

**15 MECHANICAL \PLUMBING - V15000****15.1 GENERAL****15.1.1 Description**

This standard identifies minimum requirements that shall be met for all mechanical and plumbing applications in the design and construction of elements for Arlington County Building Design Standards.

**15.1.2 Related Arlington County Standards, Specification and Policies**

including, but not limited to, those listed in Table 15.1.2

<b>Table 15.1.2</b> Applicable Standards and Specifications
Arlington County Zoning Ordinance (ACZO)
Arlington County Code (Code of the County of Arlington County, Virginia) (ACC)
Arlington County Policy for Integrated Facility Sustainability - August 19, 2008 ("Green Building" Policy)
Building Design – Vertical Infrastructure, Chapter 16 - ELECTRICAL - V16000 (see pg. 16-69)
Arlington County Building Energy Performance standard

**15.1.3 Applicable Standards and Specifications**

including, but not limited to, those listed in Table 15.1.3

<b>Table 15.1.3</b> Applicable Standards and Specifications
Advanced Energy Design Guide for Small Office Buildings (AEDGSOB)
American Society for Testing and Materials (ASTM)
American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
EPA Energy Star®
ICC International Mechanical Code/2012
ICC International Plumbing Code/2012
National Electrical Manufacturers Association (NEMA)
US Green Building Council's Leadership in Energy and Environmental Design (LEED) green building rating system

**15.1.4 Quality Assurance**

- 15.1.4.1 The County may retain an independent HVAC Commissioning Authority to review mechanical plans and specifications during design, review submittals and perform site inspections during construction, and to conduct complete commissioning of HVAC systems and controls in the heating and cooling modes as required by Arlington County.

**15.1.5 Submittals**

**15.2.1 REGISTERED DESIGN PROFESSIONAL COORDINATION**

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15.1.5.1 Reserved

**15.2 DESIGN****15.2.1 Registered Design Professional Coordination**

- 15.2.1.1 Mechanical equipment rooms and Generators located on the ground floor and roof should be accessible from outside the Building. Door access to mechanical rooms shall be sized to allow passage of the largest piece of installed equipment as required, with double doors to be installed at a minimum. Equipment rooms shall be weatherproofed and have secured locking hardware. Mechanical equipment rooms located on the ground floor shall be provided with suitable vehicle access and a paved area shall be provided adjacent to the entrance for maintenance vehicles.
- 15.2.1.2 Roof mounted equipment shall be accessible by permanent stairs or ladders, provided with walkways from roof entry points to the equipment, and be mounted on or adjacent to level platforms providing access to all points requiring maintenance. If mechanical equipment is placed closer than 10 feet to the roof edge guardrails shall be provided.
- 15.2.1.3 All mechanical equipment located on the exterior of the Building shall be screened in accordance with the Arlington County Zoning Ordinance and the County Code where applicable. Door access to screened areas shall be sized to allow passage of the largest piece of installed equipment as required
- 15.2.1.4 A maintenance storage room shall be located adjacent to mechanical room.
- 15.2.1.5 In ceiling areas where HVAC equipment, such as Variable Air Volume Boxes, need to be located, Registered Design Professional shall provide appropriate ceiling heights such that equipment can be maintained with no greater than an 8' step ladder.
  - 15.2.1.5.1 All HVAC equipment (such as VAV boxes) required to deliver service to high ceiling areas, shall be located in adjacent areas where an 8' foot step ladder can be used to maintain equipment.
  - 15.2.1.5.2 Special attention and coordination shall be given to space being used as return plenum to minimize air movement restrictions caused by items such as recessed lighting, sprinkler, plumbing, low and high voltage electrical conduit, and any other items located above the ceiling.
  - 15.2.1.5.3 The Registered Design Professional and MEP shall coordinate and monitor the installation of all ceiling mounted equipment and data, communications and audio visual systems to ensure they will have the minimum clearances required by the manufacturer and electrical codes.
  - 15.2.1.5.4 Duct design and spaces above ceilings shall be given special attention so as to keep as low an aspect ratio as possible, so that their design will improve the HVAC sustainability and meet LEED design intent.
  - 15.2.1.5.5 An exception to equipment location due to architectural and design priorities and/or existing site conditions shall be considered and approved on a case by case basis by the Arlington County Project Officer.
- 15.2.1.6 Building attic spaces used as air return plenums shall be designed and tested to limit air leakage. The Registered Design Professional and Mechanical Engineer shall develop performance requirements to be demonstrated during construction. Double ceilings and sound damping shall be provided when Building attic spaces are used as air return

## 15.2.1 REGISTERED DESIGN PROFESSIONAL COORDINATION

plenums. In cases where the use of the attic as a plenum is not practical, a double ceiling or ducted return air system shall be provided.

## 15.2.1.7 Electrical Generators

Generators less than 150kW in size, other than those that serve Fire Stations, shall be fueled by natural gas where available. All other Generators shall be fueled by ultra low sulfur fuel oil (Diesel). Generator runtime shall be determined on a project by project basis. Fuel ports and fill pipes shall be industry standard. It is preferred that Generators be installed at ground level. In the case where this is not practicable, only natural gas Generators shall be installed on roof tops. Refer to Building Design – Vertical Infrastructure, Chapter 16 - ELECTRICAL - V16000, pg. 16-69 for all electrical design criteria of Generators.

## 15.2.1.8 House Keeping Pads: A concrete pad shall be provided for each piece of floor mounted mechanical and electrical equipment.

15.2.1.8.1 Concrete House Keeping Pad for ground mounted equipment shall be oversized by a minimum of 6 inches beyond equipment frame on all sides and a minimum of 4” inches high.

15.2.1.8.2 Concrete House Keeping Pads for Generators located outside of a Building shall be oversized by a minimum of 24 inches beyond equipment frame on all sides and a minimum of 4 inches high.

15.2.1.8.3 Provide House Keeping Pad with half-inch chamfer on all exposed edges, placed and finished smooth and level to ensure proper and continuous support for the bearing surfaces of equipment.

15.2.1.8.4 Consult with the structural engineer to determine if a thickened floor slab under base is required.

15.2.1.8.5 The design criteria for load requirements of pad and subfloor equals the total operating equipment weight by the overall length, width and thickness of the House Keeping Pad. Structural Engineer shall provide for the design of reinforced concrete for the House Keeping Pad and anchoring to structural slab or sub-floor.

15.2.1.8.6 All House Keeping Pad reinforcing shall be to **ACI** standards for minimum area and concrete coverage.

15.2.1.8.7 The concrete used in the House Keeping Pad is 3000 psi min, standard weight.

15.2.1.8.8 All House Keeping Pads located in interior spaces shall have a Type 2A – Floated Finish. All House Keeping Pads located outside the Building shall have a Type 3 - Broom Finish.

15.2.1.8.9 Provide for **OSHA** compliant safety floor warning marking with safety color code (yellow/black striping) for marking physical hazard (tripping) at perimeter of House Keeping Pad.

## 15.2.1.9 Service Platforms

A maintenance access platform shall be provided for all roof top equipment (e.g. Generators, chillers, roof top units) that is either mounted on dunnage or elevated above the roof. The platform must be designed and installed to allow for proper maintenance

access and code compliant clearances to safely work on equipment. Steps with proper safety railing shall be provided for access to all platforms installed for safe access to roof top mounted equipment. All screening around roof top equipment shall be provided with double doors of the proper material and design to match the screening with the means to secure with lock and latch. The service platform shall not prevent access to other equipment for maintenance (e.g. valves, fittings, junction boxes). Provide lighting to the service area as needed for maintenance.

15.2.1.10 Pool covers

Interior pools shall be covered after open hours to provide reduced evaporation of water into the space and provide energy savings in conditioning the space.

### 15.2.2 Submission Requirements

15.2.2.1 The designer shall prepare ¼ in = 1 ft scale equipment layout drawings for the mechanical equipment room and any roof mounted equipment. The layout drawings shall show all equipment, both footprint and door swing and manufactures recommended maintenance clearances using the basis of design for equipment sizing, ducting, piping, valves, cable tray and conduit routing, fire protection, lighting, housekeeping pads' size and location and all other appurtenances in the room. Piping, duct and valves will be shown to scale with thermal insulation if applicable

15.2.2.2 The design shall provide for code-mandated and manufacturers recommend clearances around all equipment, but in no case shall be less than 36 inches. Only for renovations and no minimum clearance requirement, clearances less than 36 inches will be considered due to architectural and design priorities and/or existing site conditions on a case by case basis by the Arlington County Project Officer. Drawings shall indicate layout and clearances for the largest and heaviest equipment included in the design and specifications. At a minimum, the Registered Design Professional team shall design around three manufacturers.

15.2.2.3 The design shall indicate, in plan view and as appropriate in elevation at each submission, required accessibility clearances to all mechanical equipment, control panels, valves, pump motors and other items such as walk ways, cat walks and access doors etc. requiring access. Valves shall be located within 48 inches of floor or be equipped with chain actuator. 9

15.2.2.4 Registered Design Professional shall use DOE's EnergyPlus Version 8.3.0 whole building energy simulation program to conduct a life-cycle cost analysis for mechanical system selection, optimized Building orientation, architectural shading methods, Building envelope characteristics, and day lighting options during the Schematic/Design Development phases. The County and Registered Design Professional shall meet to determine what options shall be evaluated and to review costs/benefits of various design alternatives. The Registered Design Professional shall provide the County an annual energy budget based upon the computer simulation.

15.2.2.5 The Registered Design Professional shall confirm design conditions at schematic design phase in the project and submit all heating and cooling load calculations for review by the Arlington County Project Officer.

15.2.2.6 Provide an operating data points list and sequence of operations for each project to be reviewed in detail during the design phases by the Arlington County Project Officer.

## 15.2.2.7 Riser Diagrams

Riser diagrams are required for the following systems installed within the Buildings: Soil, waste and vent; cold water; hot water; gas and fuel gas. Riser diagrams may be shown flat or in isometric projection. Diagrams include story heights, size of all horizontal and vertical piping, fixture numbers being served, and means of connection between fixtures and the stacks and mains. Each system shall be complete and continuous.

## 15.2.3 Plumbing

- 15.2.3.1 Regarding the plumbing system, the following Owner's Project Requirements shall be included in the specifications in accordance with Table 15.2.3.1:

<b>Table 15.2.3.1 Plumbing System Owner's Project Requirements</b>
Clean outs - Sanitary Sewer: Provide accessible sanitary sewer clean-outs in all locker rooms and rest rooms.
Clean outs - Sanitary Sewer: Provide sanitary sewer clean-outs at each building penetration of sanitary sewer trunk lines.
Cooling Towers: Any Building requiring <i>Cooling Towers</i> shall be evaluated to determine if separate metering of make up water supply is cost effective or desirable for other reasons.
<u>Drinking Fountains</u> : shall have a bottle filling station
Faucets: All faucets to meet EPA Water Sense standards. Self-closing metering faucets shall not be specified unless required by code. Single lever is preferred. Plastic handles/knobs Not Acceptable. Provide repair kit for any non-standard type plumbing fixtures, flush valves and faucets.
Flush Valves: All flush valves to be properly matched to specified urinal or water closet. Flush valves for urinals to be specified as 0.5 gpf. Flush valves for water closets to be specified as 1.5 gpf. Provide repair kit for any non-standard type plumbing fixtures, flush valves and faucets.
Heat Trace: listed thermostatically controlled electric heat trace tape system shall be provided for water lines located in unconditioned spaces.
Hose Bibb: Provide Hose Bibbs connections outside the building and near rooftop mechanical equipment, cooling tower drains, blowdown to sanitary sewer. Hose Bibbs on the exterior of the building shall be frost proof and shall have keyed access.
<u>Hose Bibb</u> requirement for Green Roofs: Provide Hose Bibb at key locations around roof to allow maintenance workers to water plants on a regular basis. Provide paving, ballast or roof protection pads immediately surrounding the Hose Bibbs to avoid damage to roof membrane from maintenance activities. Consideration shall also be given to allow sufficient space between planted areas for hose movement.

**Table 15.2.3.1**  
**Plumbing System Owner's Project Requirements**

Infrared Sensors: In cases where infrared sensors are specified they shall be hard wired in automatically activating lavatories, urinals or water closets. All fixtures shall be low flow and shall be able to be manually operated.
<u>Isolation Valves</u> : Domestic water shut-off (isolation) ball type valves shall be installed where shown on drawings, to isolate individual plumbing fixtures, groups of plumbing fixtures, individual rest rooms, each piece of equipment, each branch take-off from mains and at the base of each riser to permit shut down of the fixture or equipment element without affecting the remainder of the Building. Isolation ball type valves shall be provided at each floor in an accessible chase. Provide access to valves in janitor's closets adjacent to rest rooms where applicable.
<u>Mixing valves - Temperature-actuated</u> : shall be installed at sink faucets to reduce water temperatures to defined limits shall comply with ASSE 1017. Such valves shall be installed at the hot water source. Provide repair kit for any non-standard type plumbing fixtures, flush valves and faucets.
Piping - Condensate: Condensate pumps are Not Acceptable. All condensate drain piping shall be gravity flow. Provide condensate drains with traps and removable plugs for clean-out.
Piping - Condensate: In all cases for external equipment, condensate piping shall be terminated at a storm drain or directly outside; and the piping securely anchored to the floor. Minimum condensate piping size shall be 3/4".
Piping: All piping shall be properly insulated to minimize heating and cooling costs and condensation problems. All roof drain piping shall be insulated. All pipe insulation joints must be properly sealed.
Piping: No plumbing or sprinkler piping shall be installed over top of electrical panels or equipment, unless in compliance with NEC current edition.
Piping: On remodeling projects where piping is being capped, remove abandoned piping back to active mains. This will avoid dead legs of stagnant water.
Toilet areas: shall be provided with and serviced by a 3 feet wide plumbing chase to facilitate maintenance.
Underground Storage Tanks (UST): Double wall, urethane coated steel. Act 100U, Type II, and approved by .58 for underground storage of motor fuel. Double wall welded steel with a primary (internal) tank and a secondary (external) tank. UST shall include quick release filler neck, water tight raised access to filler neck, and shall support accessory equipment including drop tubes, two tank sumps, and submersible removable pumps. UST design shall allow for continuous monitoring of the interstitial spaces between the two walls and the two manways. Refer to 15.3.1 - Mechanical Equipment for Owner's Project Requirements for Brand Name Product(s).

## 15.2.4 HEATING, VENTILATION AND AIR CONDITIONING SYSTEM SELECTION

**Table 15.2.3.1**  
**Plumbing System Owner's Project Requirements**

Urinals shall be waterless type except those installed in fire station living areas. All urinals shall be made of Vitreous China and be low flow. An exception may be granted for the use of stainless steel on a case-by-case basis. Provide repair kit for any non-standard type plumbing fixtures, flush valves and faucets.
Valves all valves 2" and smaller should be ball type valves.
Water Closets: The water closet shall be properly matched to the specified flush valve. Water closets to be made of vitreous china. An exception may be granted for the use of stainless steel on a case by case basis. Provide repair kit for any non-standard type plumbing fixtures, flush valves and faucets.
The <i>Registered Design Professional</i> shall require in the specification sections the <i>Contractor</i> to perform specific plumbing commissioning tasks prior to County's acceptance of substantial completion. The <i>Contractor</i> shall run all plumbing fixtures for a minimum of 30 minutes continuously to demonstrate sanitary lines are clear of debris to allow for adequate flow. This demonstration shall be witnessed by the Arlington County Project Officer or designee. The <i>Contractor</i> shall also provide video documentation to the County of all sanitary lines 3" or larger to the building sanitary sewer lateral. Any sanitary blockages discovered during commissioning shall be the <i>Contractor's</i> responsibility to remediate.

#### 15.2.4 Heating, Ventilation and Air Conditioning System Selection

- 15.2.4.1 The Registered Design Professional shall coordinate with the Arlington County Project Officer prior to selection of the mechanical system.
- 15.2.4.2 Where Building size and use require complex multi-zone comfort systems, central plant configurations are preferred. In such cases, the basis of the heating and cooling system shall incorporate the following:
- 15.2.4.2.1 Basis for HVAC system's design shall include consideration for a four-pipe system.
  - 15.2.4.2.2 Temperature controls shall be electronic (DDC).
  - 15.2.4.2.3 Chillers shall be located in an enclosed mechanical room at grade level unless otherwise approved by the County.
  - 15.2.4.2.4 Air Handling Units shall be located in mechanical rooms unless otherwise approved by the County.
  - 15.2.4.2.5 Design shall not allow for boiler operation when outside air temperature is above 80 degrees.
  - 15.2.4.2.6 Design shall not allow for chiller operation when outdoor air temperature is below 50 degrees and free cooling shall be applied.
  - 15.2.4.2.7 Any space that requires 24/7 cooling must use a DX system.
- 15.2.4.3 In less complex Buildings, roof top units with natural gas heat (where available) and DX cooling with expansion valves shall always be used.

## 15.2.5 HEATING, VENTILATION AND AIR CONDITIONING DESIGN CRITERIA

- 15.2.4.4 In all cases, DX units shall have multiple compressors or unloading capabilities to remove moisture under low load conditions. When available in the market any unit greater than 10 ton shall include a VFD to match blower speed to load.
- 15.2.4.5 VAV or VRV/VRF systems shall be used for indoor comfort control. Exception for VRV/VRF split wall-mounted units in rooms under 200 Sq. Ft.
- 15.2.4.6 Constant volume systems used for variable occupancy spaces such as meeting and conference rooms are Not Acceptable
- 15.2.4.7 Where natural gas is not available, packaged air to air heat pump units with 100% electric back up shall be used.

**15.2.5 Heating, Ventilation and Air Conditioning Design Criteria**

Optimal design will emphasize energy efficiency, accessibility and maintainability.

- 15.2.5.1 Energy Efficiency
  - 15.2.5.1.1 The Registered Design Professional shall use all code approved methods to reduce occupant loads to match actual conditions.
  - 15.2.5.1.2 For libraries the square footage of permanent stacks shall be removed prior to applying occupants per square foot code requirements.
  - 15.2.5.1.3 Occupant averaging, room volume, transfer air techniques or other approved code methods shall be used to optimize fresh air requirements. This is mandatory for all meeting rooms, conference rooms, or other assembly areas.
- 15.2.5.2 Building systems shall be designed to minimize continuous noise (“background noise”) within a space. Use the ASHRAE Handbooks for acoustical design guidelines and parameters.
- 15.2.5.3 Cooling equipment shall be sized to match actual Building occupant load conditions.
- 15.2.5.4 Central plant equipment shall be sized for the Building peak, not the sum of the zone peaks.
- 15.2.5.5 If packaged **DX** equipment is used, they shall have multiple steps of cooling and heating to meet part load conditions for proper humidity control.
- 15.2.5.6 HVAC systems shall be designed to maintain indoor humidity levels in cooling mode to 50% ( $\pm 5\%$ ) for regularly occupied spaces. Maximum humidity levels in regularly occupied spaces shall not exceed 55% at any time.
- 15.2.5.7 HVAC system zones shall be provided for different functional areas and to allow for night use in appropriate areas.
- 15.2.5.8 Systems shall be designed with capacity reduction capabilities for spaces where the design loads may vary significantly from actual loads.
- 15.2.5.9 CO2 sensors shall be incorporated to minimize outside air requirements while maintaining acceptable CO2 levels.
- 15.2.5.10 Systems shall be designed to maintain the following temperature settings.

<p><b>Table 15.2.5.10</b> <b>System Temperature Settings</b></p>
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Building Type	Occupied	Unoccupied
General Office Space Heating	72°F	55°F
General Office Space Cooling	75°F	85°F
Warehouses/Enclosed Garages/Apparatus Heating	60°F	60°F

- 15.2.5.11 Outside Air Design Parameters (temperatures) for General Building Areas.

Table 15.2.5.11 Outside Air Design Parameters
Winter 14°F
Summer 95°F/50% Relative Humidity
Verify design temperatures with ASHRAE Standards.

- 15.2.5.12 The Building thermal envelope shall, as a minimum, be designed as follows:

Table 15.2.5.12 Building Thermal Envelope Criteria	
Building Type	Occupied
Whole Window U-Factor	0.40 Maximum
Average Wall U-Factor	0.06 Maximum
Soffit/Floors U-Factor	0.05 Maximum
Roof U-Factor	0.03 Maximum
	0.03 Maximum in storage/equipment room

- 15.2.5.13 Exterior envelope should also have interior and exterior vapor barriers, and entire thermal envelope must be sealed to the exterior, including attic and plenum spaces.
- 15.2.5.14 Warehouses, garages and Fire Station Apparatus Bays shall be provided with infrared tube heating systems and ventilation systems as appropriate and should not be air-conditioned.
- 15.2.5.15 HVAC equipment with energy recovery shall use air-to-air heat exchangers; use of energy recovery wheels will be considered on a case by case basis by the County.
- 15.2.5.16 Omitted
- 15.2.5.17 Air filtration systems shall be designed to meet the minimum standard. All equipment with MERV 13 or greater filters shall have pleated pre-filters. Fiberglass as a means of filtration are Not Acceptable. Special filtration requirements for areas such as computer rooms and laboratories shall be reviewed by the County on a case by case basis.
- 15.2.5.18 Cooling Tower Drains and Blowdowns shall be piped and discharged to sanitary sewer.

### 15.2.6 Accessibility and Maintainability

All HVAC equipment shall be installed to provide minimum space clearance around equipment per manufacturer's recommendation or applicable building codes, whichever is more stringent.

- 15.2.6.1 Where possible mechanical rooms shall be placed on the ground level, at an outside wall with maintenance vehicle parking spaces and loading zone immediately adjacent

## 15.2.7 HEATING, VENTILATION AND AIR CONDITIONING SPECIFICATIONS

to the mechanical room door. All major HVAC equipment would be located in or near the mechanical rooms.

15.2.6.2 Access to equipment on the roof shall be passing through the interior of the *Building* in accordance with Table 15.2.6.2.

15.2.6.3 Equipment located on the roof or in the attic shall be accessible in accordance with Table 15.2.6.3.

<b>Table 15.2.6.3 Accessibly Requirements For Equipment Located On Roof</b>	
<b>Equipment Category</b>	<b>Requirement</b>
<b>Equipment under 20 tons</b>	A Ship Ladder for equipment under 20 tons with a minimum Roof Hatch size of 36"x 30"
<b>Equipment 20 tons or larger</b>	A staircase with double-doors at top and bottom landings. Staircases are preferable for roof access in all cases. The width of the staircase shall be equivalent to the width of the double doors.
<b>Equipment for Multi-story Buildings</b>	An Elevator shall be provided for <b>all</b> equipment located on the roof designed for multi-story Buildings.
<b>Maintenance Access Platforms</b>	Provide maintenance access platforms with a minimum width of 36" for controls or equipment/components greater than 30" above floor or roof level.

15.2.6.4 A ladder shall be installed with all roof hatches. The roof hatch shall have the capability of being secure and locked from the ground.

15.2.6.5 Equipment hanging above ceiling or in attic shall have a working platform with appropriate safety rails.

15.2.6.6 Access panels or doors must be provided for any equipment located in all wall or ceiling spaces that may require maintenance, repairs, or modifications.

15.2.6.7 All equipment, smoke detectors, heat detectors, etc., which are located above a suspended ceiling must be clearly labeled at the appropriate location on the ceiling.

15.2.6.8 If roof mounted A/C units are used a power receptacle shall be provide at the location of the installed equipment.

### 15.2.7 Heating, Ventilation and Air Conditioning Specifications

15.2.7.1 *Boilers* – The Registered Design Professional shall compose the Specification in accordance with the requirements of Table 15.2.7.1.

## 15.2.7 HEATING, VENTILATION AND AIR CONDITIONING SPECIFICATIONS

<b>Table 15.2.7.1</b> <b><i>Boiler Owner's Project Requirements</i></b>	
<b>Equipment Category</b>	<b>Requirement</b>
<b>Boiler Type</b>	Only condensing type boilers shall be provided.
<b>Boiler Controls</b>	Boiler controls that do not allow water temperature resetting from the BAS are Not Acceptable.
<b>Boilers Larger than 250,000 BTU</b>	Boilers with an input larger than 250,000 BTU should the modulating type to minimize on-off cycling.
<b>Combustion Efficiency Test</b>	Combustion Efficiency Test - Burner should be tuned up for maximum performance, including correct nozzle size, flame shape, and air damper adjustment for minimum excess air. Performance should be verified via written results of an instrumented combustion efficiency test, including test data net stack temperature, percentage CO <sub>2</sub> or O <sub>2</sub> oil smoke spot or percentage CO, and total combustion efficiency percentage.
<b>Outside Air Reset</b>	Outside Air Reset of system supply water temperature shall provide to maintain a constant temperature inside the boiler above the condensing temperature to reduce wear caused by expansion, contraction, and condensation.

- 15.2.7.2 Provide two extra changes for each type filter. Install new filters prior to testing and balancing, and another new set at Substantial Completion in addition to the two spare sets.
- 15.2.7.3 The temperature control system and the energy management control system shall be manufactured by Siemens or Trane No Substitutions.
- 15.2.7.4 Provide wall mounted (framed and covered with Plexiglas) control diagrams in all boiler and mechanical rooms.
- 15.2.7.5 All valves shall be numbered with brass tags and referenced to operational instructions.
- 15.2.7.6 All chillers shall have non-CFC refrigerant.
- 15.2.7.7 All HVAC equipment shall be specified to operate using CFC-free refrigerants
- 15.2.7.8 All motors are to be NEMA™ premium efficiency type.
- 15.2.7.9 All ductwork and piping that will gain or lose energy to/from the surrounding atmosphere, or may cause condensation problems, shall be properly insulated to minimize energy costs and condensation problems. All pipe insulation joints must be properly sealed.
- 15.2.7.10 Listed thermostatically controlled electric heat trace tape system shall be provided for water lines located in unconditioned spaces.
- 15.2.7.11 Use of butterfly valves for equipment or piping isolation is Not Acceptable.

**15.2.8 ENERGY MANAGEMENT AND CONTROL SYSTEMS (EMCS)**

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- 15.2.7.12 All open loop water-cooled chillers shall have condensers that are shell and tube heat exchangers.
- 15.2.7.13 Refrigerant Piping Shall be hard copper (exceptions must be approved by Arlington County Project Officer).
- 15.2.7.14 Use of Triple duty valves is prohibited.

**15.2.8 Energy Management and Control Systems (EMCS)**

- 15.2.8.1 The EMCS network architecture shall consist of three levels of networks:
  - 15.2.8.1.1 The Management level shall utilize BACnet/IP over Ethernet to the EMCS Automation Server and/or Arlington County VIRTUAL SERVER.
  - 15.2.8.1.2 The Automation level network shall be BACnet/IP over Ethernet. The Native BACnet controllers for the central plant and large infrastructure air handlers shall reside on the BACnet/IP network.
  - 15.2.8.1.3 The Floor level network shall be BACnet over MS/TP or manufacturer standard protocol FLN/TEC network will be accepted. It shall be network to all of the DDC controlled equipment on a floor or in a system and network to a router that connects to the Automaton level BAS backbone.
- 15.2.8.2 In all Buildings, a Direct Digital Control (DDC) system EMCS shall be installed in a lockable cabinet. EMCS devices must be BACnet BTL Products. BACnet native controllers and BACnet for TEC shall not be specified by engineer or accepted as part of submittals by Contractors. TEC can be specified to communicate through the manufacturer's standard protocol. The EMCS shall be remotely accessible from the Facilities Management Bureau (FMB) remote access computer and server located at 1400 North Uhle Street, Suite 603, Arlington, VA 22201. FMB's remote access computer and separate server shall be upgraded as to fully access the EMCS. This includes software to allow for complete control of all points. Remote access capabilities shall include ability to view system graphics, and monitor, control, and configure HVAC system and its properties.
- 15.2.8.3 EMCS shall have graphics including Floor-level graphics with links to equipment for each Building system. Graphics shall be reviewed for approval by the County during the submittal process.
- 15.2.8.4 The EMCS shall have the capability of full control of all thermostats and the ability to release them to local control if necessary.
- 15.2.8.5 The energy management and control system shall monitor and control lighting, HVAC operations and conditions, alarm abnormal conditions and index control modes and provide AHU optimized start/stop operations, and provide reporting and trend logs. The specific system requirements shall be reviewed with the County during design.
- 15.2.8.6 The plans and specifications for the EMCS and mechanical system must include a detailed points list showing all monitor and control points and identify all required software and hardware, and must also include a sequence of operations for major equipment and systems. Sequence of operations shall be provided on the drawings in lieu of in the specifications.
- 15.2.8.7 The EMCS must be capable to perform the following functions:

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- 15.2.8.7.1 Monitor and Alarm Selected Conditions: Space temperature; Space Humidity; Outside Air Temperature (OAT), Outside Air Humidity (RH), Pressure; Flow; On/Off, Start/Stop Status; Safety Control Status (Fire, Freeze, Smoke).
  - 15.2.8.7.2 Initiate Selected Control Sequences: AHU/Chiller/boiler/pump; Start/Stop; Occupied/unoccupied modes; Optimized Equipment Start/Stop operation, monitor total Building electric usage and provide demand limiting routines as determined by the County.
  - 15.2.8.8 The EMCS server/network shall not be directly involved in the local loop controls, and the local loops shall continue to operate if the EMCS server/network fails.
  - 15.2.8.9 All EMCS components shall have surge suppression devices. All EMCS programming components shall have battery backup.
  - 15.2.8.10 The EMCS must be capable of alarming to, and be communicated and programmed by any compatible personal computer via the County's LAN. EMCS shall be expandable and be compatible with the electronic equipment controls. EMCS must have a security password/code for system entry and programming. A network RJ45 jack shall be provided for network communications over the County's LAN.
  - 15.2.8.11 Specifications shall require Contractor to provide necessary interface equipment for the EMCS system including individual equipment interface. The local interface devices shall be a PC with lockable cabinet. The local PC shall have the ability of complete and full control over the components and points of the EMCS. Provide submittal for interface device hardware and software to confirm system configuration and operating system for approval by the County. Remote processing units shall be capable of communicating with the local terminal. Provide licensed software for the EMCS. The system shall be connected to the County's server for the specified system. Provide disk copy of graphics package and programming software and install at County's central EMCS control station.

### 15.2.9 Commissioning

- 15.2.9.1 Requirements for an HVAC system commissioning process shall be included in the scope of work for the Registered Design Professional, Mechanical Engineer, and the construction contract. An independent Commissioning Authority may be hired by the County. The ASHRAE standard guidelines for commissioning shall serve as the basis for all HVAC commissioning and the guidelines will be tailored to the specific requirements of the project. Random sampling shall be used for commissioning of VAV boxes. A minimum of 20 VAV boxes, but no less than 40% of the total VAV boxes shall be checked by the commissioning Authority. If 10% of those inspected are found to be non-functioning then no less than 50% of the total number of VAV boxes shall be inspected. All AHU, chillers, boilers, RTU's and HVAC pumps and controls systems shall be checked by the commissioning Authority.
- 15.2.9.2 The Registered Design Professional and Mechanical Engineer and Commissioning Authority will perform reviews of the HVAC system design from a commissioning perspective at all review phases of the design process, and will cooperate fully with the County's Commissioning Authority throughout the design review process as applicable. Review by the County will not relieve the Registered Design Professional and

- Mechanical Engineer of their responsibility to deliver a functional system that complies with the design intent.
- 15.2.9.3 The contract specifications must clearly spell out the responsibilities of the General Contractor and all appropriate sub-Contractors relative to commissioning, and shall also define the role of the Commissioning Authority.
- 15.2.9.4 The Architect and Mechanical Engineer will coordinate and cooperate fully with the County's Commissioning Authority (if applicable) and with County representatives throughout the actual HVAC system commissioning process prior to and subsequent to system acceptance. The Registered Design Professional and Mechanical Engineer will provide all design and or system information that is requested by the commissioning team members and will respond to all comments from the Commissioning Authority from design through system acceptance.
- 15.2.9.5 An instructional session shall be held after systems are functional to familiarize Arlington County professional and technical staff with the design and construction of the system. A Schedule shall be set up during the warranty period for operational problem solving ("shake down") meetings as needed. Total instruction which includes classroom and operational training shall be provided by the design engineer and installing Contractor. This instruction shall not be less than sixteen hours in duration. Contractor shall video record all instructional sessions and provide the DVD to the County.
- 15.2.9.6 Prior to substantial completion, the Arlington County Project Officer shall be notified of when water and air system balancing is scheduled so County technical staff may observe operational procedures.
- 15.2.9.7 All open loop water-cooled chillers shall have condensers that are shell and tube heat exchangers.
- 15.2.9.8 Housekeeping Pads  
A concrete House Keeping Pad shall be provided for each piece of floor mounted mechanical equipment.
- 15.2.9.9 Concrete housekeeping pads for ground mounted equipment shall be oversized by a minimum of 36 inches on all sides of the equipment and a minimum of 4" inches high.

## 15.3 PRODUCTS

### 15.3.1 Mechanical Equipment

Brand Name(s) for Building Element in accordance with Table 15.3.1 The Specification shall identify a minimum of three (3) Brand Names (manufactures) that comply with the Owner's Project Requirements used for the Invitation to Bid, unless the Brand Name Category listed as No Substitutions.

<b>Table 15.3.1</b> <b>Brand Name Product(s) for the Mechanical Equipment</b>		
<b>Building Element</b>	<b>Brand Name(s) Brand Name Model</b>	<b>Brand Name - Category</b>
<u>Air Handler</u>	Buffalo, Carrier, McQuay and Trane	Preferred Manufacturer(s)
Baseboard Heaters	Trane without Dampers	Or Equal
<u>Building Automation Systems</u>	Siemens	No Substitutions
Chillers	Carrier, Climacool, McQuay, MultiStack, Trane and York	No Substitutions
Condensing Boilers	Aerco, Triangle Tube Viessmann and Weil-McLain (based on technical specs including turndown ratio)	No Substitutions
Cooling Towers	Baltimore Aircoil, Evapco and Marley	No Substitutions
Domestic WTR Booster	Bell & Gossett Bronze Construction	Or Equal
EMCS	Siemens Trane	No Substitutions
<u>Fire dampers</u>	Air Balance Inc. Greenheck Fan Corporation Ruskin Company	Or Equal
Fire Station Diesel Exhaust Extraction System	Plymovent	No Substitutions
<u>Lockable cabinet</u>	Global Mobile Security computer black Model No. T9A706669BK	Or Equal
Pumps	Bell & Gossett	Or Equal
Rooftop Units	AAON, Carrier, McQuay and Trane	No Substitutions
Underground Storage Tanks ( <u>UST</u> )	Highland Tank & Manufacturing Company, Inc.	Or Equal

<b>Table 15.3.1</b> <i>Brand Name Product(s) for the Mechanical Equipment</i>		
<b>Building Element</b>	<b>Brand Name(s) Brand Name Model</b>	<b>Brand Name - Category</b>
Variable Speed Drives	ABB Magnetek Reliance Electric Toshiba	Or Equal
<u>VAV Boxes</u>	Titus & Trane	Or Equal

**15.3.2 Plumbing Equipment**

Brand Name(s) for Building Element in accordance with Table 15.3.2 The Specification shall identify a minimum of three (3) Brand Names (manufactures) that comply with the Owner's Project Requirements used for the Invitation to Bid, unless the Brand Name Category listed as No Substitutions.

<b>Table 15.3.2</b> <i>Brand Name Product(s) for the Plumbing Equipment</i>		
<b>Building Element</b>	<b>Brand Name(s) Brand Name Model</b>	<b>Brand Name Category</b>
Dry Sprinkler Valves	Victaulic	Or Equal
Faucets	American Standard, Kohler and Moen	No Substitutions
Flush Valves	Sloan and Zurn	No Substitutions
Flush Valves – Automatic	Sloan	No Substitutions
Frost Free Hydrants	Josam Woodford	Or Equal
Garbage Disposals	Insinkerator (I.S.E.)	Or Equal
Vitreous China Fixtures	American Standard Kohler Moen Toto	Or Equal
Water Closets	American Standard, Kohler, Moen & Toto	No Substitutions
<u>Water Coolers:</u>	Elkay, Halsey & Taylor®	No Substitutions
Waterless Urinals	Waterless Co. Inc.	No Substitutions