PART 1 - GENERAL

1.01 OVERVIEW

A. This section supplements Design Guideline Elements D3041 and D300101 on air handling distribution with additional 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 pretreat units, terminal units, air devices, fan coil units, unit heaters, stairwell pressurization fans, ductwork, and exhaust / intake louvers.

2. Special Contract Document Requirements and products applicable to the Project.

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

D. Refer to NFPA 92A for Smoke Control Systems Utilizing Barriers and Pressure Differences.

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. Single duct constant air volume (CAV) terminals with reheat air are used for Patient Care areas such as operating rooms, protective environmental rooms, and exam rooms where air change rates need to remain constant.
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 7 as rated by ASHRAE Standard 52.2-99.
3. Pre-heat hot water heating coil. Refer to requirements listed in Design Guideline Element D3041.
4. Access section.
5. Chilled water-cooling coil: Refer to requirements listed in Design Guideline Element D3041.
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. All patient care areas shall have MERV 14 (HEPA) final filters.
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 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. For each project, evaluate with the Owner if the total exhaust from all of the combined isolation rooms should 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 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 Operating Room Suites 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 Operating Room Suites using MERV 18 HEPA Filters.

2. The quantity of supply air to each Orthopedic Operating 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 Operating Room 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. Orthopedic Operating Rooms that have glass windows with exposure to the outside environment do not require smoke evacuation systems.

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

6. Humidity requirements for each Orthopedic Operating Room 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 TERMINAL UNITS AND AIR VALVES

A. This section addresses design of terminal units for zone air distribution in patient treatment areas. The casing for terminal units serving hospitals shall be double wall construction. Refer to Design Guideline Element D3041 for general design criteria related to terminal units.

B. Specify single duct variable volume terminal units (except where space protocol and applicable Code/Standards merit otherwise) 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’s serving for all patient areas and clinics shall be be double wall manufactured to MDACC standards, per the Master Construction Specifications.

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

2.04 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.

2.05 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.

2.06 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 Owner’s Master Construction Specifications. These are available on the Owner’s Design Guidelines website: http://www2.mdanderson.org/depts/cpm/standards/specs.html

B. Consider the use of heat recovery components in the design of the system where the sensible and latent heat from outside air is transferred to the exhaust air. Refer to Design Guideline Element 3041 for energy recovery requirements.

PART 5 - DOCUMENT REVISION HISTORY

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Revision Description</th>
<th>Reviser</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>01-01-07</td>
<td>Initial Adoption of Element</td>
<td></td>
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<tr>
<td>Rev. 1</td>
<td>12-11-07</td>
<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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<tr>
<td>Rev. 2</td>
<td>12-09-08</td>
<td>Included sustainability requirements throughout document based upon TGCE’s evaluation. (Paragraphs 2.02 B3; 2.02 B 5; 2.02 G 1; 2.02 G 3; 2.03 D 6 a; 2.03 D 6 b; 2.04 B &amp; 4.01 B)</td>
<td>JCD</td>
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<tr>
<td>Rev. 3</td>
<td>07-23-09</td>
<td>Added 1.01 D. reference standard.</td>
<td>PDN</td>
</tr>
<tr>
<td>Rev. 4</td>
<td>07-08-10</td>
<td>Revised 2.02 A., 2.02, B.8. 2.03. Deleted requirement for dual duct AHU. Editorial corrections to other sections.</td>
<td>PDN</td>
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<tr>
<td>Rev. 5</td>
<td>05-17-12</td>
<td>2.02 B. 2 Revised Pre-Filter from MERV 8 to 7, and 2.02 B 8. Revised the Final filter From MERV 18 to 14.</td>
<td>JR / VS PDN</td>
</tr>
<tr>
<td>Rev. 6</td>
<td>06-14-12</td>
<td>2.03 B added clarification that VAV terminals for hospitals are to be double wall construction.</td>
<td>JR / VS PDN</td>
</tr>
<tr>
<td>Rev 7</td>
<td>06-28-12</td>
<td>2.03 E. Revised the statement to direct the engineer to use double wall terminal units for all patient and clinic areas.</td>
<td>VS/PDN</td>
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END OF ELEMENT D304101