



Infection Control



Table 1. Methods of sterilization and disinfection

DISINFECTION AND STERILIZATION GUIDELINE

PAGE 33 of 45 | [ALL PAGES](#) ↓

Guideline for Disinfection and Sterilization in Healthcare Facilities (2008)

AT A GLANCE

Table 1 from the Guideline for Disinfection and Sterilization in Healthcare Facilities (2008).

ON THIS PAGE

Methods of sterilization and disinfection

[Table 1A. Smooth, Hard Surface^{1,4}](#)
[Table 1B. Rubber Tubing and Catheters^{3,4}](#)
[Table 1C. Polyethylene Tubing and Catheters^{3,4,7}](#)
[Table 1D. Lensed Instruments⁴](#)
[Table 1E. Thermometers \(Oral and Rectal\)⁸](#)
[Table 1F. Hinged Instruments⁴](#)

Methods of sterilization and disinfection

Sterilization

- Critical items (will enter tissue or vascular system or blood will flow through them)

Disinfection

- High-level (semicritical items; [except dental] will come in contact with mucous membrane or nonintact skin)
- Intermediate-level (some semicritical items¹ and noncritical items)
- Low-level (noncritical items; will come in contact with intact skin)

Format Change [February 2017]

The format of this section was changed to improve readability and accessibility. The content is unchanged.



Table 1A. Smooth, Hard Surface^{1,4}

Sterilization Procedure	Sterilization Exposure Time	High-level Disinfection(exposure time 12-30 m at $\geq 20^{\circ}\text{C}$) ^{2,3}	Intermediate Disinfection(exposure time ≥ 1 m) ⁹	Low-level Disinfection(exposure time ≥ 1 m) ⁹
Heat sterilization, including steam or hot air (see manufacturer's	Manufacturer's recommendations	Glutaraldehyde-based formulations ($>2\%$ glutaraldehyde, caution should be exercised with	Ethyl or isopropyl alcohol (70-90%)	Ethyl or isopropyl alcohol (70-90%)

Sterilization Procedure	Sterilization Exposure Time	High-level Disinfection(exposure time 12-30 m at $\geq 20^{\circ}\text{C}$)^{2,3}	Intermediate Disinfection(exposure time ≥ 1 m)⁹	Low-level Disinfection(exposure time ≥ 1 m)⁹
recommendations, steam sterilization processing time from 3-30 minutes)		all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (1.12%) and 1.93% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minutes at 35°C.		
Ethylene oxide gas (see manufacturer's recommendations, generally 1-6 hours processing time plus aeration time of 8-12 hours at 50-60°C)	Manufacturer's recommendations	Ortho-phthalaldehyde (OPA) 0.55%	Sodium hypochlorite (5.25-6.15% household bleach diluted 1:500 provides >100 ppm available chlorine) ⁵	Sodium hypochlorite (5.25-6.15% household bleach diluted 1:500 provides >100 ppm available chlorine)
Hydrogen peroxide gas plasma (see manufacturer's recommendations for internal diameter and length restrictions, processing time between 45-72 minutes).	Manufacturer's recommendations	Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)	Phenolic germicidal detergent solution (follow product label for use-dilution)	Phenolic germicidal detergent solution (follow product label for use-dilution)
Glutaraldehyde-based formulations (>2% glutaraldehyde, caution should be exercised with all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (1.12%) and 1.93% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minutes at 35°C.	10 h at 20–25°C	Hydrogen peroxide (7.35%) and 0.23% peracetic acid; hydrogen peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)	Iodophor germicidal detergent solution (follow product label for use-dilution)	Iodophor germicidal detergent solution (follow product label for use-dilution)
Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)	6 h	Wet pasteurization at 70°C for 30 minutes with detergent cleaning ⁶		Quaternary ammonium germicidal detergent solution (follow product label for use-dilution)
Peracetic acid, concentration variable but 0.2% or greater is sporicidal. Peracetic acid immersion system operates at 50-56°C	12 m at 50–56°C	Hypochlorite Hypochlorite, single use chlorine generated on-site by electrolyzing saline containing >650-675 active free chlorine; (will corrode metal instruments)		
Hydrogen peroxide (7.35%) and 0.23% peracetic acid; hydrogen peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)	3–8 h			

Sterilization procedures and times for smooth surfaces.

Table 1B. Rubber Tubing and Catheters^{3,4}

Sterilization Procedure	Sterilization Exposure Time	High-level Disinfection(exposure time 12-30 m at $\geq 20^{\circ}\text{C}$) ^{2,3}	Intermediate Disinfection(exposure time ≥ 1 m) ⁹	Low-level Disinfection(exposure time ≥ 1 m) ⁹
Heat sterilization, including steam or hot air (see manufacturer's recommendations, steam sterilization processing time from 3-30 minutes)	Manufacturer's recommendations	Glutaraldehyde-based formulations (>2% glutaraldehyde, caution should be exercised with all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (1.12%) and 1.93% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minutes at 35°C.		
Ethylene oxide gas (see manufacturer's recommendations, generally 1-6 hours processing time plus aeration time of 8-12 hours at 50-60°C)	Manufacturer's recommendations	Ortho-phthalaldehyde (OPA) 0.55%		
Hydrogen peroxide gas plasma (see manufacturer's recommendations for internal diameter and length restrictions, processing time between 45-72 minutes).	Manufacturer's recommendations	Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)		
Glutaraldehyde-based formulations (>2% glutaraldehyde, caution should be exercised with all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (1.12%) and 1.93% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minutes at 35°C.	10 h at 20-25°C	Hydrogen peroxide (7.35%) and 0.23% peracetic acid; hydrogen peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)		
Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)	6 h	Wet pasteurization at 70°C for 30 minutes with detergent cleaning ⁶		
Peracetic acid, concentration variable but 0.2% or greater is sporicidal. Peracetic acid immersion system operates at 50-56°C	12 m at 50-56°C	Hypochlorite Hypochlorite, single use chlorine generated on-site by electrolyzing saline containing >650-675 active free chlorine; (will corrode metal instruments)		
Hydrogen peroxide (7.35%) and 0.23% peracetic acid; hydrogen peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)	3-8 h			

Disinfection procedures for rubber tubing and catheters.

Table 1C. Polyethylene Tubing and Catheters^{3,4,7}

Sterilization Procedure	Sterilization Exposure Time	High-level Disinfection(exposure time 12-30 m at ≥20°C) ^{2,3}	Intermediate Disinfection(exposure time ≥1 m) ⁹	Low-level Disinfection(exposure time ≥1 m) ⁹
Heat sterilization, including steam or hot air (see manufacturer's recommendations, steam sterilization processing time from 3-30 minutes)	Manufacturer's recommendations	Glutaraldehyde-based formulations (>2% glutaraldehyde, caution should be exercised with all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (1.12%) and 1.93% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minutes at 35°C.		
Ethylene oxide gas (see manufacturer's recommendations, generally 1-6 hours processing time plus aeration time of 8-12 hours at 50-60°C)	Manufacturer's recommendations	Ortho-phthalaldehyde (OPA) 0.55%		
Hydrogen peroxide gas plasma (see manufacturer's recommendations for internal diameter and length restrictions, processing time between 45-72 minutes).	Manufacturer's recommendations	Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)		
Glutaraldehyde-based formulations (>2% glutaraldehyde, caution should be exercised with all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (1.12%) and 1.93% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minutes at 35°C.	10 h at 20-25°C	Hydrogen peroxide (7.35%) and 0.23% peracetic acid; hydrogen peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)		
Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)	6 h	Wet pasteurization at 70°C for 30 minutes with detergent cleaning ⁶		
Peracetic acid, concentration variable but 0.2% or greater is sporicidal. Peracetic acid immersion system operates at 50-56°C	12 m at 50-56°C	Hypochlorite Hypochlorite, single use chlorine generated on-site by electrolyzing saline containing >650-675 active free chlorine; (will corrode metal instruments)		
Hydrogen peroxide (7.35%) and 0.23% peracetic acid; hydrogen peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)	3-8 h			

Sterilization procedures for polyethylene tubing and catheters listing time, high-level, intermediate, and low-level disinfection procedures.

Table 1D. Lensed Instruments⁴

Sterilization Procedure	Sterilization Exposure Time	High-level Disinfection(exposure time 12-30 m at ≥20°C) ^{2,3}	Intermediate Disinfection(exposure time ≥1 m) ⁹	Low-level Disinfection(exposure time ≥1 m) ⁹
Heat sterilization, including steam or hot air (see manufacturer's recommendations, steam sterilization processing time from 3-30 minutes)	Manufacturer's recommendations	Glutaraldehyde-based formulations (>2% glutaraldehyde, caution should be exercised with all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (1.12%) and 1.93% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minutes at 35°C.		
Ethylene oxide gas (see manufacturer's recommendations, generally 1-6 hours processing time plus aeration time of 8-12 hours at 50-60°C)	Manufacturer's recommendations	Ortho-phthalaldehyde (OPA) 0.55%		
Hydrogen peroxide gas plasma (see manufacturer's recommendations for internal diameter and length restrictions, processing time between 45-72 minutes).	Manufacturer's recommendations	Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)		
Glutaraldehyde-based formulations (>2% glutaraldehyde, caution should be exercised with all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (1.12%) and 1.93% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minutes at 35°C.	10 h at 20-25°C	Hydrogen peroxide (7.35%) and 0.23% peracetic acid; hydrogen peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)		
Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)	6 h	Hypochlorite Hypochlorite, single use chlorine generated on-site by electrolyzing saline containing >650-675 active free chlorine; (will corrode metal instruments)		
Peracetic acid, concentration variable but 0.2% or greater is sporicidal. Peracetic acid immersion system operates at 50-56°C	12 m at 50-56°C			

Sterilization Procedure	Sterilization Exposure Time	High-level Disinfection(exposure time 12-30 m at $\geq 20^{\circ}\text{C}$)^{2,3}	Intermediate Disinfection(exposure time ≥ 1 m)⁹	Low-level Disinfection(exposure time ≥ 1 m)⁹
Hydrogen peroxide (7.35%) and 0.23% peracetic acid; hydrogen peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)	3-8 h			

Sterilization procedures for lensed instruments listing time, high-level, intermediate, and low-level disinfection procedures.

Table 1E. Thermometers (Oral and Rectal)⁸

Sterilization Procedure	Sterilization Exposure Time	High-level Disinfection(exposure time 12-30 m at $\geq 20^{\circ}\text{C}$)^{2,3}	Intermediate Disinfection(exposure time ≥ 1 m)⁹	Low-level Disinfection(exposure time ≥ 1 m)⁹
				Ethyl or isopropyl alcohol (70-90%) ⁸

Sterilization procedures for thermometers (oral and rectal) listing time, high-level, intermediate, and low-level disinfection procedures.

Table 1F. Hinged Instruments⁴

Sterilization Procedure	Sterilization Exposure Time	High-level Disinfection(exposure time 12-30 m at $\geq 20^{\circ}\text{C}$)^{2,3}	Intermediate Disinfection(exposure time ≥ 1 m)⁹	Low-level Disinfection(exposure time ≥ 1 m)⁹
Heat sterilization, including steam or hot air (see manufacturer's recommendations, steam sterilization processing time from 3-30 minutes)	Manufacturer's recommendations	Glutaraldehyde-based formulations (>2% glutaraldehyde, caution should be exercised with all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (1.12%) and 1.93% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minutes at 35°C.		
Ethylene oxide gas Ethylene oxide gas (see manufacturer's recommendations, generally 1-6 hours processing time plus aeration time of 8-12 hours at 50-60°C)	Manufacturer's recommendations	Ortho-phthalaldehyde (OPA) 0.55%		
Hydrogen peroxide gas plasma (see manufacturer's recommendations for internal diameter and length restrictions, processing time between 45-72 minutes).	Manufacturer's recommendations	Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)		
Glutaraldehyde-based formulations (>2%)	10 h at 20-25°C	Hydrogen peroxide (7.35%) and 0.23% peracetic acid; hydrogen		

Sterilization Procedure	Sterilization Exposure Time	High-level Disinfection(exposure time 12-30 m at ≥20°C) ^{2,3}	Intermediate Disinfection(exposure time ≥1 m) ⁹	Low-level Disinfection(exposure time ≥1 m) ⁹
glutaraldehyde, caution should be exercised with all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (1.12%) and 1.93% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minutes at 35°C.		peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)		
Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)	6 h	Wet pasteurization at 70°C for 30 minutes with detergent cleaning ⁶		
Peracetic acidacid, concentration variable but 0.2% or greater is sporicidal. Peracetic acid immersion system operates at 50-56°C	12 m at 50-56°C	Hypochlorite Hypochlorite, single use chlorine generated on-site by electrolyzing saline containing >650-675 active free chlorine; (will corrode metal instruments)		
Hydrogen peroxide (7.35%) and 0.23% peracetic acidacid; hydrogen peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)	3-8 h			

Sterilization procedures for hinged instruments listing time, high-level, intermediate, and low-level disinfection procedures.

Modified from Rutala and Simmons.^{15, 17, 18, 421} The selection and use of disinfectants in the healthcare field is dynamic, and products may become available that are not in existence when this guideline was written. As newer disinfectants become available, persons or committees responsible for selecting disinfectants and sterilization processes should be guided by products cleared by the FDA and the EPA as well as information in the scientific literature.

[READ NEXT](#)

[Table 2: Properties of an ideal disinfectant](#)



TABLE OF CONTENTS
DISINFECTION AND STERILIZATION GUIDELINE

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- 1. See text for discussion of hydrotherapy.
- 2. The longer the exposure to a disinfectant, the more likely it is that all microorganisms will be eliminated. Follow the FDA-cleared high-level disinfection claim. Ten-minute exposure is not adequate to disinfect many objects, especially those that are difficult to clean because they have narrow channels or other areas that can harbor organic material and bacteria. Twenty-minute exposure at 20°C is the minimum time needed to reliably kill *M. tuberculosis* and nontuberculous mycobacteria with a 2% glutaraldehyde. Some high-level disinfectants have a reduced exposure time (e.g., ortho-phthalaldehyde at 12 minutes at 20°C) because of their rapid activity against mycobacteria or reduced exposure time due to increased mycobactericidal activity at elevated temperature (e.g., 2.5% glutaraldehyde at 5 minutes at 35°C, 0.55% OPA at 5 min at 25°C in automated endoscope reprocessor).
- 3. Tubing must be completely filled for high-level disinfection and liquid chemical sterilization; care must be taken to avoid entrapment of air bubbles during immersion.
- 4. Material compatibility should be investigated when appropriate.
- 5. A concentration of 1000 ppm available chlorine should be considered where cultures or concentrated preparations of microorganisms have spilled (5.25% to 6.15% household bleach diluted 1:50 provides > 1,000 ppm available chlorine). This solution may corrode some surfaces.
- 6. Pasteurization (washer-disinfector) of respiratory therapy or anesthesia equipment is a recognized alternative to high-level disinfection. Some data challenge the efficacy of some pasteurization units.
- 7. Thermostability should be investigated when appropriate.
- 8. Do not mix rectal and oral thermometers at any stage of handling or processing.
- 9. By law, all applicable label instructions on EPA-registered products must be followed. If the user selects exposure conditions that differ from those on the EPA-registered products label, the user assumes liability from any injuries resulting from off-label use and is potentially subject to enforcement action under FIFRA.

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