# DESIGN CONSIDERATIONS - COMPOUNDING PHARMACY

v100

ANTEC controls

The following are considerations when designing a compounding pharmacy. The items listed below help scope out project requirements and provide guidance on designing based on the specific needs.

## What is the intended use of this pharmacy?

Compounding pharmacies are used to mix compounds that are not commercially available in the required doses. These compounds are known as compounding sterile preparations (CSPs) and fall into four categories:

- Hazardous Drugs – reference USP 800
- Non-Hazardous Drugs
- Sterile Drugs – reference USP 797
- Non-Sterile Drugs – reference USP 795

Pharmacies have different space requirements for each drug type. Reference the appropriate standard listed above for the type of drug being mixed in the space.

### Will an ante room be required?

The USP 800 standard requires that the pharmacy equipment, typically a biological safety cabinet, provides a clean space to perform compounding activities:

> "Containment Primary Engineering Controls (C-PEC) must be located in a Containment – Secondary Engineering Control (C-SEC), which may either be an ISO Class 7 buffer room with an ISO Class 7 ante-room (preferred) or an unclassified containment segregated compounding area (C-SCA)."

This equipment needs to be housed in a space that is maintained at ISO Class 7 levels (refer to USP 797, Table 1 for details on ISO Classification). The equipment is known as the primary containment, the room itself is known as the secondary containment.

## What type of Primary Engineering Controls (C-PEC) are used?

Biological Safety Cabinets (BSC) are the most common form of C-PEC in a pharmacy. BSCs are split three classes:

- Class I – Provide protection for personnel only. They provide no protection for the agent being mixed nor the environment
- Class II – Provide protection for the agent being mixed, personnel and the environment. This class is split into 4 categories, A1, A2, B1 and B2. For more information on each type, reference the ASHRAE Applications Handbook, 2019, Chapter 16

- Class III – Create a physical barrier between the worker and the agent being mixed. These offer the highest form of containment and protect the agent being mixed, personnel and the environment

### How will the C-PEC exhaust flow be controlled?

C-PECs must be continuously operated in the compounding pharmacy. All three cabinet types are required to exhaust some proportion of their total airflow directly outside. Most C-PECs are constant volume devices and should be controlled with a constant volume valve. Some may require a decontamination sequence which will require an air valve capable of shutoff (0 CFM) or a separate bubble tight damper.

## What air valve technology will be used?

The preferred air valve technology in compounding pharmacies is dependent on the application.

### What air valve technology should be used for supply and general exhaust (secondary containment)?

High accuracy terminals paired with a standard speed actuator are the preferred method of room level airflow control. Compounding pharmacies are often designed with dedicated air handling and exhaust systems meaning that variation in pressure in the system will be minor. Standard speed actuation will ensure modulation for these changes does not introduce instability and provides a stable, accurate form of airflow control.

Venturi valves are also an acceptable solution for the supply and exhaust air in the pharmacy provided that a sufficient pressure drop is available.

Standard accuracy terminals are another potential solution in this application but should be applied with caution. Standard accuracy terminals can struggle to keep up with changes in duct static pressure which may result in a loss of room pressurization.

### What air valve technology should be used for primary containment exhaust (C-PEC)?

Venturi valves are the preferred method for control of the C-PEC exhaust as they will provide the most simple and cost-effective control for these cabinets. No controller is required to perform this function as constant volume venturi valves are mechanically set and the plunger responds instantaneously to changes in duct static pressure without the need for any additional controls.

### Will the installed valve need to be horizontal, vertical up or vertical down?

Venturi valves must be installed in their ordered configuration to ensure the valve is able to regulate airflow while accounting for the effect of gravity on the plunger. Both high accuracy and standard accuracy terminals can be mounted in any orientation.

### Is sound a concern?

High accuracy and standard accuracy terminals are generally quieter than venturi valves, but silencers can be used in conjunction with venturi valves if required.

## What room control strategy will be used?

Flow offset control is the preferred room control strategy in compounding pharmacies as it is the most stable solution. Compounding pharmacies are generally small spaces with high air change rates which creates an environment that is difficult to steadily pressurize. Flow offset control is employed by maintaining a constant volumetric offset between supply and exhaust flow in the space.

Pressure control, where the room is controlled to a constant pressure, is also an acceptable control strategy. This method should be employed with caution as it can be less stable and introduces the risk of overshoot or undershoot.

### What is the required room setpoint?

USP 800 provides requirements for the room pressures that must be maintained:

For hazardous drugs mixing spaces the buffer room must be maintain between -0.01 and -0.03 in.w.c at all times.

The ante space must be maintained at least at +0.02 in.w.c. In spaces using a pressure control strategy, this is the room setpoint.

When using flow offset control, the setpoint will be the difference between the supply and exhaust flows; this value will vary depending on the size and leakage of the space. An offset setpoint between 10 – 20% of maximum flow is acceptable in most cases. If this setpoint does not provide the required room pressurization, the value can be balanced on site.

### Is pressure monitoring required?

Refer to USP 797, which states:

> "A pressure gauge or velocity meter shall be installed to monitor the pressure differential or airflow between the buffer area and the ante-area and between the ante-area and the general environment outside the compounding area"

This means pressure monitoring is required between each adjacent space in the compounding pharmacy.

## What is the minimum ventilation rate?

USP 800 requires that pharmacies mixing sterile preparations maintain a minimum of 30 air changes per hour (ACH) in the mixing space and the connected ante space. Non-sterile spaces are required to maintain a minimum of 12 ACH.

### Will there be auxiliary exhaust equipment?

Consideration should be made in each space for the equipment as well. Biological safety cabinets will require an exhaust airflow rate that may inflate the minimum ACH value.

### Will there be additional thermal demand?

In some spaces, thermal demand may exceed the minimum ventilation rate. It is imperative that the valve system is capable of handling the expected worst-case scenario, while also having a turndown ratio capable of reaching the minimum ventilation rate.

## Additional Design Considerations

Compounding pharmacies pose a unique design problem when compared to other healthcare environments. In particular, the Sterile Hazardous Drugs mixing space can be particularly difficult to design, install, balance and commission. The combination of the issues outlined below creates a highly sensitive space that will exacerbate any issue that has been previously addressed.

Individually these are minor design considerations, however taken together they require special design:

### High Air Change Rates

High air change rates on their own are generally not an issue. To achieve a higher airflow rate in the space the designer can simply supply more air. However, when supplying more air to a space, air valve accuracy must be considered. Venturi Valves and High Accuracy Terminals have an accuracy of +/-5%, across the board. When this value is applied to higher air volumes, the actual volume of air to be considered as a part of the error increases. This means that as the air volume increases, valve accuracy will become a larger and larger issue to consider.

### Room Size

Hazardous Drug (HD) rooms are home to several different pieces of equipment, staff members and are fairly high traffic areas. These small areas mean that any small change to the mechanical system will have a large effect on room layout and design. Designers should always consider:

+ The installation of air valves, fan filter units and other equipment
+ Leakage areas are sealed up and removed from these spaces. This extremely tight construction space causes the differential volume of air required for pressurization to shrink.
    - This includes checking for door sweeps, sealing around diffusers and registers among other methods
    - For example, if a standard room requires an offset of 200 CFM to achieve -0.02 in.w.c. then a tightly sealed, smaller space may require 50 CFM to achieve the same set point. When you combine the 50 CFM requirement with the high air change rate in this space, the small required offset may mean that no air valve technology is accurate enough to control this space

## Room Pressure Requirements

In most pressurized applications such as operating rooms and laboratories, the required room pressure is given as a minimum value.  For example, operating rooms need to be maintained at +0.01 in.w.c at a minimum. It is permissible to go more positive than this. For the HD room, this pressure is provided as a range, -0.01 - -0.03 in.w.c. This means that the HD room must be set to -0.02 in.w.c. with extremely limited room for error.