

# **UNIFIED FACILITIES CRITERIA (UFC)**

---

## **HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS**



**APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED**

**UNIFIED FACILITIES CRITERIA (UFC)**

**HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS**

Any copyrighted material included in this UFC is identified at its point of use. Use of the copyrighted material apart from this UFC must have the permission of the copyright holder.

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by \1\ ... /1/)

<b>Change No.</b>	<b>Date</b>	<b>Location</b>
<u>1</u>	<u>October 2014</u>	<u>Numerous clarifications, corrections, additions and deletions throughout the document in response to Criteria Change Requests (CCRs) and Tri-Service reviews; the addition of Appendices E, F and G.</u>
<u>2</u>	<u>October 2015</u>	<u>Changes to Chapters 3, 4, 5 and Appendix A in response to CCRs and Tri-Service reviews.</u>
<u>3</u>	<u>January 2017</u>	<u>Criteria Change Request to address variable refrigerant flow (VRF) systems.</u>
<u>4</u>	<u>November 2017</u>	<u>Changes to Chapters 3 and 4 and Appendices A and B in response to CCRs and Tri-Service reviews.</u>

---

This UFC supersedes UFC 3-400-10N, dated July 2006; UFC 3-410-01FA, dated 15 May 2003; MIL-HDBK-1190, Chapter 10, dated 1 September 1987; and TI 800-01, Chapter 13, dated 20 July 1998.

areas that are difficult to ventilate, such as hangars. Consider nighttime air flushing of spaces, multi-speed fans, increased insulation, improved shading, and building site to improve the effectiveness of comfort ventilation.

**B-6 FAN COIL UNITS.**

The limitations of fan-coil units with regards to latent loads associated with simply providing adequate ventilation for occupancies such as living quarters make them unsuitable as the only means of cooling and dehumidification in most locations and for most occupancies, unless the fan coil unit is equipped with a split coil to allow for the continuous conditioning of outside air.

**B-7 \1\ DEDICATED OUTSIDE AIR SYSTEM (DOAS). /1/**

Consider using a separate system for outdoor air where necessary to maintain a sensible heat ratio of the mixed air entering the primary air-conditioning unit within the required limits of commercially available equipment and/or to reduce corrosive, salt-laden air from entering the primary air distribution system.

**B-8 INFRARED HEATING.**

Consider infrared radiant heating for high-bay areas or where spot heating is required. Gas, oil, and electricity may be considered as fuel sources.

**B-9 RELIABILITY.**

For Data Processing and Electronic Office areas use two or more smaller units to satisfy the required cooling capacity. This will generally reduce energy consumption at partial cooling loads and will also increase overall system reliability.

**B-10 PHOTOCOPIERS & LASER PRINTERS.**

If possible, locate photocopiers and laser printers in a separate room or group them together and provide local exhaust. Maintain the separate room at a negative pressure relative to adjacent areas by transferring air from these adjacent areas to the separate room. Do not add the air exhausted from the separate room or local exhaust to the return air or transfer it to any other areas. Coordinate with the architect to place areas requiring negative pressure relative to other spaces in the interior of the building to minimize the chances for negative pressure induced infiltration.

\4\

**B-11 VRF SYSTEMS**

A variable refrigerant flow (VRF) system is defined as any system containing two or more interconnected DX refrigerant coils that are designed for installation within a

facility's occupied space. They are 'ductless' A/C or heat pump systems in which refrigerant is moved from fan-coil unit to fan-coil unit within the occupied facility spaces.

DoD has placed special requirements on these systems due to their inherent risks. Three primary risk areas have been identified: 1) VRF systems currently contain proprietary hardware and software in conflict with 10 USC 2867, 2) VRF systems increase the risk of adverse mission impacts due to new EPA leak-rate rules on HFC refrigerant systems (if 50 lbs or greater of refrigerant) and the challenge of locating and repairing a leak in often hard to access areas, and 3) VRF systems have uncertain life-cycle costs (LCC) making comparisons with traditional HVAC systems difficult.

1. **Proprietary Systems:** Public law (10 USC 2867) states: "*The Secretary of Defense shall adopt an open protocol energy monitoring and utility control system specification for use throughout the Department of Defense in connection with a military construction project, ...*" It continues: "*The energy monitoring and utility control system specification ... shall cover: (A) ... (B) Indoor environments, including temperature and humidity levels. (C) Heating, ventilation, and cooling components. ...*" To meet these requirements, the DoD delivered revised Utility Monitoring and Control System specification UFGS 25 10 10 and related HVAC control specifications UFGS 23 09 00, UFGS 23 09 23.01 and UFGS 23 09 23.02, all of which specify the use of Open protocols, specifically requiring HVAC control systems to use either LonWorks or BACnet. To our knowledge, all VRF systems currently in production use a proprietary control network and thus fail to meet the requirements of these specifications. The adoption and use of systems with proprietary control networks is in conflict with the legal requirement of adopting systems with an 'open protocol'. While many VRF systems can connect to a LonWorks or BACnet DDC system through a Gateway device, this does not meet the requirements of an Open system and installation of proprietary networks communicating through a gateway is not permitted by the specifications. Further, the facility owner remains dependent upon the original vendor for maintenance and support which also violates the Open system requirements of the specifications.
2. **New EPA HFC-Refrigerant Regulations:** Beginning 1-Jan-2019, the EPA will implement new rules to regulate HFC refrigerant systems including those used for comfort cooling. This regulation includes R-410A, a common HFC refrigerant used in VRF and DX systems. The new rules will lower the threshold leak rate to 10% loss annually. Systems exceeding this rate must be repaired within 30-days or else face mandatory system shutdown, costly retrofits, or replacement. (The Services estimate a current annual refrigerant leak rate of 25%.) While all HFC refrigerant systems are affected, VRF systems have attributes that significantly increase DoD exposure to adverse impacts. For instance, VRF systems have refrigerant line lengths much greater than traditional DX systems. These lines extend through the occupied space and are mounted above ceilings and through walls. Tracing and repairing a leak on a VRF system is many times more difficult with an additional access requirement of maintenance crews to the workspace

environment. In classified workspaces, shut down of the mission may be necessary to affect repairs.

3. **Uncertain Life-Cycle Costs**: Currently, VRF systems have an above-average initial capital cost. However, the out-year maintenance costs and labor man-hours are uncertain as VRF systems are relatively new within the U.S. For instance, there is a lack of information on the rate of component wear to predict replacement intervals. ASHRAE Handbooks show a service life of 15-yrs for DX systems yet some life-cycle cost studies indicate a VRF expected life of 30-yrs. In addition, the proprietary nature of VRF systems implies a disproportionate reliance on contract repair and proprietary parts vice in-house maintenance.

The DoD will continue to monitor and/or investigate these risk elements and update the UFC as appropriate.

/4/