Element D Services
Heating, Ventilating, and Air Conditioning
D304101 Patient Treatment Air Handling Distribution

PART 1 - GENERAL

1.01 OVERVIEW

A. This section supplements Design Guideline Elements D3041 and D300101 on air handling distribution with specific criteria for projects involving design of patient treatment or clinical space.

B. Refer to Design Guideline Element D3041 for the following:
   1. General design criteria related to outside air pre-treatment units, terminal units, air devices and ductwork.
   2. Special Contract Document Requirements and products applicable to the Project.

C. Air Handling Unit selection shall be compliant with ASHRAE 90.1.

PART 2 - DESIGN CRITERIA

2.01 GENERAL

A. Air handling systems that serve outpatient and inpatient care areas shall be designed as single duct VAV distribution systems.

B. Air handling units serving inpatient care treatment areas shall have redundant (N+1) fan systems. Multiple supply and return air fans or fan wall technology shall be incorporated in the unit design to achieve redundancy.

C. Dual Duct VAV air handling units are to be used only in cases when an existing air handler serving a dual duct air distribution system is to be replaced.

D. Air handling systems that serve Operating Rooms (OR) and Pre-and-Post Operating rooms shall have redundant air handling units and return air fan systems.

E. Variable air volume terminals that modulate supply air based on ASHRAE 62.1 and room temperature shall be confined only to spaces that do not require constant air change rates and/or critical pressure differentials with respect to adjoining spaces.

2.02 PATIENT TREATMENT AIR HANDLING UNITS

A. Air handling units serving Patient Care Rooms, Cancer Treatment Rooms, or Clinical Exam Rooms shall be single duct VAV systems unless noted otherwise.

B. Each single zone unit VAV shall include, but not be limited, to the following components for air distribution systems serving OR spaces:
1. Mixing air plenum section.
2. Pre-filter section MERV 8 as rated by ASHRAE Standard 52.2-99.
3. Pre-heat hot water heating coil.
4. Access section.
5. Chilled water-cooling coil: minimum water velocity of 2 fpm; copper tubes, copper fins, maximum 9 fins per inch, and maximum 6-row coil.
6. Access section.
7. Supply fan direct drive fans preferred; centrifugal type, minimum 12 blades per fan. Fan speed is controlled with a VFD.
8. MERV 18 final filters (varies by application; confirm with M. D. Anderson Cancer Center).
9. High static pressure and smoke detection shutdown control and reset capability.
10. Instrument measurement taps for static pressure, temperature, etc.

C. Patient care areas that require special ventilation include Surgical Operating Rooms, Catheter Labs, Protective Environment (PE) Rooms, Airborne Infection Isolation Rooms, Laboratories, and local exhaust systems for hazardous agents. These areas require redundant mechanical systems to ensure infection control and to ensure that ventilation deficiencies do not occur due to loss of power of major HVAC equipment components.

D. Restrooms, janitors, and locker rooms in patient facilities are negative with respect to adjacent spaces corridors, and they are connected to the building’s general exhaust fan system.

E. Design patient rooms for care and recuperation at proper outside ventilation and recirculation air change rates, and slightly positive with respect to the corridor and private patient restroom. Outside air and supply air handling units’ major active components must be redundant (N+1). Patient restrooms are to be connected to the building’s general exhaust fan system.

F. Design criteria, ventilation air rates and recirculation air rates for Intensive Care Rooms (ICUs) are similar to Patient Care Rooms.

G. Patient Isolation Rooms:

1. Rooms must be designed as once-through ventilation systems served with dedicated redundant (N+1) exhaust air filtration (MERV 17 HEPA filters) and fan systems. The quantity of supply air to each isolation room shall meet the required supply and exhaust air offset to maintain the room at a negative pressure per AIA requirements and also meet room total cooling heating load requirements.
2. The exhaust airflow rate from the isolation room shall meet the minimum required air change rate, and also maintain constant exhaust airflow during all modes of system operation. The patient private restroom shall also be considered as part of the isolation room exhaust air requirement.

3. The total exhaust from all of the combined isolation rooms shall be filtered with a bag-in and bag-out HEPA filter caisson prior to being discharged to the environment by a high plume exhaust fan.

H. Patient Protective Environment (PE) Rooms:

1. Rooms must be designed at proper outside ventilation and recirculation air change rates, and maintained at the required minimum positive pressure with respect to the corridor and adjacent rooms or spaces per AIA requirements. Filter the supply air to PE rooms using MERV 18 HEPA filters.

2. The quantity of supply air to each PE room shall meet the required supply and return air offset to maintain the room at a positive pressure with respect to adjacent spaces and the corridor and to also meet the room’s cooling and heating load requirements.

3. The exhaust airflow rate from the patient restroom shall be included in the required air change rate and to also maintain constant exhaust airflow during all modes of system operation.

I. General Operating Room (OR) Suites:

1. Suites must be designed at proper outside ventilation and recirculation air change rates, and maintained at the required minimum positive pressure with respect to the corridor and adjacent rooms or spaces per the AIA requirements. Filter supply air to OR Suites using MERV 17 HEPA filters.

2. The quantity of supply air to each OR Suite shall meet the required supply and return air offset to maintain the room at a positive pressure with respect to adjacent spaces and to also meet room total cooling and heating load requirements.

3. The A/E must consider special exhaust air requirements if a laser knife will be used in the room to perform cutting and cauterizing of tissue and blood vessels.

4. The exhaust airflow rate from the OR Suite shall meet the minimum required air change rate and also maintain constant exhaust airflow during all modes of supply air system operation.

5. If explosive anesthetic medical gases are used in the OR Suite, then an emergency smoke purge fan must meet the required air change rate and also maintain the affected OR Suite at a slightly negative pressure with respect to the sterile processing suite and adjacent OR Suite and corridors. Operating Rooms that have glass windows with exposure to the outside environment do not require smoke evacuation systems.
6. Humidity requirements for each OR Suite shall be individually maintained and the humidifier steam distribution manifold shall be installed in the supply duct downstream of the terminal unit reheat coil. Access panels are to be placed in hard ceilings to gain access to the humidifiers for maintenance purposes.

J. Orthopedic Operating (OR) Room Suites:

1. Suites designed for surgery or bone marrow transplants shall have an outside ventilation rate of 4 air changes per hour and a recirculation rate of 40 air changes per hour. The orthopedic OR Suite shall be maintained at the required minimum positive pressure with respect to the corridor and adjacent rooms or spaces per AIA requirements. Filter supply air to Orthopedic OR Suites using MERV 18 HEPA Filters.

2. The quantity of supply air to each Orthopedic OR room suite shall meet the required supply and return air offset to maintain the room at a negative pressure respect to adjacent spaces and to also meet room total cooling and heating load requirements.

3. The A/E must consider requirements if a laser knife will be used in the room to perform cutting and cauterizing of tissue and blood vessels.

4. If explosive anesthetic medical gases are used in the Orthopedic OR Suite, an emergency smoke purge fan must meet the required air change rate and also maintain the affected room at a slightly negative pressure with respect to the sterile processing suite and adjacent ORs and corridors. Operating Rooms that have glass windows with exposure to the outside environment do not require smoke evacuation systems.

5. Operating Rooms that utilize glass windows with exposure to the outside environment do not require smoke evacuation systems.

6. Humidity requirements for each OR Suite shall be individually maintained and the humidifier steam distribution manifold shall be installed in the supply duct downstream of the terminal unit reheat coil. Access panels are to be placed in hard ceilings to gain access to the humidifiers for maintenance purposes.

K. Cath Lab Suites:

1. Suites must be designed at proper outside ventilation and recirculation air change rates of and maintained at the required minimum positive pressure with respect to the corridor and adjacent rooms or spaces per AIA requirements. Filter supply air using MERV 17 HEPA filters.

2. The quantity of supply air to each Cath Lab shall meet the required supply and return air offset to maintain the room at a positive pressure with respect to adjacent spaces and also to meet room total cooling and heating load requirements.

3. The exhaust airflow rate from each Cath Lab room shall meet the minimum required outdoor ventilation air change rate.
4. If explosive anesthetic medical gases are used in the Cath Lab, an emergency smoke purge fan shall meet the required air change rate and also maintain the affected Cath Lab at a slightly negative pressure with respect to adjacent Cath Labs and corridors. Cath Labs that have glass windows with exposure to the outside environment do not require smoke evacuation systems.

5. Humidity requirements for Cath Lab Suites shall be maintained and the humidifier steam distribution manifold shall be installed downstream of the final filter at the discharge of the air handling unit.

2.03 REPLACEMENT DUAL DUCT AIR HANDLING UNITS

A. The conventional single fan blow through dual duct air handling unit can only be used in extreme cases where physical space excludes the use of a dual fan dual duct unit. The standard conventional dual duct air handling unit shall be served by an outside air pretreat air handling unit to condition the ventilation air.

B. Dual fan (cold deck fan, hot deck fan), dual duct, draw through air handling units may not require pretreated outside air since the design of the cold deck and hot deck fans draw air through cooling and heating coils. A/E to confirm based on project design conditions.

C. The dual fan, dual duct air handling unit must have an insulated partition wall between the unit the hot deck and the cold deck side of the unit. A relief damper located downstream of the pre-filter section allows return air to enter the cold deck and mix with the outside air upstream of the cooling coil section.

D. The dual fan, dual duct air handling unit shall include, but not be limited to, the following components:

   1. Return air inlet plenum (hot deck side of unit).
   2. Outside air inlet plenum (cold deck side of unit).
   3. Access doors to both return and outside air plenums.
   4. Pre-filter section MERV 8 as rated by ASHRAE Standard 52.2-99; (split filter sections for hot deck and cold deck).
   5. Access sections and doors to hot deck side and cold deck side.
   6. Coil section:
      a. Hot deck hot water heating coil: copper tubes, aluminum fins; maximum 9 fins per inch, minimum 2 fins per inch.
      b. Cold deck, chilled water cooling coil, minimum water velocity of 2 fpm; copper tubes, copper fins; maximum 9 fins per inch, minimum 2 fins per inch, maximum 6 row coil.
c. UV Lamps located in downstream of cooling coil in access section if required by the application (the impact of the UV light on materials should be checked). All the safety features should be installed along with UV installation.

7. Access section downstream of heating coil and cooling coil sections

8. Hot deck and cold deck fan sections; direct drive fans preferred; Centrifugal airfoil blade type, minimum 12 blades per fan. Fan speed is controlled with a VFD.

9. Access doors to fan sections.

10. Final filter sections for cold deck and hot deck MERV 16, 17, or 18 as rated by ASHRAE Standard 52.2-99; (varies by application; confirm with M. D. Anderson Cancer Center).

11. Cold deck and hot deck discharge air plenum sections.

12. High static pressure and smoke detection shutdown control and reset capability.

13. Instrument measurement taps for static pressure, temperature, etc.

E. Reference Design Guideline Element D3041 for the design configuration of an Outside Air Pretreat Unit.

2.04 TERMINAL UNITS AND AIR VALVES

A. This section addresses design of terminal units for zone air distribution in patient treatment areas. Refer to Design Guideline Element D3041 for general design criteria related to terminal units.

B. Specify single duct constant volume terminal units with hot water zone heating coils for patient care areas. Normally three patient exam rooms are served by one terminal unit, but in some cases a minimum of two exam rooms may be served from one terminal unit.

C. Protective Environment Rooms and Isolation Rooms will require air valves that are capable of maintaining a constant offset between supply air and return or exhaust air from the space which is dependant on the function of the room. Hot water reheat coils are used to maintain room temperature settings.

D. For all occupied patient spaces, both exterior and interior zones, the minimum hot and cold settings of terminal units shall be such that minimum ventilation needs per ASHRAE 62.1 for the occupants are met at all times.

E. Terminal unit insulation shall be fiber-free, encapsulated type meeting UL181 and NFPA 90A standards, per Master Construction Specifications.

F. When zoning patient treatment areas, design no more than three (3) exam rooms per terminal unit.
2.05 AIR DEVICES

A. Air supply for operating rooms (OR) used for invasive procedures shall be at the ceiling. Return or exhaust air inlets shall be near the floor level. Laminar flow devices are to be used in all ORs and Cath Labs.

B. Each OR must have at least two return air inlets located as remotely from each other as practical. Design should consider turbulence and other factors of air movement to minimize fall of particulates onto sterile surfaces. Specify laminar flow supply air devices for this application.

C. Air supply for ORs shall be from ceiling outlets near the center of the work area. Return air shall be near the floor level.

D. Smoke evacuation exhaust air grilles are to be installed in the ceilings of ORs and Cath Labs where nitrous oxide will be used for anesthesia. Operating Rooms or Cath Labs that utilize glass windows with exposure to the outside environment do not require smoke evacuation systems.

E. Wall mounted exhaust air grille shall be located near the floor and at the head of the patient bed for Post-Operative Rooms where patients have received anesthesia using nitrous oxide gas.

F. The supply air diffusers PE Room shall be located above near the patient bed and the wall return grilles or registers shall be located near the patient room door.

G. Wall mounted exhaust air grilles shall be located near the floor and at the head of the patient bed for patient Airborne Infection Isolation Rooms.

2.06 HUMIDIFIERS

A. Air distribution systems located in climate zones where low humidity condition exist the during the winter months; the humidifier shall be a steam manifold jacketed type with return air duct-mounted sensor/controller and supply duct-mounted high limit switch. The humidifier shall be installed downstream of the final filter at the hot deck discharge duct side of the air handling unit. Clean steam must be used for humidification purposes.

B. Air distribution systems located in climate zones where high humidity conditions exist except for short period of time during the winter months, a packaged electronic humidifier can be used in lieu of the standard steam system humidifier. When an electronic humidifier is used in the design, the makeup water to the unit needs to be a 50/50 mix of either RO or soft water mixed with domestic potable water.

2.07 DUCTWORK

A. Except for patient isolation rooms, which are totally exhausted, return air shall be ducted and shall be considered as a design standard for patient care, patient treatment, examination rooms, protective environment rooms, and areas.
B. Duct sections shall be made of stainless steel where clean steam humidifiers are placed, and stainless steel train piping or tubing shall be placed at the bottom of the duct to prevent condensed steam from remaining inside the supply air duct.

PART 3 - SPECIAL CONTRACT DOCUMENT REQUIREMENTS

3.01 GENERAL

A. Not applicable.

PART 4 - PRODUCTS

4.01 GENERAL

A. Refer to Master Construction Specifications.

PART 5 - DOCUMENT REVISION HISTORY

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<td>Revised 2.01 B and C, 2.02 A, B rolled in 2.04 to 2.02 Revised 2.02 G, I, J, and K, 2.06 now is 2.05, revised 2.05 F and added G. 2.06 redefined as Humidifiers.</td>
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