FROM: AFCESA/CES
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SUBJECT: **Engineering Technical Letter (ETL) 97-13: Dormitory Ventilation and Exhaust System Design Criteria**

1. Purpose. This ETL establishes design criteria for Air Force dormitory ventilation and exhaust systems, and adopts HVAC criteria contained in the *Facility Design Guide for Enlisted Dormitories*. In cases of conflict, this ETL takes precedence. Follow existing guidance in areas not covered by this ETL.

2. Application: Requirements of this ETL are mandatory for design of new or renovated Air Force dormitories. Improper or partial application of the requirements of this ETL can result in the system failing to satisfy minimum criteria and exacerbation of mold and mildew problems.

2.1. Effective Date: Immediately.

2.2. Expiration: Five years from date of issue.

2.3. Ultimate Recipients:
- MAJCOM and Base Civil Engineers
- Air Force Design and Construction Agents

2.4. Exceptions:
- Dormitories beyond the Project Definition phase
- Dormitories to which ETL 93-2 applies

2.5. Waivers. Waivers to requirements of this ETL require MAJCOM approval.

3. Referenced Publications:

3.1. *Facility Design Guide for Enlisted Dormitories*, HQ AFCEE/DCD, June 1997.

3.2. ETL 93-2, *Dormitory Criteria for Humid Areas*.

3.3. AFM 88-29, *Engineering Weather Data*, 1 July 1978 (currently under revision).

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3.4. ASHRAE 52.1-1992, *Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.*

3.5. ANSI/ASHRAE 55-1992, *Thermal Environmental Conditions for Human Occupancy* and addendum ANSI/ASHRAE 55a-1995.

3.6. ASHRAE 62-1989, *Ventilation for Acceptable Indoor Air Quality.*

3.7. CoE ER 1110-345-723, *Systems Commissioning Procedures.*

4. Definitions:

4.1. *Module:* Dormitory living unit consisting of two net living areas sharing a common kitchen and bathroom.

4.2. *Net Living Area:* The floor area of the living/bedroom space.

4.3. *Summer and Winter Comfort Zones:* Acceptable ranges of operative temperature and humidity for people in typical summer and winter clothing during primarily sedentary activity. (Reference paragraph 3.5)

5. Requirements:

5.1. Background. A recent survey sponsored by AF/ILEH identified problems of mold and mildew growth in many Air Force dormitories. This problem was prevalent in the bathroom area, where high humidity, wet surfaces, and lack of air circulation for extended periods provided favorable conditions. Continuous, treated ventilation -- independent of heating and cooling requirements -- and continuous bath exhaust will ensure occupant ventilation requirements are met, and prevent growth of mold and mildew.

5.2. Ventilation System Design. Provide a central ventilation system to supply 100 percent outside air to each module conforming with criteria in paragraph 5.3. Ventilation air must be evenly divided and supplied directly to each net living area. The system must operate continuously and independent of the module's heating and/or air conditioning system.

5.2.1. Capacity. Base ventilation system total capacity on the following design conditions (reference AFM 88-29):

- Summer -- 2.5% dry bulb (DB) temperature and the mean coincidental wet bulb (MCWB) temperature
- Winter -- 99 percent winter design conditions

5.2.2. Active Humidity Control. In locations where dehumidification is needed to satisfy ventilation requirements, equip the ventilation system with active controls to

ensure requirements are continuously met.

5.2.3. Engineering Analysis. Include engineering analyses in the design documents showing the ventilation system is capable of achieving and continuously maintaining ventilation air criteria over a full range of ambient conditions. The purpose is to evaluate system capacity and control to achieve and maintain steady state operation at various latent and sensible loads. Evaluate the system operation at the following psychometric points:
(1) the 2.5% DB and MCWB design condition
(2) the enthalpy determined by the conditions in (1) at 50% relative humidity
(3) the enthalpy determined by the conditions in (1) at 70% relative humidity
(4) 2.5% DB from (1) at 30% relative humidity

5.3. Ventilation Air Criteria:

5.3.1. Quantity. Supply ventilation air to each module to satisfy ASHRAE 62-1989 for the number of occupants, or as required to meet bathroom exhaust air requirement plus 15 percent for module pressurization, whichever is larger.

5.3.2. Conditioning. Continuously condition ventilation air supplied to each net living area to within the humidity and temperature ranges defined by the summer and winter comfort zones (see charts in ASHRAE 55), with the following modifications:
- Do not exceed 60 percent relative humidity.
- Do not humidify air to meet lower comfort limits.

Note: Conditioning of ventilation air is not required for dormitories not otherwise air conditioned.

5.3.3. Filtering. Filter air prior to the air handler or conditioning equipment. Use extended media filters rated at a minimum average dust spot efficiency of 30 percent per ASHRAE 52.

5.4. Ventilation Air Distribution:

5.4.1. Volume Control Dampers. Equip all main trunks, branches, and branch lines with accessible volume control dampers to ensure quiet and accurate air balancing.

5.4.2. Ceiling/High Wall Registers. Discharge ventilation air directly into the net living area through ceiling or high wall registers to ensure mixing and high ventilation effectiveness. Terminal velocity must not exceed 0.25 meters per second (50 feet per minute) in the occupied zone.

5.4.3. Flow Pattern. Establish a ventilation flow pattern through the entire module by transferring air from net living area, to kitchen, and then to the bathroom to be

exhausted. The purpose is to promote air change within these spaces to control moisture and odors independent of the heating and/or air-conditioning system.

5.4.4. Transfer Ducts. Provide transfer duct(s):

- Between the kitchen area and the bathroom, if the kitchen and bathroom are not directly connected. Position the kitchen register at a ceiling or high wall location, and the bathroom register near the floor. This will promote ventilation through the kitchen area and cross-flow through the bathroom.
- Between the net living area and kitchen area if a single heating or air conditioning unit serves the entire module. Size duct(s) for minimum pressure drop. This will reduce room overpressurization affecting ventilation air flow into the net living area.

Note: Undercutting doors is not recommended due to increased sound transmission and possible limitations on return air transfer.

5.4.5. Construction of Transfer Ducts. Construct transfer ducts to prevent line-of-sight between registers through the duct.

5.4.6. Interstitial Space. Do not use interstitial space above the ceiling as a plenum for transfer air.

5.5. Exhaust Air System. Provide a central exhaust system to serve the bathrooms, in accordance with the following:

- The system runs continuously and is interlocked with the ventilation air system.
- Exhaust quantity is based upon 2.54 L/s/m^2 (0.5 cfm/ft^2) of kitchen or bathroom area, whichever is larger.
- An exhaust grill is located just outside each shower stall or bathtub and specified to be constructed of corrosion-free material.
- The system has accessible volume control dampers at all main trunks, branches, and branch line connections to ensure quiet, accurate air balancing and facilitate cleaning.
- Exhaust air is filtered with extended media filters prior to the exhaust fan or energy recovery equipment.

To reduce equipment fouling, preserve effectiveness, and maintain efficiency, minimum Average Dust Spot Efficiency for filters must be (per ASHRAE 52):

- 30 percent for energy recovery equipment
- 20 percent for exhaust-fan-only applications

5.6. Energy Recovery Systems:

5.6.1. Reclaim waste energy from the bathroom exhaust, dehumidification, or air conditioning systems for conditioning the ventilation air, except when life cycle cost analysis shows reclaiming is not cost effective

5.6.2. Recommend configuring the duct layout to allow for future conversion where bathroom exhaust energy recovery systems are not cost effective for conditioning ventilation air.

5.7. Commissioning. The HVAC system(s) will be commissioned IAW with Corps of Engineers Engineering Regulation (ER) 1110-345-723.

6. Technical Assistance. Contact the installation or MAJCOM mechanical engineers for assistance. HQ AFCESA Technical Support Directorate can assist MAJCOMs and Design Agents in applying ETL requirements. AFCESA assistance with the HVAC system design process is most beneficial at the Project Definition stage.

7. Point of Contact: Mr. K. Quinn Hart, HQ AFCESA/CESM, DSN 523-6346, commercial (904) 283-6346 or INTERNET hartq@afcesa.af.mil.

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