Technical Guidelines for Ultraviolet Disinfection for Non-Community Water Systems Installation, Operation and Maintenance

1. Purpose and Scope

To provide guidance on the design, installation, operation and acceptance of ultraviolet light (UV) disinfection for Non-Transient Non-Community (NTNC) and Transient Non-Community (TNC) water systems with properly protected groundwater sources (as determined considering the source and site information required under 3.b. below). Prior to installation of a UV disinfection system, a water supply permit to construct application will need to be submitted to the Water Supply Division together with plans prepared by a Vermont Licensed Engineer and an application fee of $275.

2. General

For simple installations for existing NTNC and TNC systems utilizing a properly protected groundwater source with limited external distribution piping, the Ultraviolet (UV) disinfection unit shall be installed, operated and maintained in accordance with these guidelines. Installations must comply with the Vermont Standards for Water System Design, Construction and Protection (see Vermont Water Supply Rule – Chapter 21). By adhering to these guidelines, UV installations at NTNC and TNC water systems will meet the Vermont Water System Standards.

3. Design Considerations

a. System Demand - Average daily, maximum daily and peak flow demands of the water system.

b. Source and Site Conditions –

i. Groundwater source type (i.e., drilled well, dug well, spring).

ii. Location of the groundwater source(s) and locations of and distances to wastewater disposal systems, buildings, potential sources of contamination, etc.

iii. Well construction – Information can be obtained from well completion report(s)/log information indicating source yield, construction details (e.g., length of casing), soil conditions, capacity and type of pump.

iv. Water Quality - Influent water quality data[1] (water entering the UV chamber), including microbiological data (total and fecal coliform and heterotrophic plate count), and the following inorganic and physical constituents (water sample(s)

[1] The water quality parameters listed are for existing sources. New sources require some additional testing (see Water Supply Rule, Part 11, Non-Community and Non-Public Water Systems).

are to be tested by a State of Vermont Safe Drinking Water Act certified or approved laboratory):

Parameter	Design Limit
a. Color	15 APHA units
b. Turbidity	1.0 NTU
c. Iron	0.3 mg/L
d. Hardness ($CaCO_3$)	120 mg/L
e. Suspended solids	10 mg/L
f. Manganese	0.05 mg/L
g. Hydrogen sulfide	Non-Detectable
h. pH	6.5 to 9.5
i. UV Transmittance	75%

Note: UV disinfection is not suitable for systems where influent water quality exceeds any of the values listed above. However, proposals for the installation of treatment systems prior to the UV units to meet the water quality design limits will be considered for review and approval by the Water Supply Division.

c. System Schematic - A sketch or schematic of the ultraviolet disinfection system should be prepared showing all plumbing and treatment (meters, storage tanks, raw and disinfected water sampling taps, filters, etc.). See page 3 for a typical schematic of an acceptable ultraviolet installation.

d. Manufacturer Information Sheets - UV water treatment devices must comply with Class A criteria under the American National Standard Institute (ANSI)/National Sanitation Foundation (NSF) Standard 55 (Ultraviolet Microbial Water Treatment Systems), and the installations must comply with Appendix A - Design and Operating Criteria for Ultraviolet Disinfection Units. Calculations for UV system selection shall adhere to Appendix A.

4. Completed Works

Installation shall be completed in accordance with Appendix A. Immediately (within 24 hours) following installation, a total coliform sample shall be collected from the location nearest to the point following disinfection to determine if the system is free of bacteriological contamination. This sample should be marked “other” on the laboratory form prior to sending the sample to the lab for analysis. Please note this sample will not be used in compliance determinations with the Maximum Contaminant Levels or bacteriological monitoring requirements established under the federal Total Coliform Rule (TCR). Routine sampling is required under the TCR on a quarterly, or if directed by WSD, more frequent basis.

5. System Operation/Operation Reports

A water system operation report for UV disinfection shall be prepared, kept on-site and made available for review by WSD staff upon request. An operation log shall be maintained at the facility and entries shall be made for dates and types of maintenance and repair, including cleaning, bulb replacement, etc. At a minimum, annual cleaning of the quartz sleeve and annual bulb replacement is required, which shall be documented in the operation report. Cleaning as frequently as monthly may be required in some installations. Periodic sampling for heterotrophic plate count (HPC) should be performed to assess water quality immediately downstream of the UV contact chamber to serve as an indicator of system performance. Periodic testing for HPC will aid in establishing an appropriate cleaning frequency. The attached operation report form can be used to maintain the operation and maintenance log for the UV unit.

ULTRAVIOLET DISINFECTION UNIT SCHEMATIC

Manufacturer _____ Model # _____

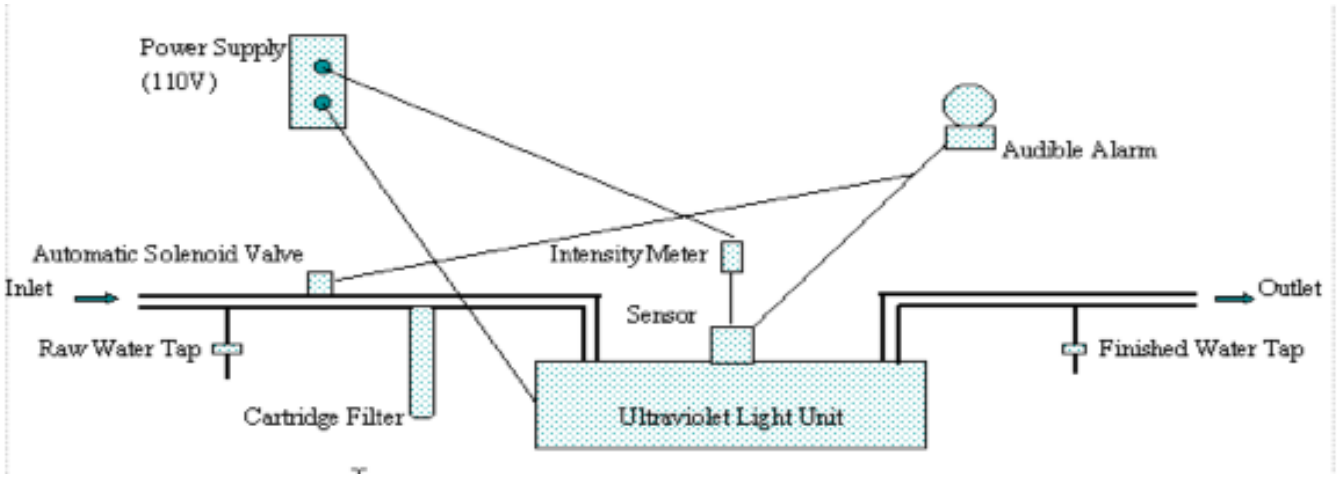
NSF (or equivalent) Approved _____ UV Intensity & Dosage _____

Flow Rate (mfg) _____ Intensity Meter _____

Automatic Shut Off Valve _____ Micron Filter Provided * _____

Alarm _____ Location to be Installed _____

* The 5 micron filter is recommended but not required.



APPENDIX A

DESIGN AND OPERATING CRITERIA FOR ULTRAVIOLET DISINFECTION UNITS

1. The minimum UV dosage will be 40 milliwatt-sec per square centimeter (mW-sec/cm^2) or 40 millijoules per square centimeter (mJ/cm^2).

2. The ultraviolet radiation will be delivered at the optimum germicidal wavelength of 254 nanometers (nm).

3. Installation of the unit shall be in a protected enclosure not subject to extremes of temperature. Location of unit will be such that there is free access for repairs and maintenance.

4. All water from the source is to be treated. A bypass may be installed but may only be opened if an approved disinfection alternative is in use, or a voluntary boil water notice is issued. For further guidance on operating in bypass mode, please contact WSD personnel by phone at 1-800-823-6500. Maximum distance in the chamber, measured from the tube surface to the chamber wall shall not exceed three inches unless the applicant can demonstrate the ability to achieve the requisite UV intensity transmitted through the proposed depth.

5. The installation of a single UV unit for disinfection is acceptable for transient non-community water systems. For non-transient non-community water systems (e.g., schools), two units must be installed in parallel with each UV unit having the capacity of disinfecting the total flow to meet water demands with one of the UV units off line.
   Water systems having UV units in parallel must operate the treatment units so that no unit sits unused for a period longer than one week. A time delay mechanism shall be installed to enable at least a 2-minute tube warm-up period before water flows out of the idled unit.

6. The reactor is to be constructed of stainless steel. The ultraviolet tubes shall be:
   a. Sleeved so that a proper operating temperature of about 104 degrees Fahrenheit is maintained, and
   b. The sleeve shall be of quartz or high silica glass with similar optical characteristics.

7. The unit shall be designed to permit mechanical cleaning of the water contact surface of the sleeve without disassembly of the unit or be of such design that quick disassembly is possible for surface cleaning. The unit shall also have a drain to facilitate the unit's removal for service or replacement.

8. An automatic flow control valve, accurate within the expected pressure range, shall be installed to restrict flow to the maximum design flow of the treatment unit. The treatment unit should be located before any storage tanks to avoid having to oversize the unit in terms of flow capacity.

9. An accurately calibrated ultraviolet intensity meter, properly filtered to restrict its sensitivity to the disinfection spectrum shall be installed in the wall of the disinfection chamber at the point of greatest distance from the tube or tubes.

10. The unit must have a display panel with lamp operation status and alarm indicators.

11. An automatic shut-off valve on the influent side of the unit shall be installed which will permit flow into the potable water system only when the minimum ultraviolet dosage is applied. When power is not being supplied to the unit, the valve should be in a closed (fail safe) position which prevents the flow of water into the potable water system. The water system from the source to the UV unit should be checked to ensure equipment is in place to release pressure that may build-up when the shut-off valve closes.

12. An automatic, audible alarm shall be installed to warn of malfunction or impending shutdown.

13. The unit shall be designed to protect the operator against electrical shock or excessive radiation.

14. A spare ultraviolet tube and other necessary equipment to affect prompt repair by qualified personnel properly instructed in the operation and maintenance of the equipment shall be provided on site.

15. Sampling taps must be installed before and after the UV unit. A receptacle for the connection of portable power is recommended.

16. A tap for the injection of chlorine must be installed after the UV unit and before the water distribution system (maximizing chlorine contact time) to deal as needed with bacteriological contamination of the distribution system. In addition, an electrical system must be in place and operational for chlorine injection only when there is flow into the water system.

Instructions: Complete form and keep on file with water systems records.

Water Systems Name: _____ WSID: _____ Year _____

OPERATION INFORMATION

Once a month conduct visual inspection to ensure unit is working. The visual inspection should occur on the same data each month. Record findings inspection on chart below.

Month	Is UV Light Working?	Intensity Meter Level	Check By	Date
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

MAINTENANCE INFORMATION

At a minimum, annual cleaning of the quartz sleeve and annual bulb replacement is required.

Date	Type of MAINTENANCE (Repair, change/clean bulb etc.)	Serviced By

BYPASS INFORMATION

When bypassed, an alternative disinfectant must be used or a voluntary boil water notice must be issued. *Please record anytime the UV unit was bypassed.*

Was the UV Unit Bypassed?	Why was unit bypassed?	Date(s) UV Unit was bypassed

ALARM INFORMATION

Record and explain any alarm conditioned that occurred during the year. (ex. low dose bulb failure)

Date	Description of Alarm Condition	Corrective Action Taken

SAMPLING INFORMATION

Routine coliform sampling shall be performed quarterly. If any sample is positive for total or fecal coliform bacteria, 4 repeat samples must be collected within 24 hours of notification and 5 routine samples collected during the next month of operation.

Sampling Location	Date of Sample	Type of Sample (Routine, Repeat or Other)	Total Coliform Positive	E.Coli Positive
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No
			____Yes ____ No	____Yes ____ No

Comments:

_____

_____

_____

_____

Reported By: _____ Date: _____

Title: _____ Signature _____

This guidance sheet and related environmental information are available electronically via the internet. For information visit us through the Vermont Homepage at http://www.vermont.gov or visit VT WSD directly at http://www.vermontdrinkingwater.org

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