TITUS OPERATING ROOM AIR DISTRIBUTION SYSTEM

SYSTEM SIZING AND LAYOUT

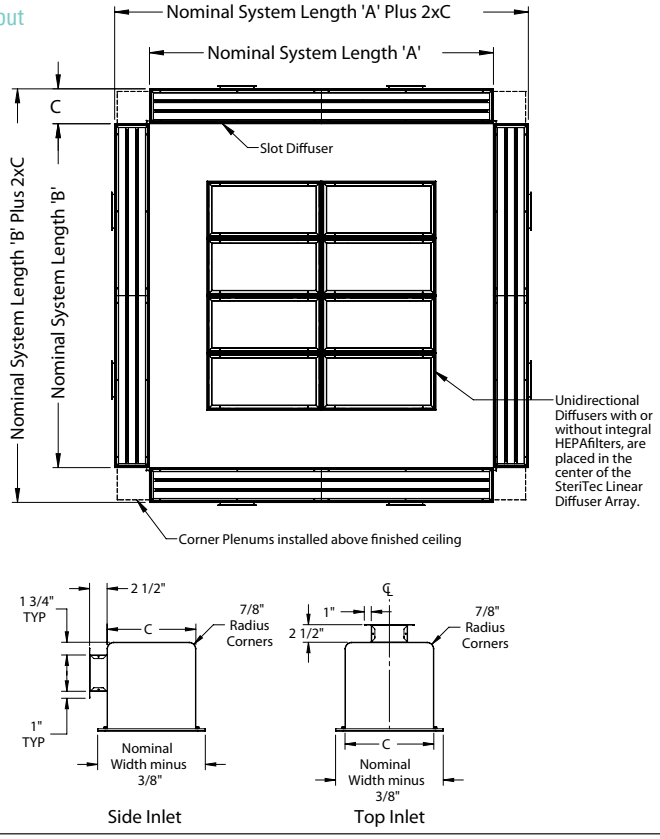
SYSTEM CALCULATIONS STEPS

1. Determine room size
2. Determine desired number of air changes with a mimimum of 4 outdoor air changes per hour for the SteriTec perimeter air curtain and the TLF internal diffusers
3. Determine SteriTec nominal system size
4. Determine desired total system cfm
5. Determine perimeter air curtain cfm
6. Determine internal diffuser cfm (usually 50 to 75 percent of the total cfm)
7. Select number of inlets and the location from the chart shown
8. Determine number TLF units and inlet size for each unit

ASHRAE guidelines point to providing continuous pillar of laminar airflow air distribution over the operating table and personnel as well as the surgical instrument table. These guidelines indicate the laminar airflow velocity should not exceed 25-35 fpm at the patient. The reason is the laminar flow should not overcome the natural plumage of airflow from the body and allow the laminar flow to drive contaminants in a wound. Data has now been shown that space inside the "sterile field" can be used for lighting, gas connections, etc. This data shows that up to 30% of the primary supply diffuser array area may be allocated for non-diffuser use such as lights, gas columns, etc. but caution is advised.

The air curtain, or air wall, is recommended around the sterile field to stop contamination from entrainment along the ceiling line and along the outer perimeter of the airflow coming down form the TLF supply diffusers. Most operating rooms are now recommended to be designed at a minimum 20 air changes per hour (ACH). The guidelines do not state a minimum. The airflow should be HEPA filtered and the operating room is normally at a positively pressure. Most codes call for the return grilles to be located at the external lower wall areas above the floor level in the corners of the room. For critical operating rooms a LineaTec air curtain should be added. The air curtain provides an air wall outside the laminar airflow zone to decrease entrainment or induction into the laminar airflow perimeter. The air curtain is normally selected for a terminal velocity of 50 fpm at 2 feet. above the floor The Titus LineaTec diffuser has a deflector that can be adjusted to deflect the air stream inward or slightly outward.

System Layout



The operating room system specifications table provides SteriTec and TLF specifications based on different combinations of ACH and room dimensions. Rectangular sizes can also be used.

Air Changes Per Hour	Ceiling Height (ft.)	Room Dim. (ft.)	SteriTec Specifications								TLF Specifications					System Total cfm
			Dim. (ft.) A + B	Active Slots	System Layout*	Max Inlet Size (in.)	Inlets Required	Plenum Inlet Locations*	Total cfm	Throw (ft.) @ 50 fpm @ 2' A.F.	No. of units	Dim. (in.)	Inlet Size (in.)	Total cfm	Throw to 30 fpm	
20	10	30 x 38	12 x 12	2	A	60 x 8	4	2, 4, 6, 8	1,920	8	8	24 x 48	12	1,920	7	3,840
25	10	30 x 31	12 x 12	2	A	60 x 8	4	2, 4, 6, 8	1,920	8	8	24 x 48	12	1,920	7	3,840
30	10	28 x 27.5	12 x 12	2	A	60 x 8	4	2, 4, 6, 8	1,920	8	8	24 x 48	12	1,920	7	3,840
35	10	27 x 26	12 x 12	2	A	60 x 8	4	2, 4, 6, 8	1,920	8	8	24 x 48	12	1,920	7	3,840
20	10	44 x 45	14 x 14	2	B	42 x 8	8	1, 3, 4, 6, 7, 9, 10, 12	2,240	8	18	24 x 48	10	4,320	7	6,560
25	10	39 x 40	14 x 14	2	B	42 x 8	8	1, 3, 4, 6, 7, 9, 10, 12	2,240	8	18	24 x 48	10	4,320	7	6,560
30	10	36 x 37	14 x 14	2	B	42 x 8	8	1, 3, 4, 6, 7, 9, 10, 12	2,240	8	18	24 x 48	10	4,320	7	6,560
35	10	33 x 34	14 x 14	2	B	42 x 8	8	1, 3, 4, 6, 7, 9, 10, 12	2,240	8	18	24 x 48	10	4,320	7	6,560

*Refer to page R58 for Plenum Inlet Location diagrams
**cfm for 30 fpm see R52
A.F. = Above Floor

Required System Information

- Room Volume _____ft^3.
- Air Change per Hour _____.
- SteriTec Dimensions _____' x _____'.
- System Total cfm _____.
- SteriTec Total cfm _____.
- Number of TLF diffusers _____.
- cfm per TLF diffuser _____.

OPERATING ROOM AIR DISTRIBUTION SYSTEM

The discussion presented in the application notes are intended as aids to heating and air conditioning engineers and designers with skill and knowledge about cleanroom design. Titus has no control over the system design and application of these critical environment products, a function that rightfully belongs to the designer.

Contaminated air outside the air curtain is prevented from entering the clean zone by the air curtain. Contaminated air in the clean zone is pushed down and outward by the laminar flow on the interior of the clean zone.

The interior of the system should have the highest room pressure due to velocities and air volume from the air diffusers.

Velocities should be kept to a maximum of 35 fpm at operating table height so the natural plumage velocity of the patient is not over powered and helps to prevent contaminants from getting into open wounds during surgery. The laminar flow diffuser should have quarter-turn fasteners and all internal parts shall be removable for cleaning and sterilization.

The entire operating room is usually under positive pressure created by dampering exhaust air and by providing extra makeup air. This helps to prevent an ingress of contaminated particles from outside the cleanroom. As doors or dividers are opened or parted, the positive internal pressure causes air to flow toward the lower external pressure outside the clean environment. The outward airflow forces particles away from the interior zone. Some hospital rooms are designed for negative pressure to keep contaminants from contaminating other hospital areas and endangering other people.

Plenums for LineaTec diffusers used in operating rooms usually have radiused corners. Corners are radiused with a ¾" radius to facilitate cleaning and to avoid areas where microorganisms can grow, later contaminating incoming clean air. The face of the LineaTec can be removed by rotating quarter-turn fasteners.

The entire plenum is then exposed to the maintenance worker. The plenum system is usually interconnected so a minimum number of inlets can be utilized for incoming air from the air handler.

Corner transitions are utilized so the plenum can be continuous, even at the corners. Corner transitions found on Titus plenum systems are covered on the operating room side by a cover plate. When the plate is removed, the entire plenum corner is exposed for easy cleaning. The cover plate itself can be put in an autoclave for sterilization. Some competitive models utilize an elbow behind the ceiling as corner transitions. To clean the corner transitions, the maintenance worker must reach around the corner in areas that are hidden from sight; this is not recommended.

The operating room design engineer determines the number of ACH based on the cleanliness level desired and current industry standards. Plenum inlets are sized so the maximum inlet velocity is in the 500 fpm range. Inlets can be lengthened and made longer to reduce entrance velocities or multiple inlets can be used. Plenum velocities should be kept as low as possible to facilitate automatic balancing of the air curtain. The 800 fpm range is considered top end, 400 to 500 fpm is desirable.

Total room airflow should be divided between the perimeter air curtain and the center diffusers. The perimeter air curtain should be supplying air between 25 to 50 cfm per foot. HEPA filters should be located remotely.

The standard material of construction is 304 stainless steel. The 304 stainless steel offers durability and an attractive appearance; plus it can withstand manual sterilization using harsh chemicals normally encountered for this purpose. The standard finish is #04 mill finish.

Manual balancing dampers should be sufficient to allow balancing of individual duct branches. Design flow rates to the interior clean zone should be established through normal balancing procedure by a certified air balancing professional. The perimeter zone should be adjusted to obtain the required cfm per foot as designed.