treat the design flow with the largest process train out of service for maintenance or cleaning.

(h) Bearing Maintenance. The bearings in each RBC must be easily accessible for inspection, lubrication, and replacement.

(i) Organic Loading Design Requirements.

(1) The design of an RBC must be based on the organic loading rate.

(2) The maximum loading rate must not exceed 8.0 pounds of five-day biochemical oxygen demand (BOD_5) per day per 1,000 square feet (sf) of media in any stage.

(3) The RBC media area must be adjusted to compensate for the effects of the ratio of soluble BOD_5 to total BOD_5.

(4) Allowable organic loading for the entire RBC system must not exceed:

(A) 3.0 lbs of BOD_5 per day per 1,000 sf of media area for wastewater treatment facilities required to meet secondary treatment; or

(B) 2.0 lbs of BOD_5 per day per 1,000 sf of media for a wastewater treatment facility required to meet advanced secondary treatment.

(j) Hydraulic Loading Design Requirements. A wastewater treatment facility using an RBC system must include flow equalization when the peak flow is more than 2.5 times the design flow to prevent loss of fixed growth from the media.

(k) Stages.

(1) An RBC system designed for BOD_5 removal must have at least three stages in series, unless the engineering report justifies that equivalent treatment will be achieved with less than three stages. Justification must use operational data from either a full-scale operating wastewater treatment facility or pilot unit with an appropriate scale-up factor.

(2) The first stage of an RBC system must include a means of spreading the influent flow evenly across the media.

(l) Drive Systems. An RBC drive system must be able to handle the maximum anticipated media load and may be a variable speed system. An RBC may be mechanically driven or air driven.

(1) Mechanical Drive Systems.

(A) A mechanical drive system must have a motor and speed control unit capable of maintaining the required revolutions per minute.

(B) A fully assembled spare mechanical drive unit must be kept on-site for each size of mechanical drive unit used in the RBC.

(2) Air Drive System.

(A) Each RBC using an air drive system must have air diffusers mounted below the media and off-center from the vertical axis of the RBC and must have air cups mounted on the outside of the media to collect the air.

(B) The blowers must provide the capacity to supply:

(i) the airflow rate necessary for each RBC;

(ii) double the airflow rate to any one RBC while the others are running normally; and

(iii) the required airflow with the largest blower out of service.

(C) The air diffuser pipe to each RBC must:

(i) be mounted so that the air diffuser pipe may be removed without draining the tank or without moving the RBC media; and

(ii) include an air control valve to each RBC.

(m) Dissolved Oxygen.

(1) An RBC system must maintain a minimum dissolved oxygen concentration of 1.0 milligram per liter in all stages under the maximum organic loading rate.

(2) The executive director may require supplemental aeration.

Adopted November 4, 2015 Effective December 4, 2015

§217.186. Nitrifying Rotating Biological Contactors.

(a) A rotating biological contactor (RBC) system designed for five-day biochemical oxygen demand (BOD_5) removal and nitrification of domestic wastewater in a single system must include four stages and have a maximum overall organic loading rate of 1.6 pounds of BOD_5 per day per 1,000 square feet of media.

(b) A nitrifying RBC must be designed to allow chemical addition if the influent pH is below 7.0 standard units.

(c) The engineering report must justify the nitrification rate of a system using calculations.

(d) A nitrifying RBC system may be subject to the requirements of §217.7(b)(2) of this title (relating to Types of Plans and Specifications Approvals).

Adopted November 4, 2015 Effective December 4, 2015

§217.187. Dual Treatment Utilizing Rotating Biological Contactors.

(a) A rotating biological contactor (RBC) may be used in conjunction with other treatment as a dual treatment system.

(b) An RBC may be used as aroughing unit, as described in §217.182(b)(1) of this title (relating to Trickling Filters--General Requirements, regarding trickling filter classifications), in series with an activated sludge system.

(c) The engineering report must include supporting data, calculations, process descriptions, and vendor information to describe how a proposed RBC system will meet the permitted effluent limitations.

(d) Combined systems may be subject to the requirements of §217.7(b)(2) of this title (relating to Types of Plans and Specifications Approvals).

Adopted November 4, 2015 Effective December 4, 2015

§217.188. Submerged Biological Contactor.

(a) A submerged biological contactor (SBC) must be air driven and does not require a cover. An SBC is any biological contactor where more than 60% of the surface is below the water level at design flow.

(b) An SBC system requires the same pretreatment as a rotating biological contactor system and must meet the criteria in §217.185 of this title (relating to Rotating Biological Contactors), except as described in paragraphs (1) and (2) of this subsection.

(1) Each SBC unit must include two air headers - one to provide rotation of the unit, and one to provide dissolved oxygen for biological activity.

(2) Submerged bearings must be sealed to prevent intrusion of wastewater.

(c) If an SBC has any moving parts that require lubrication, an SBC must have lubrication access above the water level.

Adopted November 4, 2015 Effective December 4, 2015

§217.189. Dual Treatment Systems Using Submerged Biological Contactor.

(a) A submerged biological contactor (SBC) may be used in conjunction with other treatment systems.

(b) An SBC may be used as a roughing unit, as described in §217.182(b)(1) of this title (relating to Trickling Filters--General Requirements), in series with activated sludge.

(c) SBC units may be installed in existing activated sludge basins to create a combination of fixed and suspended growth processes.

(d) If a dual treatment system employs an SBC, the engineering report must include supporting data, calculations, process descriptions, and vendor information to describe how the proposed dual treatment system will provide the required treatment levels.

(e) These designs may be subject to the requirements of §217.7(b)(2) of this title (relating to Types of Plans and Specifications Approvals).

Adopted November 4, 2015 Effective December 4, 2015

§217.190. Filtration.

(a) Reasons for Use.

(1) Permit Requirements. A wastewater treatment facility that requires tertiary effluent limitations must use filtration as a unit of operation to supplement suspended solids removal. Tertiary effluent limits are any limits less than or equal to five milligrams per liter for five-day biochemical oxygen demand or total suspended solids.

(2) Specific Water Quality Requirements. A wastewater treatment facility designed for secondary or advanced secondary treatment effluent limitations may use filtration as a unit of operation to supplement suspended biological floc removal. Filters may be designed for intermittent operation if filters are not necessary to meet permitted effluent limitations.

(b) Redundancy.

(1) A wastewater treatment facility using filtration to provide tertiary treatment to comply with a permit requirement must have a minimum of two independent, fully functional filter basins with independent, fully functional equipment.

(2) The design of a filtration system must specify the submerged filter surface area required to treat the peak flow with the largest filter unit out of service.

(3) If a filter is provided solely to polish wastewater in situations where permit compliance does not depend on the use of a filter, such as in some cases of reclaimed water use, one filter is allowed.

(c) Source of Backwash Water. A filtration system must use filtered effluent as the source of backwash water.

(d) Disposition of Backwash Water. A filtration system must return backwash water containing material cleaned from a filter to the headworks of the wastewater treatment facility or to the influent lift station for processing.

(e) Sequence of Treatment Units.

(1) A final clarifier must precede a filter.

(2) A filter system may be used in conjunction with a disinfection tank to provide additional detention time, provided the filter is backwashed to the headworks of the wastewater treatment facility or to the influent lift station.

(f) Overload Conditions. A design must prevent effluent or partially treated effluent from overflowing from any filtration unit.

(g) Control of Slime Growth. A filtration system must provide periodic disinfectant in the influent stream to control slime growth in the filter and backwash storage tank.

Adopted November 4, 2015 Effective December 4, 2015

§217.191. Additional Requirements for Deep Bed, Intermittently Backwashed, Granular Media Filters.

(a) Application Rates. With one unit out of service, the peak application rate to any deep bed, intermittently backwashed, granular media (deep bed) filtration unit must not exceed twice the design application rate.

(1) Single Media (Sand).

(A) The design filtration rate for single media (sand) filters must not exceed three gallons per minute per square foot (gpm/sf) of media surface.

(B) The maximum filtration run time between backwash periods is 6.0 hours.

(2) Dual Media (Stratified Anthracite and Sand). The design filtration rate for a dual media (anthracite and sand) filter must not exceed 4.0 gpm/sf of media surface.

(3) Mixed Media (Non-stratified Anthracite, Sand, Garnet, or Other Materials). The design filtration rate for mixed media (non-stratified anthracite, sand, garnet, or other materials) must not exceed 5.0 gpm/sf of media surface.

(b) Media Design.

(1) A deep bed filter underdrain system must include a graded gravel layer with a minimum depth of 15 inches. Filter support media other than gravel may be used if justified in the engineering report.

(2) The uniformity coefficient of media used in a deep bed filter must be 1.7 or less.

(3) A dual or mixed deep bed filter must be designed to maintain stratification of media during backwash, based on the particle size distribution.

(4) Media material depths for the various deep bed filter types must conform to the values in the following table, unless other media depths are justified in the engineering report with an analysis of the backwash rates:

Figure: 30 TAC §217.191(b)(4)

Table G.4. - Minimum Filter Depths for Deep Bed, Intermittently Backwashed Filters

Filter Type	Type of Media	Effective Particle Size (millimeters)	Minimum Depth (inches)
Single Media	Sand	1.0-4.0	24
Dual Media	Anthracite & Sand *Anthracite* *Sand*	1.0-4.0 *1.0-2.0* *0.5-1.0*	16 total *10* *6*
Mixed Media	Anthracite, Sand & Other *Anthracite* *Sand* *Garnet or Similar Material*	1.0-4.0 *1.0-2.0* *0.6-0.8* *0.3-0.6*	16 total *10* *4* *2*

(c) Backwash Systems.

(1) Flowrate and Media Expansion.

(A) A backwash system must allow a fluidized media expansion of at least 20% by volume.

(B) A single media deep bed filter must provide a minimum backwash flowrate of 6.0 gpm/sf of media area.

(C) Dual and mixed media deep bed filters must provide a minimum backwash rate of 15 gpm/sf of media area.

(D) Backwash times must be at least 10 minutes but not more than 15 minutes, unless the engineering report justifies a different time.

(2) Surge Control.

(A) A wastewater treatment facility that does not have flow equalization or other means of surge control must have a backwash tank.

(B) A surge control device must prevent increases in flow greater than 15% of the design flow of the upstream treatment units if backwash is taken directly to the headworks of the wastewater treatment facility or the influent lift station.

(C) The design of a surge control device must be based on calculations that demonstrate the slug effects of backwash water and that demonstrate treatment capabilities are not diminished with the return of backwash water to the headworks of the wastewater treatment facility or the influent lift station.

(D) An enclosed backwash tank must be vented.

(3) Pumps.

(A) Pumps for backwashing deep bed filters units must deliver the required flow rate for backwash operations according to paragraph (1) of this subsection with the largest pump out of service.

(B) A backup pump must be available on-site.

(C) A valve arrangement for isolating a deep bed filter unit for backwashing must be accessible for maintenance.

(D) A backwash system employing automatic controls must include a manual override system.

(4) Supplemental Systems.

(A) A single deep bed media filter system must include either an air scour system or a combination air and water scour system in addition to an up-flow backwash water system.

(B) A dual or mixed deep bed media filter system must include either a surface air or water scour system that meets one of the following requirements for air or water scouring.

(i) Air scour system flowrates must be at least 3.0 standard cubic feet per minute per square foot (scfm/sf) of media surface area but not more than 5.0 scfm/sf of media surface area.

(ii) Water scour system flowrates must be at least 0.5 gpm/sf of media area but not more than 2.0 gpm/sf of media area.

(d) Underdrain System. An underdrain system must provide a uniform distribution for filter backwash without plugging or exceeding the manufacturer's recommendation for maximum head loss. The manufacturer's recommendation for maximum head loss must be included in the engineering report.

(e) Tank Design.

(1) The bottom of a wash water collection trough must be a minimum of 6.0 inches above the maximum elevation of the expanded media during backwash.

(2) A wash water collection trough must have a minimum freeboard of 3.0 inches during the maximum backwash flowrate.

(f) Controls.

(1) The deep bed filter operation controls may be manual or automatic.

(2) Control indicators must be visible to a wastewater treatment facility operator while adjusting the controls.

(3) An automatically controlled system must include a manual override system.

(4) Each deep bed filter unit must have a head loss indicator.

Adopted November 4, 2015 Effective December 4, 2015

§217.192. Additional Design Requirements for Multi-Compartmented, Low Head, Automatically Backwashed Filters.

(a) Application Rates.

(1) With one unit out of service, the peak application rate to any multi-compartmented, low head, automatically backwashed (multi-compartmented) filter unit must not exceed twice the design application rate.

(2) The engineering report must include manufacturer's recommended filtration and application rates with test data.

(3) Single Media. A single media multi-compartmented filter must have a maximum design filtration rate of 3.0 gallons per minute per square foot of media surface.

(4) Dual Media. A dual media multi-compartmented filter must have a maximum design filtration rate of 4.0 gallons per minute per square foot of media surface.

(b) Media Design. Media sizes and depths must correspond to the values in Table G.5. in Figure: 30 TAC §217.192(b), unless an engineer uses calculations to justify different media sizes, depths, or both in the engineering report.

Figure: 30 TAC §217.192(b)

Table G.5. - Filter Depths for Multi-Compartmented, Low Head, Automatic Backwash Filters

Filter Type	**Type of Media**	**Effective Particle Size** *(millimeters)*	**Minimum Depth** *(inches)*
Single Media	Sand	0.55-0.65	11
Dual Media	Anthracite & Sand *Anthracite* *Sand*	0.55-0.65 *1.0-2.0* *0.5-1.0*	16 *10* *6*

(c) Backwash System.

(1) A backwash system must provide a minimum backwash rate of 20 gallons per minute per square foot of media.

(2) The backwash duration must last at least 20 seconds for each compartment and must allow a fluidized media expansion of at least 20% by volume, unless the engineering report includes the manufacturer's recommended backwash rates with test data that supports a shorter backwash duration or less expansion of the fluidized media.

(3) The surge control and pumping system requirements must be the same as those detailed in §217.191(c)(2) and (3) of this title (relating to Additional Requirements for Deep Bed, Intermittently Backwashed, Granular Media Filters).

(d) Traveling Bridge. A traveling bridge mechanism must:

(1) provide support and access to the backwash pumps and equipment;

(2) be constructed of corrosion-resistant materials;

(3) have provisions for consistent tracking of the bridge and safe support of the power cords; and

(4) initiate a backwash cycle automatically when a preset head loss through the filter media occurs.

(e) Floating Material Control. A multi-compartmented filter system must provide for automatic removal of any floating material from the surface of the multi-compartmented filter and return the floating material to the headworks of the wastewater treatment facility for further processing.

Adopted November 4, 2015 Effective December 4, 2015

§217.193. Cloth or Disk Filter Systems.

(a) Cloth or disk filter systems must meet the requirements in §217.190 of this title (relating to Filtration).

(b) Media Design.

(1) The average pore size of cloth or disk filter media must not exceed 30 microns.

(2) The media thickness must be based on the manufacturer's recommendations, considering frequent pressure changes. The manufacturer's recommendations must be included in the engineering report.

(3) The media must be disinfectant-resistant if the filter will be exposed to disinfectants.

(4) The media must be chlorine-resistant if the filter will be exposed to chlorine.

(c) Filtration Rates and Hydraulic Requirements.

(1) The design filtration rate must be based on the effective submerged surface area of the media. If the submerged surface area of the media varies based on the operational mode, the design filtration rate must account for the variability.

(2) The maximum design filtration rate for peak flow must not exceed 6.5 gallons per minute per square foot of submerged media.

(3) The filtration system must be able to treat the design flow rate with one filter unit in backwash mode.

(4) The backwash flux rate must be at least 6.0 gallons per minute per square foot of media, based on the portion of the filter surface that is being actively backwashed.

(d) Disposal of Backwashed Material.

(1) Liquid filter backwash must be re-filtered or must be returned to the headworks of the wastewater treatment facility or to the influent lift station.

(2) Solid filter backwash material must be pumped to the influent lift station, the headworks, the digester, or to another location approved in writing by the executive director for processing at least once per day.

(e) Monitoring and Controls.

(1) Cloth or disk filters must use an automatic control system.

(2) An automatic control system must include manual override capability.

(3) Each filter unit must monitor head loss across the unit and must have a head loss gauge or readout.

(4) Each filter unit must monitor effluent turbidity and have a turbidity gauge or readout.

(5) Gauges and readouts must be readable from the control panel.

(f) Weather Resistance. Cloth or disk filter systems must be protected from the environment. The engineering report must describe how the system will be protected from freezing conditions, ultraviolet light, and similar environmental concerns.

Adopted November 4, 2015 Effective December 4, 2015

§217.194. Alternative Designs for Effluent Polishing.

The executive director shall review alternative processes for tertiary suspended solids removal, other than filters, as non-conforming technologies subject to the requirements of §217.7(b)(2) of this title (relating to Types of Plans and Specifications Approvals).

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