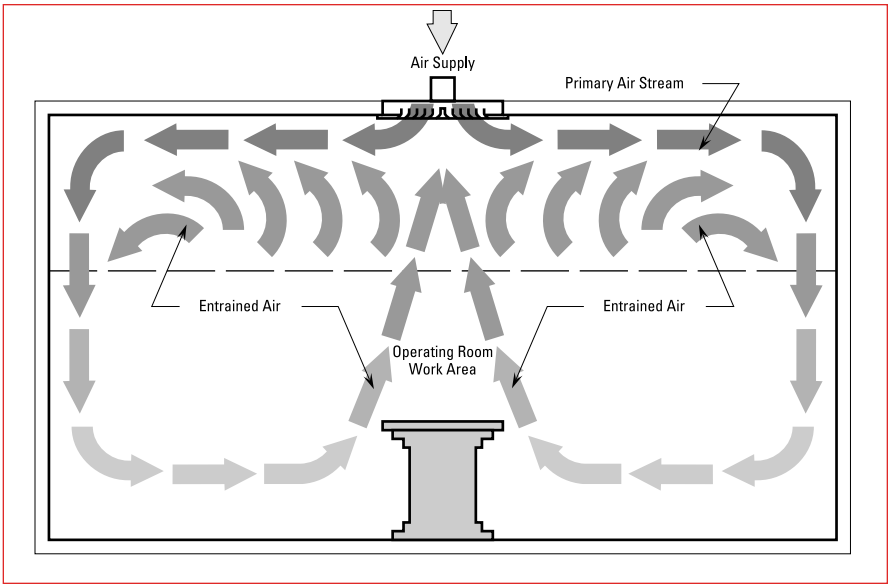
Hospital Operating Rooms

Hospital Operating Rooms
Air distribution for hospital operating rooms is much more critical and specialized than for a typical air conditioned office building space. In an office building the air distribution system is designed to entrain room air into the supply air stream so as to rapidly mix the two air masses and create a more uniform temperature in a draftless occupied zone.

This type of air distribution system is not suitable for a hospital operating room as it would cause the uncontrolled spread of airborne contaminants.

In the hospital operating room, the control of airborne contaminants is a consideration in addition to the room comfort conditions. Opinions vary regarding the importance of airborne contamination with respect to post-operative infection. It is generally agreed that the majority of infections are caused by contact contamination from the patient themselves or the surgical team. Studies have also indicated a relationship between the incidence of infection and the level of air contamination. While the validity of these results can be questioned due to changes in surgical gowns, surgical techniques, antibiotics, etc., the consensus is simply that the air should be kept as clean as possible.

The two primary sources of airborne contamination are generally considered to be micro-organisms present within the operating room and particles introduced into the operating room by ventilation or infiltration. Particles entering the operating room by ventilation can be controlled with the use of high efficiency particulate filters, while infiltration is controlled by maintaining a positive pressure in the operating room as compared to the surrounding spaces.



The largest sources of contamination in a sterilized operating room, with a clean air supply and isolation from adjacent areas, are the surgical team and patient. The function of the operating room's air distribution system, therefore must be to carry away any contaminants expelled into the air by either the surgical team or the patient on the operating table. The system must also isolate and remove this contaminated air so it cannot mix with the clean supply air. The simplest way to reduce the airborne contaminants present in the operating room is to increase the fresh air ventilation rate. This practice of dilution has led to air supply exchange rates much in excess of those typically required for thermal control. In fact, these increased air exchange rates can lead to thermal discomfort due to drafts. As a result, an air distribution system for the operating room must be capable of introducing a large volume of supply air into the space in a controlled manner while maintaining an acceptable comfort level in the occupied zone. An effective method of controlling the transport of airborne contamination is the introduction of supply air into the operating room at a low uniform velocity to promote a stable downward flow of air.

All Metric dimensions ( ) are soft conversion.
Imperial dimensions are converted to metric and rounded to the nearest millimetre.

Hospital Operating Rooms

Laminar Flow Systems

The laminar flow ventilation system was developed to provide a method of controlling the transport of air contamination by introducing the supply air into the operating room at low uniform velocities promoting a stable downward flow of air. The most effective laminar flow ventilation system would have the entire ceiling consisting of laminar flow diffusers to prevent entrainment. A complete ceiling of laminar flow panels would require much more air to develop a proper air pattern than is required to achieve the specified number of air changes per hour.The high air change rates required to produce laminar flow over the entire room normally rule out this system due to high energy costs.

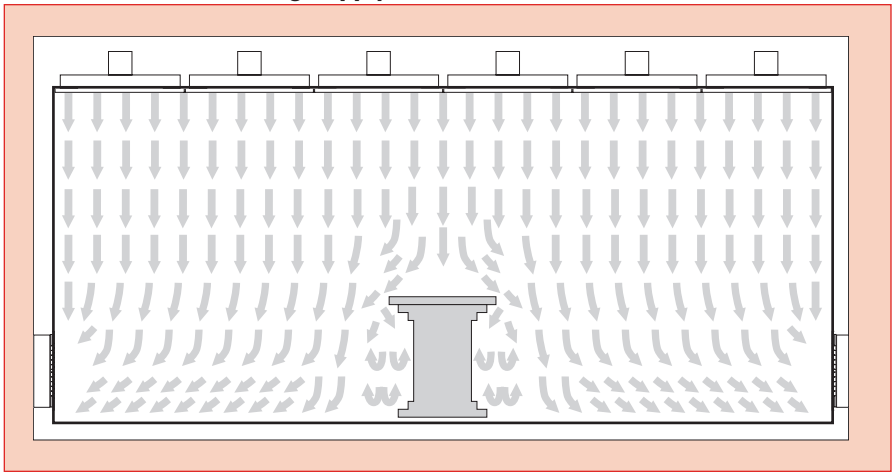
By reducing the area of laminar airflow to the critical zone around the operating table, the total air requirements of the system can be reduced. Although laminar flow diffusers discharge air at low face velocity, some entrainment of room air still occurs. This entrainment in combination with the temperature differential of the supply air causes the air pattern to angle towards the center of the discharge air envelope. As a result the clean zone is reduced as the distance from the face of the diffuser is increased. This should be considered when laying out the location for the laminar flow diffusers.

The supply air for a laminar flow ventilation system is filtered by a HEPA filter bank located upstream of the operating room air distribution system, or by HEPA filters which are an integral part of each of the laminar flow diffusers.

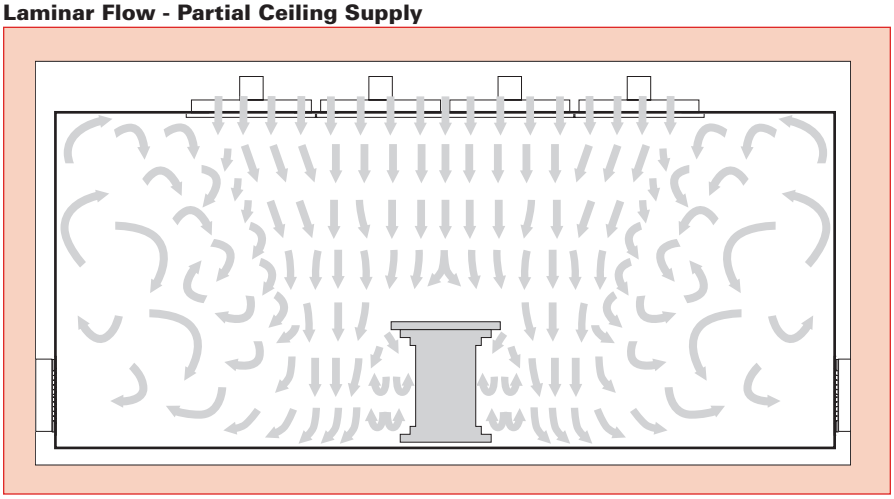
With the HEPA filters located in a bank upstream of the operating room, filter service and maintenance can be performed without entering the sterile environment of the operating room.

Supply diffuser with room side replaceable integral HEPA filters offer ease of accessibility for filter service and change-out, but must be accessed from inside the sterile operating room.

Laminar Flow - Full Ceiling Supply

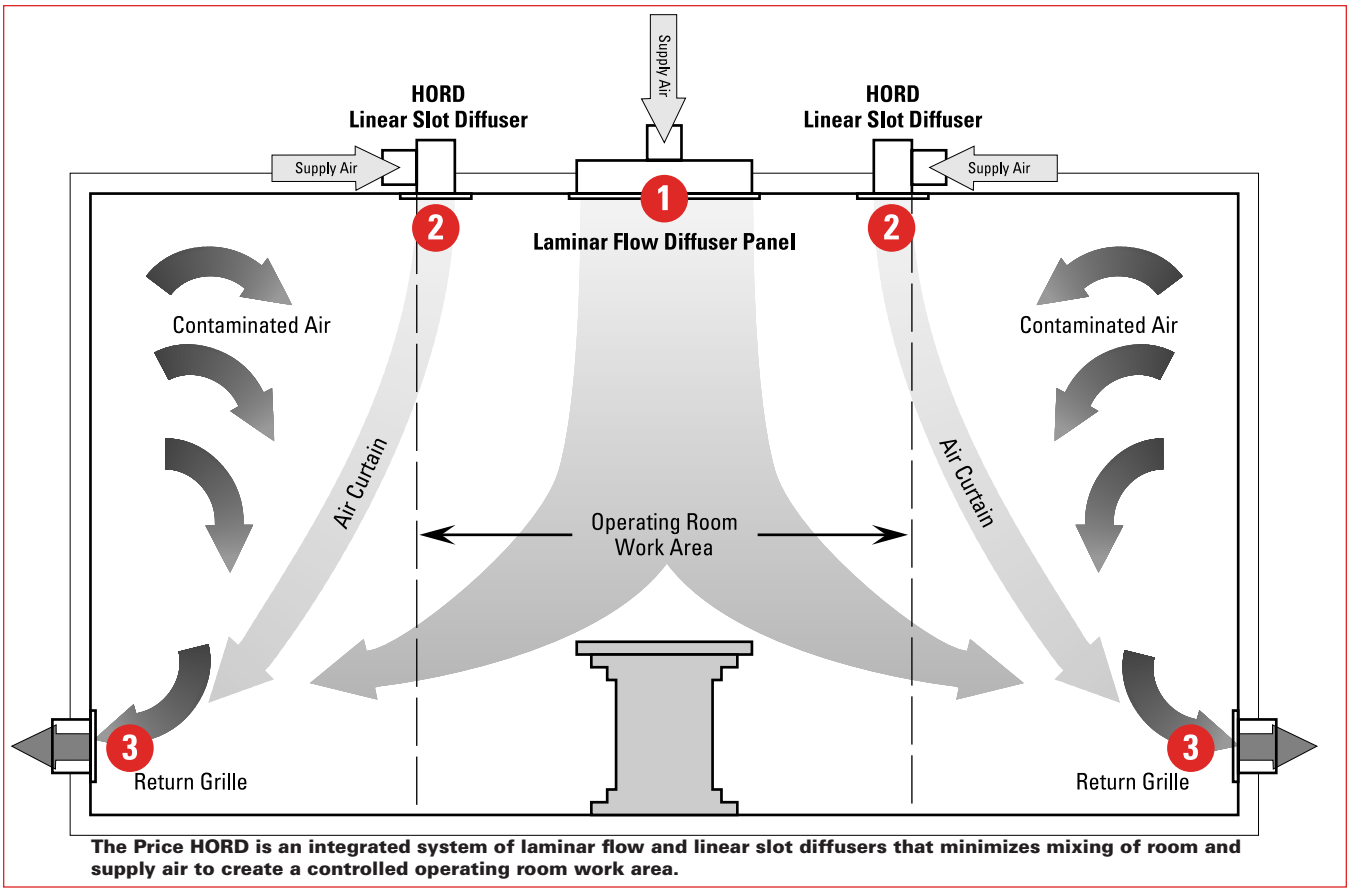


Laminar Flow - Partial Ceiling Supply



All Metric dimensions ( ) are soft conversion.
Imperial dimensions are converted to metric and rounded to the nearest millimetre.

Hospital Operating Rooms



The Price HORD is an integrated system of laminar flow and linear slot diffusers that minimizes mixing of room and supply air to create a controlled operating room work area.

Laminar Flow with Air Curtain

In many cases, the ongoing energy costs associated with a full ceiling laminar flow ventilation system can be reduced by reducing the size of the area requiring laminar airflow. Essentially, creating a clean zone around the operating table within the operating room. This is achieved by surrounding the operating table with an air curtain.

This air curtain is created using linear slot diffusers on each of the four sides around the operating table. The linear slot diffusers are installed in the ceiling a minimum of 3 feet out from the sides of the operating table, allowing room for the surgical staff and equipment to move and still be contained in the clean zone. The linear air diffusers discharge the supply air at an angle of approximately 15° from vertical, maintaining a barrier between the clean zone around the operating table and the surrounding operating room. The air curtain presents a physical barrier, in the form of a clean air curtain, between the laminar flow diffusers and the contaminated room air at the ceiling level, where the laminar flow diffuser is most likely to entrain room air.

The air curtain entrains contaminated room air to its outer boundary layer and carries it away from the operating table work area, toward exhaust grilles, thus speeding dilution of the contaminated room air.

Laminar flow diffusers installed in the ceiling inside the air curtain provide low velocity, laminar flow of clean air over the surgical staff, patient and operating table.

The supply air for this type of system is typically filtered using HEPA filters located upstream of the operating room air distribution system. Of the total supply air, 65 – 75% of the supply air is delivered through the air curtain and the remaining 25 – 35% is distributed through the laminar flow diffusers.

Contamination entering the operating room by infiltration is controlled by keeping the operating room at a positive pressure in relation to the surrounding areas. For this reason, the return air volume must be slightly less than the supply air volume. Care must be taken that the differential between return and supply air volumes is not too great as this could impede the dilution of the contaminated air. Typically the return system is sized for approximately 85% of the total supply airflow.

The return grilles are mounted at low level, approximately three to six inches above the floor. In this location they exhaust both the contaminated air and any heavier-than-air gases.

The operating room return air system ideally consists of four return grilles, one located in the center of each wall. In the case where it is not possible to have a return grille in each wall, the next best option is to have two return grilles, located on opposite sides of the air curtain. Alternatively, the grilles could be located in opposite corners of the room. When using only two return grilles if they were located on adjacent walls, this could result in the migration of contaminated air back into the operating area.

All Metric dimensions ( ) are soft conversion.
Imperial dimensions are converted to metric and rounded to the nearest millimetre.

Hospital Operating Rooms

Ceiling Construction

The role of the ceiling in an operating room is to seal the room from the ceiling plenum. This is to prevent infiltration of contaminants from the ceiling space and to allow for pressurization of the operating room.

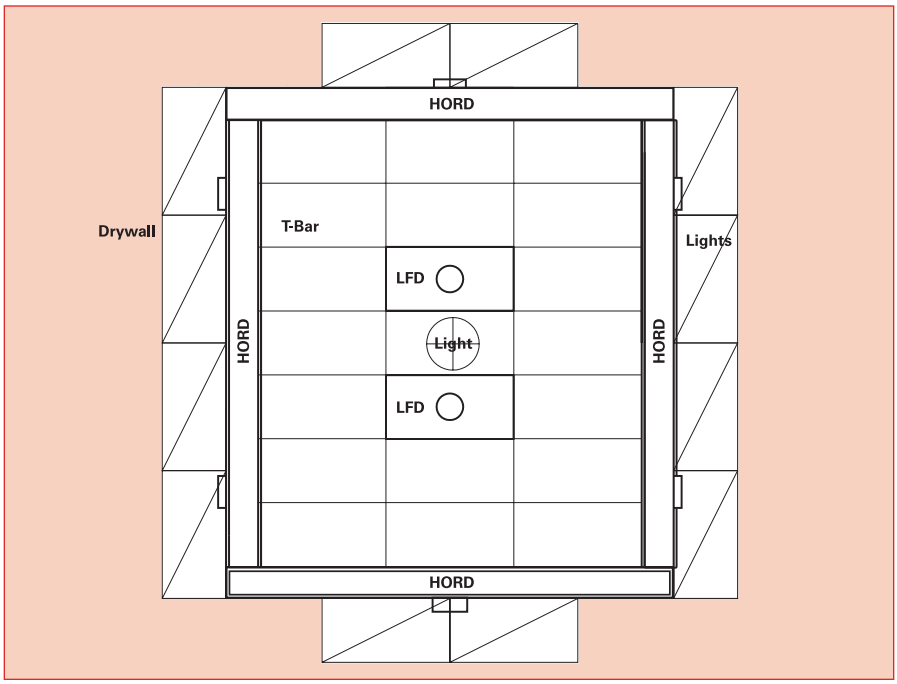
There are typically three ceiling systems used in hospital operating rooms. These are drywall ceilings, gasketed t-bar ceilings and a combination of drywall and gasketed t-bar ceilings.

The drywall ceiling works well for sealing the operating room from the ceiling plenum, but can pose a problem when ceiling space access is required. Sealed access doors in the drywall ceiling are installed near equipment requiring periodic maintenance and service. If equipment must ever be removed from the ceiling space, the access doors may not be large enough to facilitate this, requiring removal of large portions of the drywall ceiling.

A gasketed T-bar ceiling also works well for sealing the operating room from the ceiling plenum and has the added advantage of allowing access to the ceiling space when required. Ceiling panels are clipped in place, compressing the gasket between the panel and tee, forming the seal. When it is necessary to get into the ceiling space, the clips are removed and the panels are lifted allowing access to the equipment installed above the operating room. In the event equipment must be removed, panels and tees can be removed to allow access. Panels are normally constructed of painted metal to facilitate cleaning.

The third type of ceiling system is the combination of drywall and gasketed t-bar ceilings. This typically consists of the perimeter of the room being drywall and the center, above the operating table being gasketed t-bar as shown in the drawing. This system provides easy access to equipment located above the t-bar system.

Combination Drywall/T-Bar Ceiling



All Metric dimensions ( ) are soft conversion.
Imperial dimensions are converted to metric and rounded to the nearest millimetre.

Acuflow O.R. Systems™ - Air Curtain

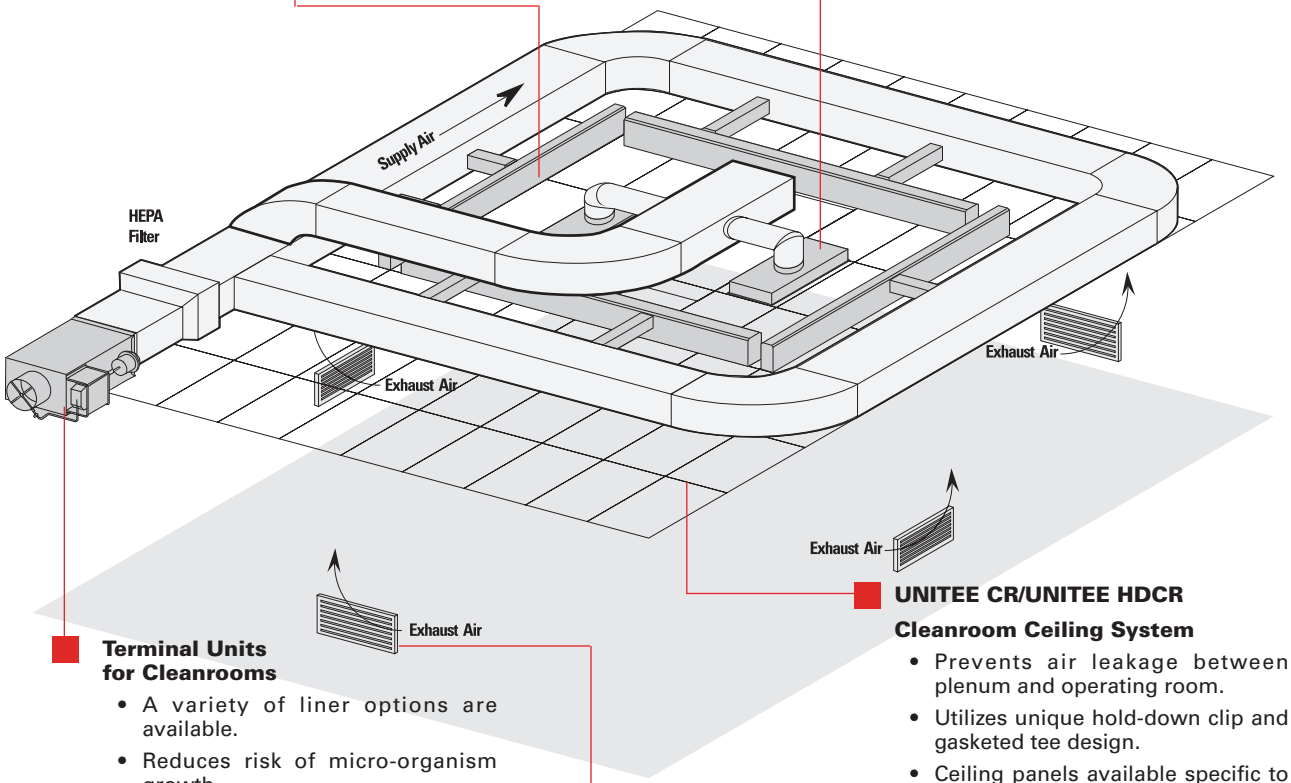
acuflow O.R. SYSTEMS™

HORD
Linear Slot Diffuser

- Linear slot discharges vertical curtain of clean air.
- Creates a "room within a room" around perimeter of operating table work area.
- Single or multiple side feeds from supply air plenum.

LFD/LFDSS/LFD2
Laminar Flow Diffuser

- Perforated face discharges non-aspirating (non-mixing) vertical flow of clean air.
- Air pattern "flows" over the operating table on its way to the floor.
- Creates a "washing" and "rinsing" effect.



UNITEE CR/UNITEE HDCR
Cleanroom Ceiling System

- Prevents air leakage between plenum and operating room.
- Utilizes unique hold-down clip and gasketed tee design.
- Ceiling panels available specific to applications.

Terminal Units for Cleanrooms

- A variety of liner options are available.
- Reduces risk of micro-organism growth.
- Prevents fibrous particles from entering supply air stream.

730/735 Series
Stainless Steel Exhaust Grilles

- Low level exhaust grilles remove contaminated air and heavier-than-air gases from O.R.
- Stainless steel construction ensures strength and ease of cleaning.
- Exhaust volume should be 15% lower than supply to ensure positive room pressure.

System Overview

Price offers a wide variety of products which meet the air distribution requirements of modern hospitals and medical facilities.

Illustrated is a typical installation of a hospital operating room to meet stringent ventilation needs.

Price specialized environment products and engineering expertise have been created to handle any critical hospital applications (Intensive Care units, Burn Wards, Recovery Rooms, etc.)

All Metric dimensions ( ) are soft conversion.
Imperial dimensions are converted to metric and rounded to the nearest millimetre.

Acuflow O.R. Systems™ - Laminar Flow

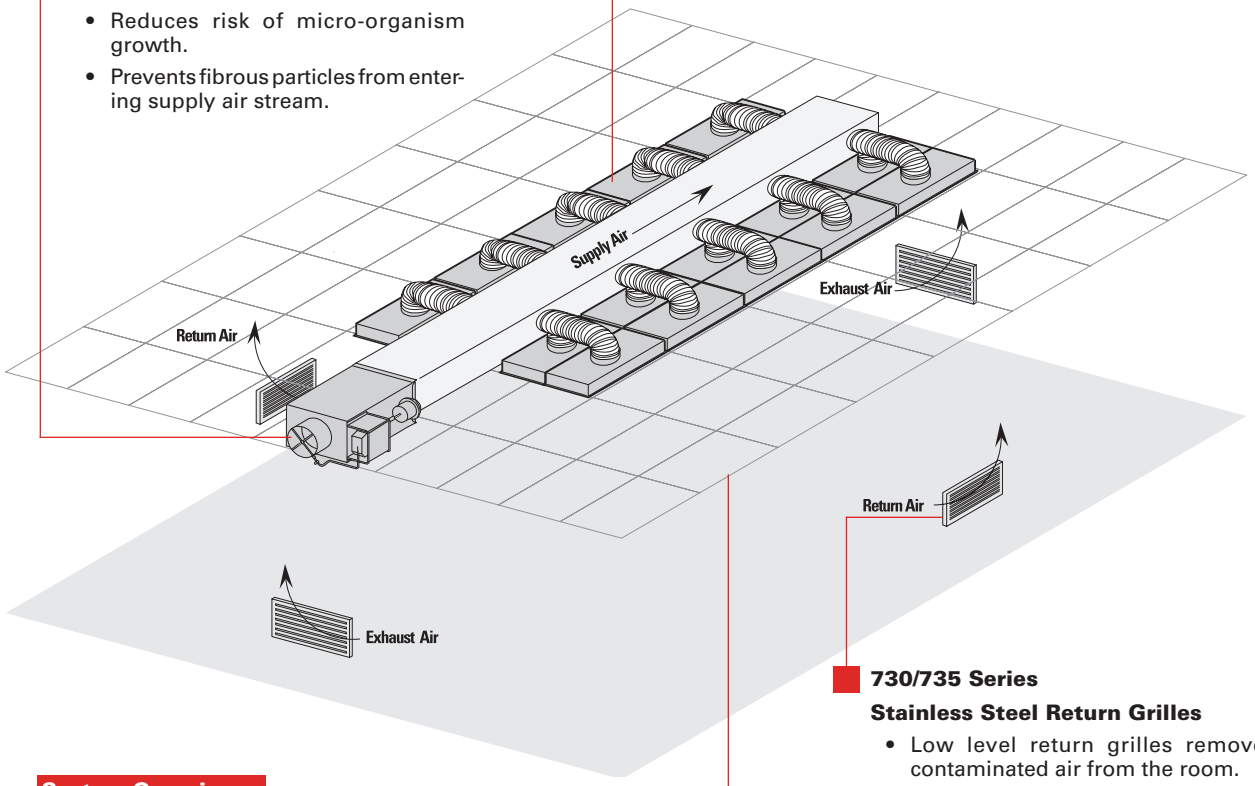
acuflow O.R. SYSTEMS™

Terminal Units for Cleanrooms

- A variety of liner options are available.
- Reduces risk of micro-organism growth.
- Prevents fibrous particles from entering supply air stream.

LFD/LFD2/LFDC
Laminar Flow Diffuser with Optional High Efficiency Filters

- Provides a laminar or uni-directional flow of clean air over the operating table.
- Houses an optional high efficiency filter with extraction efficiencies from 95% to 99.999%.



730/735 Series
Stainless Steel Return Grilles

- Low level return grilles remove contaminated air from the room.
- Stainless steel construction ensures strength and ease of cleaning.

UNITEE CR/UNITEE HDCR
Cleanroom Ceiling System

- Prevents air leakage between plenum and cleanroom.
- Utilizes unique hold-down clip and gasketed tee design.
- Ceiling panels available specific to applications.

System Overview

Price offers a wide variety of products which meet the air distribution requirements of modern hospitals and medical facilities.

Illustrated is a typical installation of a hospital operating room to meet stringent ventilation needs.

Price specialized environment products and engineering expertise have been created to handle any critical hospital applications (Intensive Care units, Burn Wards, Recovery Rooms, etc.)

All Metric dimensions ( ) are soft conversion.
Imperial dimensions are converted to metric and rounded to the nearest millimetre.