Briefing

800 Hazardous Drugs—Handling in Healthcare Settings. Because there is no existing USP chapter for this topic, the Compounding Expert Committee and the Compounding with Hazardous Drugs Expert Panel propose this new general chapter to guide the handling of hazardous drugs in healthcare settings. This new general chapter has been created to identify the requirements for receipt, storage, mixing, preparing, compounding, dispensing, and administration of hazardous drugs to protect the patient, healthcare personnel, and environment. Facility requirements that differ from general chapter 797 Pharmaceutical Compounding—Sterile Preparations and this chapter will be harmonized. These differences include the following:

1. Elimination of the current allowance in 797 for facilities that prepare a low volume of hazardous drugs that permits placement of a BSC or CACI in a non-negative pressure room. All hazardous drug compounding shall be done in a separate area designated for hazardous drug compounding.
2. Allowance for a Containment Segregated Compounding Area (C-SCA), a separate, negative pressure room with at least 12 air changes per hour (ACPH) for use with compounding hazardous drugs. Low- and medium-risk hazardous drug CSP may be prepared in a BSC located in a C-SCA, provided the beyond-use date of the CSP does not exceed 12 hours. A CACI that meets the requirements in 797 may be used for hazardous drug compounding if it is placed in a C-SCA.

The proposed chapter is posted online at www.usp.org/usp-nf/notices/compounding-notice with line numbers. To ensure that your comments are received and addressed, please provide the line numbers corresponding to your comments when submitting comments to CompoundingSL@usp.org.

(CMP: J. Sun.) Correspondence Number—C139868

Add the following:

800 HAZARDOUS DRUGS—HANDLING IN HEALTHCARE SETTINGS

1. INTRODUCTION

1.1 Organization
The sections in this general chapter are organized to facilitate the practitioner’s understanding of the fundamental quality practices for preparing hazardous drugs (HDs). The chapter is divided into the following main sections:

1. **Introduction**
2. **List of HDs**
3. **Types of Exposure**
4. **Responsibilities of Personnel Handling HDs**
5. **Facility Design and Engineering Controls**
6. **Personal Protective Equipment**
7. **Hazard Communication Program**
8. **Training for Compounding Personnel**
9. **Receiving**
10. **Transporting**
11. **Dispensing HD Dosage Forms Not Requiring Alteration**
12. **Compounding HD Dosage Forms**
13. **Protection When Administering HDs**
14. **Cleaning: Deactivation, Decontamination, Cleaning, and Disinfection**
15. **Spill Control**
16. **Disposal**
17. **Environmental Quality and Control**
18. **Documentation**
19. **Medical Surveillance**

**Appendices**

a. **Acronyms and Definitions**
b. **Suggested Standard Operating Procedures**
c. **Types of Biological Safety Cabinets**
d. **Best Practices for Handling HDs**
e. **Examples for Design of Hazardous Drug Compounding Areas**
f. **Requirements for Personal Protective Equipment**
g. **Bibliography**

**1.2 Objective**

The objective of this chapter is to protect personnel and the environment when handling HDs. This includes but is not limited to receipt, storage, mixing, preparing, compounding, dispensing, administering, disposing, and otherwise altering, counting, crushing, or pouring HDs, and includes both sterile and nonsterile products and preparations. The standards in this chapter apply to all personnel who compound HDs preparations and all places where HDs are prepared (e.g., pharmacies, hospitals and other healthcare institutions, patient treatment clinics, physicians’ practice facilities, veterinarians’ offices) and other locations and facilities in which HDs are stored, transported, and administered. Persons who compound HDs include but are not limited
to pharmacists, nurses, pharmacy technicians, physicians, physician assistants, veterinarians, and veterinary technicians.

1.3 Overview

There is no acceptable level of personnel exposure to HDs. The processes listed in this chapter are intended to provide containment of HDs to as low a limit as reasonably achievable (ALARA). HDs shall be compounded in proper engineering controls, as defined in this chapter. Entities and personnel involved in compounding HDs shall be compliant with the appropriate USP General Notices and Requirements, general chapters, and monographs pertaining to compounding. These include but are not limited to {795} Pharmaceutical Compounding—Nonsterile Preparations, {797} Pharmaceutical Compounding—Sterile Preparations, and {1163} Quality Assurance in Pharmaceutical Compounding.

In addition to these USP general chapters, the following documents (or their successors) are best practice. Where conflicts exist, the most stringent requirements prevail.

- OSHA Hazard Communication: OSHA Standards  
  (http://www.osha.gov/dsg/hazcom/standards.html)
- OSHA Technical Manual (OTM). Section VI: Chapter 2: Controlling Occupational Exposure to Hazardous Drugs  
  (http://www.osha.gov/dts/osta/otm/otm_vi/otm_vi_2.html)
- NIOSH Alert: Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings (NIOSH Publication Number 2004-165)  
- NIOSH List of Antineoplastics and Other Hazardous Drugs in Healthcare Settings 2012 (NIOSH Publication Number 2012-150)  
  (http://www.cdc.gov/niosh/docs/2012-150/pdfs/2012-150.pdf)
- Workplace Solutions: Personal Protective Equipment for Health Care Workers Who Work With Hazardous Drugs (NIOSH Publication Number 2009-106)  
- Workplace Solutions: Safe Handling of Hazardous Drugs for Veterinary Healthcare Workers (NIOSH Publication Number 2010-150)  
- Workplace Solutions: Medical Surveillance for Healthcare Workers Exposed to Hazardous Drugs (NIOSH Publication Number 2013-103)  
- ASHP Guidelines on Compounding Sterile Preparations (2013)  
  (http://www.ashp.org/DocLibrary/BestPractices/PrepGdlCSP.aspx)
  (http://www.ashp.org/s_ashp/docs/files/BP07/Prep_Gdl_HazDrugs.pdf)
- Oncology Nursing Society: Safe Handling of Hazardous Drugs (Second Edition)  
An entity compounding HDs shall have a comprehensive approach to prevent worker and environmental exposure. The entity’s safety and health program shall include but is not limited to:

- Engineering controls (including primary, secondary, and supplemental)
- Competent personnel
- Robust work practices
- Availability of appropriate Personnel Protection Equipment (PPE), such as gloves tested to the American Society for Testing and Materials (ASTM) standard for HD permeability, gowns made of material tested for HD permeability or with evidence of reduced permeability, and eye and respiratory protection
- Policies for the use of PPE and employee compliance with PPE use and policies
- Medical surveillance program
- Policies for HD waste segregation and disposal

All personnel who handle HDs shall be responsible for understanding these fundamental practices and precautions and for continually evaluating these procedures and the quality of final HDs to prevent harm to patients or personnel and to prevent contamination of the environment. Compounding personnel shall be responsible for safely preparing and handling HDs. Table 1 describes the ISO classified air environment for handling HDs and Table 2 describes the types of devices for compounding HDs.

### Table 1. ISO Classification of Particulate Matter in Room Air

<table>
<thead>
<tr>
<th>Class Name</th>
<th>Particle Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO Class 5</td>
<td>U.S. FS 209E: 3,520 particles/m³ (ISO Class 5) is equivalent to 100 particles/ft³ (Class 100) (1 m³ = 35.2 ft³).</td>
</tr>
<tr>
<td>ISO Class 7</td>
<td>U.S. FS 209E: 352,000 particles/m³ (Class 100) (1 m³ = 35.2 ft³).</td>
</tr>
<tr>
<td>ISO Class 8</td>
<td>U.S. FS 209E: 3,520,000 particles/m³ (Class 100) (1 m³ = 35.2 ft³).</td>
</tr>
</tbody>
</table>

### Table 2. Types of Devices for Compounding with HD

<table>
<thead>
<tr>
<th>Type of Compounding</th>
<th>Type of Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonsterile</td>
<td>Containment Ventilated Enclosure (CVE) or Class I Biological Safety Cabinets (BSC)</td>
</tr>
<tr>
<td></td>
<td>[NOTE—Class II BSCs or Compounding Aseptic Containment Isolators (CACIs) may be used for nonsterile compounding if they are dedicated for nonsterile compounding; if they are used for occasional]</td>
</tr>
<tr>
<td>Type of Compounding</td>
<td>Type of Device</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>nonsterile compounding, Class II BSCs or CACIs must undergo thorough cleaning and disinfection before being used for sterile compounding.]</td>
<td></td>
</tr>
<tr>
<td>Sterile</td>
<td>Class II BSC or CACI</td>
</tr>
</tbody>
</table>

2. LIST OF HDS

The National Institute for Occupational Safety and Health (NIOSH) maintains a list of antineoplastic and other HDs used in healthcare. The entity shall include all items on the current NIOSH list and may add others not on the NIOSH list. The entity’s list shall be reviewed at least annually and whenever a new agent or dosage form is used. If the information provided is deemed insufficient to make an informed decision, the drug should be considered hazardous until more information is available.

Some dosage forms defined as hazardous may not pose a significant risk of direct occupational exposure because of their dosage formulation (e.g., coated tablets or capsules—solid, intact medications that are administered to patients without modifying the formulation). Uncoated tablets may present a risk of exposure from dust by skin contact and/or inhalation when the tablets are counted. Any solid dosage form may pose a risk if altered, such as by crushing tablets or making solutions. The entity’s standard operating procedure (SOP) (see Appendix B) shall identify the risk mitigation strategies for items on the entity’s list of HDs.

3. TYPES OF EXPOSURE

Routes of unintentional entry of HDs into the body include dermal and mucosal absorption, inhalation, injection, and ingestion either of contaminated foodstuffs or mouth contact with contaminated hands. Both clinical and nonclinical personnel may be exposed to HDs when they create or use aerosols, generate dust, clean up spills, or touch contaminated surfaces during the receipt, preparation, administration, cleaning, or disposal of HDs.

The following list of activities may result in exposures through skin contact, inhalation, ingestion, or injection:

- Receiving and unpacking HD orders
- Counting individual oral doses and tablets from bulk containers
- Crushing tablets or opening capsules to make oral liquid
- Pouring oral or topical liquids from one container to another
- Mixing topical dosage forms
- Weighing or mixing components
- Constituting or reconstituting powdered or lyophilized HDs
- Withdrawing or diluting injectable HDs from parenteral containers
- Expelling air from syringes filled with HDs
- Expelling HDs from a syringe
Contacting HD residues present on drug container exteriors, work surfaces, floors, and final drug preparations (e.g., bottles, bags, cassettes, and syringes)

Contacting or inhaling HD residue or aerosolization from another patient’s medications (such as a patient in an adjacent treatment area or exposure of visitors)

Administering HDs by various routes, including but not limited to intramuscular, subcutaneous, intravenous (IV), epidural, intrathecal, irrigation, oral, or topical routes

Performing certain specialized procedures (such as intraoperative intraperitoneal HD therapy or bladder instillation) in surgical and procedural areas

Generating aerosols during the administration of HDs, such as by direct IV push or by IV infusion

Priming the IV set with an HD-containing solution

Handling body fluids or body-fluid-contaminated clothing, dressings, linens, and other materials

Handling contaminated wastes generated at any step of the preparation, dispensing, or administration process

Deactivating, decontaminating, cleaning, and disinfecting areas contaminated or suspected of contamination with HDs

Maintenance activities for potentially contaminated equipment and devices

Spill generation, management, and subsequent disposal of spill clean-up materials

4. RESPONSIBILITIES OF PERSONNEL HANDLING HDS

Each entity shall have a compounding supervisor who is the designated individual responsible for developing and implementing appropriate procedures; overseeing facility compliance with this chapter and other applicable laws, regulations, and standards; ensuring competency of personnel; and assuring environmental control of the compounding areas. The compounding supervisor shall also be responsible for the continuous monitoring of the facility and compounded sterile preparations (CSPs), including reports of all testing from all contractors and laboratories on facilities, CSPs, and/or their components.

All personnel involved with mixing, compounding, and otherwise handling HDs shall be responsible for compounding HDs of acceptable strength, quality, and purity and in accordance with a prescription or medication order from a licensed prescriber. Compounding personnel shall be responsible for dispensing the finished preparation with appropriate packaging and labeling in compliance with the requirements and recommendations established by the applicable federal, state, and local agencies, including state boards of pharmacy, Occupational Safety and Health Administration (OSHA), NIOSH, Environmental Protection Agency (EPA), and other organizations (e.g., accrediting organizations, where appropriate). Individuals who are engaged in HD compounding shall be competent in HD compounding and should continually expand their compounding knowledge by participating in seminars, training programs, and/or studying appropriate literature. They shall be knowledgeable in the contents of chapters 795, 797, and 1163, other applicable USP chapters and General Notices and
Requirements, and applicable federal and state laws, regulations, and guidelines. Personnel who transport, compound, or administer HDs shall document training according to OSHA standards (see OSHA Standard 1910.120 Hazardous Waste Operations and Emergency Response) and other applicable laws and regulations.

5. FACILITY DESIGN AND ENGINEERING CONTROLS

5.1 General Guidance

Facilities as described in this chapter for both nonsterile and sterile HD compounding are in addition to the requirements to chapters 795 and 797. HDs shall be handled under conditions that promote patient safety, worker safety, environmental protection, and infection prevention. Manipulation of HDs requires appropriate administrative controls, PPE, engineering and environmental controls, and work practices.

Access to areas where HDs are stored and prepared shall be restricted to authorized staff to protect persons not involved in HD handling. The location of the HD compounding area shall be located away from break rooms and refreshment areas for staff, patients, or visitors to reduce risk of exposure. Signs designating the hazard shall be prominently displayed before entry into the HD area.

Separate designated areas shall be available for (see Appendix D):

- Unpacking HDs
- Nonsterile HD compounding (if performed by the entity)
- Sterile HD compounding (if performed by the entity)

Designated HD handling areas shall be segregated from non-HD areas. Unpacking HDs from external shipping containers shall not occur in an area used for sterile compounding.

Storage of antineoplastic HDs shall be separate from storage of non-HDs. Storage of non-antineoplastic HDs shall be separate from storage of non-HDs, unless only coated, final-manufactured dosage forms are clearly labeled as HDs and safety strategies are included in the entity’s SOPs (see Appendix B).

HDs shall not be stored, unpacked, compounded, or otherwise manipulated in an area that is positive pressure relative to the surrounding areas. A laminar air flow workbench (LAFW) or compounding aseptic isolator (CAI) shall not be used for the compounding of an HD.

A BSC or CACI used for the preparation of HDs shall not be used for the preparation of a non-HD unless the non-HD preparation is placed into a protective outer wrapper before removal from the Containment Primary Engineering Control (C-PEC) and is labeled to require PPE handling precautions. When asepsis is not required, a Class I BSC, CVE, or an isolator intended for containment applications may be sufficient. A Class II BSC may be used if it is dedicated for nonsterile preparations. For occasional nonsterile HD compounding, a C-PEC used for sterile compounding may be used but shall be thoroughly cleaned and disinfected before resuming sterile compounding in that
C-PEC. HDs intended to be sterile shall be prepared in a dedicated Class II BSC or CACI and shall follow aseptic practices specified in chapter 797.

5.2 Storage of HDs

All HD storage areas and containers, regardless of the formulation, shall be labeled as such to prevent improper handling.

Unless the HDs already exist in their final unit dose or unit-of-use packaging, HDs shall be stored separately from other inventory in a manner to prevent contamination and personnel exposure, which includes storage in a negative pressure room with at least 12 air changes per hour (ACPH). Depending upon pharmacy design, HD storage within the HD buffer area can fulfill this storage criterion.

Refrigerated HDs shall be stored in a dedicated refrigerator in the HD storage room, buffer room, or containment segregated compounding area (C-SCA). In a containment secondary engineering control (C-SEC) used for sterile preparations, an exhaust located adjacent to the refrigerator’s compressor and behind the refrigerator should be considered.

HDs shall be stored at or below eye level, in containers that minimize the risk of breakage and leakage, and shall not be stored on the floor. Areas prone to specific types of natural disasters (e.g., earthquakes) shall ensure that storage meets applicable safety precautions, such as secure shelves with raised front lips. Storage of sterile and nonsterile HDs may be intermingled. HD storage in a sterile compounding buffer area shall be limited to those used for sterile compounding (see chapter 797).

5.3 Engineering Controls

5.3.1 BACKGROUND

HDs shall be prepared only under conditions that protect the healthcare workers and other personnel in the preparation and storage areas. Within this chapter, engineering controls are divided into three categories representing primary, secondary, and supplementary levels of control (see Appendix A and Appendix C for more details). C-PECs provide the environment at the point of use and are integrated into the C-SEC (i.e., room). The C-SEC supports the C-PEC. Supplemental engineering controls are adjunct controls [e.g., closed-system drug-transfer device (CSTD)] used in conjunction with primary and secondary control strategies.

HDs that require alteration shall be manipulated (mixed, diluted, compounded, and others) in a C-PEC in an area that is physically separated from other preparation areas, that is under negative pressure, and has at least 12 ACPH. Additional criteria are listed below.

5.3.2 CONTAINMENT PRIMARY ENGINEERING CONTROLS

All C-PECs shall be externally vented and placed in a restricted access segregated room which has a minimum negative pressure of 0.01 inches of water column.

5.3.3 CONTAINMENT SECONDARY ENGINEERING CONTROLS

HD compounding activities must occur within a C-SEC where any C-PEC shall be vented to the outside air through high efficiency particle air (HEPA) filtration. For both sterile and nonsterile HD compounding, a sink shall be available for hand washing as well as emergency access to water for removal of hazardous substances from eyes and
skin; it shall not be within an ISO Class 7 buffer area. An eyewash station or other emergency or safety precautions that meet applicable laws and regulations shall be readily available; however, care must be taken to locate them in areas where their presence will not interfere with required ISO classifications.

5.4 Nonsterile HD Compounding

5.4.1 C-PEC FOR NONSTERILE HD COMPOUNDING

Nonsterile HD compounding shall be performed in a C-PEC that provides personnel and environmental protection, such as a Class I BSC or CVE. Unidirectional airflow within the C-PEC is not required, because the critical environment for nonsterile compounding does not require an ISO-classified environment. The C-PEC used for nonsterile compounding shall be externally vented. A C-PEC is not required if manipulations are limited to handling of intact final manufactured products (e.g., coated tablets or capsules) that do not produce aerosols or gasses or involve manipulation of powders. A Class II BSC or a CACI may be used if it is dedicated for use with nonsterile compounding or if it undergoes thorough cleaning and disinfection procedures after nonsterile compounding and before re-use for sterile compounding.

5.4.2 C-SEC FOR NONSTERILE HD COMPOUNDING

Nonsterile compounding shall be performed in an area that meets the requirements of chapter 795 and the requirements of this chapter. The C-PEC shall be placed in a room that is physically separated (i.e., a different room from other preparation areas) but does not need to be ISO 7 nor have HEPA-filtered air. The C-SEC shall meet the following requirements:

- Minimum of 12 ACPH
- Maintained at a negative pressure of at least 0.01 inches of water column relative to all adjacent spaces (rooms, above ceiling, and corridors). [NOTE—Although negative pressure within the HD buffer area is important, the negative pressure should not be so strong that it induces environmental contamination migration into the buffer area from unclassified adjacent spaces.]
- Due to the difficulty of cleaning HD contamination from surfaces, the architectural finish requirements (e.g., smooth, seamless, impervious surfaces) prescribed in chapter 797 also apply to nonsterile compounding areas (see Table 3).

Table 3. Acceptable Configuration for Nonsterile HD Compounding

<table>
<thead>
<tr>
<th>Function</th>
<th>C-PEC</th>
<th>C-SEC</th>
<th>Airflow</th>
<th>Maximum BUD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonsterile compounding</td>
<td>Any C-PEC</td>
<td>C-SEC 12 ACPH (exhaust)</td>
<td>As listed in 795</td>
<td></td>
</tr>
</tbody>
</table>

See Appendix D for best practices for compounding nonsterile HDs.

5.5 Sterile HD Compounding

5.5.1 C-PEC FOR STERILE HD COMPOUNDING
Sterile HD compounding shall be performed in a C-PEC that provides an ISO Class 5 critical area and shall be used in conjunction with aseptic practices specified for the appropriate risk levels defined in chapter 797.

The airflow in the C-PEC shall be unidirectional (laminar flow), and because of the particle collection of the filter, the “first air” at the face of the filter is, for the purposes of aseptic compounding, free from airborne particulate contamination. HEPA-filtered air shall be supplied in critical areas (ISO Class 5) at a velocity sufficient to sweep particles away from the compounding area and to maintain unidirectional airflow during operations. Proper design and control prevents turbulence and stagnant air in the critical area. In situ air pattern analysis via smoke studies shall be conducted at least every 6 months at the critical area to demonstrate unidirectional airflow and to demonstrate the sweeping action over and away from the product under dynamic conditions. C-PECs include Class II and III BSCs, CACIs, or any other device intended to create an aseptic work environment or containment (e.g., a robot system enclosure).

Class II BSC types A2, B1, or B2 are all acceptable; however, for most known HDs, type A2 cabinets offer a simple and reliable integration with the ventilation and pressurization requirements of the secondary engineering control. Class II type B2 BSCs are typically reserved for use with highly volatile components.

Sterile compounding shall be performed in an area that meets the requirements of 797 and the requirements of this chapter. Three C-PEC/C-SEC configurations are acceptable for sterile-to-sterile compounding (e.g., low-risk level, and medium-risk level CSPs). Two C-PEC/C-SEC configurations are acceptable for nonsterile-to-sterile compounding (e.g., high-risk level CSPs). C-PEC placement in a C-SEC that meets ISO Class 7 is preferred. If a C-PEC is placed in a room with air quality worse than ISO class 7, the BUD of all CSPs prepared in that area may need to be limited to 12 h, depending on the type of C-PEC used (see Table 4).

Table 4. Acceptable Configurations for Sterile-to-Sterile HD Compounding

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Function</th>
<th>C-PEC</th>
<th>C-SEC</th>
<th>Airflow</th>
<th>Maximum BUD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Compounding sterile HD in a cleanroom</td>
<td>BSC or CACI</td>
<td>ISO 7 Cleanroom</td>
<td>30 ACPH (HEPA supply)</td>
<td>As listed in 797</td>
</tr>
<tr>
<td>2</td>
<td>Compounding sterile HD in a CACI that meets the requirements listed in 797</td>
<td>CACI</td>
<td>C-SCA</td>
<td>12 ACPH (exhaust)</td>
<td>As listed in 797</td>
</tr>
<tr>
<td>3</td>
<td>Compounding low- or medium-risk sterile HDs in a BSC. [NOTE—This configuration is not acceptable for high-risk sterile HD compounding.]</td>
<td>BSC</td>
<td>C-SCA</td>
<td>12 ACPH (exhaust)</td>
<td>12 hours</td>
</tr>
</tbody>
</table>

See Appendix D for best practices for compounding sterile HDs.
5.5.2 CONFIGURATION 1 FOR STERILE COMPOUNDING

The C-PEC shall be placed in an ISO Class 7 buffer area that is physically separated (i.e., a different room from other preparation areas) and meets the following requirements:

- Minimum of 30 ACPH of HEPA-filtered supply air
- Buffer area shall be maintained at a negative pressure of at least 0.01 inches of water column relative to all adjacent spaces (rooms, above ceiling, and corridors).
- NOTE—Although negative pressure within the HD buffer area is important, the negative pressure should not be so strong that it induces environmental contamination migration into the buffer area from unclassified adjacent spaces.
- Incorporate the remaining relevant design criteria specified in chapter 797.

Rooms through which entry into the negative-pressure buffer room occurs (anteroom or non-HD buffer room) shall be positive-pressure ISO Class 7 or better so that inward air migration is of equal cleanliness classification to that in the negative-pressure buffer area. A pressure indicator shall be installed that can be readily monitored for correct room pressurization.

Because the anteroom leading into the HD buffer room plays an important function in terms of total contamination control within the buffer room, the anteroom must be constructed using principles similar to those used in non-HD sterile compounding. These include:

- Minimum of 30 ACPH of HEPA-filtered supply air
- Anteroom shall be maintained at a minimum positive pressure of 0.02 inches of water column relative to all adjacent unclassified spaces
- The anteroom shall be maintained at a minimum positive pressure of at least 0.01 inches of water column relative to the HD buffer room
- The anteroom should incorporate a visual line of demarcation to differentiate the "clean" side from the "dirty" side of the anteroom to support the gowning requirements prescribed in 797
- A hand-washing sink shall be placed within the anteroom on the "clean" side of the line of demarcation

Although not a recommended facility design, if the negative pressure HD buffer room is entered though the positive-pressure, non-HD buffer room, additional facility criteria are required:

- An area used for garbing/degarbing shall be defined by a line of demarcation within the negative-pressure buffer room
- A method to transport HDs into the negative-pressure buffer room and to remove CSPs and waste from the negative-pressure buffer room shall be used to minimize the spread of HD contamination. This may be accomplished by use of a pass-through between the negative-pressure buffer room and adjacent space. The pass-through shall be included in the required semi-annual facility
certification to ensure that particles are not compromising the air quality of the
negative-pressure buffer room. Other methods of containment (such as sealed
containers) may be used if the entity can demonstrate HD containment and
appropriate environmental control.

HD CSPs prepared in this cleanroom configuration may use the BUDs listed in chapter
797, based on risk levels and storage temperature.

5.5.3 CONFIGURATION 2 FOR STERILE COMPOUNDING

A CACI that meets the requirements listed in chapter 797 may be placed in a C-
SCA that is physically separated (i.e., a different room from other preparation areas) but
does not need to be ISO 7 nor have HEPA-filtered air. The C-SCA shall meet the
following requirements:

- Minimum of 12 ACPH
- Maintained at a negative pressure of at least 0.01 inches of water column relative
to all adjacent spaces (rooms, above ceiling, and corridors). Note—Although negative pressure within the HD buffer area is important, the
negative pressure should not be so strong that it induces environmental
contamination migration into the buffer area from unclassified adjacent spaces.
- Incorporate the remaining relevant design criteria specified in chapter 797

HD CSPs compounded in this CACI/C-SCA configuration may use the BUDs listed in
chapter 797 based on risk levels and storage temperature.

5.5.4 CONFIGURATION 3 FOR STERILE COMPOUNDING

This configuration shall not be used for high-risk, sterile HD compounding. A BSC or
CACI that does not meet the requirements in 797 may be placed in a C-SCA that is
physically separated (i.e., a different room from other preparation areas) but does not
need to be ISO Class 7 nor have HEPA-filtered air. The C-SCA shall meet the following
requirements:

- Minimum of 12 ACPH
- Maintained at a negative pressure of at least 0.01 inches of water column relative
to all adjacent spaces (rooms, above ceiling, and corridors). Note—Although negative pressure within the HD buffer area is important, the
negative pressure should not be so strong that it induces environmental
contamination migration into the buffer area from unclassified adjacent spaces.
- Incorporate the remaining relevant design criteria specified in chapter 797

HD CSPs compounded in this configuration shall not exceed a BUD of 12 hours.

5.6 Nonsterile and Sterile Compounding

For entities that compound both nonsterile and sterile HDs, the respective C-PECs
shall be placed in segregated rooms separate from each other, unless those C-PECs
used for nonsterile compounding are sufficiently effective that the room can
continuously maintain ISO 7 classification throughout the nonsterile compounding activity.

5.6.1 FACULTY DESIGN
See Appendix E for example designs of HD compounding areas.

5.6.2 ENGINEERING CONTROL OPERATION
The C-PEC shall operate continuously. If it is necessary to power off the unit for repair or moving, clean the C-PEC (see 14. Cleaning section) and protect the unit by appropriately covering it per the manufacturer’s recommendations. Once the C-PEC can be powered on, disinfect all interior surfaces before resuming compounding, and wait the time required for the system to purge as listed in the manufacturer’s instructions. Activities of handling HDs shall be immediately suspended if there is an interruption of operation to the C-PEC or the C-SEC, such as loss of room pressurization due to loss of power.

5.7 Containment Supplemental Engineering Controls
Some CSTDs have been shown to limit the potential for generating aerosols during compounding; however, there is no certainty that all CSTDs will perform adequately. There does not yet exist a universal performance protocol by which all CSTDs are evaluated for containment. Until such a protocol is developed and adopted, users should carefully evaluate the performance claims associated with available CSTDs. When a widely-accepted protocol for CSTD performance evaluation is developed, users are encouraged to focus upon CSTD manufacturers that subject their CSTD devices to independent evaluation under this protocol. CSTDs used as a supplemental control for compounding shall be used inside a C-PEC. CSTDs should be used when compounding HDs when the dosage form allows. CSTDs shall be used when administering HDs when the dosage form allows.

6. PERSONAL PROTECTIVE EQUIPMENT
PPE provides worker protection by supplementing engineering controls to reduce exposure to HD aerosols and drug residue. When performing a task when engineering controls are not generally available, such as cleaning a spill, additional PPE may be required. Appropriate PPE shall be worn when handling HDs. See Appendix F for requirements for PPEs based on function:

- Receiving intact supplies (remote from the compounding area)
- Receiving suspected/broken supplies
- Transporting intact supplies or compounded HDs
- Receiving intact supplies in the compounding area
- Stocking and inventory control of the compounding area
- Nonsterile compounding
- Sterile compounding
- Collecting and disposing compounding waste
- Administering
- Routine cleaning
The garbing and gloving requirements listed here shall be used for compounding any HD (nonsterile and sterile) in any setting and when using any and all C-PECs. The SOP manual (see Appendix B) of the compounding facility shall specifically describe the appropriate PPE to be worn based on a written safety and health program. PPE, in addition to those listed below, may be used to reduce exposure or to protect workers from contamination.

6.1 Gloves

Gloves used shall be labeled as ASTM-tested chemotherapy gloves; this information is available on the box or from the manufacturer.

- Use powder-free gloves, because the powder can contaminate the work area and can adsorb and retain HDs.
- Inspect gloves for physical defects before use. Do not use gloves with pin-holes or weak spots.
- Wear two pairs of ASTM-tested chemotherapy gloves when compounding, administering, managing a spill, and disposing of HDs. For sterile preparations, the outer glove shall be sterile. Wear the inner glove under the gown cuff and the outer glove over the cuff. Place gloves with long cuffs over the cuff of the gown to protect the wrist and forearm.

The following work practices shall be followed:

- Hand hygiene shall be performed in accordance with the CDC Guidelines for Hand Hygiene in Healthcare Settings or WHO Guidelines on Hand Hygiene in Health Care before donning gloves and immediately after removal of the gloves.
- When working within a CACI, the outer glove (over the isolator glove) shall be a sterile, powder-free, ASTM-tested chemotherapy glove. Maintain an additional supply of gloves near the CACI to don when needed during transfer of materials in or out of the CACI antechamber.
- Change gloves every 30 min or when torn, punctured, or contaminated. Carefully remove and discard them immediately in an approved HD waste container inside the C-PEC or contain them in a sealable bag for discarding outside the C-PEC.

6.2 Gowns

Disposable gowns that protect the worker from spills and splashes of HDs and waste materials and that have been tested to resist permeability by HDs shall be worn when handling HDs. Selection of gowns shall be based on the HDs used.

Disposable gowns made of polyethylene-coated polypropylene or other laminate materials offer better protection than those of noncoated materials. Gowns shall close in the back (no open front), have long sleeves, and have closed cuffs that are elastic or knit. Gowns shall not have seams or closures that could allow drugs to pass through.
Cloth laboratory coats, surgical scrubs, isolation gowns, or other absorbent materials are not appropriate outer wear when handling HDs, because they permit the permeation of HDs and can hold spilled drugs against the skin and increase exposure.

The following work practices shall be followed:

- Wear gowns whenever there is a possibility of HD contact with skin or clothing during compounding or administration of HDs. Clothing may retain HD residue from contact, and personnel may transfer this residue to patients, family members, staff, or other surfaces. Washing of non-disposable clothing contaminated with HD residue may transfer drug residue to other clothing.
- Do not wear gowns outside the compounding or administration area if they have been worn in the HD compounding area to avoid spreading drug contamination to other areas and exposing unprotected workers.
- Adhere to the time limit that the manufacturer lists for permeation of the gown. If no permeation information is available for the gowns used, change them every 2–3 hours or immediately after a spill or splash.

6.3 Head, Hair, Shoe, and Sleeve Covers

Head and hair (including beard and moustache, if applicable) and shoe covers shall be worn to reduce the possibility of particulate or microbial contamination in HD compounding areas. Hair, head, and shoe covers provide additional protection from contact with HD residue on surfaces and floors.

The following work practices shall be followed:

- Do not wear shoe covers outside the HD compounding areas to avoid spreading drug contamination to other areas and possibly exposing unprotected workers.
- If sleeve covers are used, they shall be constructed of coated materials to provide additional protection for the areas of the arms that may come in contact with HDs within BSCs. Use disposable sleeve covers to protect the wrist area, and remove the covers carefully after the task is complete. Discard sleeve covers after one use, and contain and dispose of them as trace contaminated or trace chemotherapy waste.

6.4 Eye and Face Protection

Appropriate eye and face protection shall be worn when handling HDs outside an engineering control. A full-facepiece respirator also provides eye and face protection. Goggles shall be used when eye protection is needed; eye glasses alone or safety glasses with side shields do not provide adequate protection to the eyes from splashes. Many HDs are irritating to eyes and mucous membranes. Follow these work practices when using eye and face protection:

- Use eye and face protection when manipulating an HD outside of a C-PEC (e.g., in the surgical suite), working at or above eye level, cleaning a C-PEC, or cleaning a spill.
6.5 Respiratory Protection

For most activities requiring respiratory protection, an NIOSH-certified N95 or more protective respirator is sufficient to protect against airborne particles; however, these respirators offer no protection against gases and vapors and little protection against direct liquid splashes (see CDC’s Respirator Trusted-Source Information at http://www.cdc.gov/niosh/nptl/topics/respirators/disp_part/RespSource3healthcare.html #e). Surgical masks do not provide respiratory protection from drug exposure and should not be used to compound or administer drugs. A surgical N95 respirator provides the respiratory protection of an N95 respirator and the splash protection provided by a surgical mask.

Personnel unpacking HDs that are not contained in plastic should wear an elastomeric half-mask with a multi-gas cartridge and P100-filter. If the type of drug can be better defined, then a more targeted cartridge could be used.

Fit test the respirator and train workers to use respiratory protection. Follow all requirements in the OSHA respiratory protection standard (29 CFR 1910.134) (http://www.osha.gov/SLTC/etools/respiratory/index.html). An appropriate full-facepiece, chemical cartridge-type respirator shall be worn when attending to HD spills larger than what can be contained with a spill kit, or when there is known or suspected airborne exposure to powders or vapors.

6.6 Disposal of Used PPE

Consider all PPE worn when handling HDs as being contaminated with, at a minimum, trace quantity of HDs. Unless local regulations prohibit, these items shall be incinerated at a regulated medical waste incinerator. They should not be placed into red bag or red sharps containers.

7. HAZARD COMMUNICATION PROGRAM

OSHA requires each workplace to have a written Hazard Communication Program. The Hazardous Communication Standard (HCS) (see https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099) applies to all workers. Employers are required to establish policies and procedures to ensure worker safety in all aspects of the distribution of these drugs and chemicals.

The HCS requires each employer to provide training, proper labeling, and Safety Data Sheets (SDS), based on the Globally Harmonized System of Classification of Labeling of Chemicals (GHS).

Elements of the plan shall include:

- A written plan that describes how the standard will be implemented.
- All containers of hazardous chemicals shall be labeled, tagged, or marked with the identity of the material and appropriate hazard warnings.
Chemical manufacturers and importers are required to obtain or develop an SDS for each hazardous chemical they produce or import. Distributors are responsible for ensuring that their customers are provided a copy of these SDSs. Employers shall have an SDS for each hazardous chemical they use. Each employee who may be exposed to hazardous chemicals when working shall be provided information and training before initial assignment to work with a hazardous chemical, and whenever the hazard changes.

Employers shall maintain in the workplace copies of the required SDSs for each hazardous chemical and shall ensure that the SDSs are readily accessible to employees during each work shift and when they are in their work areas.

8. TRAINING FOR COMPOUNDING PERSONNEL

Administrative controls include establishment of policies and procedures, a robust training program, and implementation of appropriate work practices. All personnel who compound HDs shall be fully trained in the storage, handling, and disposal of these materials. This training shall occur before preparing or handling hazardous preparations, and the effectiveness of the training shall be verified by testing specific HD preparation techniques. All training shall be documented, and personnel competency shall be reassessed and documented at least every 12 months, or whenever a new HD is used or a new or significant change in process or SOP occurs. Personnel who compound sterile hazardous preparations shall be trained in aseptic and negative-pressure techniques. Steps in the training procedure (for both nonsterile and sterile compounding) include the following:

- All compounders involved in hazardous compounding shall read and become familiar with this chapter. They shall be knowledgeable with the contents of chapters \(795\), \(797\), and \(1163\); specific publications of NIOSH Alert: Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings, Medical Surveillance for Healthcare Workers Exposed to Hazardous Drugs, OSHA Technical Manual, and Controlling Occupational Exposure to Hazardous Drugs; and other relevant publications, including how to read and interpret SDSs.
- All compounders shall read and become familiar with each of the entity’s SOPs (see Appendix B) related to hazardous compounding, including those involving the facility, equipment, PPE, compounding processes, hazardous waste disposal, evaluation, packaging, storage, spill containment, decontamination, and dispensing or delivery.
- The compounding supervisor or designee shall demonstrate the procedures for the compounder and shall observe and guide the employee throughout the training process. The compounder shall then repeat the procedure without any assistance from, but under the direct supervision of, the compounding supervisor or designee.
- The compounding supervisor shall routinely monitor the work of the compounder and ensure that the compounder is following appropriate HD precautions and
that the compounder’s calculations and work are accurate and adequately performed. The monitoring shall be documented as part of the entity’s competency assessment program.

The training shall include at least the following:

- Didactic overview of types of HDs and their risks, including carcinogenic, genotoxic, teratogenic, organ toxicity, and adverse reproductive properties
- Review of the entity’s policies and procedures for personnel who handle HDs, including the process to request alternative duty
- Ordering, receiving, and stocking of HDs
- Proper hand hygiene
- Use of PPE
- Use of C-PECs and other equipment and devices
- Negative-pressure techniques when using C-PECs
- Safe aseptic practices, if applicable
- Containment, clean-up, and disposal procedures for normal use and for breakage and spills
- Treatment of personal contact and any unintended exposure

9. RECEIVING

The compounding supervisor shall ensure that the products and components received are consistent with principles of Good Distribution Practices. HDs should be received from the supplier sealed in impervious plastic to segregate them from other drugs, to allow for safety in the receiving and internal transfer process, and should be immediately delivered to the C-SEC. HDs shall only be stored in areas with the ventilation controls described in this chapter.

Receiving personnel shall be trained per the entity’s SOP (see Appendix B). Training shall be documented.

PPE, including ASTM-tested, powder-free chemotherapy gloves, shall be worn when handling HDs (see Appendix F for PPE requirements). A spill kit shall be accessible in the receiving area.

The entity shall enforce policies that include a tiered approach, including:

- Visual examination of the shipping container for signs of damage or breakage
  - If shipping containers appear undamaged, they shall be handled per entity-defined procedures.
  - If shipping containers appear damaged, the following additional action is required:
    - Don appropriate PPE.
    - Enact facility policies to determine whether the package will be sealed and returned to the supplier or whether it will be opened.
If the intent is to return the package to the supplier, enclose the package in an impervious container, label the outside container as "Hazardous", and contact the supplier for instructions. Transportation by common carrier will require compliance with Hazardous Materials Limited Quantity Marking Requirements (see http://www.ecfr.gov/cgi-bin/text-idx?rgn=div8&node=49:2.1.1.3.8.4.25.11).

- If the damaged package must be opened, a Class I (see Appendix C) containment device used for nonsterile HD compounding shall be used.

- Place a plastic-backed preparation mat on the work surface of the Class I device.

- Open the package and remove usable items.
  - Wipe the outside of the usable items with a disposable wipe.
  - Enclose the damaged item(s) in an impervious container, label the outside container as “Hazardous”, and contact the supplier for instructions.

- Clean the Class I device (see 14. Cleaning section), and discard the mat and cleaning disposables as hazardous waste.

Damaged packages or shipping cartons shall be considered spills that shall be reported to the compounding supervisor and conform to other entity-defined reporting processes. Clean-up shall comply with established SOPs (see Appendix B).

10. TRANSPORTING

10.1 Transporting from Receiving to the Storage/Compounding Area
Personnel transporting HDs shall be trained and their competency documented. HDs require safeguards to maintain the integrity of the HD and to minimize the potential for breakage or spill exposure of these products to the environment and to personnel who may come in contact with them. Drugs that have been identified as requiring HD handling precautions shall be clearly labeled at all times during their transport and use. HDs shall be transported in closed containers that minimize the risk of breakage or leakage.

10.2 Transporting from Compounding to Patient Areas Within the Healthcare Entity
The entity shall establish SOPs (see Appendix B) pertaining to packaging, transport, and handling of HDs. The SOPs shall address prevention of accidental exposures or spills, personnel training to respond to exposure, and use of a spill kit. Examples of
special exposure-reducing strategies include Luer lock syringes and connections, syringe caps, the capping of container ports, sealed impervious plastic bags, impact-resistant and/or water-tight containers, and cautionary labeling. HDs shall not be transported in pneumatic tubes because of potential breakage and contamination.

10.3 Transporting from Compounding to Outside the Healthcare Entity

When HDs are distributed to locations outside the premises in which they are compounded, compounding personnel shall select packing containers and materials that are expected to maintain physical integrity, stability, and sterility (if needed) of HDs during transit. Packing shall be selected that simultaneously protects HDs from damage, leakage, contamination, and degradation and protects personnel who transport packed HDs. The entity’s approved SOPs (see Appendix B) shall specifically describe appropriate packing containers and insulating and packing materials, based on information from product specifications, vendors, and the experience of the compounding personnel. Written instructions that clearly explain how to safely open containers of packed HDs shall be provided to patients and other recipients. Transport of HDs shall be labeled, stored, and handled in accordance with applicable federal, state, and local regulations.

Compounding personnel shall ascertain that temperatures of HDs during transit by the selected mode do not deviate from the warmest temperature specified on the storage temperature range on HD labels (see 1079 Good Storage and Distribution Practices for Drug Products). Compounding personnel should communicate directly with the couriers to learn shipping durations and exposure conditions that HDs may encounter. Refer to 795 and 797 for additional storage information.

Compounding facilities that ship HDs to patients and other recipients outside their own premises shall ascertain or provide, whichever is appropriate, the following assurances:

- Delivery performance of couriers to ascertain that HDs are being efficiently and properly transported.
- Labels and accessory labeling for HDs include clearly readable BUDs, storage instructions, disposal instructions for out-of-date units, and HD category labels that shall be consistent with the carrier’s policies.
- Each facility, patient, or other recipient can store the HD properly; including the use of a properly functioning refrigerator or freezer if the HD is labeled for such storage.

11. DISPENSING HD DOSAGE FORMS NOT REQUIRING ALTERATION

HDs in unit-dose or unit-of-use packaging that do not require any further alteration before delivery to the patient or the patient’s caregiver may be dispensed without any further requirements for containment unless required by the manufacturer. If the entity’s SOPs permit, non-antineoplastic HDs that require only transfer from the manufacturer’s package to a prescription container may be dispensed without any further requirements for containment unless required by the manufacturer. Counting of HDs should be done carefully, and clean equipment should be dedicated for use with these drugs.
Tablet and capsule forms of HDs shall not be placed in automated counting machines, which subject them to stress and may introduce powdered contaminants into the work area. Counting coated tablets and capsules does not require a C-PEC, as long as they are not altered or broken.

12. COMPOUNDING HD DOSAGE FORMS

Compounding personnel are responsible for ensuring that HDs are accurately identified, measured, diluted, and mixed and are appropriately sterilized (when appropriate), packaged, sealed, labeled, stored, dispensed, and distributed. These performance responsibilities include maintaining clean conditions and providing labeling and supplementary instructions for the proper administration of HDs.

Work practices for compounding nonsterile HD dosage forms shall include:

- Using requirements listed in chapter 795.
- Avoiding use of active pharmaceutical ingredients (APIs) if a suitable manufactured product is available and appropriate for use, e.g., using an injection rather than a bulk powder.
- Manipulation of any HDs (such as crushing tablets or opening capsules) shall be performed carefully, within a C-PEC using appropriate PPE. Clean equipment (such as mortars and pestles, spatulas, and others) shall be dedicated for use with HDs. Crushing tablets or opening capsules should be avoided if possible; liquid formulations should be used if oral solids are not appropriate for the patient.
- Handling bulk containers of liquid HDs carefully to avoid spills. These containers shall be dispensed and maintained in sealable, impervious plastic bags or other suitable containers to contain any inadvertent contamination.
- Ensuring that processes for labeling the compound do not introduce contamination into non-HD areas.
- Dispensing in the final dose and form whenever possible.

Work practices for compounding sterile HD dosage forms shall include:

- Using requirements listed in chapter 797.
- Avoiding the use of APIs if a suitable manufactured product is available and appropriate for use, e.g., using an injection rather than a bulk powder.
- Appropriately preparing materials used in compounding before introduction into the Class II BSC or the pass-through of a CACI (see chapter 797 for details).
- Ensuring that processes for labeling the compound do not introduce contamination into non-HD areas.

The compounding areas shall be properly cleaned after compounding activities.

13. PROTECTION WHEN ADMINISTERING HDS
Work practices for administering HDs shall include:

- Administering drugs safely by using protective medical devices (such as needleless and closed systems) and techniques (such as spiking and priming of IV tubing by pharmacy personnel inside a C-PEC, and/or priming in-line with nondrug solutions).
- Using CSTDs when administering HDs, when the dosage form allows.
- Complying with hand hygiene practices before and after manipulation of the HDs.
- Wearing PPE (including two pairs of ASTM-tested gloves and protective gowns) for activities associated with drug administration—opening the outer bag, assembling the delivery system, delivering the drug to the patient, and disposing of all equipment used to administer drugs. Wear eye protection where splashing is possible.
- Removing outer gloves and gowns and bagging them for disposal in the approved chemotherapy waste container at the site of drug administration.
- Remembering that HDs administered in locations, such as the surgical suite, present challenges to training and containment. Intracavitary administration of HDs (e.g., into the bladder, peritoneal cavity, or chest cavity) frequently requires equipment for which locking connections may not be readily available or possible.
- Ensuring that all staff members who handle HDs receive safety training that includes recognition of HDs and appropriate spill response. HD spill kits, containment bags, and disposal containers shall be available in all areas where HDs are handled.
- Using techniques and ancillary devices that minimize the risk of open systems when administering HDs through unusual routes or in non-traditional locations.

The Oncology Nursing Society (ONS) Safe Handling of Hazardous Drugs publication contains additional details that may be incorporated into SOPs (see Appendix B).

14. CLEANING: DEACTIVATION, DECONTAMINATION, CLEANING, AND DISINFECTION

Personnel performing cleaning activities (including compounding, direct care, environmental services, laundry, waste handling, and others) shall be protected from inadvertent exposure to HDs.

14.1 Routine Cleaning, Decontaminating, and Waste Disposal

Work practices for environmental services and other personnel who handle HDs shall include:

- Wearing two pairs of ASTM-tested chemotherapy gloves that are chemically resistant to the decontamination or cleaning agents used. Consult manufacturers’ and suppliers’ information to determine appropriateness.
- Wearing eye protection.
- Wearing face shields, if splashing is possible.
14.2 Exposure to Biologic Waste from HD-Treated Patients

Follow applicable laws, regulations, guidelines, and entity policy.

14.3 Cleaning HD Areas

The entity shall establish cleaning routines consistent with this chapter and with recommendations from the C-PEC manufacturer. The routines shall include periodic cleaning of all work surfaces and equipment that may become contaminated, including administration carts and trays. Details shall be included in the entity’s SOPs (see Appendix B), including processes, solutions and dilutions used, and documentation requirements.

Personnel shall wear eye protection and ASTM-tested chemotherapy gloves for deactivating, decontaminating, cleaning, and disinfecting. Gloves used shall be chemically resistant to the cleaning agents used. Face shields shall be worn if splashing is possible.

The choice of cleaning products shall be related to the product and preparation, time, and application of the decontamination product, equipment used, and resistance patterns.

The equipment used for compounding HDs shall be dedicated for HDs and shall be chosen so that the equipment can be effectively cleaned (and sterilized, if necessary, by steam, dry heat, or other methods). Perform cleaning in areas that are sufficiently ventilated to prevent build-up of hazardous airborne drug concentrations and decontamination agents. Cleaning of nonsterile compounding equipment shall not be done when sterile compounding is underway in the same room.

14.4 Cleaning C-PEC and Other Devices Used for Compounding HDs

Cleaning C-PEC, other devices and equipment, and areas used for compounding HDs involves several steps that are discussed below:

14.4.1 Deactivation

14.4.2 Decontamination

14.4.3 Cleaning

14.4.4 Disinfecting

The entity’s SOPs shall include the procedure, the components and dilutions (if applicable) used, and the documentation requirements for all four steps.

14.4.1 DEACTIVATION

Chemical deactivation of a hazardous substance is preferred, but no single process has been found to deactivate all currently available HDs. Deactivation shall occur when an appropriate agent is identified. Note that alcohol is not a deactivation agent, and the use of alcohol before deactivating and decontamination may result in the spread of contamination rather than any actual cleaning. A multi-component deactivation system is theoretically more efficient than a single-agent system because of the diverse nature of HDs.

The SDSs of some HDs recommend use of sodium hypochlorite; generally, this should be a 2% solution. Note that sodium hypochlorite will pit stainless steel surfaces; therefore, the sodium hypochlorite must be removed with sodium thiosulfate or followed by use of a germicidal detergent in sterile water.
14.4.2 DECONTAMINATION

Decontamination occurs by removing HD residue from surfaces, and transferring them to a low-lint wipe, which is then contained and discarded as contaminated waste. The amount of HD contamination introduced into the BSC or CACI may be reduced by surface decontamination (i.e., wiping down) of HD containers. Although no wipe-down procedures have been studied, the use of low-lint wipes moistened with alcohol, sterile water, peroxide, or sodium hypochlorite solutions may be effective. The solvent used for wiping vials must not alter the product label. The BSC or CACI should be decontaminated at least weekly, any time a spill occurs, before and after certification, voluntary interruption, or if the ventilation tool is moved.

14.4.3 CLEANING

The Cleaning section in chapter 797 is appropriate for both nonsterile and sterile HDs. The products used for cleaning shall not contaminate the compounding equipment with substances that are toxic, volatile, corrosive, or otherwise harmful to the surface. To clean C-PECs, refer to manufacturer’s information and appropriate references for guidance in developing the entity’s cleaning procedures.

14.4.4 DISINFECTING

The products used for disinfecting shall not contaminate the compounding equipment with substances that are toxic, volatile, corrosive, or otherwise harmful to the surface. C-PECs used for compounding HDs shall be disinfected at the beginning of the workday, between batches of compounding medications, at the beginning of each subsequent shift (if compounding takes place over an extended period of time), routinely during compounding, and after anytime the C-PEC has been powered off. The area under the work tray shall be cleaned at least monthly to reduce the contamination level in the BSCs and CACIs. Clean as much as possible before opening the area under the work tray. When cleaning a CACI, don a respirator when opening the front of the cabinet.

15. SPILL CONTROL

Spills shall be contained and cleaned immediately by trained workers. Signs shall be available to restrict access to the spill area. Only trained workers with appropriate PPE shall manage an HD spill. All workers who may be required to clean up a spill of HDs shall receive proper training in spill management and in the use of PPE and NIOSH-certified respirators (see 6. Personal Protective Equipment).

Policies and procedures shall be developed to prevent spills and to govern clean-up of HD spills. Written procedures shall specify who is responsible for spill management and shall address the size and scope of the spill. Spill kits containing all of the materials needed to clean HDs spills shall be readily available in all areas where HDs are routinely handled. If HDs are being prepared or administered in a non-routine area (e.g., home setting, unusual patient care area), a spill kit and respirator shall be available. The circumstances and handling of spills shall be documented. Workers who are contaminated during the spill or spill clean-up, or who have direct skin or eye contact with HDs, require immediate treatment. Staff and nonemployees exposed to an HD spill should also complete an incident report or exposure form and report to the designated...
emergency service for initial evaluation. All spill materials shall be disposed of as hazardous waste.

SOPs (see Appendix B) shall be developed to include:

- Management of HD spills.
- Assurances that clean-up of a spill according to its size and type is handled by workers who are trained in handling hazardous materials.
- Recognition that the size and type of the spill might determine who is authorized to conduct the clean-up and decontamination and how the clean-up is managed.
- Description of the protective equipment required for various spill sizes, the possible spreading of material, restricted access to HD spills, and signs to be posted.
- Use of an appropriate full-facepiece, chemical cartridge-type respirator for spills that exceed the capacity of the spill kit, such as when an IV bag breaks or a line disconnects and leaks, or where there is known or suspected airborne exposure to vapors or gases.
- Location of spill kits and other clean-up materials in the immediate area where exposures may occur.

The entity shall determine by policy when emergency management (including the entity’s safety and hazardous materials personnel) shall be contacted.

**16. DISPOSAL**

Disposal of all HD waste (including unused and unusable HDs) shall comply with all applicable federal and state regulations. All personnel who perform routine custodial waste removal and cleaning activities in storage and preparation areas for HDs shall be trained in appropriate procedures to protect themselves and the environment and to prevent contamination.

**17. ENVIRONMENTAL QUALITY AND CONTROL**

To ensure containment of HDs, environmental wipe sampling to detect uncontained HDs should be performed routinely (e.g., initially as a benchmark and at least every 6 months, or more often as needed, to verify containment). This sampling should include surface wipe sampling of the working area of C-PEC; countertops where finished preparations are placed; areas adjacent to BSCs and CACIs, including the floor directly under the working area; and patient administration areas.

Common marker HDs that can be assayed include cyclophosphamide, ifosfamide, methotrexate, fluorouracil, and platinum-containing drugs. If any measurable contamination (cyclophosphamide levels more than 1.00 ng/cm² have been found to cause human uptake) is found by any of these quality assurance procedures, practitioners shall identify, document, and contain the cause of contamination. Such action may include reevaluating work practices, retraining, thorough deactivation/decontamination/disinfection/cleaning, and improving engineering controls.
Examples of improving engineering controls include implementing use of CSTDs or re-assessing the types of C-PEC used.

18. DOCUMENTATION

The entity shall establish policies and procedures to ensure that compounding and dispensing records meet the requirement of this chapter, chapters 795 and 797, entity policy, and federal and state laws and regulations. Activities that shall be documented include but are not limited to the acquisition, preparation, and dispensing of a compounded HD, personnel training, and the use and maintenance of equipment and supplies. These records shall be available for review by the applicable authorities. Policies and procedures shall be reviewed at least annually by the compounding supervisor, and the review shall be documented. Revisions in forms or records shall be made as needed and communicated to all compounding personnel.

19. MEDICAL SURVEILLANCE

The goal of medical surveillance is to minimize adverse health effects in workers exposed to HDs. A medical surveillance program involves collecting and interpreting data to detect changes in the health status of working populations potentially exposed to hazardous substances. Medical surveillance augments and evaluates the protection afforded by engineering controls, other administrative controls, good work practice, PPE, and worker education about the hazards of the materials they work with or they may come into contact with in the course of their duties.

Employers shall ensure that healthcare workers who are exposed to HDs are routinely monitored as part of a medical surveillance program. Workers may be exposed to HDs when they create aerosols, generate dust, clean up spills, or touch contaminated surfaces when compounding, administering, or disposing of HDs or patient waste. This includes workers who directly handle HDs, such as nurses, pharmacists, and pharmacy technicians. In addition, other workers (e.g., patient care assistants, or environmental services staff), who may come directly into contact with patient wastes within 48 hours after a patient has received an HD, should be included in a medical surveillance program.

Workers who are potentially exposed to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent occupational injury and disease. The purpose of surveillance is to identify the earliest reversible biologic effects so that exposure can be reduced or eliminated before the employee sustains irreversible damage. The information should help affected workers and identify and correct system failures that may have resulted in harmful exposures.

The elements of a medical surveillance program are used to establish a baseline of workers’ health and then monitor their future health for any changes that may result from exposure to hazardous agents. Program results should be examined in aggregate for trends that may be a sign of health changes related to exposure to HDs. Elements of a medical surveillance program shall be consistent with the entity’s Human Resource policies and shall include:
- Development of an organized approach to identify workers who are potentially exposed to HDs on the basis of their job duties
- Design of medical surveillance that is appropriate to the exposure
- Establishment of an initial baseline (pre-placement) of workers' medical health (including reproductive history) and occupational history (as an estimate of prior exposure), such as:
  - Records of drugs and quantities and dosage forms handled,
  - Hours spent handling these drugs per week, and
  - Number of preparations/administrations per week.
- Exposure assessment of all employees who have worked with HDs is important, and the maintenance of records is required by OSHA regulation concerning access to employee exposure and medical records (29 CFR 1910.1020).
- Monitor workers' future health as it relates to potential exposures to hazardous agents through periodic and routine physical examinations and reproductive and general health questionnaires; exposure histories should also be updated. Track current exposure, which includes careful documentation of an individual's routine exposure and any acute accidental exposures.
- Monitoring of the data to identify prevention failure leading to disease
- Development of a follow-up plan for workers who have shown health changes suggesting toxicity or who have experienced an acute exposure. This follow-up shall include evaluation of current engineering and administrative controls and equipment to ensure that all systems are appropriately and accurately implemented.
- Completion of an exit examination to document the information on the employee's medical, reproductive, and exposure histories. Examination and laboratory evaluation should be guided by the individual's history of exposures, and follow the outline of the periodic evaluation.

**19.1 Follow-up Plan**

The occurrence of exposure-related disease or health changes should prompt immediate re-evaluation of primary preventive measures (e.g., administrative and engineering controls, PPE, and others). In this manner, medical surveillance acts as a check on the appropriateness of controls already in use.

The employer should take the following actions:

- Post-exposure examinations: Post-exposure evaluation is tailored to the type of exposure (e.g., spills or needle sticks from syringes containing HDs). An assessment of the extent of exposure is made and included in the confidential database (discussed below) and in an incident report. The physical examination focuses on the involved area as well as other organ systems commonly affected (i.e., the skin and mucous membranes; the pulmonary system for
aerosolized HDs). Treatment and laboratory studies follow as indicated and should be guided by emergency protocols.

- Compare performance of controls with recommended standards: Conduct environmental sampling when analytical methods are available.
- Verify and document that all controls are in proper operating condition.
- Verify and document that the worker complied with existing policies or when new policies went into effect. Review policies for the use of PPE and employee compliance with PPE use and policies. Review availability of appropriate PPE including ASTM-tested chemotherapy gloves, low-permeation gowns, respiratory protection, and eye protection.
- Develop and document a plan of action that will prevent additional worker exposure.
- Ensure a confidential two-way communication between the worker and the employee health units regarding notification, discussions about a change in health condition, or finding of an adverse health effect.
- Provide and document a follow-up medical survey that the plan implemented is effective.
- Ensure confidential notification of any adverse health effect to an exposed worker and offer alternative duty or temporary reassignment.
- Provide ongoing medical surveillance of all workers at risk to determine whether the plan implemented is effective.

Refer to the guidelines of professional organizations such as the American Society of Health-System Pharmacists (ASHP), NIOSH, and ONS, which recommend medical surveillance as the recognized standard of occupational health practice for personnel who handle HD. The American College of Occupational and Environmental Medicine (ACOEM) also recommends surveillance for these workers in their Reproductive Hazard Management Guidelines.

APPENDIX A: ACRONYMS AND DEFINITIONS

ACRONYMS

<table>
<thead>
<tr>
<th>ACRONYM</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACOEM</td>
<td>American College of Occupational and Environmental Medicine</td>
</tr>
<tr>
<td>ACPH</td>
<td>Air changes per hour</td>
</tr>
<tr>
<td>ALARA</td>
<td>As low as reasonably achievable</td>
</tr>
<tr>
<td>API</td>
<td>Active pharmaceutical ingredient</td>
</tr>
<tr>
<td>ASHP</td>
<td>American Society of Health-System Pharmacists</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>BSC</td>
<td>Biological safety cabinet</td>
</tr>
<tr>
<td>BUD</td>
<td>Beyond-use date</td>
</tr>
<tr>
<td>CACI</td>
<td>Compounding aseptic containment isolator</td>
</tr>
</tbody>
</table>
CAI Compounding aseptic isolator
CDC Centers for Disease Control and Prevention
CETA Controlled Environment Testing Association
CFR Code of Federal Regulations
C-PEC Containment primary engineering control
C-SCA Containment segregated compounding area
C-SEC Containment secondary engineering control
CSP Compounded sterile preparation
CSTD Closed system drug-transfer device
CVE Containment ventilated enclosure
EPA Environmental Protection Agency
GHS Globally harmonized system of classification and labeling of chemicals
HCS Hazardous Communication Standard
HD Hazardous drug
HEPA High efficiency particulate air
IV Intravenous
LAFW Laminar air flow workbench
NIOSH National Institute for Occupational Safety and Health
ONS Oncology Nursing Society
OSHA Occupational Safety and Health Administration
PEC Primary engineering control
PPE Personal protective equipment
RCRA Resource Conservation and Recovery Act
SDS Safety Data Sheet
SOP Standard Operating Procedure
ULPA Ultra low particulate air
USP United States Pharmacopeia

DEFINITIONS

Active pharmaceutical ingredient (API): Any substance or mixture of substances intended to be used in the compounding of a drug preparation, thereby becoming the active ingredient in that preparation and furnishing pharmacological activity or other direct effect in the diagnosis, cure, mitigation treatment, or prevention of disease in humans and animals or affecting the structure and function of the body.

Alternative duty: Performance of other tasks that do not include the direct handling of HDs.
Anteroom: Transition area between the general area and the room containing the C-PEC. Hand hygiene, garbing, staging of components, order entry, and other particle-generating activities are performed in the anteroom. For sterile compounding, the anteroom shall meet ISO Class 7 (for all references to ISO classification, see Table 1) and also provides assurance that pressure relationships between rooms are constantly maintained.

Batch: More than one unit of a compounded preparation that is intended to have uniform character and quality within specified limits, prepared in a single process, and completed during the same and limited time period.

Beyond-use date (BUD): The date or time after which a compounded preparation shall not be used, stored, or transported (see 795 and 797 for additional details).

Biohazard: Infectious agent or hazardous biological material that presents a risk or potential risk to the health of humans, animals, or the environment. The risk can be direct through infection or indirect through damage to the environment.

Biological safety cabinet (BSC): A ventilated cabinet often used for preparation of hazardous drugs. BSCs shall be NSF/ANSI listed. These cabinets are divided into three general classes (Class I, Class II, and Class III). Class II BSCs are further divided into types (Type A1, Type A2, Type B1, and Type B2). See Appendix C for details.

Buffer room: Part of the HD compounding area under negative pressure where the C-PEC is physically located. Activities that occur in this area are limited to the preparation and staging of components and supplies used when compounding HDs.

Chemotherapy glove: A medical glove that meets the ASTM Standard Practice (D6978-05-2013) for Assessment of Resistance of Medical Gloves to Permeation by Chemotherapy Drugs.

Cleaning: The removal of soil (e.g., organic and inorganic material) from objects and surfaces, normally accomplished manually or mechanically using water with detergents or enzymatic products.

Cleanroom: A room in which the concentration of airborne particles is controlled through directional airflow and HEPA-filtered air supply to meet a specified airborne particulate cleanliness class. Microorganisms in the environment are monitored so that a microbial level for air, surface, and personnel are not exceeded for a specified ISO-classified space (see 1116 Microbiological Control and Monitoring of Aseptic Processing Environments and also the definition of Buffer room).

Closed system drug-transfer device (CSTD): A drug transfer device that mechanically prohibits the transfer of environmental contaminants into the system and the escape of HD or vapor concentrations outside of the system.

Compounded preparation: A nonsterile or sterile drug or nutrient preparation that is compounded in a licensed pharmacy or other healthcare-related facility pursuant to the order or anticipation of order of a licensed prescriber.
**Compounding aseptic containment isolator (CACI):** A specific type of CAI that is designed for compounding of sterile HDs. The CACI shall be certified in accordance with CETA-CAG-002, designed to provide worker protection from exposure to undesirable levels of airborne drugs throughout the compounding and material transfer processes and to provide an aseptic environment with unidirectional airflow for compounding sterile preparations. Air exchanged with the surrounding environment shall not occur unless it is first passed through a microbially retentive filter (HEPA minimum) system capable of containing airborne concentrations of the physical size and state of the drug being compounded. Exhaust air from the isolator shall be appropriately removed by properly designed building ventilation.

**Compounding aseptic isolator (CAI):** An isolator specifically designed for compounding sterile, non-hazardous pharmaceutical ingredients or preparations that shall be certified in accordance with CETA-CAG-002. It is designed to maintain an aseptic compounding environment within the isolator throughout the compounding and material transfer processes. Air exchange into the isolator from the surrounding environment shall not occur unless the air has first passed through a microbially retentive filter (HEPA minimum). A CAI shall not be used for the manipulation of HDs.

**Compounding personnel:** Individuals who participate in the compounding process who are competent and knowledgeable and are responsible for the preparation of HDs, using information from this chapter, the entity’s SOPs, and instructions from the compounding supervisor.

**Compounding supervisor:** The individual who is responsible for developing and implementing appropriate procedures; overseeing facility compliance with this chapter and other applicable laws, regulations, and standards; ensuring competency of personnel; and assuring environmental control of the compounding areas.

**Containment primary engineering control (C-PEC):** A ventilated device designed to minimize worker and environmental exposures to HDs by controlling emissions of airborne contaminants through the following:

- The full or partial enclosure of a potential contaminant source
- The use of airflow capture velocities to capture and remove airborne contaminants near their point of generation
- The use of air pressure relationships that define the direction of airflow into the cabinet
- The use of HEPA filtration on all potentially contaminated exhaust streams

Examples of C-PECs include Class I, II, or III BSCs, CACIs, and CVE (e.g., powder hood).

C-PECs used for nonsterile compounding do not need to have ISO Class 5 air quality. C-PECs used for sterile compounding shall have ISO Class 5 air quality (see Table 2).

**Containment secondary engineering control (C-SEC):** The C-SEC is the room in which the C-PEC is placed. It incorporates specific design and operational parameters required to contain the potential hazard within the compounding room, e.g., restricted...
access, barriers, special construction technique, ventilation, and room pressurization are components of the secondary control strategy.

**Containment segregated compounding area (C-SCA):** A type of C-SEC with nominal airflow and room pressurization requirements as they pertain to HD compounding. The C-SCA is limited for use with a BSC when preparing low- or medium-risk level CSPs with 12-hour or less BUDs, preparing CSPs in a CACI that meets the requirements in 797, or preparing nonsterile HDs in a C-PEC.

**Containment ventilated enclosure (CVE):** A full or partial enclosure that uses ventilation principles to capture, contain, and remove airborne contaminants (through HEPA filtration) and prevent their release into the work environment (see Table 2).

**Critical area:** An ISO Class 5 (see Table 1) environment.

**Critical site:** A location that includes any component or fluid pathway surfaces (e.g., vial septa, injection ports, beakers) or openings (e.g., opened ampules, needle hubs) exposed and at risk of direct contact with the air (e.g., ambient room or HEPA filtered), moisture (e.g., oral and mucosal secretions) or touch contamination.

**Deactivation:** Treatment of an HD with another chemical, heat, ultraviolet light, or other agent to create a less hazardous agent.

**Decontamination:** Inactivation, neutralization, or removal of HDs, usually by chemical means.

**Disinfectant:** A chemical agent that destroys or inhibits the growth of microorganisms that cause disease.

**Engineering control:** Primary, secondary, and supplemental devices designed to eliminate or reduce worker exposure to a chemical, biological, radiological, ergonomic, or physical hazard, and in the case of CSPs, to protect the compounded product from environmental contamination. Examples include ventilation controls such as BSCs or CACIs, CSTDs, retracting syringe needles, and safety interlocks.

**Entity:** Pharmacy, hospital, physician’s office, clinic, veterinary office, or other locations wherever HDs are received, stored, prepared, dispensed, and distributed to a final user or healthcare personnel who will administer the HD.

**Expiration/expiry date:** The expiration date identifies the time during which the article may be expected to meet the requirements of the compendia monograph, provided it is kept under the prescribed storage conditions (see General Notices and Requirements 10.40.100).

**Globally harmonized system of classification and labeling of chemicals (GHS):** A system for standardizing and harmonizing the classification and labeling of chemicals.

**Goggles:** Tight-fitting eye protection that completely covers the eyes, eye sockets, and the facial area that immediately surrounds the eyes and that provide protection from impact, dust, and splashes. Some goggles will fit over corrective lenses.
**Hazardous communication standard (HCS):** A U.S. government regulation designed to ensure that the hazards of all chemicals produced or imported are evaluated and that details regarding their hazards are transmitted to employers and employees.

**Hazardous drug (HD):** Any drug identified by at least one of the following six criteria:

- Carcinogenicity
- Teratogenicity or developmental toxicity
- Reproductive toxicity in humans
- Organ toxicity at low doses in humans or animals
- Genotoxicity
- New drugs that mimic existing hazardous drugs in structure or toxicity

**High efficiency particulate air (HEPA) filtration:** An extended-medium, dry-type filter in a rigid frame, having a minimum particle collection efficiency of 99.97% for 0.3-µm mass-median diameter particles when tested at a rated airflow in accordance with MIL STD 282 using IEST Recommended Standard RP-CC001.5.

**Labeling:** A term that designates all labels and other written, printed, or graphic matter on an immediate container of an article or preparation, or on, or in, any package or wrapper in which it is enclosed, except any outer shipping container. The term "label" designates that part of the labeling on the immediate container [see General Notices and Requirements and 21 USC 321 (k) and (m)].

**Laminar air flow workbench (LAFW):** A primary engineering control designed for use when compounding sterile non-HDs. An LAFW shall not be used for the manipulation of HDs.

**Negative-pressure room:** A room that is at a lower pressure than the adjacent spaces and, therefore, the net flow of air is into the room.

**Pass-through:** An enclosure with interlocking doors positioned between two spaces for the purpose of reducing particulate transfer while moving materials from one space to another. A pass-through serving negative-pressure rooms shall be equipped with sealed doors.

**Personal protective equipment (PPE):** Items such as gloves, gowns, respirators, goggles, face shields, and others that protect individual workers from hazardous physical or chemical exposures.

**Pharmaceutical product:** A commercially manufactured drug, biologic, or nutrient that has been evaluated for safety and efficacy by the FDA. Products are accompanied by full prescribing information, which is commonly known as the FDA-approved manufacturer’s labeling or product package insert.

**Positive-pressure room:** A room that is at a higher pressure than the adjacent spaces and, therefore, the net flow of air is out of the room.

**Primary engineering control (PEC):** A ventilated device that provides a prescribed environment for the exposure of critical sites and when desired, protects workers and
the environment from exposure to the compounds under manipulation. PECs used for manipulation of HDs shall be designed for containment (see also *Containment primary engineering control*).

**Resource conservation and recovery act (RCRA) empty:** A vial, ampule, IV bag, or other container that once held a drug regulated under the Resource Conservation and Recovery Act, if all the contents have been removed that can be removed by normal means and no more than 3% of the contents by weight remain.

**Safety data sheet (SDS):** An informational document that provides written or printed material concerning a hazardous chemical that is prepared in accordance with the HCS [previously known as a Material Safety Data Sheet (MSDS)].

**Spill kit:** A container of supplies, warning signage, and related materials used to contain the spill of an HD.

**Sterilization:** A process that destroys or eliminates all forms of microbial life (including spores) and is carried out by physical or chemical methods. Steam under pressure, dry heat, ethylene oxide gas, hydrogen peroxide gas plasma, and liquid chemicals are the principal sterilizing agents used in healthcare settings.

**Supplemental engineering control:** An adjunct control (e.g., CSTD) used in concurrence with primary and secondary control strategies. Supplemental engineering controls offer additional levels of protection and may facilitate enhanced occupational protection because the HD is handled outside of the protective controls of primary and secondary control environments (e.g., post-compounding transit, administration, and disposal).

**Trace chemotherapy waste:** Components such as vials, ampules, IV bags, etc., which once held antineoplastic agents but after use are considered to be “RCRA empty”.

**Trace contaminated waste:** Items used in the handling, compounding, dispensing, administration, or disposal of antineoplastic agents which are not overtly contaminated (e.g., gowns, gloves, goggles, wipes).

**APPENDIX B: SUGGESTED STANDARD OPERATING PROCEDURES**

- Policies and procedures for the safe handling of HDs shall be in place for all situations in which these drugs are used throughout a facility. Chapters 795 and 797 list SOPs recommended for use for nonsterile and sterile compounding. Additionally, the following HD-related procedures should be considered:
  - Comprehensive hazardous drug safety program
  - Hazard communication program
- Entity policy for labeling containers from acquisition to disposal with hazardous warnings
- Procurement of HDs
- Use of C-PECs, including work practices specific to the type of device used
- Use of PPE, including receipt and transport, compounding, administration, disposal, and handling waste
- Cleaning of C-PEC and surrounding areas
- Cleaning solutions and dilutions
- Spill control, including use and contents of spill kit, cleaning, and notification
- Waste management of trace chemotherapy and hazardous waste
- Medical surveillance

**APPENDIX C: TYPES OF BIOLOGICAL SAFETY CABINETS**

**Class I:** A BSC that protects personnel and the environment but does not protect the product/preparation. Personnel protection is provided as a minimum velocity of 75 linear feet/min of unfiltered room air is drawn through the front opening and across the work surface. The air is then passed through a HEPA/ULPA filter either into the room or to the outside in the exhaust plenum, providing environmental protection.

**Class II:** Class II (Types A1, A2, B1, and B2) BSCs are partial barrier systems that rely on the movement of air to provide personnel, environmental, and product/preparation protection. Personnel and product/preparation protection is provided by the combination of inward and downward airflow captured by the front grille of the cabinet. Side-to-side cross-contamination of products/preparations is minimized by the internal downward flow of HEPA/ULPA filtered air moving toward the work surface and then drawn into the front and rear intake grilles. Environmental protection is provided when the cabinet exhaust air is passed through a HEPA/ULPA filter.

**Type A1 (formerly, Type A):** These Class II BSCs maintain a minimum inflow velocity of 75 ft/min, have HEPA-filtered, down-flow air that is a portion of the mixed down-flow and inflow air from a common plenum, may exhaust HEPA-filtered air back into the laboratory or to the environment through an exhaust canopy, and may have positive-pressure contaminated ducts and plenums that are not surrounded by negative-pressure plenums. They are not suitable for use with volatile toxic chemicals and volatile radionucleotides.
**Type A2 (formerly, Type B3):** These Class II BSCs maintain a minimum inflow velocity of 100 ft/min, have HEPA-filtered, down-flow air that is a portion of the mixed down-flow and inflow air from a common exhaust plenum, may exhaust HEPA-filtered air back into the laboratory or to the environment through an exhaust canopy, and have all contaminated ducts and plenums under negative pressure or surrounded by negative-pressure ducts and plenums. If these cabinets are used for minute quantities of volatile toxic chemicals and trace amounts of radionucleotides, they must be exhausted through properly functioning exhaust canopies.

**Type B1:** These Class II BSCs maintain a minimum inflow velocity of 100 ft/min, have HEPA-filtered down-flow air composed largely of uncontaminated, recirculated inflow air, exhaust most of the contaminated down-flow air through a dedicated duct exhausted to the atmosphere after passing it through a HEPA filter, and have all contaminated ducts and plenums under negative pressure or surrounded by negative-pressure ducts and plenums. If these cabinets are used for work involving minute quantities of volatile toxic chemicals and trace amounts of radionucleotides, the work must be done in the directly exhausted portion of the cabinet.

**Type B2 (total exhaust):** These Class II BSCs maintain a minimum inflow velocity of 100 ft/min, have HEPA-filtered down-flow air drawn from the laboratory or the outside, exhaust all inflow and down-flow air to the atmosphere after filtration through a HEPA filter without recirculation inside the cabinet or return to the laboratory, and have all contaminated ducts and plenums under negative pressure or surrounded by directly exhausted negative-pressure ducts and plenums. These cabinets may be used with volatile toxic chemicals and radionucleotides.

**Class III:** The Class III BSC is designed for work with highly infectious microbiological agents and other hazardous operations. It provides maximum protection for the environment and the worker. It is a gas-tight enclosure with a viewing window that is secured with locks and/or requires the use of tools to open. Both supply and exhaust air are HEPA/ULPA filtered. Exhaust air must pass through two HEPA/ULPA filters in series before discharge to the outdoors.

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**APPENDIX D: BEST PRACTICES FOR HANDLING HDS**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Location</th>
<th>C-PEC</th>
<th>HEPA filtration</th>
<th>Minimum ACPH</th>
<th>Pressure (inches of water column)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unpacking HDs</td>
<td>Designated receiving area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unpacking damaged shipping</td>
<td>Class I device designated for</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>containers</td>
<td>this purpose or Class I device</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Activity</td>
<td>Location</td>
<td>C-PEC</td>
<td>HEPA filtration</td>
<td>Minimum ACPH</td>
<td>Pressure (inches of water column)</td>
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<td>--------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Nonsterile preparations</td>
<td>Separate room for nonsterile HDs</td>
<td>Negative-pressure, ventilated enclosure, such as a Class 1 BSC or CVE</td>
<td>Not required if hazardous preparations are handled only in the C-PEC</td>
<td>12</td>
<td>Minimum 0.01&quot; negative</td>
</tr>
<tr>
<td>Sterile preparations</td>
<td>Negative-pressure ISO Class 7 room</td>
<td>Class II BSC or CACI</td>
<td>Required in supply to maintain room state of control</td>
<td>30</td>
<td>Minimum 0.01&quot; negative</td>
</tr>
<tr>
<td></td>
<td>Negative-pressure SCA</td>
<td>Class II BSC or CACI</td>
<td>Not required if CACI meets minimum criteria established in the chapter</td>
<td>12</td>
<td>Minimum 0.01&quot; negative</td>
</tr>
</tbody>
</table>

**APPENDIX E: EXAMPLES FOR DESIGN OF HAZARDOUS DRUG COMPOUNDING AREAS**
<table>
<thead>
<tr>
<th>Use</th>
<th>Optimal Primary and Secondary Control</th>
<th>Minimum ACPH</th>
<th>Limitations Primary and Secondary Control</th>
<th>Minimum ACPH</th>
<th>Notes for Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonsterile HD compounding</td>
<td><img src="image1" alt="Diagram" /></td>
<td>12</td>
<td></td>
<td></td>
<td>In the absence of stability information, the maximum BUDs listed by type of formulation in &lt;795&gt; apply.</td>
</tr>
<tr>
<td>Sterile HD compounding</td>
<td><img src="image2" alt="Diagram" /></td>
<td>30</td>
<td><img src="image3" alt="Diagram" /></td>
<td>12</td>
<td>Maximum BUD of 12 hours unless the CACI meets the requirements listed in &lt;797&gt;</td>
</tr>
<tr>
<td>Sterile HD and sterile non-HD compounding</td>
<td>Separate rooms are required.</td>
<td>30</td>
<td><img src="image4" alt="Diagram" /></td>
<td>30</td>
<td>This shall not be used for high-risk preparations. Maximum BUD of 12 hours for non-HD CSPs made in LAFW. Maximum BUD of 12 hours for CSPs made in a CACI unless the CACI meets the requirements listed in &lt;797&gt;.</td>
</tr>
<tr>
<td>Sterile HD and nonsterile HD compounding</td>
<td><img src="image5" alt="Diagram" /></td>
<td>30</td>
<td><img src="image6" alt="Diagram" /></td>
<td>30</td>
<td>For rooms used for both sterile and nonsterile compounding, particle-generating activity shall not be performed when sterile compounding is in progress. CPECs shall be at least 1 meter apart; a solid partition is preferred. If the CACI is not in an ISO 7 buffer room, CSPs have a maximum BUD of 12 hours unless the CACI meets the requirements listed in &lt;797&gt;.</td>
</tr>
<tr>
<td>Activity</td>
<td>Gloves</td>
<td>Gown</td>
<td>Hair, Face, Beard, Shoe Covers</td>
<td>Eye and Face Protection</td>
<td>Respiratory Protection</td>
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<td>--------------------------------</td>
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<td>------------------------</td>
</tr>
<tr>
<td>Receiving intact supplies (remote from compounding area)</td>
<td>ASTM-tested chemotherapy gloves shall be worn for all handling of HDs. Two pairs are required for compounding, administering, managing a spill, and disposal of HDs.</td>
<td>Disposable, long-sleeved and cuffed gowns, with a solid front and closure in the back, made of polyethylene-coated polypropylene or other laminate material</td>
<td>Not required for routine use when a C-PEC is used. Use eye and face protection when manipulating HDs outside of a C-PEC and working at or above eye level, cleaning a C-PEC, or cleaning a spill.</td>
<td>A NIOSH-certified N95 respirator is generally sufficient to protect against particles. Consult the SDS for respiratory protection information.</td>
<td></td>
</tr>
<tr>
<td>Receiving suspected/broken supplies</td>
<td>ASTM-tested chemotherapy glove shall be worn over the industrial glove.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Transporting intact supplies or compounded HDs</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiving in compounding area</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stocking</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Gloves</td>
<td>Gown</td>
<td>Hair, Face, Beard, Shoe Covers</td>
<td>Eye and Face Protection</td>
<td>Respiratory Protection</td>
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<td>------------------------</td>
</tr>
<tr>
<td>compounding area</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Nonsterile compounding</td>
<td>+</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Sterile compounding</td>
<td>+</td>
<td></td>
<td>Outer glove shall be sterile (including outer glove in CACI)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Administering</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td>Required when splashing or aerosolization is possible</td>
</tr>
<tr>
<td>Clean-up, routine (such as following compounding or administration)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collection and disposal of patient waste</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Spills</td>
<td></td>
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<td></td>
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<td>+</td>
</tr>
</tbody>
</table>

- Use an appropriate, full-facepiece, chemical cartridge-type respirator for spills and when there is known or suspected airborne exposure to vapors or gases.
Activity | Gloves | Gown | Hair, Face, Beard, Shoe Covers | Eye and Face Protection | Respiratory Protection
---|---|---|---|---|---

*a + = Required.*

### APPENDIX G. BIBLIOGRAPHY


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