REVISED GUIDELINES FOR AIR CONDITIONING IN OPERATION THEATRES (2018)

Air Conditioning in OT

A. The air conditioning requirements for operation theatre in HCO have been revisited in the context of points raised by various HCOs during surveys. These standards were examined by Technical committee and various latest international and national standards on air conditioning were reviewed. Retrofitting in the HCOs constructed before these guidelines came in to being was also considered. SHCOs and Eye HCOs were also considered while recommending certain new requirements.

B. Though these guidelines are desirable under all programs, they are NOT MANDATORY for the SHCOs and HCOs implementing pre-entry certification standards.

C. Modular Operation Theatre is NOT A MANDATORY REQUIREMENT under any program. It is totally left to HCO whether they want to install it.

D. For this purpose operation theatres have been divided into two groups:

1. ***Type A (Erstwhile Super specialty OT)*:** Type A OT means operation theatres for Neurosciences, Orthopaedics (Joint Replacement), Cardiothoracic and Transplant Surgery (Renal, Liver, heart etc.).

2. ***Type B (Erstwhile General OT)*:** This includes operation theatres for Ophthalmology, day-care surgeries and all other basic surgical disciplines.

REQUIREMENTS – Type A (Erstwhile Super Specialty OT)

1. **Air Changes Per Hour**:

   - Minimum total air changes should be **20** based on biological load and the location.
   - The fresh air component of the air change is required to be minimum **4** air changes out of total minimum **20** air changes.
   - If Healthcare Organization (HCO) chooses to have 100% fresh air system then appropriate energy saving devices like heat recovery wheel, run around pipes etc. should be installed.

2. **Air Velocity**: The airflow needs to be unidirectional and downwards on the OT table. The air face velocity of **25-35 FPM** (feet per minute) from non-aspirating unidirectional laminar flow diffuser/ceiling array is recommended.

3. **Positive Pressure**: The minimum **positive pressure** recommended is **2.5 Pascal** (0.01 inches of water). There is a requirement to maintain positive pressure differential between OT and adjoining areas to prevent outside air entry into OT. Positive pressure will be maintained in OT at all times (operational & non-operational hours)

4. **Air handling in the OT including air Quality**: Air is supplied through Terminal **HEPA** (High-Efficiency Particulate Air) filters in the ceiling. The HEPA can be at AHU level if it not feasible at terminal level inside OT. The minimum size of the filtration area should extend one foot on all sides of the OT table.

5. **Air Filtration**: The AHU (i.e. air handling unit) must be an air purification unit and air filtration unit. There must be two sets of washable flange type filters of efficiency 90% down to **10 microns** and 99% down to **5 microns** with aluminium / SS 304 frame within the AHU. The necessary service panels to be provided for servicing the filters, motors & blowers. HEPA filters of efficiency 99.97% down **to 0.3 microns** or higher efficiency are to be provided. Air quality at the supply i.e. at grille level should be Class 100/ISO Class 5 (at rest condition). Note : class 100 means a cubic foot of air should not have more than 0.5 microns or larger.

6. **Temperature & Relative Humidity**: It should be maintained **21^0C ± 3^0C** *(*except for Joints replacement where it should be **18^0C ± 2^0C***)* with corresponding relative humidity between **20 to 60%,** though the ideal RH is considered to be **55%**. Appropriate devices to monitor and display these conditions inside the OT may be installed.

REQUIREMENTS – Type B (Erstwhile General OT)

1. **Air Changes Per Hour:**
   - Same as Type A OT requirements above

2. **Air Velocity**:
   - Same as Type A OT requirements above.

3. **Positive Pressure**:
   - Same as Type A OT requirements above

4. **Air Filtration**:

The AHU (i.e. air handling unit) must be an air purification unit and air filtration unit. There must be two sets of washable flange type filters of efficiency 90% down to **10 microns** and 99% down to **5 microns** with aluminium/ SS 304 frame within the AHU. The necessary service panels to be provided for servicing the filters, motors & blowers. HEPA filters of efficiency 99.97% down **to 0.3 microns** or higher efficiency **may be** provided. The Air quality at the supply i.e. at grille level should be class 1000/ISO Class 6 (at rest condition). Note: Class 1000 means a cubic foot of air must have no more than 1000 particles measuring 0.5 microns or larger.

5. **Temperature and Humidity:**

The temperature should be maintained at **21^0C ± 3^0C** inside the OT at all times with corresponding relative humidity between 20 to 60%. Appropriate devices to monitor and display these conditions inside the OT may be installed.

Design considerations for Operation Theatres

A. The AHU of each OT should be **dedicated one** and should not be linked to air conditioning of any other area in the OT and surroundings.

- ✓ One AHU for multiple OTs is permitted provided there is a back-up/contingency plan to accommodate surgeries in other OTs in the eventuality of failure of infection control in these OTs. Redundancy in terms of multiple fans for return and input air with UPS and DG set supply is provided to such type of common AHU. Direct drive fans will be required in such common AHU. The specific evidence of validation for the above will have to be provided either by the vendor/third party.

B. Outdoor Air intakes: The location of outdoor air intake for an AHU must not be located near potential contaminated sources like DG exhaust hoods, lab exhaust vents, and vehicle parking area.

C. Window & split A/c **should not** be used in any type of OT because they are pure re-circulating units and have pockets for microbial growth which cannot be sealed.

D. For old constructions and for retrofitting (constructed/renovated prior to 2015)

1. Where space is a constraint, ceiling suspended AHU is permitted provided there is accessibility for maintenance of filters and other parts of AHU.
2. Dx unit with AHU is recommended for OTs where retrofitting solution is possible. It is also recommended as cost effective solution for OTs in **SHCO/Eye care** hospitals.
3. All requirements spelt out for new constructions and Type A and Type B OTs above in terms of air changes, particle count, positive pressure, temperature, humidity and air velocity will have to be met by such OTs in old constructions/HCOs.

E. During the non-functional hours AHU blower will be operational round the clock (may be without temperature control). Variable frequency devices (VFD) may be used to conserve energy. Air changes can be reduced to **25%** during non-operating hours thru VFD provided positive pressure relationship is not disturbed during such period.

Maintenance of the system

- **Validation of system** should be done every 6 months and as per ISO 14644 standards. This should include:
  - ✓ Temperature and Humidity check
  - ✓ Air particulate count
  - ✓ Air Change Rate Calculation
  - ✓ Air velocity at outlet of terminal filtration unit /filters
  - ✓ Pressure Differential levels of the OT with respect to ambient / adjoining areas
  - ✓ Validation of HEPA Filters by appropriate tests.

- **Preventive Maintenance of the system**: It is recommended that periodic preventive maintenance be carried out in terms of cleaning of pre filters, micro vee filters at the interval of **30 days.** Preventive maintenance of all the parts of AHU is carried out as per manufacturer recommendations.

References

1. ANSI/ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) /ASHE standards 170-2017.
2. Previous NABH guidelines for air conditioning in operation theatre 2015.

3. Memarazadeh I,and A. Manning 2002. Comparison of operating room ventilation systems in the protection of surgical site.
4. HVAC Design Manual for hospitals and clinics 2nd edition, ASHRAE 2016.
5. CPWD design guidelines HVAC guide 2017 Ministry of Public works New Delhi 2017.