

designate an alternative basis for awarding UV disinfection credit.

EPA is developing the UV Disinfection Guidance Manual (USEPA 2003d) to assist systems and States with implementing UV disinfection, including validation testing of UV reactors. This guidance is available in draft in the docket for today's proposal (<http://www.epa.gov/edocket/>).

#### UV Dose Tables

Table IV-21 shows the UV doses that systems must apply to receive credit for up to 3 log inactivation of *Cryptosporidium* and *Giardia lamblia* and up to 4 log inactivation of viruses. These dose values are for UV light at a wavelength of 254 nm as delivered by a low pressure mercury vapor lamp. However, the dose values can be

applied to other UV lamp types (e.g., medium pressure mercury vapor lamps) through reactor validation testing, such as is described in the draft UV Disinfection Guidance Manual (USEPA 2003d). In addition, the dose values in Table IV-21 are intended for post-filter application of UV in filtration plants and for systems that meet the filtration avoidance criteria in 40 CFR 141.71.

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**Table IV-21.-- UV Dose Requirements for *Cryptosporidium*, *Giardia lamblia*, and Virus Inactivation Credit**

Log credit	<i>Cryptosporidium</i> UV dose (mJ/cm <sup>2</sup> )	<i>Giardia lamblia</i> UV dose (mJ/cm <sup>2</sup> )	Virus UV dose (mJ/cm <sup>2</sup> )
0.5	1.6	1.5	39
1.0	2.5	2.1	58
1.5	3.9	3.0	79
2.0	5.8	5.2	100
2.5	8.5	7.7	121
3.0	12	11	143
3.5	NA	NA	163
4.0	NA	NA	186

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##### Reactor Validation Testing

For a system to receive UV disinfection credit, the UV reactor type used by the system must undergo validation testing to demonstrate the operating conditions under which the reactor can deliver the required UV dose. Unless the State approves an alternative approach, this testing must involve the following: (1) Full scale testing of a reactor that conforms uniformly to the UV reactors used by the system and (2) inactivation of a test microorganism whose dose response characteristics have been quantified with a low pressure mercury vapor lamp.

Validation testing must determine a set of operating conditions that can be monitored by the system to ensure that the required UV dose is delivered under the range of operating conditions applicable to the system. At a minimum, these operating conditions must include flow rate, UV intensity as measured by

a UV sensor, and UV lamp status. The validated operating conditions determined by testing must account for the following factors: (1) UV absorbance of the water, (2) lamp fouling and aging, (3) measurement uncertainty of on-line sensors, (4) dose distributions arising from the velocity profiles through the reactor, (5) failure of UV lamps or other critical system components, and (6) inlet and outlet piping or channel configurations of the UV reactor. In the draft UV Disinfection Guidance Manual (USEPA 2003d), EPA describes testing protocols for reactor validation that are intended to meet these criteria.

##### Reactor Monitoring

Systems must monitor for parameters necessary to demonstrate compliance with the operating conditions that were validated for the required UV dose. At a minimum systems must monitor for UV intensity as measured by a UV sensor, flow rate, and lamp outage. As part of this, systems must check the calibration of UV sensors and recalibrate

in accordance with a protocol approved by the State.

b. *How was this proposal developed?* UV disinfection is a physical process relying on the transference of electromagnetic energy from a source (lamp) to an organism's cellular material (USEPA 1986). In the Stage 2 M-DBP Agreement in Principle, the Advisory Committee recommended that EPA determine the UV doses needed to achieve up to 3 log inactivation of *Giardia lamblia* and *Cryptosporidium* and up to 4 log inactivation of viruses.

The Agreement further recommends that EPA develop standards to determine if UV systems are acceptable for compliance with drinking water disinfection requirements, including (1) a validation protocol for drinking water applications of UV technology and (2) on-site monitoring requirements to ensure ongoing compliance with UV dose tables. EPA also agreed to develop a UV guidance manual to facilitate design and operation of UV installations. Today's proposal and