NAVIGATING USP 797/800

LUNCH & LEARN

DECEMBER 8, 2022

Wisconsin Healthcare Engineering Association

RING & DUCHATEAU CONSULTING ENGINEERS

NAVIGATING USP 797/800

HVAC PRESENTER

RING & DuCHATEAU HVAC DEPARTMENT EXPERIENCE

635

YEARS

RING & DuCHATEAU PHARMACY EXPERIENCE

60+

IN THE PAST 20 YEARS

Heather Erdman
Associate & HVAC Project Manager

Navigating USP 797/800

OVERVIEW

- What is USP?
- Importance of USP 797/800
- What is the difference between 797/800?
- HVAC requirements
- Design of Pharmacy Clean Rooms
- Testing & Certification requirements
- Maintaining Pharmacy Clean Rooms
- Other Considerations

Image Source: usp.org

NAVIGATING USP 797/800

What is USP?

United States Pharmacopeia

- It is an independent scientific nonprofit organization that was founded over 200 years ago.

- The main focus of USP is to ensure safe and reliable medicine, dietary supplements and foods.

- USP also focuses on protecting patient safety.

- USP sets high quality and rigorous standards which have become recognized and used world-wide.

- 140 countries around the globe recognize USP standards.

Image Source: usp.org

NAVIGATING USP 797/800

USP 797 and 800?

USP Chapters 797 and 800 were developed to ensure sterile and safe compounding of drugs.

- After a tragedy at the New England Compounding Center in 2012 that killed more than 100 patients that had received contaminated steroid injections USP updated the USP 797 Pharmacy Compounding and Sterile Preparation chapter with additional compounding criteria and restrictions.

- The same tragedy also triggered the publishing of a new chapter, USP 800 Hazardous Drugs Handling in Healthcare Settings.

- In 2019 revisions were published to both chapters triggering pharmacies in healthcare settings to be modified and upgraded throughout Wisconsin and nationwide.

NAVIGATING USP 797/800

USP 797 VS USP 800

USP General Chapter 797 –
Pharmaceutical Compounding – Sterile Preparations

- The requirements of this chapter intend to ensure the sterility of compounded sterile preparations (CSPs) to provide safe medicine.

USP General Chapter 800 –
Hazardous Drugs – Handling in Healthcare Settings

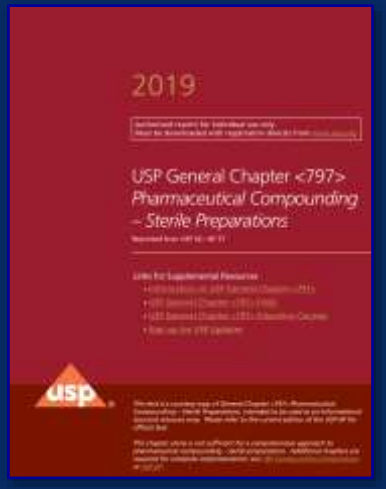
- This chapter covers standards for handling hazardous drugs that protects patients, workers, and the environment.

NAVIGATING USP 797/800

USP 797 Overview

USP General Chapter 797 – Pharmaceutical Compounding – Sterile Preparations

- Covers all requirements for sterile compounding including:
  - Personnel training, Hygiene and Garbing
  - Facilities and Engineering Controls
  - Certification and Recertification
  - Microbial Air and Surface Monitoring
  - Cleaning and Disinfecting
  - Master Formulation and Compounding Records
  - Labeling
  - CSP Handling, Storage, Packaging
  - and more….



NAVIGATING USP 797/800

USP 800 Overview

USP General Chapter 800 – Hazardous Drugs – Handling in Healthcare Settings

- Covers all requirements for sterile compounding including:
  - Lists of Hazardous Drugs
  - Types of Exposure
  - Facilities and Engineering Controls
  - Responsibilities of Personnel Handling Hazardous Drugs
  - Environmental Quality and Control
  - Personal Protective Equipment
  - Deactivating, Decontamination, Cleaning and Disinfecting
  - Spill Control
  - Documentation and Standard Operating Procedures
  - and more….

NAVIGATING USP 797/800

ISO Class Ratings

- ISO Class ratings define acceptable air qualities levels for clean rooms.
- The number of Air Changes Per Hour (ACPH) is an important factor to ensure the proper ICO Class rating is maintained.

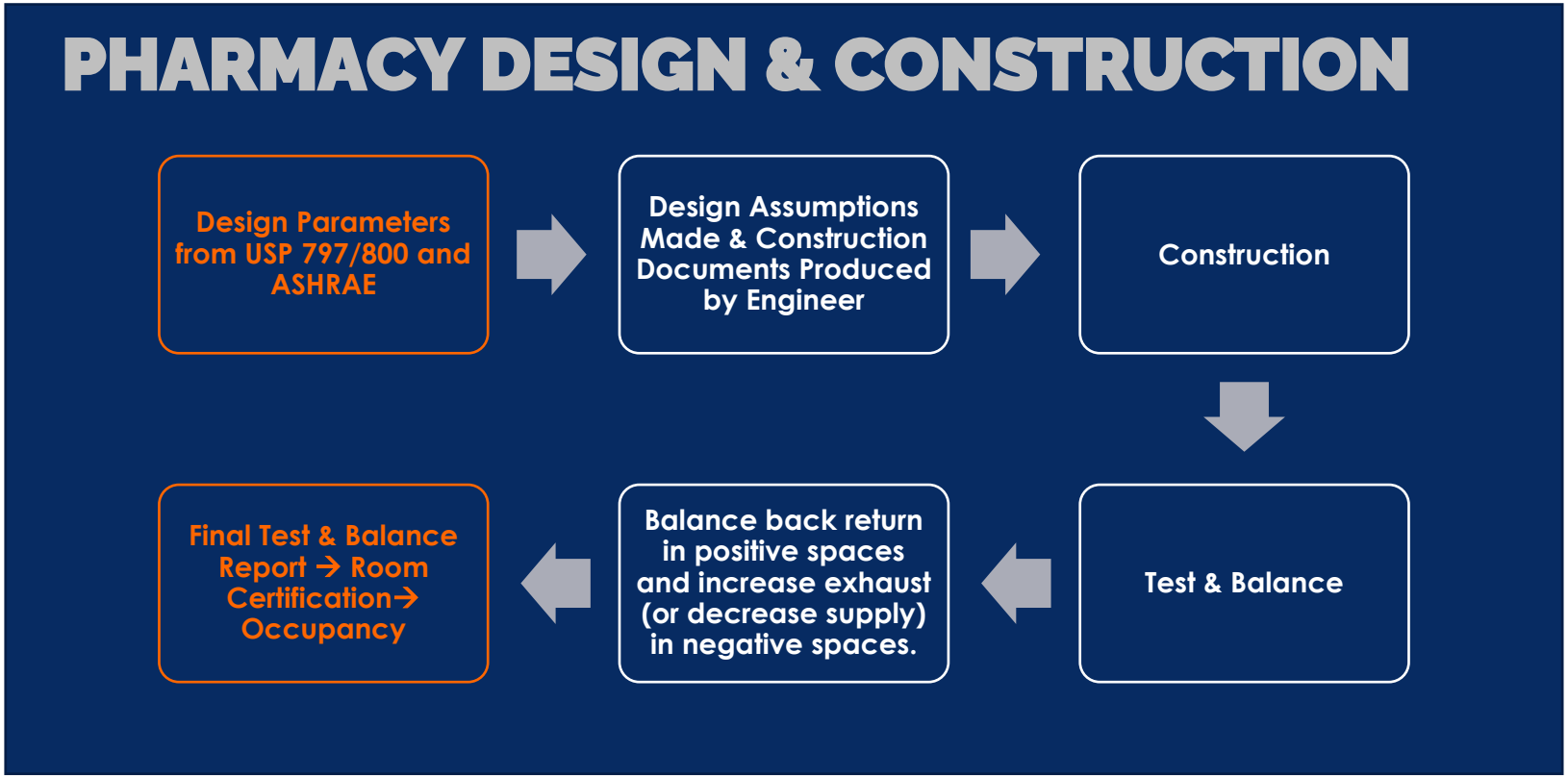
Table 2. ISO Classification of Particulate Matter in Room Air[a]

ISO Class	Particle Count[b] /m³
3	35.2
4	352
5	3520
6	35,200
7	352,000
8	3,520,000

[a] Adapted from ISO 14644-1, Cleanrooms and associated controlled environments—Part 1: Classification of air cleanliness by particle concentration.
[b] Limits for number of particles ≥0.5 µm measured under dynamic operating conditions.

- Ante-rooms connecting to positive pressure buffer rooms must meet a minimum of ISO Class 8.
- Ante-rooms connecting to negative pressure buffer rooms must meet a minimum of ISO Class 7.
- Typically, one Ante-room connects to both buffer rooms so designing to ISO Class 7 is best design practice.
- Buffer rooms must meet a minimum of ISO Class 7.

NAVIGATING USP 797/800

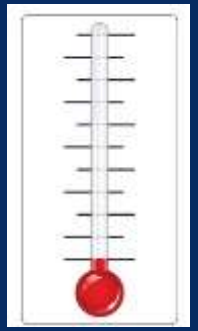


NAVIGATING USP 797/800

Construction/Architectural Requirements

- Sealing of Room
  - This is critical for pharmacy clean rooms
  - Gasketed/sealed light fixtures
  - Sealing of back boxes and wall penetrations
  - NO Door sweeps – source of contamination
  - Epoxy Paint (especially in humidified spaces)
  - Anywhere air can escape
- Design with no edges
- All surfaces need to be cleanable

HVAC Requirements



- USP Room Temperature Range – Below 68°F
  - Due to required layers of personal protective equipment (PPE) most facilities request pharmacies are design for maintain a temperature as low as 65°F.

- Humidity – no minimum but maximum of 60% RH
  - 20% minimum is recommended to avoid issues with personnel and equipment.
  - During the cooling season it is difficult to remain under 60% RH one hundred percent of the time unless you are using a sub-cooling or desiccant system which is often times cost prohibitive when a pharmacy is being built.

HVAC Requirements

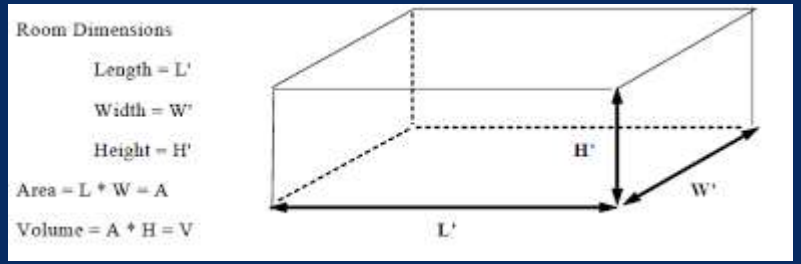
- Airflow calculations are performed to determine room air change requirements + heating/ cooling loads.

- Air Changes per Hour (ACH)
  - This is the amount of time air changes over within a given space within one hour of time.
  - The ACH is critical for removal of contaminants from the air and bringing ventilation air into the space.
  - When discussing air change rate there are three types of air to keep in mind.
    - Outside air: brought in through the central air handling unit.
    - Supply air: entering a room through the central air handling system.
    - Recirculated/filtered air: moving through air handling equipment within a given space (not considered fresh air).

HVAC Requirements

- How to calculate room air change rate?

$$\frac{CFM * 60}{ROOM\ VOLUME}$$

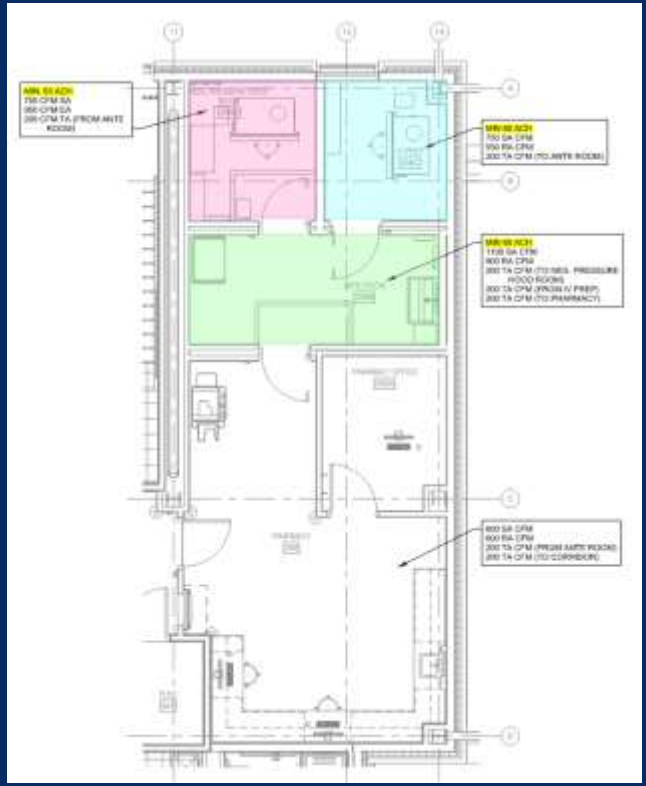


Note that gross room volume is used therefore the space occupied by furniture, cabinets, counters or small soffit volumes are included in overall volume.

HVAC Requirements

- USP Minimum Air Changes per Hour (ACH)
  - Ante Room = 30 ACH
  - Sterile Prep (IV Prep) = 30 ACH
  - Hazard Drug (Chemo Prep) = 30 ACH

- Best Practice Recommended Air Changes per Hour
  - Ante Room = 60 ACH
  - Sterile Prep (IV Prep) = 60 ACH
  - Hazard Drug (Chemo Prep) = 60 ACH



HVAC Requirements

Filtration Requirements

- USP requires all air being supplied to pharmacy clean rooms to pass through a HEPA filtered supply diffuser.
- The supply diffuser shall be sealed to ensure all air passes through the filter to avoid any contaminants from entering the room through the air stream.
- HEPA filtered diffusers shall be leak tested on a regular basis as part of the room recertirication process.

Image Source: priceindustries.com

HVAC Requirements

Room Pressurization

- Ante Room – positive to surrounding hospital.
- Sterile Processing (IV Prep) – positive to Ante room and other surrounding spaces.
- Hazardous Drug (Chemo Prep) – negative to Ante room and other surrounding spaces.

USP-797

ESTABLISHING AND MAINTAINING PRESSURE DIFFERENTIALS

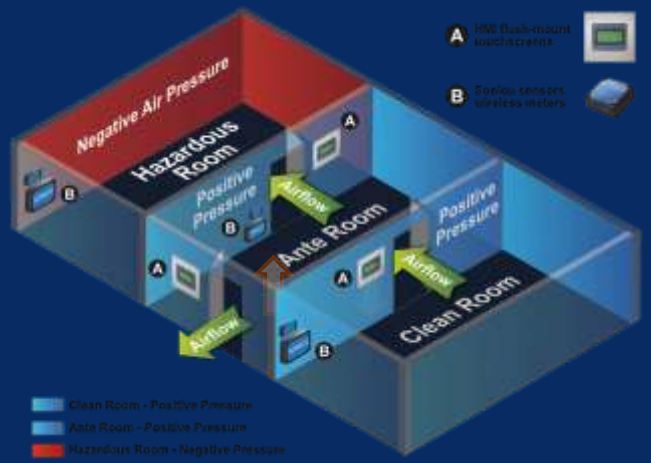
Continuous differential positive pressure is required to minimize airflow from an area with lower air-quality classification to an area of higher air-quality classification. In a cleanroom suite, a minimum differential positive pressure of 0.020-inch water column is required between each ISO classified area (e.g., between the buffer room and ante-room). The pressure differential between the ante-room and the unclassified area must not be less than 0.020-inch water column. No pressure differential is required between the SCA and the surrounding area. See (800) for pressure requirements for compounding HD CSPs.

Where pressure differentials are required, a pressure differential monitoring device must be used to continuously monitor the pressure differentials. The quantitative results from the pressure monitoring device must be reviewed and documented at least daily on the days when compounding is occurring.

USP-800

Table 2. Engineering Controls for Nonsterile HD Compounding

C-PEC	C-SEC Requirements
• Externally vented (preferred) or redundant-HEPA filtered in series • Examples: CVE, Class I or II BSC, CACI	• Externally vented • 12 ACPH • Negative pressure between 0.01 and 0.03 inches of water column relative to adjacent areas



- Image Source: sonicu.com

HVAC Requirements

Estimating room construction leakage

- Standard Practice: 100-150 CFM offset per door
- Is the space existing and leaks?
  - We have seen as much as 700 CFM offset to maintain pressures.
  - We have seen as little as 25 CFM offset to maintain pressures in clean room/pharmacy spaces
- Take our best estimate based on anticipated tightness of room construction

▪ Image Source: cleanlink.com

Room Pressure Control

- Room pressurization in a vital component in maintaining a sterile environment for compounding drugs and ensuring a safe environment for pharmacy staff and patients.

- Room pressure monitors or controllers shall be used at each room to inform users if the room meets the pressure requirements.
  - Room pressure monitors do just that, monitor the pressure but does not control the pressure.
  - Room pressure controllers provide active and dynamic control of the rooms through modulating air terminal boxes and/or fans on the system.

Room Name	Pressure Setpoint	Alarm Setpoint
Ante Room	+0.03" W.C.	+0.015" W.C.
HD Prep	-0.03" W.C.	-0.015" W.C.
Viral Prep	-0.03" W,C.	-0.015" W.C.
IV Prep	+0.05" W.C.	+0.01" W.C.

What effects room pressure?

- Tightness of construction.
- Movement of occupants in and out of the room.
- Changes in airflow in and out of the room.
- Changes in airflow in spaces outside of the clean room suite.
- Changes in the HVAC system such as an air handling unit going into or out of economizer mode.
- Changes in static pressure which occur overtime from filter loading.

Design of Cleanroom

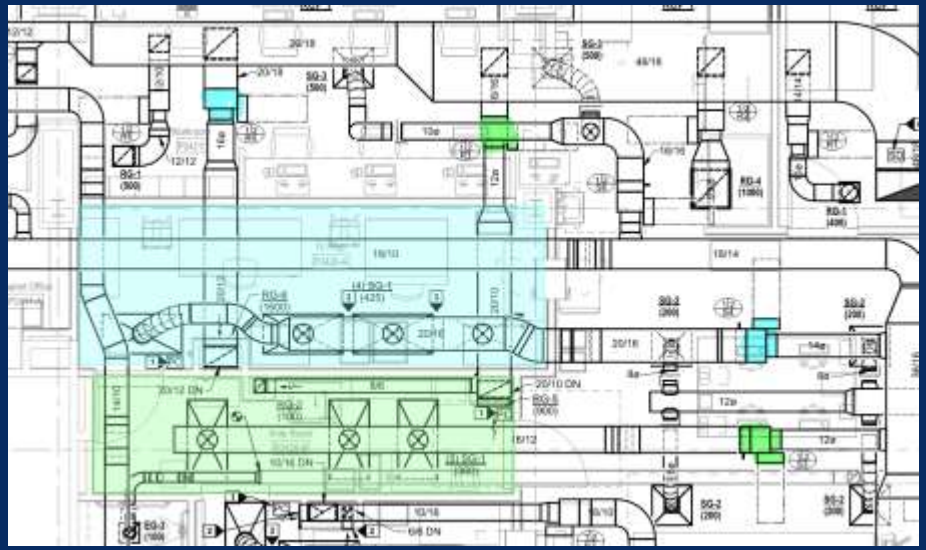
It is critical to any healthcare facility that the pharmacy can maintain its operations interruption free. This should be the goal of any pharmacy design.

Architects, Engineers, Facility team members, and Pharmacy staff should work together to obtain this goal.

When the following key components are utilized in pharmacy clean room design it helps to ensure a stable running and problem free pharmacy.

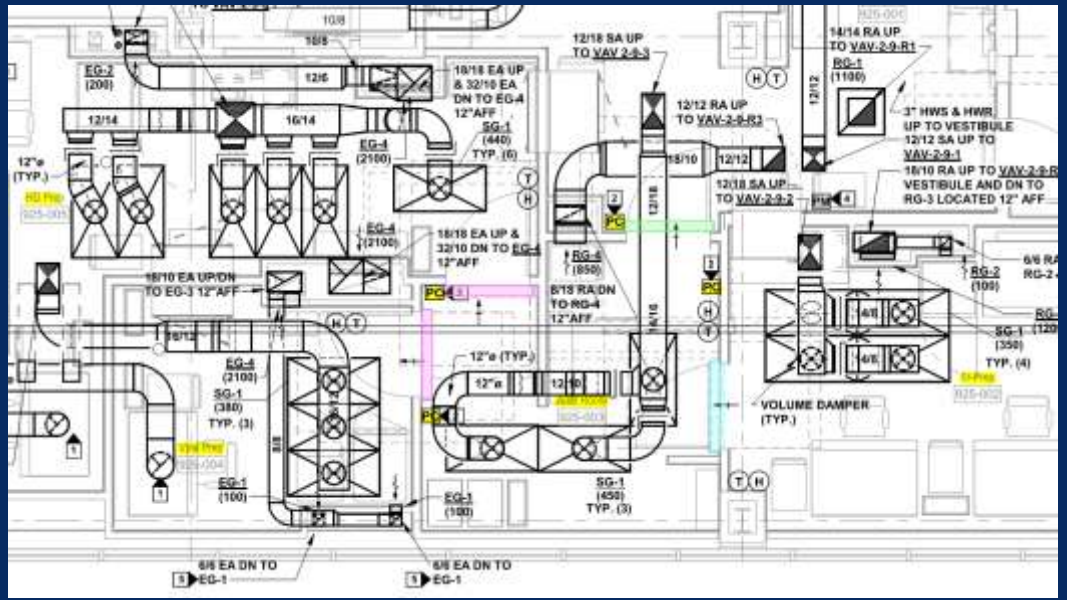
Design of Cleanroom

- Utilize air terminal boxes on supply and return/exhaust sides of any clean room. Boxes need to be located outside clean rooms.
- Use dedicated air terminal boxes for each individual room.



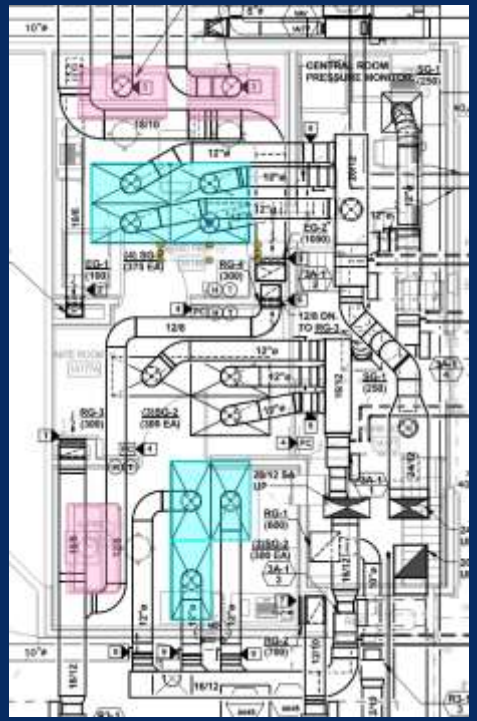
Design of Cleanroom

- Utilize room pressure controllers when possible.
- Include door switches.



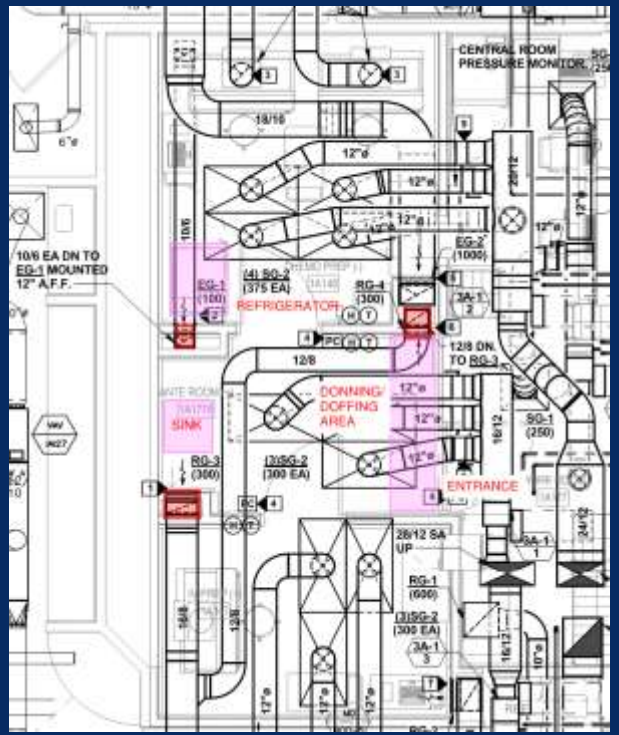
Design of Cleanroom

- Locate HEPA filtered supply diffusers away from the face of any hoods.
- Locate room return/exhaust grilles low in walls to help maintain unidirectional airflow at work areas.
- Proper location of supply diffusers and return/exhaust grilles helps to prevent turbulent air.



Design of Cleanroom

- Locate room return/exhaust grilles near entrance.
- Locate return/exhaust grilles at the compressor height on all refrigerators and freezers.
- Locate return/exhaust grilles at other potential sources of air contamination.



Design of Cleanroom

- Hazardous exhaust shall be discharged at roof level from a high plume exhaust fan.
- Best design practice includes redundancy in system which allows pharmacy to maintain operations in the event of equipment failure or required maintenance.
- Fan outlets shall be labeled as hazardous exhaust.

Image Source: greenheck.com

Testing and Certification

Certification of classified areas must be performed prior to occupancy and use of clean room. Recertification must occur at least every 6 months.

The following are tests that are required for certification/recertification:

- Airflow Testing including air velocity and volume, air change rate, and room pressures.
- HEPA Filter Testing which involve leak testing in the installed location.
- Total Particle Count Testing which must be performed under dynamic operating conditions.
- Dynamic Airflow Smoke Pattern Test to demonstrate unidirectional airflow

- Recertification is required if room goes out of the required pressurization range for longer than 59 minutes.

Maintaining Pharmacy Clean Rooms

- Replace HEPA filters in clean room diffusers on a regular scheduled basis.
  - HEPA filters can be provided with indicator lights to signal when filters need to be replaced.
  - Pressure sensor at HEPA filter should be connected to the BAS to notify facilities if there are issues.
- Perform preventative maintenance on all HVAC equipment serving clean rooms including AHUs and exhaust fans.
  - Schedule PM to occur at the same time the pharmacy needs to go through routine recertification to avoid additional shutdowns of clean rooms.
- Maintaining equipment will avoid complications in room pressure variances or unexpected failure of equipment.
  - If a clean room goes out of pressurization for longer than 59 minutes it will require recertification.

NAVIGATING USP 797/800

OTHER CONSIDERATIONS

- Zone pressurization
- Building occupancy schedules
- Building pressurization impacts
- Maintaining pressure relationships
- Indoor Air Quality (IAQ) importance
- Reliability of equipment including sensors

QUESTIONS/ ANSWERS

Contact Information:
Heather Erdman
Email: herdman@ringdu.com
Phone: 414.778.7407

Wisconsin Healthcare Engineering Association

RING & DuCHATEAU CONSULTING ENGINEERS

YOUR PARTNERS IN HEALTHCARE MEPT DESIGN

BROOKFIELD: 414.778.1700
MADISON: 608.733.5800