VA

U.S. Department
of Veterans Affairs

Office of Construction &
Facilities Management

HVAC
design manual

NOVEMBER 1, 2017

Rev. November 1, 2022

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FOREWORD

VA Program Offices, project teams, designers and constructors, are obligated to our Nation's Veterans and taxpayers to make the most effective and efficient use of resources, by providing a continuum of safe, secure, high quality, high performance, and high value environments of care and service for Veterans. The VA Office of Construction and Facilities Management (CFM) supports the Department's mission through development and application of standards as a basis for disciplined planning, design, and construction of VA facilities.

VA Standards are the culmination of a partnership among the Department of Veterans Affairs (VA), the VA Administrations, Program Officials, Clinicians, Industry, Academic and Research Organizations, Expert Consultants, and the Office of Construction and Facilities Management. VA Standards are developed through integration of VA-specific requirements, Federal law and regulation, benchmarking of industry best practice, evidence-based research and design, and value-based analysis of leading edge innovation. The result is the establishment of best value standards for optimum functionality, safety, operability, performance, and quality throughout the VA environment of care and service.

The VA Technical Information Library (TIL) (www.cfm.va.gov/TIL) provides standards for all VA planning, design, and construction projects. VA TIL Standards communicate the basis of design and are required to be utilized by project teams working on new construction and renovations of existing facilities. VA Standards will maximize the effectiveness and efficiency of the planning and design process and facilitate a high level of design, while controlling construction, operating, and maintenance costs.

For all VA projects, it is required that project teams comply with the following in all phases of project development:

1) All applicable VA Standards published in the VA Technical Information Library (TIL) shall be applied as a basis, foundation, and framework in planning, design, and construction. Any substantial variance from Standards shall be considered only as required to accommodate specific site, functional, and operational conditions. Upon consideration of variance CFM shall be consulted, and each Administration will function as Authority Having Jurisdiction for decision. Each substantial variance shall have a basis rationale and be documented in the project record;
2) Clinicians, providers, primary users, and other stakeholders shall be involved in all phases of project development to best adapt Standards for specific functional, operational, and site conditions, and to provide optimum service environments for Veterans. This also includes installations and modifications of systems or technology involving safety, security, functionality, or environmental quality. Stakeholder involvement shall be documented in the project record.

VA TIL Standards are not project-specific. It is impossible to foresee all rapidly evolving requirements of VA facilities and each site or project will have unique requirements or conditions. Site-specific issues must be addressed within the context of these standards and applied to each individual project. Use these Standards does not preclude the need for, nor absolve planners, designers, and constructors of their responsibility to provide complete, functional, safe, and secure designs suited to the unique requirements of each project, within budget, and on schedule.

Materials, equipment and systems are shown in an illustrative, performance-based format and are not intended to depict, suggest, or otherwise constitute endorsement of any specific product or manufacturer. Manufacturers should be consulted for actual dimensions, configurations, and utility requirements.

For additional information regarding the VA Technical Information Library and development and application of VA planning, design, and construction standards, please contact Donald L. Myers, Director, Facilities Standards Service, US Department of Veterans Affairs, Office of Construction and Facilities Management.

ACKNOWLEDGEMENTS

The following individuals are those whose guidance, insight, advice and expertise made the update and revision of the HVAC Design Manual possible:

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INTRODUCTION

This VA HVAC Design Manual for the Department of Veterans Affairs (VA) Healthcare Facilities is the only detailed design requirements manual for VA. The original 2017 version has been edited several times since first publication to keep the information updated and synchronized with the latest industry trends. VA lessons learned, collected from VHA clinicians and operations personnel, have been incorporated as well. The November 1, 2021 revision of this manual includes high priority changes recommended by the VA CFM/VHA HVAC committee in response to the COVID-19 pandemic. Compliance to the Design Manual, which promulgates minimum performance design standards for VA owned and leased new buildings and renovated facilities, ensures that VA facilities will be of the highest quality to support Veterans Health Care.

The Office of Construction and Facilities Management (CFM) is responsible for developing and maintaining this Design Manual. Revisions are made as necessary. The Architect/Engineers (A/E), Project Managers (PM), Resident Engineers (RE), Contractors, and Consultants should refer to the VA Directives, VA Policies, VA Design Alerts and Memorandums before each use of this design manual to note any updates that have been made since the last use. The VA Design Manuals align the VA Facilities program with the VA mission.

VA has adopted the latest edition of the codes and standards as a minimum for all projects performed in the modernization, alteration, addition, or improvement of its real property and the construction of new structures. VA design Manuals and Master Specifications specify additional codes and standards that VA follows on its projects.

Design, construction, renovation and installation of all VA Facilities must be in accordance with this Design Manual and with the latest editions and/or revisions of all applicable codes, policies and standards. Nothing in this Design Manual should be construed as authorization or permission to disregard or violate local and legal requirements.

Variance from this Design Manual may be proposed to promote new concepts and design enhancements. Variance shall not conflict with Federal Regulations, Public Laws, Executive Orders, or the needs of the end users. All variances shall be reviewed by the VHA Office of Healthcare Engineering (OHE) in consultation with CFM Consulting Support Service (CSS).

Any reviewed variances are subject to written approval by the VA Authority. The VA Authority for all VHA projects is the Director of the Office of Healthcare Engineering. The VA Authority for VBA and NCA projects is the Director of the Office of Construction and Facilities Management (CFM). Request for variance shall be submitted in writing by the A/E through the COR in sufficient detail to explain the issues.

Chapter 1: BASIC REQUIREMENTS

1.1 GENERAL

HVAC Design Manual for New, Replacement, Additions, and Renovations of Existing VA Facilities (March 2011 with Amendments A and B) and HVAC Design Manual for Community Living Centers and Domiciliary (March 2011) are revised to combine both documents into one manual and to incorporate changes resulting from the following:

- International Building Code (IBC) Including IMC and IPC
- ASHRAE Standard 170 – 2013 (Ventilation of Health Care Facilities)
- HVAC Design Criteria Revisions – Surgery Suite, SPS Suite, Animal Research, etc.
- Coordination With Current VA Design Guides
- Miscellaneous Corrections and Users' Input
- VA Sustainable Design Manual
- Addition of Requirements for Central Laundries, and Office Buildings

This manual is intended for the Architect/Engineer (henceforth referred to as the A/E) and others engaged in the design and renovation of VA facilities. It is applicable to all Major Projects, Non-Recurring Maintenance (NRM) and Minor Construction Projects to ensure quality control and uniformity in design and construction practice and procedures.

Use of this manual shall result in meeting the primary objective of providing environmental comfort to patients, staff, and visitors. The HVAC system shall be:

- Technically correct, complete, and coordinated.
- In compliance with all applicable safety standards.
- Easily accessible for repairs and maintenance.
- Energy efficient.
- In compliance with prescribed noise and vibration levels.

1.1.1 DEVIATIONS AND VA AUTHORITY

Deviations from this manual may be proposed to promote new concepts and design enhancements and to contend with adverse existing conditions and limitations in renovation projects. Deviations shall not conflict with Federal Regulations, Public Laws, Executive Orders, or the needs of the end users. All deviations shall be reviewed and approved in writing by the VA Authority. The VA Authority for all VHA projects is the Director of the Office of Healthcare Engineering (OHE). The VA Authority for VACO, VBA and NCA projects is the Director of the Office of Construction and Facilities Management (CFM). Request for deviations shall be submitted in writing by the A/E through the COR in sufficient detail to explain the issues. The amount of documentation will vary on a case by case basis but in general may contain some or all of the following elements:

- Narrative explanation of the requested deviation (provided in all cases).
- Construction cost impact (provided in all cases).
- Construction schedule impact (provided in all cases).
- Equipment and material data sheets when applicable.
- Photographs of existing conditions when applicable.

- Calculations, including cost estimates.
- Drawings and sketches.
- Other background information such as codes, standards etc.

The complete request for deviation shall include all the required elements listed above in a concise narrative package with supporting data which clearly communicate what the deviation is, why the deviation is being requested, and the operational, maintenance, energy, cost, and schedule impacts of accepting the deviation and of rejecting the deviation.

1.2 ENERGY CONSERVATION

Refer to the VA Sustainable Design Manual, May 6, 2014 or approved latest edition available at the time design NTP is issued.

1.2.1 ENERGY REDUCTION REQUIREMENT - NEW CONSTRUCTION

All new buildings and/or additions to existing buildings entering design on or after November 6th, 2016, must be designed to meet the minimum requirements of ASHRAE 90.1-2013. In addition, if lifecycle cost-effective, reduce site energy use by 30 percent compared to the baseline building performance rating per ASHRAE 90.1-2013, Appendix G, excluding plug and process loads. If a lifecycle cost effective design cannot be achieved that meets the 30 percent reduction requirements, select the most efficient design that meets or exceeds the minimum requirements and is lifecycle cost-effective. No design shall be less than 30 percent more efficient than ASHRAE 90.1-2007, excluding plug and process loads. Provide energy model results comparing the design to both ASHRAE 90.1-2007 and ASHRAE 90.1-2013.

1.2.2 ENERGY REDUCTION REQUIREMENT - MAJOR RENOVATIONS

Major Renovation projects must be designed to reduce energy used by a minimum of 30 percent compared to the baseline building performance rater per ASHRAE 90.1-2007 Appendix G. A project classified as “major renovation” shall meet the following two criteria:

(a) For a facility selected for renovation, the area of renovation is greater than 50% of the total area.

(b) A project is planned that significantly extends the building’s useful life through alterations or repairs and totals more than 25% of the replacement value of the facility.

1.2.3 LIFE-CYCLE COST ANALYSIS – METHODOLOGY

An engineering and economic analysis shall be performed in accordance with the procedure outlined by the DOE in the National Institute of Standards and Technology (NIST) Handbook 135 dated February 1996 (or the approved latest edition) – Life-Cycle Costing Manual for the Federal Energy Management Program. The available resources are:

NIST Handbook 135 – Life-Cycle Costing Manual for the Federal Energy Management Program

Located in: http://fire.nist.gov/bfrlpubs/build96/PDF/b96121.pdf

Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis – 2016 (current year) – Annual Supplement to NIST Handbook 135

Located in: http://nvlpubs.nist.gov/nistpubs/ir/2016/NIST.IR.85-3273-31.pdf

NIST Building Life Cycle Cost (BLCC) Programs (current version and year)

Located in: https://energy.gov/eere/femp/building-life-cycle-cost-programs

1.2.4 VA POLICY

Reduction in the energy budget shall be expressed in Btu/sf (gross) [kWh/sm (gross)]. Follow the requirements in the approved latest edition of the VA Sustainable Design Manual.

1.3 MEASUREMENT AND VERIFICATION

Per DOE Guidelines issued under Section 103 of EPACT, install building-level utility meters in new major construction and renovation projects to track and continuously optimize performance. Memorandum of Understanding (MOU) mandates that the actual performance data from the first year of operation shall be compared with the energy design target. After one year of occupancy, the A/E shall measure all new major installations using the ENERGY STAR® Benchmarking Tool for building and space types covered by ENERGY STAR® or FEMP-designated equipment. The A/E shall submit a report of findings to the VA Authority identified in paragraph 1.1.

1.4 ABBREVIATIONS AND REFERENCES

See Chapter 7: CLIMATIC DATA for weather design conditions to be used for calculations.

See Chapter 8: ABBREVIATIONS AND REFERENCES for abbreviations and references used in this manual.

1.5 COMMISSIONING

In accordance with the Guiding Principles for Sustainable Federal Buildings (Feb 2016), employ commissioning practices tailored to the size and complexity of the building and its system components in order to verify performance of building components and systems and help ensure that design requirements have been meet.

Comply with VA's Whole Building Commissioning Process Manual May 2013, Revised November 2013.

1.6 VA STANDARDS

At the beginning of every design project the A/E shall download from the VA Technical Information Library (TIL) all technical documents pertinent to the scope of the project being completed and shall use those documents and the documents referenced therein as references for the completion of the project. The documents in force at the time the design notice to proceed (NTP) is issued shall govern unless they are contractually changed by the CO. The use of VA provided information does not relieve the A/E from their legal and ethical obligations to correctly apply the information and to research additional information when the VA provided documents are insufficient for the project at hand. The Fundamental Cannons of the National Society of Professional Engineers (NSPE) Code of Ethics for Engineers shall apply. Descriptions of major standards follow:

1.6.1 VA MASTER CONSTRUCTION SPECIFICATIONS (PG-18-1)

Located in Technical Information Library
https://www.cfm.va.gov/TIL/spec.asp

The VA Master Construction Specifications provide a standardized method for the A/E to ensure that the contractor provides equipment and systems that meet the design intent in terms of performance, quality and cost.

The VA Master Construction Specifications accomplish this by:

- Providing specific narrative descriptions of required equipment, salient elements, and system construction
- Listing applicable standards and codes and references
- Requiring individual submittal of equipment and systems for review and approval prior to contractor purchase
- Defining specific installation methods to be used

1.6.2 DESIGN AND CONSTRUCTION PROCEDURES (PG-18-3)

Located in Technical Information Library
https://www.cfm.va.gov/TIL/cPro.asp

The design and construction procedures establish minimum consistent design and construction practices.

The Procedures section accomplishes this by:

- Referencing applicable codes and policies
- Describing standard drawing formats
- Listing security strategies
- Including miscellaneous design details

1.6.3 STANDARD DETAILS AND CAD STANDARDS (PG-18-4)

Located in Technical Information Library
https://www.cfm.va.gov/TIL/sDetail.asp

The standard details and CAD standards provide a standardization of CAD documents submitted to the VA Authority.

The Standard Details section accomplishes this by:

- Providing downloadable equipment schedules
- Listing symbols and abbreviations

- Providing downloadable standard details in .dwg or .dwf format
- Providing requirements for preparing CAD drawings

Note: The A/E shall utilize the VA Standard Details to the fullest extent possible. A modification to a Standard Detail requires the approval of VA Authority identified in paragraph 1.1.1 DEVIATIONS AND VA AUTHORITY. A comprehensive list of symbols and abbreviations is included with the VA Standard Details. Use of the VA abbreviation list is mandatory. Edit the VA abbreviation list to be project specific.

All drawings shall be numbered and arranged in strict accordance with VA CAD Standards.

1.6.4 DESIGN MANUALS (BY DISCIPLINE) (PG-18-10)

Located in Technical Information Library
http://www.cfm.va.gov/TIL/dManual.asp

The design manuals provide specific VA design philosophy for medical and support facilities.

The Design Manuals accomplish this by:

- Explaining specific design methodologies
- Listing acceptable system types
- Codifying certain code interpretations
- Listing values for design parameters
- Referencing certain sections of the Master Specification and Standard Details
- Containing examples of certain design elements

The A/E shall review all applicable design manuals. Some that are specific importance are as follows:

1.6.4.1 Fire Protection Design Manual

This manual provides the fire protection engineering design criteria for all categories of VA construction and renovation projects.

The Manual accomplishes this by:

- Mandating code and standard compliance
- Defining water-supply requirements

Defining fire extinguishing and fire alarm system requirements

1.6.4.2 Physical Security and Resiliency Design Manual (PSRDM) For VA Facilities

This manual defines physical security standards required for facilities to continue operation during a natural or man-made extreme event and for facilities that are required to protect the life safety of patients and staff in an emergency.

The Manuals accomplish this by:

- Setting objectives for physical security

- Providing strategies for use in design and construction to provide protection to VA facilities
- Providing cost-effective design criteria

1.6.4.3 Plumbing Design Manual

This manual provides the plumbing engineering design criteria for all categories of VA construction and renovation projects.

The Manual accomplishes this by:

- Mandating code and standard compliance
- Setting objectives for Legionella Mitigation
- Listing values for design parameters

1.6.4.4 Steam, Heating Hot Water, and Outside Distribution Design Manual

Volume 1 - Steam Boilers
Volume 2 - Water Boilers
Volume 3 - Outside Steam and Heating Hot Water Distribution Systems

This manual provides the engineering design criteria for steam, hot water and outside distribution systems for all categories of VA construction and renovation projects.

The Manual accomplishes this by:

- Mandating code and standard compliance
- Establishing VA requirements on the quantity, capacity, arrangement, and standby capability of boilers and auxiliary equipment
- Establishing a baseline for LCCA and equipment life for system comparisons

1.6.4.5 Sustainable Design Manual

https://www.cfm.va.gov/til/sustain.asp

This manual provides sustainable design practices to improve the building environment and to provide cost savings for long-term building operations and maintenance.

The Manual accomplishes this by:

- Prescribing the use of integrated design practices
- Providing strategies for optimization of energy performance
- Providing strategies for protection and conservation of water resources
- Providing strategies for enhancement of indoor environmental quality
- Providing strategies for reduction of environmental impact of materials

1.6.5 DESIGN GUIDES (GRAPHICAL, BY FUNCTION) (PG-18-12)

Located in Technical Information Library
https://www.cfm.va.gov/TIL/dGuide.asp

The design guides provide the designer with specific layout templates and medical equipment lists for all types of spaces, uses and specific design parameters for structural, electrical and mechanical service.

The Design Guides accomplish this by:

- Publishing design information
- Including functional diagrams and layout plates
- Listing standards

1.6.5.1 Ambulatory Care (Hospital Based) Design Guide

This design guide provides design requirements of ambulatory care clinics within a hospital environment.

1.6.5.2 Cardiovascular Laboratory Service Design Guide

This design guide provides design requirements for cardio vascular laboratory service clinics within hospital or outpatient clinic environments.

1.6.5.3 Dental Service Design Guide

This design guide provides design requirements for dental services clinics within hospital or outpatient clinic environments.

1.6.5.4 Digestive Diseases Endoscopy Service Design Guide

This design guide provides design requirements for digestive diseases and endoscopy service clinics within hospital or outpatient clinic environments.

1.6.5.5 Electroencephalography Laboratory (EEG) Design Guide

This design guide provides design requirements for electroencephalography laboratories within hospital or outpatient clinic environments.

1.6.5.6 Medical/Surgical Inpatient Units & Intensive Care Nursing Units Design Guide

This design guide provides design requirements for medical inpatient units, surgical inpatient units and intensive care nursing units within a hospital environment.

1.6.5.7 Magnetic Resonance Imaging (MRI) Design Guide

This design guide provides design requirements of MRI services suites within hospital or outpatient clinic environments.

1.6.5.8 Mental Health Facilities Design Guide

This design guide provides design requirements for several mental health (MH) facilities / services including inpatient MH units, outpatient services, and residential rehabilitation and treatment facilities. Depending on the service and circumstances these facilities may be part of hospitals, outpatient clinics or even standalone MH facilities.

1.6.5.9 Nuclear Medicine Design Guide

This design guide provides design requirements for a variety of nuclear medicine treatment and diagnostic services such as PET/CT, bone densitometry, and administration of nuclear medicines. The services may be located within hospital or outpatient clinic environments.

1.6.5.10 Office of Information & Technology Design Guide

This design guide provides design requirements for main computer / server rooms, auxiliary data and communication rooms, administrative / staff spaces all applicable to office of information and technology services spaces in any VA facility medical or VBA.

1.6.5.11 Lease Based Outpatient Clinic Design Guide

https://www.cfm.va.gov/til/leasing.asp

This design guide provides design requirements for leased based outpatient clinics. Depending on the size and location these clinics will contain numerous services. The A/E shall refer to other specialty design guides for additional information. A related document, Leased Based Outpatient Clinic SFO Template, shall be used by the A/E tasked with developing the SFO documents for the leased based clinic.

1.6.5.12 Patient Aligned Care Team (PACT) Module Design Guide

This general design guide provides design requirements to implement PACT concepts on inpatient and outpatient clinics and other departments.

1.6.5.13 Pharmacy Service Design Guide

This design guide provides design requirements for inpatient and outpatient pharmacy service units. Note that while outpatient clinics will only have outpatient pharmacies, hospitals will have both inpatient and outpatient units.

1.6.5.14 Polytrauma Rehabilitation Center Design Guide

This design guide provides design requirements for polytrauma rehabilitation centers. These centers may be standalone buildings within a medical center campus or may be a section of a larger hospital.

1.6.5.15 Pulmonary Medicine Service Design Guide

This design guide provides design requirements for pulmonary medicine services clinics within hospital or outpatient clinic environments.

1.6.5.16 Radiation Therapy Service Design Guide

This design guide provides design requirements for radiation therapy clinics within hospital or outpatient clinic environments.

1.6.5.17 Radiology Service Design Guide

This design guide provides design requirements for radiology service units within hospital or outpatient clinic environments.

1.6.5.18 Small House Model Design Guide

This design guide provides design requirements for community living centers which include resident living spaces, dining areas and other community areas such as the community center. These typically standalone facilities may be located within a larger medical center campus or as a completely standalone facility away from a main campus.

1.6.5.19 Spinal Cord Injury Disorders Center

This design guide provides design requirements for spinal cord injury disorders centers. These facilities may be a single ward, a wing of a larger hospital, or a standalone building within a medical center.

1.6.5.20 Sterile Processing Service and Logistics Service Design Guide

This design guide provides design requirements for logistics services spaces and sterile processing service spaces. Both these functions occur in hospitals and in outpatient clinics.

1.6.5.21 Surgical and Endovascular Services Design Guide

This design guide provides design requirements of operating rooms and their support spaces within hospital or outpatient clinic environments.

1.6.6 OTHER DOCUMENTS AND STANDARDS

Located in Technical Information Library
https://www.cfm.va.gov/TIL/

In addition to Design Guides and Design Manuals the Technical Information Library contains other types of documents listed below. The purposes of these documents vary from addressing A/E submission requirements and peer reviews to specific technical guidance, to urgent response to discovered recurring or non-recurring deficiencies.

1.6.6.1 A/E Submissions Requirements (PG-18-15)

Located in Technical Information Library
https://www.cfm.va.gov/til/aeDesSubReq.asp

These requirements provides a staged list of tasks in various design categories to define the A/E scope and ensure thorough and timely completion of the final design package and bid documents.

The requirements accomplish this by:

- Progressively listing tasks at Schematic, Design Development, and Construction Documents stages
- Requiring task completion and submission for each stage according to a Critical Path Method (CPM) calendar
- Requiring implementation of a QA/QC process to ensure a quality design product
- Requiring life-cycle analysis of alternatives in order to optimize the design-to-cost tradeoff
- Listing and detailing all the drawings, calculations, and specifications required for a complete design package
- Indicating the final distribution of bid documents
- Indicating the interface between this Design Manual and Submission Requirements at each submission phase

1.6.6.2 Design Review Checklist

Located in Technical Information Library
https://www.cfm.va.gov/til/aeDesSubReq.asp

This checklist provides the VA Peer Reviewer with a minimum list of critical items which must be included in each A/E submission. Also, it ensures the design A/E is aware of the required data at each submission. These actions mitigate delays on the project and additional costs to the A/E due to rework.

The Checklist accomplishes this by:

- Referring to all VA design tools which pertain to the specific project
- Detailing certain life safety and coordination requirements

1.6.6.3 Seismic Design Requirements (Structural) (H-18-8)

Located in Technical Information Library
https://www.cfm.va.gov/TIL/seismic.asp

The manual defines the requirements for seismic design in new facilities and for rehabilitation of existing facilities.

The Manual accomplishes this by:

- Defining critical and essential facilities

- Prescribing code compliance with modifications
- Prescribing occupancy categories

1.6.6.4 Design Alerts

Located in Technical Information Library
http://www.cfm.va.gov/TIL/alertDesign.asp

Design Alerts are issued for the purpose of reducing construction change orders and for addressing other construction related issues.

The Design Alerts accomplish this by:

- Publishing periodic alert memos
- Summarizing design solutions

1.6.6.5 Standards Alerts

Located in Technical Information Library
http://www.cfm.va.gov/TIL/alert.asp

This category of Alert serves to identify innovative and broad ranging Standards and Design processes and procedures that have a major impact on the VA's goal of delivering world-class facilities.

The Standards Alerts accomplish this by:

- Publishing immediate memos that modify standards before updates are able to be coordinated and issued formally
- Providing guidance pertaining to updated national references

1.6.6.6 Cost Estimating Manual

Located in Technical Information Library
http://www.cfm.va.gov/cost/

The manual provides guidance on VA cost estimating requirements and philosophy for medical facilities.

The Manual accomplishes this by:

- Explaining specific estimating methodologies
- Providing examples of certain design elements.

1.6.6.7 Building Information Modeling (BIM) - VA BIM and CAD Standards

Located in Technical Information Library
http://www.cfm.va.gov/til/projReq.asp

The use of BIM platform is required for all major construction and renovation projects per details given in VA BIM Manual.

1.6.6.8 Whole Building Commissioning Process Manual

Located in Technical Information Library
https://www.cfm.va.gov/til/spclRqmts.asp#Cx

This manual provides the VA requirements for the commissioning process during design phase, construction phase and warranty phase.

1.7 HVAC DESIGN MANUAL (PG 18-10) AND A/E SUBMISSION REQUIREMENTS (PG 18-15)

1.7.1 COORDINATION

The documentation requirements outlined in PG-18-15 are the minimum contractual milestones and not the details and procedures described in this Manual. By supplementing each other, these two documents provide comprehensive guidelines to develop supporting documentation for successful and state-of-the-art design.

1.7.2 COMPLIANCE REQUIREMENTS

For each submittal, the A/E shall forward to the VA a detailed list of the submissions required with a notation of full or partial compliance.

1.7.3 EQUIPMENT SCHEDULES

1.7.3.1 Order of Presentation

For each item in a schedule, show the Basis of Design, including the manufacturer and model number selected. These columns shall be hidden on the final design documents but available for VA use and for use later in the design, construction and maintenance process.

Equipment schedules shall be grouped on the design documents by system type, such as air side, water side, and steam.

1.7.3.2 Equipment Capacity and Performance Data Requirements

Scheduled output (required) performance such as CFM, cooling and heating capacities, GPM, lbs. of steam per hour etc. shall be based on the actual design calculations and not on any particular manufacturer’s capacity. Other equipment characteristics such as internal friction losses, exterior dimensions, fan and pump efficiencies, motor horsepower and other electrical requirements shall be scheduled using actual equipment data from the range of available manufactured products.

1.7.3.3 Equipment Schedules – Glycol Data

Heat exchangers, coils, pumps and chillers in glycol-water system shall be identified on the equipment schedule showing the percent glycol by volume of the circulating fluid for equipment derating purposes.

1.8 VA HOSPITAL BUILDING SYSTEM

Located in Technical Information Library
https://www.cfm.va.gov/TIL/spclRqmts.asp#VAHBS

The VA Hospital Building System (VAHBS) is a methodology based on a modular concept for planning, designing, and constructing hospitals.

The methodology has been used nationwide successfully for capital and operating cost containment, shortened delivery schedules, and improved space utilization flexibility. All new and replacement VA hospital buildings shall use the VAHBS system. This system is also recommended for major additions to existing hospitals where future adaptability is an important factor.

See VHA Program Guide PG-18-3, Design and Construction Procedures, Topic 3, "VA Hospital Building System," for further guidance. The complete reference for the VAHBS is contained in the 1976 Development Study (referred to as the Redbook) and the 2006 Supplement. Additional details are included in Appendix 1-A.

APPENDIX 1-A: VA HOSPITAL BUILDING SYSTEM

1-A.1 DESCRIPTION OF MODULES

GENERAL

The Redbook (see link in Paragraph 1-A.2 below) proposes a systematic or modular approach to the design of new hospital buildings with interstitial spaces. The building system approach requires integration of service modules starting with the initial stages of the design process. Service modules are defined as one-story units of building volumes with a footprint of 10,000 sf (930 m^2) to 20,000 sf (1,860 m^2). Each module consists of structural bays, a service zone, and a functional zone (often subdivided into space modules). Each service module is completely contained in a fire compartment, either alone or with one or more other modules. The A/E shall ascertain that the duct layout and related equipment in the interstitial spaces and elsewhere are accessible for maintenance, operation, and replacement.

STRUCTURAL BAYS

The structural bay is the basic unit of which all other modules are composed. The dimensions of the structural bay are influenced by the functional layout, service zone clearances, and the type of structural system selected.

THE SERVICE ZONE

A service zone includes a full height service bay (with independent mechanical, electrical, and telecommunications rooms) and an independent service distribution network that includes an interstitial space above the functional zone.

THE FUNCTIONAL ZONE

The functional zone is the occupied floor area within a service module. Space modules are subdivisions of the functional zone.

FIRE COMPARTMENT

A fire compartment is a unit of area enclosed by a two-hour-rated fire resistive construction with at least two different exits.

UTILITIES

Individual HVAC, plumbing, electrical power, telecommunications, and fire protection (sprinkler systems) are all fully integrated into the service module.

ZONING OF AIR-HANDLING UNITS

As far as possible, selection of the air-handling unit shall follow the modular concept and match the boundary of the service zone. To achieve this, the space planners must ensure that only a single functional department is fitted in the space below the service zone.

During the conceptual design development, the following issues should be raised and resolved with the space planners:

(a) A single air-handling unit is meant to serve one medical function such as surgery, the patient wing, or a clinic. The same air-handling unit cannot service multiple functional areas due to their substantially differing HVAC needs.

(b) Should the boundary of the single air-handling unit extend beyond the service zone, the air-handling unit shall cross the service zone to serve the spaces located beyond the zone. Conversely, if two functional areas share the space below the same service zone, multiple air-handling units may be required for the same service zone. Multiple air-handling units may also be required if the capacity requirement of the functional space exceeds the limiting parameter of 60,000 cfm [28,300 L/s]. The design may also consider multiple air units to serve large functional areas – for example a large surgery suite to preclude the possibility of losing all of surgery due to the failure of one unit.

1-A.2 REFERENCES

DEVELOPMENT STUDY-VAHBS (REDBOOK – REVISED 1976)

https://www.cfm.va.gov/til/studies.asp#VAHBS

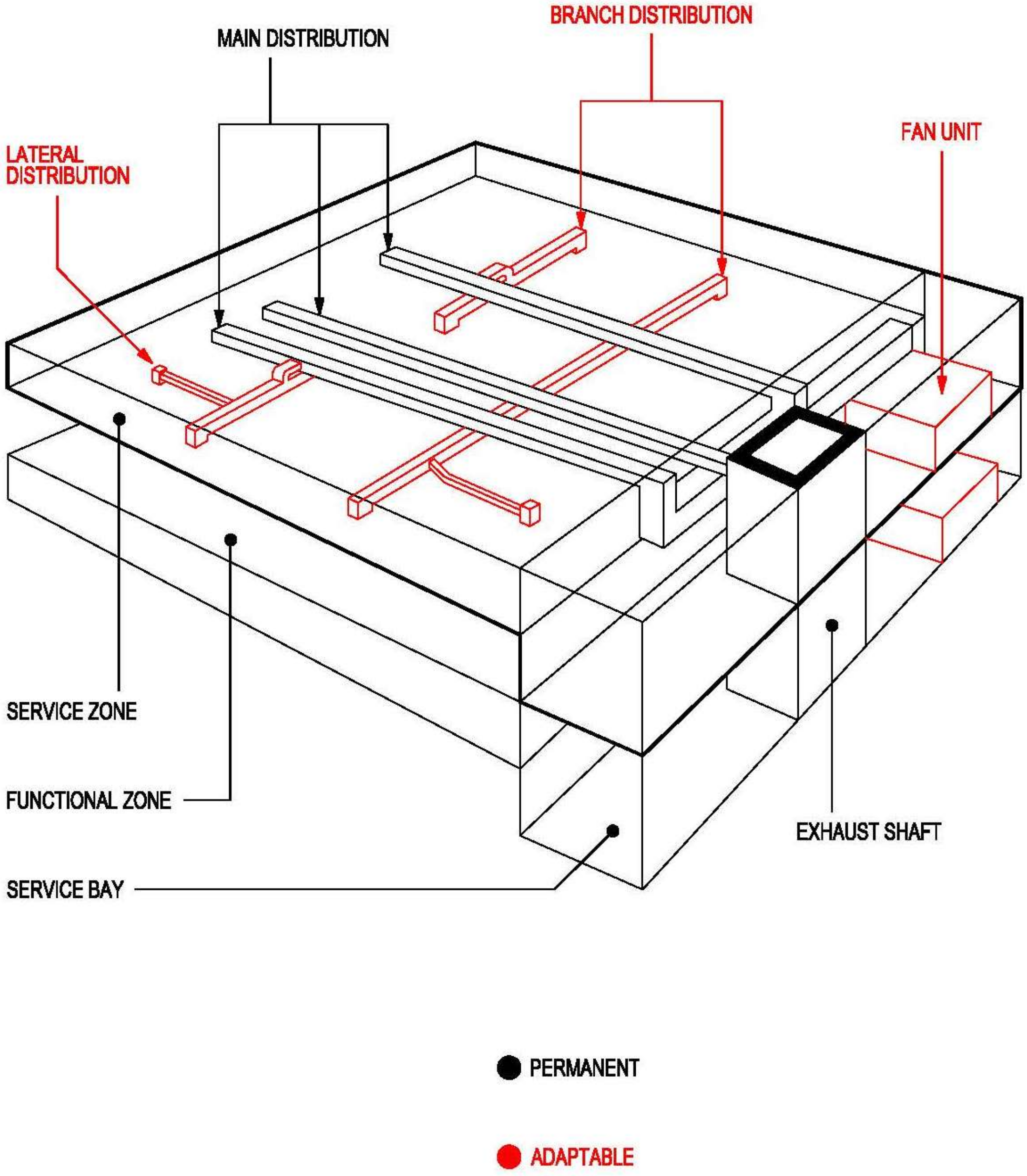
SUPPLEMENT TO DEVELOPMENT STUDY (2006)

https://www.cfm.va.gov/til/studies.asp#VAHBS

1-A.3 BASIC DESIGN OF A SERVICE ZONE

Figure 1-A (following) shows a typical service zone.

HVAC DESIGN MANUAL
CHAPTER 1
APPENDIX 1-A



BASIC DESIGN OF A SERVICE ZONE

Not to Scale

Chapter 2: HVAC DESIGN PARAMETERS AND SELECTION CRITERIA

2.1 GENERAL

This chapter covers the Heating, Ventilation, and Air-Conditioning (HVAC) systems requirements for design and special studies in all VA facility projects. Information given below shall be used in conjunction with the Master Construction Specifications, and associated documents, described in Chapter 1 and located on the TIL.

2.2 BASIS OF DESIGN

2.2.1 OUTDOOR DESIGN CONDITIONS

Weather conditions for VA facilities are provided in Chapter 7. These conditions are based on the locations closest to the VA facilities published in the ASHRAE Handbook of Fundamentals - 2013 or approved latest edition. The A/E can recommend and use (subject to prior approval by VA Authority – identified in Chapter 1, paragraph 1.1) more severe conditions, based on experience and knowledge of local weather conditions.

- High Humidity Locations: Chapter 7, for VA Facilities in High Humidity Locations.
- Low Humidity Locations: Chapter 7, for VA Facilities in Low Humidity Locations.

2.2.1.1 Cooling and Heating Load Calculations

Use the following conditions in software calculating the space cooling and heating loads:

- Cooling (critical facilities such as inpatient wards, nursing home care, OR research labs, etc.) – 0.4% Dry-bulb and mean coincident wet bulb temperatures).
- Heating (critical facilities such as inpatient wards, nursing home care, OR research labs, etc.) – 99.6% Dry-bulb and mean coincident wet bulb temperatures).
- Cooling (non-critical facilities such as offices, warehouses, central laundry etc.) – 1.0% Dry-bulb and mean coincident wet bulb temperatures).
- Heating (non-critical facilities such as offices, warehouses, central laundry etc.) – 99.0% Dry-bulb and mean coincident wet bulb temperatures).

Note: Refer to VA Physical Security Design Manual – Mission Critical Facilities and Life Safety Protection Facilities for the types of facilities identified as mission critical.

2.2.1.2 Air System Mixed Air Conditions Calculations

Use the following conditions for air handling unit mixed air calculations and for sizing heating coils, cooling coils, and humidifiers:

- Cooling (100% outdoor air unit) – 0.4% wet bulb and 0.4% dry-bulb.
- Pre-Heating (100% outdoor air unit) – Mean of minimum annual extremes temperature.
- Cooling (Units with recirculation serving in-patient facilities) – 0.4% Dry-bulb and mean coincident wet bulb temperatures.
- Heating (Units with recirculation serving in-patient facilities) – 99.6% Dry-bulb temperature.
- Cooling (All other units with recirculation) – 1.0% Dry-bulb and wet-bulb temperatures.

- Heating (All other units with recirculation) – 99.0% dry-bulb temperature.
- All Humidifiers: 99.6% Humidification dew point and mean coincident dry-bulb temperatures. See ASHRAE Handbook of Fundamentals 2013 or approved latest edition.

2.2.1.3 Cooling Tower Selection

Use the following conditions for selecting evaporative cooling tower:

- 2 F [1 C] above 0.4 Percent Wet-Bulb Temperatures

2.2.2 INDOOR DESIGN CONDITIONS

See Chapter 6, paragraph 6.4 General Notes and Room Data Sheets. Refer to ASHRAE Standard 170-2013 or approved latest edition for any clinical or medical spaces not listed in Chapter 6.

2.2.3 COOLING AND HEATING LOAD CALCULATIONS – PARAMETERS

2.2.3.1 Occupancy:

Consider as many of the following as are available to determine occupancy. Base design occupancy on the most accurate information available

- Applicable VA Design Guides
- Project Program Data
- Furniture Layout – Architectural Drawings
- ASHRAE Standard 62.1-2016 or approved latest edition (Ventilation for Acceptable Indoor Air Quality)
- Existing furniture layout in spaces being renovated.

2.2.3.2 Occupant Heat Loads:

Use appropriate occupant sensible and latent heat output based on activity level and male or female occupancy ratio. See table in chapter entitled “Nonresidential Cooling and Heating Load Calculations” in ASHRAE Handbook of Fundamentals -2013 or approved latest edition. For animal laboratory and/or animal housing projects obtain animal metabolic rate information from tables in chapter entitled “Laboratories” in ASHRAE Handbook of HVAC Applications 2015 or approved latest edition.

2.2.3.3 Light and Power Loads

Calculate the heat gain due to lighting (overhead and task lights) and power (connected and plug-in equipment) loads, using the actual lighting and equipment layout and the manufacturer’s published data. Use of assumed parameters (W/sf or Btuh/sf) is not acceptable in the final design. As part of the HVAC load calculation, prepare and submit a list of all equipment with associated heat dissipation for each space, including the applied diversity factors.

2.2.3.4 Building Thermal Envelope

For new construction and additions the building thermal envelope shall be in compliance with the appropriate edition of ASHRAE Standard 90.1 as directed in paragraphs 1.2.1 and 1.2.2 of this manual. For renovations the envelope shall be based on the actual field verified building construction and not solely on information found in record drawings.

2.2.3.5 Exhaust and Outdoor Air For Ventilation (Calculation Requirements)

Use the following published data and parameters to estimate the highest required value for exhaust CFM and for outdoor air ventilation CFM. Follow ASHRAE standards when Chapter 6 of this manual does not address the space in question:

- Room data sheets in Chapter 6 of this manual.
- ASHRAE Standard 170-2013 or approved latest edition for medical spaces
- ASHRAE Standard 62.1-2016 or approved latest edition for non-medical spaces

The minimum required ventilation outdoor air flow at the air handling unit level shall be the greater of the following two air flows:

(a) The minimum required outdoor air flow to meet VA and / or ASHRAE ventilation requirements.

(b) A flow equal to the sum of all the exhaust air flows in the spaces served by the air handling unit in question plus additional excess flow to ensure the overall spaces are positive with respect to the outside air environment.

To ensure these requirements are met the A/E shall complete Tables 2-1 and 2-2 for each air handling unit (AHU) system in the project and shall submit them at the DD and CD submission levels for VA review. To determine how much excess air is needed for item (b) above the A/E shall take into consideration the building envelope and calculate how much excess air is needed to maintain the space differential pressure between 0.02 inches WC and 0.03 inches WC [5.0 to 7.5 Pascal].

Note that the baseline building pressure shall be the pressure maintained in the unrestricted access general circulation spaces of the building between the building entrances / exits and the clinical and / or functional areas. The pressure in these spaces, relative to the outside shall be designed to be 0.01 to 0.02 inch WC [2.5 to 5.0 Pascal] higher than outside of the building. This may require balancing multiple AHUs. See paragraph 6.4.2 Air Balance for further guidance.

2.2.4 COOLING AND HEATING LOAD CALCULATIONS

Using an ASHRAE-based, public domain (DOE) or commercially available software program (Trane, Carrier, and/or other software meeting the modeling requirements needed for compliance with ASHRAE Standard 90.1-2013 or approved latest edition), calculate the cooling and heating capacities using the parameters described in the following paragraphs. Coordinate with VA Authority for software approval.

2.2.4.1 Room Data Output

The calculated HVAC design parameters for each space shall be shown in an EXCEL type spread-sheet. A sample copy of the spread sheet is shown in Table 2-2. Provide a spread sheet for each air-handling unit for review and comment.

2.2.4.2 AHU Peak Cooling Load

AHU peak cooling load is the maximum load on the air-handling unit due to room sensible, room latent, and total outdoor air for ventilation cooling loads. Note that the AHU peak-cooling load is not the sum of the individual room peak cooling loads, which occurs at different times, in different months, and due to differing orientations. If a chiller serves a single air-handling unit, use the AHU peak load to select the chilled water system.

2.2.4.3 AHU Peak Supply Air Volume

AHU peak and minimum supply air volumes are calculated from the peak space sensible cooling load and from the space peak sensible heating loads. Enter load calculation results and space specific minimum air change per hour requirements into TABLE 2-2 spread sheet to calculate maximum and minimum flows. Apply a 5% leakage allowance and 5% safety factor to the maximum CFM and round off to the nearest 100 CFM. Use AHU peak supply air volume for selecting the air-handling unit and main air distribution ductwork upstream of the air terminal boxes. For individual branch ductwork to a VAV box and for ductwork downstream of the VAV box, use the individual room peak supply air volumes. The return air duct shall be sized based on peak AHU supply air volume minus local and general exhaust CFM. The return air branch from the room shall be sized based on room peak supply air volume taking room air balance and local exhaust CFM into consideration.

2.2.4.4 Psychrometric Analysis

Provide psychrometric analysis for each air-handling unit by using software programs.

The calculated and graphic display of the system performance shall include the following:

- Outdoor and indoor design conditions
- Mixed air conditions
- Coil leaving air conditions
- Heat gain due to supply and return air fans
- Heat gains and losses in duct systems.
- Supply air volume
- Cooling, heating, and humidification loads

2.2.4.5 Building Peak Cooling Load

Building peak cooling load is the maximum cooling load due the space sensible and latent loads and the peak-cooling load due to the ventilation demand of the entire building, treated as one room. Building peak cooling load is not the sum of the peak cooling loads of the individual AHUs. Use building peak cooling load to select the cooling plant (chillers etc.). When multiple buildings are involved treat all buildings combined as one room for the purposes of sizing the cooling plant. Ensure process loads are included in chiller plant sizing.

2.2.4.6 Building Peak Heating Load

Building peak heating load is the maximum heating load due to space peak heating loads, peak-heating load due to the ventilation demand of the entire building, and process loads. Use the building peak heating load to select the heating plant (boilers etc.) When multiple buildings are involved, use the sum of the maximum heating load of each of the buildings, including process loads, for the purposes of sizing the heating plant.

2.2.5 ROOM TEMPERATURE CONTROLS

2.2.5.1 Definition

A space is defined as individually controlled only when a dedicated terminal unit (example: air terminal unit, fan coil unit, heat pump, or any other heating and/or cooling device) is used, with a dedicated room temperature sensor, to control the space temperature.

2.2.5.2 Individually Temperature Controlled Spaces or Rooms

Listed below are examples of individually controlled spaces with dedicated temperature sensors. See Room Data Sheets, Chapter 6 for all individually controlled spaces.

- Animal Holding Areas
- Chapels
- Conference Room
- ICU Rooms
- Isolation Rooms
- Kitchen
- Laboratory
- MRI Scan Room
- Operating Room
- Patient Bedroom
- Perimeter Corner Space with two or more exposures.
- Pharmacy
- Pharmacy Compounding Rooms
- SPS Functional Areas.
- Waiting Rooms

2.2.5.3 Group Temperature Control

(a) Perimeter Spaces

A single air terminal unit can serve as many as four offices or patient examination rooms located on the same exposure and with identical load characteristics. Do not combine spaces located on different zones to form a common temperature controlled zone.

(b) Interior Spaces

A single terminal unit can serve as many as six interior office or patient examination rooms with identical load characteristics.

2.2.5.4 Open Spaces

Open spaces with an exposed perimeter shall not be combined with interior spaces to form a common temperature control zone. A perimeter zone is defined as an area enclosing an exposed perimeter wall and 12 to 15 ft [4 to 5 m] width.

2.2.6 PERIMETER HEATING

2.2.6.1 Requirements

A building thermal envelope with enhanced energy efficiency can eliminate the need for perimeter heating systems. Provide supplementary perimeter heating systems for:

(a) Patient Bedrooms: When the room heat loss exceeds 180 Btuh/lin ft [173 W/lin m] of exposed wall.
(b) All Other Occupied Spaces: When the room heat loss exceeds 210 Btuh/lin ft [202 W/lin m] of exposed wall.

2.2.6.2 Heating System Description

(a) Hard to clean convective type heating units such as radiators and convectors shall not be used in patient care spaces.
(b) All patient bedrooms and associated exposed bathrooms and all patient care spaces that require supplementary heating shall use perimeter under floor radiant heaters; flat and smooth radiant ceiling panels, or flat and smooth radiant wall panels with exposed cleanable surfaces.
(c) During design development, provide coordinated details of the perimeter reflected ceiling plan, showing coordination between linear diffusers and radiant ceiling panels. Design shall optimize performance while maximizing aesthetics.
(d) For all other spaces such as non-patient bathrooms, exterior stairs, vestibules, and unoccupied spaces, thermostatically-controlled heat can be delivered by unit heaters, cabinet heaters, convectors or baseboard radiators.
(e) Perimeter heating system controls shall be integrated with the space cooling system controls to achieve sequenced heating and cooling and eliminate the possibility of simultaneous heating and cooling.

2.2.6.3 Heating Medium

For perimeters heating and reheat coils in VAV terminals or in other duct mounted applications, the A/E shall consider the Total Life Cycle Cost (TLLC) for both heating water and steam as the heating medium. The TLCC must carefully consider the energy and maintenance costs as well as the first cost. Use two-way modulating control valves to control the hot water flow. Minimum hot water flow for each heating circuit shall not be less than 0.5 gpm [0.03 L/s]. For unoccupied miscellaneous spaces, steam or gas may be used. Use of electric resistance heaters shall be approved by VA Authority identified in Chapter 1, paragraph 1.1 and may be permitted where other heating mediums are not available. Submit request for variance as explained in Chapter 1 of this manual.

2.3 SPECIAL STUDIES

The A/E shall perform the following special studies to ensure that the design intent is met. The studies, complete with estimated construction costs and the designer's specific recommendations, shall be submitted for review and approval.

2.3.1 ACOUSTIC ANALYSIS

2.3.1.1 Requirements

Perform an acoustic analysis to demonstrate that the specified room noise levels are achieved in all octave bands for all air-handling units, heating and ventilating units, fans, chillers, boilers, generators, and outdoor noise producing equipment, such as cooling towers and chillers. See Room Data Sheets in Chapter 6 for the required Noise Criteria (NC) levels. If the necessary room type is not listed in Chapter 6 consult the ASHRAE Handbook of Applications 2015 or approved latest edition. The analysis shall consider both air duct borne noise and noise transmission through walls, floors and roofs and shall be completed for all duct systems and all HVAC equipment.

2.3.1.2 Acoustic Mitigation Measures – HVAC Interior Systems

The acoustical analysis for interior HVAC systems shall include the following as a minimum:

(a) Analysis shall document the lowest equipment sound level necessary to achieve project goals without additional system or building modifications.

(b) Analysis shall demonstrate that equipment is located far enough away from noise sensitive areas to achieve project goals.

(c) Analysis shall determine the minimum attenuation performance of duct or equipment mounted sound attenuators necessary to achieve project goals and meet required noise levels or quieter. Dissipative or absorptive sound attenuators with or without films are not allowed. Reactive or packless (no-media) sound attenuators may be used if necessary. The system design shall be based on minimizing the need for installation of sound attenuators. Air pressure drop through sound attenuators shall not exceed 0.35” WG [87 Pa]

(d) Analysis shall consider radiated or breakout noise in the low frequency range (humming noise). Evaluate, quantify attenuation performance, and include such measures as the use of thicker gage ducts and duct configurations shown in the ASHRAE Handbook of Applications 2015 or approved latest edition, and in the SMACNA “HVAC System Sound and Vibration Procedural Guide”, First Edition or approved latest edition.

(e) Analysis shall consider reduced duct velocities for the achievement of satisfactory acoustical performance.

(f) Transfer ducts provided with non-fibrous or film-lined fibrous materials are permitted for speech privacy in information sensitive areas.
(g) Use of acoustical duct lining in air distribution systems is prohibited.

2.3.1.3 Acoustic Mitigation Measures – Cooling Towers and Other Exterior Equipment

Attenuation treatment of cooling towers and other exterior HVAC equipment depends upon factors such as local ordinance and functions of the surrounding spaces. The acoustical analysis shall evaluate the minimum measures below and the project shall include them as deemed necessary.

(a) Analysis shall indicate the acceptable locations for cooling towers and other noise producing HVAC equipment such as air cooled chillers and condensers to ensure project goals are met.
(b) Analysis shall determine and document the highest acceptable allowed noise levels from cooling towers, chillers and condensers for the selected locations to ensure project goals are met or exceeded.
(c) Analysis shall determine and document the use and effectiveness of acoustic screening (fencing or louvers) around cooling towers, chillers and condensers to contain the radiated noise.
(d) Analysis shall determine if intake and/or discharge sound attenuators are needed on cooling towers and outdoor air cooled condensers and chillers. Install sound attenuators on the intake and/or discharge sides.
(e) Analysis shall determine maximum permissible sound power levels measured at 5 ft [2 m] and 55 ft [17 m] from the cooling tower or other air cooled equipment. Provide this information in the equipment schedule.

2.3.1.4 Unitary Equipment

Unitary Equipment – Space Mounted

When served by unitary equipment located within the conditioned space, the room noise levels are higher than remotely located equipment. For such spaces, an increase of 5 NC (in the room noise level) is permitted. The acoustical analysis shall as a minimum consider the following:

(a) Analysis shall determine and document the maximum allowed acoustical performance that can still meet the project goals.
(b) Analysis shall determine and document the need for an acoustic enclosure over the equipment to meet project goals.

2.3.2 DISPERSION ANALYSIS

2.3.2.1 Requirements

(a) Complete during the conceptual and schematic phase of the project and submit for review by the VA Authority identified in Chapter 1, paragraph 1.1.

(b) Provide for all new buildings, for all buildings additions, and for any project of any type that makes changes to building ventilation air intakes and/or building exhausts of any type.

(c) For all required projects the A/E shall perform an analysis using either Computational Fluid Dynamics (CFD) modeling or via wind tunnel analysis. The CFD modeling must be performed by qualified practitioner using an appropriate turbulence simulation algorithm. The objective of both CFD modeling and wind tunnel is to ensure through **quantification** that odors and hazardous exhaust do not enter into outdoor air intakes and open windows of VA facilities and adjoining properties. See Chapter 24 Airflow Around Buildings in ASHRAE Handbook of Fundamentals 2013 or latest approved edition. Any contamination problems indicated by the simulation shall be corrected prior to proceeding with any additional design development.

The analysis must assess all wind directions that might pose a risk, at different wind speeds and at the range of anticipated exhaust velocities. Mitigation might require changing the height of the release which would require additional iteration through wind directions, speeds and release velocities.

(d) The dispersion analyses shall evaluate all exhaust air discharged from the surrounding systems taking into consideration the ASHRAE Standard 62.1 “Ventilation for Acceptable Indoor Air Quality” – 2016 or latest approved edition, exhaust air stream classes. Examples of exhaust sources that shall be included in the simulation are for example:

- Emergency generator and other stationary combustion engines.
- Vehicular exhausts from designated parking or loitering areas
- Boiler flue stacks
- Incinerator stacks
- Exhaust from infectious waste sanitizers
- Cooling tower exhausts
- General exhaust systems
- Special exhaust systems

(e) Airborne contamination is a serious safety and health issue. It is critical to evaluate and implement the recommendations of the analysis. All recommendations must be implemented even if OSHA and ASHRAE requirements are exceeded.

2.4 BUILDING THERMAL ENVELOPE (EXISTING FACILITIES ONLY)

The A/E shall examine the existing building thermal envelope and evaluate the possibility of making it energy-efficient. The recommended energy conservation measures shall be validated by life-cycle cost analysis.

2.5 VIBRATION CONTROL

Selection of vibration isolators shall be done from the matrix given in VA Master Construction Specification 23 05 41 (Noise and Vibration Control for HVAC Piping and Equipment) and the equipment manufacturer’s recommendations. Include applicable standard details. Indicate all vibration isolation types on the equipment schedules.

2.6 SEISMIC DESIGN REQUIREMENTS

2.6.1 REQUIREMENTS

Earthquake-resistive design for the HVAC equipment, ductwork, and piping shall comply with VA Seismic Design Handbook H-18-8, Sheet Metal and Air Conditioning Contractors National Association, Inc. Seismic Restraint Manual – Guidelines for Mechanical Systems (SMACNA SRM) - 2008 or latest approved edition and VA Master Construction Specifications Section 13 05 41, Seismic Restraint Requirements for Non-Structural Components.

For renovation projects, existing HVAC equipment, ductwork and piping that remain unaltered by the scope of work for the project shall be evaluated for seismic compliance only if the existing building is triggered for seismic evaluation per Section 2.3 of VA H18-8. If the seismic evaluation deems that retrofit is needed to safely restrain existing and unaltered HVAC equipment, ductwork, or piping, then new bracing and restraints shall be designed for these non-structural components and equipment to meet the non-structural performance objectives per H-18-8 Sections 2.5-2.6.

New or relocated, permanent non-structural components and their attachments as well as structure-supported attachments of permanent equipment in structures shall be designed to meet the requirements in H-18-8 Section 4.0.

2.6.2 EXCEPTIONS

There are conditions in H-18-8, its referenced standards and SMACNA SRM under which seismic bracing and restraint may be omitted and the most restrictive exemption criteria shall be used for instances of conflicting requirements.

2.6.3 CONFORMANCE WITH SMACNA SEISMIC RESTRAINT MANUAL

The SMACNA SRM does not cover all conditions, such as providing bracing details for seismic restraints of equipment, details of flexible joints when crossing seismic or expansion joints, or bracing of in-line equipment, etc. Also, in locations of high seismicity, the SMACNA SRM details should be used with care in conjunction with the requirements of H-18-8 and its referenced standards.

2.6.4 CALCULATIONS

Provide detailed structural calculations for conceptual or special restraint designs including but not limited to hangers, supports, anchor bolts, welds, and connections for the VA’s review. Calculations of conceptual or special designs shall be prepared by a registered professional structural engineer experienced in the area of non-structural seismic force restraints. Conceptual or special restraint calculations shall indicate all applicable SMACNA SRM tables when used and indicate sizes, material properties, spacing, and length of elements supporting equipment, piping, and ductwork to structural members. Conceptual restraint designs shall consider and be coordinated with the structural substrate in which the restraints are attached.

Special restraint designs are unique to the project for which final design will not be delegated to others. Conceptual designs are designs for typical conditions for which final design can be delegated to others in accordance with the VA Master Construction Specification 13 05 41 Seismic Restraint Requirements for Non-Structural Components.

2.6.5 DRAWINGS

2.6.5.1 Requirement

Where the SMACNA SRM details are incomplete or not applicable, provide necessary seismic restraint details. Coordinate with mechanical, architectural, and structural work as well as with existing conditions where applicable on renovation projects.

2.6.5.2 Ductwork and Piping Plans and Sections

Show locations of required restraints with reference to the SMACNA SRM or conceptual and special restraint details provided in the drawings set, whichever are applicable.

2.6.5.3 Equipment Restraints

Show locations of required restraints with reference to the SMACNA SRM or conceptual and special restraint details provided in the design drawing set, whichever are applicable. Provide special attention to the seismic provision for the suspended equipment.

2.7 FIRE AND SMOKE PROTECTION

2.7.1 COMPLIANCE

HVAC design and equipment shall be in compliance with VA Fire Protection Design Manual - 2015 or approved latest edition, and approved current edition of NFPA 72, NFPA 88A, NFPA 90A, NFPA 96, NFPA 99, NFPA 101, IMC, and other applicable codes with devices, such as, fire dampers, smoke dampers, and duct-mounted smoke detectors shown on the drawings where applicable. Figure 2-1 at the end of this chapter shows smoke damper and smoke detector configurations which meet both the requirements of NFPA 90A and IMC.

2.7.2 EQUIPMENT AND CRITERIA

2.7.2.1 Smoke Dampers and Detectors

(a) Installation of smoke dampers and detectors shall be done in compliance with the manufacturer’s published recommendations for access, duct clearance distances and elbow locations.
(b) Provide electrical actuators.
(c) Smoke dampers and detectors shall be hard-wired.

(d) When smoke dampers are required in the main supply and return ducts to isolate the air handling unit, provide duct-over pressure protection either with smoke damper end switches or with duct pressure shut off switches or both hardwired to all applicable fans to protect ductwork when smoke dampers close.
(e) Provide local audible and visible alarms and a remote alarm at the Engineering Control Center (ECC). The alarm shall operate both for smoke detector activation and for smoke damper closure.
(f) Show adequate access to the dampers and detectors on plans including duct access panels and access to the same.
(g) Coordinate with fire alarm system engineer to ensure room smoke detectors are not located next to supply diffusers.

2.7.2.2 Fire Dampers

(a) Show all fire dampers on floor plans.
(b) Show adequate access to the dampers on plans, including duct access panels and access to the same.
(c) Evaluate available fan pressures and provide duct-over pressure and duct-under pressure shut off switches hardwired to all applicable fans to protect ductwork when pressures warrant the protection.

2.7.2.3 Stair Pressurization

Stair pressurization is not used in VA facilities.

2.7.2.4 Engineered Smoke Control System

Engineered smoke control systems are not used in VA facilities. See exception for atriums below.

2.7.2.5 Atrium Smoke Control System

See Chapter 6 or the Atrium smoke control system.

2.8 DESIGN CONSIDERATIONS FOR EXISTING BUILDINGS

2.8.1 SITE SURVEY

2.8.1.1 Site Visits

Coordinate site visits with VA Authority identified in Chapter 1, paragraph 1.1 to become familiar with entry, exit, security requirements, parking, and storage requirements. Perform an extensive site survey, record crucial measurements, and interview the maintenance and operating personnel to document actual field conditions, access requirements, and maintenance history of the existing equipment.

Do NOT rely solely on as-built drawings. Take photographs and actual measurements where tight conditions prevail and provide cross-sections of such locations.

2.8.1.2 Field Survey Report

Include the detailed site survey report complete with pictures and findings of the existing conditions in the project submission and describe chronic problems and shortcomings that may impact the project scope of work. Where applicable, indicate in the report a description of any requirements of this manual that cannot be met in the design due to preexisting conditions. These conditions may be technical, or scope or budget related. The narrative shall not only state the issue, but shall discuss possible solutions and ramifications if the issue cannot be addressed and shall be a part of the formal process to request a written waiver as required in Chapter 1, paragraph 1.1.

2.8.1.3 Pre Design TAB Report

In any renovation project with a scope requirement to reuse existing HVAC systems and/or equipment components the HVAC engineer of record shall retain the services of and AABC, TABB, or NEBB certified TAB company to performance test the systems and/or equipment to be reused to establish a baseline and confirm design parameters. To be significant the testing shall be accomplished under simulated full load conditions and shall include as applicable the following:

(a) Full air flow CFM and system static pressure profile on ducts and fans (including air handling units) to be reused. On variable air systems this test shall include indexing all VAV terminals to full cooling.
(b) Estimate of duct leakage based on comparison of flow measured at air devices versus flow measured by duct traverses at the fan or air handling unit.
(c) Total chilled water and heating water flow with all control valves indexed to full heating and or full cooling as applicable. Provide flow measurement and system pressure profile at the pumps, chillers, hot water boilers, etc. Measurement must be taken with calibrated devices and instruments either provided by the vendor or through confirmation of the accuracy of the VHA installed system instrumentation.
(d) Condenser water flow measurement and pressure profiles at pumps, chillers and cooling towers. Measurement must be taken with calibrated devices and instruments either provided by the vendor or through confirmation of the accuracy of the VHA installed system instrumentation.
(e) A full report of findings and their impact on the scope shall be developed and submitted to the Contracting Officer Representative (COR) for review and documentation of the work. If the investigation work indicates that the work in the scope cannot be executed the A/E shall provide options as to the solution of the issues for the COR review.

2.8.1.4 Additional Work

Should the site survey or pre-design TAB findings lead to changes in the scope of work, notify the VA Authority identified in Chapter 1, paragraph 1.1, in writing, as soon as possible. Any additional work resulting from the site survey must be authorized in advance before it is included in the project scope.

2.8.2 MODIFICATIONS – EXISTING SYSTEMS

Work on the existing systems shall include the following measures:

2.8.2.1 Steam Radiators

Radiators and fin-tube convectors shall not be used in patient care areas. Existing steam radiators in non-patient care areas shall be retrofitted with modulating controls using a single space temperature sensor for heating and cooling to ensure that heating and cooling operate in sequence and never simultaneously.

2.8.2.2 Dual Duct Air Distribution Systems

New dual duct (cold deck or hot deck) air distribution systems are prohibited in new construction, in building additions, and in HVAC replacement projects. When renovating spaces served by dual duct air distribution systems either the entire system shall be replaced with a new terminal reheat variable air volume (VAV) system or the system components in the area of the work shall be replaced by installing new VAV terminals in the renovated areas. The VAV terminals shall be served with either steam or heating water for reheat.

2.8.2.3 DDC Controls

All new control devices shall be equipped with electric actuators. For renovation of an existing facility, where an updated control system is being installed, replace pneumatic with electric actuators.

2.8.2.4 Existing Ductwork

Where connections are made between new and existing ductwork, the existing ductwork shall be pressure tested and resealed as necessary, thoroughly cleaned, and sanitized by wiping down the interior with rubbing alcohol to avoid the possibility of contamination.

2.9 PROJECT PLANNING

The HVAC system design and development shall consider the factors listed below:

2.9.1 PHASING

Coordinate the phasing requirements with facility personnel. Phasing will have significant impact on the need for swing space, schedule, and the system design. Testing, Adjusting, and Balancing and Commissioning costs are dependent on phasing. Duplication of efforts shall be minimized. A complete detailed phasing plan shall be developed and included in the contract documents to ensure the work is executed per the plan agreed on by the VA. The plan shall include all phases of construction and testing, adjusting, balancing and commissioning. The design for required temporary cooling, heating, and ventilation shall be included with the contract documents.

2.9.2 UTILITY CONNECTIONS AND OUTAGES

In renovation projects thoroughly investigate and coordinate utility routing, available capacity, and intended outages with facility personnel. The A/E shall ensure the utility support of all systems is investigated back to the logical source to ensure that the installed systems are not impacted nor do they impact the existing systems and equipment during operation

2.10 DEMOLITION WORK

Demolition work shall be clearly documented with points of disconnections and connections clearly shown. The demolition drawings shall show the locations of new shutoff valves, end caps, and blind flanges. All demolished systems shall be fully removed and taken back to the closest branch or main.

2.11 LOCATIONS OF OUTDOOR AIR INTAKES AND EXHAUST AIR OUTLETS

2.11.1 COMPLIANCE – PHYSICAL SECURITY

Air intakes and exhausts shall be designed in accordance with the appropriate Physical Security Design Manual for VA Facilities – Life Safety Protected or Mission Critical.

2.11.2 COMPLIANCE – AIRBORNE CONTAMINATION CONTROL

(a) Outdoor air intake and exhaust air outlets shall be located in strict accordance with ASHRAE Standard 170 -2013 or approved latest edition to avoid health hazards, nuisance odors, reduction in capacity of HVAC equipment, and corrosion of equipment caused by re-entry of exhaust air from laboratories, transportation systems, electrical generators, vehicles at loading docks, cooling towers, and air-cooled condensers.
(b) Air intake for AHUs shall be located 25 feet (minimum) from the cooling towers and all exhaust and vent discharges. Exception: Airside economizer relief air stream outlet may be located 10 feet (minimum) from AHU air intakes so long as they are oriented in a way that does not inhibit the economizer operation.
(c) For ground mounted AHUs, bottom of the air intake shall be minimum 6 feet above grade.
(d) For roof mounted AHUs, bottom of the air intake shall be minimum 3 feet above the roof.
(e) In areas subject to snow fall orient and located air intakes to minimize the accumulation of snow drifts against the air intake louver.
(f) Select air intake louvers with due consideration to protection from wind borne water intrusion and excessive air pressure drops.
(g) Provide all ventilation air intakes with bird screen (minimum 0.5 inch mesh).
(h) Follow the requirements of paragraph 2.3.2. on all applicable projects.
(i) Verification: In all new buildings, building additions and in projects in which changes are made to exhaust and intake systems the construction contract shall require post construction air quality testing to ensure changes have not created any air contamination problems.

2.11.3 COMMON OUTDOOR AIR INTAKE

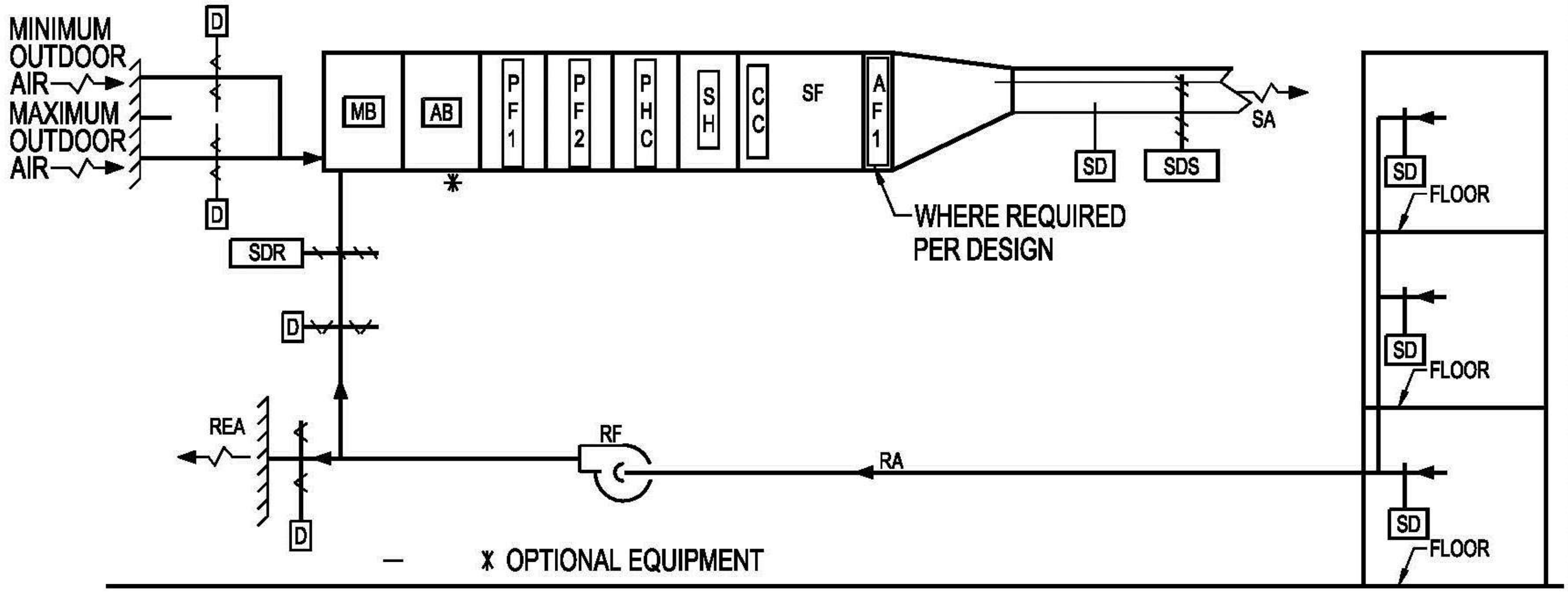
Common outdoor air intake can be used in conjunction with multiple air handling units, provided the outdoor air intake plenum is partitioned with a dedicated intake for each air handling unit.

2.11.4 BID PACKAGE COORDINATION

Ensure that the bid documents are coordinated within the mechanical discipline and across architectural and all other engineering (electrical, plumbing, fire protection and structural) disciplines to avoid delays and costly change orders or claims.

HVAC DESIGN MANUAL

CHAPTER 2
FIGURE 2-1



NOTES:

1. THIS DIAGRAM IS APPLICABLE TO SYSTEMS WITH A DESIGN CAPACITY GREATER THAN 15,000 CFM [7,075 L/S] AND SERVING MULTIPLE FLOORS.
2. SMOKE DAMPERS ARE NOT REQUIRED IF AHU IS LOCATED ON FLOORS SERVED AND SERVES ONLY THAT FLOOR OR LOCATED ON ROOF DIRECTLY ABOVE FLOOR SERVED. SEE NFPA 90A.
3. SEE STANDARD DETAILS AND CAD STANDARDS (PG-18-4) LOCATED ON THE TIL FOR A LIST OF ABBREVIATIONS.

SMOKE CONTROL FOR AIR HANDLING UNIT SYSTEMS

Not to Scale

HVAC DESIGN MANUAL
CHAPTER 2
TABLE 2-1

System Air Balance Schedule

Spaces Served: Emergency Department

Unit Number	Exhaust CFM	Ventilation CFM
EF-1	200	---------
EF-2	200	---------
EF-3	200	---------
EF-4	200	---------
AHU-1	---------	1400
Totals	800	1400
Positive CFM	---------	600
Theoretical Pressure - (IN. W.C.)	---------	0.09" wc

AIR BALANCE SCHEDULE

HVAC DESIGN MANUAL
CHAPTER 2
TABLE 2-2

ROOM COOLING AND HEATING LOADS OUTPUT DATA SUMMARY SCHEDULE

AHU NO.	ROOM NO.	ROOM NAME	ROOM SIZE				AHU	PEAK ROOM COOLING LOAD				PEAK ROOM HEATING LOAD		CALCULATED ROOM AIRFLOW				REQUIRED ROOM AIRFLOW			SELECTED DESIGN ROOM AIRFLOW		SELECTED DESIGN MINIMUM ROOM AIRFLOW		SELECTED DESIGN REHEAT TEMPERATURE	ROOM AIR RETURN EXHAUST (G) EXHAUST (S)	ROOM STATUS	ROOM AIR BALANCE
			AREA		HEIGHT		SYSTEM TYPE	SENSIBLE		LATENT																		
			SF	M²	FT	M	VAV OR CV	BTUH	W	BTUH	W	BTUH	W	CFM	L/S	ACH	ΔT	CFM	L/S	ACH	CFM	L/S	CFM	L/S	°F		VAV OR CV	(+) OR (-) OR (0)

NOTES:

1. THIS SCHEDULE IS REQUIRED FOR DESIGN SUBMISSION.
2. PROVIDE 11"x17" SPREADSHEET TO VA FOR DESIGN SUBMISSIONS.
3. USE MINIMUM AIRFLOW (CFM [L/S]) FOR AIR CHANGE CALCULATIONS. IN MOST CASES, THIS IS THE HEATING AIR FLOW RATE.
4. MAINTAIN DESIGN REHEAT TEMPERATURE BELOW 91°F.

ROOM DATA OUTPUT

Chapter 3: AIRSIDE HVAC SYSTEMS AND EQUIPMENT

3.1 INTRODUCTION

This chapter provides guidance for the design of the airside of HVAC systems and associated equipment. Information given below shall be used in conjunction with the VA Standard Details, Master Specifications, and associated documents, described in Chapter 1 and located in the TIL.

The following HVAC systems are evaluated:

- Central air handling units (all-air systems)
- Rooftop Air Handling Units (see 3.2.1.4 for limitations)
- Terminal cooling and heating systems
- Dedicated Outdoor Air Systems (100% outdoor air)
- Heating and ventilation units
- Energy recovery systems
- Exhaust systems
- Miscellaneous systems and components

Criteria for duct sizing and design are provided in section 3.7 below.

3.2 ALL-AIR SYSTEMS

3.2.1 SPECIAL REQUIREMENTS

3.2.1.1 System Selection

All-air systems shall be used for all new facilities and major renovations of existing facilities where above ceiling clearance is available to accommodate HVAC air distribution systems. All-air systems designs shall provide for the admittance of minimum required outdoor air in all operating conditions. The use of constant volume (CV) systems shall be carefully considered and only utilized if proven more cost effective through a Life Cycle Cost Analysis (LCCA), or if required due to the area served.

Air handling unit system selection shall be based on a LCCA comparing a minimum of three different air side system configurations. Systems requiring lower dew point temperatures, such as surgery, may involve more than three systems for comparison. Further consideration will be given to whether the project is in an extreme weather climate (high humidity, cold weather, etc.).

For a conventional VAV system with a pre-heat coil, steam humidifier, and chilled water coil include an analysis of water side versus air side economizer. Analysis shall include impact of additional humidification energy required when using air side economizer in low humidity areas.

Analyze the effectiveness of a DOAS ducted to the outdoor air intake of multiple air handling units.

Separate analysis will be required for the Surgery Suite, any 100% outside air systems, and any system that requires a supply air dew point below 52 F [11 C].

3.2.1.2 Maximum Capacity

The capacity of a single air-handling unit shall not exceed 50,000 cfm [23,600 L/s]. If a single air handling unit that exceeds 50,000 CFM [23,600 L/s] is found to have the lowest life cycle cost, obtain the approval of the VA Authority identified in Chapter 1, paragraph 1.1 before use.

3.2.1.3 AHU Configuration

(a) Air handling units shall be AHRI certified (either independently or in-house, dependent on fan system selection), factory-fabricated, and the standard product of one manufacturer. All air-handling units shall be constructed in modular, vertical or horizontal, and draw-through configuration. Use of blow-through air-handling units is not permitted, as fully saturated air leaving the cooling coil causes damage to the downstream filters and sound attenuators. See Figure 3-1 for a typical air handling unit configuration.

(b) Each air-handling unit shall be installed as a standalone entity without any physical interface with another air-handling unit. Selection of stacked (one on the top of another) air handling units is not permitted. Use of a common return air fan for two or more air-handling units is also not permitted.

3.2.1.4 Rooftop Air-Handling Units

Rooftop air-handling units are NOT permitted to service patient care applications and in the following areas:

- High humidity locations shown in Chapter 7.
- Hurricane-Prone Regions as defined in the Physical Security and Resiliency Design Manual.
- Locations where weather is extreme, including where the ASHRAE 99% heating design temperature is less than 10 F [-12 C].

Where permitted, rooftop air-handling unit installation must include an internal walk-in corridor to allow access for repairing system components, direct access from the main building without the use of ladders, and must address and resolve coordination issues, including but not limited to:

- Structural integrity of the roof to bear the load
- Access for repairs, removal, and replacement of equipment
- Screening needs to meet local ordinances
- Walking pads to reach equipment
- Minimize exposed piping on the roof and install underneath the unit wherever possible.
- Vibration and Noise generated from the equipment

3.2.1.5 Air Distribution

All supply, return, exhaust, relief, and outdoor air duct systems shall be fully ducted between the fan intake and discharge and air outlets and inlets. **Use of the space between the**

structural ceiling and suspended ceiling is NOT permitted as an air plenum for air distribution and/or collection.

3.2.1.6 Glycol

Use of an ethylene glycol solution is NOT permitted as an anti-freeze agent due to its toxicity level. Use propylene glycol for its lower toxicity compared to ethylene glycol. See Chapter 4 and Appendix 4-A for further technical details.

3.2.2 ALL-AIR SYSTEM COMPONENTS

3.2.2.1 Supply Air Fan(s)

(a) Plenum Fans versus Housed Centrifugal Fans: Use of a single or multiple plenum fans (fan array) is permitted over housed, air-foil centrifugal fans if proven as a superior choice based on the overall impact of the following parameters:
  - BHP Absorbed
  - Sound Power Ratings
  - Overall Space Requirements
  - Cost

The designer shall provide multiple fan selections comparing the plenum fans, housed centrifugal fans and fan array in a project specific configuration that addresses such issues as the status of the after-filters and required discharge air configuration. Note that the use of the plenum fans is approved within the fan casing only.

All plenum fans shall be direct drive. Belt driven plenum fans are prohibited.

(b) Plenum Fans - Certification and Testing Requirements (AMCA and AHRI)
  - AMCA: Each plenum fan shall be individually AMCA 210 certified for air performance and AMCA 300 certified for sound power. It is recognized that multiple fans in an array are not yet AMCA certified.
  - AHRI: Air handling units equipped with a single plenum fan shall be AHRI 430 certified for airflow capacity and AHRI 260 certified for sound data. Air handling units equipped with multiple fans in an array shall be rated and factory tested in accordance with AHRI 430 for airflow capacity and AHRI 260 for sound data

(c) Fan Motor Selection: The fan motors shall be premium efficiency type per Federal Energy Management Program (FEMP) and VA Master Specifications. The fan motors shall be selected within the rated nameplate efficiency, without relying on the service factor. When used with VSDs (Variable Speed Drives), the fan motors shall be compatible with the motor controller duty. Where a VSD is utilized for balancing on a constant volume fan provide a motor shaft ground ring.

3.2.2.2 Return Air Fan(s)

Where room air can be returned back to the system, provide a dedicated return or relief air fan for each air-handling unit to facilitate room-by-room air balance, economizer cycle, and intended volumetric air balance. Provide a direct digital control (DDC) interlock between the supply and return or relief air fans.

3.2.2.3 Exhaust Fan(s)

Provide general and special exhaust fan systems (as required) electronically interlocked with the AHU supply air fan. A single AHU may require interlocks with multiple exhaust fan systems, such as general exhaust, fume hood exhaust, and "wet exhaust".

3.2.2.4 Motor Voltages

Motor Voltages shall conform to NEMA/ANSI standards as follows:

Table 3-1: MOTOR VOLTAGE SIZING CRITERIA

System Voltage (Transformers) Nominal	System Voltage (Transformers) With 4% Drop	Utilization Voltage (Motors) Standard (For Schedule)
120	115.2	115
208	199.7	200
240	230.4	230
480	460.8	460
600	576.0	575
2400	--	2300
4160	--	4000

3.2.2.5 AHU Casing

The AHU casing shall be solid double-wall without perforations. Casing materials shall be selected based on the project type, unit location, and area served. Provide foam injected thermal insulation between the inner and outer casings. Use of exposed interior insulation is not permitted.

The combination of the casing wall thickness and the insulation characteristics (insulation type, thickness, and density) shall:

- Provide stiffness to resist dents.
- Limit panel deflection to no more than L/240 (where L is the panel length) when tested at the AHUs total static pressure.
- Limit vibration within the prescribed values – Refer to specification Section 23 05 41 "Noise and Vibration Control" for HVAC Piping and Equipment for vibration limitations.
- Limit inlet, discharge, and casing-radiated noise, refer to Chapter 2 for acoustical analysis requirements and Chapter 6 maximum room NC values.

- Prevent condensation on the exterior surface of the air handling unit or its viewing windows when located in non-conditioned spaces, such as mechanical rooms, basements, and attic spaces.
- Minimum unit insulation values shall be as defined in ASHRAE 90.1-2013 or approved latest edition.
- For AHUs in high humidity locations the interior and exterior casings shall be treated with a corrosion resistant coating. All interior components exposed to the air stream such as fan scroll, filter racks, etc. shall also be protected. Refer to Specification 23 73 00 “Indoor Central-Station Air-Handling Units” and 23 74 13 “Packaged, Outdoor, Central-Station Air-Handling Units” for additional requirements.

3.2.2.6 Access Sections and Mixing Box

Include access sections generally as shown in Figure 3-1. Show door swings on the floor plans. Include a factory-fabricated mixing box to mix the return and outdoor airstreams.

3.2.2.7 Blender Section

Provide a blender section, where recommended by the equipment manufacturer, to mix return and outside air and prevent stratification. If a blender section is recommended, the project impacts (cost, space, etc.) shall be reviewed with the VA.

3.2.2.8 Drain Pan

Provide an insulated, stainless steel, double-wall, and double sloping drain pan for removing cooling coil condensate from the pan as soon as it forms. Where two coils are stacked, include an intermediate drain pan for draining condensate from the upper coil into the main drain pan. Raise all floor-mounted air-handling units above the finished floor level to obtain adequate static head for the installation of cooling coil condensate traps. Units can be raised with housekeeping pads or support steel. Height requirements shall be coordinated during design and shown on the drawings. Drain pans shall comply with the requirements of ANSI/ASHRAE Standard 62.1-2016 or approved latest edition.

3.2.2.9 Cooling Coils

Chilled water cooling coil support frame shall be stainless steel. Select cooling coils to limit the face velocity to 450 fpm [2.3 m/s] or below. Evaluate the possibility of lowering the cooling coil face velocity if life-cycle cost-effective.

3.2.2.10 Preheat Coils

Provide preheat coils for all AHUs where the winter design temperature (ASHRAE Annual Extreme Daily Mean Dry-Bulb Temperatures – Minimum Column) is 32 F [0 C] or below. Select steam, hot water, glycol hot water, or electric preheat coils, generally with the same face velocity as the cooling coils to avoid installation of blank off plates.

(a) Steam Coils: Select steam coils with integral face and bypass dampers and two-position on/off control valves. As an option, for non-100% outdoor air units, consider the use of a distributing type steam coil with a modulating control valve. Ensure that steam condensate is removed from the coil as soon as it is formed by selecting the correct steam trap size and type, adequate static leg for the gravity drain, and the recommended slope for the gravity return.

(b) Hot Water Coils – With Glycol: Select hot water or glycol preheat coils where the preheat coil surface comes in contact with 32 F [0 C], as defined above, or lower air temperature. Use propylene glycol solution with corrosion inhibitors specifically manufactured for HVAC applications. See Chapter 4 for glycol properties and design criteria.

(c) Hot Water Coils – Without Glycol: Glycol can be omitted where the heating design temperature is above 32 F [0 C]. The following freeze protection measures are recommended:

Provide a dedicated circulating pump in the coil circuit with hydronic separation between the coil circuit and the incoming hot water piping to maintain a constant water velocity of 3.0 fps [0.9 m/s] through the coil tubes. See VA Standard Detail – Preheat Coil (Hot Water) – Piping Connections.

http://www.cfm.va.gov/til/sDetail/Div23HVACSteam/SD238216-02.pdf

Select coils with wider fin spacing to reduce pressure drop.

Provide coil connections to ensure that the coldest air faces the hottest fluid.

(d) Electric Coils: Electric preheat coils may be used where steam and/or heating hot water are not available. Select low-watt density electric coils complete with UL safety devices and Silicon Controlled Rectifier (SCR) controls for modulating operation. Refer to Chapter 4 Section 4.4 Heating Systems for additional information regarding the use of electric heat.

3.2.2.11 Unit-Mounted Reheat Coils

Air-handling unit mounted reheat coils are used for single-zone application and elsewhere where required. Hot water or steam coils with modulating control valves are the preferred choice. Electric reheat coil may be used where hot water or steam is not available. Refer to Chapter 4 Section 4.4 Heating Systems for additional information regarding the use of electric heat.

3.2.2.12 Corrosion Protection - Coils

Surgical Suite Air-Handling Units: For ALL locations, air-handling unit-mounted coils shall be equipped with copper fins. Copper fins possess anti-microbial properties and for high-humidity locations offer corrosion protection. Select coil face velocities to compensate for the use of copper fins in lieu of aluminum fins.

High Humidity Locations - All Air-Handling Units (Except Surgical Suite): All unit-mounted coils shall be equipped with multi-stage, electro-deposit coating (E-Coating) of 1-mil thick epoxy lining. Select coil face velocities and fin spacing per manufacturer's recommendations for coated coils. Copper coils do not require any additional corrosion protection coatings.

3.2.2.13 Filtration

Each air handling unit shall be provided with two pre-filter sections. Pre-filters shall be located upstream of the coil sections. Filter face velocity shall not exceed 500 fpm [3 m/s]. After-filters and final-filters (terminal filter) shall be provided as shown in Chapter 6 and Room Data Sheets. Provide side-access filters for final filter applications.

(a) Filter Pressure Drops: Estimate the fan static pressure by using the manufacturer’s published static pressure drop at the recommended replacement condition, and not at the clean condition.

The filter schedule provided on the contract drawings shall show the static pressure drop through the filters at both conditions - clean and recommend replacement.

(b) Filter Efficiency: Filter efficiencies shall comply with ASHRAE Standard 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size – 2012 or approved latest edition. All filter efficiencies are expressed as Minimum Efficiency Reporting Value (MERV) numbers.

Table 3-2 FILTER SCHEDULE

Designation	Location	MERV	Thickness
Pre-Filter (PF-1)	Upstream of All Coils and Supply Air Fan	7	2-inch Thick Throwaway
Pre-Filter (PF-2)	Downstream of PF-1	11	6-inch Thick Rigid Cartridge
Alternate Pre-Filter (PF-2)	Downstream of PF-1	13	6-inch Thick Rigid Cartridge
After-Filter (AF)	Downstream of Cooling Coil and Supply Air Fan	14	12-inch Thick Rigid Cartridge
After-Filter (AF)	Downstream of Cooling Coil and Supply Air Fan	16A	12-inch Thick Rigid Cartridge
Final-Filter	Downstream of Air Terminal Unit	17	99.97% @ 0.3 Microns (HEPA)

Notes:

1) PF-1 and PF-2 shall be located back-to–back.
2) All AHU mounted filters shall be nominal 24 in x 24 in [650 mm x 650 mm] size.
3) Designer shall coordinate filter sizes and types with the facility. If the site has no preference use size and type listed above.

4) See Chapter 6 and Air Handling Unit Data Sheets for specific filtration requirements.

(c) Manual Pressure Gauges: Provide a single differential pressure gauge with air sampling tubing and three isolation ball valves to measure static pressure across PF-1 and PF-2 and the total static pressure drop across both pre-filter sections. Provide a single differential pressure gauge at each after-filter and final-filter.

(d) DDC Pressure Differential Switch: Provide a dedicated DDC pressure differential switch for each filter section. The DDC switch shall interface with the building ECC system to provide a remote maintenance alarm, when the measured pressure drop exceeds the switch alarm setting or senses a missing filter.

(e) Provide for testing of the HEPA filter after installation. Allowances shall be made for the ability to provide aerosol photometry tests (commonly known as DOP/PAO testing) of the HEPA filters in situ. This test utilizes an aerosol photometer as the measuring device and an aerosol generator to produce an aerosol challenge to the filter. The aerosol challenge must be homogeneously mixed before entering the filter. Provide sufficient upstream straight run of duct or a dispersion plate at the HEPA housing. All HEPA filters shall be tested in situ, testing of HEPA filters shall be included in project specifications.

3.2.2.14 Humidifiers – Steam

Provide a steam humidifier to maintain the relative humidity at set point. The humidifier shall be jacketed type designed to attain full dispersion of steam in the airstream.

(a) Location: In the AHU the preferred location of the humidifier is between the pre-heat and cooling coils. Duct-mounted steam humidifiers are permitted, where space conditions are limited and after-filters are not required on the downstream side of the cooling coil and supply air fan. Provide drainable stainless steel duct sections 36 in [91 cm] in length on the upstream sides of duct-mounted humidifiers and 36 in [91 cm] in length downstream sides of duct-mounted humidifiers.

(b) Humidifier Controls: Provide a modulating steam control valve to control and maintain humidity. Locate the relative humidity sensor in the main return or exhaust air duct to control set point. Provide a high-limit humidity sensor in the supply air duct to disable humidification if the discharge humidity exceeds 80% (adjustable). Ensure full integration of the humidifier controls with the ECC, including remote alarm capability. See Chapter 5 for additional discussion of humidifier control requirements.

(c) Boiler Plant Steam: Steam from the central boiler plant may be used only if it is documented that the water treatment chemicals are FDA and OSHA approved. See 21 CFR 173.310 – Boiler Water Additives for a list of approved chemicals.

(d) Dedicated Unfired Steam Generator: Where direct use of central plant steam is not feasible, an unfired steam-to-steam generator shall be used to produce “clean steam” at 15 psig [103 kPa]. Incoming water shall be de-ionized or reverse-osmosis treated as recommended by the generator manufacturer. Determine water quality based on the site sample and lower the incoming dissolved solids to 80 ppm (parts per million).

(e) Common Unfired Steam Generator: Where direct use of central plan steam is not feasible, an unfired steam-to-steam generator shall be used to produce “clean steam”. This “clean steam” shall be distributed to multiple humidifiers. The entire clean steam supply and condensate distribution piping systems, including pipe fittings such as steam traps and valves, shall be of stainless steel material. Makeup water shall be de-ionized or reverse-osmosis treated as recommend by the generator manufacturer. Determine water quality based on the site samples and lower the incoming dissolved solids to 80 ppm (parts per million).

3.2.2.15 Humidifiers – Gas-Fired

Where central plant steam or “clean steam” is not available, evaluate the possibility of using a gas-fired steam generator. Determine water quality based on the site sample and lower the incoming dissolved solids to 80 ppm (parts per million) before entering the humidifier. All controls described above for the Steam Humidifiers shall apply to the gas fired humidifier.

3.2.3 ALL-AIR SYSTEM – TYPES

3.2.3.1 Variable Air Volume (VAV) Systems

VAV systems shall be used unless determined infeasible. The system shall be designed to vary the supply air volume in response to the prevailing space load while still maintaining the minimum outdoor air for ventilation at the air-handling unit level, under all operating conditions. In addition to the requirements defined above each VAV system is generally equipped with:

- Variable speed drives for supply and return or relief fans
- Airflow measuring devices
- Static pressure sensors
- Pressure-independent air terminal units

(a) Automatic Control Sequence: Supply air fan speed shall be controlled by polling all air terminal units and by monitoring the duct static pressure. The duct static pressure setpoint shall be reset based on the position of the air terminal units control dampers. Refer to ASHRAE 90.1-2013 or approved latest edition for additional discussion of static pressure reset control. Airflow measuring devices shall facilitate a tracking sequence in which a constant differential between the supply and return or relief air volumes shall be maintained. Limit the tracking and speed reduction sequences to avoid return or relief air fan stalling.

(b) Airside Economizer Cycle: Incorporate economizer cycle as mandated by ASHRAE Standard 90.1 – 2013 or approved latest edition, and where found cost-effective by life-cycle cost analysis. The engineer shall discuss economizer control type with the VA facility and determine the best control strategy. If the facility has no preference a dry bulb type shall be utilized.

(c) Single Zone Variable-Air Volume: Air handling and fan coil units with chilled water cooling coils or DX cooling (minimum capacity of 110 MBH at AHRI conditions for the DX equipment) and supply fans with motors greater than or equal to 5 hp shall have their supply fans controlled by two-speed motors or variable-speed drives. At cooling demands less than or equal to 50%, the supply fan controls shall be able to reduce the airflow to no greater than the larger of one half of the full fan speed (two-thirds for DX equipment), or the volume of outdoor air required to meet the ventilation requirements of ASHRAE 62.1-2016 or approved latest edition.

3.2.3.2 Constant Volume (CV) Systems

Constant volume systems, similar to variable air volume, shall be provided where the supply air volume is expected to remain constant or substantially constant.

Constant volume systems shall be subdivided into single zone low pressure constant volume and medium pressure constant volume systems. Low pressure constant volume systems shall consist of an air handling unit and low pressure ductwork.

Medium pressure constant volume system, similar to variable air volume, shall consist of an air handling unit, medium pressure supply ductwork, variable speed drives for supply and return or relief fan, airflow measuring devices, static pressure, and pressure independent constant volume air terminal units.

If the unit serves two or more zones with differing load profiles the system shall be a medium pressure constant volume system.

3.2.3.3 Air Terminal Units

All terminal units shall be pressure-independent type and equipped with DDC controls.

All air terminal units (constant volume or variable air volume) serving perimeter or interior spaces shall be equipped with integral reheat coils.

(a) Capacity
  - Capacity of a single air terminal unit shall not exceed 3,000 cfm (1,420 L/s), unless it is a dedicated box serving a single area which requires a greater flow rate (example a surgery suite).
  - Minimum hot water flow shall not be lower than 0.5 gpm [0.03 L/s].

(b) Terminal Unit Settings: The maximum and minimum air volume settings shall be factory set, but field adjustable. The minimum setting shall satisfy the following:
  - Provide make-up air for exhaust.
  - Meet minimum ventilation air needs.
  - Limit the supply air temperature to 95 F [35 C] in heating mode.

(c) Fan-Powered Air Terminal Units: For non-patient areas, evaluate the use of fan-powered boxes. Provide a 1 in [25 mm] thick throwaway filter in the return air intake opening. Use of series fan-powered boxes offers the following advantages:
  - Facilitates space heating during unoccupied hours without activating the air-handling unit.

(d) Acoustic Treatment: Provide terminal unit sound attenuators per acoustic analysis.

3.3 TERMINAL COOLING AND HEATING SYSTEMS

In this section, fan coil units are described with a DOAS for ventilation air. The use of water source and ground source heat pumps with auxiliary equipment is not addressed in this manual. Water source and ground source heat pumps are acceptable and shall be evaluated.

3.3.1 SPECIAL REQUIREMENTS

3.3.1.1 Terminal Cooling Systems

The following terminal cooling systems require the approval of the VA Authority identified in Chapter 1, paragraph 1.1 before use:

- Radiant Panels
- Chilled Beams (Active and Passive)
- Valance Systems

Provide a LCCA showing they have the lowest life cycle cost and supporting narratives on the proposed temperature and humidity control measures for approval.

Terminal cooling systems are prohibited from the following locations:

- Clinical Labs
- Procedure rooms
- Surgery areas
- ICU and NICU
- Inpatient Rooms
- All clean environments such as clean spaces within SPS and Pharmacy which require high level filtration and infection control.
- Any 100% outdoor air single pass system required for contamination control such as SPS Decontamination room.

3.3.1.2 DX Terminal Units

Through-the-wall air-conditioners, window air-conditioners, packaged terminal air-conditioners (PTAC), or terminal heat pumps are NOT permitted for all occupied spaces, unless approved by the VA Authority identified in Chapter 1 paragraph 1.1.

Where specifically approved by VA Authority, split-systems or terminal DX units may be used only for non-patient spaces, where chilled water is not available. Examples of such spaces are:

- Pharmacy Storage within a Large Warehouse
- Remotely Located Security Office
- Guard Cabin

3.3.1.3 Fan Coil Units

Fan coil units are not permitted in new construction. Fan coil units are also not permitted in renovation projects where space is available to accommodate air distribution ductwork between the structural ceiling and the suspended ceiling. Fan coil units are prohibited in renovation projects with clinical spaces. Use of 2-pipe seasonal changeover systems is not permitted.

Exception:

a) Non-clinical unoccupied spaces. Example spaces are:
  - Mechanical Rooms
  - Electrical Rooms

b) Fan coil units (two-pipe, cooling-only) may be used to serve miscellaneous non-clinical spaces requiring year around cooling. Example spaces are:
  - Elevator Machine Rooms
  - Communication Rooms

3.3.1.4 Ventilation Air

A dedicated, 100% outdoor air handling unit shall be provided when fan coil units are used. The dedicated outdoor air handling unit shall supply conditioned air to occupied spaces by fully ducted air distribution system. Admission and distribution of ventilation air (conditioned or raw) is not permitted through fan coil units or any other terminal units.

3.3.1.5 Dedicated Outdoor Air System (100% Outdoor Air)

The central ventilation system shall be similar to the all-air system described above with MERV 7 and MERV 11 pre-filters installed back-to-back on the suction side of the supply air fan and equipped with an energy recovery device, pre-heat coil, and cooling coil. Remotely located central ventilation units shall distribute conditioned air directly into the conditioned space by supply air outlet and not into the fan coil unit intake.

(a) Ventilation Air Control: Do not deliver minimum ventilation air at “neutral” condition, by reheating the air up to the room air temperature after dehumidification. Provide dynamic control of the ventilation air temperature to take full advantage of its available cooling capacity in cooling mode and heating capacity in heating mode. Ensure that the variations in the ventilation air temperature do not compromise dehumidification.

(b) Ventilation Air Outlets: Minimum ventilation air outlets shall be designed to provide the required air throw to occupied areas. With smaller ventilation air volumes, 20 cfm [9 L/s], selection of suitable outlets is necessary.

3.3.2 FAN COIL UNITS – SYSTEM DESCRIPTION

Where fan coil units are permitted (see 3.3.1.3 for limitations on fan coil usage), the system design shall be based on 4-pipe configuration, capable of providing on-demand heating or cooling. Fan coil units can be used in vertical, floor-mounted or in horizontal, ceiling-suspended (recessed or concealed) configuration with supply and return air ductwork as required. Vertical units are generally located under windows to control cold drafts and solar radiation.

3.3.2.1 System Applications

Generally, the use of 4-pipe fan coil systems shall be limited to serve perimeter spaces only. Use of fan coil units for interior spaces shall be carefully evaluated on a case-by-case basis.

3.3.2.2 Cooling Coil Condensate Piping

Design the cooling coil condensate piping to remove condensate without clogging the drain pan and drain lines. Provide insulated drain pans and condensate drain piping. Minimize the extent of horizontal runs and provide cleanouts at each turn in the direction of flow. Pitch the drain line in the direction of flow to facilitate flow by gravity.

3.3.2.3 Filtration

Unit filtration shall meet the minimum filtration requirements listed in the room data sheets for spaces being served. See Chapter 6.

3.3.2.4 Acoustic Measures

Select fan coil units to deliver the required capacity at mid-speed. Provide sound attenuation as required to achieve desired space noise level. Special attention should be paid to ceiling-suspended fan coils. Refer to Chapter 2 acoustical analysis for additional information.

3.3.2.5 Controls

4-pipe fan coil units shall be equipped with separate cooling and heating coils. Provide a modulating control valve for each coil to operate the cooling and heating modes in sequence. The use of two or three way control valves shall be coordinated with the facility to match their existing system DDC controls shall be used, where proven cost-effective. For new construction and major renovation, 2-way control valves with a modulating pump speed shall be utilized.

3.4 HEATING AND VENTILATION UNITS (HVU)

Provide central or split-function heating and ventilation systems, where mechanical cooling is not required. The system shall be able to operate from 100% outdoor air to minimum outdoor air to comply with ASHRAE Standard 62.1 – 2016 (or approved latest edition) or exhaust air requirements, whichever is greater. Example spaces are:

- Large Warehouses
- Garages
- Storage Rooms
- Mechanical or Electrical Equipment Rooms

3.4.1 DESIGN PARAMETERS

3.4.1.1 Total Air Changes per Hour

Calculate the supply air volume based on the required air changes per hour by the applicable codes, criteria, and the project-specific parameters, such as, ceiling height and air distribution mode, and the required space heating load.

3.4.1.2 Heating Mode

Refer to Chapter 6 room data sheets for room temperature and ventilation requirements.

3.4.2 CENTRAL VENTILATION AND/OR HEATING SYSTEM

Generally, a central system is comprised of a fan, filter (MERV 7), and heating sections with a uniform air distribution system. The system shall be capable of delivering from 100% to minimum outdoor air on demand. Provide a central or multiple exhaust fans to modulate the exhaust air volume in unison with the outdoor air admitted into the space.

3.4.3 SPLIT-FUNCTION OR SEPARATE HEATING AND VENTILATION SYSTEM

Heating and ventilation functions are separated by dedicated equipment for heating and ventilation. Such systems can be designed in numerous configurations. Ensure minimum ventilation per ASHRAE Standard 62.1 – 2016 or approved latest edition is maintained.

Heating is provided by thermostatically controlled, ceiling-suspended unit heaters or cabinet heaters for uniform heat distribution. Provide outdoor air tempering as needed due to the project location. Refer to Chapter 4 Section 4.4 Heating Systems for additional information on heating sources.

3.5 SUPPLY AIR OUTLETS

(a) Linear Diffusers: **(Use where it is justified)**

- For all occupied spaces with exposed perimeter windows, the design shall be based on linear supply air diffusers. Minimum length of the supply air diffusers shall match the window width. The design shall include a factory-furnished, externally insulated supply-air plenum over the diffuser. Provide a single feed or multiple feeds to the plenum, as recommended by the manufacturer, to ensure uniform velocity distribution.
- For spaces such as lobbies and reception areas with high glass, include wall-to-wall linear diffusers in the design. Provide supply air plenums continuously or intermittently, as required, to ensure required throw and air diffusion. Include blank-off plates for the diffuser segments, where plenums are not required.
- Provide a manual volume control damper for each takeoff feeding linear diffusers.
- Air Diffusion Performance Index (ADPI) shall conform to selection criteria given in ADPI table of the “Room Air Distribution” chapter of the ASHRAE Handbook – HVAC Applications 2015 or approved latest edition.

(b) Square and Rectangular Diffusers:
  - For interior spaces and elsewhere, where required, include square 24 in x 24 in [600 mm x 600 mm] or 12 in x 12 in [300 mm x 300 mm] supply air diffusers with neck sizes as required to meet the duty conditions. Provide multiple supply air diffusers to achieve uniform air distribution without dead spots.
  - Use rectangular supply air diffusers for uneven air distribution.
  - For corridors, provide two-way blow diffusers to suit the space geometry.
  - Limit the capacity of a single diffuser to 600 cfm [283 L/s].
  - Air Diffusion Performance Index (ADPI) shall conform to selection criteria given in ADPI table of the “Room Air Distribution” chapter of the ASHRAE Handbook – HVAC Applications 2015 or approved latest edition.

(c) Round Diffusers: Use round diffusers for exposed occupied spaces.

(d) See HVAC and Steam Equipment schedules (PG-18-4) supply, return and exhaust outlets for additional information.

3.6 ENERGY RECOVERY SYSTEMS

The system design shall incorporate energy recovery systems to be in compliance with ASHRAE Standard 90.1-2013 or approved latest edition, and where found cost-effective based on a LCCA. The applicability and suitability of energy recovery systems shall be evaluated by the VA COR before energy recovery systems are included in the design.

3.6.1 SENSIBLE HEAT TRANSFER

The analysis shall include each of the following systems where sensible heat transfer only is applicable.

3.6.1.1 Run-around System

This system utilizes a piping loop and circulation pump. The loop connects a finned-tube coil in the exhaust plenum with a finned tube coil in the makeup air plenum or AHU. This system typically operates to preheat outdoor makeup air but also to pre-cool the make-up air when the exhaust air stream is cooler than the outdoor make-up air. Evaluate the reduced performance impact of using propylene glycol. Pre-filters shall be used upstream of exhaust coil serving animal holding facilities. The need for coil corrosion protection shall be evaluated based on the exhaust source.

The salient features are:

- No cross contamination issues
- Exhaust and intake do not have to be located next to each other

3.6.1.2 Fixed-Plate System (Air-to-Air)

Plates augmented with fins separate air streams. No transfer media other than the plate-forming wall is used. Bypass dampers are required for times when energy recovery is not effective.

The salient features are:

- No moving parts
- Limited cross-leakage

3.6.1.3 Heat Pipes

The salient features are:

- Heat source boils a heat transfer fluid and a heat sink condenses the fluid back to its liquid state, liberating the energy transferred from the fluid’s phase change.
- Transfer fluid is contained within a pipe
- Supply and exhaust streams must be in close proximity. Use sealed-tube thermosyphon.
- Piping material shall be corrosion resistance for the air stream in which they are installed.

3.6.2 SENSIBLE AND LATENT HEAT TRANSFER

The LCCA required by paragraph 3.6 shall include each of the following systems where both sensible and latent energy transfer are applicable.

3.6.2.1 Total Energy Recovery Wheels

The use of energy recovery wheels is prohibited.

3.6.2.2 Fixed Membrane Heat Exchanger

The salient features are:

- Membrane material in multiple layers. No moving parts.
- Bypass dampers are required for times when energy recovery is not effective.
- Water vapor permeable. Sensible and latent heat recovery.
- Limited cross-leakage.
- To reduce the risk of cross contamination ensure outside air section of the heat exchanger is at a higher pressure than the exhaust section. This will cause an airflow from “clean” (outdoor air) to “dirty” (exhaust air).

3.6.3 LOAD CREDIT

Do not include any credit due to the savings in cooling and heating energies while sizing and selecting the cooling, heating, and airside equipment. Such savings can be projected into the energy analysis or life-cycle analysis without reducing the primary equipment capacity. Include two sets of operating conditions in the equipment schedule, one with and one without energy recovery devices in operation.

3.6.4 EXCEPTIONS – ENERGY RECOVERY EQUIPMENT

In addition to the exceptions identified in ASHRAE Standard 90.1 – 2013 or approved latest edition, listed below are the applications for which energy recovery systems are prohibited:

- Exhaust from all fume hoods and biological safety cabinets
- Kitchen exhaust (range hood and wet exhaust)
- Autopsy exhaust
- Isolation room exhaust
- Wet exhaust from cage and cart washers
- ETO – Ethylene Oxide Sterilizers exhaust
- Sterile Processing Services (SPS)

Except for corrosive, grease-laden, or wet exhaust air, run-around loop and heat pipe energy recovery systems may be allowed if approved by VA COR as noted above.

3.7 DESIGN CRITERIA – AIR DISTRIBUTION SYSTEMS

3.7.1 DUCT DESIGN – GENERAL

3.7.1.1 Compliance

Air distribution system shall be designed in accordance with applicable ASHRAE and SMACNA Standards. Parameters listed below shall govern in the event of discrepancies from the ASHRAE or SMACNA Standards. Use applicable sections of the SMACNA Standard to select the air distribution ductwork pressure classification.

Shafts that contain air ducts or that encloses air ducts used for the movement of environmental air shall not enclose the following:

- Exhaust ducts used for the removal of smoke and grease laden vapors from cooking equipment.
- Ducts used for the removal of flammable vapors
- Ducts used for the removal of nonflammable corrosive fumes and vapors.
- Refuse and linen chutes
- Piping, except for noncombustible piping conveying water or other nonhazardous or nontoxic materials.

Refer to NFPA 90A for additional information.

On systems where an over or under pressure event would cause system damage, provide pressure relief panels in the system near the air handling unit.

The design engineer shall submit calculations showing the need for relief panels. The engineer shall assume all safeties have failed in their calculations.

3.7.1.2 Duct Materials

Ductwork shall be fabricated from galvanized steel, except where required in this manual and depending upon specific application to be, aluminum, or stainless steel.

All ductwork and ductwork appurtenances and equipment in contact with supply air downstream of the HEPA filters for surgery and pharmacy applications shall be welded stainless steel. This includes, but is not limited to, dampers, ductwork, diffusers, etc.

3.7.1.3 Duct Selection Criteria

(a) Sizing Parameters: Duct size selection must satisfy two limiting parameters: maximum air velocity and maximum static pressure drop. The design engineer shall coordinate with the VA to determine if any oversizing will be required.
(b) Sizing Criteria: Use equal friction method for sizing low-pressure ductwork. Use static-regain method for sizing medium pressure ductwork.
(c) Exposed Ductwork: All exposed supply (visible in space) ductwork in the occupied conditioned spaces shall be designed and fabricated from double-wall, flat, oval, or round ductwork. Duct painting and finish requirements shall be coordinated with the VA.
(d) The engineer shall perform a dew point calculation to determine if insulation is needed on the return and exhaust ductwork that is located in areas with high humidity or little to no air movement, such as duct chases and ceiling space adjacent to roofs.

3.7.1.4 Mandatory Requirement

All ductwork, without exception, shall be shown in double lines on all floor plans and cross-sections.

3.7.1.5 Duct Pressure Classification

Show duct pressure requirements for all ductwork on the floor plans. Examples of required duct classification are ½ in, 1 in, 2 in, 3 in, and 4 in [125 Pa, 250 Pa, 500 Pa, 750 Pa, 1000 Pa]. Refer to SMACNA for a complete list of pressure classifications.

3.7.1.6 Flexible Ducts

(a) Use of flexible ducts shall be restricted to connections between the VAV and/or CV air terminals and the medium or high pressure supply air duct and connections between the supply air diffusers and the low-pressure supply ductwork. Refer to VA Detail number SD233600-04 Duct Connections – Air Terminal Units.
(b) Maximum length of flexible ductwork shall not exceed 5 ft [2 m].
(c) Maximum length of flexible ductwork to connect a VAV and/or CV air terminal to the medium or high pressure supply ductwork shall not exceed 3 ft [0.9 m].
(d) Maximum change in direction allowable in flexible ductwork is 45 degrees.
(e) Do not use flexible duct on exposed ductwork.
(f) Do not penetrate firewalls and interstitial decks with flexible ducts.
(g) Use of flexible duct is prohibited in all patient care areas and critical spaces with air pressurization and directional airflow requirements, including but not limited to research animal holding and laboratory facilities.

3.7.1.7 Underground Ducts

Use of underground and concrete ducts is not permitted.

3.7.1.8 Shielded Ducts

Coordinate locations of shielded rooms with the architectural drawings. Generally, lead lining in walls terminates at or below the ceiling level. However, in special instances where lead linings extend higher and ducts penetrate the lining, ducts shall be wrapped with lead sheet of the same thickness as the wall lining. Consult medical equipment vendor for specific recommendations.

For ductwork penetrating into a Radio Frequency shielded rooms (MRI for example) considerations must be taken to ensure the Radio Frequency shielding is not compromised. All ductwork, fasteners, hangers, diffusers and appurtenances within the Radio Frequency shield shall be non-ferrous. Ductwork penetrations must utilize Radio Frequency wave guides at the shielding feed-through points.

Exceptions:

- In Super Voltage therapy rooms with thick concrete walls, lead shielding may not be required for ducts penetrating the room wall. A registered health physicist shall check adjacency uses and determine lead shielding requirements.
- Dark rooms require full height lead lining. For walls of dark rooms located adjacent to rooms with walls having 7 ft [2 m] high lead lining, lead shielding of the ductwork penetrating above the suspended ceiling is not required.

3.7.1.9 Minimum Duct Size

- Rectangular Ducts: 8 in x 6 in [200 mm x 150 mm]
- Round Ducts: 6 in [150 mm]. Minimum duct size does not apply to equipment connections or to local exhaust capture systems (snorkel arms).

3.7.1.10 Limiting Duct Sizing Parameters

Table 3-3: DUCT SIZING CRITERIA

Duct Description	Maximum Air Velocity	Maximum Static Pressure Drop
Low Pressure Duct Supply Return Relief Exhaust	1,500 fpm [8 m/s]	0.08 in of water/100 ft [0.66 Pa/m]
Medium/High Pressure Duct Supply	2,500 fpm [13 m/s]	0.20 in of water/100 ft [1.64 Pam]
Transfer Air Duct	750 fpm [4 m/s]	0.04 in of water/100 ft [0.33 Pa/m]

The above sizing criteria can be altered to suit the project location. For example in a boiler plant where noise is not of concern, air velocities may be increased. The design engineer shall review any deviations from the recommended sizing criteria with the VA.

Both maximum air velocity and maximum static pressure drop shall be maintained when sizing ductwork.

3.8 EXHAUST SYSTEMS

See Chapter 6 and room data sheets for additional information. Two types of exhaust systems are used in VA Facilities:

- General exhaust
- Special exhaust (including “Wet Exhaust”)

All exhaust systems generally consist of:

- Exhaust fan and motor
- Exhaust ductwork and inlets
- Controls and interlocks
- Discharge connections (louvers, stacks, or integral outlets)

Location and type of exhaust fans shall be project-specific. Install fans at the end of the exhaust ductwork and nearer to the outdoor discharge location to keep the exhaust ductwork under negative air pressure. With the exception for room mounted ventilators exhaust fans shall be housed in adequately sized enclosed spaces. Ensure there are sufficient working clearances around roof ventilators.

Fume hood exhaust and general exhaust shall not be combined.

Smoke and fire dampers shall not be installed in exhaust ducts serving fume hoods, biosafety cabinets, and other contaminate-type equipment. See NFPA 90A for additional information.

3.8.1 GENERAL EXHAUST SYSTEM

3.8.1.1 Applications – Individual Spaces

See Chapter 6 and room data sheets for additional information. Examples of the spaces served by general exhaust systems are:

- Attics
- Atriums
- Canopy Hoods
- Housekeeping Aid Closet (HAC)
- Locker Rooms
- Lobbies
- Pipe Sub-Basement
- Soiled Storage Rooms
- Soiled Utility Rooms
- Toilets
- Toilets and Showers

3.8.1.2 Applications – Air-Handling Unit Systems

General exhaust systems are also required for spaces served by 100% outdoor air systems. Examples of these systems are:

- Sterile Processing Service (SPS)
- Laboratories
- Animal Holding and Research
- Autopsy Suite
- Kitchen (Food Preparation) without Grease Hoods and Wet Exhaust

3.8.1.3 SPECIAL EXHAUST SYSTEM - APPLICATIONS

See Chapter 6 and room data sheets for additional information.

3.8.1.4 Dry Exhaust Systems

Special dry exhaust systems are generally dedicated systems serving specialized equipment or applications, such as:

Biological Safety Cabinets (BSC)

ETO (Ethylene Oxide Sterilizer) exhaust

Fume hoods

Kitchen range hood

TB Isolation suite

These exhaust systems shall not be combined and labeling of the system shall be provided.

3.8.1.5 Wet Exhaust Systems

Dedicated exhaust system used for ventilating rooms with heavy water or steam usage are designated as wet exhaust systems. Examples are:

- Automatic Cart Wash Equipment Room
- Manual Cart Wash Room
- Therapeutic Pool Room
- Kitchen Dishwashers
- Research Cage Wash Room

For all wet exhaust systems, provide welded stainless steel ductwork and corrosion resistant fan. Mount fan bearings out of the air stream.

3.9 LABORATORIES AND ANIMAL FACILITIES

3.9.1 GENERAL

HVAC systems for Laboratories and Animal Facilities shall be designed to maintain space temperature and humidity at required set point (Refer to Chapter 6 room data sheets for required set points). Space conditions (pressure, temperatures, humidity) shall be monitored and adjusted on a continuous basis. The HVAC system shall provide for adequate ventilation to remove fumes, odors, airborne contaminates, and shall provide for the continuous operation of any fume hoods. The system shall be designed to maintain relative pressure differentials between spaces to prevent any cross contamination.

3.9.2 REFERENCES

The design of laboratory and animal facility HVAC is a complex. This design guide is intended to provide general guidance. Work closely with VA personnel at the project location to identify all project specific requirements. The following references provide additional guidance:

- AAALAC – Guide for the Care and Use of Laboratory Animals
- ASHRAE Laboratory Design Guide
- ANSI/AIHA Z9.5 -2012 Laboratory Ventilation or approved latest edition.
- CDC – Biosafety in Microbiological and Biomedical Laboratories 5th Edition
- NIH Design Requirements Manual

3.9.3 COMPLIANCE

Laboratory spaces shall meet the requirements in the “Biosafety in Microbiological and Biomedical Laboratories 5th Edition” published by the Center for Disease Control and Prevention.

Animal facilities shall meet the requirements in the “Guide for the Care and Use of Laboratory Animals” published by the Institute of Laboratory Animal Resources.

3.9.4 CONTAINMENT LEVELS

The U.S. Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC), and National Institutes of Health (NIH) classify biological laboratories into different containment levels. The following is brief description of those used by the VA:

Biosafety Level 1 is suitable for work involving well-characterized agents not know to consistently cause disease in health adult humans, and of minimal potential hazard to laboratory personnel and the environment. The laboratory is not necessarily separate for the general traffic patterns in the building. Work is generally conducted on open benchtops using standard microbiological practices. Special containment equipment is neither required nor generally used. BSL-1 represents a basic level of containment that relies on standard microbiological practices with no special primary or secondary barriers recommended, other than a sink for hand washing

Biosafety Level 2 (Most Clinical Laboratories) is suitable for work involving agents of moderate potential hazard to personnel and the environment. Laboratory access is limited when certain work is in progress. Biological safety cabinets are used. HVAC design criteria include the following:

- Single Pass Air

- 6 to 15 ACH
- Directional Airflow into the Laboratory
- Fume hood face velocities (coordinate with existing fume hoods in renovated spaces, and with laboratory planners for new construction,)
- Inclusion of Biological safety cabinets

Biosafety Level 3 applies to facilities in which work is done with indigenous or exotic agents that may cause serious or potentially lethal diseases as a result of exposure by inhalation. The Biosafety Level 3 laboratory uses a physical barrier of two sets of self-closing doors to separate the laboratory work area from areas with unrestricted personnel access. This barrier enhances biological containment to within the laboratory work area. HVAC design criteria include the following:

- Single Pass Air
- 6 to 15 ACH
- Directional Airflow into the Laboratory
- Audible alarms and visual monitoring devices for pressure relationship
- Bubble tight dampers in the supply and exhaust ductwork to allow for decontamination.
- All penetrations of the BSL 3 laboratory envelopment shall be sealable for containment and to facilitate gaseous decontamination of the work area.
- Fume hood face velocities (coordinate with existing fume hoods in renovated spaces, and with laboratory planners for new construction,)
- Inclusion of Biological safety cabinets
- HEPA filtration of all exhaust (review the need for bag-in bag-out filter system with the laboratory safety officer)

Biosafety Level 4

- Not utilized by the VA.

3.9.5 LABORATORY VENTILATION

The total airflow rate for a laboratory shall be based on the highest airflow resulting from the following requirements:

- Total amount of exhaust from containment and exhaust devices.
- Cooling required to offset internal heat gains.
- Minimum ventilation rate requirements. Refer to Chapter 6 room data sheets.
- Airflow required to maintain pressure relationships.

Ventilation systems shall be designed to comply with NFPA 45 (when chemicals are present), ANSI Z9.5, American National Standard for Laboratory Ventilation, and ASHRAE Laboratory Design Guide.

3.9.6 LABORATORY AIRFLOW MANAGEMENT

The airflow shall be from areas of low hazard to higher hazard, unless the laboratory is used as a barrier facility or other special type laboratories, such as a clean room process. When flow from one area to another is critical to emission exposure control, airflow monitoring devices shall be installed to signal or alarm that there is a malfunction.

The supply air volume shall respond to applicable dynamic events including:

- Changes in desired ventilation rate
- Flow changes in VAV exhaust devices including fume hoods and all other exhausts.
- Room pressurization
- Space temperature control demands

3.9.7 LABORATORY SUPPLY AIR DISTRIBUTION

Supply air distribution shall be designed to minimize air turbulence in laboratories to avoid any impact on the performance of the fume hoods and biosafety cabinets. Keep air jet less than one third of the capture velocity or the face velocity of the laboratory hoods at their face opening.

3.9.8 LABORATORY EXHAUST DISTRIBUTION

Exhaust system materials shall be in accordance with the current version of American Conference of Governmental Industrial Hygienists (ACGIH's) Industrial Ventilation: A Manual of Recommended Practice, the ASHRAE Handbook – Fundamentals, and NFPA 45 (when chemicals are present). Exhaust system materials shall be resistant to corrosion by the agents to which they are exposed. Exhaust materials shall be non-combustible if oxidizing agents that pose a fire or explosive hazard are used.

3.10 FUME HOOD EXHAUST SYSTEMS

3.10.1 GENERAL

Provide exhaust systems for the hoods described below. Coordinate quantities, sizes, and types of fume hoods with the architectural drawings and project-specific program needs. In this section, the following three different types of hoods are covered:

- Radioisotope Hoods
- General Purpose and Chemical Hoods
- Perchloric Acid Hoods

3.10.2 SPECIAL REQUIREMENT

Use of auxiliary make-up air hoods is not permitted.

3.10.3 COMPLIANCE

- NFPA 45 - 2015 or approved latest version
- ANSI/ASHRAE Standard 110-2016 (Hood Testing) or approved latest version
- ANSI/AIHA Z9.5 – 2012 (Laboratory Ventilation) or approved latest version
- OSHA 29 CFR (Part 1910)

3.10.4 BASIS OF DESIGN (HOODS)

3.10.4.1 General

The basic premise of the fume hood exhaust system is to maintain constant, face velocity of 100 fpm [0.5 m/s] over the hood sash area, under varying sash positions. The sash is defined as the movable glass panel, which covers the face area of the hood. The sash position can vary from almost fully closed to fully open to a pre-determined intermediate stop with a fixed sash stop typically at 18” height. Coordinate with existing fume hoods in renovated spaces, and with laboratory planners for new construction. Lower than 100 fpm [0.5 m/s] face velocity at fume hood may be allowed if high performance fume hoods are used and after approval by VA Authority.

A variable volume hood and control sequenced is the preferred and recommended system type. If constant volume equipment is proposed, review energy impact with COR before implementing and shall receive approval by VA Authority.

3.10.4.2 Specific Requirements

(a) Provide emergency power for the exhaust system and associated controls for all hood exhaust systems.
(b) Do not connect any exhaust from sources other than identical hoods to the fume hood exhaust or biosafety cabinet system. Only manifold hoods together that are in the laboratory group, the same is true for biosafety cabinets. Biosafety cabinets and hoods shall not be manifolded together.
(c) Radioisotope hoods can be grouped together to form a combined exhaust system. General Purpose or Chemical hoods can be grouped together to form a combined exhaust system. Perchloric Acid hoods cannot be grouped together. Each Perchloric Acid hood must have its own dedicated exhaust system.
(d) Provide spark-proof construction fans and explosion-proof motors.
(e) Provide an airflow control valve with readout capability or a DDC CV or VAV terminal unit in each branch exhaust duct.
(f) Provide local and remote alarm capability at the ECC for each fume hood in the event of a system failure or the face velocity readout outside the high or low set-points.
(g) Provide round, 316-L stainless-steel welded ductwork (minimum 18 gauge) for laboratory fume hood exhaust and for biosafety cabinet exhaust.
(h) Keep entire exhaust ductwork under negative air balance. Penthouse fans are allowable, however any positive pressure ductwork shall be minimized. Limit to less than 15 ft [4.6 m] horizontal run of positive pressure ductwork.
(i) Discharge exhaust air from the highest level of the building. Provide a discharge stack at least 10 ft [3 m] tall. Increase the stack height, as required to prevent exhaust air from being entrained in outdoor air intakes. The discharge velocity at the nozzle shall be 3,500 fpm [18 m/s].
(j) Include the discharge air velocity pressure and the static pressure drop through the hood in the fan static pressure calculations along with all other ductwork accessories.

(k) Include recommended acoustic analysis measures to contain the fan noise traveling back to the exhaust fan in the system design. Measures shall also examine such items as:
- Fan Selection
- Duct Velocity
- Sound Attenuators

(l) Energy recovery from exhaust ducts of fume hoods is prohibited.

(m) Do not install fume hood exhaust ducts in the same shafts that environmental ducts are housed. See NFPA 90A for additional information.

(n) Do not install fire dampers in fume hood exhaust ducts. Refer to NFPA 90A for additional information.

(o) The designer shall verify the project-specific filtration requirements for the Radioisotope hood exhaust air system in consultation with the end-users and the Radiation Safety Officer. The filtration requirements depend on the intended use, quantity and type of isotopes used and may require MERV 17 (HEPA) filter, or a combination of MERV 17 (HEPA) and a charcoal filter, or no filters at all.

3.10.5 PERCHLORIC ACID HOODS

In addition to the specific requirements listed above, the following additional requirements apply:

(a) Provide round, 316-L stainless steel welded ductwork (minimum 18 gauge) for exhaust ductwork serving Perchloric acid hoods.

(b) Water Spray System: Design a water spray system to wash down the entire exhaust system at the end of each use, including the exhaust fan, ductwork, hood, and the baffles. Ensure coordination with the plumbing and electrical disciplines for make-up water connections and heat tracing (with emergency power) of the cold water line, where required. The wash down cycle shall be either automatic or manual per local VA personnel preference. Provide a hose bibb within 30 ft [9 m] of the discharge stack to facilitate manual wash.

3.10.6 EXHAUST AIR VOLUME

(a) Hood exhaust air volume is the product of the nominal sash area multiplied by the design face velocity over the sash area. Nominal sash area is the product of the actual sash width multiplied by the operating sash height. Operating sash height is defined as the height at the working level, where all laboratory work is done. For the purpose of sizing the laboratory ventilation systems, a sash operating height of 18” [457mm] shall be used. All fume hoods shall be equipped with sash stops to limit the operating height to 18” [457mm].

(b) Exact exhaust air volume data shall be obtained from the hood manufacturers. In the absence of data, for the purpose of preliminary planning, use the average exhaust air volumes given below for each size and type of the fume hoods.

Table 3-4: Radioisotope Hoods Preliminary Exhaust Air Volumes

Hood Size in [mm]	Flow Rate cfm [L/s]	Pressure Drop in of water [Pa]
48 [1200]	550 [260]	0.36 [89]
60 [1500]	700 [330]	0.38 [93]
72 [1800]	875 [413]	0.38 [93]

Table 3-5: General Purpose or Chemical Hoods Preliminary Exhaust Air Volumes

Hood Size in [mm]	Flow Rate cfm [L/s]	Pressure Drop in of water [Pa]
36 [900]	475 [224]	0.36 [89]
48 [1200]	625 [295]	0.30 [75]
60 [1500]	775 [366]	0.32 [89]
72 [1800]	925 [437]	0.24 [60]
96 [2400]	1225 [578]	0.40 [100]

Table 3-6: Perchloric Acid Hoods Preliminary Exhaust Air Volumes

Hood Size in [mm]	Flow Rate cfm [L/s]	Pressure Drop in of water [Pa]
48 [1200]	1030 [486]	0.63 [156]
60 [1500]	1355 [639]	0.50 [125]
72 [1800]	1680 [792]	0.75 [187]
96 [2400]	2355 [1111]	0.75 [187]

3.10.7 EXHAUST SYSTEM DESIGN

3.10.7.1 Constant Volume (CV) Design

For a small project involving a limited number of fume hoods which are remotely located, the fume hood exhaust system design may be constant volume type if proven to have the lowest life cycle cost. A variable volume hood and control sequence is the preferred and recommended system type. Review LCCA with VA Authority before designing a constant volume system. Two different configurations are described:

(a) Integral Bypass Hoods: Bypass hoods maintain constant exhaust air volume. Lowering of the hood sash exposes a bypass inlet located above the sash. The bypass inlet reduces the increase in the sash face velocity, which in turn reduces turbulence and loss of containment.

(b) External Bypass Hoods: With the external bypass hood exhaust air volume is either directed through the room connection or through the hood by on/off motorized dampers connected in parallel. With the use of modulating dampers, response to keeping the constant face velocity is enhanced.

3.10.7.2 Variable Air Volume (VAV) Hoods (General Purpose and Chemical Hoods and Radioisotope Hoods Only)

(a) For new construction and major renovations to be in compliance with mandated energy conservation directives, provide a variable air volume design for Radioisotope hoods, and Laboratory hoods. This system is accurate and sophisticated in maintaining constant face velocity with varying sash positions by varying the exhaust air volume. The system has substantial potential to reduce energy consumption since it primarily operates at part load conditions.

(b) System Configuration and Controls: The design shall consist of three separate systems:

- Supply Air System: The capacity of the variable air volume supply air system shall be selected to maintain inside design conditions and/or to meet the exhaust needs of the hoods. The complete system design shall include a variable speed drive for the supply air fan, an airflow measuring device, DDC-controlled VAV air terminal units, and a static pressure sensor.
- Hood Exhaust Air System: Design a dedicated, VAV system to serve all identical hoods (either Laboratory hoods or Radioisotope hoods). The capacity of the exhaust system shall be selected to satisfy all hoods operating at their nominal capacities. Each duct connection from the hood shall be equipped with an airflow control valve, compatible with the associated exhaust duct system that modulates to vary the exhaust air volume to maintain the constant face velocity. Each hood shall be equipped with controls which continually measure and monitor sash position, calculate required exhaust air volume, and measure the exhaust air volume. In addition to the items above, the complete system design shall include a variable speed drive for the exhaust air fan, an airflow measuring device, a HEPA filter (Radioisotope hood only), and a static pressure sensor.
- General Exhaust System: Design a dedicated, VAV system which operates in parallel with the hood exhaust system. The capacity of the general exhaust system shall be sized to remove the room supply air when all hoods have assumed fully closed position. Note that even with the sash assuming a “fully-closed” position; the hood admits enough make-up air from the room to maintain negative air balance in the hood. The complete system design shall include a variable speed drive for the exhaust fan, an airflow measuring device, a DDC-controlled airflow control valves (generally one per laboratory), and a static pressure sensor.
- Controls: For each laboratory, in response to the room temperature sensor and the sash positions of the fume hoods, the DDC controls shall orchestrate a synchronized operation of the VAV supply air terminal, VAV fume hood exhaust, and VAV general exhaust system to maintain a constant offset per each door, that is, the make-up air from the corridors shall be used to maintain negative air balance. Assume an offset

of 100 cfm [47 L/s] per each single door and 150 cfm [71 L/s] for each double door. Each fan shall adjust its speed in response to a signal from its static pressure sensor to conform to the prevailing volumetric situation.

3.11 BIOLOGICAL SAFETY CABINETS (BSC)

3.11.1 COMPLIANCE

- National Sanitation Foundation (NSF), Standard 49-2004 or approved latest version.
- ASHRAE – Handbook of Applications – 2015 or approved latest version

3.11.2 CABINET CLASSIFICATION

(a) BSC protects research personnel, products, and environment from exposure to the biohazards and cross contamination. Common sizes of the cabinet are 4 ft [1 m] and 6 ft [2 m].

(b) Cabinet and Safety Classification: BSC are classified into three classes, as shown in the following table:

Table 3-7: Biological Safety Cabinet Classification

Classification	Bio-Safety Level	Application
Class I	1,2,3	Low to moderate risk biological agents
Class II	1,2,3	Low to moderate risk biological agents
Class III	4	High risk biological agents

(c) All Class II Cabinets require HEPA filters in the exhaust air system.

(d) The use of Class III Cabinets requires approval by the VA Authority.

3.11.2.1 Class I Cabinets

(a) General: These cabinets do not protect the product because the “dirty” room air passes over the work surface. Cabinets are similar to the chemical laboratory hoods.

(b) Design Criteria:
  - Design face velocity is 75 fpm [0.4 m/s]
  - Filtration – Cabinet air must be filtered (MERV 7 and MERV 17) before it is exhausted outdoors or re-circulated in the laboratory. Use a system configuration to suit the design intent. The available configurations are an integral exhaust fan or the building exhaust fan and hard duct connections or thimble.
  - Airflow Control Valve – Provide a pressure-independent airflow control valve to ensure constant exhaust air volume.
  - Exhaust Ductwork – Provide welded stainless steel ductwork.
  - Emergency Power – Provide emergency power for the exhaust fan and controls. Coordinate with the electrical engineer to ensure emergency power is provided.

3.11.2.2 Class II Cabinets

(a) Classification: Classification of BSC, Class II cabinets is based on NSF/ANSI 49 - 2014 or approved latest version. Classifications are shown in the following table:

Table 3-8: Classification of Class II Biological Safety Closets

Classification	General Description
A1	70% intake air re-circulated back to cabinet and 30% air exhausted outdoors, Provide a canopy connection for exhaust as needed, Provide cabinet air intake at 75 fpm [0.38 m/s] capacity
A2	70% intake air re-circulated back to cabinet and 30% air exhausted outdoors, Provide a canopy connection for exhaust as needed, Provide cabinet air intake at 100 fpm [0.51 m/s] capacity
B1	40% intake air re-circulated back to cabinet and 60% air exhausted outdoors, Provide a dedicated exhaust system with a dedicated exhaust valve (hard connection) to outdoors, Provide cabinet air intake at 100 fpm [0.51 m/s] capacity
B2	Provide a dedicated exhaust system with a dedicated exhaust valve (hard connection) to outdoors after passing over the unit-mounted HEPA filter, Provide air intake at 100 fpm [0.51 m/s]

(b) Exhaust Air Volumes: The average exhaust air-quantities and pressure drops for type B1 and B2 and Class II cabinets are shown in the following tables:

Table 3-9: Cabinet Type B1 Exhaust Air Requirements

Size in [mm]	Exhaust Air cfm [L/s]	Pressure Drop in of water [Pa]
48 [1200]	270 [127]	1 [249]
72 [1800]	410 [193]	1 [249]

Table 3-10: Cabinet Type B2 Exhaust Air Requirements

Size in [mm]	Exhaust Air cfm [L/s]	Pressure Drop in of water [Pa]
48 [1200]	730 [345]	1 [249]
72 [1800]	1150 [543]	1 [249]

(c) Filtration: Class II, Type B1 and Type B2 safety cabinets come with two sets of HEPA filters, one for supply within the cabinet, and one for exhaust from the cabinet.

The pressure drops include friction loss through clean exhaust MERV 17 (HEPA) filters (the supply HEPA filter within the cabinet is not included as the internal blower takes care of this filter) and transition fitting on the exhaust side. With a Type B1 hood, the exhaust filter is within the hood casing; the mounting is external with Type B2 hood.

(d) Interlock: Interlock the internal blower and external blowers. For B2 safety cabinets, coordinate the filter height above the B2 hood with other disciplines.
(e) Pressure Drop Estimation: While estimating the static pressure of the exhaust fan, use the recommended replacement pressure drop of the HEPA filter and the external ductwork.
(f) Airflow Control and Alarm: Provide a pressure-independent airflow control valve in the exhaust air stream to ensure constant airflow through the system. Provide an air monitoring device and provision for sound and visible alarm at the hood and at the central ECC in the event that the flow varies more than plus or minus 10% of the normal value. Provide an interface with the ECC control to initiate a remote alarm.
(g) Duct Damper: Provide a bubble tight damper on the exhaust side to isolate the hood for service and maintenance.
(h) Emergency Power: Provide emergency power for the exhaust fans, controls and the associated motorized dampers. Coordinate with the electrical engineer to ensure emergency power is provided.

3.12 BIOLOGICAL SAFETY LEVEL 3 (BSL3)

See Appendix 3-A.

HVAC DESIGN MANUAL
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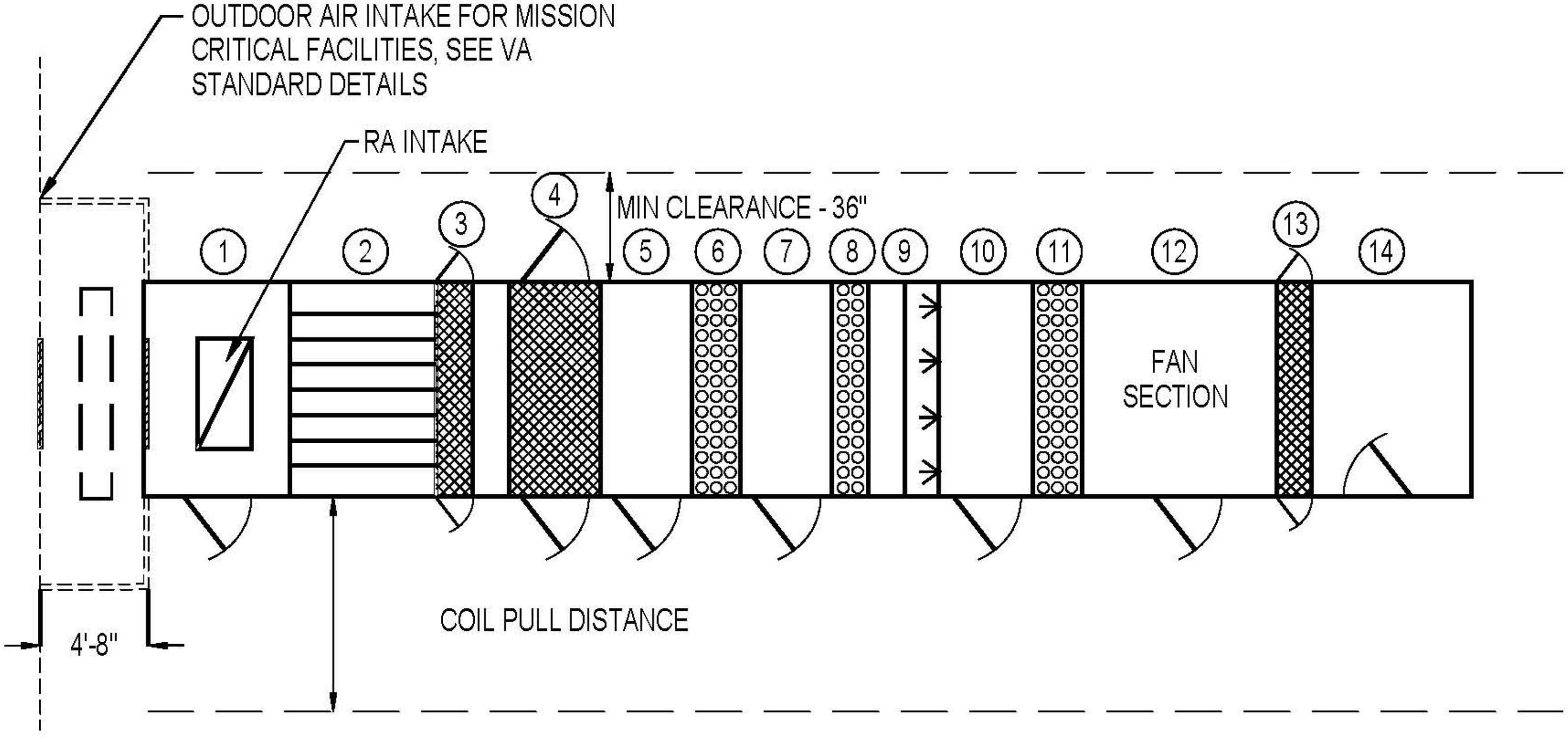
FIGURE 3-1



NOTE: SEE FIG. 3-1 CONTINUATION FOR GENERAL NOTES AND DIMENSIONS OF COMPONENTS

TYPICAL AIR HANDLING UNIT

Not to Scale

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FIGURE 3-1 (CONTINUATION)

AIR HANDLING UNIT	Item #	MINIMUM OUTSIDE AIR PRE-FILTERS & AFTER-FILTER VAV	100% OUTSIDE AIR PRE-FILTERS & AFTER-FILTER CV	LENGTH IN [CM]			
* AS REQUIRED				20,000 CFM (9,450 L/S)	30,000 CFM (14,150 L/S)	40,000 CFM (18,900 L/S)	50,000 CFM (23,600 L/S)
Mixing Box *	1	Yes	No	48 [122]	48 [122]	49 [125]	54 [137]
Blender Section *	2	Yes	No	48 [122]	48 [122]	49 [125]	54 [137]
First Stage Pre-Filter (Side Access)	3	Yes	Yes	12 [30]	15 [38]	15 [38]	15 [38]
Second Stage Pre-Filter (Side Access)	4	Yes	Yes	30 [76]	30 [76]	30 [76]	30 [76]
Access Section, med-large	5	Yes	Yes	30 [76]	30 [76]	30 [76]	30 [76]
Heat Recovery Coil *	6	No	Yes	16 [41]	20 [51]	20 [51]	20 [51]
Access Section, med-large *	7	No	Yes	30 [76]	30 [76]	30 [76]	30 [76]
Pre-Heat Coil	8	Yes	Yes	12 [30]	15 [38]	15 [38]	15 [38]
Inspection Section, small	9	Yes	Yes	12 [30]	15 [38]	15 [38]	15 [38]
Humidifier *	10	Yes	Yes	36 [92]	48 [122]	48 [122]	48 [122]
Cooling Coil	11	Yes	Yes	16 [41]	20 [51]	20 [51]	20 [51]
Fan	12	Yes	Yes	64 [163]	69 [175]	84 [213]	92 [234]
After-Filter *	13	Yes	Yes	42 [107]	42 [107]	42 [107]	42 [107]
Discharge Plenum *	14	Yes	Yes	64 [163]	64 [163]	64 [163]	64 [163]

	20,000 CFM (9,435 L/S)	30,000 CFM (14,150 L/S)	40,000 CFM (18,870 L/S)	50,000 CFM (23,597 L/S)
Overall Width (IN [CM])	110 [280]	120 [305]	140 [355]	160 [405]
Overall Height (IN [CM])	78 [198]	102[259]	113 [287]	126 [320]

NOTES:

1. IF ITEMS 1 AND 2 ARE NOT INCLUDED, PROVIDE MED-LARGE ACCESS SECTION.
2. IF SPACE IS AVAILABLE, PROVIDE ACCESS DOORS ON BOTH SIDES OF AHU. IF SPACE IS NOT AVAILABLE, ENSURE EQUIPMENT IS SERVICABLE FROM ONE SIDE OF THE AHU.
3. SEE VA STANDARD DETAILS FOR OUTSIDE AIR PLENUM DETAIL. THE PLENUM LENGTH IS APPROXIMATELY 4 FT. - 8 IN. [1.4 M].
4. THE INFORMATION GIVEN IN THE DETAIL IS FOR CONCEPTUAL DESIGN AND PLANNING. THE DESIGNER SHALL MAKE HIS OWN SELECTION BASED ON ENGINEERING CALCULATIONS AND UNIT BASIS OF DESIGN.
5. OVEDRALL LENGTH IS DEPENDENT ON COMPONENTS AND FAN SYSTEM SELECTED.
6. DETAIL ASSUME RETURN / RELIEF FAN AND RELIEF DAMPERS ARE SEPARATE FROM THE AHU.

TYPICAL AIR HANDLING UNIT

Not to Scale

APPENDIX 3-A: BIO-SAFETY LEVEL 3 (BSL3) FACILITIES

3-A.1 GENERAL

3-A.1.1 INTRODUCTION

VA Medical Centers use Bio-Safety Level 3 (BSL3) containment laboratories for animal research and general research applications. ***Containment control is an essential goal of facility design, operation, and maintenance. Primary and secondary barriers defined below are the mandatory provisions necessary to achieve the stated goal of containment.*** For new construction and existing construction with major renovation, the following design criteria shall be used.

3-A.1.2 CODE AND COMPLIANCE

The facility design shall comply with NFPA 45 Standard on Fire Protection for Laboratories using Chemicals, 2015 or approved latest edition and the Center for Disease Control (CDC) and the guidelines given in the National Institute of Health (NIH), Bio-Safety in Microbiological and Biomedical Laboratories (BMBL), 5th edition 2010 or latest edition.

3-A.1.3 CERTIFICATION

Each facility shall be inspected and certified annually by the local safety officer and/or industrial safety hygienist in accordance with the procedure outlined by the National Institute of Health (NIH).

3-A.2 PRIMARY BARRIERS

3-A.2.1 BIOLOGICAL SAFETY CABINETS

(a) Perform all manipulations that may create aerosol or splatter inside a Biological Safety Cabinet (BSC) of appropriate size and classification (Class II or Class III). BSCs constitute ***primary barriers*** to protect the community, environment, and laboratory personnel. Access, ventilation, and other features described in the respective trades below are the secondary barriers to enhance the containment.

(b) Coordinate quantity and type of cabinets with the end users. Open vessels and open batches shall not be used to perform such activities.

3-A.3 SECONDARY BARRIERS

3-A.3.1 LABORATORY – LOCATIONS

Locate BSL3 laboratories away from high-traffic areas to minimize general public exposure.

3-A.3.2 LABORATORY - ACCESS

Entry in the laboratory shall be through a dedicated and enclosed passageway or an Ante Room, that is, through two sets of self-closing and self-locking doors. Provide interlocking mechanism to prevent both sets of doors being opened at the same time. The passageway or the Ante Room can be used for changing clothes. Movement of supply and waste can be through a separate double-door access or autoclave.

3-A.3.3 ARCHITECTURAL CONSIDERATIONS

3-A.3.3.1 Windows

All windows in the laboratory shall be closed and sealed. Due to security concerns, provide high impact glass with wire mesh for the windows and doors. Coordinate the glass characteristics with the VA Master Construction Specifications.

3-A.3.3.2 Penetrations

All floor, wall, and ceiling penetrations shall be sealed to prevent any aerosol movement. All duct and pipe openings shall also be sealed.

3-A.3.3.3 Walls, Ceilings, and Floors

(a) Provide smooth surfaces for the walls, ceilings, and floors. The surfaces shall be impermeable to liquids and resistant to the chemicals and disinfects used in the laboratories.
(b) Floors shall be monolithic with continuous cove moldings that extend at least 4 in [100 mm] up the wall.
(c) Use of the acoustic tile suspended ceiling is not permitted. The ceiling shall have a water-proof, hard surface for ease of cleaning.

3-A.3.3.4 Doors

(a) Provide galvanized, epoxy-painted hollow metal doors with smooth impervious surfaces.
(b) Use of wooden doors is ***not*** permitted.

3-A.4 PLUMBING AND FIRE PROTECTION CONSIDERATIONS

(a) All laboratory valves, gas cylinder manifold stations, vacuum system filters, and other plumbing and fire protection equipment requiring service and maintenance shall be located in a secured location outside of the BSL-3 laboratory suite.
(b) Provide a dedicated hands-free (sensor) hand washing sink located near the exit of the laboratory. Do not locate the hand washing sink in the vestibule.
(c) The BSL-3 laboratory suite shall be on a separate sprinkler zone with a dedicated, supervised control valve.
(d) The sprinkler heads shall be concealed-type or provide a sprinkler design capable of being decontaminated on a regular basis.
(e) The suction side of the vacuum pump shall be piped to a 0.2 micron hydrophobic inline filter with valve bypass prior as close as possible to the laboratory. A mechanism for the decontamination of filters shall be incorporated into the design of the vacuum system.

(f) The vacuum pump discharge shall have a sampling port and shall be vented to atmosphere in a secured location at least 10 ft [3 m] above any accessible location.
(g) An emergency shower/eyewash station shall be within the same room as the chemical fume hood. The emergency shower/eyewash station shall not have a floor drain.
(h) An autoclave shall be made available inside the laboratory for decontamination purposes.

Chapter 4: BUILDING COOLING AND HEATING SYSTEM

4.1 INTRODUCTION

This chapter describes refrigeration, heating and ventilation systems for building HVAC systems. Information given below shall be used in conjunction with the Master Construction Specifications, and associated documents, described in Chapter 1 and located on the TIL.

The following systems are evaluated:

Cooling Systems

- Central Chilled Water Plants and Small Chilled Water Systems
- Chilled Water System Components
- Direct Expansion (DX) Systems

Heating Systems

- Steam Systems (Excluding Generation and Outside Distribution)
- Hydronic Hot Water Systems
- Glycol Systems
- Electrical Heating Systems
- Gas Heating Systems
- Miscellaneous Systems

4.2 COOLING SYSTEMS – CHILLED WATER

4.2.1 CENTRAL CHILLED WATER PLANTS AND SMALL CHILLED WATER SYSTEMS

4.2.1.1 General

(a) Select cost-effective and optimum central chilled water plants and/or small chilled water systems to meet the project-specific requirements. Each installation shall consist of multiple (minimum two) chillers. For central plants, water-cooled chillers shall be centrifugal (open or hermetically sealed) or rotary-screw compressors or absorption machines. Small chilled water systems are generally equipped with air-cooled or water-cooled rotary-screw or scroll compressors. Use of reciprocating compressors is not permitted.

(b) Where smaller facilities such as CLC/DOM, central laundries, or outpatient clinics are located within the Medical Center Complex, use of the existing central chilled water plant and the distribution loop, including upgrade of the existing central plant, is the preferred option to meet the cooling needs. The A/E shall thoroughly investigate the existing central plant in consultation with local VA Engineering Department and provide recommendations. The investigation shall include:

  - Chilled Water Availability – Year Around or Seasonal
  - Available Spare Capacity
  - Feasibility to Extend the Distribution Loop
  - Chilled Water Temperature
  - Required redundancy

- System Hydronics

(c) If the results of this investigation and other project requirements indicate the need for a separate source of chilled water or if chilled water is otherwise not available from an existing chilled water plant then the design shall provide a dedicated chilled water system. Use of air-cooled chillers within the capacity limitations outlined herein is preferred to ensure water conservation, absence of water treatment and chemicals, and ease of installation with quick start during mild weather. However, in all cases the final decision shall be based on the required chilled water optimization study.

4.2.1.2 Chilled Water Optimization Study – Central Plants and Small Systems

(a) For central plants and small systems conduct a comprehensive study to evaluate and define the lowest life-cycle cost performance of the chilled water system. In all cases the lowest allowed efficiency chillers shall be as indicated in Table 6.8.1-3 of the approved latest edition of ASHRAE Standard 90.1. The study shall address system components and parameters, such as, variable speed chillers, chilled water leaving temperature, inlet/outlet temperature differential, flow, pipe and pump sizes, thermal storage, energy recovery, water side economizer, variable flow primary only pumping, primary secondary piping with variable flow secondary and constant or variable flow primary, oversize cooling towers etc. While optimizing the chilled water system parameters, special consideration shall be given to spaces requiring conditions dryer than 68 F and 55% RH and winter time cooling requirements; see paragraph 4.2.1.3 below.

(b) The study shall justify the choice of refrigerant. The refrigerant shall be EPA approved and compatible with all local, state, and federal regulations. Base the system selection on refrigerants HCFC 123, HFO 1233zd, HFC 410a, HFC 134a, and R513a. Follow ASHRAE Standard 15, Safety Code for Mechanical Refrigeration and ASHRAE Standard 34, Designation and Safety Classification of Refrigerants to ensure full compliance.

4.2.1.3 Central Chilled Water Plant Sizing

(a) Plant capacity shall be based on campus peak block load including ventilations load and process loads and not on a sum of individual air handling unit peak loads.

(b) Consider excluding the cooling load requirements for special applications such as low humidity applications, process loads, and intermittent loads.

4.2.1.4 Maximum Chiller Capacity

Capacity of a single water-cooled chiller equipped with centrifugal or rotary-screw compressor(s) and or a single water-cooled absorption chiller shall not exceed 1,250 tons of refrigeration capacity. Capacity of a single air-cooled chiller equipped with rotary-screw or scroll compressors shall not exceed 250 tons of refrigeration capacity.

Chillers shall be rated and certified per AHRI conditions.

4.2.1.5 Standby Chiller Capacity

(a) For new construction and major renovation projects, the central chilled water plant and small chilled water system shall be comprised of N+1 chillers, where N is the number of chillers in operation to meet the total cooling demand and 1 (one) is the installed standby chiller. Capacity of the standby chiller shall match the capacity of the largest installed chiller. All plant components, condenser and chilled water piping, and controls shall be sized and selected to match the N + 1 requirement.

(b) The N + 1 requirement shall extend to all essential system components (chillers, pumps, and cooling towers.) Configure all piping, pumps, and cooling towers to maintain N+1 capability regardless of component failure. For example condenser water piping shall be configured so that any cooling tower can service any chiller. Design the piping systems using manifolds, automatic flow control valves, inherently balanced pipe configurations and/or combinations of these to ensure proper flow under all possible operating conditions.

(c) On systems with variable primary flow maintain the capacity of all chillers equal or with at most no more than 10% difference between the largest and smallest chiller. If this cannot be accomplished, due to project issues or existing conditions, design system with positive means for maintenance of equal capacity distribution on all operating chillers.

4.2.1.6 Small Chilled Water Systems

(a) When the required studies indicated the need for a small chilled water system the requirements indicated herein will apply.

(b) Provide N+1 chillers, pumps, cooling towers, controls, piping etc. to maintain N+1 capacity. For example chilled water piping shall be configured so that any primary chilled water pump can service any chiller.

(c) Whenever possible, design small air cooled chilled water plants utilizing chillers with independent refrigeration circuits and/or with independent power circuits and controls for maximum system reliability.

(d) For air cooled chiller in noise-sensitive locations, include chiller manufacturer’s standard acoustic options in the design. Ensure compliance with the physical security guidelines.

(e) For air cooled chillers in corrosive environments and/or high-humidity locations, include factory-applied anti-corrosion treatment for condenser coil fins.

(f) Each small chilled water system (individual chillers 150 tons or less) must maintain minimum recommended water volume in circulation to avoid frequent cycling of the compressors, and the inherent poor chilled water temperature control that results from that cycling. While a minimum of 6 gallons per ton is more than adequate in most HVAC applications, the requirement for extremely high efficiency chillers does in some cases exceed that number. During design determine the worst case volume for chillers in the required size range and specified configuration (type of compressors, heat exchangers, efficiency etc.) to determine the highest required volume for the specific application. If the calculated, chilled-water system volume, as designed, is less than the calculated highest required volume, include an inline, pressurized, and insulated chilled water storage tank in the piping circuit to provide the required thermal inertia. Specify the tank as an internally baffled tank specifically designed for this application to eliminate the possibility of flow short circuiting through the tank. Tank installation shall be complete with supports, isolating valves, drain connections, access for tank maintenance, and inlet/outlet nozzles.

4.2.1.7 Process Chillers for MRI and Other Imaging System Cooling Applications

Imaging systems such as MRIs and PET CT Scanners require chilled water for equipment process cooling. Central plant chilled water may be used for this process cooling application if the use is approved by the imaging equipment manufacturer and if adequate capacity, temperature, and year round availability are all present, otherwise a dedicated chiller plant must be provided. Typically the chiller, buffer tanks, and pumps for these applications are provided by the manufacturer of the imaging equipment for installation by others. When designing one of these installations closely follow the installation requirements provided by the imaging equipment manufacturer as these applications required accessories not normally found in other chiller applications (glycol, flow meters, gages etc.). The contract documents also need to indicate which components are furnished by the imaging equipment manufacturer for contractor installation and which are furnished and installed by the contractor. Startup may be by the installation contractor or by the imaging equipment manufacturer on a case by case basis.

4.2.2 DESIGN FOR SUSTAINABILITY AND SERVICEABILITY

(a) For all projects the design team shall complete a design that is consistent with sustainable practices in terms of energy savings, system reliability, and maintainability. Within the available space and cost constraints the design shall consider and where practical implement the following minimum requirements:

1) Design for non-disruptive access to all chillers, pumps, cooling tower, and cooling tower components without the need to disassemble or remove other equipment or systems and/or building components such as piping, doors, walls etc.
2) Ensure sufficient horizontal and vertical spaces are provided for access to pumps using fork lift trucks of adequate capacity for the pumps being used.
3) Provide chillers with marine water boxes.
4) Provide large chillers with factory installed davits for rigging of heat exchanger end covers.
5) Provide cooling towers with OSHA approved service ladders, service platforms and with factory installed davits for rigging of fans and motors.
6) Provide adequate access to all the equipment in the plant so that it is unnecessary to move one piece of equipment (pump, chiller, electrical component etc.) in order to replace another component. The design shall provide roll up doors of sufficient size and quantity and clear access path between equipment and doors to allow the un-interrupted replacement of the largest chiller in the plant without having to remove walls or other parts of the building.

7) Arrange piping, especially piping in hydraulic decoupler to ensure that all water flow meters have ideal flow conditions for accurate measurement. Follow worse case flow meter recommendations.
8) When cooling towers and air cooled chillers are on the ground provide fully paved area around the entire installation to eliminate the need for landscaping work (weed eating or mowing) around the equipment and provide a perimeter fence for security and to keep windblown debris from fouling the equipment. The distance between the fence and the heat transfer equipment shall be appropriate for the proper functioning of the equipment.
9) Provide all cooling towers with a basin sweeper system and self-cleaning filter system. In any situation where the basin sweeper cannot be retrofitted provide a side stream filter system on the condenser water loop. Minimum filtration efficiency is 50 micron and minimum flow is one complete change of volume per hour.
10) On water cooled systems consider condenser automatic alternating tube brush systems in the life cycle cost analysis.
11) Sometimes there is a need to provide condenser water or chilled water from external sources to maintain cooling during maintenance or emergencies. Make provisions for this in every plant (new and upgrade) by providing temporary service water connections on both the condenser water system and on the secondary chilled water system. Locate in an area convenient to access temporary air cooled chillers and cooling towers as the case may be. The temporary connections shall be flanged complete with valves and blind flanges. Provide additional valves as necessary for the installation to work as intended. Due to the critical nature of the valves in this installation all butterfly valves should be specified as MSS SP-68 High Performance Butterfly Valves.
12) The variable speed compressor motor drive for chillers utilizing variable speed compressors shall not be cooled with condenser water. Condenser water is always too dirty and eventually fouls the variable speed drive (VSD) heat exchanger thereby shutting the chiller down. All manufacturers are capable of cooling the VSD with chilled water in lieu of condenser water.

4.2.3 CHILLED WATER SYSTEM COMPONENTS

4.2.3.1 Chilled and Condenser Water Pumps

(a) General: Provide base-mounted, centrifugal (horizontal or vertical split-case or vertical turbine) pumps for chilled water and condenser water applications. In-line pumps can be used for small (5 hp [4 kW] and smaller) sizes. For condenser water pumps, available net positive suction head (NPSHA) must exceed required net positive suction head (NPSHR) to avoid pump cavitation. Provide NPSHA calculations with design analysis.

(b) Selection Criteria: Select pumps to operate at 1750 rpm. Higher speeds are approved for use, if pumps are not available that operate at 1750 rpm. Select the operating point at or near the highest efficiency and to the left side of the maximum efficiency point but not more than 5% from the maximum efficiency curve. The pump motors shall be non-overloading over the entire range of their operation and compatible with variable speed drives, where such applications are used.

(c) For flow rates in excess of 1,200 gpm [76 L/s], the pump selection shall be optimized, based on multiple types and sizes, including single suction or double suction pumps.

4.2.3.2 Cooling Towers

(a) General: Provide induced draft-type, gravity-flow, factory-fabricated, and factory-tested cooling towers. Use of forced-draft cooling towers shall be avoided except for special applications, such as, indoor locations. The cooling towers shall be certified by the Cooling Tower Institute (CTI) and shall meet OSHA safety requirements and comply with the VA Physical Security Manual. See Figure 4-4 for the piping and pumping arrangement.

(b) Selection Criteria: The cooling tower shall be selected to fit within the available footprint and height constraints. The cooling tower selection shall address corrosion resistance and noise criteria requirements. Design the cooling tower discharge in accordance with the recommendations of the dispersion analysis. The engineer shall consider and address in the design all of the following:

1) Cooling tower location to mitigate noise and IAQ (Legionella) issues.
2) Cross flow or counter flow towers
3) Gear drive or belt-drive fans
4) Variable speed fans
5) Concrete basin or stainless steel basin
6) Walking platform for complete safe access to fan, fan motor, and hot water deck and nozzles.
7) Properly specify spray nozzle.
8) Stairs and ladder safety cage, with locked access.
9) Davit for fan and motor service
10) Tower Loading and Supporting Structure
11) Basin Heating System
12) Drain down issues on remote basins
13) Pump inlet air entrainment on remote basins
14) Basin equalizer piping / weirs and drain, overflow and bleed down connections.
15) Sanitary connection to completely drain the basins.
16) Specify tower manufacturer’s controls for water level and freeze protection.
17) Multi cell versus single cell towers.

(c) Cooling Tower - Roof Location: For cooling towers installed on the roof, address and resolve the following:

1) Operating weight with structural discipline.
2) Adequate clear height (4 feet minimum) above roof for roofing maintenance and repair. The clear height must take into consideration piping and valves protruding from the bottom of the towers.

3) Shading requirement with architectural discipline.
4) Walking pads location coordination with architectural discipline.

(d) Controls: Provide a dedicated controller for each cooling tower. During off-peak season, the control strategy shall allow the tower to lower the water temperature below the design leaving water temperature and follow the ambient wet-bulb temperature.

4.2.3.3 Water Treatment - Chilled Water System

(a) In addition to specifying the water treatment system components, tests, chemicals, and other requirements, the A/E shall provide details and indicate on floor plans and piping schematics the required locations of the water treatment system components ensuring the design includes adequate space for equipment to perform correctly and fit in the allotted space. For example the details shall indicate minimum installation requirements for the accurate, reliable measurement of water and chemical flows.

(b) Chemical Shot Feeder: Provide a chemical shot feeder in bypass position to treat the closed-loop chilled water system. Select the feeder size and chemicals based on the system volume and the water analysis, but not less than 5 gal [19 L]. Provide piping connections per VA Standard Detail.

(c) Corrosion Coupon Rack: Provide coupon rack in bypass position which at a minimum shall include coupons of the evaporator tube material, cooling coil tube materials, and all piping materials.

(d) Water Filter: Where filtration is needed due to poor past maintenance or system age provide a cartridge-type filter in bypass position to remove solid suspended particles from the chilled water system. The initial filter should be between 25 and 50 microns but after the system is clean a 5 micron filter may be used. Filter capacity shall at least filter the entire system volume in a 12 hour period. Include the bypass flow in the pump duty or provide a dedicated filtration pump. Provide piping connections per VA Standard Detail.

4.2.3.4 Water Treatment - Condenser Water System

(a) In addition to specifying the water treatment system components, tests, chemicals, and other requirements the A/E shall provide details and indicate on floor plans and piping schematics the required locations of the water treatment system components ensuring in the design that adequate space existing for equipment to perform correctly and fit in the allotted space. For example the details shall indicate minimum installation requirements for the accurate, reliable measurement of water and chemical flows.

(b) General: Design a water treatment system for treating cooling tower water based on make-up water samples. Use non-toxic chemicals approved by local and EPA requirements. The water treatment shall operate automatically with the chemical feed and blowdown systems.

(c) System Description: Provide a chemical feed pump for each chemical feed tank, specifically, tower scale and corrosion inhibitor, acid and biocide. Each pumping system shall be equipped with a check valve, drain connections, and a safety relief arrangement. Monitor the pump status at the ECC. Provide a chemical feed controller, conductivity probe, and pH and oxidation reduction potential (ORP) systems. Obtain makeup water analysis and include blowdown makeup in sizing the makeup water system.

(d) Corrosion Coupon Rack: Provide coupon rack in bypass position which at a minimum shall include coupons of the condenser tube material and all piping materials.

(e) Water Meters: Provide a water meter in the condenser water make-up and blow down piping. Water meter shall be capable of reading the instantaneous flow and totalized flow locally and at the ECC.

(f) Floor Space: Provide floor space marked reserved on the floor plans for the water treatment system to include an eye wash and emergency shower. Coordinate with the plumbing discipline to provide a washbasin. Provide storage cabinets to house the chemical testing equipment for the water treatment system.

(g) Basin Sweeper and Side Stream Filter System: Include a cooling tower basin sweeper jet system on each cooling tower and provide with a self-cleaning filter system with dedicated filtration and back wash pumps and controls. The minimum filtration capacity shall be 50 microns and the minimum filtration flow shall filter the entire system volume every hour. Do not use centrifugal separators because their filtration level is inadequate and do not use sand filters because their backwash water usage is excessive. If in retrofit projects it is not possible to provide the basin sweeper system provide the side stream filter on the supply or return piping. Ensure the filtered water does not bypass the tower or the condenser.

(h) Automatic Condenser Tube System: As indicated by TLCC analysis provide automatic alternating condenser tube brush system consisting of alternating brushes, brush retention capsules, and four way flow reversing valve and controls.

4.2.4 PIPING AND PUMPING ARRANGEMENT

4.2.4.1 Constant Volume System

Comply with ASHRAE Standard 90.1-2013 paragraph 6.4.5.2 or the equivalent paragraph in the approved latest edition. Only systems meeting the exceptions allowed therein can be constant volume type using three-way control valves. All other systems shall be variable flow and as required by the approved latest edition of ASHRAE Standard 90.1. See Figure 4-3

4.2.4.2 Variable Flow Systems - Chilled Water

(a) Based on chilled water system optimization study and other project parameters select either one of the two generally used variable flow piping and pumping systems.
- PSS (Primary - Secondary System)
- VPS (Variable Primary System)

(b) Both systems are designed to maintain constant chilled water temperature entering the terminal units during full load to part load conditions.

(c) Primary-Secondary System (PSS)

See Figure 4-1 for the piping and pumping arrangement.

1) Primary Loop: Piping arrangement consists of constant volume primary loop. Chilled water header shall be piped to permit isolation of any chiller and any pump as required during part load condition and permit the use of any chiller with any pump. The design shall address positive means of maintaining constant evaporator water flow regardless of what pump and chiller combination is used (automatic flow control valves, flow control, balanced piping arrangements, manifolds etc.
2) Secondary Loop: Chilled water flow is variable in the secondary loop serving the terminal units. The loop consists of multiple pumps equipped with variable speed drives. The terminal cooling units are equipped with two-way modulating control valves. Provide a high-accuracy flow meter in the secondary circuit and ensure the design allows for installation that exceeds the meter's minimum un-interrupted straight pipe distances before and after the meter.
3) De-Coupler Piping: Provide hydronic separation (de-coupler piping) between the primary and secondary loops to provide hydronic separation between the two circuits and enable chilled water to flow in either direction.
4) Control Strategy: When designing a variable flow system in situations where variable flow is not required by ASHRAE 90.1, secondary loop chilled water flow varies as the field two-way valves modulate. The secondary loop pressure will be maintained at the set point by varying the secondary chilled water pump speed. The set point is measured and maintained by differential pressure assembly(s) (DPA) installed in the secondary loop. The A/E shall determine the required number of assemblies and indicate the required locations on the drawings. Coordinate the DPA set-point with the Testing, Adjusting, and Balancing (TAB) contractor. Indicate location of the DPA on the floor plans and riser diagrams. When a variable flow system is mandatory per ASHRAE 90.1 then the required control scheme shall poll all chilled water coil control valves and reset the chilled water differential setpoint to the lowest value which satisfies all zones (at least one valve nearly wide open).

(d) Variable Primary System (VPS)

See Figure 4-2 for the piping and pumping arrangement.

1) General
VPS is less expensive in first cost and energy efficiency is higher when compared to a "traditional" PSS. However, VPS may not be suitable for all applications. While VA encourages the use of VPS, inherent complexities of the system controls, start-up, and loading/unloading of the chillers shall be resolved during design development. It is also important to ensure that a minimum constant cooling load is always present for the VPS to be effective.
2) System Operation
VPS consists of a single circulation/distribution loop that circulates the same water through the terminal cooling units and the chiller evaporators. The flow is permitted to vary throughout the loop, including through the evaporator tubes. Minimum velocity through the evaporator tubes must not be allowed to decrease below the

manufacturer’s recommended value. A bypass assembly, similar to the PSS system shall be included in the design as shown in the Figure 4-2.

3) Control Strategy
Include a high-accuracy flow meter to monitor the evaporator water flow rate and ensure the design allows for installation that exceeds the meter’s minimum un-interrupted straight pipe distances before and after the meter. In retrofit applications a pressure-differential sensor across the evaporator can be utilized in lieu of a flow meter. Reduce the pump speed at part load conditions by using the same concept (DPA) used in the PSS systems. Avoid sudden variations of the connected load by resorting to sequencing to maintain the system stability. Start/stop of all air-handling units shall be programmed and software controlled. Accomplish loading, unloading, and sequencing of chillers and associated auxiliaries in response to the prevailing load and accumulated run time. Include devices such as a chiller control panel, chilled water temperature sensors in the supply and return pipes, and a flow meter.

4.2.5 CHILLED WATER FREEZE PROTECTION - PROPYLENE GLYCOL

4.2.5.1 VA Policy For Propylene Glycol In Chilled Water Systems

(a) For VA Central Office Projects, propylene glycol solutions are not permitted for freeze-protection on any central chilled water plant systems. The VA Regions and Medical Centers are advised not to use glycol solutions in chilled water systems unless all other means of freeze protection have been exhausted. See the example in Appendix 4-A for small, standalone chilled water systems requiring coil freeze protection. Propylene glycol compromises the mandated energy conservation goal by substantially increasing the pumping horsepower consumption and reducing the heat transfer efficiency of the chillers and AHU cooling coils. The use of glycol results in higher first cost due to larger chiller, larger chilled water pumps, the need for storing and purchasing of the glycol solution, and the pumping or charging kit. Maintenance of the proper glycol level also results in additional cost due to recurring maintenance of the glycol system when compared to water only systems.

(b) The use of propylene glycol in chilled water systems is permitted in thermal storage ice or brine applications.

4.2.5.2 Freeze Protection Measures

(a) Evaluate risk of pipe freezing by as a minimum using BIN weather data and the methods found in the chapter entitled “Insulation for Mechanical Systems” in the ASHRAE Handbook of Fundamentals 2013, or approved latest edition.

(b) To counteract the possibility of freezing, the designer shall evaluate and include project-specific measures.

1) Insulation – Thickness: Increase the insulation thickness of exposed chilled water piping by at least 1-in [25 mm] over the recommended thickness for indoor piping.

Specify stainless steel or aluminum jacket and higher density insulation for exposed piping.

2) Electric Heat Tracing: Specify thermostatically-controlled heat tracing by selecting heating cable of appropriate density (W/lin ft [W/lin m]). Connect heat-tracing circuit to the emergency power circuit.
3) Design and specify thermostatically controlled steam tracing where applicable.
4) Controls: Specify a control sequence to monitor chilled water temperature in exposed pipes and start the chilled water pumps and keep chilled water in circulation when ambient temperature is below 32 F [0 C] Alarm control system if chilled water temperature drops to 39 F [3 C].
5) Consult with VA Authority for established local practice.

4.3 COOLING SYSTEMS - DIRECT EXPANSION (DX)

4.3.1 GENERAL

Where chilled water is not available year-round, non-patient spaces requiring mechanical cooling can be served by terminal DX units of suitable configuration. Use of DX cooling systems is not permitted in high humidity locations. The use of DX cooling shall be discussed with and approved by the VA project COR. The VA’s preference is to utilize chilled water whenever possible.

4.3.2 SELECTION CRITERIA

Equipment selection shall comply with the minimum Energy Efficient Ratio requirements outlined in ASHRAE Standard 90.1 – 2013 or approved latest edition

4.3.3 DX SYSTEM DESIGN CONSIDERATIONS

4.3.3.1 Refrigerant Piping

Refrigerant piping layout and design shall be reviewed and approved by the equipment manufacturer. Limit field-installed refrigerant piping lengths and minimize elbows and changes in elevations to avoid oil return problems and loss of efficiency. Refrigerant circuit must be clean, dry and leak-free. Filter-driers are required, if they are not installed at the factory, they shall be field installed.

4.3.3.2 Compressors

DX system compressor selection shall be based on capacity, system type (CV or VAV), area control requirements (precise temperature control needed), and reliability.

Select two compressors in parallel, where feasible, in place of a single compressor to facilitate part load operation and provide partial redundancy. With two compressors serving a single DX coil, provide intertwined coil circuiting to facilitate refrigerant flow through the entire coil even with one compressor in operation. Review design requirements and provide low ambient control where cooling will be required in low ambient temperatures (equipment rooms for example).

Provide compressors with capacity reduction (multiple compressors, unloaders, hot-gas bypass, digital scroll, etc.) as required to ensure all part load conditions are satisfied.

4.3.3.3 System Controls

Where the DX system is equipped with integral, local microprocessor-based controls, provide an interface with the ECC via open BACnet protocol. Specify the following features as applicable:

(a) Hot gas bypass capacity control.
(b) Low ambient outdoor air temperature controls.
(c) Hot gas reheat control.
(d) Computer room specialized units.

4.3.3.4 Design for Sustainability and Serviceability

(a) Design for non-disruptive access to all DX equipment and interconnecting refrigerant piping.
(b) Avoid mounting products containing compressors on or touching the building foundation.
(c) Coordinate any fences, walls, overhangs or bushes with the location of outdoor air-cooled units. Confirm that manufacturer’s minimum clearances are maintained.
(d) DX equipment should be properly sized; avoid gross oversizing. Equipment performance should be carefully evaluated at all expected load conditions, and equipment should be selected to achieve the most efficient operation at all expected occupancy conditions.
(e) Chlorofluorocarbon (CFC)-based refrigerants shall not be used in new construction or equipment. Utilize refrigerant types that have an ozone depletion potential (ODP) of zero (ex. R-134a, R-410a, R-407c, etc.)

4.4 HEATING SYSTEMS

The HVAC Design Manual provides general guidance for the design and modification of steam and hydronic heating systems. The designer shall refer to the Steam Heating, Hot Water, and Outside Distribution Systems Design Manuals (Volumes 1 through 3) for additional information.

Located in Technical Information Library at https://www.cfm.va.gov/til/dManual.aspx

4.4.1 STEAM HEATING SYSTEM

4.4.1.1 General

High-pressure steam generated at most VA facilities, by a central boiler plant, is used to serve a variety of applications, such as:

- Laundry Service
- Sterilizers

- Kitchen Equipment
- Building Heating Systems
- Domestic Hot Water

The system design shall be based on the actual steam generation pressure in summer and winter seasons. The average range is between 80 psig [552 kPa] and 125 psig [863 kPa]. Coordinate steam pressures with VA Engineering at the project site.

4.4.1.2 Steam Pressure Classification

For VA facilities, the following steam pressure classifications are used:

- Low-Pressure Steam (LPS) – 15 psig [103 kPa] and below
- Medium-Pressure Steam (MPS) – 16 psig [110 kPa] through 60 psig [414 kPa]
- High-Pressure Steam (HPS) – 61 psig [421 kPa] and above

When sizing steam piping from the boiler plant to the mechanical equipment rooms, the steam pressure drop (line losses) is restricted to 10 psig [69 kPa]. This pressure drop requirement only applies to exterior piping, refer to Table 4.3 for pressure drop limitations within the buildings.

4.4.1.3 Steam Pressure Requirements

Listed below are the suggested operating pressures:

Table 4-1: SUGGESTED STEAM OPERATING PRESSURES

Equipment	Operating Steam Pressure psig [kPa]
Radiators	5 [34]
Convectors	5 [34]
Terminal Humidifiers; Duct Mounted	15 [103]
Heating Coils	30 [206]
Steam-to-Hot Water Converters	30 [206]
Unit Heaters	30 [206]
Domestic Water Heaters	30 [206]
AHU Mounted Steam Humidifiers	30 [206]
Sterilizers and Washers	Refer to Space Planning Criteria PG-18-9 & Equipment Guide List PG-18-5
Dietetic Equipment (Nutrition and Food Service)	Refer to Space Planning Criteria PG-18-9 & Equipment Guide List PG-18-5
Laundry Presses and Ironers	125 [862]

NOTE: Radiators and Convectors shall not be utilized in new construction. Coordinate with existing systems and new equipment for required pressures.

For existing facilities the designer shall coordinate with the existing steam system pressure reduction strategy. For example, if the pressure reducing valves are centralized continue with this strategy, if there are terminal pressure reducing stations continue with this strategy. Do not provide a mixture of centralized and terminal pressure reducing stations.

For new facilities conduct a comprehensive study to evaluate and define the lowest life-cycle cost performance of the steam system. The study shall address system components and parameters, such as, location and number of steam pressure reducing stations, different steam pressure loops (high, medium, and low pressure loops), steam condensate return requirements, etc. While optimizing the steam distribution system parameters, special consideration shall be given to maintainability and access for all system components.

4.4.1.4 Pressure Reducing Valve (PRV) Stations – Selection Guidelines

(a) Provide dedicated PRV station(s) for each building and for each steam pressure setting.

  1) Pressure reduction shall occur in mechanical spaces and secondary reduction downstream of the PRV station room shall not be allowed, unless proven to have the lowest LCC. The point of use pressure reduction shall be limited to small application for equipment, and located near the specific equipment served. No PRVs shall be installed above drop ceiling. Maximum allowed turndown ratio is 10:1.

(b) PRV station noise generation shall be less than 80 db and the turndown ratio shall be limited to 10:1.

(c) The PRV station shall be provided with removable fabric insulation jacket to reduce noise and heat gained in the space. The insulation jackets shall be easily removable and allow for reinstallation without any damage to the insulation.

(d) The PRV station shall be isolated from the building structure to limit structure-borne noise.

(e) Do not provide two-stage PRV station to reduce high-pressure steam.

(f) Provide two PRVs, in parallel, where significant (>2/3) variation in the steam demand is expected. For such applications, two PRV valves, of uneven sizes should be provided. The smaller valve (1/3 capacity) set at higher than the exit pressure shall open first and the larger valve (2/3 capacity) set at lower than the exit pressure shall open next but only when the smaller valve is unable to meet the increasing load demand and resulting higher pressure drop.

(g) Install a bypass loop with a globe valve designed for steam service and sized to meet the combined capacity of the two PRV's in the PRV station.

(h) While sizing the PRV station, assume diversity for the process load by assuming 100% load of the largest equipment and 25% load of the remaining steam-consuming equipment from the same department.

(i) Size PRV bypass valve and the safety relief valve according to the National Board Inspection Code of the National Board of Boiler and Pressure Vessel Inspectors

(Columbus, Ohio) and ASME code. Size the safety valve to meet the combined capacity of the two PRV's or the bypass. Verify that the bypass valve capacity does not exceed the capacity of the safety valve.

(j) Provide isolation valves to accommodate maintenance of the PRVs while maintaining steam flow.

(k) Provide a pressure gage at the inlet and outlet of the station complete with isolation valve with a range and construction appropriate for the pressure.

4.4.1.5 Steam System Components and Procedures

(a) Shutoff Valve - HPS
Provide a shutoff valve and a pressure gage, 4.5 in [115 mm] dial for each incoming steam service in the mechanical equipment room. For a shutoff valve, larger than 4 in [100 mm] size, include a factory-installed, integral warm-up valve of 0.75 in [20 mm] or 1 in [25 mm] size in bypass position.

(b) Steam Flow Meter
For each steam PRV station, include a steam-flow meter with interface to the EEC. Provide capability to read instantaneous and total steam flow. Where the facility is equipped with an Advanced Metering System, ensure coordination between the new steam flow meter and the existing metering system.

(c) Stress Analysis
Perform a computerized stress analysis on the actual steam piping layout and show anchors, guides, and expansion loops to avoid pipe deflection and contain expansion. All devices shall be shown in the floor plans at approximately the same location where they are intended. Submit calculations for review and approval.

(d) Flash Tank
The steam gravity return piping design shall not permit direct connections between the high-pressure gravity return and medium-pressure gravity return to the low-pressure gravity return lines to avoid flashing. Provide a flash tank, where all gravity returns will reduce pressure and temperature. From the flash tank, the low-pressure gravity return shall flow into the condensate receiver of the condensate return pump. Adjust the flash tank elevation to ensure gravity flow into the condensate receiver. Gravity return must not be lifted. The flash tanks shall be shown at all applicable locations on the floor plans and elevations.

(e) Condensate Storage Tank
The condensate storage tank shall be sized to accommodate surges without overflow. The tank shall be sized for 20 minutes minimum storage to overflow at peak plant output.

(f) Steam Reheat Coils
See Chapter 2, paragraph 2.2.6.3.

(g) Vent Lines
Provide vent lines, as required, extending above the building roof. Vent lines from the condensate tank and flash tank can be combined into a single line. Vent line from safety valve(s) at the PRV station shall be independent of other vent lines and shall extend a

minimum of 6 ft [2 m] above the roof.

To avoid long safety valve discharge piping, safety valves may be located close to the termination point, provided no shut-off valve is installed between the PRV and the safety valve.

Specify steam system exhaust heads on vents where entrained moisture presents a hazard to roofs, walls and other building components.

(h) Condensate Return Pumps

Provide duplex condensate pumps, complete with a receiver, to return liquid condensate to boiler plant. Provide emergency power for the pumps. Provide an alternator to facilitate switching the pump operation.

(i) Steam Traps – Selection Criteria and Limitations

Fixed orifice steam traps with no operating mechanism are prohibited due to the small diameter orifices that become plugged with dirt causing trap to fail shut. A failed trap will result in build-up of condensate in the steam main and dangerous water hammer may occur.

Provide a steam strainer at the inlet of all steam traps to prevent scale and other solid particles from entering the trap.

1) Float and Thermostatic Traps

Provide float and thermostatic (F&T) traps for all modulating loads such as heat exchangers, domestic hot water heaters, and modulating control valves (where used) for preheat coils and equipment with modulating loads. Provide minimum 12 in [300 mm] static head for the trap operation. Space permitting, provide 18 in [450 mm] head. Static head shall be shown in the steam trap installation detail and the floor plans must emphasize the need to provide maximum available static head. Non-compliance with this requirement has been a cause of operational problems in many installations. Size all F&T traps at 0.25 psig [1.7 kPa] pressure drop.

Size traps for heat exchangers and AHU preheat coils at 250% of the design load to meet the start-up needs. Capacity of a single trap shall not exceed 5,000 lb/h [2268 kg/h].

2) Inverted Bucket Traps

Steam traps on the steam line drip points shall be inverted bucket type, with bi-metallic thermal element for air removal. Select the working pressure range suitable for the maximum line pressure. For steam lines in continuous operation with infrequent shut downs, drip traps shall be sized for the line radiation loss, in lb/h [kg/h] multiplied by three. The trap pressure differential shall be 80% of the line operating pressure.

3) Installation and Documentation Needs

- Each coil shall be individually trapped.
- Provide a steam trap schedule by assigning a unique trap number and location. Indicate the type, capacity, and the pressure differential at which the trap is selected. The trap schedule shall be shown on the drawings.

(j) Steam Gun Sets
Provide a steam gun set consisting of steam, water, and detergent, at the following locations (see VA standard detail for more information):

- Trash or trash compaction rooms
- Dietetics - manual cart wash
- Sterile Processing Services (SPS) - Manual Equipment Wash

4.4.2 HYDRONIC HOT WATER SYSTEMS

The HVAC Design Manual provides general guidance for the design and modification of heating hot water systems. The designer shall refer to the Hot Water System Design Manual (Volume 2) for additional information.

Located in Technical Information Library at https://www.cfm.va.gov/til/dManual.aspx

4.4.2.1 General

Hot water heating systems are commonly used due to ease of transportation of the heating medium, flexibility of piping layout, and versatility of the controls. For terminal heating devices, not in direct contact with freezing ambient air, use a hot water heating system.

4.4.2.2 Hot Water Source - Steam

For most VA facilities, steam is available from the central boiler plant via existing steam distribution loop to generate heating hot water. Each hot water generating system shall consist of two steam-to-hot water heat exchangers (shell and tube), circulating pumps, and associated system auxiliaries. One heat exchanger and circulating pump acts as 100% standby. See Figure 4-5.

4.4.2.3 Hot Water Source - Hot Water Boilers

(a) General
Where steam is not available (example: Standalone Facilities), packaged, hot water heating boilers can be used to meet the heating and reheat demands. The boiler type, heating water temperatures, fuel type, and pumping/piping system configuration shall be based on the project requirements and a Life Cycle Cost Analysis. See Figure 4-6. Refer to the Steam Heating, Hot water, and Outside Distribution Systems Design Manual – Volume 2 Water Boilers for LCCA, fuel selection, and sizing requirements.

4.4.2.4 Hot Water Design Temperature

The supply water temperature entering the terminal units are generally selected in the range of 150 F [65 C] to 180 F [82 C] to allow for heating hot water temperature reset. The hot water temperature differential (supply temperature minus return temperature) shall be optimized to gain maximum energy advantage. The design water temperature differential is maintained between 20 F [11 C] to 30 F [17 C]. Higher water temperature difference will result in less water flow, smaller pipe sizes and reduced pumping power consumption.

Coordinate the supply water temperature within existing systems to ensure all coils are selected with the same entering water and differential temperature.

4.4.2.5 Hot Water Piping and Pumping

The piping and pumping configuration shall be similar to the chilled water piping and pumping configurations described in Section 4.2.3 above.

4.4.2.6 Freeze Protection – Hot Water

(a) General
For hot water preheat coils coming in contact with ambient air or mixed air below freezing temperatures, provide freeze protection by mixing propylene glycol in the heating hot water. A separate glycol-hot water heating system by way of a heat exchanger (hot water to glycol hot water), circulating pumps, and interconnecting piping is recommended. See Figures 4-5 and 4-6

(b) Glycol Properties
Select the smallest possible concentration of glycol to produce the desired antifreeze properties. Include an inhibitor in the glycol solution to prevent corrosion. Water used in conjunction with glycol shall be low in chloride and sulfate ions.

(c) HVAC Equipment Selection
Selection of equipment utilizing glycol shall take into account the loss of efficiency, impact on the flow and pressure drop, and increased pump BHP. See Appendix 4-A for corrections.

4.4.2.7 Terminal Units

The terminal units generally used with hot water heating systems are:

- Heating Coils – VAV/CV Air Terminal Units
- Unit Heaters
- Cabinet Unit Heaters
- Convectors
- Radiant Ceiling Panels
- Finned Tube Radiation
- Hot Water Curtains
- Fan Coil Units
- Hot Water Coils – Preheat and Reheat Coil mounted in AHU

4.4.2.8 Design For Sustainability and Serviceability

(a) For all projects the design team shall complete a design that is consistent with sustainable practices in terms of energy savings, system reliability, and maintainability. Within the available space and cost constraints the design shall consider and where practical implement the following minimum requirements:

1) Design for non-disruptive access to all hydronic equipment, including but not limited to pumps, heat exchangers, expansion tanks, control valves, etc. without the need to

disassemble or remove other equipment or systems and/or building components such as piping, doors, wall, etc.

2) Ensure sufficient horizontal and vertical space is provided for access to pumps for A-frame lifting of adequate size for the pumps being installed.
3) Provide for emergency shutdown station at exterior doors to all boiler rooms. Shutdown shall close gas valves and de-energize electrical connections to all boilers.

4.4.3 ELECTRICAL HEATING SYSTEMS

4.4.3.1 General

Use of electric resistance heaters shall be prohibited, except when other heating sources (hot water, steam, gas) are not available, and/or for applications where use of any other heating source could pose a safety hazard. Written approval by VA Authority identified in Chapter 1, paragraph 1.1 is required for use of electric resistance heating.

4.4.3.2 Applications

Use terminal heating units (unit heaters, finned-tube radiation, and radiant panels) for locations such as:

- Emergency Generator Rooms
- Electrical Equipment Rooms
- Telecommunication Rooms
- Elevator Machine Rooms

4.4.3.3 Controls

The heating elements shall be controlled either in steps or by SCR (Silicon Controlled Rectifiers). Ensure safety compliance with heaters, such as high-temperature cutouts, as mandated by UL certification. Provide electrical disconnecting means at all electric heaters.

4.4.4 GAS HEATING SYSTEMS

4.4.4.1 General

Use of natural gas heaters shall be prohibited, except when other heating sources (hot water or steam) are not available. Alternately if no natural gas, hot water, or steam is available the use of liquid propane gas (LPG) can be investigated. Written approval by VA Authority identified in Chapter 1, paragraph 1.1 is required for use of natural gas or LPG.

4.4.4.2 Applications

Gas-fired equipment is generally used for miscellaneous heating applications. These applications are:

- Mechanical Rooms
- Gymnasiums
- Storage Spaces

- Warehouses
- Mechanical/Maintenance Shops

Ensure that combustion air and exhaust air needs are addressed and included in the design per the manufacturer's recommendations and NFPA 54, National Fuel Gas Code. Care shall be taken to avoid any possibility of exhaust air short-circuiting into an outdoor air intake or operable windows. Follow the recommendations of the dispersion analysis. Wherever available and feasible, use modulating burners to provide energy-efficient and smooth temperature control. Do not use direct fired gas burners, use indirect fired gas burners unless approved by VA Engineering.

4.4.5 GEOTHERMAL HEATING AND COOLING

The designer shall analyze the potential of using geothermal heating and cooling. If other facilities in the area are using geothermal energy, the designer shall prepare a white paper to discuss the applicability, pros and cons and include life-cycle analysis with geothermal heating and cooling as an option for VA authority.

4.5 DESIGN CRITERIA – PIPING SYSTEMS

4.5.1 PIPE DESIGN – GENERAL

4.5.1.1 Pipe Selection Criteria

Pipe size selection must satisfy limiting parameters, maximum water velocity and maximum fluid pressure drop.

4.5.1.2 Minimum Pipe Size

For closed loop piping systems, minimum size of the individual takeoff shall not be less than 0.75 in [20 mm].

4.5.1.3 Mandatory Requirements

All piping 6 in [150 mm] and larger shall be shown in double lines on all floor plans in the final submission.

4.5.1.4 Miscellaneous Requirements

- Dielectric unions where connecting two dissimilar metals
- Drain connections at all low points in piping
- Manual air vents at all high points in piping
- Provide isolation valves for each floor/wing of a facility
- Provide air separators in all closed loop hydronic systems
- Provide an expansion tank for all closed loop hydronic systems
- Provide a chemical shot feeder for all closed loop hydronic systems

4.5.2 LIMITING PIPE SIZING PARAMETERS

Table 4-2: HYDRONIC PIPE SIZING CRITERIA

Pipe Type and Size	Maximum Fluid Velocity	Maximum Pressure Drop
Chilled Water 2 in [50 mm] and below	4.0 fps [1.2 m/s]	4.0 ft WG/100 ft [0.4 kPa/m]
Hot Water 2 in [50 mm] and below	4.0 fps [1.2 m/s]	4.0 ft WG/100 ft [0.4 kPa/m]
Hot Glycol Water 2 in [50 mm] and below	4.0 fps [1.2 m/s]	4.0 ft WG/100 ft [0.4 kPa/m]
Chilled Water Above 2 in [50 mm]	10.0 fps [3.0 m/s]	4.0 ft WG/100 ft [0.4 kPa/m]
Hot Water Above 2 in [50 mm]	10.0 fps [3.0 m/s]	4.0 ft WG/100 ft [0.4 kPa/m]
Hot Glycol Water Above 2 in [50 mm]	10.0 fps [3.0 m/s]	4.0 ft WG/100 ft [0.4 kPa/m]
Condenser Water Any Size	10.0 fps [3.0 m/s]	4.0 ft WG/100 ft [0.4 kPa/m]

NOTE:

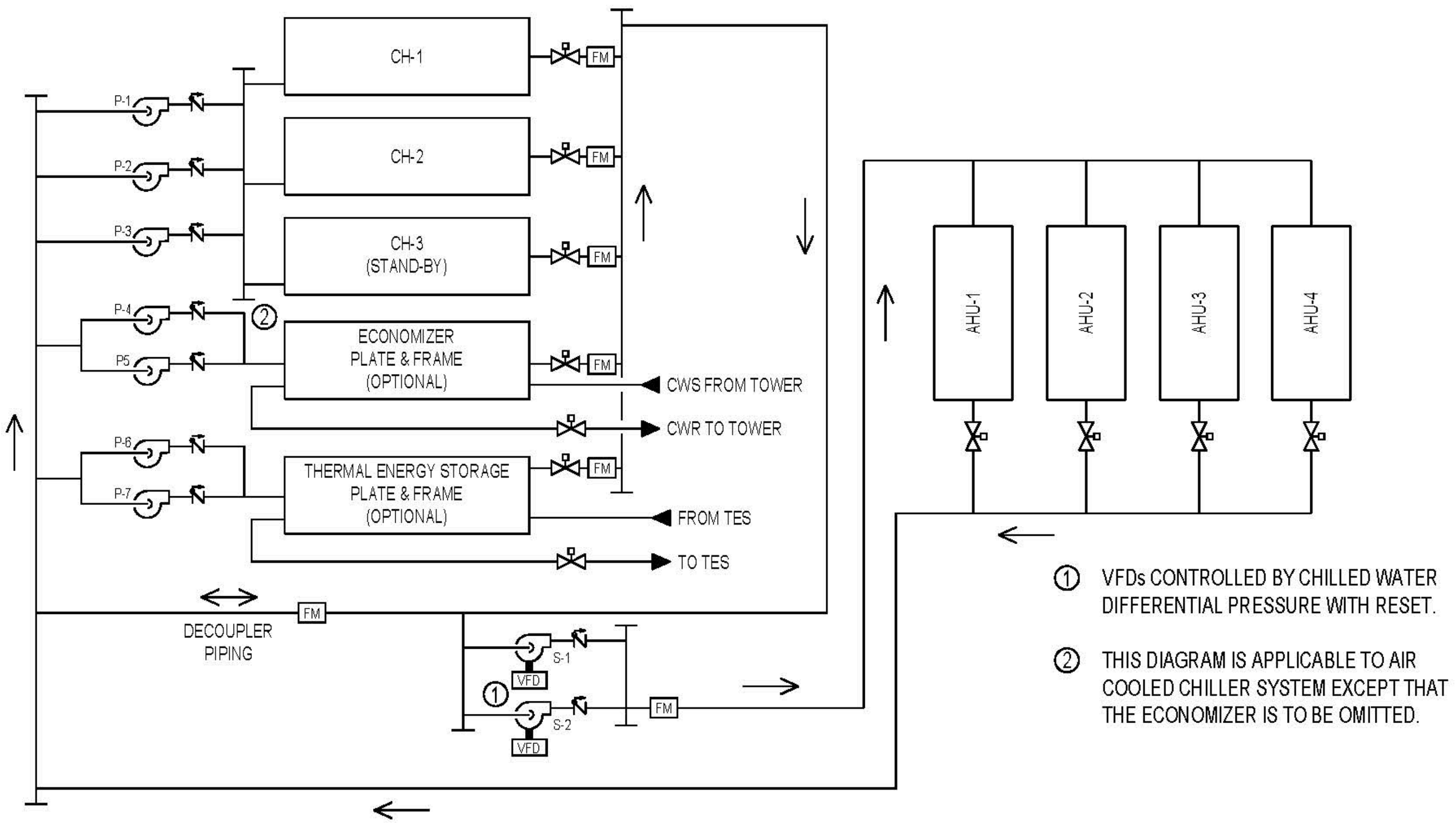
For closed-loop hydronic chilled water, heating hot water, and glycol/hot water systems, pipe sizing is based on ASHRAE Handbook of Fundamentals 2013, Chapter 22 Pipe Sizing. Select pipe shall not exceed maximum fluid velocity or maximum pressure drop.

Table 4-3: STEAM PIPING SIZING CRITERIA

Pipe Type and Size	Maximum Total System Pressure Drop (% of system pressure)	Maximum Friction Rate	Maximum Velocity
High Pressure Steam - Supply Any Size	10%	2.0 psig/100 ft	7,200 fpm [36.6 m/s]
Medium Pressure Steam - Supply Any Size	20%	2.0 psig/100 ft	7,200 fpm [36.6 m/s]
Low Pressure Steam- Supply Any Size	25%	1.0 psig/100 ft	7,200 fpm [36.6 m/s]
High Pressure Steam - Condensate Any Size	2%	1.0 psig/100 ft	7,000 fpm [35.6 m/s]
Medium Pressure Steam - Condensate Any Size	4%	0.25 psig/100 ft	7,000 fpm [35.6 m/s]
Low Pressure Steam - Condensate Any Size	6%	0.0625 psig/100 ft	7,000 fpm [35.6 m/s]
Pumped Condensate Any Size	N/A	4.0 ft WG/100 ft	10.0 fps [3.0 m/s]

HVAC DESIGN MANUAL

CHAPTER 4
FIGURE 4-1



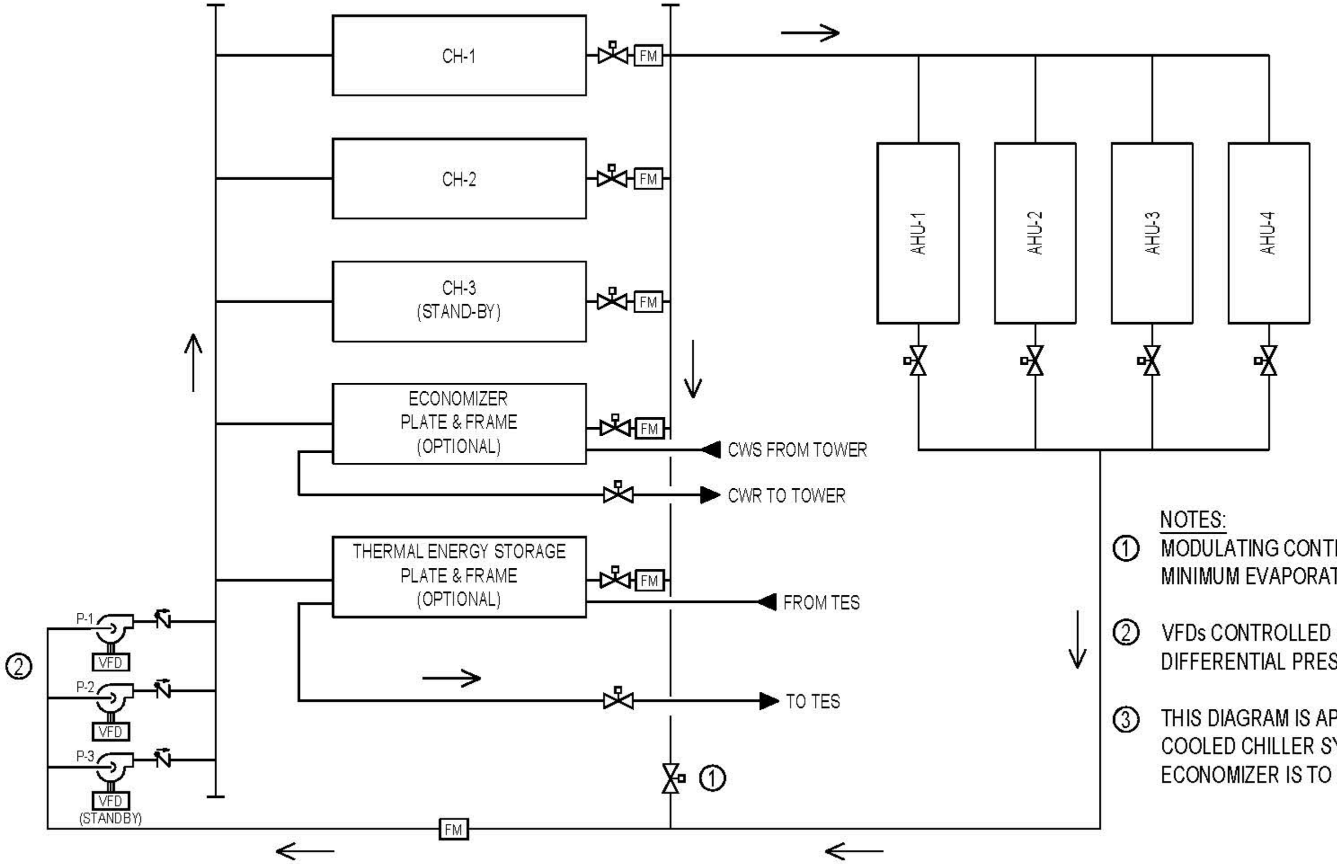
① VFDs CONTROLLED BY CHILLED WATER DIFFERENTIAL PRESSURE WITH RESET.

② THIS DIAGRAM IS APPLICABLE TO AIR COOLED CHILLER SYSTEM EXCEPT THAT THE ECONOMIZER IS TO BE OMITTED.

CHILLED WATER PRODUCTION AND DISTRIBUTION - PRIMARY - SECONDARY SYSTEM (PSS)

Not to Scale

HVAC DESIGN MANUAL
CHAPTER 4
FIGURE 4-2



NOTES:

① MODULATING CONTROL VALVE TO MAINTAIN MINIMUM EVAPORATOR FLOW.

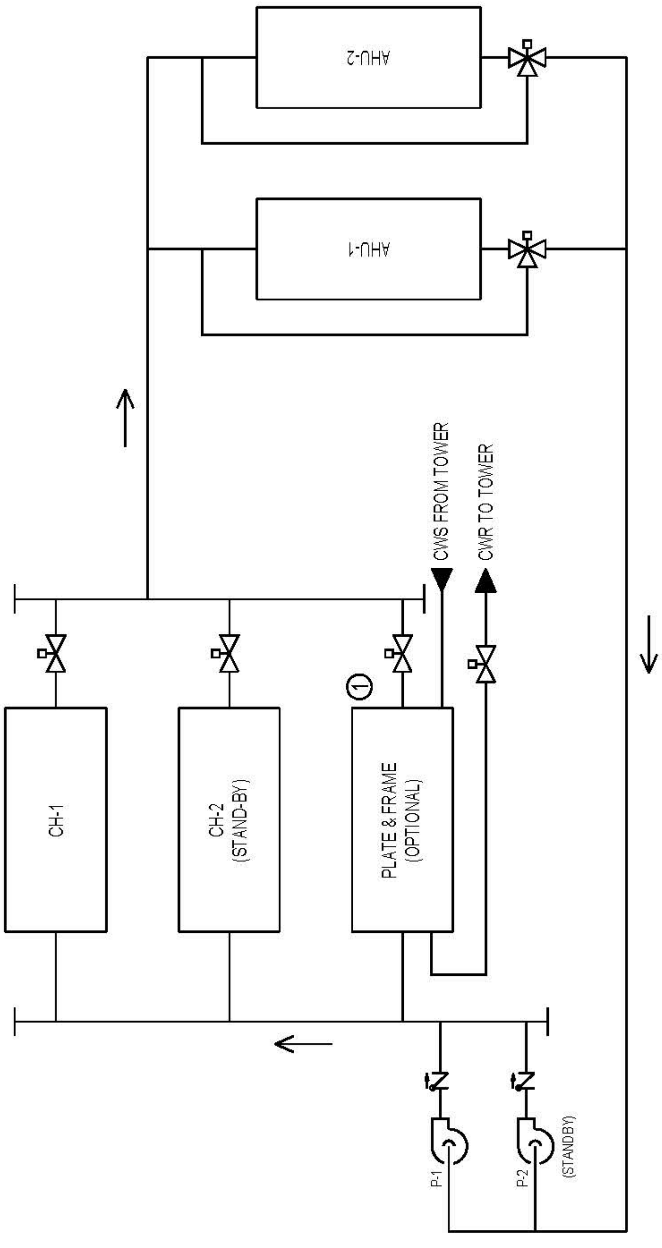
② VFDs CONTROLLED BY CHILLED WATER DIFFERENTIAL PRESSURE WITH RESET.

③ THIS DIAGRAM IS APPLICABLE TO AIR COOLED CHILLER SYSTEM EXCEPT THAT THE ECONOMIZER IS TO BE OMITTED.

CHILLED WATER PRODUCTION AND DISTRIBUTION - VARIABLE PRIMARY SYSTEM (VPS)

Not to Scale

HVAC DESIGN MANUAL
CHAPTER 4
FIGURE 4-3

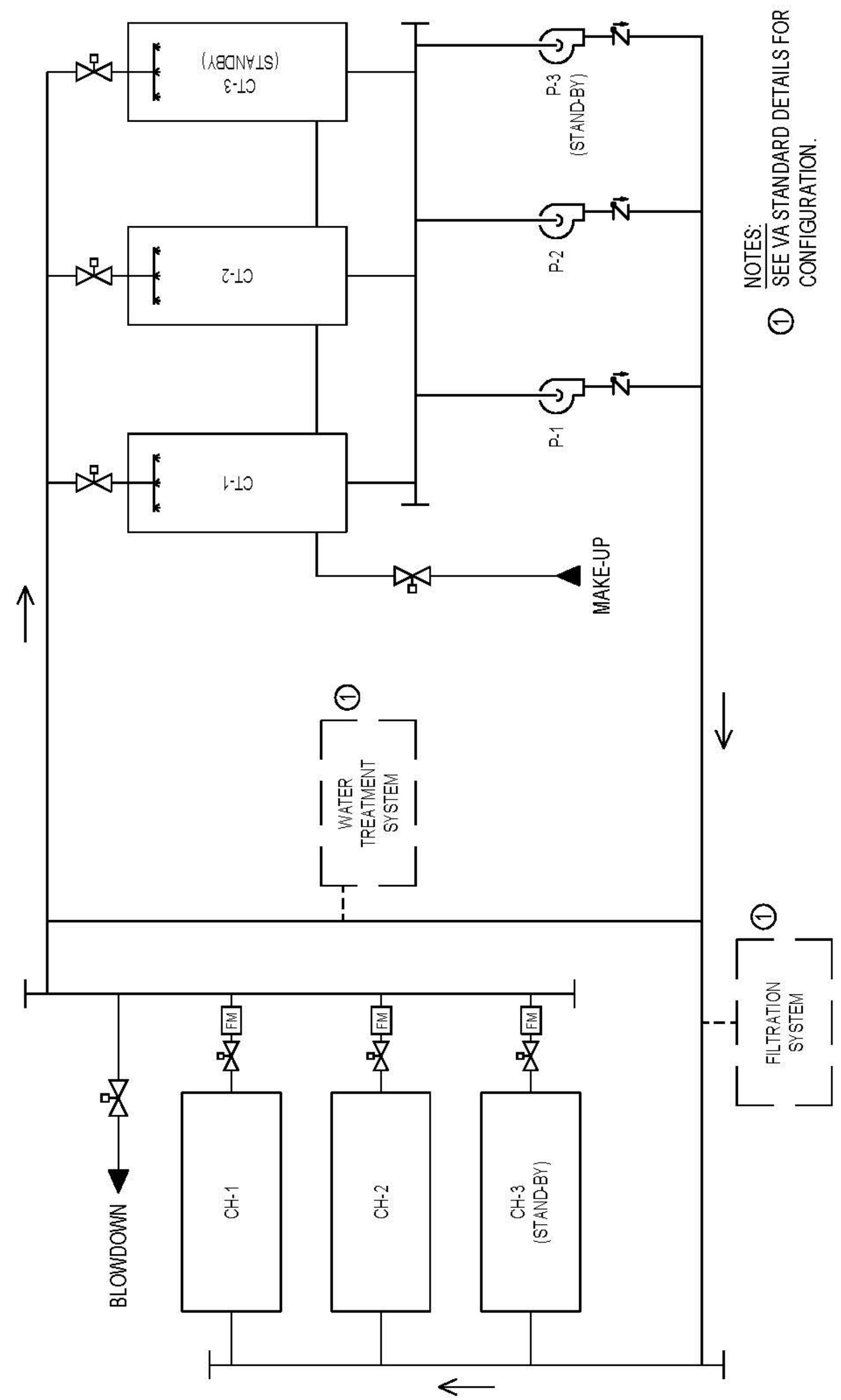


NOTES:
① THIS DIAGRAM IS APPLICABLE TO AIR COOLED CHILLER SYSTEM WITH ECONOMIZER OMITTED.

CHILLED WATER PRODUCTION AND DISTRIBUTION - SINGLE CHILLER SYSTEMS, CONSTANT VOLUME

Not to Scale

HVAC DESIGN MANUAL
CHAPTER 4
FIGURE 4-4



COOLING TOWER SYSTEM

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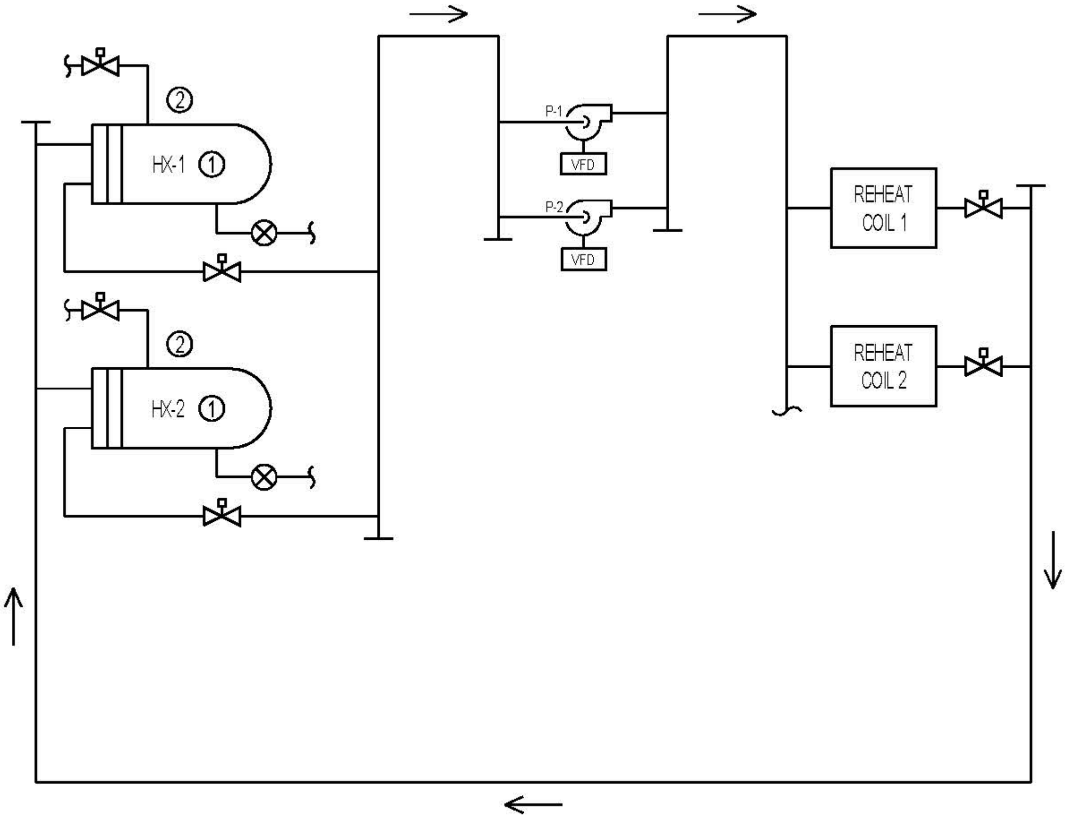
HVAC DESIGN MANUAL

CHAPTER 4

FIGURE 4-5



GENERAL NOTES

A. PROVIDE VFDs FOR 10HP AND LARGER PUMPS. VFDS SHALL BE CONTROLLED BY AHU HOT WATER CONTROL VALVE POSITION OR DIFFERENTIAL PRESSURE ASSEMBLY (NOT SHOWN).

B. PROVIDE EITHER 3-WAY VALVES OR BYPASS FOR MINIMUM FLOW CONTROL.

C. PROVIDE GLYCOL WHEN USE IN PREHEAT COILS AND HEATING DESIGN DRY BULB TEMPERATURE <25°F [-3.9C].

NOTES

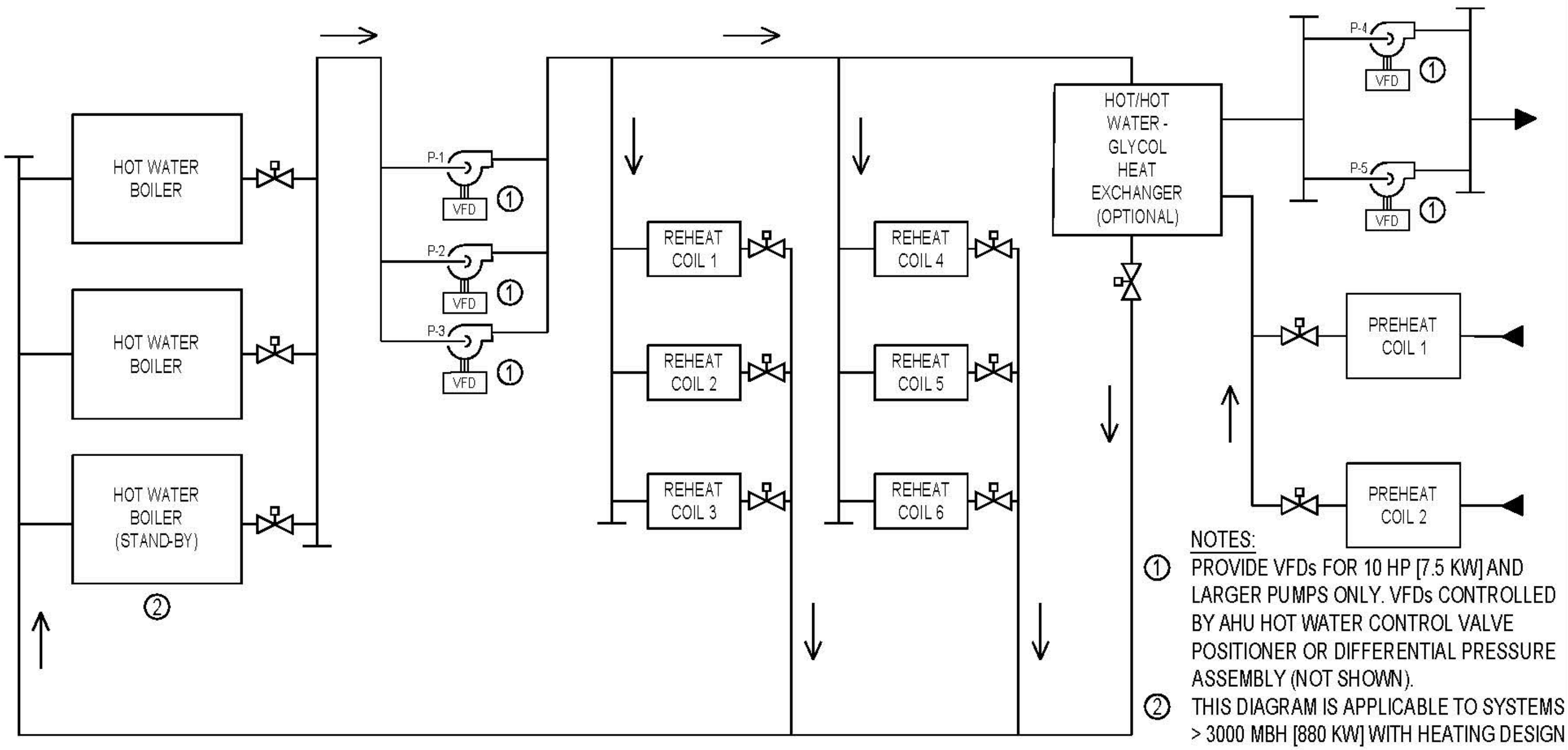
① PROVIDE 100% REDUNDANT HX.

② SEE DETAIL HEAT EXCHANGER - STEAM TO HOT WATER FOR DETAIL OF STEAM PIPING.

STEAM TO HOT WATER HYDRONIC HOT WATER DISTRIBUTION

Not to Scale

HVAC DESIGN MANUAL
CHAPTER 4
FIGURE 4-6



NOTES:

① PROVIDE VFDs FOR 10 HP [7.5 KW] AND LARGER PUMPS ONLY. VFDs CONTROLLED BY AHU HOT WATER CONTROL VALVE POSITIONER OR DIFFERENTIAL PRESSURE ASSEMBLY (NOT SHOWN).

② THIS DIAGRAM IS APPLICABLE TO SYSTEMS > 3000 MBH [880 KW] WITH HEATING DESIGN DRY BULB TEMPERATURE < 25° F [-3.9 C].

HYDRONIC HOT WATER DISTRIBUTION

Not to Scale

APPENDIX 4-A: PROPYLENE GLYCOL – WATER SOLUTION

4-A.1 GENERAL

Every attempt shall be made to avoid the use of propylene glycol in chilled water and heating water systems to include protection of piping within building envelope, use of additional pipe insulation, heat tracing of piping, circulation of fluid during freezing weather, or a combination of the above. If the above measures are deemed too risky propylene glycol may be used in accordance to this appendix. Additionally, low temperature brine systems; ice storage systems; and run-around loop energy recovery systems in regions where freeze danger exist shall use propylene glycol solution where heat transfer applications require lower freezing temperature than water. The primary application for the addition of propylene glycol is for freeze protection.

Propylene glycol is less toxic than the commonly used ethylene glycol.

4-A.1.1 SELECTION CRITERIA

(a) **Hot Water Freeze Protection:**
The freezing point of the glycol solution shall be at least 5 F [3 C] lower than the anticipated ambient temperature to prevent the formation of crystals. The anticipated ambient temperature shall be the minimum annual extreme daily temperature for the location. See Chapter 7 for this temperature.

(b) **Chilled Water Freeze Protection:**
The freezing point of the glycol solution shall be at least 5 F [3 C] lower than the anticipated ambient temperature to prevent the formation of crystals. The anticipated ambient temperature shall be the minimum annual extreme daily temperature for the location. See Chapter 7 for this temperature.

(c) **Thermal Energy Storage (Ice) Systems:**
Consult the tank and chiller manufacturer for glycol correction sizing information and direction.

(d) **Run-around Loop Exhaust Air Energy Recovery:**
The freezing point of the glycol solution shall be at least 5 F [3 C] lower than the anticipated ambient temperature to prevent the formation of crystals. The anticipated ambient temperature shall be the minimum annual extreme daily temperature for the location. See Chapter 7 for this temperature

(e) The glycol solution shall be inhibited for corrosion control.

(f) Verify the water quality based on a site water sample to ensure compliance with the following guidelines:
- Less than 500 ppm calcium and magnesium in chemicals (chloride and sulfate)
- Less than 25 ppm of chloride and sulfate
- Less than 100 ppm (5 grains) of total hardness
- Less than 100 ppm dissolved solids

Use of distilled or deionized water shall be blended with municipal water if required to meet the standards above.

4-A.1.2 COIL FREEZE PROTECTION

To determine the required concentration of propylene glycol, the designer shall compare the freezing temperature of the solution and the selection criteria above. The solution can be expressed by weight or volume, almost interchangeably, as the difference is negligible. The freeze point of propylene glycol is listed below:

Table 4-A1 –PROPYLENE GLYCOL PROPERTIES
(From ASHRAE Fundamentals – 2013)

Percentage Concentration by Volume	Freezing Temperature F [C]
0%	32 [0.0]
10%	26 [-3.0]
20%	19 [-7.0]
30%	9 [-13.0]
40%	-6 [-21.0]
50%	-28 [-33.0]

4-A.1.3 PROPYLENE GLYCOL PROPERTIES

The properties of propylene glycol are shown in the following table:

Table 4-A2 – PROPERTIES OF PROPYLENE GLYCOL SOLUTIONS
(From ASHRAE Fundamentals – 2013)

Percentage Concentration by Volume	Density* lb/cf [kg/m^3] 25-45 F [-4-7 C]	Density* lb/cf [kg/m^3] 120-160 F [49-71 C]	Thermal Conductivity Btu-ft/h- sf –F [W/m-C] 25-45 F [-4-7 C]	Thermal Conductivity Btu-ft/h- sf –F [W/m-C] 120-160 F [49-71 C]
0%	63.38 [1015]	62.28 [998]	0.298 [0.515]	0.338 [0.584]
10%	64.14 [1027]	62.85 [1007]	0.267 [0.462]	0.301 [0.521]
20%	64.79 [1038]	63.33 [1014]	0.240 [0.415]	0.268 [0.463]
30%	65.35 [1047]	63.74 [1021]	0.214 [0.370]	0.237 [0.410]
40%	65.82 [1054]	64.06 [1026]	0.191 [0.330]	0.209 [0.361]
50%	63.38 [1015]	62.28 [998]	0.298 [0.515]	0.338 [0.584]

Table 4-A2 – PROPERTIES OF PROPYLENE GLYCOL SOLUTIONS (continued)

Percentage Concentration by Volume	Specific Heat Btu/lb-F [J/kg-C] 25-45 F [-4-7 C]	Specific Heat Btu/lb-F [J/kg-C] 120-160 F [49-71 C]	Viscosity cP [Pa-s] 25-45 F [-4-7 C]	Viscosity cP [Pa-s] 120-160 F [49-71 C]
0%	0.966 [4042]	0.985 [4121]	2.80 [$2.80*10^{-3}$]	0.75 [$0.75*10^{-3}$]
10%	0.938 [3920]	0.965 [4038]	4.23 [$4.23*10^{-3}$]	0.97 [$0.97*10^{-3}$]
20%	0.906 [3782]	0.939 [3929]	7.47 [$7.47*10^{-3}$]	1.30 [$1.30*10^{-3}$]
30%	0.868 [3623]	0.908 [3799]	13.20 [$13.20*10^{-3}$]	1.71 [$1.71*10^{-3}$]
40%	0.825 [3443]	0.871 [3644]	19.66 [$19.66*10^{-3}$]	2.36 [$2.36*10^{-3}$]
50%	0.966 [4042]	0.985 [4121]	2.80 [$2.80*10^{-3}$]	0.75 [$0.75*10^{-3}$]

* For pump power calculations, specific gravity is the density of propylene divided by density of water

4-A.2 PUMP SELECTION

4-A.2.1 STEP 1: EQUIPMENT FLOW RATE AND HEAD

Propylene glycol, more viscous and less thermally efficient than water, requires different considerations when using standard pump selection data. Furthermore, propylene and ethylene glycol have very different properties and cannot be interchanged.

The designer shall consult the manufacturers of coils, chillers and heat exchangers to determine flow and head requirements of the equipment at the specified glycol percentage and temperature. The equipment manufacturer shall select equipment to account for specific heat, thermal conductivity and viscosity effects of the glycol solution. The designer shall coordinate with the manufacture to optimize the equipment selection to maximize the water/glycol mixture temperature differential and minimize the increase in flow rate.

4-A.2.2 STEP 2: HEAD CORRECTION DUE TO VISCOSITY

A correction is applied to account for the increased viscosity of the propylene glycol solution. This correction factor is applied to pipe, valves and fitting pressure drop only and changes the required pump head. The manufacturer's flow rates at the specified glycol percentage are used when determining the initial pressure drop in the piping system. The designer shall use the correction factors from Table 4-A3 when calculating the viscosity correction. The designer shall indicate the corrected values (GPM, WPD, APD, EWT, LWT) on the HVAC Equipment schedules. Provide appropriate notes.

The head correction required due to flow increases provided by the manufacturer's equipment selection may be excessive and the designer shall evaluate increasing the pipe size to reduce the pressure drop. Maximum fluid velocity and maximum pressure drop criteria for pipe sizing shall conform to Chapter 4 requirements.

Note that operating temperatures above 160 F [71 C] does not require head correction due to the effects of viscosity.

Table 4-A3 – EFFECT OF PROPYLENE GLYCOL SOLUTIONS
(From ASHRAE HVAC Systems and Equipment – 2016)

Percentage Concentration by Volume	Changes Due To Viscosity Coefficient Head Increase 25-45 F [-4-7 C]	Changes Due To Viscosity Coefficient Head Increase 120-160 F [49-71 C]
10%	1.08*	0.90
20%	1.14*	0.95
30%	1.27*	0.97
40%	1.45	1.00
50%	1.60	1.03

* Used for low temperature chilled water.

4-A.2.3 STEP 3: POWER CORRECTION DUE TO VISCOSITY

The final correction factor is applied to account for the change in pump power requirements. To find that correction, the designer shall refer to Hydraulic Institute Standard 9.6.7, Rotodynamic Pumps – Guidelines for Effects of Liquid Viscosity on Performance, 2015. It is the Design Professional's responsibility to consult the standard to determine the correction factor for pump efficiency due to changes in viscosity.

4-A.3 SAMPLE PUMP SELECTION – WITH PROPYLENE GLYCOL SOLUTION

Application 1 – Chilled Water Freeze Protection

A simple, all-water example follows:

A chiller and an air handling unit chilled water coil are connected by pipe and a water-based pump operating under conditions of:

200 gpm [12.6 L/s]

70 ft [209 kPa] total head

40 ft [120 kPa] head due to pipe, valves and fittings

30 ft [90 kPa] head due to equipment

40 F [4 C] fluid temperature

5.0 bhp [3.7 kW] and 71% efficiency pump

Specific gravity = 1.0

The equipment is a chiller and an air handling unit chilled water coil.

Determine the operating values of the same system if the fluid is changed to a solution of 40% glycol by volume.

Step 1:

Manufacturers are consulted and the chilled water coil requires 300 gpm [18.9 L/s] and 22 ft [66 kPa] head and the chiller evaporator pressure drop at 300 gpm is 28 ft [84 kPa] when using 40% glycol.

Step 2:

Using the pump affinity laws, correct the pipe, valves and fittings head for the new flow rate. At 300 gpm, the new head is 90 ft [269 kPa]

Total Dynamic Head Correction (due to viscosity increase) = 90 x 1.45 = 131 ft of water [390 kPa].

Resultant Pumping Power Required:

$$P = \frac{\text{flow (gpm) x head (ft of water) x specific gravity (unitless)}}{\text{3960 x pump efficiency (unitless)}}$$

$$P = \frac{300 \times (22+28+131) \times 1.046}{3960 \times 0.71} = \text{20.2 bhp [15.1 kW]}$$

Step 3:

Pump Efficiency Correction (due to viscosity increase from Table 4-A3) = 0.93* x 0.71 = 0.66

* Value found from Hydraulic Institute Standard 9.6.7 Rotodynamic Pumps – Guidelines for Effects of Liquid Viscosity on Performance, 2015.

Resultant Pumping Power Required:

$$P = \frac{300 \times 181 \times 1.046}{3960 \times 0.66} = \text{21.7 bhp [16.2 kW] for 40\% by volume glycol solution}$$

Table 4-A4 – SUMMARY RESULTS, TYPICAL EXAMPLE

Items	Water	Propylene Glycol – Water Solution 40% by Volume 40 F [4.4 C]
Flow Rate	200 gpm [12.6 L/s]	300 gpm [18.9 L/s]
Head	70 ft of water [209 kPa]	181 ft of water [541 kPa]
Power	5.0 bhp [3.7 kW]	21.7 bhp [16.2 kW]

Application 2 – Heating Hot Water Freeze Protection

A simple, all-water example follows:

A steam to hot water heat exchanger and an air handling unit hot water coil are connected by pipe and a water-based pump operating under conditions of:

40 gpm [2.5 L/s]

30 ft [90 kPa] total head

20 ft [60 kPa] head due to pipe, valves and fittings

10 ft [30 kPa] head due to equipment

140 F [60 C] fluid temperature

0.75 bhp [0.56 kW] and 50% efficiency pump

Specific gravity = 1.0

The equipment is a steam to hot water heat exchanger and an air handling unit hot water coil.

Determine the operating values of the same system if the fluid is changed to a solution of 40% glycol by volume.

Step 1:

Manufacturers are consulted and the hot water coil requires 50 gpm [3.2 L/s] and 4 ft [12 kPa] head and the heat exchanger pressure drop at 50 gpm is 10 ft [30 kPa] when using 40% glycol.

Step 2:

Using the pump affinity laws, correct the pipe, valves and fittings head for the new flow rate. At 50 gpm, the new head is 31 ft [93 kPa]

Total Dynamic Head Correction (due to viscosity increase) = 31 x 1.00 = 31 ft of water [93 kPa].

Resultant Pumping Power Required:

$$P = \frac{\text{flow (gpm) x head (ft of water) x specific gravity (unitless)}}{\text{3960 x pump efficiency (unitless)}}$$

$$P = \frac{50 \text{ x } (4+10+31) \text{ x } 1.046}{3960 \text{ x } 0.50} = 1.19 \text{ bhp [0.89 kW]}$$

Step 3:

Pump Efficiency Correction (due to viscosity increase from Table 4-A3) = 1.00* x 0.50 = 0.50

* Value found from Hydraulic Institute Standard 9.6.7.

For hot water applications, pump efficiency is not generally penalized due to viscosity. It is the designer’s responsibility to confirm the correction factor Hydraulic Institute Standard 9.6.7, Rotodynamic Pumps – Guidelines for Effects of Liquid Viscosity on Performance, 2015.

Table 4-A5 – SUMMARY RESULTS, TYPICAL EXAMPLE

Items	Water	Propylene Glycol – Water Solution 40% by Volume 140 F [60 C]
Flow Rate	40 gpm [2.5 L/s]	50 gpm [3.2 L/s]
Head	30 ft of water [90 kPa]	45 ft of water [135 kPa]
Power	0.75 bhp [0.56 kW]	1.19 bhp [0.89 kW]

Application 3 – Thermal Storage System (Ice)

For thermal energy storage (ice) systems, consult the tank and chiller manufacturer for glycol correction sizing information and direction.

4-A.4 NOTES TO BE ADDED TO EQUIPMENT SCHEDULES

(a) **Pumps**
For pumps using an aqueous solution of water and glycol, the designer shall add a remark that "Pump corrections have been applied" after calculating the appropriate correction factors. This remark shall be located on the pump equipment schedule.

(b) **Coils, Chillers, Heat Exchangers**
For coils, chillers and heat exchangers using an aqueous solution of water and glycol, the manufacturer shall increase the heat transfer surfaces to account for the percentage of glycol. The GPM, EWT, LWT and WPD indicated on the schedule shall be shown for the solution indicated, and not pure water. A remark shall be added that "Coil corrections have been applied for GPM, WPD, APD, EWT and LWT for the solution shown" (substitute chiller or heat exchanger as required) on the schedule.

Chapter 5: HVAC CONTROL SYSTEMS

5.1 GENERAL

(a) This chapter covers the design of building HVAC Control Systems. The intent is to provide suitable, compatible and uniform design throughout the campus.

(b) Provide Direct Digital Control (DDC) system(s) for new buildings, building additions, minor and major renovations of existing facilities, and HVAC system replacements and upgrades. The DDC system will monitor and control the HVAC, system and monitor Legionella data point. Coordinate the design work with specifications, VA Standard Details, and Chapter 6 (Applications).

(c) The HVAC control system shall be configured as a network with control functions and points at multiple levels. The controllers shall perform local control functions and execute application programs without requiring communications with the central server or workstation.

(d) The designer shall meet with the local VA Medical Center Representative to discuss and establish the level of integration between the following building systems as a minimum:

- Central Chilled Water Plant
- Central steam or hot water plant
- HVAC systems
- Monitoring of Legionella monitoring points
- Fire alarm system.

(e) The new DDC system shall be designed to include sufficient capacity for future system growth as determined by the VA Medical Center Representative. This additional capacity shall include initial additional spare control points and controllers, as well as expandability of the new control panels.

(f) The designer shall also coordinate with the local VA Medical Center Representative and Office of Information and Technology (OIT) Manual Requirements, and as a minimum develop the following:

- DDC system infrastructure schematics, including location and quantity of operator interfaces, and stationary and portable operator workstations.
- Detailed and project specific sequence of operations, including all modes of operation such as normal, during and after power outage, and fire emergencies.
- Complete list of all control input and output (I/O) points
- Valve schedules
- Control point naming conventions
- Equipment numbering conventions
- Graphic formats and layouts
- Required level of user access
- Preferred or standardized local control sequences
- Level of integration and compatibility between new and existing systems
- Trending capability requirements
- Location of all local and main control panels, including those located above ceilings.

- Level of DDC system redundancy for critical spaces such as biocontainment, isolation suites, animal facilities, and surgical suites.
- Commissioning requirements
- Type and location of training requirements
- Warranty period and maintenance requirements.

(g) The requirements of this chapter to use DDC controls shall be mandatory on all projects as the use of pneumatic control systems and analog electronic control systems is prohibited except in the case of minor repairs to keep existing pneumatic and analog electronic systems operating.

(h) As indicated in the paragraphs below, the implementation of DDC HVAC control systems is complex for multiple reasons. There are numerous vendors, some vendors manufacturer multiple systems using different protocols and even within one vendor's protocol there exist different options in implementation. The procurement (contracting) process also has options (sole source, restricted competitive, fully open, etc.) that contribute to the complexity and overall control systems operation. Therefore, each medical center is strongly encouraged to share, or develop and share if not available, specific local guidance with all A/E's together with VA OIT, VHA and CFM at project kick off. The designer shall seek guidance as a minimum on the following information if any hardware or/and software used shall be approved by OIT:

- Local procurement method for HVAC controls. If restricted in any way the guidance should list qualified manufacturers and communications protocols.
- If procurement includes an integrator separate from the controls contractor this company and its POC shall be provided in the specifications.
- Type of engineering control center (ECC) used – WEB based or fixed locations.
- LAN to be used. Is it the VA Ethernet or a separate LAN for the control system alone?
- Samples of local control system graphics of every type and require submittal of graphics for approval during construction.
- Preferred control sequences. Determine if the Medical Center has specific control sequence they standardize on and use them as a beginning template for the current work.

(i) Project Scope Options: The A/E shall cooperate with the local engineering, contracting, and HVAC maintenance staff to determine the appropriate DDC controls strategy used at the facility and shall tailor the construction documents based on one of the following options:

- Option 1 - Upgrade the ECC and existing DDC control system to a new BACnet compatible control system; provide new controllers as required for new scope of work.
- Option 2 - Upgrade ECC; provide new controllers as required for new scope of work, utilize BACnet gateway for communication to existing DDC system.
- Option 3 - Provide new BACnet compatible control system for new scope of work; existing DDC or pneumatic system to remain.

- Option 4 - Install new BACnet software package to existing ECC; install BACnet controllers for new scope of work and existing DDC system is to remain.
- Option 5 - Integrate new scope of work into existing DDC system (same manufacturer).

(j) LAN Options: If the LAN to be used has not yet been established the options are to provide a local controls LAN or place the controls on the VA Ethernet. Both options are currently used within the VA. While some vendors prefer to have a controls system LAN that option is usually more costly, more proprietary, less reliable and less secure. By placing the DDC control system server in the medical centers main server room the protection of the server is enhanced, it is upgraded regularly, backed up regularly, provided with UPS power, with network security, and with physical security. By placing the control system on the VA Ethernet the overall project cost is reduced.

(k) ECC Options: If the type of ECC to be used has not yet been established the options are WEB based ECC accessible with WEB Browser software or fixed location ECC (one or more) such as at the boiler plant, HVAC shop etc. While it is important to maintain at least one fixed ECC location for alarm response at the boiler plant, fixed locations are generally less useful because they require that a maintenance staff member responding to a trouble call get in contact by radio or telephone with the operator at the ECC while that person remotely accesses the system. WEB Browser ECC on the other hand is accessible through any PC on the LAN so that a technician responding to an issue can access the ECC through any computer at the location of the trouble.

(l) Control Sequence Options: There are too many control sequence options to be listed herein. Some options are more reliable and/or more effective than others. The recommended approach is to use sequences that are well understood by the local technicians and standardize on these.

(m) On additions and renovations where the existing ECC remains, the interface with the existing ECC shall be seamless. The system shall include a personal computer (PC), laptop computers, color printer, distributed DDC controllers, panels, sensors, switches, alarms, flowmeters, relays, control valves and dampers, wiring, system graphics, control sequences, interface devices and all required accessories to make a complete and workable system.

(n) Use of DDC controls shall result in energy efficient operation and help achieve the mandated goal of energy conservation, described in Chapter 1.

5.2 BASIC DESIGN NEW STANDALONE FACILITY

(a) On a standalone new facility such as a replacement hospital not associated to a larger campus or outpatient clinic where there are no considerations to connect to any existing DDC control infrastructure the system shall be designed using the most advantageous system options following VA manual and guidelines.

(b) The controls shall reside on the VA Ethernet LAN and the controls system server shall be located in the medical center’s main computer room.

(c) The communications protocol shall be native BACnet without use of integration hardware or software.

(d) The ECC shall be web based accessible through pass word protected Web browser application accessible through selected PC on the VA LAN.
(e) Control sequences shall be standardized for every specific type of system at the same VA facility.

The A/E shall generate a project specific local DDC controls manual containing all the standard control sequences used in the project. This document shall be provided to the VA in electronic MS Word format and in a bound printed hard copy.

5.3 BACNET CONTROLLER IDENTIFICATION

B-AWS	BACnet Advanced Workstation
B-BC	BACnet Building Controller
B-AAC	BACnet Advanced Application Controller
B-ASC	BACnet Application Specific Controller

5.4 BASIC DESIGN ALL PROJECTS INTEGRATING TO EXISTING DDC SYSTEMS

On projects that require integrating the new control systems to existing DDC systems the A/E shall first refer to the local-medical center-specific-DDC-controls guide to determine the local strategies. If such a guide has not been developed, the A/E shall collaborate with the local VA engineering and maintenance staff together with the PM and central office recommendations to determine which of the following options is most advantageous for the specific project.

5.4.1 OPTION 1

Replace existing ECC with new BACnet Engineering Control Center (B-AWS), replace all existing DDC controllers with new BACnet controllers, install new BACnet communication network, install new building (B-BC) and equipment controllers (B-AAC, B-ASC) as required for new scope of work.   Provide new portable operators terminal.

5.4.2 OPTION 2

Replace existing ECC with new BACnet Engineering Control Center (B-AWS), install new BACnet gateway with full communication to existing controllers, install new BACnet communication network, install new building (B-BC) and equipment controllers (B-AAC, B-ASC) as required for new scope of work.   Provide new portable operator’s terminal.

5.4.3 OPTION 3

Install new BACnet Engineering Control Center (B-AWS). Install new building (B-BC) and equipment controllers (B-AAC, B-ASC) as required for new scope of work.   Provide new portable operator’s terminal. Existing ECC, associated communication network and controllers to remain.

5.4.4 OPTION 4

Install new BACnet software on existing ECC which shall co-exist with current ECC operation software package, existing communication network to be re-used, install new building (B-BC) and equipment controller's (B-AAC, B-ASC) as required for new scope of work. Provide new portable operator's terminal.

5.4.5 OPTION 5

Integrate new scope of work into existing DDC system (same manufacturer). This option will require sole source procurement with approval from VHA central office.

5.5 SPECIFIC REQUIREMENTS

5.5.1 CONTROL ACTUATORS

Automatic control valves and dampers shall be equipped with electric actuators. The use of pneumatic actuators is prohibited except that replacement pneumatic actuators or actuator re-build kits may be used to repair existing pneumatic actuators that have failed.

Coordinate with specifications and specify actuators with non-powered spring return position to pre-determined condition either normally open (NO), or normally closed (NC). In general, the use of floating control type actuators that do not have a normal position to which they return on power loss shall not be allowed except in specific applications where actuator failure has no significant detrimental consequences. In all other cases actuators NO or NC shall be selected and indicated in the control schematics. The specific selection shall be made to mitigate the consequences of control power failure. For example in a 100% outside air unit in a northern location such as Augusta, Maine the heating coil valve shall be NO (fail open) and the cooling coil valve NC. In Miami, Florida where humidity would cause a disturbance the normal coil positions would be NO (fail open) for cooling and NC for heating. Actuators serving spaces with controlled pressurization shall be fast acting type as specified in Section 23 36 00 Air Terminal Units under air flow control valves.

5.5.2 CONTROL VALVES

Coordinate the selection of control valves with the specifications. Equal percentage type valves shall be used on all modulating services controlling water flow, linear flow type valves shall be used on all modulating services controlling steam flow. Specify bubble tight shutoff against 1.5 times design pressure. Utilize two-way, modulating control valves to the greatest extent possible, and provide 3-way valves or bypass legs at dead end conditions to maintain minimum required flow and to prevent loss of temperature. Schedule or specify acceptable Cv range for each valve taking into consideration acceptable valve authority at the high end of the Cv range and pump total dynamic head calculations at the low end of the range. Specify non-modulating (on/off) valves for durability, bubble tight shutoff, and specify with opened and closed verification end switches. Ensure end switch inputs are listed in the points list and referred to in the control sequence. At the very minimum incorrect end switch positions should generate an alarm condition.

5.5.3 CONTROL DAMPERS

Coordinate the selection of control dampers with specifications. Select airfoil-type control dampers with blade and edge seals to minimize air leakage while in the shutoff position. All modulating dampers shall be of the opposed blade configuration. All on/off dampers may be of the parallel blade configuration and should be equipped with end switches to verify fully open and fully closed position. Ensure end switch inputs are listed in the points list and referred to in the control sequence. At the very minimum incorrect end switch positions should generate an alarm condition. Show all damper sizes on the mechanical equipment floor plans and section drawings. For modulating dampers the engineer shall determine the damper size for proper control authority and shall account for the resultant pressure loss in the fan pressure calculations. On all systems requiring air side economizer the system design shall include a minimum outside air control damper and a separate economizer outside air control damper.

5.5.4 END-SWITCHES

Provide end-switches on all on/off valves and dampers such as 100% outdoor air dampers, duct-mounted smoke dampers, and blocking valves on chillers, cooling towers, and heat exchangers. Ensure end-switch inputs are listed on controls point list and are referred to on control sequences. End switches shall be used to verify valve and damper status, generate alarms when actuators are not in the correct position, to eliminate the possibility of operating fans and motors against dead head or dead suction conditions, and to ensure equipment switch overs occur without flow interruption, i.e. verify the lag heat exchangers valves are open before beginning to close the lead heat exchanger blocking valves.

5.5.5 SAFETIES AND SAFETY ALARMS

Design the use of safeties and safety alarms in all instances where control system failure or other failure can cause equipment or system damage or yield uncomfortable or unhealthy conditions for building occupants. Provide hard-wired interlocked connections for all safety devices. All safety devices shall be provided with additional dry contacts and shall be connected to the DDC system for monitoring, alarming, and other required control system actions. Sensors, including dry contacts such as freeze stats and alarms through the controls software shall not be substitutes for safeties – all safeties shall be hard wired for actions as follow:

(a) Smoke detectors hardwired into fan starter solenoid or VFD emergency shutoff.
(b) General fire alarm contact hardwired into fan starter solenoid or VFD emergency shutoff.
(c) Smoke damper closed end switch hardwired into fan starter solenoid or VFD emergency shutoff.
(d) Unless not possible due to distance provide hardwired interlock between associated fans to ensure all fans shutoff. For example the failure of a supply fan should in most cases necessitate turning off the related return fan.

(e) Duct over-pressure (negative or positive) switch hardwired into fan starter solenoid or VFD emergency shutoff. Provide only where fan size and fan type can cause duct system damage.

(f) Drain pan float switch: Depending on specific case alarm only or alarm and hardwired into fan starter solenoid or VFD emergency shutoff.

(g) Moisture indicators under main computer room floor: Alarm and if available switch computer room unit operation to the standby system(s).

(h) Moisture indicators in other locations: Alarm only or alarm and action as necessary.

(i) Humidifier duct mounted high limit humidistat: Route control signal to normally closed humidifier control valve through normally closed contact of duct mounted high limit humidistat and monitor humidistat status for alarm purposes through normally open contact of humidistat.

(j) Steam to hot water heat exchangers high limit aquastat: Route control signal to normally closed steam control valve through normally closed contact of pipe mounted high limit aquastat and monitor heat exchanger high limit status for alarm purposes through normally open contact on aquastat. Switch to standby heat exchanger if available.

(k) Refrigerant leak detection sensor: Dry contact hard wired to chiller room exhaust fan and air intake louvers. Auxiliary dry contacts to activate sound and visual annunciators in chiller room and outside chiller room personnel doors.

(l) Control system interlock. When a system turns off either due to motor failure or due to occupancy schedule control power shall be removed from all controls to allow actuators to return to their normal position.

5.5.6 CONTROL WIRING

Coordinate with specifications and specify all UL-listed components and wiring installation in accordance with the National Electric Code. All control wiring in interstitial spaces and mechanical rooms, including wiring inside air units shall be installed in electric metallic tubing or conduits. If allowed by the local VA authority identified in Chapter 1 paragraph 1.1, plenum rated control cabling may be used above ceilings. When this is allowed, ensure specifications require the controls contractor to install cabling neatly arranged and properly supported on J hooks or other supports provided for that purpose along above ceiling walls and not on piping, ductwork or other equipment.

5.5.7 AIR FLOW MEASURING STATIONS

Consult local VA project manager and HVAC controls shop to determine type of air flow measuring station (hot wire anemometer array or velocity pressure grid) to be used, then coordinate with the controls specifications. Design ductwork layout to provide air flow measuring station locations with sufficient upstream and downstream straight duct requirements per manufacturer’s recommendations. Define minimum and maximum cfm values for each station and design duct size to ensure minimum and maximum flow ranges fall within the accurate range of the type of measurement technology used.

5.5.8 DDC CONTROL SYSTEM SERVER

If the DDC system requires a server for control system LAN specify a rack mounted server for installation in a rack in the medical centers main server room. Coordinate the requirements with the current state of the art advanced server at the time of design and the minimum requirements detailed by the medical center IT department to ensure the server's compatibility with other components in the system. The A/E shall ensure that all HVAC Controls Software is specified to be DIACAP certified and that submittals include proof of said certification.

5.5.9 ECC PERSONAL COMPUTER (PC) AND PRINTERS

If the project requires a fixed ECC the A/E shall update the computer hardware and software specification paragraphs in Section 23 09 23 to match state of the art PC, drives, RAM, processor, monitors, alarm printer, report printer etc. as required for the specific project. Coordinate with VA project manager to determine if systems furniture is also needed and to determine other software requirements such as word processors, spread sheets, presentation software and type of operating system. Specify all hardware to be Energy Star rated.

5.5.10 LAPTOP COMPUTER

If the project requires a laptop specify a laptop computer similar to the PC above with at least a 19 in [425 mm] color monitor. All laptop computers provided shall be Energy Star rated, coordinate this with the specifications, with the end users and with the local IT department to determine the number of laptop computers required to be provided in the project.

5.5.11 SOFTWARE

Controls system software acquisition will vary greatly depending on the project scope and the status of existing DDC system(s). For new installations specify that the successful controls company shall provide their latest software with all current updates. For projects with existing systems the requirements may range from updating the graphics, to installation of software updates, to complete software replacement. Local VA engineering and maintenance staff and/or local control vendors familiar with the facility will have to be contacted to determine the extent of the work.

5.5.12 COLOR GRAPHICS

For new installation specify a complete dynamic color graphics package on all ECC devices including the server on web based ECC. For additions, alterations, and upgrades to existing systems specify that the graphics shall be updated, all graphics rendered obsolete shall be removed or modified and new graphics shall be added for new systems and equipment. To ensure visual and functional standardization on these types of projects provide samples of existing graphics as guidelines and require that all graphics shall be submitted for VA approval prior to implementation. Graphics shall be provided for each system and subsystem and include all equipment. Graphics shall display values of all variables and all outputs including end switch positions. Graphics shall have full functionality to place control loops and other functions in manual or automatic mode and shall alarm when loops are in manual override.

During manual override graphics shall allow manipulation of actuator positions and shall have hot spot navigation from system to system.

5.5.13 DATA TRENDS

Specify that the system ECC through the system graphics shall allow users and operators the capability to implement data trends on all output and inputs. As a minimum the trends shall allow time of day, day of week scheduling of trends as well as the frequency of data collection. The data output files shall be Microsoft Excel compatible for importing and for data manipulation. See AHU data sheets for specific temperature, pressure, and humidity data logging requirements.

5.5.14 SECURITY

Specify that the system shall have a minimum of three levels of password protection to restrict altering the device setpoints, data trends, schedules, and overrides. The A/E shall ensure that all HVAC Controls Software is specified to be DIACAP certified and that submittals include proof of said certification.

5.5.15 EQUIPMENT STATUS MONITORING

Control system on/off command shall not be used to determine the status of equipment in the system. Design a control system with status feedback on all motors and on other critical devices. The status of motors shall be positively determined through motor current transducers. The status of valves and dampers shall be positively determined through end switches. Flow status in components such as heat exchangers shall be determined through flow switches of differential pressure sensors. Ensure the proper devices are selected to avoid false alarm conditions.

5.5.16 ROOM TEMPERATURE SENSORS

Specify commercial grade room temperature sensors with programmable temperature adjustment limits and night setback push button override capabilities. Specific sensor tolerances should be noted in project specifications. Indicate room temperature sensor locations on contract documents and select locations based on proper control function and not on convenience to wire chases, or aesthetics. Sensors shall not be placed on exterior walls or on partitions between the conditioned space and adjacent non conditioned space. Sensors locations shall be coordinated with existing furniture layout where applicable or proposed furniture layout on new construction and renovations. In some cases, for example in clinical laboratories where heat producing equipment density is so high that few locations are unaffected by heat sources, the engineer should consider wall mounted modules with a remote temperature sensor in the exhaust ductwork. See AHU data sheets for specific temperature, pressure, and humidity data logging requirements.

5.6 HUMIDITY SENSORS

Due to their inherent instability, the use of humidity sensors for control loops should be kept to a minimum. Since in some cases faulty humidity sensors can cause extreme conditions and problems each application should be evaluated for the severity of the problems it may cause and proper precautions such a specifying industrial grade duct and room mounted humidity sensors, accuracy of +/- 2% (0-90%) or dual sensors with an alarm algorithm which indicates if the reading between sensors exceeds a predetermined value. See AHU data sheets for specific temperature, pressure, and humidity data logging requirements

5.6.1 METERING REQUIREMENTS

Coordinate metering requirements, with similar ongoing efforts (if any) at the VA facilities, to ensure seamless integration and avoid duplication. Coordinate the efforts with the VA Master Construction Specification 25 10 10 - Advanced Utility Metering System. Follow the following guidelines when providing utility metering:

- Protect meters from weather – indoor installation is preferred.
- Specify the proper requirements (peak flow, total flow, or both)
- Provide insertion meters with valve insertion point or provide meter bypass to eliminate the need for flow interruption when servicing meters.
- Coordinate with plumbing meters and electrical meters when used.
- Coordinate with VA Medical Center engineers for all sub metering requirements such as submeters for cooling tower, laundry facility and central cage washing equipment makeup water.
- Consult with VA project manager to ensure all metering requirements are addressed.

5.7 SYSTEM APPLICATIONS

5.7.1 GENERAL

Listed below are generic control requirements for various HVAC systems. The list does not cover all control requirements and sub-sequences. Similarly, many control requirements are not applicable in all situations. Using information given below, and other available resources, the A/E shall develop detailed control sequences for all systems. As stated in paragraph 5.1 the A/E and the local VA engineering staff should make every effort to standardize control sequences within in each VA medical center.

5.7.2 AIRSIDE CONTROLS

Airside controls include operation of the air-handling units, exhaust systems, room level controls, and other miscellaneous controls.

5.7.2.1 Air-Handling Units

(a) System Start-Up
(b) Morning Warm-Up Mode

(c) Morning Cool-Down Mode
(d) Unoccupied Mode
(e) Supply Air Temperature Control (include all applicable modes)
  - Heating Mode
  - Mechanical Cooling Mode
  - Economizer Cycle Mode
  - Mechanical Cooling with Economizer Cycle Mode
  - Supply Air Temperature Reset Control, in low humidity locations only.

(f) Freeze Protection Control – Pre-Heat Coil
  - Mixed Air Temperature Control
  - Fan Operation Control
  - Outside Air Damper Control
  - Integral Face and Bypass Preheat Coil Control on 100% Outside Air Systems.

(g) Fan Speed Control – Supply Air Fan
Refer to ASHRAE Standard 90.1-2013 or approved latest edition for mandated static pressure reset control.
(h) Fan Tracking Control – Supply and Return Air Fans
(i) Minimum Ventilation Air – Outdoor Air Control
  - Minimum Outside Air Damper Control.
  - Demand Control Ventilation

(j) Smoke Detector and Smoke Damper Operation
(k) Filter Maintenance Alarm
  - Pre-Filters
  - After-Filters
  - Final-Filters
  - Missing Filter Alarm (on all filter banks)
  - Order Filters Alarm (on all filter banks)

(l) Volumetric Data
  - Supply Air Volume – cfm [L/s]
  - Return Air Volume – cfm [L/s]
  - Minimum Ventilation Air (Outdoor Air) – cfm [L/s]

(m) Energy Recovery System Operation
  - Applicable to 100% Outdoor Air Ventilation Systems
  - Run Around Coil
  - Energy Recovery Coil
  - Plate and Fin Heat Exchangers
  - Energy Recovery Bypass Mode. (For example, air side energy recovery must be bypassed when the air system is operating in air-side economizer mode.)

(n) Humidity Control
  - Humidification Mode with Operating and High-Limit Controls
  - High-Humidity Controls – Mechanical Cooling Mode
  - Regenerated desiccant systems.

(o) Special Systems
- Fume Hoods Exhaust
- Biological Safety Cabinets Exhaust
- Space Pressurization and Air Flow Tracking Controls
- Space Temperature, Relative Humidity, and Pressurization Logging

5.7.2.2 Individual Room Temperature or Pressure Control

(a) Constant Volume Air Terminal Unit
- See Figure 5-1

(b) Variable Volume Air Terminal Unit
- With Dead-Band (see Figure 5-2)
- Without Dead-Band (see Figure 5-3)

(c) Room Pressure Differential Control
- Air Flow Control Valves

(d) Fan Coil Unit Control
- Four-Pipe System
- Two-Pipe System

(e) Ground Source Heat Pump (GSHP) Control
- Variable Speed Pump Control
- Seasonal Shutdown

5.7.3 HEATING SYSTEM CONTROLS

(a) Pumping System Controls
- Start-Up with Automatic Changeover (Emergency and Equal Runtime)
- Primary-Secondary Piping and Pumping Control
- Variable Primary Piping and Pumping Control
- Refer to ASHRAE Standard 90.1-2013 or approved latest edition for mandated differential pressure reset control.

(b) Heat Exchanger Controls
- Leaving Water Temperature Control
- Water Temperature Reset Control
- Evaluate minimum capacity and design 1/3 and 2/3 steam control valve where warranted.

(c) Boiler Controls
- Safety Controls
- Outdoor Air Reset
- Combustion Controls
- Fuel Oil Pumping Controls
- Fuel Gas Supply Controls
- Integration with the Central DDC (ECC) Controls

(d) Geothermal Heating Control
- Safety Controls

- Outdoor Air Reset

5.7.4 CHILLED WATER SYSTEM CONTROLS

(a) Standalone Chilled Water Plant
  - System Start-Up
  - Automatic Part-Load Operation
  - Chiller Safety Controls and Interlock With Central DDC System

(b) Chilled Water Temperature Control
  - Fixed Water Temperature Control (Leaving Chiller)
  - Reset Water Temperature Control, where applicable

(c) Pumping System Control
  - Start-Up with Automatic Changeover (Emergency and Equal Runtime)
  - Primary-Secondary Piping and Pumping Control
  - Variable-Primary Piping and Pumping Control, where applicable
  - Minimum Pump Speed Control
  - Refer to ASHRAE Standard 90.1-2013 or approved latest edition for mandated differential pressure reset control.

(d) Cooling Tower Control
  - Leaving Water Temperature Control
  - Fan Speed Control
  - Vibration Isolation Control
  - Make-Up Water Control
  - Basin Temperature Control
  - Water Treatment Controls Including Integration with DDC Controls
  - Side Stream or Basin Sweeper System Controls Including Integration with DDC Controls.
  - Plate Heat Exchanger Control (Economizer Mode, where applicable)

(e) Thermal Energy Storage Control – Water or Ice
  - Storage Capacity
  - Special Equipment Requirements
  - Utility Rate Information
  - Recharge/Discharge Control
  - Cooling Tower Temp Control Requirements.

5.7.5 NON-DDC CONTROLS

For standalone closed-loop applications, DDC controls and connection to the central ECC system shall be eliminated if it is determined that remote monitoring, alarm, and start-up are not necessary. Such applications are generally non-critical and should be evaluated on a case-by-case basis. Specific applications may require DDC temperature sensors for high or low limit alarms.

Examples of closed-loop controls are:

- Elevator Machine Room (Using Standalone DX System)
- Vestibule Heater
- Exterior Stairs Heater
- Attic Heating and Exhaust Ventilation Systems
- Mechanical Room – Heating and Ventilation Control

5.8 SUSTAINABILITY AND MAINTAINABILITY PRACTICES

This chapter encourages medical center level standardization of HVAC controls because standardization promotes reliability and maintainability, but many sequences are not appropriate in all location, thus standardization of control sequences should take place at the medical center level. This list of good control practices is not all inclusive or mandatory but does contain time tested practices that work well in the applications indicated.

(a) On air systems with energy recovery ensure the control sequence accounts for conditions during which energy recovery is detrimental. For example energy recovery from a high internal heat environment is detrimental when exhaust air is used to heat incoming 55 F air to a higher temperature which is too high to provide cooling thereafter causing mechanical cooling to come on. Analyze energy recovery at all possible conditions.

(b) Design systems air side filter diagnostics. Use analog differential pressure sensors instead of pressure switches and set multiple alarms. Pressure drop below normal indicates a missing or damaged filter, pressure drop at mid-range indicates time to order filters, and final pressure drop indicates time to replace filters.

(c) Design motor on/off schedule diagnostics: Motor status on when the motor command is off indicates motor starter or VFD has been placed on bypass.

(d) Carefully consider delays on all alarms. If the delays are too short false alarms can occur if they are too long problems can go undetected for too long. Therefore, all alarm delays should be indicated as a time variable in the control sequence.

(e) For critical alarms rather than relying on time delays alarm based on multiple variables and/or alarm at different levels. For example in the main computer room alarm if the space temperature reaches a specified first level AND the supply air temperature is above setpoint.

(f) When humidity sensors are used to control a loop provide two sensors inputs. One sensor to the control the loop and the other to check calibration. If the reading between sensors differs by a specified amount an alarm should be generated.

(g) On differential pressure sensors (water and steam) design a manifold with a single valve so that the sensor accuracy can be easily checked.

(h) Provide proper piping and ductwork design for flow measurement when it is used. The location of flow measurement devices should never be an afterthought. Do not compromise on this location.

(i) Ensure the system design provides adequate locations for sensors, panels, actuators etc. so that the installed control system components are easily accessible for maintenance, testing, and calibration.

(j) Ensure the piping and ductwork designs take into consideration metering requirements, both for control meters and energy meters. Improperly located meters are not accurate.
(k) Indicated location of DDC control enclosures and ensure enclosures are safely accessible in compliance with NEC.

5.9 DOCUMENTATION REQUIREMENTS

5.9.1 SCHEMATIC DIAGRAM AND CONTROL SEQUENCE

Provide a control diagram showing all controlled devices with unique designation numbers, such as valves V-1 and V-2, dampers D-3 and D-4, etc. Describe the role of each controlled device in the sequence of operation. Describe the sequence of operation in all modes, generally as outlined above.

The control schematic diagram and the written specific sequence of operation must be included in the contract drawings. Do NOT include the sequence of operation in the specifications.

5.9.2 POINT LIST

Provide a comprehensive DDC point schedule for each system. Provide a list of all analog and binary points, alarm requirements, and measurement needs. Sample point lists are shown in Figure 5-4, Figure 5-5, Figure 5-6, and Figure 5-7.

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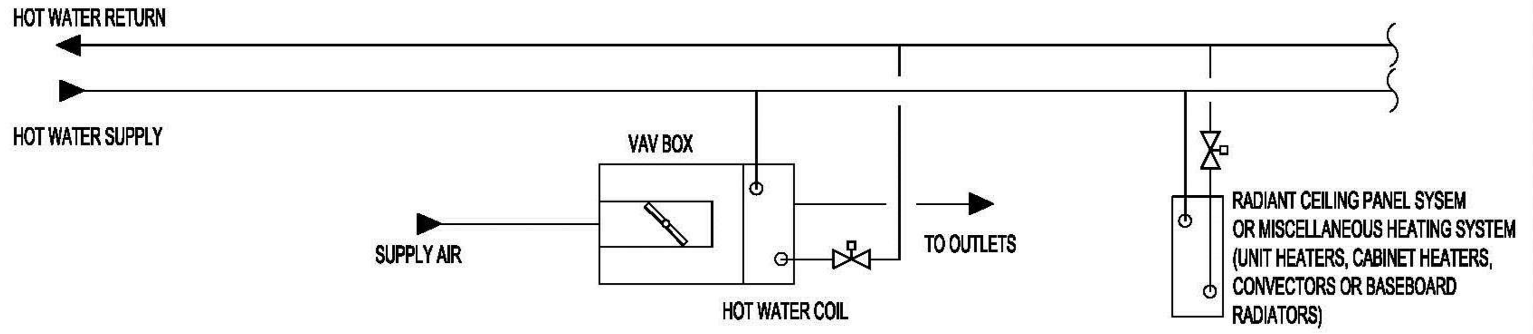
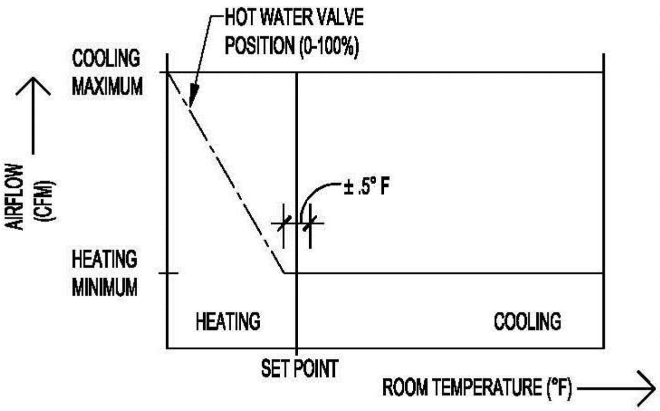
FIGURE 5-1





VAV BOX CONTROL SEQUENCE

CONTROL SEQUENCES

CASE 1: NO PERIMETER HEATING
- A. HOT WATER VALVE ENABLED AT ALL TIMES.
- B. HOT WATER VALVE OPENS IF ROOM TEMPERATURE IS LESS THAN SET POINT.

CASE 2: WITH RADIANT CEILING PANEL SYSTEM
- A. RADIANT PANEL CONTROL VALVE ENABLED BELOW A SPECIFIED OUTSIDE AIR TEMPERATURE.
- B. IF CV BOX HOT WATER VALVE IS 100% OPEN AND ROOM TEMPERATURE IS LESS THAN SETPOINT, RADIANT CEILING PANEL HOT WATER VALVE MODULATES OPEN TO MAINTAIN ROOM TEMPERATURE SET POINT.

CASE 3: WITH MISCELLANEOUS HEATING
- A. CONTROL VALVE FOR MISCELLANEOUS HEATING SYSTEM ENABLED BELOW A SPECIFIED OUTSIDE AIR TEMPERATURE.
- B. IF CV BOX HOT WATER VALVE IS 100% OPEN (AND RADIANT CEILING PANEL SYSTEM VALVE, IF INSTALLED) AND ROOM TEMPERATURE IS LESS THAN SETPOINT. MISCELLANEOUS HEATING HOT WATER VALVE MODULATES TO MAINTAIN ROOM TEMPERATURE.

CV TERMINAL UNIT WITH REHEAT AND PERIMETER HEATING

Not to Scale

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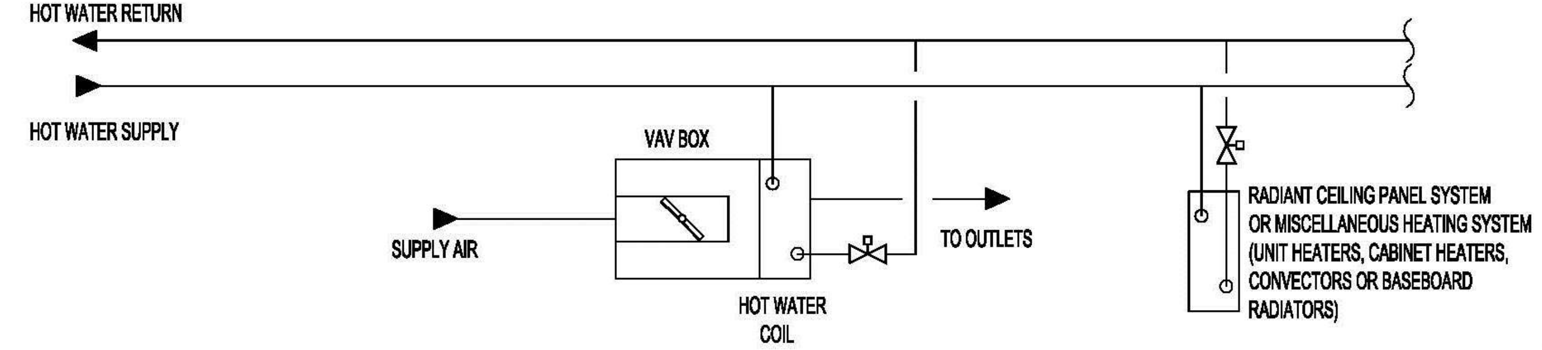
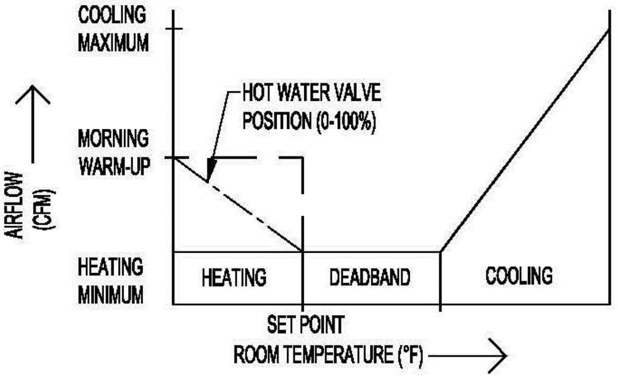
FIGURE 5-2





VAV BOX CONTROL SEQUENCE

CONTROL SEQUENCES

CASE 1: NO PERIMETER HEATING
- A. HOT WATER VALVE ENABLED AT ALL TIMES.
- B. HOT WATER VALVE OPENS IF ROOM TEMPERATURE IS LESS THAN LOWER LIMIT.

CASE 2: WITH RADIANT CEILING PANEL SYSTEM
- A. RADIANT PANEL CONTROL VALVE ENABLED BELOW A SPECIFIED OUTSIDE AIR TEMPERATURE.
- B. IF VAV BOX HOT WATER VALVE IS 100% OPEN AND ROOM TEMPERATURE IS LESS THAN SETPOINT, RADIANT CEILING PANEL HOT WATER VALVE MODULATES OPEN TO MAINTAIN ROOM TEMPERATURE SET POINT.

CASE 3: WITH MISCELLANEOUS HEATING
- A. CONTROL VALVE FOR MISCELLANEOUS HEATING SYSTEM ENABLED BELOW A SPECIFIED OUTSIDE AIR TEMPERATURE.
- B. IF VAV BOX HOT WATER VALVE IS 100% OPEN (AND RADIANT CEILING PANEL SYSTEM VALVE, IF INSTALLED) AND ROOM TEMPERATURE IS LESS THAN SETPOINT. MISCELLANEOUS HEATING HOT WATER VALVE MODULATES TO MAINTAIN ROOM TEMPERATURE.

VAV TERMINAL UNIT WITH REHEAT AND PERIMETER HEATING, WITH 5° DEADBAND

Not to Scale

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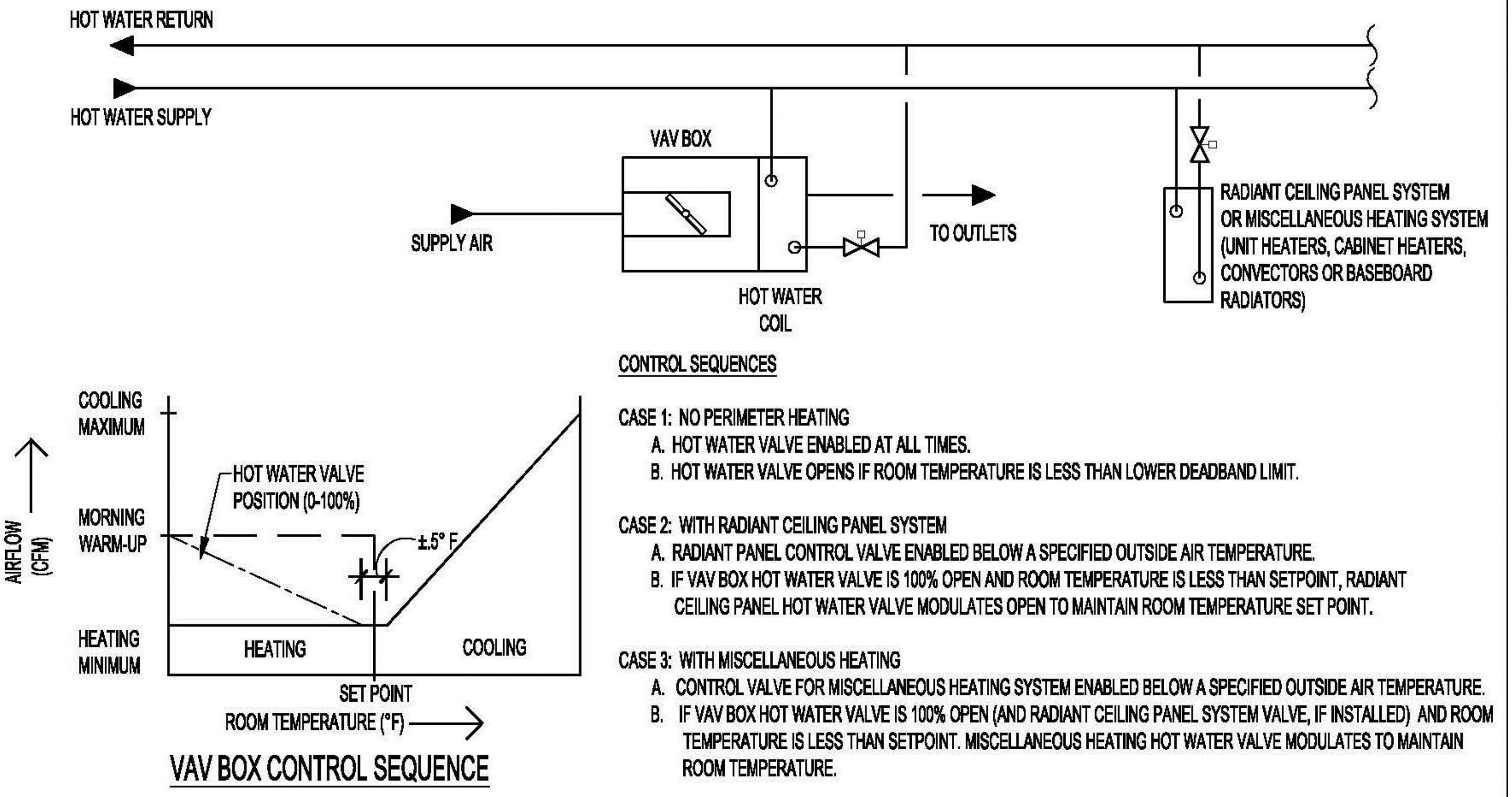
FIGURE 5-3



CONTROL SEQUENCES

CASE 1: NO PERIMETER HEATING
A. HOT WATER VALVE ENABLED AT ALL TIMES.
B. HOT WATER VALVE OPENS IF ROOM TEMPERATURE IS LESS THAN LOWER DEADBAND LIMIT.

CASE 2: WITH RADIANT CEILING PANEL SYSTEM
A. RADIANT PANEL CONTROL VALVE ENABLED BELOW A SPECIFIED OUTSIDE AIR TEMPERATURE.
B. IF VAV BOX HOT WATER VALVE IS 100% OPEN AND ROOM TEMPERATURE IS LESS THAN SETPOINT, RADIANT CEILING PANEL HOT WATER VALVE MODULATES OPEN TO MAINTAIN ROOM TEMPERATURE SET POINT.

CASE 3: WITH MISCELLANEOUS HEATING
A. CONTROL VALVE FOR MISCELLANEOUS HEATING SYSTEM ENABLED BELOW A SPECIFIED OUTSIDE AIR TEMPERATURE.
B. IF VAV BOX HOT WATER VALVE IS 100% OPEN (AND RADIANT CEILING PANEL SYSTEM VALVE, IF INSTALLED) AND ROOM TEMPERATURE IS LESS THAN SETPOINT. MISCELLANEOUS HEATING HOT WATER VALVE MODULATES TO MAINTAIN ROOM TEMPERATURE.

VAV TERMINAL UNIT WITH REHEAT AND PERIMETER HEATING - 0° DEADBAND

Not to Scale

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FIGURE 5-4

		System Outputs		System Inputs											System Software/Control					
		Binary	Analog	Binary	Analog										Alarm Processing			Application/Function		
System Component	Point ID	Command	Position %	Status	Temperature	Pressure	Humidity	Flow	Current	Totalization	Conductivity	ORP	Percent	Data (Comm Line)	Equipment Status	Low Limit	High Limit	Lead/Lag	Start/Stop	
Supply Fan																				
On/Off									X						X					
Start/Stop		X																	X	
Status Auto				X																
Status Hand				X																
VFD Control Panel														X						
Return Fan																				
On/Off									X						X					
Start/Stop		X																	X	
Status Auto				X																
Status Hand				X																
VFD Control Panel														X						
Relief Fan																				
On/Off									X						X					
Start/Stop		X																	X	
Status Auto				X																
Status Hand				X																
VFD Control Panel														X						
Exhaust Fan																				
On/Off									X						X					
Start/Stop		X																	X	
Status Auto				X																
Status Hand				X																
VFD Control Panel														X						
Glycol Energy Recovery Pump																				
On/Off									X						X					
Start/Stop		X																	X	
Status Auto				X																
Status Hand				X																
Outside Air Temperature					X															
Outside Air Humidity							X													
Mixed Air Temperature					X											X	X			
Heat Recovery CoilTemperature					X											X	X			
Preheat Coil Temperature					X											X	X			
Chilled Water Coil Temperature					X											X	X			
Supply Air Temperature					X											X	X			
Supply Air Humidity							X									X	X			
Space Temperature					X											X	X			
Space Humidity							X									X	X			
Pre-Filter Status				X											X					
Freezestat Status				X											X					
Duct Mounted Smoke Detector Status				X											X					
Static Pressure Sensor						X										X	X			
Return Air Damper Position													X							
Outside Air Damper Position													X							
Mixed Air Damper Position													X			X	X			
VAV Box Flow								X												
VAV Box Supply Air Temperature					X											X	X			

AIR HANDLING SYSTEM OVERVIEW

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FIGURE 5-5

		System Outputs		System Inputs											System Software/Control					
		Binary	Analog	Binary	Analog										Alarm Processing			Application/Function		
System Component	Point ID	Command	Position %	Status	Temperature	Pressure	Level	Flow	Current	Totalization	Conductivity	ORP	pH	Data (Comm Line)	Status Equipment	Low Limit	High Limit	Lead/Lag	Start/Stop	
Chilled Water Pump																				
On/Off									X						X					
Start/Stop		X																X	X	
Status Auto				X																
Status Hand				X																
VFD Control Panel Data														X						
Chilled Water Supply Temp					X											X	X			
Chilled Water Return Temp					X											X	X			
Chilled Water Supply Flow								X												
Chiller Control Panel																				
Safeties/Failures				X												X	X			
On/Off									X						X					
Start/Stop		X																X	X	
Data														X						
Chilled Water Pump																				
On/Off									X						X					
Start/Stop		X																X	X	
Status Auto				X																
Status Hand				X																
VFD Control Panel Data														X						
Cooling Tower Make Up Flow								X		X										
Cooling Tower Blow Down Flow								X		X										
Cooling Tower Fan																				
On/Off									X						X					
Start/Stop		X																X	X	
Status Auto				X																
Status Hand				X																
VFD Control Panel Data														X						
Condenser Water Supply Temperature					X											X	X			
Condenser Water Return Temperature					X											X	X			
Cooling Tower Fan Vibration				X																
Condenser Water pH													X							
Condenser Water Conductivity											X									
Condenser Water ORP												X								
P&F Economizer																				
Chilled Water Supply Temperature					X											X	X			
Chilled Water Return Temperature					X											X	X			
Chiller kW									X											
Cooling Tower Fan kW									X											
Chilled Water Pump kW									X											
Condenser Water Pump kW									X											

CHILLED WATER SYSTEM OVERVIEW

HVAC DESIGN MANUAL
CHAPTER 5
FIGURE 5-6

		System Outputs		System Inputs											System Software/Control					
		Binary	Analog	Binary	Analog										Alarm Processing			Application/Function		
System Component	Point ID	Command	Position/90	Status	Temperature	Pressure	Differential Pressure	Level	Flow	Current	Totalization	Conductivity	ORP	Data (Comm Line)	Equipment Status	Low Limit	High Limit	Leed/Lag	Start/Stop	
Hot Water Pump																				
On/Off										X					X		X			
Start/Stop		X																X	X	
Status Auto				X																
Status Hand				X																
VFD Control Panel Data														X						
Hot Water Supply Temperature					X											X	X			
Hot Water Return Temperature					X											X	X			
Hot Water Flow									X											
Boiler Control Panel																				
Safeties/Failures				X											X					
On/Off										X					X					
Start/Stop		X																X	X	
Data														X						

HEATING SYSTEM OVERVIEW

HVAC DESIGN MANUAL

CHAPTER 5

FIGURE 5-7

		System Outputs		System Inputs											System Software/Control					
		Binary	Analog	Binary	Analog										Alarm Processing			Application/Function		
System Component	Point ID	Command	Position /90	Status	Temperature	Differential Pressure	Pressure	Level	Flow	Current	Totalization	Conductivity	ORP	Data (Comm Line)	Status Equipment	Low Limit	High Limit	Leed/Lag	Start/Stop	
Freezers and Refrigerators																				
Dietetics					X															
Compressed Air																X	X			
On/Off				X																
Safeties/Failures				X																
Pressure				X											X					
Medical Gas																X				
On/Off				X																
Safeties/Failures				X																
Pressure				X											X					
Vacuum System																X				
On/Off				X																
Safeties/Failures				X																
Pressure				X											X					
Emergency Generators																	X			
Control Panel Data														X						
On/Off										X					X					
Domestic Hot Water Supply Temperature					X											X	X			
Domestic Hot Water Return Temperature					X											X	X			
Domestic Hot Water Pump																				
On/Off										X					X					
Start/Stop		X																X	X	
Status Auto				X																
Status Hand				X																
Sewage Pumps																				
Elevator Machine Room Temperature					X												X			
Electrical Room Temperature					X												X			

MISCELLANEOUS SYSTEM OVERVIEW

CHAPTER 6: APPLICATIONS

All Chapter 6 System and Room Data in Excel (Section 508 compliant)

6.1 OVERVIEW

This chapter includes HVAC design criteria for the air-handling units (AHUs) and for the individual rooms. Note that room names and codes were taken from Design Guides and PG-18-5 Equipment Guide List. Refer to PG-18-5 for updated room names and codes. The tables at the end of the chapter are organized by functional area e.g. Surgical Suite, Pulmonology, Laundry, Non Patient Care Support etc. and these are presented alphabetically. Within each functional area, first appears the AHU System Data Sheet and following each air handling unit data sheet are the Room Data Sheets (RDS) for rooms served by that air handling unit. The AHUs are classified into two categories: **Dedicated Air-Handling Units** and **Common Air-Handling Units**.

6.2 DEDICATED AIR-HANDLING UNITS

These air-handling units are selected to serve the specific clinical functions and/or departments to maintain their functional and operational integrity. The design criteria of each dedicated AHU are given in the **AHU System Data Sheet**. Each dedicated AHU has its own unique system configuration and needs that may or may not match with other dedicated AHUs and functions. For example, an AHU serving the Dining Area and Cafeteria has patently different criteria than the Nursing Wing. Specific examples of unique system configurations are:

- 100% Outdoor Air or Minimum Outdoor Air
- Quality of Filtration (MERV Values) and Locations of After-Filters
- Hours of Operation (24-Hours or Daytime Use only)
- Energy recovery requirement

The number of dedicated air-handling units shall vary with the size and type of projects. For replacement and/or new hospitals and major renovations, where each medical function defined below is a full-fledged department, the following dedicated air-handling units shall be provided:

- Animal Research and Holding Areas
- Atrium
- Auditoriums and Theaters
- Autopsy Suite
- Cardiovascular Lab Services
- Dental Clinic
- Dining Area (Cafeteria)
- Emergency Care Unit
- Gymnasium
- Imaging Series
- Kitchen
- Laundry (Central Laundry)
- Main Computer Room
- Main Entrance Lobby
- Nursing Wing

- Pathology and Laboratories
- Pharmacy Service
- Pharmacy compounding suite
- Polytrauma Rehab Center
- Standalone Smoking Facility
- Sterile Processing Service (SPS)
- Surgical Suite
- Spinal Cord Injury Unit

As stated, the above list is primarily intended for major renovations and for new and replacement hospitals. On smaller projects the design team is encouraged to apply the intent of this requirement by grouping similar functions together based on the physical proximity and relative size of the clinical function departments as well as their operating schedule. This scenario is most likely to occur in outpatient clinics and in older medical centers where clinics are distributed among smaller out buildings away from the main hospital building. In these cases where air handling units are combined the design shall be based on the aggregate of the most stringent requirements for the units being combined so that the selected unit meets all requirements of the combined units.

Following the description of each air-handling unit, the HVAC data of each unique room served by the dedicated air-handling unit is given in the Room Data Sheets (RDS). The RDS within the functional area, however, do NOT include **Support Rooms**, generally present in almost all medical departments and functions. A few examples of these support rooms are:

- Conference Rooms
- Corridors
- Housekeeping Aid Closet (HAC)
- Locker Rooms
- Offices
- Toilets

To reduce the amount of repetition these types of rooms are listed in common patient care RDS and in support RDS.

6.3 COMMON (NON-DEDICATED) AIR-HANDLING UNITS

These air-handling units serve multiple functions consisting of patient care (clinics, treatment, and procedure rooms) and non-patient care common rooms (described in section 6.2). For small projects, such as standalone clinics, where the scope of work is limited involving only a few rooms of a specific medical function, and not a full-fledged department, the common air-handling units can serve such rooms otherwise covered by the dedicated air-handling units in large projects. Likewise, the design team is encouraged to consider the size of the clinical departments, functional requirements, and operating schedule and where advantageous provide air handling units dedicated to a specific functional area.

It is important to note that when the rooms of differing requirements are grouped together, the serving common air-handling unit shall be selected to meet the most stringent room requirements as outlined in Room Data Sheets These requirements are:

- Filtration Requirements (this includes the status of after-filters).
- Indoor Design Conditions (this includes temperature and relative humidity).
- Hours of Operation

6.3.1 COMMON ROOMS

As much as possible the **AHU System Data Sheets** and their respective **Room Data Sheets (RDS)** are grouped by functional area and presented alphabetically. Three additional functional categories are included in the tables to adequately document the requirements for spaces that occur within several functional areas. These are:

6.3.1.1 Patient Examination, Treatment, and Procedure Rooms

In this category patient care rooms not specific to the other listed clinical functions are described.

6.3.1.2 Non Patient Rooms - Support Areas

Rooms from this category are general in nature, and are found in nearly all departments. These rooms include Conference Rooms, Corridors, HAC, Locker Rooms, Offices and Toilets.

6.3.1.3 Non Patient Rooms - Miscellaneous Areas

Rooms not directly involved with patient care but are an innate part of the building construction and require HVAC. A few examples of these rooms are:

- Attic Space
- Electrical Equipment Rooms
- Engineering Shops
- Exterior Stairs
- Mechanical Equipment Rooms
- Vestibules

6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS

Design the AHU system to operate in 100% outdoor air mode during an emergency created by an epidemic of contagious diseases. The 100% outdoor air mode shall be activated manually.

Size the heating coils, cooling coils, humidifier(s), and other system components to maintain the required space conditions at peak demand loads during operation delivering 100% outdoor air. Also, size the utilities (e.g., chilled water, hot water, steam......) and controls to be compatible with the normal and emergency modes. Select the controls hardware and software to ensure stable operation in normal and emergency epidemic mode.

During emergency epidemic mode, all air shall be exhausted outdoors from the highest point above the roof as practical, through a single or multiple stacks at least 10 ft [3m] high at a discharge velocity of 3,500 fpm [18 m/s]. Perform dispersion analysis to avoid air re-entrainment (Refer to Chapter 2 for Dispersion Analysis requirements). Dispersion analysis recommendations may require higher stack heights. If required distances from the exhaust termination points cannot be maintained or if dispersion analysis does not demonstrate acceptable outdoor air at the intakes, HEPA filters with isolation bypass dampers at the HEPA filter box shall be utilized.

Provide the AHU return/relief fan(s) external to the AHU. As an alternate, dedicated exhaust fans for epidemic emergency mode may be provided. Either of these would allow bypassing the returned air from spaces and discharging directly to exterior without passing through and potentially contaminating the AHU mixing box during emergency operation mode. In addition to AHU section doors, provide access doors to allow access to fans, dampers, and ducts connected to AHU.

Use ultra-low leakage AMCA 511 – CLASS 1A class rating automatic dampers to minimize risk associated with returned air leakage into the 100% OA air stream during emergency epidemic mode. Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU interior surfaces.

6.5 GENERAL NOTES

The general notes described below are applicable to all AHUs and all rooms.

These notes are NOT repeated elsewhere.

In addition, there are specific notes applicable only to the air-handling units and/or rooms under which they are written.

6.5.1 INDOOR DESIGN CONDITIONS

The indoor design conditions used in this design manual are generally based on the ASHRAE Standard 170-2021 Ventilation of Healthcare Facilities or approved latest edition. Some design conditions for critical spaces are based on field experience and feedbacks received from the VA expert clinicians and operations.

6.5.1.1 Common Design Conditions

Indoor Design Temperature:
Unless otherwise indicated in the room data sheets the minimum temperature shall be during the heating season and the maximum temperature shall be during the cooling season.

- Tolerance: +/- 1.0 F [+/- 0.6 C]
- Dead-Band Room Temperature 5 F [3 C] – Adjustable for VAV applications for the qualified spaces described in ASHRAE Standard 170-2021 or approved latest edition.

Indoor Design Relative Humidity

(a) Range

The required indoor relative humidity range shall be as indicated in room data sheets. Unless otherwise indicated in the room data sheet notes the room % RH maximum and minimum shall be based on the space extreme conditions. Also unless indicated in the room data sheet notes, a single central humidifier at the air handling unit shall be used. Individual zone humidifiers are generally not required.

(b) Tolerance

+/- 2.5% RH in Humidification Mode

(c) Humidification Design Condition

Design condition per Room Data Sheets

Using an exhaust or return air duct-mounted relative humidity sensor, relative humidity shall be controlled at the set point by the steam control valve serving the humidifier.

(d) Dehumidification Design Condition

Design condition at 5% below maximum value allowed by Room Data Sheets

Direct control of relative humidity in dehumidification mode is not required or recommended. The relative humidity is indirectly controlled to maintain 5% RH below allowed maximum by controlling the cooling coil apparatus dew point temperature. Perform psychrometric analysis using indoor design parameters listed in the Room Data Sheets to establish the cooling capacity, mixed air conditions, fan heat gain, and cooling coil leaving air conditions and select cooling coil apparatus dew point to yield room relative humidity 5% below allowed room maximum. The 5% difference between the room maximum and the design condition is the permissible drift. The alarms and the corrective actions shall be initiated when the relative humidity exceeds the room maximum.

(e) Room Humidity Control

The system does not require individual room humidity control, unless mentioned specifically.

(f) Uncontrolled Humidity Range

The relative humidity is uncontrolled between the humidification and dehumidification modes.

(g) Humidifier Capacity

Size humidifiers to be capable of delivering a minimum of 40% RH in spaces during extreme conditions all year long. Some rooms require higher than a minimum of 40% RH during extreme conditions, for which the humidifiers shall be of higher capacity to meet the room %RH minimum specific requirement. See the room data sheets for %RH minimum design condition requirement within each space.

6.5.2 AIR BALANCE

6.5.2.1 Definitions and Requirements

In this Design Manual, for the purpose of infection control, volumetric air difference between the supply and return air volumes or supply and exhaust air volumes is characterized as positive air balance, negative air balance, or neutral air balance and general rules are presented below. However, it is the responsibility of the A/E to ensure that the general rules achieve the required effect which is measurable pressure differentials to ensure directional air flow as required for the spaces. For example, a 15% CFM differential between supply and exhaust, in a small room may not provide the required pressure drop through a normal sized door so the A/E must calculate the CFM required achieving the desired pressure drop.

(a) Building Baseline Pressure

The baseline building pressure shall be the pressure maintained in the unrestricted access general circulation spaces of the building between the building entrances / exits and the clinical and / or functional areas. The pressure in these spaces, relative to the outside shall be designed to be 0.01 to 0.02 inch WC [2.5 to 5.0 Pascal] higher than outside of the building. See paragraph 2.2.3.5 for related information and additional guidance. Examples of such spaces include but are not limited to:

- Public / patient entrance lobbies.
- Information desk area off of the entrance lobbies.
- General waiting area off of the entrance lobbies.
- Corridors directly connected to the entrance lobbies.
- General retain shops off corridors connected to the entrance lobbies.
- Elevator lobbies off main corridors at the entrance levels.

(b) Pressure Differentials

In critical environments such as OR's, pharmacy compounding rooms, burn units, SPS, etc. the design engineer shall take into consideration maintenance of pressure differentials and calculate actual required airflow differences as required to maintain said pressures. The designer shall include elements such as tightness of room, door, and window crack leakage areas which impact room pressurization. The design intent shall be to provide sufficient differential pressure to maintain proper airflow direction (typically 0.01 inches of water column or higher) between the subjected room and adjacent space to maintain proper airflow direction, as well as ensuring proper pressure reading by the space pressure monitoring sensors, and avoiding false alarms. Each differential pressure step must generally be equated to minimum 0.01 inches of water column. Examples: (1) The differential pressure between a space with a positive air balance designated as (+) and a space with neutral air balance designated as (0) equates to minimum 0.01 inches of water column; (2) The differential pressure between a space with a double positive air balance designated as (++) and a reference space with neutral air balance designated as (0) equates to minimum 0.02 inches of water column.

(c) Pressure References / Example

The requirement of building air balance is to create the desired space pressure induced air flows between spaces for the purposes of infection control, temperature control and odor control. All clinical and / or functional spaces shall be designed to be positive, negative, or neutral to the building baseline pressure or other adjacent space pressure. An example of this is as follows:

1) A protective environment room in a patient ward accessible from main public corridor. Solution: Ward corridor pressure is greater than main corridor pressure; PE ante room pressure is greater than ward corridor pressure; PE room pressure is greater than ante room pressure; and PE toilet room pressure is less than PE room pressure. Note that air flow is from PE room, to anteroom, to ward corridor, to public corridor. While designing to meet these conditions the engineer shall at a minimum consider the following:

    - The integrity of the building envelope including doors, ceilings, windows, and walls to ensure that excessive air flow differentials are not needed to maintain required air pressure differentials.
    - Minimum required pressure differentials and pressure indicating devices as required in this design manual. Use ASHRAE Standard 170-2021 or approved latest edition in case of missing these requirements in this manual.
    - Maximum pressure relationship between any two spaces which if excessive can make it difficult to close or open doors between the spaces.

(d) Positive Air Balance

Positive air balance is designated as (+) in the Room Data Sheets. Generally this can be achieved when supply air flow exceed return and / or exhaust air flow. The excess air exfiltrates into the adjoining spaces.

(e) Double Positive Air Balance

Double Positive air balance is designated as (++) in the Room Data Sheets. Generally this can be achieved when supply air flow exceed return and / or exhaust air flow. The excess air exfiltrates into the adjoining spaces.

(f) Negative Air Balance

Negative air balance is designated as (-) in the Room Data Sheets. Generally this can be achieved when exhaust and / or return air exceed supply air flow. The air deficiency infiltrates from the adjoining spaces.

(g) Double Negative Balance

Double Negative air balance is designated as (--) in the Room Data Sheets. Generally this can be achieved when exhaust and / or return air exceed supply air flow. The air deficiency infiltrates from the adjoining spaces.

(h) Neutral Air Balance

Neutral air balance, designated as (0) in the Room Data Sheets, occurs when the air supplied to the space equals return and/or exhaust air volumes. Air is not exchanged between adjoining spaces.

(i) Air Flow Relationship Diagrams

Provided with the Room Data Sheets (RDS) at the end of this chapter are representative Air Flow Relationship Diagrams. These are general diagrams which do not include all possible room and / or space arrangements between the different types of spaces. The arrangements that are presented are some of the most commonly found in the VA Design Guides and in existing VA Medical Centers. The purpose of these diagrams is to provide additional visual guidance to what is shown in the RDS. Since space relationships are not always ideal the engineer is required to develop a full understanding of the requirements found in in this design manual, and ASHRAE Standard 170-2021 or approved latest edition, and adjust the system design to meet the design intent to the fullest extent possible without creating excessive pressure differences and / or conditions that do not meet the required air flow relationships.

Provide complete air balance/airflow relationship diagram(s) to include all healthcare spaces within the entire building such as patient areas, and other non-patient critical spaces requiring specific air pressurization such as pharmacy, SPS, laboratories, and animal holding facilities. The diagram(s) must include airflow directions, differential pressure and airflow values at each opening between spaces, and must indicate the location of all the pressure monitoring devices and their proposed settings.

6.5.2.2 Design Considerations

(a) Air Distribution

To enhance the effectiveness of the intended air balance the direction of air flow must be established by judicious locations of the supply and return or exhaust air devices. See individual notes in Room Data Sheets for specific requirements.

(b) Automatic Controls

To maintain verifiable air balance with trend logging capabilities, devices such as airflow control valves are required in the exhaust or return air ducts. Where the air balance is required to create verifiable differential air pressure, the complexity of the automatic control system shall be reviewed and upgraded as required.

(c) Building Construction

In critical environments such as OR’s, biological safety laboratories, pharmacy compounding rooms, burn units etc. the design engineer shall take into consideration maintenance of pressure differentials and calculate actual required air flow differences required to maintain said pressures based on actual door and window crack leakage areas.

(d) Air Changes

For design purposes, the minimum number of total air changes indicated shall be either supplied for positive pressure rooms or exhausted for negative pressure rooms.

(e) Constant Volume (CV), and Variable Air Volume

The air handling unit sheets indicate some air handling units as constant volume (CV) and some as variable air volume (VAV). Through the use of CV terminals which modulate to maintain a constant air flow volume in response to varying system supply air pressure and VAV terminals with modulate to change the flow to the space in response to space temperature, either type of air handling unit (CV and VAV) can be used for either purpose. The CV and VAV designation for the air handling unit is provided based on the majority type of terminals connected to that system. VAV air handling units serve primarily VAV terminals, however, if necessary CV terminals can be added to the system. For example, an air handling unit serving a patient ward will be a VAV air handling unit because it mainly serves VAV terminals; however, that unit is also required to have a CV terminal to serve the satellite sterile storage for that ward. Conversely CV air handling units serve primarily CV terminals but can also have VAV terminals added. All CV terminal units shall be of the two-position type, equipped with necessary controls for airflow setback during unoccupied mode.

6.5.3 INDIVIDUAL ROOM CONTROL

6.5.3.1 Individual Room Control

Refer to Chapter 2, Room Temperature Controls and requirements in Room Data Sheets.

6.5.4 ROOM DATA SHEET CLARIFICATIONS

6.5.4.1 Room Air

(a) Air Distribution

- Return = Return Air System
- Exhaust (G) = General Exhaust System
- Exhaust (S) = Special Exhaust System

(b) Exhaust the entire room air where no Return Air is indicated.

Note: See Room Data Sheet notes and Chapter 3 for exhaust systems.

6.5.4.2 Minimum Outdoor Air

Use 100% outside air where the same quantity of air changes per hour is indicated for Minimum Total and Minimum Outside Air.

6.5.4.3 Room Differential Pressure Monitoring Device

Where indicated, provide an electronic space differential pressure monitoring device. Where an Ante room is provided for the space with a pressure monitoring device requirement, provide two pressure differential devices, one between the space and Ante room and one between Ante room and corridor. Coordinate with the VA Medical Center Representative and provide additional space differential pressure monitoring devices per their recommendations. Each device shall be connected to the ECC and equipped with a local visual alarm and remote alarm at ECC to show non-compliance in maintaining the required air pressure difference. Provide an automatic (DDC) airflow control in the exhaust air duct to modulate as required to maintain room pressurization. The space shall be equipped with a sensor indicating the status of the door (open or closed). The sensor shall provide an input to the room differential pressure monitor to disable or provide a delay on the alarm as appropriate. The space differential pressure monitor shall be installed outside of the room being monitored with an additional red/green indicator light mounted on the opposite side of the wall (in bidirectional people flow).

ANIMAL RESEARCH AND HOLDING AREAS - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Dedicated Medium Pressure Constant Volume (paragraphs 3.2.3 and 6.2)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes Per Hour	Room Data Sheets
Minimum Outdoor Air Changes Per Hour	100%
Return Air Permitted	No
Exhaust Air Required	Yes
Air Economizer Cycle Required	Not Applicable
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filters (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean" Steam
General Exhaust System Required	Yes
Special Exhaust System Required	Yes
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets
Compliance	AAALAC and NIH DRM

Note 1 - Listed Rooms and Their Names

Since current VA design guides are a not available the listed rooms, their names, and the design conditions are based on research for compliance with the American Association for Accreditation of Laboratory Animal Care (AAALAC) and the National Institute of Health Design Requirement Manual (NIH DRM).

Note 2 - Number of Air-Handling Units

(a) Provide two separate air-handling units, one to meet the lower indoor design temperature, 65 F [18 C], for the Animal Surgical Suite and Rabbit Holding Area and another unit to serve the Animal Holding Areas and Associated Spaces for which the indoor design temperature ranges from 72 F [22 C] to 77 F [25 C].

(b) Due to the lower space temperatures and humidity requirements in the animal surgery room a separate unit or supplemental cooling may be required. The supply temperature of chilled water (if connecting to an existing plant) shall be considered to ensure surgery conditions can be maintained.

(c) For smaller facilities with few spaces requiring lower (65 F [18 C]) indoor temperature, dedicated, re-circulatory terminal cooling units can provide supplementary cooling in lieu of a dedicated air-handling unit.

Note 3 - Special Acoustical and Vibration Needs

Animals are susceptible to low-frequency rambling noise and vibrations. Implement the recommendations of the acoustic analysis in the HVAC system and building design. Address the noise and vibration transmitted between the floors and the cage washing equipment and the animal holding areas by using acoustic blankets and/or tiles.

ANIMAL RESEARCH AND HOLDING AREAS - AIR HANDLING UNIT

AHU System Data Sheet

Note 4 - High-Limit Temperature Controls

(a) Room Air Temperature Control - Animal Holding and Serving Areas

Each room temperature sensor shall be equipped with a high-limit sequence to disable the room air terminal unit when the temperature exceeds the design set point by 5 F [3 C] and initiate a visible local alarm and a remote alarm at the EEC.

(b) Supply Air Temperature Control - Air Handling Units

Each supply air temperature sensor must be equipped with a high-limit sequence to disable the air-handling unit and initiate a visible alarm at the serving area and a remote alarm at the ECC, if the supply air temperature exceeds the set point by 10 F [6 C].

Note 5 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies. Provide local and ECC alarms as required for the space functions.

(b) Humidifier capacity.

Note 6 -Local Alarms

All local alarms must be visible type, such as, rotating red light, as audible alarms disturb animals and create panic situations. All remote alarms at the ECC must initiate an audible device and a printed message. High / low temperature and humidity alarms are required in all animal holding areas.

Note 7 -Chilled Water

If uninterrupted supply of chilled water is not available on demand from the central chilled water plant, provide dedicated air-cooled chillers (N+1) connected to an emergency power supply. The air-cooled machines will facilitate easy start in mild weather. Dedicated chillers may also be required if the central chilled water plant cannot deliver chilled water at the lower temperature required to maintain 65 F [18 C] at 55% RH for the surgery and laboratory areas, etc.

Note 8 - Temperature and Humidity

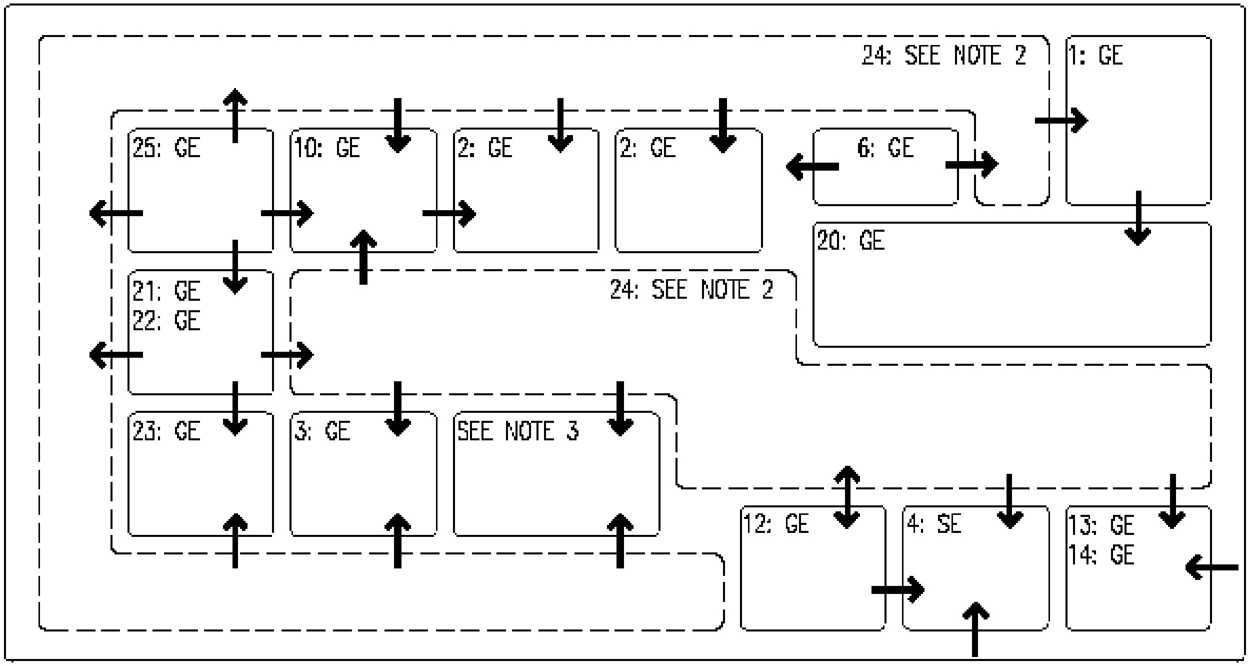
(a) All animal holding rooms must be capable of housing all types of species. The HVAC system must also be capable of maintaining the full range of requirements for all anticipated animal populations. The temperature range required to accommodate most commonly used research animals is 65 F [18 C] to 84 F [29 C]. The ranges do not represent acceptable fluctuation ranges. The fluctuation ranges must be determined during the design with input from the COR and the researchers.

(b) Room temperatures shall be maintained +/- 2 F [1 C] and +/- 5% RH.

Note 9 - Redundancy

Requirements for N+1 redundancy must be discussed with the project COR. This requirement will be dependent on the project scope, for stand alone research facilities the redundancy requirements identified in the NIH DRM must be utilized. For research areas inside existing facilities the COR must provide guidance.

ANIMAL RESEARCH AND HOLDING AREAS AIR FLOW RELATIONSHIPS



NOTES:
1. OTHER ROOM ARRANGEMENTS POSSIBLE.
2. CORRIDORS DON'T NEED RETURN OR EXHAUST THEY TRANSFER ALL THEIR AIR TO ROOMS.
3. OTHER LABORATORIES AND ANIMAL HOUSING AS REQUIRED.
4. SEE LEGEND ON THE FOLLOWING SHEET.

ANIMAL RESEARCH AND HOLDING AREAS AIR FLOW RELATIONSHIPS (CONTINUED)

LEGEND
1: XXXX: Animal Receiving and Examination Room (–)
2: XXXX: Animal Housing Rooms (various types) (–)
3: XXXX: Animal Treatment Room (–)
4: XXXX: Cage Wash Room (–)
5: XXXX: Carcass and Waste Storage (––)
6: XXXX: Clean Cage Storage Room (+)
7: XXXX: Cold Room (–)
8: XXXX: Diagnostic Laboratory (–)
9: XXXX: Diet Kitchen (––)
10: XXXX: Dry Feed and Bed Storage (0)
11: XXXX: Environmental Laboratory (0)
12: XXXX: Equipment Storage (0)
13: XXXX: Hazardous Waste Disposal Room (––)
14: XXXX: Incinerator Room (–)
15: XXXX: Necropsy (–)
16: XXXX: Procedural Laboratory (Barrier Suite) (–)
17: XXXX: Procedural Laboratory (Chemical / Radioisotope) (–)
18: XXXX: Procedural Laboratory (Infectious Disease) (––)
19: XXXX: Procedural Laboratory (Standard) (–)
20: XXXX: Quarantine Room (––)
21: XXXX: Animal Operating Room (Survival) (+)
22: XXXX: Animal Operating Room (Terminals) (+)
23: XXXX: Animal Surgical Preparation Room (–)
24: XXXX: Corridors (+)
25: XXXX: Post–Operative Intensive Care (++)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST (WET EXHAUST / FUME HOODS)
RA: RETURN AIR
AIR FLOW DIRECTION BETWEEN SPACES ⟶
NEUTRAL AIR FLOW ⟷
PEDESTRIAN CIRCULATION – – – – – – – – – –

ANIMAL RESEARCH AND HOLDING AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
General: The room names listed below are from the American Association for Accreditation of Laboratory Animal Care (AAALAC). The actual room layouts, equipment disposition, and the HVAC parameters may vary with the project scope of work.													
XXXX: Animal Receiving and Examination Room	72	22	72	22	55	45	10	10	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Air Pick-Up Collect room exhaust air at approximately 7 in [175 mm] above the floor level through 1 in [25 mm] thick, MERV 6 filter grille.													
XXXX: Animal Room - Mouse	79	26	65	18	40	30	15	15	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Air Pick-Up Provide exhaust air inlets at base corners and center the ceiling supply outlet in each cubical to ensure uniform air distribution.													
XXXX: Animal Room - Hamster	79	26	65	18	40	30	15	15	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Air Pick-Up Provide exhaust air inlets at base corners and center the ceiling supply outlet in each cubical to ensure uniform air distribution.													
XXXX: Animal Room - Guinea Pig	79	26	65	18	70	40	15	15	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Air Pick-Up Provide exhaust air inlets at base corners and center the ceiling supply outlet in each cubical to ensure uniform air distribution.													
XXXX: Animal Room - Rabbit	68	20	60	16	70	40	15	15	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Air Pick-Up Provide exhaust air inlets at base corners and center the ceiling supply outlet in each cubical to ensure uniform air distribution.													

ANIMAL RESEARCH AND HOLDING AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
XXXX: Animal Room - Dog and Cat	84	29	60	16	70	30	15	15	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Air Pick-Up Provide exhaust air inlets at base corners and center the ceiling supply outlet in each cubical to ensure uniform air distribution.													
XXXX: Animal Room - Nonhuman Primate	84	29	60	16	70	45	15	15	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Air Pick-Up Provide exhaust air inlets at base corners and center the ceiling supply outlet in each cubical to ensure uniform air distribution.													
XXXX: Animal Room - Chicken and Farm Animals	80	27	60	16	70	45	15	15	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Air Pick-Up Provide exhaust air inlets at base corners and center the ceiling supply outlet in each cubical to ensure uniform air distribution.													
XXXX: Animal Room - Aquatics (zebra fish)	84	29	78	26	70	50	15	15	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Air Pick-Up Provide exhaust air inlets at base corners and center the ceiling supply outlet in each cubical to ensure uniform air distribution.													
XXXX: Animal Treatment Room	72	22	72	22	55	40	8	8	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Air Pick-Up Collect room exhaust air at approximately 7 in [175 mm] above the floor level through 1 in [25 mm] thick, MERV 6 filter grille.													

ANIMAL RESEARCH AND HOLDING AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
XXXX: Cage Wash Room	72	22	72	22	55	40	20	20	Exhaust (S)	40	(-)	Yes	CV
Note 1 - Wet Exhaust System Provide a dedicated wet exhaust system to serve the Cage Washer Room and Cage Wash Room (with Tunnel Washer Room).													
XXXX: Cage Wash Room (with Tunnel Washer)	77	25	77	25	55	40	15	15	Exhaust (S)	40	(-)	Yes	CV
Note 1 - Wet Exhaust System See Cage Wash Room.													
XXXX: Carcass and Waste Storage	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (G)	40	(- -)	No	CV
Note 1 - Room Exhaust Maintain double negative air balance by drawing all transfer air from the adjoining space.													
XXXX: Clean Cage Storage Room	77	25	70	21	55	40	6	6	Exhaust (G)	40	(+)	Yes	CV
Note 1 - Room Exhaust Collect exhaust through the hood over the sterilizer.													
XXXX: Cold Room	36	2.2	36	2.2	NA	NA	NA	NA	Exhaust (G)	40	(-)	Yes	CV
Note 1 - Room Exhaust Draw 50 cfm [24 L/s] exhaust from the cold room. Provide transfer air through ducted ceiling connection. Provide a dedicated refrigeration unit.													
XXXX: Diagnostic Laboratory	72	22	72	22	55	40	15	15	Exhaust (G)	40	(-)	Yes	CV
Note 1 - Room Exhaust Coordinate exhaust with equipment, such as, fume hoods and/or Biological Safety Cabinets.													

<table>
<tr><th colspan="14">ANIMAL RESEARCH AND HOLDING AREAS - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN
EXHAUST G
EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th>% RH</th><th>% RH</th><th rowspan="2">TEMP</th><th rowspan="2">FLOW</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>MAX</th><th>MIN</th></tr>
<tr><td>XXXX: Diet Kitchen</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>4</td><td>NA</td><td>Exhaust (G)</td><td>45</td><td>(--)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Room Exhaust
Transfer air from the adjoining space for exhaust. Do not provide supply air.</td></tr>
<tr><td>XXXX: Dry Feed and Bed Storage</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>4</td><td>4</td><td>Exhaust (G)</td><td>40</td><td>(o)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Room Supply Air
Provide a ducted, supply air takeoff from an adjoining air terminal unit.</td></tr>
<tr><td>XXXX: Environmental Laboratory</td><td>72</td><td>22</td><td>72</td><td>22</td><td>55</td><td>40</td><td>4</td><td>4</td><td>Exhaust (G)</td><td>40</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Room HVAC
HVAC is required for the work area only.</td></tr>
<tr><td>XXXX: Equipment Storage</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>4</td><td>4</td><td>Exhaust (G)</td><td>40</td><td>(o)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Room Supply Air
Provide a ducted, supply air takeoff from an adjoining air terminal unit.</td></tr>
<tr><td>XXXX: Hazardous Waste Disposal Room</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>10</td><td>10</td><td>Exhaust (S)</td><td>40</td><td>(- -)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Exhaust System
Provide a dedicated exhaust system. Terminate exhaust at least 10 ft. [3 m] above the highest roof level. Discharge exhaust at 3,500 fpm [18 m/s] and/or according to the dispersion analysis recommendations. Evaluate the need for filtration in the exhaust air duct before discharging outdoors. Consult with the end users and local safety officer for exhaust air filtration requirements.</td></tr>
<tr><td>XXXX: Incinerator Room</td><td>NA</td><td>NA</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>50</td><td>50</td><td>Exhaust (S)</td><td>45</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Exhaust System
Provide a thermostatically controlled terminal heater. Provide a dedicated exhaust fan with motorized intake and discharge dampers. Coordinate intake (transfer) air volume for exhaust with the combustion air requirement of the incinerator.</td></tr>
<tr><td>XXXX: Necropsy</td><td>72</td><td>22</td><td>72</td><td>22</td><td>55</td><td>40</td><td>15</td><td>15</td><td>Exhaust (S)</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Exhaust Coordination
Coordinate exhaust over the trimming and necropsy tables.</td></tr>
</table>

ANIMAL RESEARCH AND HOLDING AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
XXXX: Procedural Laboratory (Barrier Suite)	72	22	72	22	55	40	15	15	Exhaust (S)	40	(-)	Yes	CV
Note 1 - Fume Hood Exhaust Provide a dedicated exhaust system for the fume hood.													
XXXX: Procedural Laboratory (Chemical/Radioisotope)	72	22	72	22	55	40	15	15	Exhaust (S)	40	(-)	Yes	CV
Note 1 - Fume Hood Exhaust Provide a dedicated exhaust system for the fume hood.													
XXXX: Procedural Laboratory (Infectious Disease)	72	22	72	22	55	40	15	15	Exhaust (S)	40	(- -)	Yes	CV
Note 1 - Fume Hood Exhaust Provide a dedicated exhaust system for the fume hood.													
XXXX: Procedural Laboratory (Standard)	72	22	72	22	55	40	15	15	Exhaust (S)	40	(-)	Yes	CV
Note 1 - Fume Hood Exhaust Provide a dedicated exhaust system for the fume hood.													
XXXX: Quarantine Room	72	22	72	22	55	45	15	15	Exhaust (G)	35	(--)	Yes	CV
Note 1 - Room Air Distribution Coordinate supply and exhaust air distribution with the Quarantine Room layout. Provide multiple exhaust air grilles over each quarantine area.													

ANIMAL SURGICAL SUITE AND RABBIT HOLDING AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
General: The room names listed below are from the VA Design Guide - Veterinary Medical Unit dated 26 February 1993. The actual room layouts, equipment disposition, and the HVAC parameters may vary with the project scope of work.													
XXXX: Animal Operating Room (Survival)	65	18	65	18	60	45	15	15	Exhaust (G)	35	(+)	Yes	CV
Note - None													
XXXX: Animal Operating Room (Terminal)	65	18	65	18	60	45	15	15	Exhaust (G)	35	(+)	Yes	CV
Note - None													
XXXX: Animal Surgical Preparation Room	65	18	65	18	60	45	4	4	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Room Air Balance While maintaining negative air balance with respect to the adjoining operating rooms, adjust exhaust air volume as required.													
XXXX: Control Booth	72	22	72	22	60	45	8	8	Exhaust (G)	40	(o)	Yes	CV
Note - None													
XXXX: Corridors	72	22	72	22	60	45	4	4	Exhaust (G)	40	(+)	Yes	CV
Note 1 - Room Air Balance Adjust supply and exhaust air volumes, as required, to meet the air balance requirements of the adjoining spaces. Exhaust may not be required.													
XXXX: Dark Room	72	22	72	22	60	45	6	6	Exhaust (G)	40	(-)	Yes	CV
Note 1 - Exhaust Duct Provide acid-resistant exhaust duct if chemicals are used for film processing.													
Note 2 - Plumbing Evaluate the use of silver recovery plumbing, if required.													

ANIMAL SURGICAL SUITE AND RABBIT HOLDING AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
XXXX: Post-Operative Intensive Care	65	18	80	27	60	45	10	10	Exhaust (G)	40	(+ +)	Yes	CV
Note 1 - Room Temperature Adjustment Size the reheat coil to maintain higher space temperature on demand.													
XXXX: Radiographic Room	72	22	72	22	60	45	8	8	Exhaust (G)	40	(-)	Yes	CV
Note - None													
XXXX: Scrub and Gown	72	22	72	22	60	45	4	4	Exhaust (G)	35	(+)	Yes	CV
Note - None													
XXXX: Surgical Work and Supply	72	22	72	22	60	45	4	4	Exhaust (G)	35	(o)	Yes	CV
Note 1 - Room Exhaust Draw exhaust air over the sterilizer hood. Adjust supply air volume to meet the exhaust needs.													

ATRIUM - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Dedicated (paragraph 6.2). Constant or Variable Air Volume
Indoor Design Temperature - Cooling	75 F [24 C]
Indoor Design Temperature - Heating	70 F [21 C]
Indoor Design Relative Humidity - Dehumidification	60%
Indoor Design Relative Humidity - Humidification	Optional (20%)
Minimum Total Air Changes Per Hour	4
Minimum Outdoor Air Changes Per Hour	2
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Smoke Evacuation Mode)
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition.
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant or "Clean" Steam
General Exhaust System Required	No
Special Exhaust System Required	Yes (Smoke Evacuation Mode)
Emergency Power Required	Yes (Smoke Evacuation System)
Individual Room Temperature Control Required	Yes
Room Air Balance	Positive (+) (Normal Mode) Negative (-) (Smoke Evacuation)

Note 1 - HVAC System

Based on Atrium configuration and air distribution arrangement, evaluate using a variable air volume HVAC system in lieu of a constant volume system.

Note 2 - Smoke Evacuation System

Design the smoke evacuation system per NFPA 101 and its associated documents. VA has opted to follow NFPA 101 with the understanding that the provisions of NFPA 101 may be at variance with the IBC. The design calculations must be performed by a fire protection professional engineer and reviewed by an independent fire protection professional engineer. The VA fire protection engineer may serve as the independent reviewer.

Note 3 - Design Details

(a) Upon activation of the smoke evacuation system, the Atrium AHU must operate in 100% outdoor air mode. Provide an additional make-up air system if the required smoke removal volume is greater than the Atrium AHU supply air volume. The make-up air system must be complete with fan, MERV 7 filter, and a heating coil.

(b) Size the heating capacity to maintain 50 F [10 C] minimum space temperature in the smoke evacuation mode. For 32 F [0 C] and lower ambient temperatures, design the heating system with freeze protection measures.

Note 4 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

AUDITORIUMS AND THEATERS - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Dedicated (paragraph 6.2). Constant or Variable Air Volume
Indoor Design Temperature - Cooling	75 F [24 C]
Indoor Design Temperature - Heating	70 F [21 C]
Indoor Design Relative Humidity - Dehumidification	60%
Indoor Design Relative Humidity - Humidification	(20%)
Minimum Total Air Changes Per Hour	4
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant or "Clean" Steam
General Exhaust System Required	Yes
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Yes
Room Air Balance	Positive (+)

Note 1 - HVAC System

Based on Auditorium and Theater air distribution arrangement and extent of conditioned air volume, evaluate using a variable air volume HVAC system in lieu of a constant volume system.

Note 2 - Demand Control Ventilation

Incorporate demand-controlled ventilation sequence, if feasible, to control outdoor air based on carbon-dioxide concentration. Follow ASHRAE Standard 62.1 - 2016 or latest approved edition, for demand control ventilation.

Note 3 - Relative Humidity

See paragraph 6.5.1.1 for:
(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

Note 4 - General Exhaust Control

Exhaust the spaces associated with the Auditorium and Theater either by a dedicated or a common exhaust system (examples: toilets, HAC, etc.).

AUTOPSY SUITE - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Dedicated Medium Pressure Constant Volume (paragraphs 3.2.3 and 6.2)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes Per Hour	Chapter 2 and Room Data Sheets
Minimum Outdoor Air Changes Per Hour	100%
Return Air Permitted	No
Exhaust Air Required	Yes
Air Economizer Cycle Required	Not Applicable
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant or "Clean" Steam
General Exhaust System Required	Yes
Special Exhaust System Required	Yes
Emergency Power Required	Yes (Exhaust System Only)
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - Dedicated Air-Handling Unit

A dedicated air-handling unit for the Autopsy Suite is NOT required if a 100% OA air-handling unit in the vicinity can meet the requirements of the hours of operation and filtration.

Note 2 - Dedicated General Exhaust System

(a) Exhaust System and Discharge Requirement

Provide a dedicated exhaust system to serve the Autopsy Suite. Locate the exhaust fan on the roof with the fan discharging above the highest point of the building. Provide a stack of sufficient height (minimum 10 ft. [3 m]) to discharge air at 3,500 fpm [18 m/s]. Follow the recommendations of the dispersion analysis to ensure that exhaust air does not enter outside air intakes, operable windows and other openings. Mount the fan bearings outside the airstream and monitor the fan status at the ECC.

(b) Exhaust Ductwork

Maintain exhaust ductwork under negative pressure. Provide an airflow control valve to ensure accurate exhaust air volumetric flow. Provide an alarm locally and at the ECC to report air flow disruption.

Note 3 - Special Exhaust System

Provide a special exhaust system(s) to serve fume hoods and/or biological safety cabinets included in the project-scope.

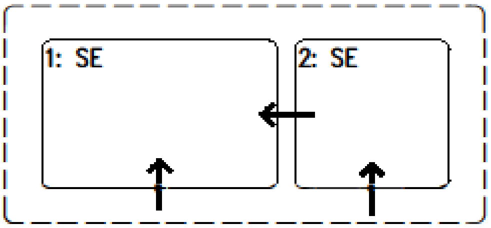
Note 4 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

AUTOPSY SUITE AIR FLOW RELATIONSHIPS



LEGEND
1: LBAR1: AUTOPSY ROOM (–)
2: LBTS1: GROSS SPECIMEN STORAGE ROOM (–)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST
RA: RETURN AIR
AIR FLOW DIRECTION BETWEEN SPACES ⟶
NEUTRAL AIR FLOW ⟷
PEDESTRIAN CIRCULATION – – – – – – – – – –

<table>
<tr><th colspan="14">AUTOPSY SUITE - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN
EXHAUST G
EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th>% RH</th><th>% RH</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>MAX</th><th>MIN</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td colspan="14">General: The room names listed below are from the VA PG 18-9 Chapter 240 Revised October 3, 2016. The actual room layouts, equipment disposition, and the HVAC parameters may vary with the project scope of work.</td></tr>
<tr><td>LBAR1: Autopsy Room</td><td>75</td><td>24</td><td>68</td><td>20</td><td>60</td><td>30</td><td>12</td><td>12</td><td>Exhaust (S)</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Air Distribution
Locate exhaust air intakes at the ceiling and floor level. Locate the floor level inlets approximately 7 in [175 mm] above the floor.
Note 2 - Canopy Hood
A canopy hood may be required over the dissecting tables to capture exhaust at the maximum rate of 100 fpm [0.5 m/s] through the hood face area. Coordinate the exhaust air volume and exhaust location with the manufacturer of the dissecting tables.
Note 3 - Room Noise Level
Noise level lower than NC 35 may be required where audio/video recording is performed.
Note 4 - Occupied and Unoccupied Modes
Evaluate the feasibility of providing occupied/unoccupied modes based on anticipated usage of these spaces.</td></tr>
<tr><td>LBTS1: Gross Specimen Storage Room</td><td>75</td><td>24</td><td>68</td><td>20</td><td>60</td><td>30</td><td>6</td><td>6</td><td>Exhaust (S)</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Air Distribution
Coordinate location of the exhaust air inlet over the sink and counter area to capture the exhaust air fumes.</td></tr>
</table>

CARDIOVASCULAR LAB SERVICE - AIR HANDLING UNIT

AHU System Data Sheet

Air-Handling Type	Dedicated Variable Air Volume or Medium Pressure Constant Volume (paragraphs 3.2.3 and 6.2)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14 (Normal Mode) AF = MERV 16A (Emergency Mode)
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	No
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - General

Depending on the size of the Cardiovascular Lab Service area, the space may be served by a non-dedicated air handling unit as long as the unit meets all the minimum requirements described herein.

Note 2 - Listed Rooms and Their Names

Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on the VA Cardio Vascular Laboratory Service Design Guide dated November 29, 2011. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note 3 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 4 - Enhanced Air Filtration

(a) During Emergency Epidemic use enhanced after-filters as noted above.

(b) Size the AHU supply and return/relief fan motors to compensate for the additional air pressure drop due to enhanced filtration application.

(c) The AHU filter section shall be configured to accommodate installation of enhanced after-filters during Emergency Epidemic.

(d) Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU interior surfaces.

CARDIOVASCULAR LABORATORY SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
Procedure Room													
OPEC1: EKG Testing Room	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	VAV
OPHM1: Holter Monitoring Room	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	VAV
OPPE1: Echocardiograph Room	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	VAV
OPPE2: Stress Echocardiograph Room	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	VAV
OPTM1: Stress Testing Treadmill Room	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	VAV
OPTM2: Tilt Table Testing Room	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	VAV
OPHM2: Event / Holter Monitor Work Room	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	VAV
EXRC1: Cardiology Exam Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
EXRC2: Pacemaker ICD Interrogation Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
OFDC2: Consult Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
XVC01: ECHO Reading Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
XVC01: EKG Reading Station	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV

Note 1 - General

The space types listed in this manual reflect the terminology and functions used in the Department of Veterans Affairs, Cardiovascular laboratory Service Design Guide dated November 29, 2011.

Note 2 - Air Handling Unit

If the size and / or arrangement of a specific cardiovascular laboratory service warrants it, a separate air handling unit may be provided for this function, in general, however, any air handling unit meeting the minimum requirements of the Cardiovascular Laboratory AHU sheet and space requirements in the room data sheets (RDS) may be used.

COMMUNITY LIVING CENTER - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Non-dedicated Variable Air Volume (paragraphs 3.2.3, 6.3 and 6.4)
Indoor Design Temperature - Cooling	Room Data Sheets
Indoor Design Temperature - Heating	Room Data Sheets
Indoor Design Relative Humidity - Dehumidification	Room Data Sheets
Indoor Design Relative Humidity - Humidification	Room Data Sheets
Minimum Total Air Changes Per Hour	Room Data Sheets
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode)
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant or "Clean" Steam
General Exhaust System Required	Yes
Special Exhaust System Required	Room Data Sheets
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - VAV Air-Handling Units
The all-air VAV system describe here can also be used for applicable spaces such as offices, lobbies, classrooms, examination rooms, conference rooms, etc. The number of air handling units shall be determined by practical design considerations such as available mechanical room spaces, available above ceiling space for ductwork, functional space grouping, occupancy schedules etc. Spaces requiring constant volume shall be served by constant volume air terminals.

Note 2 - Emergency Epidemic Air-Handling Unit
Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 3 - Dedicated Air-Handling Unit
A dedicated air-handling unit is required if the AHU serving CLC and other spaces is not capable of operating at 100% OA during emergency epidemic mode, or if the AHU does not meet the requirements of the hours of operation and filtration.

Note 4 - Listed Rooms and Their Names
Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on the VA Community Living Center Design Guide dated June 2011. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note 5 - Relative Humidity
See paragraph 6.5.1.1 for:
(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

HOME ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
XXXXX: Home Entry/Front Porch	75	24	70	21	60	30	4	2	Return	35	(o)	No	VAV
Note 1 - General Provide HVAC in the porch if enclosed.													
CLHFY: Foyer	NA	NA	NA	NA	NA	NA	4	NA	Return	35	(o)	No	VAV
Note 1 - General Since Foyer is part of a bedroom, individual room temperature control is not required.													
CLHOF: Home Office	75	24	70	21	60	NA	4	2	Return	35	(o)	Yes	VAV
Note - None													
CLHLR: Living Room	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note 1 - Unoccupied Mode Provide a project-specific unoccupied control sequence to reduce or stop the HVAC during unoccupied hours.													
CLHDR: Dining Room	75	24	70	21	60	30	4	2	Return	40	(-)	Yes	VAV
Note 1 - Ventilation Evaluate minimum outside air for ventilation based on ASHRAE 62.1-2016 or latest approved edition for food and beverage service establishments and if it exceeds 2 ACH use that value.													
Note 2 - Unoccupied Mode Provide a project-specific unoccupied control sequence to reduce or stop the HVAC during unoccupied hours.													

HOME ROOM DATA SHEET

<table>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN EXHAUST G EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th><th rowspan="2">TEMP</th><th rowspan="2">FLOW</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th></tr>
<tr><td>IPK01: Kitchen and Servery</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>NA</td><td>6</td><td>2</td><td>Exhaust G & S</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td>SRS01: Pantry</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="14">Note 1 - General
Space includes a pantry not requiring HVAC.</td></tr>
<tr><td colspan="14">Note 2 - Outside Air Requirements
If this space is served by a dedicated air handling unit return air may be used. If the space is served by an air handling unit used for other occupied spaces then all air delivered to the kitchen must be exhausted and no return must be allowed. Adjust the minimum outside air for the air handling unit such that the entire system is at least 15% positive, while maintaining the kitchen negative to its surroundings.</td></tr>
<tr><td colspan="14">Note 3: - Kitchen Exhaust For Kitchens With Dedicated Air Handling Units
An NFPA 96 dedicated exhaust system must serve hoods over cooking equipment. When the kitchen hood systems are off the exhaust system must exhaust at least 2 air changes per hour and must maintain the kitchen negative relative to its surroundings.</td></tr>
<tr><td colspan="14">Note 4: - Kitchen Exhaust For Kitchens Without Dedicated Air Handling Units
An NFPA 96 dedicated exhaust system must serve hoods over cooking equipment. Supplemental exhaust must ensure the kitchen space is maintained negative to its surrounding during all occupied times regardless of whether or not the kitchen hoods are operating.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>CLHKH: Kitchen Housekeeping Closet</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(- -)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>JANC1: Housekeeping Aides Closet</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(- -)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>CLHDN: Den</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>CLHBD: Resident Bedroom</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td>CLHBR: Resident Bathroom</td><td>NA</td><td>NA</td><td>70</td><td>21</td><td>NA</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust G</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Bathroom Ventilation
Bathroom total air change per hour (ACH) is achieved through exhaust only, with makeup air coming from the patient room supply system.</td></tr>
<tr><td colspan="14">Note 2: - Bathroom Temperature Control
Bathrooms subject to heat loss must be heated through a thermostatically controlled terminal unit.</td></tr>
</table>

<table>
<tr><th colspan="14">HOME ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th>ROOM AIR</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th>% RH</th><th>% RH</th><th rowspan="2">RETURN
EXHAUST G
EXHAUST S</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>MAX</th><th>MIN</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td>CLHBS: Bathing Suite</td><td>75</td><td>24</td><td>82</td><td>28</td><td>60</td><td>NA</td><td>10</td><td>2</td><td>Exhaust S</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td>TNPG1: Toilet</td><td>NA</td><td>NA</td><td>70</td><td>21</td><td>NA</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust S</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Bathing Suite Supply and Exhaust
Maintain minimum of 10 ACH or minimum required to maintain temperature. All exhaust must be through a dedicated wet exhaust system designed with due consideration to removal of moisture laden air. Exhaust quantity must maintain the bathing suite negative to its exterior.</td></tr>
<tr><td colspan="14">Note 2 - Bathroom Ventilation
Bathroom total air change per hour (ACH) is achieved through exhaust only, with makeup air coming from the bathing suite supply system. The bathroom must be maintained negative to the bathing suite. Use the same wet exhaust system used to serve the bathing suite.</td></tr>
<tr><td colspan="14">Note 3: - Bathroom Temperature Control
Bathrooms subject to heat loss shall be heated through a thermostatically controlled terminal unit.</td></tr>
<tr><td>CLHLD: Laundry</td><td>78</td><td>26</td><td>70</td><td>21</td><td>60</td><td>NA</td><td>10</td><td>2</td><td>Exhaust G</td><td>45</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Dryer Vent
Coordinate dryer vent exhaust with actual equipment used.</td></tr>
<tr><td colspan="14">Note 2: - General Exhaust and Room Air Balance
Provide constant volume supply and constant volume general exhaust to maintain minimum 10 ACH and negative space conditions when the dryers are off.</td></tr>
<tr><td>SPSU1: Soiled Utility Room</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust G</td><td>40</td><td>(--)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note 1: - General Exhaust and Room Air Balance
Provide constant volume exhaust only to maintain a minimum of 10 ACH. Depending on the size of the room it may be necessary to provide a transfer air duct to keep the pressure on the door from being excessive (in excess of 0.08 inches WC [20 Pascal]).</td></tr>
<tr><td>CLHS1: Clean Linen Storage</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>4</td><td>NA</td><td>Return</td><td>40</td><td>(+)</td><td>Notes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Storage Type
Two different configurations of the clean linen closet are described.</td></tr>
<tr><td colspan="14">Note 2 - Small Closet
For small, unoccupied closet (60 sf to 80 sf [6 m$_2$ to 7 m$_2$] size) supply conditioned air under positive air pressure but do not provide room temperature control and ducted return air. Allow air to ex-filtrate to the adjoining space to maintain positive air balance.</td></tr>
<tr><td colspan="14">Note 3 - Large Storage Closet
For large occupied storage closet (greater than 80 sf [7 m$_2$]) provide a dedicated air terminal unit with room temperature control and ducted return air. Balance supply and return air flows to maintain positive air balance.</td></tr>
</table>

<table>
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<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN
EXHAUST G
EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td>TNPG1: Toilet - Resident / Visitor</td><td>NA</td><td>NA</td><td>70</td><td>21</td><td>NA</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(- -)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Bathroom Ventilation
Bathroom total air change per hour (ACH) is achieved through exhaust only, with makeup air coming from the corridors.</td></tr>
<tr><td colspan="14">Note 2: - Bathroom Temperature Control
Bathrooms subject to heat loss must be heated through a thermostatically controlled terminal unit.</td></tr>
<tr><td>CLCHC: Hair Care (Barber/Beauty Salon)</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>(-)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Ventilation and Exhaust
Evaluate ventilation per ASHRAE Standard 62.1-2016 or latest approved edition and use that value if it exceeds 2 ACH.</td></tr>
<tr><td>CLHS2: Home Storage</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="14">Note 1 - General
This is a small closet and does not require HVAC.</td></tr>
<tr><td>CLHGR: Garage</td><td>NA</td><td>NA</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>35</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - General
Provide a thermostatically-controlled heater for colder climates (40 F [5 C] and below) when the Garage is equipped with fire protection or water piping.</td></tr>
<tr><td>Corridor</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>(+)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note - 1 General
The HVAC data is applicable to all corridors (circulation spaces) in the CLC/DOM.</td></tr>
<tr><td colspan="14">Note - 2 Supply Air Volume
Adjust supply air volume as required to meet the transfer air demand of the adjoining spaces, such as, toilets, HACs and/or soiled utility rooms requiring negative air balance</td></tr>
</table>

<table>
<tr><th colspan="14">COMMUNITY CENTER - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN
EXHAUST G
EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th>% RH</th><th>% RH</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>MAX</th><th>MIN</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td>LOB02: Vestibule</td><td>NA</td><td>NA</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>40</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Heating
Provide a thermostatically-controlled terminal heater. Coordinate heater type and location with the architectural discipline. Floor-mounted cabinet unit heaters with bottom horizontal supply and top return have proven effective in counter-acting cold air settling at the floor level.
Note 2 - Space Pressurization
Supply 1.0 cfm/sf [5.1 L/s/m$_2$] air under positive pressure from an adjoining air terminal unit serving the lobby to maintain positive air pressure by allowing air to ex-filtrate outdoors.</td></tr>
<tr><td>CLCCS: Concierge Station</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>(-)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note – None</td></tr>
<tr><td>CLCBB: Bistro</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>(-)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Ventilation</td></tr>
<tr><td colspan="14">Evaluate minimum outside air for ventilation based on ASHRAE 62.1-2016 or latest approved edition for food and beverage service establishments and if it exceeds 2 ACH use that value.</td></tr>
<tr><td>CLCGR: Great Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Energy Conservation Initiative
Provide a carbon-dioxide (CO2) and/or occupancy sensor to conserve energy during light occupancy. The control sequence must be project-specific. Follow ASHRAE Standards 62.1 -2016 or latest approved edition requirements.</td></tr>
<tr><td>CLNMR: Multipurpose Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Folding Partitions
Where the room is equipped with folding partitions, provide individual room temperature control for either side of the partition. Design the supply and return grill layout to operate at acceptable ADPI values with the partition open and with the partition closed. Include return grill on both sides of the partition.</td></tr>
<tr><td colspan="14">Note 2 - Energy Conservation Initiative
Provide a carbon-dioxide (CO2) and/or occupancy sensor to conserve energy during light occupancy. The control sequence must be project-specific. Follow ASHRAE 62.1 -2016 or latest approved edition requirements.</td></tr>
<tr><td>STCL1: Multipurpose Storage</td><td>NA</td><td>NA</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>40</td><td>(o)</td><td>Yes</td><td>NA</td></tr>
<tr><td colspan="14">Note 1 - Temperature Control
Storage rooms subject to heat loss shall be heated through a thermostatically controlled terminal unit.</td></tr>
</table>

COMMUNITY CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
CLCLB: Media Center	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
Note 1 - Equipment Heat Gain Coordinate equipment heat gain with the equipment manufacturer.													
CLCHC: Hair Care (Barber/Beauty Salon)	75	24	70	21	60	30	4	2	Return	40	(-)	Yes	VAV
Note 1 - Minimum Ventilation Evaluate minimum outside air for ventilation based on ASHRAE 62.1-2016 or latest approved edition for barber and beauty salon establishments and if it exceeds 2 ACH use that value.													
Note 2 - Ducted Exhaust Provide ducted exhaust per ASHRAE Standard 62.1-2016 or latest approved edition.													
CFR01: Conference Room	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note 1 - Energy Conservation Initiative Provide a carbon-dioxide (CO2) and/or occupancy sensor to conserve energy during light occupancy. The control sequence must be project-specific. Follow ASHRAE 62.1 -2016 or latest approved edition requirements.													
TNPG1: Toilet - Resident / Visitor	NA	NA	70	21	NA	NA	10	NA	Exhaust (G)	40	(- -)	Yes	CV
Note 1 - Bathroom Ventilation Bathroom total air change per hour (ACH) is achieved through exhaust only, with makeup air coming from the corridors.													
Note 2: - Bathroom Temperature Control Bathrooms subject to heat loss must be heated through a thermostatically controlled terminal unit.													
OFA09: Administrative Office / Nursing Office / Activities Director's Office / Maintenance Office / Physician Office	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note 1 - Individual Room Temperature Control See Chapter 2 for individual room temperature control requirements.													

<table>
<tr><th colspan="14">COMMUNITY CENTER - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th>ROOM AIR</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th>% RH</th><th>% RH</th><th rowspan="2">RETURN
EXHAUST G
EXHAUST S</th><th colspan="2"></th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>MAX</th><th>MIN</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td>SACP1: Copy Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>NA</td><td>6</td><td>2</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Room Temperature Control
Copy Room may not require individual room temperature control if open to an adjoining space during the occupied mode. Room air from the adjoining space can be returned over the copy equipment to reduce heat concentration.</td></tr>
<tr><td colspan="14">Note 2 - Exhaust Requirements
Provide general exhaust as required by ASHRAE Standard 62.1-2016 or latest approved edition.</td></tr>
<tr><td>SALG2: Staff Lounge and Lockers</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Exhaust (G)</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
<tr><td>TNPG1: Staff Toilet</td><td>NA</td><td>NA</td><td>68</td><td>20</td><td>NA</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(- -)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Terminal Heater
Provide a thermostatically-controlled, terminal heater for the toilets subject to heat loss.
Note 2 - Transfer Air for Exhaust
For Staff Toilets located with the Staff Lounge and Lockers, provide transfer air for exhaust from the Staff Lounge and Lockers.</td></tr>
<tr><td>Storage -STCL1: Multi-Purpose Room/ STCL2: General/ CLCS3: Maintenance</td><td>NA</td><td>NA</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>40</td><td>NA</td><td>Yes</td><td>NA</td></tr>
<tr><td colspan="14">Note 1 - Terminal Heater
Provide a thermostatically-controlled, terminal heater for a storage room subject to heat loss and possibility of fire protection and/or water pipe freezing.</td></tr>
<tr><td>SPHC1: HAC</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(- -)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Terminal Heater
Provide a thermostatically-controlled, terminal heater for a HAC room subject to heat loss and possibility of fire protection and/or water pipe freezing.</td></tr>
<tr><td>XXYYC: Satellite Telephone/Communications Closet</td><td>68</td><td>20</td><td>68</td><td>20</td><td>NA</td><td>NA</td><td>6</td><td>NA</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - General
The Satellite Telephone/Communication Closet (also known as Room) must be served by a dedicated, cooling unit in operation on-demand and uninterrupted.
Evaluate project-specific cooling sources, such as chilled-water fan coil units, self-contained DX units, and/or environmental air-handling unit in operation round-the- clock and year-round.</td></tr>
</table>

<table>
<tr><th colspan="14">COMMUNITY CENTER - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN
EXHAUST G
EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td colspan="14"></td></tr>
<tr><td>CLHGR: Garage</td><td>NA</td><td>NA</td><td>60</td><td>15</td><td>NA</td><td>NA</td><td>-</td><td>100%</td><td>Exhaust (S)</td><td>50</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Ventilation (100% Outdoor Air)
Provide a ventilation system complete with fan(s), exhaust and/or supply, and air inlet and outlet connections equipped with motorized dampers. Size and select the system to move air at the rate of 1.5 cfm/sf [7.6 L/s/m$_2$].
Note 2 - Heating
Provide thermostatically-controlled heat delivered either by the supply air system or individual air terminal units. During heating mode, reduce the outdoor air to minimum as mandated by ASHRAE Standard 62.1-2016 or latest approved edition and other applicable documents.
Note 3 - Compliance and Reference
The HVAC system must be in compliance with the American Council of Government Industrial Hygienists (ACCIH) and NFPA 88B. Refer to the ASHRAE Handbook of Applications for further information.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>CLCCH: Chapel/Meditation/Quiet Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Energy Conservation Initiative
Provide a carbon-dioxide (CO2) and/or occupancy sensor to conserve energy during light occupancy. The control sequence must be project-specific. Follow ASHRAE 62.1 -2016 or latest approved edition requirements.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>OFA09: Physicians Office</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Individual Room Temperature Control
Required for a single office. Otherwise see Chapter 2 for room temperature control requirements.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>CLCEX: Exam Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Individual Room Temperature Control
Required for a single office. Otherwise see Chapter 2 for room temperature control requirements.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>MEDP1: Pharmacy</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
<tr><td colspan="14"></td></tr>
</table>

COMMUNITY CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
CLCOF: Security Office	75	24	70	21	60	NA	4	2	Return	35	(o)	Yes	VAV
Note 1 - Individual Room Temperature Control Required for a single office. Otherwise see Chapter 2 for room temperature control requirements.													
CLCRC: Receiving and Loading	75	24	70	21	60	30	4	2	Return	35	(+)	Yes	VAV
Note 1: Air Curtain Provide an air curtain with a heating element. Interlock the air curtain start sequence with the loading door dock operating mechanism. Activate heating when the ambient temperature falls below 45 F (7 C).													

CENTRAL LAUNDRY FACILITY - AIR HANDLING UNITS

AHU System Data Sheet

Air-Handling Type	Dedicated (paragraph 6.2). Constant Volume / Variable Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Room Data Sheets
Exhaust Air Required	Room Data Sheets
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS. Also see Note 2
Filtration - Pre-filters	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water, DX, Evap Cooling
Heating Source	Hot Water or Steam
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	Yes
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - Listed Rooms and Their Names In RDS Sheets
Since a current VA design guides are a not available the listed rooms, their names, and the design conditions are based on research for compliance with ASHRAE, American Conference of Governmental Industrial Hygienists Industrial Ventilation Manual and past VA HVAC Design Manual.

Note 2 – Energy Recovery System
A central laundry presents many opportunities for Energy recovery.

(a) Hot exhaust from dryers and ironers can be used to preheat incoming domestic water prior to going to water heaters.
(b) Hot exhaust from ironers can be recirculated into dryers and ironers.
(c) Waste water from washer extractors can be used to preheat incoming domestic cold water.
(d) Recover high pressure condensate flash steam from laundry equipment and reuse in domestic water heaters or in space heating.
(e) Whenever using dryer and ironer exhaust provide lint filters in exhaust air stream. Provide instrumentation to alarm when filters are dirty.
(f) Do not recirculate dryer exhaust into dryers as it will inhibit drying due to the moisture content of the air.

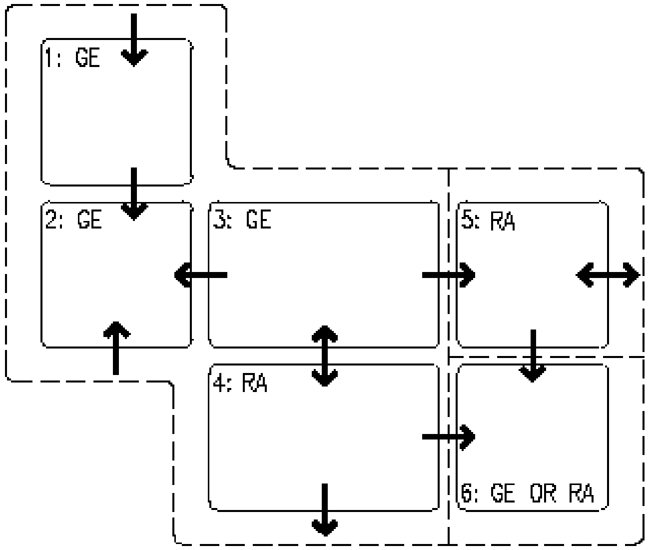
Note 3 – Special Exhaust Systems
Exhaust all air in soiled receiving through exhaust grills above washer / extractor loading door to remove contaminated air and to create directional air flow on the contaminated side. Dryers and ironers must be exhausted and must have makeup air systems. See energy recovery note 2.

Note 4 - General Exhaust Systems
Provide general exhaust above washer extractor unloading doors to help control heat and humidity.

Note 5 – Load Calculations

Consult laundry equipment manufacturer for heat dissipation off washer extractors, dryers and ironers and ensure the information provided includes heat given off by linen as it is transported from machine to machine and while it is stored.

CENTRAL LAUNDRY FACILITY AIR FLOW RELATIONSHIPS



LEGEND

1: XXXX: SOILED RECEIVING AND SORTING ANTE ROOM (+)
2: XXXX: SOILED RECEIVING AND SORTING ROOM (–)
3: XXXX: CLEAN LAUNDRY WORK ROOM (+)
4: XXXX: CLEAN LAUNDRY STORAGE ROOM (+)
5: OFA09: OFFICES (0)
6: SLXXX: BREAK ROOM / STAFF LOUNGE (–)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST (WET EXHAUST)
RA: RETURN AIR
AIR FLOW DIRECTION BETWEEN SPACES ⟶
NEUTRAL AIR FLOW ⟷
PEDESTRIAN CIRCULATION – – – – – – – – – –

<table>
<tr><th colspan="14">CENTRAL LAUNDRY FACILITY - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN EXHAUST G EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td colspan="14"></td></tr>
<tr><td colspan="14">General: At the time this manual was published a VA central laundry design guide was not available in the VA TIL, therefore, the nomenclature of the spaces may not match future laundry design guides. To compensate for that the space names are descriptive by function. The actual room layouts, equipment disposition, and the HVAC parameters may vary with the project scope of work.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>XXXX: Soiled Receiving and Sorting Ante Room</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>10</td><td>2</td><td>None</td><td>45</td><td>(+)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 – Soiled Receiving and Sorting Ante Room:
If provided, this is an air lock space between the corridor outside the laundry and the soiled receiving space. The space must have double doors to the corridor and double doors to the soiled receiving area. The leakage on these doors must be analyzed to determine the amount of air required for pressurization. No return or exhaust must be provided and temperature control must be from the soiled receiving and sorting room.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>XXXX: Soiled Receiving and Sorting Room</td><td>78</td><td>26</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Exhaust (G)</td><td>45</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 – Soiled Receiving and Sorting Room
This contaminated room is separated from the clean side by the washer / extractors and typically has a high ceiling mounted track system for trolley cars that are used to move the bags of laundry. Therefore the air supply ductwork and grills are mounted high above the tracks. The air distribution should be directional with supply slots or high wall grills blowing down at the far end away from the loading doors of the washer extractors towards the door and exhaust grills in a line directly above the washer / extractor doors.</td></tr>
<tr><td colspan="14"></td></tr>
</table>

<table>
<tr><th colspan="14">CENTRAL LAUNDRY FACILITY - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN EXHAUST G EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td>XXXX: Clean Laundry Work Room</td><td>78</td><td>26</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Note 3 and 4</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 – Clean Laundry Work Room
This uncontaminated space is separated from the soiled receiving and sorting room by the washer extractors and the washer extractor unload doors open into this space. The dryers, ironers, clean linen bins and other equipment are located in this space.
Note 2 – Air Distribution
This space also contains high ceiling mounted track system for trolley cars that are used to move the bags of laundry so that air distribution must be above and out of the way requiring high velocity side grills / drum louvers for proper air motion in the space.
Note 3 – Return and Local Exhaust
Provide local exhaust system above the unloading doors for the washer extractors to remove hot humid air when unloading the machines. Exhaust quantity must not exceed minimum required ventilation (outdoor) air. Note the space is positive .
Note 4 – Special Exhaust
Provide direct ducted exhaust from dryers and ironers. See air handling unit data sheet for energy recovery opportunities.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>XXXX: Clean Laundry Storage Room</td><td>78</td><td>26</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 – Clean Laundry Storage Room
This uncontaminated space may be separate from the clean laundry work room or may be a designated storage area within the clean laundry work room. If it is not separate then temperature control must be concurrent with the controls for the Clean Landry Work Room.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>OFA09: Offices</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>0</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 – Space Temperature Control
Provide VAV terminal and reheat.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>XXXX: Break Room / Staff Lounge</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Exhaust (G)</td><td>40</td><td>(-)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Room Air
Return air is permitted if the lounge space is not equipped with cooking equipment (microwave, hot plate, toasters).</td></tr>
<tr><td colspan="14"></td></tr>
</table>

MINIMUM AHU REQUIREMENTS TO SERVE DENTAL CLINIC SPACES

AHU System Data Sheet

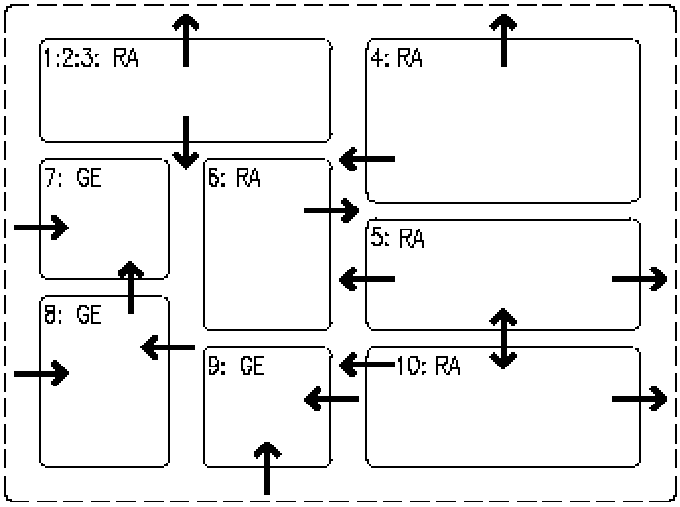
Air-Handling Type	Dedicated Variable Air Volume (paragraphs 3.2.3, 6.2 and 6.4)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode). Also, see Room Data Sheets
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Room Data Sheets
Special Exhaust System Required	Room Data Sheets
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - Emergency Epidemic Air-Handling Unit
Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 2 - Listed Rooms and Their Names
Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on the VA Dental Service Design Guide dated June 2014. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note 3 - Relative Humidity
See paragraph 6.5.1.1 for:
(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

DENTAL CLINIC AIR FLOW RELATIONSHIPS



LEGEND

1: DNXS1: X-RAY PANORAMIC / CEPHALOMETRIC (+)
2: DNXC1: CONE BEAM COMPUTERIZED TOMOGRAPHY (+)
3: DNXC2: CONE BEAM COMPUTERIZED TOMOGRAPHY CONTROL ROOM (+)
4: DNTG1/DNTG5: DENTAL TREATMENT ROOMS (+)
5: DNTS1: MINOR PROCEDURE ROOM ORAL SURGERY (+)
6: DNSC3: STERILE INSTRUMENT STORAGE (+)
7: MECH1: DENTAL EQUIPMENT MECHANICAL ROOM (–)
8: DNPL1: GENERAL PURPOSE LABORATORY (–)
9: DNPC1: LABORATORY PORCELAIN / CERAMICS (–)
10: DNTR1: PATIENT PREP / RECOVERY ROOM (+)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST
RA: RETURN AIR
AIR FLOW DIRECTION BETWEEN SPACES →
NEUTRAL AIR FLOW ↔
PEDESTRIAN CIRCULATION – – – – – – – – – –

DENTAL CLINIC - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
Dental Suite													
DNXS1: X- Ray Panoramic / Cephalometric	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
DNXC1: Cone Beam Computerized Tomography	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
DNXC2: Cone Beam Computerized Tomography Control Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note 1 - General Coordinate equipment heat gain with the manufacturer and evaluate resultant conditions. Remove heat by practical, available means. Adjust required temperature and humidity to match manufacturer's requirements.													
DNTG1: Multi-functional Dental Treatment Room	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
DNTG5: Special Needs Patient Dental Treatment Room	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
DNTS1 Minor Procedure Room Oral Surgery	75	24	70	21	60	30	15	3	Return	35	(+)	Yes	CV
Note 1 - Space Classification The design criteria are based on the assumption that the Oral Surgery Room is classified as Class A Surgery/Procedure Room (ASHRAE Standard 170 - 2013 or latest approved edition). The designer must verify the requirements with the end-users and modify the classification, if necessary. **Note 2 - Nitrous Oxide Gas** Where nitrous oxide gas is used, the design must implement the recommendation of National Institute for Occupational Safety and Health (NIOSH) to limit the occupational exposure within the prescribed limits by installing a local scavenging system. Compliance is also required to NFPA 99 for other safety requirements.													
DNSC3: Sterile Instrument Storage	66	19	72	22	55	30	4	4	Return	40	(+)	Yes	CV
MECH1 Dental Equipment Mechanical Room	80	27	65	18	N/A	N/A	N/A	N/A	Exhaust (G)	40	(-)	No	VAV/CV
Note 1 - General Coordinate equipment heat gain with the manufacturer and evaluate resultant conditions. Remove heat by practical, available means.													

DENTAL CLINIC - ROOM DATA SHEET

<table>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th>ROOM AIR</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th>% RH</th><th>% RH</th><th rowspan="2">RETURN
EXHAUST G
EXHAUST S</th><th rowspan="2">TEMP</th><th rowspan="2">FLOW</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>MAX</th><th>MIN</th></tr>
<tr><td colspan="14"></td></tr>
<tr><td colspan="14">Dental Suite (continued)</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>DNPL1: General Purpose Laboratory</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Exhaust (G)</td><td>40</td><td>(-)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Exhaust from Prosthetic Dental Workstation
Provide exhaust from the prosthetic dental workstation either by wall registers, installed at the table height, or by a canopy hood. Exhaust can be connected to the general exhaust system. Estimate the exhaust air volume based on the geometry of the work area.
Note 2 - Heat Gain
Coordinate equipment heat gain with the manufacturer.
Note 3 - Boil-Out Sink and Casing Soldering Areas
Provide exhaust over the boil-out sink and case-soldering area using a canopy hood, connected to a general exhaust system, and sized at 100 fpm [0.5 m/s] face velocity. Coordinate the hood size and location with the architectural drawings.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>DNPC1: Laboratory Porcelain / Ceramics</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Exhaust (G)</td><td>40</td><td>(-)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1: Heat Gain
Coordinate equipment heat gain with the manufacturer.
Note 2 - Exhaust Air Intakes
Locate exhaust registers and / or exhaust hoods at or near the technician's workbench. Coordinate with architectural and electrical drawings.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>DNTR1: Patient Prep / Recovery Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Return</td><td>35</td><td>(+)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
<tr><td colspan="14"></td></tr>
</table>

MINIMUM AHU REQUIREMENTS TO DIALYSIS TREATMENT SPACES	
AHU System Data Sheet	
Air-Handling Type	Non-dedicated Variable Air Volume (paragraphs 3.2.3, 6.3 and 6.4)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode). Also, see Room Data Sheets
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Room Data Sheets
Special Exhaust System Required	Room Data Sheets
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - Dedicated Air-Handling Unit

A dedicated air-handling unit is required if the AHU serving Dialysis Treatment and other spaces is not capable of operating at 100% OA during emergency epidemic mode, or if the AHU does not meet the requirements of the hours of operation and filtration. If warranted for other reasons the dialysis clinic may be provided with its own dedicated air handling unit.

Note 2 - Emergency Epidemic Air-Handling Unit

Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 3 - Listed Rooms and Their Names

Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on VA PG18-9 Chapter 316 Dialysis Center, Revised October 03, 2016. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

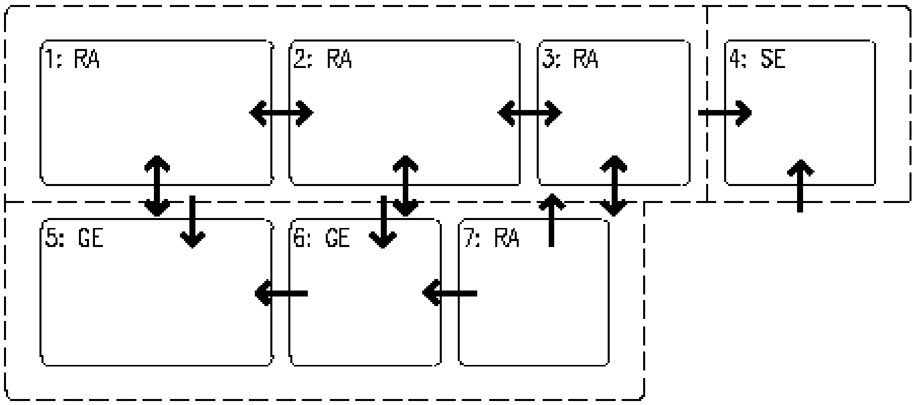
Note 4 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

DIALYSIS TREATMENT SPACES AIR FLOW RELATIONSHIPS



LEGEND

1: XXYYC: RENAL DIALYSIS PRIVATE BED STATION (0)

2: RDCD1: RENAL DIALYSIS CUBICLE CHAIR STATION (0)

3: XXYYC: RENAL DIALYSIS CUBICLE BED STATION (0)

4: RDCD2: RENAL DIALYSIS NEGATIVE ISOLATION PRESSURE BED STATION (--)

5: CSDE1: EQUIPMENT PROCESSING SOILED RECEIVING (--)

6: CSSS1: EQUIPMENT PROCESSING CLEAN PREPARATION (-)

7: CSSS1: EQUIPMENT PROCESSING CLEAN STORAGE (+)

GE: GENERAL EXHAUST

SE: SPECIAL EXHAUST (CONTAMINATED AIR)

RA: RETURN AIR

AIR FLOW DIRECTION BETWEEN SPACES →

NEUTRAL AIR FLOW ↔

PEDESTRIAN CIRCULATION - - - - - - - - - -

DIALYSIS CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN							
	F	C	F	C								TEMP	FLOW
XXYYC: Renal Dialysis Private Bed Station	78	26	72	22	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
RDC02: Renal Dialysis Negative Isolation Private Bed Station	78	26	72	22	60	30	12	2	Exhaust (S)	35	(--)	Yes	CV
Note 1 - Negative Isolation Pressure Bed Station See additional requirements on Room Data Sheets for Infectious Isolation rooms.													
RDC01: Renal Dialysis Cubicle Chair Station	78	26	72	22	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
XXYYC: Renal Dialysis Cubicle Bed Station	78	26	72	22	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
CSDE1: Equipment Processing Soiled Receiving	78	26	72	22	60	30	10	NR	Exhaust (G)	40	(--)	Yes	CV
Note - None													
CSSS1: Equipment Processing Clean Preparation	78	26	72	22	60	30	10	NR	Exhaust (G)	40	(-)	Yes	CV
Note - None													
CSIA1: Equipment Processing Clean Storage	70	21	70	21	55	30	4	4	Return	40	(+)	Yes	CV
Note - None													

MINIMUM AHU REQUIREMENTS TO SERVE DIGESTIVE DISEASES ENDOSCOPY SUITE

AHU System Data Sheet

Air-Handling Type	Non-dedicated Variable Air Volume or Medium Pressure Constant Volume (paragraphs 3.2.3, 6.3 and 6.4)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode). Also, see Room Data Sheets
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

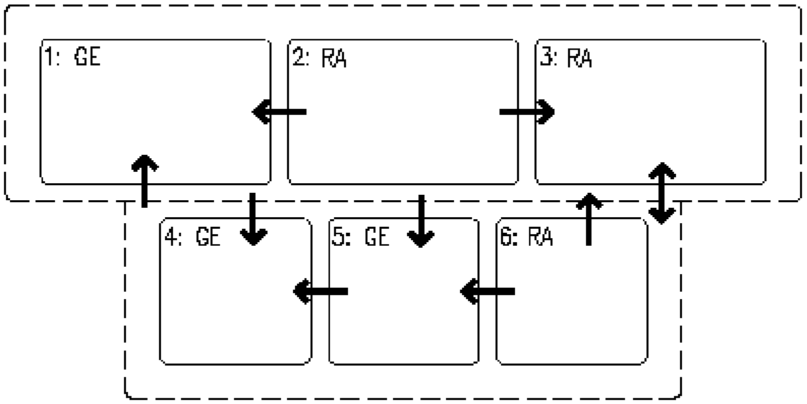
Note 1 - Dedicated Air-Handling Unit
A dedicated air-handling unit is required if the AHU serving Digestive Health and other spaces is not capable of operating at 100% OA during emergency epidemic mode, or if the AHU does not meet the requirements of the hours of operation and filtration.

Note 2 - Emergency Epidemic Air-Handling Unit
Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 3 - Listed Rooms and Their Names
Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on the VA Digestive Disease Endoscopy Service Design Guide dated November 29, 2011. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note 4 - Relative Humidity
See paragraph 6.5.1.1 for:
(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

DIGESTIVE DISEASES ENDOSCOPY SUITE AIR FLOW RELATIONSHIPS



LEGEND

1: TREE1: ENDOSCOPY PROCEDURE (–)
2: TREE2: ENDOSCOPIC ULTRASOUND PROCEDURE (ERCP) (+)
3: RRSS1: PREP AND RECOVERY (0)
4: USCL2: SCOPE DECONTAMINATION ROOM (–)
5: USCL3: SCOPE REPROCESS (–)
6: USCL4: CLEAN SCOPE STORAGE (+)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST
RA: RETURN AIR
AIR FLOW DIRECTION BETWEEN SPACES →
NEUTRAL AIR FLOW ↔
PEDESTRIAN CIRCULATION – – – – – – – – – –

DIGESTIVE DISEASES - ENDOSCOPY SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
Procedure Room													
TREE1: Endoscopy Procedure	68	20	73	23	60	30	10	2	Exhaust (G)	35	(-)	Yes	CV
TREE2: Endoscopic Ultrasound Procedure (ERCP)	68	20	73	23	60	30	6	2	Return	35	(o)	Yes	CV
USCL2: Scope Decontamination Room	66	19	72	22	60	30	10	10	Exhaust (G)	40	(--)	Yes	CV
USCL3: Scope Reprocess	66	19	72	22	60	30	10	10	Exhaust (G)	40	(-)	Yes	CV
USCL4: Clean Scope Storage	66	19	72	22	60	30	4	2	Return	40	(+)	Yes	CV
RRSS1: Prep and Recovery	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV

Note 1 - General: The space types listed in this manual reflect the terminology and functions used in the Department of Veterans Affairs, Digestive Diseases - Endoscopy Service Design Guide dated November 29, 2011. Endoscopy services suites constructed prior to this may also contain procedure rooms lists as proctoscopy, sigmoidoscopy, and colonoscopy, EGD. In the current practice all these procedures take place in the same space.

Note 2 - Air Handling Unit: If the size and / or arrangement of a specific endoscopy service warrants it, a separate air handling unit may be provided for this function, in general, however, any air handling unit meeting the minimum requirements in the Digestive Diseases AHU sheet and the space requirements on this sheet may be used. Provide in the design constant volume pressure independent reheat terminals to maintain the required constant volume air flows regardless of AHU type and operation.

Note 3 - Endoscopy Procedure: Includes, but not limited to all endoscopy, anoscopy, proctoscopy, colonoscopy, sigmoidoscopy, EGD, ERCP etc.

(a) Neutral room airflow pattern is acceptable if only GI procedures are performed. If there is reasonable likelihood the procedure room will be used for more than one type of procedure (e.g., GI endoscopy and bronchoscopy), the room must meet the most stringent criteria for the types of procedures to be performed in the room.

(b) Existing GI Endoscopy Procedure Rooms can meet original design standards required at the time of build if GI procedures only are performed in the room. If other procedures are performed besides GI procedures (e.g., bronchoscopy), the room must meet the standards/most stringent criteria for the types of procedures performed.

Note 4 - Scope Decontamination Room: See SPS for additional requirements of scope decontamination and processing rooms.

Note 5 - Room Air Balance

(a) The above stipulation of the positive air balance (clean room environment) is based on the assumption that the instruments shall be cleaned and sterilized in a separate space after the procedure. This separate cleaning room shall be maintained under negative air balance.

(b) If the above procedures are performed on a patient suspected of tuberculosis or similar infectious disease, the procedure room must be maintained under negative air balance and the room air should be exhausted outdoors without mixing with any other general exhaust.

DINING AREA (CAFETERIA) - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Unit	Dedicated (paragraph 6.2) Variable Air Volume
Indoor Design Temperature - Cooling	75 F [24 C]
Indoor Design Temperature - Heating	70 F [21 C]
Indoor Design Relative Humidity - Dehumidification	60%
Indoor Design Relative Humidity - Humidification	Optional (20%)
Minimum Total Air Changes Per Hour	6
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	Yes
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	Yes
Emergency Power Required	No
Individual Room Temperature Control Required	Yes
Room Air Balance	Negative (-)

Note 1 - Kitchen Make-Up Air
Estimate the make-up air requirement for the adjoining kitchen (if any) and transfer room air to the kitchen. Maintain the dining or cafeteria under positive air balance with respect to the kitchen.

Note 2 - Exhaust System
Provide a general or special exhaust system (NFPA 96) when the Dining Area (Cafeteria) is a standalone facility using a canopy and/or a range hood. Coordinate the exhaust air requirement with the kitchen consultant, drawings, and equipment catalogue cuts.

Note 3 - Air Balance
Maintain the Dining Area (Cafeteria) under negative air balance with respect to the adjoining spaces.

Note 4 - Relative Humidity
See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

DOMICILIARY - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Non-dedicated Variable Air Volume (paragraphs 3.2.3, 6.3 and 6.4)
Indoor Design Temperature - Cooling	Room Data Sheets
Indoor Design Temperature - Heating	Room Data Sheets
Indoor Design Relative Humidity - Dehumidification	Room Data Sheets
Indoor Design Relative Humidity - Humidification	Room Data Sheets
Minimum Total Air Changes Per Hour	Room Data Sheets
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode)
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant or "Clean" Steam
General Exhaust System Required	Yes
Special Exhaust System Required	Room Data Sheets
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - VAV Air-Handling Units

The all-air VAV system describe here can also be used for applicable spaces such as offices, lobbies, classrooms, examination examination rooms, conference rooms, etc. The number of air handling units shall be determined by practical design considerations such as available mechanical room spaces, available above ceiling space for ductwork, functional space grouping, occupancy schedules etc. Spaces requiring constant volume shall be served by constant volume air terminals.

Note 2 - Emergency Epidemic Air-Handling Unit

Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 3 - Dedicated Air-Handling Unit

A dedicated air-handling unit is required if the AHU serving Domiciliary and other spaces is not capable of operating at 100% OA during emergency epidemic mode, or if the AHU does not meet the requirements of the hours of operation and filtration.

Note 4 - Listed Rooms and Their Names

Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on VA PG18-9 Chapter 312 Domiciliary, Revised October 03, 2016. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note-5 - Relative Humidity

See paragraph 6.5.1.1 for:
(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

DOMICILIARY ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
OFDC2: Consult Room	75	24	70	21	60	30	4	2	Return	35	(o)	Note 1	VAV
Note 1 - Temperature Controls If one room is provided provide it with temperature control. If more than one room is provided follow Chapter 2 requirements.													
DAYR1: Patient Lounge	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
Note 1 - Folding Partitions Where the room is equipped with folding partitions, provide individual room temperature control for either side of the partition. Design the supply and return grill layout to operate at acceptable ADPI values with the partition open and with the partition closed. Provide return grill on both sides of the partition.													
Note 2 - Energy Conservation Initiative Provide a carbon-dioxide (CO2) and/or occupancy sensor to conserve energy during light occupancy. The control sequence must be project-specific. Comply with the requirements of ASHRAE 62.1 -2016 or latest approved edition.													
BRUN1: One-Bed Bedroom Addiction Treatment Program / Homeless Program / Health Maintenance Program / PTSD Program / Brain Injury Program	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
BRUN1: Two-Bed Bedroom Addiction Treatment Program / Homeless Program / Health Maintenance Program / PTSD Program	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note - None													
TSPB1: Toilet / Shower, Bariatric	NA	NA	70	21	NA	NA	10	NA	Exhaust G	40	(-)	Yes	CV
Note 1 - Bathroom Ventilation Bathroom total air change per hour (ACH) is achieved through exhaust only, with makeup air coming from the patient room supply system.													
Note 2: - Bathroom Temperature Control Bathrooms subject to heat loss must be heated through a thermostatically controlled terminal unit.													

DOMICILIARY ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
XXYYC: Multiple Living Unit Sleeping Area	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note - none													
TSPG1: Multiple Living Unit, Toilet / Shower	NA	NA	70	21	NA	NA	10	NA	Exhaust G	40	(-)	Yes	CV
Note 1 - Bathroom Ventilation Bathroom total air change per hour (ACH) is achieved through exhaust only, with makeup air coming from the patient room supply system.													

MINIMUM AHU REQUIREMENTS TO SERVE ELECTROENCEPHALOGRAPHY LABORATORY (EEG) SPACES

AHU System Data Sheet

Air-Handling Type	Non-dedicated (Par 6.3) Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	See Room Data Sheets
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14 (Normal Mode) AF = MERV 16A (Emergency Mode)
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Room Data Sheets
Special Exhaust System Required	Room Data Sheets
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - General

A separate air handling unit is not required and not prohibited. Any air handling unit used must meet the minimum requirements listed. If warranted for other reasons the EEG Laboratory may be provided with its own dedicated air handling unit.

Note 2 - Makeup Air Requirements

Any air handling unit serving the EEG Laboratory spaces need not be a 100% outside air system, however, the system must have adequate outside air flow to match the exhaust requirement of all spaces served plus additional air flow for overall space pressurization, or the minimum required outside air of all the spaces served whichever is greater.

Note 3 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 4 - Enhanced Air Filtration

(a) During Emergency Epidemic use enhanced after-filters as noted above.

(b) Size the AHU supply and return/relief fan motors to compensate for the additional air pressure drop due to enhanced filtration application.

(c) The AHU filter section must be configured to accommodate installation of enhanced after-filters during Emergency Epidemic.

(d) Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU

ELECTRONENCEPHALOGRAPHY LABORATORY (EEG) - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
Procedure Room													
OPEE1: EEG Exam Room	75	24	70	21	60	30	6	2	Return	35	(o)	No	VAV
EXRE 2: EMG Exam Room	75	24	70	21	60	30	6	2	Return	35	(o)	No	VAV
OPPF8: Patient Prep Room	75	24	70	21	60	30	6	2	Return	35	(o)	No	VAV

Note 1 - General

The space types listed in this manual reflect the terminology and functions used in the Department of Veterans Affairs, Electroencephalography Laboratory (EEG) Service Design Guide dated November 29, 2011.

Note 2 - Air Handling Unit

If the size and / or arrangement of a specific EEG service warrants it, a separate air handling unit may be provided for this function, in general, however, any air handling unit meeting the minimum requirements in the EEG Laboratory AHU sheet and the space requirements on this sheet may be used.

EMERGENCY DEPARTMENT - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Unit	Dedicated (paragraph 6.2) Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes Per Hour	Room Data Sheets
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Pandemic Emergency Mode)
Air Economizer Cycle Required	ASHRAE Standard 90.1, latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filters (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	Yes (Emergency Mode)
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - Listed Rooms and Their Names

Room name and criteria shown in attached Room Data Sheets (RDS) are based on VA PG 18-12 Emergency Services Design Guide.

Note 2 - Pandemic Emergency Mode

Design the AHU system to operate in 100% outdoor air mode during a medical emergency created by an epidemic of contagious diseases. The 100% outdoor air mode shall be activated manually. Size the utilities (chilled water, hot water, and steam) and controls to be compatible with the normal and Pandemic Emergency Modes. See the Emergency Department Design Guide for additional information.

Note 3 - Exhaust System

During pandemic emergency mode, the air handling unit and associated air distribution system shall be capable of providing 100% system exhaust; return air dampers shall be fully closed. Mixing dampers are to meet AMCA Standard 511 Class 1A leakage class rating. This may be accomplished by using return fan(s) or providing dedicated exhaust fans for pandemic emergency mode. Perform dispersion analysis to ensure that air exhausted during Pandemic Emergency Mode does not enter building, see 2.3.2.1. If required distances from the exhaust termination cannot be maintained, HEPA filters shall be utilized.

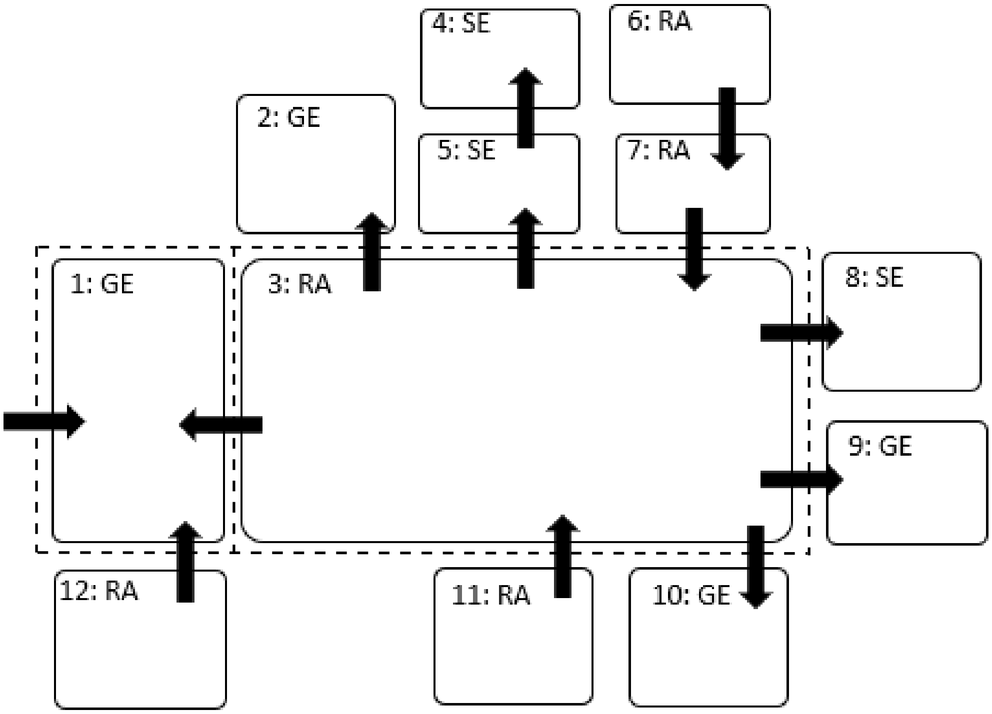
Note 4 - Humidity Control

See paragraph 6.4.1.1 Indoor Design Relative Humidity for required high and low relative humidity control strategies.

Note 5 - Post Pandemic Mode

Before switching from pandemic emergency mode to normal mode, change all filters and sterilize air handling unit. Method of sterilization will be dependent on the pathogen or event. In addition to AHU section doors, provide access doors in connected ductwork that allows access to dampers and other components. If the return or exhaust fans are external, provide access doors to allow access to fans, dampers, and duct connected to AHU.

EMERGENCY CARE UNIT AIR FLOW RELATIONSHIPS



LEGEND

1: WAITING ROOM (-)
2: TRIAGE (-)
3: STAFF, ADMINISTRATION, AND OTHER NEUTRAL AREAS (0)
4: AIRBORNE INFECTION ISOLATION (AII) EXAM / TREATMENT ROOM (--)
5: AIRBORNE INFECTION ISOLATION ANTE ROOM (-)
6: PROTECTIVE ENVIRONMENT (PE) EXAM / TREATMENT ROOM (++)
7: PROTECTIVE ENVIRONMENT ANTE ROOM (+)
8: AMBULANCE GARAGE (-)
9: TOILETS, SHOWERS, AND OTHER EXHAUSTED ROOMS (-)
10: EXAM / TREATMENT ROOM (-)
11: RESUSCITATION (+)
12: VESTIBULE (+)

GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST (CONTAMINATED AIR)
RA: RETURN AIR
AIRFLOW DIRECTION BETWEEN SPACES ➡
PEDESTRIAN CIRCULATION - - - - - - - -

EMERGENCY DEPARTMENT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
Airborne Infection Isolation (AII) Anteroom	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (S)	35	(-)	No	CV
Airborne Infection Isolation (AII) Exam / Treatment Room	75	24	70	21	60	30	12	2	Exhaust (S)	35	(--)	Yes	CV
Airborne Infection Isolation (AII) Patient Toilet	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (S)	40	(--)	No	CV
Protective Environment Anteroom	NA	NA	NA	NA	NA	NA	10	NA	Return	35	(+)	No	CV
Protective Environment (PE) Exam / Treatment Room	75	24	70	21	60	30	12	2	Return	35	(++)	Yes	CV
Protective Environment Patient Toilet	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (G)	40	(--)	No	CV
Note 1 - General: See Infectious Isolation Room Data Sheets for more information. Note that dual purpose negative / positive isolation rooms are prohibited.													
Resuscitation Room	75	24	70	21	60	30	15	3	Return	35	(+)	Yes	CV
Note 1 - Provide Group E nonaspirating supply diffusers for Trauma rooms. Group E diffusers are defined in the ASHRAE Handbook - Fundamentals.													
Workroom	75	24	70	21	60	30	6	2	Return	35	(o)	No	VAV
Exam / Treatment Room	75	24	70	21	60	30	6	2	Exhaust (G)	35	(-)	Note 1	CV
Note 1 - See Group Temperature Control in HVAC DM.													
Note 2 - All Exam / Treatment rooms are fully exhausted to outside and are negative pressure to provide continuous infection prevention for airborne disease.													
Note 3 - The ceiling exhaust grille shall be generally located over the head of the patient bed.													
Note 4 - A space differential pressure monitoring device connected to the building automation system shall be provided next to the room door on the corridor side.													
Note 5 - Provide tow exhaust fans for the Exam / Treatment exhaust system and operate in LEAD/LAG configuration with automatic controls to activate LAG fan upon LEAD fan failure.													
Bariatric Triage Room / Triage Room	75	24	70	21	60	30	12	2	Exhaust (G)	35	(-)	Yes	CV
General Waiting	75	24	70	21	65	30	12	2	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Infection Control: General Waiting Room shall be 100% exhausted and maintained negative to adjacent spaces.													
Note 2 - When the waiting room is open to larger, non-waiting spaces, the exhaust air volume shall be calculated based on the seating area of the waiting area. The intent is not to require the volume calculation to include a very large space (e.g. atrium) just because the waiting area opens up to it.													
Waiting areas	75	24	70	21	65	30	12	2	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Infection Control: All waiting rooms and areas are recommended to be 100% exhausted and maintained negative to adjacent spaces.													
Note 2 - When the waiting room is open to larger, non-waiting spaces, the exhaust air volume shall be calculated based on the seating area of the waiting area. The intent is not to require the volume calculation to include a very large space (e.g. atrium) just because the waiting area opens up to it.													

EMERGENCY DEPARTMENT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
Imaging Patient Dressing Room	NA	NA	NA	NA	NA	NA	4	NA	Return	35	(o)	No	VAV
Private Search Room	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Reception	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Quiet / Consult Room	75	24	70	21	60	30	4	2	Return	35	(o)	Note 1	VAV
Note 1 - See Group Temperature Control in Chapter 2.													
Security Room	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Equipment / Secure Evidence Room	75	24	70	21	60	30	4	2	Return	40	(o)	No	VAV
Private Search Room	75	24	70	21	60	30	4	2	Return	40	(o)	No	VAV
Medical Supplies Storage Room	75	24	70	21	60	30	4	2	Return	40	(o)	No	VAV
Sally Port	75	24	70	21	60	30	4	2	Return	40	(o)	No	VAV
Staff Training / Class Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Office	75	24	70	21	60	30	4	2	Return	40	(o)	Note 1	VAV
Note 1 - See Group Temperature Control in Chapter 2.													
Staff Breakroom	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Storage Room / Patient Belongings Room	75	24	70	21	60	30	4	2	Return	40	(o)	No	VAV
Mental Health Intervention Room	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Outbound / Inbound Staging / Holding Bay	75	24	70	21	60	30	4	2	Return	35	(o)	No	VAV
Tele-Health Room	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Medication Room	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Copy / Supply Room	NA	NA	NA	NA	NA	NA	6	NA	Exhaust (G)	40	(-)	No	VAV
Clean Utility Room	70	21	70	21	55	30	4	2	Return	40	(+)	Yes	CV
Note 1 - Provide humidity monitoring of this room is required. Verify with hospital.													
Decontamination Shower	NA	NA	NA	NA	NA	NA	12	2	Exhaust (G)	40	(-)	No	CV
Note 1 - Thermostat shall be in adjacent Decontamination Patient Changing Room													
Decontamination Patient Changing Room	75	24	70	21	60	30	4	2	Exhaust (G)	35	(-)	Yes	CV
Trash / Recycling Holding	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (G)	40	(--)	No	CV
Vestibule	75	24	50	10	60	NA	NA	NA	NA	45	(+)	Yes	CV
Note 1 - Heating - Provide a thermostatically controlled terminal heater. Coordinate type and location with the architectural discipline. Floor mounted cabinet heaters with bottom horizontal supply and top return have proven effective in counter-acting cold air settling at floor level.													
Note 2 - Space Pressurization - Supply 1.0 cfm/sf [5.1 L/s/m2] air under positive pressure from adjoining air terminal unit serving lobby to maintain positive pressure by allowing air to ex-filtrate outdoors.													

EMERGENCY DEPARTMENT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN							
	F	C	F	C								TEMP	FLOW
Patient Discharge Room	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Staff Toilet	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (G)	40	(--)	No	CV
Note 1 - Perimeter Heating - For toilets with an exterior wall subject to heat loss, provide thermostatically-controlled (closed -loop, local control) terminal heater(s) to maintain setpoint													
Toilet / Shower	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (G)	40	(--)	No	CV
Note 1 - Perimeter Heating - For toilets with an exterior wall subject to heat loss, provide thermostatically-controlled (closed -loop, local control) terminal heater(s) to maintain setpoint													
Workstation / Work Area	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Patient Toilet / Visitor Toilet / Mental Health Toilet	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (G)	40	(--)	No	CV
Note 1 - Perimeter Heating - For toilets with an exterior wall subject to heat loss, provide thermostatically-controlled (closed -loop, local control) terminal heater(s) to maintain setpoint													
Staff Locker Room	75	24	70	21	60	30	6	2	Exhaust (G)	40	(-)	Yes	CV
Patient Dressing Room / Patient Changing Room	NA	NA	NA	NA	60	30	4	2	Return	35	(o)	No	VAV
Simulation / Resuscitation Viewing Room	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Staging Area	75	24	70	21	60	30	4	2	Return	40	(o)	No	VAV
Supply Room	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Satellite Sterile Supply Room	72	22	66	19	60	30	4	2	Return	40	(+)	No	CV
Patient Belongings Room	75	24	70	21	60	30	4	2	Return	40	(o)	No	VAV
On-Call Bedroom / On-Call Room	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note 1 - See Group Temperature Control in Chapter 2.													
Class 2 Radiology Imaging Room	75	24	70	21	60	30	15	3	Return	35	(+)	Yes	CV
Radiology System Component Room	75	24	70	21	60	30	6	2	Return	36	(o)	Yes	VAV
Ultrasound Scanning Room	75	24	70	21	60	30	8	2	Return	37	(o)	Yes	CV
Note 1 - This is a class 1 imaging room													
Class 2 CT Scanning Room	75	24	70	21	60	30	15	3	Return	35	(+)	Yes	CV
CT Control Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV
CT System Component Room	70	21	70	21	50	30	6	2	Return	40	(o)	Yes	VAV
Ambulance Garage									Exhaust (S)		(-)	Yes	
Note 1 - HVAC design is highly dependent on location and site. See ED Services Design Guide and HVAC Design Manual for more information.													

MINIMUM AHU REQUIREMENTS TO SERVE EYE CLINIC SPACES

AHU System Data Sheet

Air-Handling Type	Non-dedicated (Par 6.3) Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	See Room Data Sheets
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14 (Normal Mode) AF = MERV 16A (Emergency Mode)
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Room Data Sheets
Special Exhaust System Required	Room Data Sheets
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - General

A separate air handling unit is not required and not prohibited. Any air handling unit used must meet the minimum requirements listed. If warranted for other reasons the Eye Clinic may be provided with its own dedicated air handling unit.

Note 2 - Listed Rooms and Their Names

Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on VA PG18-9 Chapter 233 Eye Clinic, Revised October 03, 2016. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note 3 - Makeup Air Requirements

Any air handling unit serving the Eye Clinic spaces need not be a 100% outside air system, however, the system must have adequate outside air flow to match the exhaust requirement of all spaces served plus additional air flow to ensure overall area is positive or the minimum required outside air of all the spaces served whichever is greater.

Note 4 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 4 - Enhanced Air Filtration

(a) During Emergency Epidemic use enhanced after-filters as noted above.

(b) Size the AHU supply and return/relief fan motors to compensate for the additional air pressure drop due to enhanced filtration application.

(c) The AHU filter section shall be configured to accommodate installation of enhanced after-filters during Emergency Epidemic.

(d) Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU interior surfaces.

EYE CLINIC - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
EYOT2: Exam / Treatment Room, Optometry	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note 1 - Temperature Control If more than one space is provided follow Chapter 2 requirements for temperature control zones.													
TREY2: Laser Room	75	24	70	21	60	30	15	3	Return	35	(+)	Yes	CV
Note - None													

GYMNASIUM - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Dedicated (Par 6.2) Constant Volume
Indoor Design Temperature - Cooling	75 F [24 C]
Indoor Design Temperature - Heating	70 F [21 C]
Indoor Design Relative Humidity - Dehumidification	60%
Indoor Design Relative Humidity - Humidification	Optional
Minimum Total Air Changes Per Hour	6
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water or DX
Heating Source	Steam and/or Hot Water
Humidification Source	Plant or "Clean" Steam
General Exhaust System Required	Yes
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Yes
Room Air Balance	Neutral (o)

Note 1 - Demand-Controlled Ventilation

Incorporate demand-controlled ventilation sequence, if feasible, to control outdoor air based on carbon-dioxide concentration. Follow requirements of ASHRAE Standard 62.1 -2016 or latest approved edition.

Note 2 - General Exhaust System

Provide a general exhaust system to serve adjoining support spaces (examples: toilets, locker rooms, HAC, etc.).

Note 3 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

IMAGING SERIES - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Dedicated Variable Air Volume (paragraphs 3.2.3, 6.2 and 6.4)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes Per Hour	Room Data Sheets
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode). Also, see Room Data Sheets
Exhaust Air Required	Yes (Emergency Mode). Also, see Room Data Sheets
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filters (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	Yes
Emergency Power Required	MRI Unit Emergency Exhaust Fan Associated Controls
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - Listed Rooms and Their Names

Room names shown in the attached Room Data Sheets are based on the VA Radiology Service Design Guide, April 2008; the VA MRI Design Guide, April 2008; the VA Radiation Therapy Service Design Guide, April 2008; and the VA Nuclear Medicine Design Guide April 2008. See other sections of Chapter 6 for the miscellaneous and support rooms, such as, Housekeeping Aide's Closet (HAC), Attic Space, Crawl Space (Pipe Basement), Exterior Stairs, Mechanical/Electrical Rooms, etc.

Note 2 - Emergency Epidemic Air-Handling Unit

Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 3 - Number of Air Handling Units

The number of air handling units to be used shall depend on a study of the differences in required space conditions amongst the different types of imaging systems being provided, the expected operating hours, project budget, and physical space constraints of the project.

Note 4 -MRI (Magnetic Resonance Imaging) Unit

(a) Reference Document

MRI Design Guide published by the VA Office of Construction and Facilities Management: This Publication contains valuable information about the space layout, equipment list, exhaust system and utility requirements. A design guide plate for each room shows tentative room dimensions and equipment layout.

(b) Coordination

Capacity and configuration of the MRI Unit varies by manufacturer. Coordinate with the project specific MRI vendor is mandatory. Coordinate vibration isolation requirement of AHU(s) sited in proximity to the MRI scanner.

(c) RF Shielding

For HVAC ducts and pipes penetrating RF shielding of the MRI Scanning Room, coordinate penetration requirements with MRI system manufacturer, RF shield vendor, and architectural discipline.

(d) Other HVAC Related Issues

MRI chilled water system, and MRI quench vent system design shall be closely coordinated with the specific MRI system being provided. Ensure the coordination in the documents takes into consideration all MRI system provided equipment to be installed by the building contractor.

IMAGING SERIES - AIR HANDLING UNIT

AHU System Data Sheet

Note 4 - Radiology Service

(a) Reference Document

Radiology Service Design Guide Published by the VA Office of Construction and Facility Management: This publication contains valuable information about the space layout, equipment list, and utilities requirements. A design guide plate for each room shows tentative room dimensions and the equipment layout.

(b) Shielded Walls and Ceilings

For HVAC ducts and pipes penetrating shielded walls and ceilings, ensure coordination with the architectural discipline and provide treatment as specified by the equipment manufacturer and medical physicist.

Note 5 - Nuclear Medicine

(a) Reference Document

Radiology Service Design Guide Published by the VA Office of Construction and Facility Management: This publication contains valuable information about the space layout, equipment list, and utilities requirements. A design guide plate for each room shows tentative room dimensions and the equipment layout.

(b) Exhaust Systems

Provide a special exhaust system(s) for fume hoods and biological safety cabinets. Coordinate hood locations and sizes with the architectural discipline. For radioisotope hoods, coordinate the need for HEPA filters or Carbon Filters or both or no filters with the VA Safety Officer.

(c) Shielded Walls and Ceilings

For HVAC ducts and pipes penetrating shielded walls and ceilings, ensure coordination with the architectural discipline and provide treatment as specified by the equipment manufacturer and medical physicist.

Note 6 - Radiation Therapy Service

(a) Reference Document

Radiology Service Design Guide Published by the VA Office of Construction and Facility Management: This publication contains valuable information about the space layout, equipment list, and utilities requirements. A design guide plate for each room shows tentative room dimensions and the equipment layout.

(b) Shielded Walls and Ceilings

For HVAC ducts and pipes penetrating shielded walls and ceilings, ensure coordination with the architectural discipline and provide treatment as specified by the equipment manufacturer and medical physicist.

Note 7 - Indoor Design Conditions

(a) Variance from This Manual

Indoor design conditions may vary from Room Data Sheets to meet the requirements of the selected equipment.

(b) Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 8 - Design Documents

The Room Data Sheets indicate generic requirements of various equipment in the Imagining Series. If the details of the selected equipment are not known when design documents are issued, provide a design based on information in the Room Data Sheets and based on an agreed vendor. The purpose is to provide a reasonable level of documentation for construction pricing and bidding.

IMAGING SERIES (MRI UNIT) - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
XMRC1: MRI Control Room	75	24	70	21	50	30	6	2	Return Exhaust (G)	40	(o)	Yes	VAV
Note - None													
XMRS1: MRI Scanning Room	68	20	70	21	50	40	12	2	Return Exhaust (S)	35	(o)	Yes	VAV

Note 1- Construction Coordination

Carefully coordinate all technical requirements indicated herein with the specific MRI system being installed. Also, carefully coordinate contractual requirements of the MRI systems installation with the MRI manufacturer's requirements. For example in many cases the MRI manufacturer's warranty requires chilled water system startup to be by the manufacturer and in that event the HVAC design documents have to provide a specific piping and instrument manifold that allows chilled water system startup prior to MRI installation. Review all requirements and coordinate.

Note 2- MRI Scanning Room Temperature

MRI scanners' image quality can be degraded by environmental conditions outside of the equipment manufacturer's specifications. MRI Scanning Room temperature must be maintained between 68 F - 70 F [20 C - 21 C] under both heating and cooling conditions.

Note 3 - Emergency Exhaust Fan

(a) Provide a special automatic/manual emergency exhaust system to exhaust the scanning room in the event cryogen spills in the room. Provide directly ducted connection between the exhaust air inlet and the fan, as shown in the sketch in the MRI Design Guide. The designer shall consult with MRI equipment manufacturer for required capacity.

(b) Automatic operation of the exhaust system must be interlocked to the MRI equipment vendor automatic alarm system (if provided) by an electric relay. Provide two manual switches (one located in the scanning room and the other in the control room) under the custody of the designated operating personnel.

(c) Exhaust fan can discharge from the walls or roof if there are no operable windows or outside air intakes, or if regular or scheduled human traffic is not within a 25 ft [7.6 m] radius. Provide a motorized damper in the return air duct to stop return air pick up.

(d) Provide a laser optical oxygen sensor, located 18 in [450 mm] below the suspended architectural ceiling, to sound an audible and visible local alarm and an alarm at the ECC in the event the oxygen level drops. Alternatively, if saturable sensor oxygen monitor systems are used, these must be located outside the MRI Scanning Room with a sampling tube entering the MRI Scanning Room at 18 in [450 mm] below the suspended architectural ceiling. Coordinate any and all penetrations of the required RF shield assembly with the RF shield vendor. Alarm must automatically activate the emergency exhaust fan operation sequence.

Note 4 - Cryogen (Quench) Vent Pipe

(a) Provide a vent pipe (size, location, and material to be coordinated with the MRI equipment supplier) from the RF shield to outdoors.

(b) Divide the scope of work such that the MRI vendor is responsible for the supply and installation of the vent pipe, including RF Shield fitting, from the magnet to the RF Shield Barrier.

(c) Helium gas vent can discharge horizontally, through exterior walls, or vertically, though the roof. For both discharge conditions, there must be no operable windows or outside air intakes, and no regular or scheduled human traffic within 25 ft [7.6 m] radius in all directions. Terminate the vent pipe with a turndown weather head. Horizontal chamfered terminations are not permitted. Termination must be protected from horizontal wind driven rain entry. Insulate the quench piping from the MRI connection to termination. Insulation must be calcium silicate type.

(d) Provide manual quench activation switches if required by the MRI manufacturer. Coordinate with specific system used.

IMAGING SERIES (MRI UNIT) - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW

Note 5 - Overpressure Relief

(a) Hatch in RF Shield Enclosure: MRI equipment vendor must be responsible for the supply, installation, and testing of the pressure relief hatch (gravity-operated). The hatch must be similar to a back draft damper. Upon sensing a difference in pressure between the occupied space and the void between the suspended ceiling and the RF Shield enclosure, the hatch must open to permit the cryogen gas to escape into the void between the RF Shield and the floor or roof above.

(b) Hatch in the Roof or Wall: Install an "explosion" hatch in the roof or wall, whichever is the closest, to relieve gas under pressure to the outdoors. The explosion hatch is pressure-actuated and can be connected to the quench alarm system. Coordinate the location, size and design or the hatch with the MRI equipment vendor. Provide snow/ice melt systems in hatch cover as indicated by position and local climate.

Note 6 - Optional MRI Equipment Circulating Fan (Room Air Distribution)

(a) At the MRI vendor's option, room air can be circulated through the MRI equipment by a dedicated circulating fan and returned back to the system by an indirect (thimble) connection. Coordinate the division in the scope of work between the MRI vendor and the general contractor.

(b) Arrange room air distribution to allow the conditioned air to flow over/through the MRI scanner with return and/or exhaust inlets located at the rear of the equipment back to facilitate MRI equipment cooling.

Note 7 - Ductwork and Devices

(a) All active devices (VAVs, fan coil units, dampers, humidifiers, sensors or detectors) shall be located outside the MRI Scanning Room.

(b) Ductwork, hangers, fasteners and appurtenances used within the MRI Scanning room plenum should be of non-magnetic materials and construction (e.g. aluminum).

(c) MRI manufacturer may recommend supply and return duct penetrations both enter the MRI Scanning Room from the MRI System Component room. Coordinate locations/routes.

(d) All piping and ductwork penetrations of MRI Scanning Room RF shield must be carefully coordinated with MRI manufacturer's and RF shield vendors' sitting requirements.

<table>
<tr><th colspan="14">IMAGING SERIES (MRI UNIT) - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th>ROOM AIR</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th><th rowspan="2">RETURN
EXHAUST G
EXHAUST S</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td>XMRC2: MRI Systems Component Room</td><td>70</td><td>21</td><td>70</td><td>21</td><td>60</td><td>40</td><td>6</td><td>2</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - HVAC System
(a) Provided a dedicated air conditioning unit to serve the System Component Room. Coordinate size and configuration with the equipment manufacturer. Coordinate air distribution with the raised floor. Provide water sensor alarm (local and at the ECC) in the event of water leakage below the raised floor.
(b) Provide a closed loop, dedicated, water chiller to cool the MRI equipment. Chiller shall be air cooled and remotely located. Provide cross connections with the central chilled water plant. Additional considerations are: Ensure that the water quality (pH value, hardness, and solid suspended contents) are in accordance with the equipment manufacturer's specifications. All piping from the System Component Room entering the MRI Scanning Room shall meet "Radio Frequency Requirements." Provide clearly marked and identified access for the piping located in walls and chases. Coordinate chilled water flow requirement, chilled water temperature, and division in scope of work (connection detail) at each chilled water connection.</td></tr>
<tr><td>WTG04: MRI Visiting Area</td><td>75</td><td>24</td><td>70</td><td>21</td><td>50</td><td>40</td><td>6</td><td>2</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
</table>

IMAGING SERIES (NUCLEAR MEDICINE SERVICES) - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN							
	F	C	F	C								TEMP	FLOW
XDBD1: Bone Densitometry Room	70	21	70	21	50	30	6	2	Return	35	(0)	Yes	CV
Note - None													
NMGS1: Nuclear Medicine Scanning Room (Patient Examination Room)	75	24	70	21	50	30	6	2	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Air Balance Provide visual indicator to demonstrate negative air balance. Exhaust space at 115% of supply air flow.													
Note 2 - Air Distribution Locate supply and exhaust air outlets to create a directional airflow and transfer air from the adjoining area. Locate 50% of exhaust air outlets at ceiling level and 50% of exhaust air outlets at 7 in [175 mm] above finished floor.													
Note 3 - Xenon Gas If xenon gas is used in this room, coordinate with the local radiation safety officer for any additional measures.													
NMRP1: Nuclear Medicine “Hot Lab” / Radiopharmacy	75	24	70	21	60	30	6	2	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Fume Hoods This room is also known as the Radiopharmacy Room. Coordinate quantity and type of fume hoods and/or biological safety cabinets and provide an appropriate, dedicated exhaust system(s) to serve the hoods. See Chapter 3. If radioactive xenon gas and/or radioactive iodine are used in this space, coordinate with the local radiation safety officer for additional measures necessary, if any. Provide a supplementary general exhaust system, if required per the room air balance.													
Note 2 - Air Balance Provide volumetric controls to demonstrate negative air balance.													
Note 3 - Air Distribution Locate supply and exhaust air outlets to create a directional airflow and transfer air from the adjoining area.													
NMIR1: Patient Dose Administration	75	24	70	21	50	30	6	2	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Air Balance Provide visual indicator to demonstrate negative air balance. Exhaust space at 115% of supply air flow.													
Note 2 - Air Distribution Locate supply and exhaust air outlets to create a directional airflow and transfer air from the adjoining area.													

IMAGING SERIES (NUCLEAR MEDICINE SERVICES) - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
NMRCR1: PET/CT Control Room	70	21	70	21	55	40	6	2	Exhaust (G)	35	(+)	Yes	VAV
Note - None													
NMSS1: PET/CT Scanning Room	70	21	70	21	55	40	12	2	Exhaust (G)	35	(-)	Yes	VAV
Note 1 - Air Balance Provide volumetric controls to demonstrate negative air balance.													
Note 2 - Air Distribution Locate supply and exhaust air outlets to create a directional airflow and transfer air from the adjoining area. Locate 50% of exhaust air outlets at ceiling level and 50% of exhaust air outlets at 7 in [175 mm] above finished floor.													
XMRC2: PET/CT System Component Room	70	21	70	21	50	40	6	2	Exhaust (G)	40	(+)	Yes	VAV
Note 1 - HVAC System **(a)** Provided a dedicated air conditioning unit to serve the System Component Room. Coordinate size and configuration with the equipment manufacturer. Coordinate air distribution with the raised floor. Provide water sensor alarm (local and at the ECC) in the event of water leakage below the raised floor.													
(b) Provide a closed loop, dedicated, water chiller to cool the PET/CT equipment. Chiller must be air cooled and remotely located. Provide cross connections with the central chilled water plant. Additional considerations are: Ensure that the water quality (pH value, hardness, and solid suspended contents) are in accordance with the equipment manufacturer's specifications. Provide clearly marked and identified access for the piping located in walls and chases. Coordinate chilled water flow requirement, chilled water temperature, and division in scope of work (connection detail) at each chilled water connection.													
(c) Coordinate technical and contractual requirements with manufacturer of PET/CT system. Ensure chilled water equipment, if provided by PET/CT manufacturer is installed by mechanical contractor and powered by electrical contractor. Ensure system startup is consistent with PET/CT manufacturer's requirements and provide pipe manifolds and instruments needed for startup.													
NMRP1: Radio Chemistry Room	75	24	70	21	60	30	10	2	Exhaust (G)	40	(-)	Yes	VAV
Note 1 - Air Balance Provide volumetric controls to demonstrate negative air balance.													

IMAGING SERIES (RADIATION THERAPY SERVICES) - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
XTSC1: CT Simulator Control Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV
Note - None													
XTSG1: CT Simulator Unit Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV
Note - None													
XTLA1: Linear Accelerator (IMRT) Room	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	CV
XTLC1: Linear Accelerator Control Area	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	CV
Note - None													
XTTP1: Treatment Planning Computer Room - Dosimetry Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV
Note - None													
XDUS1: Ultrasound Planning Unit Room	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	CV
Note 1 - Air Balance Maintain negative room air balance in adjoining toilet by 100% exhaust of toilet at 10 ACH.													

IMAGING SERIES (RADIOLOGY SERVICES) - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
XCTC1: CT Area - Control Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV
Note - None													
XCTS1: CT Area - Scanning Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV
Note - None													
Interventional Radiology (IR) Rooms													
XACR1: IR Area - Control Room	75	24	70	21	60	30	15	2	Return	35	(o)	Yes	CV
XABP1: IR Area - Procedure Room	66	24	75	24	60	30	20	4	Return	35	(+)	Yes	CV
XACV1: IR Area - System Component Room	70	21	70	21	60	30	6	2	Return	35	(o)	Yes	CV
Note - None													
XDCS1: Patient Area - Chest Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV
XDR01: Patient Area - Head Room/ Tomography	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV
Note - None													
XDR01: Patient Area - General Purpose Radiology Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV
Note - Communicable Disease Isolation													
See Communicable Disease Isolation room requirements elsewhere in Chapter 6 tables if a room needs to be provided with isolation capability.													
XDM01: Mammography Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	CV
Note - None													

<table>
<tr><th colspan="14">IMAGING SERIES (RADIOLOGY SERVICES) - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th>ROOM AIR</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th><th rowspan="2">RETURN
EXHAUST G
EXHAUST S</th><th rowspan="2">TEMP</th><th rowspan="2">FLOW</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th></tr>
<tr><td colspan="14"></td></tr>
<tr><td>XDRF1: Patient Area - Radiographic/Fluoroscopic Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Alternate Exhaust System
Provide a special exhaust system and maintain the room under negative air balance if the procedures involve the use of noxious gases and / or chemical vapors, generally contained in a hood. Coordinate hood size and type with the equipment drawings.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>XDUS1: Patient Area - Ultrasound Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>8</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Air Balance
Maintain negative room air balance in adjoining toilet by 100% exhaust of 10 ACH.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>WTG03: Radiology Waiting Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Risk Assessment
Conduct risk assessment to determine if radiology waiting room should be 100% exhausted and maintained negative. If warranted design the HVAC for this room as indicated in Table 7.1 of the ASHRAE Standard 170 - 2013 or latest approved edition.</td></tr>
<tr><td colspan="14"></td></tr>
</table>

MINIMUM AHU REQUIREMENTS TO SERVE INFECTIOUS ISOLATION ROOMS / PROTECTIVE ENVIRONMENTS

AHU System Data Sheet

Air-Handling Type	Non-dedicated Variable Air Volume or Medium Pressure Constant Volume (paragraphs 3.2.3, 6.3 and 6.~~2~~4)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode). Also, see Room Data Sheets
Exhaust Air Required	Yes (Emergency Mode). Also, see Room Data Sheets
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	No
Special Exhaust System Required	Yes
Emergency Power Required	Yes - Equipment Branch
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

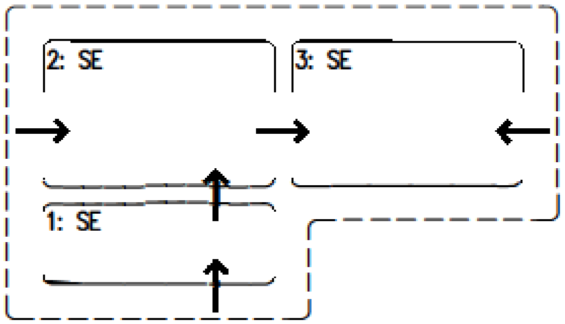
Note 1 - Emergency Epidemic Air-Handling Unit
Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 2 - Dedicated Air-Handling Unit
A dedicated air-handling unit is required if the AHU serving Infectious Isolation and other spaces is not capable of operating at 100% OA during emergency epidemic mode, or if the AHU does not meet the requirements of the hours of operation and filtration.

Note 3 - Constant Volume
Constant volume air flow control valves shall be used to maintain constant air flow as well as constant air flow differential between adjacent spaces.

Note 4 - Relative Humidity
See paragraph 6.5.1.1 for:
(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

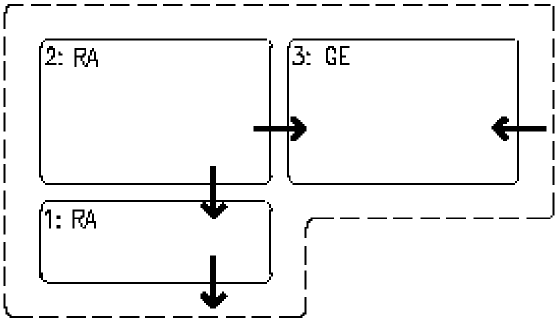
COMMUNICABLE DISEASE ISOLATION (AII) ROOM AIR FLOW RELATIONSHIPS



LEGEND

1: XXXX: AII ANTE ROOM (–)
2: XXXX: AII ISOLATION ROOM (––)
3: TLTP1: AII TOILET (––)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST (CONTAMINATED AIR)
RA: RETURN AIR
AIR FLOW DIRECTION BETWEEN SPACES →
NEUTRAL AIR FLOW ↔
PEDESTRIAN CIRCULATION – – – – – – – – –

PROTECTIVE ENVIRONMENT ISOLATION (PE) ROOM AIR FLOW RELATIONSHIPS



LEGEND

1: XXXX: PE ANTE ROOM (+)
2: XXXX: PE ISOLATION ROOM (++)
3: TLTP1: PE TOILET (--)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST
RA: RETURN AIR
AIR FLOW DIRECTION BETWEEN SPACES →
NEUTRAL AIR FLOW ↔
PEDESTRIAN CIRCULATION - - - - - - - - -

INFECTIOUS ISOLATION AND PROTECTIVE ENVIRONMENT - ROOM DATA SHEET

Infectious Isolation Rooms and Protective Environments

Note 1 - General

Isolation Rooms are classified into two categories: Airborne Infection Isolation (AII), and Protective Environment (PE). Combining the two types of rooms is strictly prohibited. An ante room must be provided for every PE room and for every AII room. Room codes assigned to these rooms will vary based on the clinical function in which they are being used.

(a) Ante Rooms facilitate intended design air balance and maintain pressure differentials.

(b) Ante Rooms provide better protection by isolating PE patients from the adjoining environment and the adjoining environment from the AII patient.

(c) Ante Rooms provide the space required to don protective equipment before entering the isolation room.

(d) Ante Rooms can be used for hand hygiene and storage of personal protective equipment and clean equipment.

(e) ACH ventilation rates are minimum, actual number must be the higher of 12 ACH, CFM required for cooling load, and CFM required to maintain required space pressure differential between the AII room and the anteroom. The differential must be calculated based on the installed door size and characteristics. Coordinate with architecture.

Infectious Isolation Rooms

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
AII Ante Room	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (S)	35	(-)	No	CV
AII Isolation Room	75	24	70	21	60	30	12	2	Exhaust (S)	35	(--)	Yes	CV

Note 1 - Special Exhaust System

Provide a dedicated, special exhaust system for the Patient Bedroom, Ante Room and Patient Toilet (where present). Do not connect rooms other than infection isolation rooms to the dedicated exhaust system. Locate the exhaust fan at the end of the duct run to maintain the ductwork within the building at a negative pressure and install bag-in-bag out HEPA filters just prior to the fan inlet. Discharge exhaust air above the highest roof level through a stack at least 10 ft [3 m] tall at 3,500 fpm [18 m/s] discharge velocity. The discharge air outlet must be located at least 25 ft [8 m] from outdoor air intakes and operable windows. Follow the recommendations of the dispersion analysis for higher than minimum requirements. Provide emergency power for the exhaust fan and associated controls. Label ductwork, filter, and fan "COMMUNICABLE DISEASE CONTAMINATED AIR". Where ever practical connect as many AII rooms as possible to one exhaust system. In all cases provide two exhaust fans per exhaust system and operate in LEAD/LAG configuration with automatic controls to turn on LAG fan upon LEAD fan failure.

Note 2 - Instrumentation

Provide a room differential pressure monitoring device between Ante Room and Isolation Room, and between Ante Room and corridor.

Note 3 - Air Distribution Layout

(a) AII Isolation Room

Locate the exhaust air inlet over or near the patient bed to ensure that air flows into the room and away from the patient room door. Preferred location of the exhaust air inlet is in the wall, 7 in [175 mm] above the floor, and near the patient head rest.

(b) AII Ante Room

Air must transfer from the Corridor into the Ante Room and then to the Isolation Room. The Ante Room is positive with respect to the Isolation Room and negative with respect to the Corridor.

INFECTIOUS ISOLATION AND PROTECTIVE ENVIRONMENT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S				
	F	C	F	C								TEMP	FLOW
Protective Environment (PE) (Positive Air Pressure)													
PE Ante Room	NA	NA	NA	NA	NA	NA	10	NA	Return	35	(+)	No	CV
PE Isolation Room	75	24	70	21	60	30	12	2	Return	35	(++)	Yes	CV

Note 1 - Terminal HEPA Filter

Provide duct-mounted, terminal MERV 17 (HEPA) filter downstream of the dedicated air terminal units serving the Isolation Rooms. Ensure access for filter replacement and instrumentation. Provide a differential pressure gage and a differential pressure switch with a remote alarm to the ECC when the pressure drop exceeds the recommended pressure drop.

Note 2 - Instrumentation

Provide a room differential pressure monitoring device between Ante Room and Isolation Room, and between Ante Room and corridor.

Note 3 - Air Distribution Layout

(a) PE Isolation Room

Locate the exhaust air inlet over or near the entry door to ensure that air flows into the room and away from the patient bed.

(b) PE Ante Room

Air must transfer from the Isolation Room into the Ante Room and then to the Corridor. The Ante Room is negative with respect to the Isolation Room and positive with respect to the Corridor.

KITCHEN (FOOD PRODUCTION) - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Dedicated Constant Volume (paragraphs 3.2.3, 6.2 and 6.4)
Indoor Design Temperature - Cooling	78 F [26 C]
Indoor Design Temperature - Heating	70 F [21 C]
Indoor Design Relative Humidity - Dehumidification	60%
Indoor Design Relative Humidity - Humidification	Not Required
Minimum Total Air Changes Per Hour	10
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Not Required
General Exhaust System Required	Yes
Special Exhaust System Required	Yes
Emergency Power Required	No
Individual Room Temperature Control Required	Yes
Room Air Balance	Negative (-)
Compliance	NFPA 96

Note 1 - Space Air Balance

Minimum room air changes can be increased to meet the exhaust requirements of the range hood and canopy hoods. Conversely, room air can be returned back to the air-handling unit if the system air balance shows surplus air after accounting for the hood exhaust requirement and the use of the return air is economically viable. Transfer air from the exit corridor may be used to maintain negative air balance in the space.

Note 2 - Emergency Epidemic Air-Handling Unit

Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 3 - Grease Hood Exhaust System

Provide a dedicated exhaust system to remove grease-laden air in accordance with NFPA 96. The design shall also follow the following code requirements:

(a) Discharge exhaust per dispersion analysis recommendations.

(b) Maintain at least 40 in [1,000 mm] between the roof surface and exhaust air outlet.

(c) Do not install fire dampers, volume dampers, and turning vanes in the exhaust duct. Avoid excessive horizontal runs and install access doors at each turn for grease removal. Slope duct towards the hood.

(d) Do not install exhaust duct in the shaft carrying environmental ducts (NFPA 90A).

(e) Provide exhaust system and AHU with controls to reduce exhaust and make-up air flows when the cooking equipment is turned off.

Note 4 - Make-Up Air Hood (Grease Hood Exhaust)

Make-up air hood is permitted if proven economically viable. Past experience has shown that the initial and recurring costs associated with the make-up air system and the discomfort experienced by the kitchen staff due to the proximity of marginally tempered make-up air makes the make-up air hood system as a less desirable alternate.

Note 5 - General Exhaust System (Optional)

Provide a dedicated exhaust system to capture heat over refrigeration condensing units, plate warmer, mixer, etc. Factory or field-installed installed canopy hoods may be required.

KITCHEN (FOOD PRODUCTION) - AIR HANDLING UNIT

AHU System Data Sheet

Note 5 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 6 - Wet Exhaust System

Provide a dedicated exhaust system to capture and remove moisture over pot/pan washing areas, dishwashers, steam kettles, steamers and high-pressure cookers. Use field-installed or integral hoods furnished by the equipment manufacturer.

Note 7 - Energy Recovery System or Return Air

Based on the actual air balance and the life-cycle cost analysis, either return the "clean air" to the system or exhaust outdoors after passing through an energy recovery system. Note that the use of an energy recovery system is not permitted with grease laden and wet air exhausts.

PATHOLOGY & LABORATORIES - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Dedicated (Par 6.2) Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes Per Hour	Room Data Sheets
Minimum Outdoor Air Changes Per Hour	100%
Return Air Permitted	No
Exhaust Air Required	Yes
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	Yes
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets
Compliance	NFPA 45 and 99

Note 1 - Air-Handling Unit

A dedicated air-handling unit with 100% outdoor air is required when a group of laboratories, forming a full-fledged department is in the project scope. One or two laboratories, in the outpatient clinic or similar facilities, can be served by an air-handling unit with minimum outdoor air shown in the Room Data Sheets (Reference: ASHRAE Standard 170-2013 or latest approved edition) and meeting the filtration requirements.

Note 2 - Fume Hoods and Biological Safety Cabinets

Coordinate exhaust needs with the laboratory equipment (fume hoods and biological safety cabinets). Room noise levels can be increased by NC 5 for laboratories equipped with fume hoods and/or biological safety cabinets.

Note 3 - AHU System Configuration

(a) The system configuration (CV or VAV) shall be project specific. Applications involving multiple hoods, selected to maintain fixed face velocity at varying sash positions, are ideally suited for a variable air volume system. Such VAV systems are signed to meet the simultaneous, but at times differing, needs of the room cooling load and equipment exhaust. The control system shall be designed to provide dynamic interaction between the equipment exhaust and general systems while still maintaining a constant "offset" (make-up air) from the adjoining corridor for negative air balance.

(b) Use of low flow fume hoods shall be evaluated and compared to the VAV system.

Note 4 - General Laboratory

General Laboratory or "Dry Laboratory" is defined as a space without hoods or biological safety cabinets and chemical are not used within the space. Generally used for research activities, these laboratories contain electronic equipment. Room air can be returned back to the unit, but the cost-effectiveness of doing so when using 100% outdoor air units shall be evaluated before doing so.

Note 5 - Nuclear Laboratory

Nuclear Medicine Laboratory is included in the dedicated air-handling system for the Imaging Series.

Note 6 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 7 - Local Exhaust

Where compatible with electronic laboratory equipment provide local snorkel indirect connections to remove heat directly from the laboratory equipments cooling fan into the general exhaust system.

PATHOLOGY & LABORATORIES - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C	MAX	MIN							
General: Coordinate supply and exhaust air volumes with the fume hoods and biological safety cabinets. A general exhaust system must be provided where spaces are not equipped with fume hoods and/or biological safety cabinets.													
Bacteriology	75	24	70	21	60	30	6	2	Exhaust (S)	40	(-)	Yes	CV or VAV
Note 1 - Where VAV supply is provided, an exhaust valve shall also be provided to ensure room balance is maintained.													
Biochemistry	75	24	70	21	60	30	6	2	Exhaust (S)	40	(-)	Yes	CV or VAV
Note 1 - Where VAV supply is provided, an exhaust valve must also be provided to ensure room balance is maintained.													
Cytology	75	24	70	21	60	30	6	2	Exhaust (S)	40	(-)	Yes	CV or VAV
Note 1 - Where VAV supply is provided, an exhaust valve must also be provided to ensure room balance is maintained.													
Dry Laboratories	75	24	70	21	60	30	6	2	Return	40	(-)	Yes	CV or VAV
Note 1 - Where VAV supply is provided, an exhaust valve must also be provided to ensure room balance is maintained.													
Note 2 - Room air can be returned only if chemicals are not used in the room.													
Glass Washing	NA	NA	NA	NA	NA	NA	10	2	Exhaust (S)	40	(-)	No	CV
Note 1 - Wet Exhaust System Provide a wet exhaust system.													
Histology	75	24	70	21	60	30	6	2	Exhaust (S)	40	(-)	Yes	CV
Note - None													
Media Transfer	75	24	70	21	60	30	4	2	Exhaust (S)	45	(+)	Yes	CV
Note 1 - Room Air Return Room air can be returned if chemicals are not used in the room.													

PATHOLOGY & LABORATORIES - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
Microbiology	75	24	70	21	60	30	6	2	Exhaust (S)	40	(-)	Yes	CV or VAV
Note 1 - Where VAV supply is provided, an exhaust valve shall also be provided to ensure room balance is maintained.													
Pathology	75	24	70	21	60	30	6	2	Exhaust (S)	40	(-)	Yes	CV or VAV
Note 1 - Where VAV supply is provided, an exhaust valve shall also be provided to ensure room balance is maintained.													
Serology	75	24	70	21	60	30	6	2	Exhaust (S)	40	(-)	Yes	CV or VAV
Note 1 - Where VAV supply is provided, an exhaust valve shall also be provided to ensure room balance is maintained.													
Sterilizing	75	24	70	21	60	30	10	2	Exhaust (S)	40	(-)	Yes	CV or VAV
Note 1 - Wet Exhaust System **(a)** Provide a wet exhaust system. **(b)** Where VAV supply is provided, an exhaust valve must also be provided to ensure room balance is maintained.													

MAIN ENTRANCE LOBBY - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Dedicated Variable Air Volume (paragraphs 3.2.3, 6.2 and 6.4)
Indoor Design Temperature - Cooling	75 F [24 C]
Indoor Design Temperature - Heating	70 F [21 C]
Indoor Design Relative Humidity - Dehumidification	60%
Indoor Design Relative Humidity - Humidification	Optional (20%)
Minimum Total Air Changes Per Hour	6
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode). Also, from Selected Spaces)
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Yes
Room Air Balance	Positive (+)

Note 1 - Areas Served

The air-handling unit may serve adjoining spaces, such as, Gift Shop, Barber's Shop, Chapel, Public Toilets, and Waiting and Admitting. See Non Patient Room Data Sheets, for additional information on these spaces.

Note 2 - Emergency Epidemic Air-Handling Unit

Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 3 - Air Balance

Maintain lobby at positive air balance with respect to the vestibule. Calculate exfiltration to maintain at least 0.02 Inch WC.

Note 4 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

MINIMUM AHU REQUIREMENTS TO SERVE INPATIENT MENTAL HEALTH UNIT

AHU System Data Sheet

Air-Handling Type	Non-dedicated Variable Air Volume (paragraphs 3.2.3, 6.3 and 6.4)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode)
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - Emergency Epidemic Air-Handling Unit
Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 2 - Dedicated Air-Handling Unit
A dedicated air-handling unit is required if the AHU serving Inpatient MH and other spaces is not capable of operating at 100% OA during emergency epidemic mode, or if the AHU does not meet the requirements of the hours of operation and filtration.

Note 3 - Listed Rooms and Their Names
Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on the VA Mental Health Facilities Design Guide dated December of 2010 and Revised August of 2014. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note 4 - Relative Humidity
See paragraph 6.45.1.1 for:
(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

MENTAL HEALTH INPATIENT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
BRNP1: One Bed Patient Room Standard/Accessible/Bariatric	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
TLTS2: Patient Toilet Standard/Accessible/Bariatric	NA	NA	68	20	NA	30	10	NA	Exhaust (G)	35	(--)	Notes	CV

Note 1 - Safety Requirements - Exposed Equipment

Use of exposed and accessible HVAC equipment is not permitted (examples: Room-mounted fan coil units and convectors, air outlets/inlets, temperature sensors, etc.).

Note 2 - Safety Requirements - Suspended Ceiling

Do not use lay-in tile acoustical ceiling. Use hard ceiling or concealed snap in arrangement. Keep ceiling height as high as possible. Use security clips to retain radiant ceiling panels in place. Ensure coordination with the architectural discipline.

Note 3 - Safety Requirements - Suspended Air Outlets/Inlets

Provide security diffusers, grilles, and registers.

Note 4 - Bathroom Exhaust

Bathroom must be constantly exhausted at highest of 10 ACH rate, 50 CFM, or room air balance with the makeup air coming from the patient room thus maintaining the bathroom flow 30% negative to the patient room and the patient room neutral to the corridor; therefore, the minimum outside air to the patient room must be 2 ACH or the required bathroom makeup whichever is greater.

Note 5 - Bathroom Temperature

Bathrooms without heat loss do not required heating or cooling. Bathrooms with heat loss must be provided with a supply diffuser from the room variable air volume terminal, or radiant heating which meets the safety requirements of Note 1.

BRNP2: Two Bed Patient Room Standard	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
TLTS2: Patient Toilet Standard	NA	NA	68	20	NA	30	10	NA	Exhaust (G)	35	(--)	Notes	CV

Note 1 - Safety Requirements - Exposed Equipment

Use of exposed and accessible HVAC equipment is not permitted (examples: Room-mounted fan coil units and convectors, air outlets/inlets, temperature sensors, etc.).

Note 2 - Safety Requirements - Suspended Ceiling

Do not use lay-in tile acoustical ceiling. Use hard ceiling or concealed snap in arrangement. Keep ceiling height as high as possible. Use security clips to retain radiant ceiling panels in place. Ensure coordination with the architectural discipline.

Note 3 - Safety Requirements - Suspended Air Outlets/Inlets

Provide security diffusers, grilles, and registers.

Note 4 - Bathroom Exhaust

Bathroom must be constantly exhausted at highest of 10 ACH rate, 50 CFM, or room air balance with the makeup air coming from the patient room thus maintaining the bathroom flow 30% negative to the patient room and the patient room neutral to the corridor; therefore, the minimum outside air to the patient room must be 2 ACH or the required bathroom makeup whichever is greater.

Note 5 - Bathroom Temperature

Bathrooms without heat loss do not required heating or cooling. Bathrooms with heat loss must be provided with a supply diffuser from the room variable air volume terminal, or radiant heating which meets the safety requirements of note 1.

MENTAL HEALTH INPATIENT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
BRNP5: Isolation Restraint Room / Isolation Seclusion Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
BRNP6: Ante Room	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
TLTS3: Patient Toilet Standard	NA	NA	68	20	NA	30	10	NA	Exhaust (G)	35	(--)	Notes	CV
Note 1 - Safety Requirements - Exposed Equipment Use of exposed and accessible HVAC equipment is not permitted (examples: Room-mounted fan coil units and convectors, air outlets/inlets, temperature sensors, etc.).													
Note 2 - Safety Requirements - Suspended Ceiling Do not use lay-in tile acoustical ceiling. Use hard ceiling or concealed snap in arrangement. Keep ceiling height as high as possible. Use security clips to retain radiant ceiling panels in place. Ensure coordination with the architectural discipline.													
Note 3 - Safety Requirements - Suspended Air Outlets/Inlets Provide security diffusers, grilles, and registers.													
Note 4 - Bathroom Exhaust Bathroom must be constantly exhausted at highest of 10 ACH rate, 50 CFM, or room air balance with the makeup air coming from the patient room thus maintaining the bathroom flow negative to the patient room and the patient room neutral to the corridor; therfore, the minimum outside air to the patient room must be 2 ACH or the required bathroom makeup whichever is greater.													
Note 5 - Bathroom Temperature Bathrooms without heat loss do not required heating or cooling. Bathrooms with heat loss must be provided with a supply diffuser from the room variable air volume terminal, or radiant heating which meets the safety requirements of Note 1.													
NSTA1: Nursing Station	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note - None													
WRCH1: Nurse Workroom	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note - None													
MEDP1: Medication Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
CRA01: Team Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													

MENTAL HEALTH INPATIENT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
FSCD1: Dining Room	75	24	70	21	60	30	6	2	Return	40	(-)	Yes	VAV
Note 1 - Local Exhaust Requirements. Provide general and / or local exhaust as required by ASHRAE 62.1-2016 or latest approved edition. Makeup air must come from the Corridor.													
FSPT1: Serving / Pantry	75	24	70	21	60	30	4	2	Return	40	(-)	Yes	VAV
Note 1 - Local Exhaust Requirements Provide general and / or local exhaust as required by ASHRAE 62.1-2016 or latest approved edition. Makeup air must come from the Dining Room.													
DAYR1: Day Room	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
Note - None													
OPMH1: Group Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													

MINIMUM AHU REQUIREMENTS TO SERVE MENTAL HEALTH REHABILITATION TREATMENT PROGRAM FACILITY

AHU System Data Sheet

Air-Handling Type	Non-dedicated (Par 6.3)Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14 (Normal Mode) AF = MERV 16A (Emergency Mode)
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - General

A separate air handling unit is not required and not prohibited. Any air handling unit used must meet the minimum requirements listed. The air handling unit must operate 24 hours per day, 7 days per week.

Note 2 - Listed Rooms and Their Names

Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on the VA Mental Health Facilities Design Guide dated December of 2010 and Revised August of 2014. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note 3 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 4 - Enhanced Air Filtration

(a) During Emergency Epidemic use enhanced after-filters as noted above.

(b) Size the AHU supply and return/relief fan motors to compensate for the additional air pressure drop due to enhanced filtration application.

(c) The AHU filter section shall be configured to accommodate installation of enhanced after-filters during Emergency Epidemic.

(d) Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU interior surfaces.

MENTAL HEALTH RESIDENTIAL REHABILITATION TREATMENT PROGRAM (RRTP) FACILITY - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN							
	F	C	F	C								TEMP	FLOW
BRAR2: Suite Vestibule (Two Bedroom Suite)	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV

Note 1 - Safety Requirements - Exposed Equipment

Use of exposed and accessible HVAC equipment is not permitted (examples: Room-mounted fan coil units and convectors, air outlets/inlets, temperature sensors, etc.).

Note 2 - Safety Requirements - Suspended Ceiling

Do not use lay-in tile acoustical ceiling. Use hard ceiling or concealed snap in arrangement. Keep ceiling height as high as possible. Use security clips to retain radiant ceiling panels in place. Ensure coordination with the architectural discipline.

Note 3 - Safety Requirements - Suspended Air Outlets/Inlets

Provide security diffusers, grilles, and registers.

Note 4 - Individual Temperature Control

Each bedroom in a two bedroom suite must have individual temperature control and the vestibule must be on the same controls as the accessible room.

Note 5 - Pressure Relationships and makeup air.

The vestibule must be neutral to the bedrooms and positive to the bathroom and must provide enough makeup air to makeup all the bathroom exhaust.

BRUN1: One Bed Patient Room Standard / Accessible / Bariatric	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
TLTS2: Patient Toilet Standard / Accessible / Bariatric	NA	NA	68	20	NA	30	10	NA	Exhaust (G)	35	(--)	Notes	CV

Note 1 - Safety Requirements - Exposed Equipment

Use of exposed and accessible HVAC equipment is not permitted (examples: Room-mounted fan coil units and convectors, air outlets/inlets, temperature sensors, etc.).

Note 2 - Safety Requirements - Suspended Ceiling

Do not use lay-in tile acoustical ceiling. Use hard ceiling or concealed snap in arrangement. Keep ceiling height as high as possible. Use security clips to retain radiant ceiling panels in place. Ensure coordination with the architectural discipline.

Note 3 - Safety Requirements - Suspended Air Outlets/Inlets

Provide security diffusers, grilles, and registers.

Note 4 - Bathroom Exhaust

Bathroom must be constantly exhausted at highest of 10 ACH rate, 50 CFM, or room air balance with the makeup air coming from the patient room thus maintaining the bathroom flow 30% negative to the patient room and the patient room neutral to the corridor; therefore, the minimum outside air to the patient room must be 2 ACH or the required bathroom makeup whichever is greater.

Note 5 - Bathroom Temperature

Bathrooms without heat loss do not required heating or cooling. Bathrooms with heat loss must be provided with a supply diffuser from the room variable air volume terminal, or radiant heating which meets the safety requirements of Note 1.

MENTAL HEALTH RESIDENTIAL REHABILITATION TREATMENT PROGRAM (RRTP) FACILITY - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S				
	F	C	F	C								TEMP	FLOW
BRNC2: Two Bed Patient Room Standard	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
TLTS2: Patient Toilet Standard	NA	NA	68	20	NA	30	10	NA	Exhaust (G)	35	(--)	Notes	CV

Note 1 - Safety Requirements - Exposed Equipment

Use of exposed and accessible HVAC equipment is not permitted (examples: Room-mounted fan coil units and convectors, air outlets/inlets, temperature sensors, etc.).

Note 2 - Safety Requirements - Suspended Ceiling

Do not use lay-in tile acoustical ceiling. Use hard ceiling or concealed snap in arrangement. Keep ceiling height as high as possible. Use security clips to retain radiant ceiling panels in place. Ensure coordination with the architectural discipline.

Note 3 - Safety Requirements - Suspended Air Outlets/Inlets

Provide security diffusers, grilles, and registers.

Note 4 - Bathroom Exhaust

Bathroom must be constantly exhausted at highest of 10 ACH rate, 50 CFM, or room air balance with the makeup air coming from the patient room thus maintaining the bathroom flow negative to the patient room and the patient room neutral to the corridor; therefore, the minimum outside air to the patient room must be 2 ACH or the required bathroom makeup whichever is greater.

Note 5 - Bathroom Temperature

Bathrooms without heat loss do not required heating or cooling. Bathrooms with heat loss must be provided with a supply diffuser from the room variable air volume terminal, or radiant heating which meets the safety requirements of Note 1.

DAYR1: Living Area	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV

Note 1 - Safety Requirements.

Comply with safety requirements indicated for patient rooms.

FSCD1: Dining Area	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV

Note 1 - Safety Requirements.

Comply with safety requirements indicated for patient rooms.

IPK01: Kitchenette	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV

Note 1 - Safety Requirements.

Comply with safety requirements indicated for patient rooms.

Note 2 - Local Exhaust Requirements

Provide general and / or local exhaust as required by ASHRAE 62.1-2016 or latest approved edition. Makeup air must come from the Dining Area or Multi-Purpose Room as the case may be.

MENTAL HEALTH RESIDENTIAL REHABILITATION TREATMENT PROGRAM (RRTP) FACILITY - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
DAYR1: Resident Lounge	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
Note 1 - Safety Requirements. Comply with safety requirements indicated for patient rooms.													
IPK01: Multi-Purpose Room/Kitchenette	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
Note 1 - Safety Requirements. Comply with safety requirements indicated for patient rooms.													
Note 2 - Local Exhaust Requirements Provide general and / or local exhaust in kitchenette as required by ASHRAE 62.1-2016 or latest approved edition. Makeup air must come from the Dining Area or Multi-Purpose Room as the case may be.													
Note 3 - Temperature Control If the rooms are separated by walls or half walls with cased opening provide individual temperature control in Multi-Purpose Room and in Kitchenette, otherwise provide one control zone for both rooms with the sensor in the multi-purpose room.													
CRA02: Resident Education/Conference/Group Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note 1 - Safety Requirements. Comply with safety requirements indicated for patient rooms.													
FSCD1: Dining Room	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
Note 1 - Safety Requirements. Comply with safety requirements indicated for patient rooms.													
Note 2 - Makeup Air Requirements. If provided with adjacent kitchen ensure this space has sufficient air to makeup kitchen exhaust.													

MENTAL HEALTH RESIDENTIAL REHABILITATION TREATMENT PROGRAM (RRTP) FACILITY - ROOM DATA SHEET													
ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
FSPT1: Serving / Pantry	75	24	70	21	60	30	6	2	Note 1	40	Note 1	Yes	VAV

Note 1 - Room Air Balance and Exhaust

Provide general and / or local exhaust as required by ASHRAE 62.1-2016 or latest approved edition, and / or by the equipment provided in the space. Makeup air must come from the Dining Area. If exhaust is required the space must be negative otherwise it must be neutral. Return is permitted.

IPK01: Training Kitchen	75	24	70	21	60	NA	6	2	Exhaust G & S	40	(--)	Yes	CV

Note 1 - General

Space includes a pantry not requiring HVAC.

Note 2 - Outside Air Requirements

If this space is served by a dedicated air handling unit return air may be used. If the space is served by an air handling unit used for other occupied spaces then all air delivered to the kitchen must be exhausted and no return must be allowed. Adjust the minimum outside air for the air handling unit such that the entire system is at least 15% positive by flow, while maintaining the kitchen negative to its surroundings.

Note 3: - Kitchen Exhaust For Kitchens With Dedicated Air Handling Units

An NFPA 96 dedicated exhaust system must serve hoods over cooking equipment. When the kitchen hood systems are off the exhaust system must exhaust at least 2 air changes per hour and must maintain the kitchen negative relative to its surroundings.

Note 4: - Kitchen Exhaust For Kitchens Without Dedicated Air Handling Units

An NFPA 96 dedicated exhaust system must serve hoods over cooking equipment. Supplemental exhaust must ensure the kitchen space is maintained negative to its surrounding during all occupied times regardless of whether or not the kitchen hoods are operating.

DAYR1: Recreation Therapy Room	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV

Note 1 - Safety Requirements.

Comply with safety requirements indicated for patient rooms.

MINIMUM AHU REQUIREMENTS TO SERVE OUTPATIENT MENTAL HEALTH SERVICES

AHU System Data Sheet

Air-Handling Type	Non-dedicated (Par 6.3) Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14 (Normal Mode) AF = MERV 16A (Emergency Mode)
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - General
A separate air handling unit is not required and not prohibited. Any air handling unit used must meet the minimum requirements listed. The air handling unit must operate 24 hours per day, 7 days per week.

Note 2 - Listed Rooms and Their Names
Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on the VA Mental Health Facilities Design Guide dated December of 2010 and Revised August of 2014. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note 3 - Relative Humidity
See paragraph 6.5.1.1 for:
(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

Note 4 - Enhanced Air Filtration
(a) During Emergency Epidemic use enhanced after-filters as noted above.
(b) Size the AHU supply and return/relief fan motors to compensate for the additional air pressure drop due to enhanced filtration application.
(c) The AHU filter section must be configured to accommodate installation of enhanced after-filters during Emergency Epidemic.
(d) Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU interior surfaces.

MENTAL HEALTH OUTPATIENT SERVICES - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S				
	F	C	F	C								TEMP	FLOW
EXRG3: Exam Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note 1 - Individual Room Temperature Control Required for a single office. Otherwise see Chapter 2 for room temperature control requirements.													
TRGM1: Treatment Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note 1 - Individual Room Temperature Control Required for a single office. Otherwise see Chapter 2 for room temperature control requirements.													
OPMH1: Group Therapy Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Notes - None													
OPMH2: Group Testing Room	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Notes - None													
OPMH3: Biofeedback Laboratory Treatment Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Notes - None													
CMP02: Biofeedback Laboratory Control Room / Office	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Notes - None													
OFD01: Counselor Office	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Notes - None													

MENTAL HEALTH OUTPATIENT SERVICES - ROOM DATA SHEET													
ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
SL001: Social Activities/ Dining/Multi-Purpose	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
Notes - None													
CRA02: Classroom / Group Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Notes - None													
OTGC1: Occupational Therapy	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note 1: Dryer Exhaust													
Coordinate clothes dryer exhaust with the actual machine used. **Note 2: Kiln Exhaust** Coordinate kiln exhaust with actual kiln used. Coordinate exhaust system design with NFPA 86 Standard for Ovens and Furnaces latest edition.													

NURSING WING - AIR HANDLING UNIT

AHU System Data Sheet

Air-Handling Type	Dedicated Variable Air Volume (paragraphs 3.2.3, 6.2 and 6.4)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode)
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14 (See Note 4 below)
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	Yes (Emergency Mode)
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - Listed Rooms and Their Names

The space types listed in this manual reflect the terminology and functions used in the VA Medical/Surgical Inpatient Units and Intensive Care Nursing Unit Design Guide dated November 29, 2011.

Note 2 - Emergency Epidemic Air-Handling Unit

(a) Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

(b) Minimum of 50% of the hospital Inpatient Nursing Units (WARDs) should be provided with AHUs capable of operating with 100% OA during emergency epidemic mode. For hospitals with less than 3 Inpatient Nursing Units, ALL AHUs serving the 3 or fewer Inpatient Nursing Units should be equipped with 100% OA capability for use during emergency epidemic mode.

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 4 - Enhanced Air Filtration (Not applicable to Non-Emergency Epidemic AHUs)

(a) During Emergency Epidemic use enhanced after-filters of MERV 16A.

(b) Size the AHU supply and return/relief fan motors to compensate for the additional air pressure drop due to enhanced filtration application.

(c) The AHU filter section mustbe configured to accommodate installation of enhanced after-filters during Emergency Epidemic.

(d) Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU interior surfaces.

NURSING WING - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
BRIC1: Patient Bedroom, Intensive Care	75	24	70	21	60	30	6	2	Return	35	(+)	Yes	VAV
XXXX: Patient Bedroom	75	24	70	21	60	30	6	2	Return	35	(+)	Yes	VAV
Note 1 - Filtration Requirements For ICUs served by the Surgical Suite AHU, refer to the surgical AHU for terminal filtration requirements.													
Litter Bath	82	28	70	21	60	30	15	2	Exhaust	45	(-)	Yes	VAV
Note - None													
NSTA1: Nurses Station	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
Note - None													
BRII1: Patient Room, Isolation (AII)	75	24	70	21	60	30	12	2	Exhaust	35	(--)	Yes	CV
BRII2: Patient Room, Isolation (PE)	75	24	70	21	60	30	12	2	Return	35	(++)	Yes	CV
Note 1 - Special Exhaust System See Infectious Isolation Rooms/Protective Environment Room Data Sheets for more information. Provide a dedicated, special exhaust system for the Patient Bedroom, Ante Room and Patient Toilet (where present). Do not connect other rooms to the dedicated exhaust system. Locate the exhaust fan at the end of the duct run to maintain the ductwork within the building at a negative pressure and install bag-in-bag out HEPA filters just prior to the fan inlet. Discharge exhaust air above the highest roof level through a stack at least 10 ft [3 m] tall at 3,500 fpm [18 m/s] discharge velocity. The discharge air outlet must be located at least 25 ft [8 m] from outdoor air intakes and operable windows. Follow the recommendations of the dispersion analysis for higher than minimum requirements. Provide emergency power for the exhaust fan and associated controls. Label ductwork, filter, and fan "COMMUNICABLE DISEASE CONTAMINATED AIR".													
Note 2 - Instrumentation Provide a room differential pressure monitoring device between Ante Room and Isolation Room, and between Ante Room and corridor.													
MEDP1: Medication Room	75	24	70	21	60	30	4	2	Return	40	(+)	No	VAV
Note - None													
NCWD1: Nourishment Station	75	24	70	21	60	30	6	2	Return	40	(-)	No	VAV
Note - None													

OIT MAIN COMPUTER ROOM - AIR CONDITIONING UNIT (CRAC UNITS)

AHU System Data Sheet

Air-Handling Type	Dedicated (Par 6.2) Constant Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Based on Unit Capacity
Minimum Outdoor Air Changes per Hour	ASHRAE Standard 62.1 - 2016 or latest approved edition.
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	Generally No- ASHRAE 90.1-2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration	Manufacturer's Standard
Cooling Source	Chilled Water or DX
Heating Source	Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	No
Special Exhaust System Required	No
Emergency Power Required	Yes For Unit and Controls
Individual Room Temperature Control Required	Yes
Room Air Balance	Positive (+)

Note 1 - Standby Capacity

Provide N+1 computer room air-conditioning units. N = Number of units in operation required to meet the load and 1 is the standby unit of capacity equal or greater than the largest of the N units.

Note 2 - Unit Location and Type

Locate all units in a dedicated mechanical room adjacent to the computer room. All units must be floor- mounted.
For new installations and major renovations, do not locate units in the computer room. Units must be designed for data processing applications. See VA specification 23 81 23, Computer Room Air Conditioners, for additional information.

Note 3 - Telephone Equipment Room and Facility Management Service

Provide similar air-conditioning systems for the Telephone Equipment Room and the Facility Maintenance Service (FMS). Standby units can be shared between IT (Information Technology), FMS, and Telephone Equipment Room if a common mechanical room is provided. Ensure coordination with the Office of Information and Technology (OIT) Design Guide for additional information and design criteria.

Note 4 - Raised Floor Protection

Provide an under floor, water leak detection system and a smoke detector to detect smoke and initiate corrective actions with alarms.

Note 5 - Air Distribution System

Coordinate the location and type of supply and return air distribution systems with the building design as numerous configurations outlined in the OIT Design Guide are considered as acceptable configurations.

Note 6 - Automatic Controls

Provide a local control panel in the Main Computer Room displaying temperature, RH and unit status for each AHU. Provide an open-protocol, BACnet interface between the control panel furnished with the AHU unit and the central ECC system. Controls must be protected by UPS.

OIT MAIN COMPUTER ROOM - AIR CONDITIONING UNIT (CRAC UNITS)

AHU System Data Sheet

Note 7 - Space Pressurization

Provide environmental air from a dedicated or a common adjoining air-handling unit to pressurize the space. Do not return air to the adjoining air handling unit.

Note 8 – Alarm Monitoring

The central ECC system shall monitor space conditions and unit status and shall alarm the boiler plant operator or HVAC shop whenever temperature or humidity are out of tolerance, when water is in the under floor space, when water is in the HVAC secondary drain pan if one is provided, and when the computer room unit status is not normal.

Note 9 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

(c) CRAC manufacturer's standards sequence is acceptable.

<table>
<tr><th colspan="14">OIT MAIN COMPUTER ROOM - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th>ROOM AIR</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th><th rowspan="2">RETURN EXHAUST G EXHAUST S</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td colspan="14">General: The room names listed below are from the VA PG 18-9 Chapter 232 Revised October 3, 2016. The actual room layouts, equipment disposition, and the HVAC parameters may vary with the project scope of work.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>ITAE1: OIT IT Active Equipment</td><td>81</td><td>27</td><td>64</td><td>18</td><td>60</td><td>30</td><td>2</td><td>NA</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td>ITPE1: OIT IT Passive Distribution Equipment</td><td>81</td><td>27</td><td>64</td><td>18</td><td>60</td><td>30</td><td>2</td><td>NA</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td>FMAE1: FMS Active Equipment</td><td>81</td><td>27</td><td>64</td><td>18</td><td>60</td><td>30</td><td>2</td><td>NA</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td>FMPE1: FMS Passive Distribution Equipment</td><td>81</td><td>27</td><td>64</td><td>18</td><td>60</td><td>30</td><td>2</td><td>NA</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td>TEIP1: VoIP Active Equipment</td><td>81</td><td>27</td><td>64</td><td>18</td><td>60</td><td>30</td><td>2</td><td>NA</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td>ITAD1: Storage Active Data Room</td><td>81</td><td>27</td><td>64</td><td>18</td><td>60</td><td>30</td><td>2</td><td>NA</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 – Hot and Cold Aisle Distribution and Return
Provide under floor distribution and overhead returns taking advantage of cold and hot aisles with respect to equipment racks.</td></tr>
<tr><td colspan="14">Note 2: - Ventilation
Total AC/HR based on cooling load and HVAC equipment capacity, calculate outside air per ASHRAE 62.1 -2016 or latest approved edition and provide (Option 1) from convenient nearby system or (Option 2) outside air ducted to CRAC inlet.</td></tr>
<tr><td colspan="14">Note 3: - Relative Humidity
Recommended relative humidity requirements is dew point from 42F to 59 F.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>ITNT1: Network Operation Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>35</td><td>(0)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 – Distribution
Provide with distribution from CRAC for main computer room or from other system in the vicinity.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>ITBU1: Backup Computer Room</td><td>81</td><td>27</td><td>64</td><td>18</td><td>60</td><td>30</td><td>2</td><td>NA</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 – Dedicated HVAC System
When a backup computer room is authorized it will be located remote from the main computer room and may or may not have adjacent Network Operation Room and Storage Active Data Room. The backup computer room must have a separate dedicated HVAC system meeting all the requirements indicated for the main computer room and its related spaces shown above.</td></tr>
<tr><td colspan="14"></td></tr>
</table>

OIT SATELLITE – AIR CONDITIONING UNITS

AHU System Data Sheet

Air-Handling Type	Dedicated or Non-Dedicated (Par 6.2 and 6.3), Constant Volume or Variable Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Based on Unit Capacity
Minimum Outdoor Air Changes per Hour	ASHRAE Standard 62.1-2016 or latest approved edition
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	No
Energy Recovery System Required	No
Filtration	Manufacturer’s Standard
Cooling Source	Chilled Water or DX
Heating Source	Hot Water
Humidification Source	Plant Steam or Clean Steam
General Exhaust System Required	No
Special Exhaust System Required	No
Emergency Power Required	Yes For Unit and UPS for Controls
Individual Room Temperature Control Required	Yes
Room Air Balance	Positive

Note 1 – General

HVAC for telephone and Satellite OIT spaces must be provided by systems adjacent to the space if they are systems capable of providing cooling 24/7 365 per year. Systems that do not operate 24/7 or which switch to heating a times during the year cannot be used. In such cases provide local cooling by the most practical method.

Note 2 – Standby Capacity

Provide N+1 computer room air-conditioning units. N = Number of units in operation required to meet the load and 1 is the standby unit of capacity equal or greater than the largest of the N units.

Note 3: - Heating Not Required

Where the room is located without an exterior wall or where the heat load due to electronic equipment exceeds the room’s heating load do not provide heating with this system. Ensure VAV minimum flow is low enough so as not to overcool the room.

Note 4 - Recommended Option 1

For rooms located within areas served by central air handling units operating on normal and emergency power provide one VAV terminal from one unit and a second VAV terminal from a second unit (N+1). Locate terminals outside the room it serves. Provide hot water reheat or resistance heating to each terminal if heating is needed.

OIT SATELLITE – AIR CONDITIONING UNITS

AHU System Data Sheet

Note 5 – Option 2
If only one central air handling unit operating on normal and emergency power is convenient to the space, provide one VAV terminal from that system as in Options 1 and provide one wall mounted ductless split DX heat pump or cooling only unit. Install wall unit with secondary condensate drain pan and monitor water in the secondary pan. In locations where humidification is required provide either a self-contained humidifier using plant steam or an electric steam generator.

Note 6 – Option 3
If there are no convenient central air handling units operating on emergency power nearby provide two separate wall mounted ductless split DX heat pumps with the same provisions as in option 2 including a humidifier. Provide air from any nearby system for ventilation and do not return to the air handling unit used.

Note 7 - Automatic Controls
Ductless split systems and stand-alone humidifier must work on their own integral controls. Provide space temperature sensor, space humidity sensor, auxiliary drain pan moisture sensor (not float switch) and supply air temperature sensors on all DX units and /or VAV terminals and connect these to the central ECC system for trending and alarm purposes.

Note 8 - Space Pressurization
For options 2 and 3 provide environmental air from a dedicated or a common adjoining air-handling unit to pressurize the space. Do not return air to the adjoining air handling unit.

Note 9 – Alarm Monitoring
The central ECC system must monitor space conditions and unit status and must alarm the boiler plant operator or HVAC shop whenever temperature or humidity are out of tolerance, when water is in the HVAC secondary drain pan if one is provided. and when any supply air temperature does not match what is required by room conditions.

Note 10 - Relative Humidity
See paragraph 6.5.1.1 for:
(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

<table>
<tr><th colspan="14">DATA / VOICE EQUIPMENT ROOMS - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th>ROOM AIR</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th><th rowspan="2">RETURN EXHAUST G EXHAUST S</th><th rowspan="2">TEMP</th><th rowspan="2">FLOW</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th></tr>
<tr><td colspan="14"></td></tr>
<tr><td colspan="14">General: The room names listed below are from the VA PG 18-9 Chapter 232 Revised October 3, 2016. The actual room layouts, equipment disposition, and the HVAC parameters may vary with the project scope of work.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>TEDR1: Demarcation Room (Demarc Room)</td><td>81</td><td>27</td><td>64</td><td>18</td><td>60</td><td>30</td><td>2</td><td>NA</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Ventilation
Total ACH based on cooling load and HVAC equipment capacity, outside air per ASHRAE 62.1 -2016 or latest approved edition and provide as indicated in the air handling unit data sheet.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>Telephone Equipment Room (TER)</td><td>81</td><td>27</td><td>64</td><td>18</td><td>60</td><td>30</td><td>2</td><td>NA</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Ventilation
Total ACH based on cooling load and HVAC equipment capacity, outside air per ASHRAE 62.1 -2016 or latest approved edition and provide as indicated in the air handling unit data sheet.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>TEOR1: Telephone Operators Room (TOR)</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>35</td><td>(0)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - General
Serve this space with any system suitable for offices spaces.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>TETR1: Telecommunications Room (TR)</td><td>81</td><td>27</td><td>64</td><td>18</td><td>60</td><td>30</td><td>2</td><td>NA</td><td>Return</td><td>45</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Ventilation
Total ACH based on cooling load and HVAC equipment capacity, outside air per ASHRAE 62.1 -2016 or latest approved edition and provide as indicated in the air handling unit data sheet.</td></tr>
<tr><td colspan="14"></td></tr>
</table>

MINIMUM AHU REQUIREMENTS TO SERVE PATIENT CARE AREAS

AHU System Data Sheet

Air-Handling Type	Non-dedicated (Par 6.3) Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14 (Normal Mode) AF = MERV 16A (Emergency Mode)
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	No
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - General

In general, the patient care areas in the Room Data Sheets (RDS) which follow do not require a separate air handling unit. However, if other reasons such as energy, economics, building layout or other similar concerns make a separate air handling unit advantageous, a separated dedicated air handling unit may be provided. Any air handling unit used must meet the minimum requirements listed.

Note 2 - Makeup Air Requirements

Any air handling unit serving the listed spaces need not be a 100% outside air system, however, the system must have adequate outside air flow to match the exhaust requirement of all spaces served plus additional flow to maintain the entire area positive with respect to the outside or the minimum required outside air of all the spaces served whichever is greater.

Note 3 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 4 - Enhanced Air Filtration

(a) During Emergency Epidemic use enhanced after-filters as noted above.

(b) Size the AHU supply and return/relief fan motors to compensate for the additional air pressure drop due to enhanced filtration application.

(c) The AHU filter section must be configured to accommodate installation of enhanced after-filters during Emergency Epidemic.

(d) Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU interior surfaces.

PATIENT EXAMINATION, TREATMENT, AND PROCEDURE ROOMS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH							
	F	C	F	C	MAX	MIN						TEMP	FLOW
EXOS1: Audiology Office/Therapy Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
PEHS1: Audiometric	75	24	70	21	60	30	6	2	Return	25	(o)	Yes	VAV
Note 1 - Acoustic Booth Coordinate the installation of the acoustic booth (if any) and its integral HVAC system with the architectural layout and building utilities.													
Note 2 - Room Noise Level Provide acoustic measures to maintain the design NC level.													
LBVP1: Blood Draw Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
Bone Marrow Transplant (BMT) Suite													
Donors Room	75	24	70	21	60	30	6	2	Return	35	(+ +)	Yes	CV
Medication Preparation Room	75	24	70	21	60	30	6	2	Return	35	(+ +)	Yes	CV
Patient Rooms	75	24	70	21	60	30	6	2	Return	35	(+ +)	Yes	CV
Recovery Rooms	75	24	70	21	60	30	6	2	Return	35	(+ +)	Yes	CV
Ante Room for Donor, Patient and Recovery Rooms	NA	NA	NA	NA	NA	NA	10	NA	Return	35	(+)	No	CV
Note 1 - Terminal HEPA Filter Provide duct-mounted, terminal MERV 17 (HEPA) filter downstream of the dedicated air terminal units serving the Isolation Rooms. Ensure access for filter replacement and instrumentation. Provide a differential pressure gage and a differential pressure switch with a remote alarm to the ECC when the pressure drop exceeds the recommended pressure drop.													
Note 2 - Instrumentation Provide a room differential pressure monitoring device between Ante Room and Isolation Room, and between Ante Room and corridor.													
Note 3 - Air Distribution Layout (a) Donor, Patient and Recovery Rooms Locate the exhaust air inlet over or near the entry door to ensure that air flows into the room and away from the patient bed. (b) Ante Room Air must transfer from the Donor, Patient and Recovery Rooms into the Ante Room and then to the Corridor. The Ante Room is negative with respect to the Donor, Patient and Recovery Rooms and positive with respect to the Corridor.													

PATIENT EXAMINATION, TREATMENT, AND PROCEDURE ROOMS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
Examination Rooms	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note 1 - General The design parameters are applicable to all examination rooms not involving treatment and/or procedures.													
Note 2 - Individual Room Temperature Control Refer to Chapter 2 for the guidelines on the individual room temperature control.													
Therapy Rooms													
Hydrotherapy/Therapeutic Pool	75	24	70	21	60	30	12	2	Exhaust (G)	45	(-)	Yes	CV
Kinesiotherapy	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
Occupational Therapy	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Physical Therapy	75	24	70	21	60	30	6	2	Return	35	(-)	Yes	VAV
Note 1 - Kinesiotherapy and Hydrotherapy/Therapeutic Pool Rooms The reheat coil capacity must be sized to maintain up to 82 F [28 C] space temperature for the two rooms.													
Note 2 - Hydrotherapy/Therapeutic Pool Provide a dedicated wet exhaust system.													
Treatment Rooms													
Chemotherapy	75	24	70	21	60	30	6	2	Exhaust (G)	35	(-)	Yes	CV
OPDU1: Dermatology	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note 1 -Risk Assessment Conduct risk assessment if the room is to be used for dermatological procedures design per Procedure Room (formerly Class A Operation) room on next page.													
Phototherapy/Shower Room	75	24	70	21	60	30	6	2	Exhaust (G)	35	(o)/(-)	Yes	VAV
Note 1 - Phototherapy/Shower Room Maintain negative air balance in the Shower Room and neutral air balance in the Phototherapy Room.													
Tub Room	75	24	70	21	60	30	10	2	Exhaust (G)	40	(-)	Yes	CV
Note 1 - Reheat Coil Capacity The reheat coil capacity must be sized to maintain 86 F [30 C] space temperature.													
OPPF1: Ventilatory Test Room	75	24	70	21	60	30	12	2	Exhaust (G)	35	(-)	Yes	CV
Note 1 - Exhaust Grilles Provide low level exhaust grilles 7 in [175 mm] above the finished floor.													

PATIENT EXAMINATION, TREATMENT, AND PROCEDURE ROOMS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
EYVF1: Visual Field/ EYFC1: Photography	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note - None													
Vital Signs Station	NA	NA	NA	NA	NA	NA	4	NA	Return	35	(o)	No	VAV
Note - None													
OPCR1: Orthopedic Clinic (Cast Room)	75	24	70	21	60	30	6	2	Return	40	(-)	Yes	VAV
Note - None													
Procedure Room (formerly Class A Operating)	68	20	70	21	60	30	15	3	Return	35	(+)	Yes	CV
Note 1 - Air Distribution Provide overhead supply and return air distribution.													
Note 2 - Procedure rooms (formerly Class A Operating Rooms) are rooms designated for the performance of procedures that do not meet the glossary definition of invasive procedure and may be performed outside the restricted area of a surgical suite but may require the use of sterile instruments or supplies. Local anesthesia and minimal and moderate sedation may be administered but special ventilation or scavenging equipment must not be required for anesthetic agents used in these room.													
Note 3 - Minimum Filter Requirement Provide MERV 7 and MERV 11 prefilters and MERV 14 after filter.													

PHARMACY SERVICE - AIR HANDLING UNIT

AHU System Data Sheet

Air-Handling Type	Dedicated (paragraph 6.2) Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	Yes
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2) (Note 3)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - Final-Filter (FF) (Note 3)	FF = MERV 14 (Normal Mode) FF = MERV 16A (Emergency Mode)
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	Yes
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets
Compliance	USP <797> and USP <800>

Note 1 - Listed Rooms and Their Names

Room names shown in the attached Room Data Sheets are based on Chapter 268: Pharmacy Service in PG-18-9 Space Planning Criteria dated March 2008 and revised October 3, 2016. Since the VA Pharmacy Design Guide Currently in the TIL dates back to 1998 which predates space codes and the current versions of USP 797 and USP 800 that document was not referenced for this HVAC Design Manual. See other tables in chapter 6 for general support areas such as staff and patient toilets and housekeeping aid closets (HAC), locker rooms, lounges, etc.

Note 2 - USP <797> Pharmaceutical Compounding - Sterile Preparations (CSP) and USP <800> Hazardous Drug Handling In Health Care Settings

Per USP <797>, compounding of sterile products (hazardous or non-hazardous) shall be accomplished in a clean room environment. The designer shall be familiar with the environmental requirements specified in USP <797> to ensure compliance . In the Room Data Sheets for hazardous and non-hazardous clean rooms, terminology is defined. Per USP <800> storage and handling of hazardous drugs in a health care setting shall take place in spaces protected by negative pressure differentials. The designer shall be familiar with the environmental requirements specified in USP <800> to ensure compliance.

Note 3 - Air-Handling Unit

An air-handling unit serving clean rooms must address the special HVAC needs of providing Final MERV 17 (HEPA) filters, extended hours of operations, and lower space temperature (68 F [20 C] compared to 75 F [24 C] for all other spaces). The Pharmacy suite AHU shall not serve any patient areas. Provide terminal HEPA filters at clean room ceiling supply diffusers, equipped with static pressure port and DOP port for testing.

Note 4 - Chilled Water

Chilled water shall be available uninterrupted and on demand. A dedicated chiller connected to emergency power shall be considered if the central plant is not equipped with emergency power.

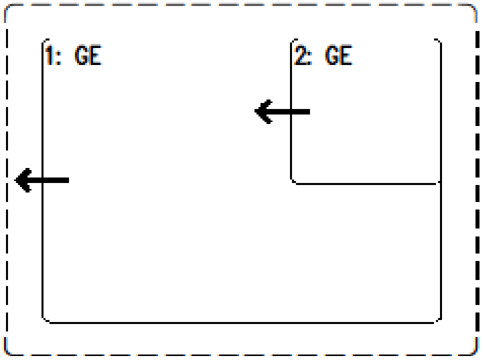
Note 5 - Relative Humidity

See paragraph 6.45.1.1 for:
(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.
(b) Humidifier capacity.

Note 6 - Enhanced Air Filtration

(a) During Emergency Epidemic use enhanced final-filters as noted above.
(b) Size the AHU supply and return/relief fan motors to compensate for the additional air pressure drop due to enhanced filtration application.
(c) The AHU filter section shall be configured to accommodate installation of enhanced final-filters during Emergency Epidemic.
(d) Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU interior surfaces.

PHARMACY INTRAVENOUS ADMIXTURE COMPOUNDING AREAS AIR FLOW RELATIONSHIPS
(NON-HAZARDOUS DRUGS ONLY)



LEGEND

1: PHIV2: INTRAVENOUS ADMIXTURE ANTEROOM (+)

2: PHIV2: INTRAVENOUS ADMIXTURE ASEPTIC TRANFER ROOM (++)

GE: GENERAL EXHAUST

SE: SPECIAL EXHAUST

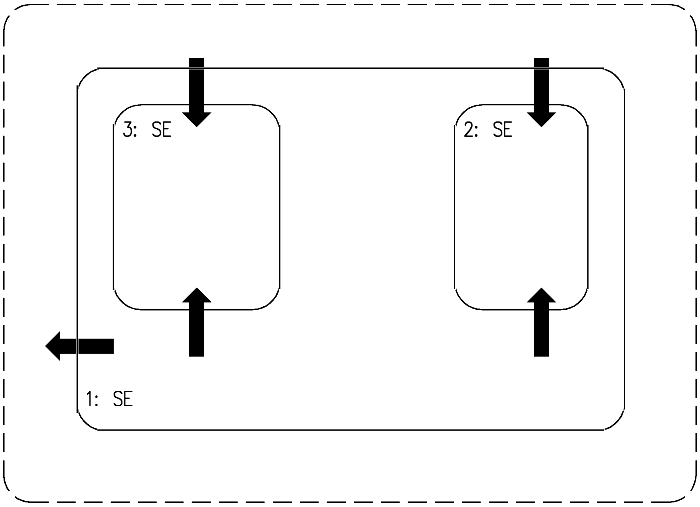
RA: RETURN AIR

AIR FLOW DIRECTION BETWEEN SPACES →

NEUTRAL AIR FLOW ↔

PEDESTRIAN CIRCULATION – – – – – – – – –

PHARMACY INTRAVENOUS ADMIXTURE COMPOUNDING AREAS AIR FLOW RELATIONSHIPS
(HAZARDOUS DRUGS ONLY)



LEGEND:

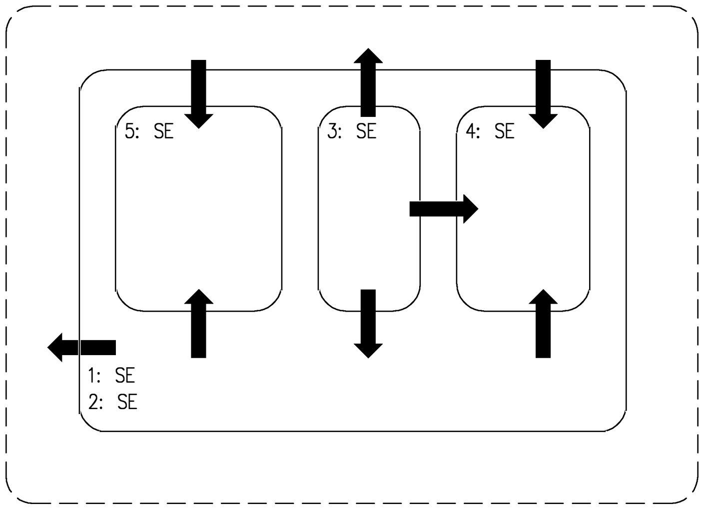
1: PHOD2: ONCOLOGY DRUG INTRAVENOUS ADMIXTURE ANTEROOM (+)
2: PHOD2: ONCOLOGY DRUG PREPARATION AREA (-)
3: PHBS2: STORAGE AND CLEAN / STORAGE HAZARDOUS DRUGS (-)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST (WET EXHAUST / ETO EXHAUST)
RA: RETURN AIR

AIR FLOW DIRECTION BETWEEN SPACES ➡

NEUTRAL AIR FLOW ⬌

PEDESTRIAN CIRCULATION — — — — —

PHARMACY INTRAVENOUS ADMIXTURE COMPOUNDING AREAS AIR FLOW RELATIONSHIPS
(HAZARDOUS DRUGS ONLY)



LEGEND:

1: PHIV2: INTRAVENOUS ADMIXTURE ANTEROOM (+)
2: PHOD2: ONCOLOGY DRUG INTRAVENOUS ADMIXTURE ANTEROOM (+)
3: PHIV2: INTRAVENOUS ADMIXTURE ASEPTIC TRANSFER ROOM (++)
4: PHOD2: ONCOLOGY DRUG PREPARATION AREA (−)
5: PHBS2: STORAGE AND CLEAN / STORAGE HAZARDOUS DRUGS (−)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST (WET EXHAUST / ETO EXHAUST)
RA: RETURN AIR

AIR FLOW DIRECTION BETWEEN SPACES	➡
NEUTRAL AIR FLOW	⬌
PEDESTRIAN CIRCULATION	— — — — —

PHARMACY SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
Inpatient and Outpatient Pharmacy Work and Support Areas													
PHOD2: Dispensing Station	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
PHOD2: Controlled Substance Work Area Vault	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
PHOD2: Secured Controlled Substance Dispensing	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
PHOD2: Extemporaneous Repackaging	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
PHOD2: Stat Counter	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
XXYYC: Drug Information Area	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note - None													
PHOD2: Breakdown and Verification Receiving Area	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note - None													
PHOD2: Inventory and Verification Receiving Area	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													

PHARMACY SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
Inpatient and Outpatient Pharmacy Work and Support Areas (continued)													
PHOD1: Prescription Receiving Window	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
PHOD2: Prescription Filling and Assembly Area	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
PHOD2: Prescription Dispensing Area	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
PHOD2: Prescription Mail Out	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
OFDC2: Consult Room	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
XXYYC: Pharmacy Cache Area	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
Outpatient Pharmacy Patient Areas													
WTG15: Waiting Room	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note - None													

PHARMACY SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
Pharmacy Education Program													
OFA07: Clinical Pharmacy Teaching Coordinator Workstation	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note - None													
XXYYC: Pharmaceutical Experimentation Laboratory	75	24	70	21	60	30	4	2	Exhaust	40	(-)	Yes	VAV
Note 1 - Local Exhaust Hood													
Provide dedicated exhaust system for fume hood or biological safety cabinet if one is provided. Coordinate exhaust and makeup air with selected hood.													
OFA07: Intern / Student Workstation	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note - None													
OFA10: Trainee Carrel	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note - None													
Inpatient Pharmacy Staff and Administrative Area													
OFA09: Pharmacy Service Chief Office / Associate Chief Office	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note - None													
WTG03: Waiting	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note - None													
OFA07: Pharmacist Workstation	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note - None													

PHARMACY SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH							
	F	C	F	C	MAX	MIN						TEMP	FLOW
Inpatient Pharmacy Staff and Administrative Area (continued)													
OFA07: Secretary Workstation / Clerical Workstation	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Note - None													
CFR01: Conference Room	75	24	70	21	60	30	6	2	Return	35	(+)	Yes	VAV
Note - None													
SL001: Staff Lounge	75	24	70	21	60	30	6	2	Return	40	(-)	Yes	VAV
Note 1 - Local Exhaust Hood and / or General Exhaust													
Evaluate the level of cooking that may take place and design accordingly, for example if a range hood is being provided design the exhaust system for the hood.													

PHARMACY SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW

USP Chapter 797 and USP Chapter 800 Areas

Note 1 - General Notes

(a) Room Names and Codes:

There are two sets of room names presented in this section. First listed is the VA room code followed by the VA room name. These are consistent with the codes and names found in Chapter 268: Pharmacy Service in PG-18-9 Space Planning Criteria dated March 2008 and revised October 3, 2016. The second room name is consistent with the best available documents for USP 797 and USP 800 at the time this manual was revised. It is recommended that the USP 797 and USP 800 room names be used on the contract documents with the VA nomenclatures presented here only for reference.

(b) USP 800:

The information in this table is consistent with USP Chapter 800 Hazardous Drugs - Handling in Health Care Settings approved for public release on February 1, 2016 and scheduled for mandatory implementation on July 1, 2018.

(c) USP 797:

At the time this manual was being revised USP Chapter 797 Pharmaceutical Compounding - Sterile Preparations was out for public review and comments with a projected completion / publishing date of May 1, 2017. Hence the information used for this table is based on unpublished information. However, since the majority of the changes to USP chapter 797 are for the purpose of coordinating the chapter to the newly released USP Chapter 800 using both available documents at the time of manual re-writing gives high confidence that the information presented here is will be consistent with both final documents (USP 797 and USP 800).

(d) Complexity:

These Room Data Sheets should be considered only a starting point for the design of HVAC for USP 797 and USP 800 rooms. The A/E must be familiar with and must references both USP 797 and USP 800 when completing the design work to ensure all the complexities of these spaces are addressed.

Note 2 - Pressure Differentials

As a minimum maintain a pressure differential of 0.02 inches of water column between spaces of different cleanliness or of different chemical substance risk level. Provide visual indicators between the rooms so that workers can easily see that correct pressure levels are being maintained.

Note 3 - Air Terminals

Air terminals, reheat coils and their controls must be outside the clean spaces to facilitate maintenance without fouling the space.

Note 4 - Air Distribution

Provide unidirectional air distribution with overhead supply and bottom return air collection. Locate return air inlet(s) in the wall at 7 in [175 mm] above the floor.

Note 5 - Materials

Flexible ductwork must not be used in any of the supply and exhaust ducts serving these spaces. All exhaust ducts and all supply ducts downstream of HEPA filters must be welded stainless steel.

Note 6 - Monitoring

Provide visual and digital pressure display as well as digital temperature and relative humidity displays. Trend and alarm all measurements.

PHARMACY SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
USP Chapter 797 and USP Chapter 800 Areas (continued)													
PHIV2: Intravenous Admixture Ante Room or USP 797 Ante-areas	68	20	68	20	60	30	25	15	Return	40	(+)	Yes	CV
PHOD2: Oncology Drug Intravenous Admixture Ante Room or USP 797 or USP 800 Ante-areas	68	20	68	20	60	30	35	35	Exhaust	40	(+)	Yes	CV

Note 1: General

This ISO Class 7 ante room is a work room for preparation to do work in the buffer rooms. It is a space positive to areas outside the compounding suite and negative to the cleaner spaces within the compounding suite. Following the convention that doors must swing into the cleaner spaces, the door into this room from outside the compounding suite must swing into this room and doors from this room to cleaner spaces must swing out of this room. This room must be equipped with touchless hand washing and dryer equipment.

Note 2: Dual Purpose Anteroom

One ante room may be used to serve both an oncology drug buffer room and a non-oncology drug buffer room. In that case the ante room would have 100% outside air pass through (100% exhaust less exfiltration to keep space pressurized). In all cases an ante room is needed for the oncology buffer.

PHIV2: Intravenous Admixture Aseptic Transfer Room or USP 797 Buffer	68	20	68	20	60	30	35	15	Return	40	(+)	Yes	CV
PHOD2: Oncology Drug Preparation Area or USP 800 Buffer	68	20	68	20	60	30	35	35	Exhaust	40	(-)	Yes	CV

Note 1: General

This ISO Class 7 work area is the area in which the IV admixture work takes place. Inside this space will be placed the Primary Engineering Controls (PEC) which in most cases is an ISO Class 5 laminar flow bench. The admixture work takes place in the PEC.

Note 2: Pressure Relationships

(a) Non-Oncology Buffer: This space must be maintained at least 0.02 inches of water column positive with respect to the ante area.

(b) Oncology Buffer Area: This space must be maintained -0.01 to 0.03 inches of water column negative with respect to the ante area or any other area adjacent to it.

Note 3: Exhaust System

Provide exhaust system for the primary engineering control, maintain ductwork negative by placing the fan at the end of the duct run and discharge in a location as discussed in Chapter 3 to prevent contamination of building air intakes. The exhaust for the primary engineering control must vented through a HEPA filter system.

PHARMACY SERVICE - ROOM DATA SHEET

USP Chapter 797 and USP Chapter 800 Areas (continued)

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
USP 800 Ante Room for Oncology Buffer	NA	NA	NA	NA	NA	NA	35	35	Exhaust	40	(+)	No	CV

Note 1: General

Although it is not a requirement, this space is intended to meet two requirements in USP 797 (1): Air from the oncology buffer must not transfer to other occupied spaces and (2): Air from an ISO 8 space must not transfer into ISO 7 space. Therefore, the ante room is designed and maintained at ISO 7 conditions and positive to the buffer and to the ante space. Its function is to keep the oncology buffer clean with its potentially hazardous conditions (spill, evaporating etc.) contained. There are other alternatives to this space discussed in USP 800.

Note 2: Pressure Relationships

This space must be maintained at least 0.04 inches of water column positive with respect to the ante area and 0.02 inches of water column positive with respect to the oncology buffer.

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
PHBS2: Storage and Clean / Decontamination Area or USP 800 Unpacking / Storage Hazardous Drugs	68	20	68	20	60	30	12	12	Exhaust	40	(-)	Yes	CV

Note 1: General

Unpacking from shipping containers must not take place in areas used for sterile compounding nor in areas used to store or unpack non-hazardous drugs.

Storage of HD must not be in the same storage as non HD.

Note 2: Venting of Containment - Primary Engineering Control

If a containment primary engineering control is provided in this space, provide exhaust system for the primary engineering control, maintain ductwork negative by placing the fan at the end of the duct run and discharge in a location as discussed in Chapter 3 to prevent contamination of building air intakes. The exhaust for the primary engineering control must vented through a HEPA filter system.

POLYTRAUMA REHABILITATION CENTER INPATIENT NURSING UNIT - AIR HANDLING UNIT

AHU System Data Sheet

Air-Handling Type	Dedicated Variable Air Volume (paragraphs 3.2.3, 6.2 and 6.4)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode)
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	Yes (Emergency Mode)
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - General

Provide a dedicated air-handling unit where the Polytrauma Rehabilitation Center is constructed as a standalone entity or full-fledged department. The air-handling unit can also serve the Polytrauma Transitional Rehabilitation Program unit (PTRP) unit if located in the same building. The air handling unit shall be served by equipment branch of emergency power.

Note 2 - Emergency Epidemic Air-Handling Unit

(a) Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 3 - Listed Rooms and Their Names

Room names shown in the attached Room Data Sheets are based on the VA Polytrauma Rehabilitation Center Design Guide dated December 2014. See other sections of Chapter 6 for the miscellaneous and support rooms, such as, Housekeeping Aide's Closet (HAC), Attic Space, Crawl Space (Pipe Basement), Exterior Stairs, Mechanical/Electrical Rooms, etc.

Note 4 - Indoor Design Conditions (Temperatures - Bedrooms and Isolation Rooms)

Temperature tolerance for heating and cooling modes is +/- 1.0 F [0.6 C].

Note 5 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

POLYTRAUMA REHABILITATION INPATIENT NURSING UNIT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN							
	F	C	F	C								TEMP	FLOW
Inpatient Nursing Unit													
BRSM1: Patient Bedroom	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
TSPP1: Patient Toilet / Shower	NA	NA	68	20	NA	NA	10	NA	Exhaust (G)	35	(-)	No	CV

Note 1 - Bathroom Temperature

Bathrooms with heat loss must be provided with diffuser from room terminal or preferably with radiant heating.

Note 2 - Bathroom Exhaust and Makeup Air

Bathrooms must be constantly exhausted at a minimum of 10 ACH per hour and must be maintained negative under all load conditions. Makeup air must be from the patient room. The patient room must be neutral to the corridor and positive to the bathroom.

NSTA1: Inpatient Nurse Station	75	24	70	21	6	30	6	2	Return	40	(o)	Yes	VAV
RCA01: Crash Cart Alcove	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	NA

Note 1 - General

If crash cart alcove is exposed to heat loss or gain provide the space with a diffuser from the terminal serving the nurse station to offset the loads.

MEDP1: Medication Room	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
PRD01: Dining Room	75	24	70	21	60	30	6	2	Return	40	(-)	Yes	VAV
SRE01: Food Pantry Storage	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
IPK01: OT Training Kitchen	75	24	70	21	60	NA	6	2	Return	40	(-)	Yes	CV

Note 1: Dining Room Exhaust

Provide general exhaust to maintain space negative and to meet ASHRAE 62.1-2016 or latest approved edition requirements. The remainder of the supply can be returned to the air handling unit.

Note 2: Kitchen Exhaust

Provide general exhaust to maintain space negative. The remainder of the supply can be returned to the air handling unit. If a range hood is provided, design exhaust per NFPA 96 latest edition at the time of design. Ensure general exhaust by itself is adequate to maintain the space negative even if the hood exhaust is off.

CLR09: Family Wellness Multipurpose Room	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
PLAY1: Playroom	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV

POLYTRAUMA REHABILITATION INPATIENT NURSING UNIT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C	MAX	MIN							
Inpatient Nursing Unit (continued)													
LAUN1: Patient Laundry Room	78	26	70	21	60	NA	10	2	Exhaust (G)	45	(-)	Yes	CV
Note 1 - Exhaust Provide dryer exhaust and coordinate with actual equipment used. General exhaust must maintain the space negative and at minimum 10 ACH when the dryer exhaust is not in use.													
PRGY1: Rehabilitation Therapy Gym	75	24	70	21	60	30	6	2	Return	35	(-)	Yes	VAV
Note 1 - Exhaust Maintain minimum required exhaust per ASHRAE Standard 62.1-2016 or latest approved edition and ensure space is minimum 15% negative under all load conditions.													
PREV1: PT/OT Evaluation Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
WRTM1: Team Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
PRRT1: Recreation Therapy Group Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note 1 - General Evaluate planned activities that may require the space to be negative or may require local or general exhaust.													
PRNT1: Neuropsychology Testing Lab	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
PRTM1: BROS Treatment/Office	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV

POLYTRAUMA REHABILITATION INPATIENT NURSING UNIT - ROOM DATA SHEET													
ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW
	F	C	F	C									
Inpatient Nursing Unit (continued)													
PRAT1: Assistive Technology Lab	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
PRRE1: Rehabilitation Engineering Room	75	24	70	21	60	30	4	2	Exhaust (G)	45	(-)	Yes	CV
SRS01: Assistive Technology Equipment Storage	75	24	70	21	60	30	4	2	Return	40	(o)	No	VAV
Note 1 - Rehabilitation Engineering Room In addition to 100% exhaust from this space evaluate the need for local contaminant source exhaust.													
Note 2 - Temperature Control in Assistive Technology Equipment Storage Provide temperature control only if required by Chapter 2. Otherwise provide cooling and heating from the Rehabilitation Engineering Room VAV terminal.													
EXOS1: Speech Language Pathologist Office	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
OFD05: Provider Office	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV

POLYTRAUMA REHABILITATION CENTER - ROOM DATA SHEET

Polytrauma Transitional Rehabilitation Program (PTRP)

ROOM NAME	INDOOR TEMPERATURE COOLING		INDOOR TEMPERATURE HEATING		INDOOR RELATIVE HUMIDITY % RH	% RH	MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	F	C	F	C	MAX	MIN						TEMP	FLOW
BRPT3: Resident Bedroom	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
TSPB1: Resident Toilet/Shower	NA	NA	70	21	NA	NA	10	NA	Exhaust (G)	40	(-)	No	CV

Note 1 - Bathroom Temperature

Bathrooms with heat loss must be provided with diffuser from room terminal or preferably with radiant heating.

Note 2 - Bathroom Exhaust and Makeup Air

Bathrooms must be constantly exhausted at a minimum of 10 ACH per hour and must be maintained negative under all load conditions. Makeup air must be from the patient room. The patient room must be neutral to the corridor and positive to the bathroom.

ROOM NAME	INDOOR TEMPERATURE COOLING		INDOOR TEMPERATURE HEATING		INDOOR RELATIVE HUMIDITY % RH	% RH	MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	F	C	F	C	MAX	MIN						TEMP	FLOW
PRAP1: Apartment Living Room	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
BRPT1: Apartment Bedroom	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
BTPU1: Apartment Bathroom	NA	NA	70	21	NA	NA	10	NA	Exhaust (G)	40	(-)	No	CV
PRCO3: Apartment Kitchenette/Laundry	75	24	70	21	60	30	4	2	Exhaust (G)	40	(-)	Note 3	VAV
SRE01: Apartment Storage	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note 1 - Bathroom Temperature

Bathrooms with heat loss must be provided with diffuser from room terminal or preferably with radiant heating.

Note 2 - Bathroom Exhaust and Makeup Air

Bathrooms must be constantly exhausted at a minimum of 10 ACH per hour and must be maintained negative under all load conditions. Makeup air must be from the patient room. The patient room must be neutral to the corridor and positive to the bathroom.

Note 3 - Kitchenette / Laundry Temperature Control

When consistent with good engineering practice based on load profiles, the kitchenette / laundry may be placed on the same temperature control zone as the living room.

Note 4 - Kitchenette / Laundry Exhaust

Provide dryer exhaust system. Coordinate with equipment to be used. Provide NFPA 96 kitchen hood exhaust system in the design and coordinate with equipment to be used.

POLYTRAUMA REHABILITATION CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH						TEMP	FLOW
	F	C	F	C	MAX	MIN							
Polytrauma Transitional Rehabilitation Program (PTRP) (continued)													
NSTA6: Transitional Rehabilitation Nurse Station	75	24	70	21	6	30	6	2	Return	40	(o)	Yes	VAV
MEDP1: Medication Room	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
RCA01: Crash Cart Alcove	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	NA
Note 1 - General If crash cart alcove is exposed to heat loss or gain provide the space with a diffuser from the terminal serving the nurse station to offset the loads.													
DAYR1: Resident Living Room	75	24	70	21	60	30	6	2	Return	40	(-)	Yes	VAV
PRD01: Resident Dining Room	75	24	70	21	60	30	6	2	Return	40	(-)	Yes	VAV
PRK01: Resident Kitchen	75	24	70	21	60	NA	6	2	Exhaust (G)	40	(-)	Yes	CV
Note 1: Dining Room Exhaust Provide general exhaust to maintain space negative to corridor and to meet ASHRAE 62.1-2016 or latest approved edition requirements. The remainder of the supply can be returned to the air handling unit. Note this space must be positive to the kitchen.													
Note 2: Kitchen Exhaust Provide NFPA 96 compliant exhaust system for cooking equipment and provide general exhaust as required to ensure the space is 100% exhausted even when kitchen equipment is not being operated.													
PRGY2: Rehabilitation Therapy Gym	75	24	70	21	60	30	6	2	Exhaust (G)	35	(-)	Yes	VAV
Note 1 - Exhaust Maintain minimum required exhaust per ASHRAE Standard 62.1-2016 or latest approved edition and ensure space is minimum 15% negative under all load conditions.													
PRAT2: Assistive Technology Lab	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
SRS01: Assistive Technology Equipment Storage	NA	NA	NA	NA	NA	NA	NA	NA	Return	45	(o)	No	VAV
Note 1 - General If equipment storage is exposed to heat loss or gain provide the space with a diffuser from the terminal serving the nurse station to offset loads.													

MINIMUM AHU REQUIREMENTS TO SERVE POLYTRAUMA OUTPATIENT UNIT

AHU System Data Sheet

Air-Handling Type	Non-dedicated (Par 6.3) Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14 (Normal Mode) AF = MERV 16A (Emergency Mode)
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	No
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - General

A separate air handling unit is not required and not prohibited. Any air handling unit used must meet the minimum requirements listed. The air handling unit must operate on the same schedule as the outpatient unit.

Note 2 - Listed Rooms and Their Names

Room names shown in the attached Room Data Sheets are based on the VA Polytrauma Rehabilitation Center Design Guide dated December 2014. See other sections of Chapter 6 for the miscellaneous and support rooms, such as, Housekeeping Aide's Closet (HAC), Attic Space, Crawl Space (Pipe Basement), Exterior Stairs, Mechanical/Electrical Rooms, etc.

Note 3 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 4 - Enhanced Air Filtration

(a) During Emergency Epidemic use enhanced after-filters as noted above.

(b) Size the AHU supply and return/relief fan motors to compensate for the additional air pressure drop due to enhanced filtration application.

(c) The AHU filter section must be configured to accommodate installation of enhanced after-filters during Emergency Epidemic.

(d) Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU interior surfaces.

POLYTRAUMA OUTPATIENT UNIT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S				
	F	C	F	C								TEMP	FLOW
Outpatient Unit													
EXRG0: Outpatient Exam Room	75	24	70	21	60	30	6	2	Return	35	(o)	Note 1	VAV
Note 1 - Temperature Control If a single exam room is provided it must have local temperature control. If more than one exam room see applicable sections of Chapter 2.													
PTEM1: EMG Exam Room	75	24	70	21	60	30	6	2	Return	35	(o)	Note 1	VAV
Note 1 - Temperature Control If a single exam room is provided it must have local temperature control. If more than one exam room see applicable sections of Chapter 2.													
PTBT1: Chiropractic Exam Room	75	24	70	21	60	30	6	2	Return	35	(o)	Note 1	VAV
Note 1 - Temperature Control If a single exam room is provided it must have local temperature control. If more than one exam room see applicable sections of Chapter 2.													
PRP01: Pain Procedure Room	75	24	70	21	60	30	6	2	Return	35	(+)	Yes	VAV
PRDT1: Driver Training Room	70	21	65	18	60	30	4	2	Return	40	(o)	Yes	VAV
PTGL1: Gait Observation Lab	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
SRE01: Gait Lab Storage Room	75	24	70	21	60	30	4	NA	Return	40	(+)	Yes	VAV
PREX1: Gait Lab Exam Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV

POLYTRAUMA OUTPATIENT UNIT - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
Outpatient Unit (continued)													
PRGY3: Patient Rehabilitation Therapy Gym	75	24	70	21	60	30	6	2	Return	35	(-)	Yes	VAV
Note 1 - Exhaust Maintain minimum required exhaust per ASHRAE Standard 62.1-2016 or latest approved edition and ensure space is minimum 15% negative under all load conditions.													
PRST1: Speech Therapy Lab	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
PRN01: Balance Testing Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
PRV01: Vestibular Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
OFDC2: Cognitive Therapy / Counseling Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
PRRT2: Recreational Therapy Group Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV

MINIMUM AHU REQUIREMENTS TO SERVE PULMONARY MEDICINE SERVICE

AHU System Data Sheet

Air-Handling Type	Non-dedicated (par 6.3) Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14 (Normal Mode) AF = MERV 16A (Emergency Mode)
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	No
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - General

A separate air handling unit is not required and not prohibited. Any air handling unit used must meet the minimum requirements listed.

Note 2 - Listed Rooms and Their Names

Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on the VA Pulmonary Medicine Service Design Guide dated November 29, 2011. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note 3 - Makeup Air Requirements

Any air handling unit serving the pulmonary medicine services spaces need not be a 100% outside air system, however, the system must have adequate outside air flow to match the exhaust requirement of all spaces served plus additional flow to maintain the area positive relative to the outside, or the minimum required outside air of all the spaces served whichever is greater.

Note 4 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

Note 5 - Enhanced Air Filtration

(a) During Emergency Epidemic use enhanced after-filters as noted above.

(b) Size the AHU supply and return/relief fan motors to compensate for the additional air pressure drop due to enhanced filtration application.

(c) The AHU filter section must be configured to accommodate installation of enhanced after-filters during Emergency Epidemic.

(d) Before switching from emergency to normal operation mode, replace all air filters and thoroughly clean and disinfect AHU interior surfaces.

PULMONARY MEDICINE SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
Procedure Room													
OPPF1: Pulmonary Function Testing Laboratory	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	VAV
OPPF2: Extended Pulmonary Function Testing Laboratory	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	VAV
OPPF5: Pulmonary Exercise Physiology Laboratory	75	24	70	21	60	30	10	2	Exhaust (G)	40	(-)	Yes	VAV
OPRT1: Respiratory Therapy Room	75	24	70	21	60	30	8	2	Return	35	(o)	Yes	VAV
OPRT1: Aerosolized Pentamidine Room	75	24	70	21	60	30	12	2	Exhaust (G)	35	(-)	Yes	CV
TRPE2: Bronchoscopy Procedure Room	75	20	70	21	60	30	12	2	Exhaust (G)	35	(-)	Yes	CV
OPPF6: Sleep Study Room	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
OPPF7: Sleep Study Monitor Room	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
RRSS1: Patient Prep and Recovery	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV

Note 1 - General

The space types listed in this manual reflect the terminology and functions used in the Department of Veterans Affairs, Pulmonary Medicine Service Design Guide dated November 29, 2011.

Note 2 - Air Handling Unit

If the size and / or arrangement of a specific pulmonary medicine service department warrants it, a separate air handling unit may be provided for this function, in general, however, any air handling unit meeting the minimum requirements of the Pulmonary Medicine Service AHU sheet and space requirements in the room data sheets (RDS) may be used.

Note 3 - Sputum Collection

Induced sputum collection should be preformed in a negative pressure room appropriate for that purpose.

SPINAL CORD INJURY/DISORDERS CENTER - AIR HANDLING UNIT

AHU System Data Sheet

Air-Handling Type	Dedicated Variable Air Volume (paragraphs 3.2.3, 6.2 and 6.4)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode)
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	No
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - General

Provide a dedicated air-handling unit where the Spinal Cord Injury/Disorders Center (SCI) is constructed as a standalone entity or full-fledged department. The air-handling unit can also serve the SCI Long Term Care unit if located in the same building. The air handling unit must be served by equipment branch of emergency power.

Note 2 - Emergency Epidemic Air-Handling Unit

Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 3 - Listed Rooms and Their Names

Room names shown in the attached Room Data Sheets are based on PG-18-9 Chapter 104 Spinal Cord Injury / Disorders Center See other sections of Chapter 6 for the miscellaneous and support rooms, such as, Housekeeping Aide's Closet (HAC), Attic Space, Crawl Space (Pipe Basement), Exterior Stairs, Mechanical/Electrical Rooms, etc.

Note 4 - Indoor Design Conditions (Temperatures - Bedrooms and Isolation Rooms)

Temperature tolerance for heating and cooling modes is +/- 1.0 F [0.6 C]

Note 5 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

SPINAL CORD INJURY/DISORDERS CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH							
	F	C	F	C	MAX	MIN						TEMP	FLOW
Acute Care Unit Patient Area and Long Term Care Unit Patient Area													
BRMS1: One-Bed Patient Room	72	22	82	28	60	30	6	2	Return	35	(o)	Yes	VAV
BRMS2: Two-Bed Patient Room	72	22	82	28	60	30	6	2	Return	35	(o)	Yes	VAV
TSPS1: Patient Bathroom	75	24	70	21	NA	NA	15	NA	Exhaust G	40	(--)	Yes	CV

Note 1 -Total Air Changes Per Hour & Negative Air Balance

Unlike other patient room / patient bathroom combinations these bathrooms will only get part of the makeup air from the patient bathroom. Each bathroom must have its own constant volume temperature control terminal which must provide enough makeup air to keep the bathroom negative relative to the patient room.

Note 2 - Energy Conservation Initiative

Include occupied / unoccupied mode of operation to conserve energy by analyzing the cost effectiveness of such features as occupancy sensors, two position supply air control, two position exhaust air control, and variable outside air control at the air handling unit.

BRIT1: Negative Pressure Isolation Patient Room (AII)	72	22	82	28	60	30	12	2	Exhaust (S)	35	(--)	Yes	CV
BRAR1: Isolation Anteroom	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (S)	35	(-)	No	CV
TSPS1: Isolation Patient Bathroom	75	24	70	21	NA	NA	15	NA	Exhaust (S)	40	(--)	Yes	CV

Note 1 - Special Exhaust System

Provide a dedicated, special exhaust system for the Patient Bedroom, Ante Room and Patient Toilet (where present). Do not connect other rooms to the dedicated exhaust system. Locate the exhaust fan at the end of the duct run to maintain the ductwork within the building at a negative pressure and install bag-in-bag out HEPA filters just prior to the fan inlet. Discharge exhaust air above the highest roof level through a stack at least 10 ft [3 m] tall at 3,500 fpm [18 m/s] discharge velocity. The discharge air outlet must be located at least 25 ft [8 m] from outdoor air intakes and operable windows. Follow the recommendations of the dispersion analysis for higher than minimum requirements. Provide emergency power for the exhaust fan and associated controls. Label ductwork, filter, and fan "COMMUNICABLE DISEASE CONTAMINATED AIR".

Note 2 - Instrumentation

Provide a room differential pressure monitoring device between Ante Room and Isolation Room, and between Ante Room and corridor.

SPINAL CORD INJURY/DISORDERS CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH							
	F	C	F	C	MAX	MIN						TEMP	FLOW
Acute Care Unit Patient Area and Long Term Care Unit Patient Area (continued)													
Note 3 - Air Distribution Layout **(a) Patient Bedroom** Locate the exhaust air inlet over or near the patient bed to ensure that air flows into the room and away from the patient room door. Preferred location of the exhaust air inlet is in the wall, 7 in [175 mm] above the floor, and near the patient head rest. **(b) Ante Room** Air must transfer from the Corridor into the Ante Room and then to the Isolation Room. The Ante Room is positive with respect to the Isolation Room and negative with respect to the Corridor.													
Note 4 -Toilet Room Total Air Changes Per Hour & Negative Air Balance Unlike other patient room / patient bathroom combinations these bathrooms will only get part of the makeup air from the patient bathroom. Each bathroom shall have its own constant volume temperature control terminal which shall provide enough makeup air to keep the bathroom a minimum of 30% negative relative to the patient room.													
Note 5 - Additional Information See room data sheets (RDS) for isolation rooms.													
DAYR1: Day Room/Lounge	72	22	82	28	60	30	6	2	Return	35	(o)	Yes	VAV
Note 1 - Smoking Provide a dedicated 100% exhaust system if smoking is permitted in the lounge.													
NCWD1: Nourishment Kitchen	75	24	70	21	60	30	6	2	Exhaust (G/S)	40	(-)	Yes	VAV
Note 1 - Exhaust System Connect exhaust to a common general exhaust system. Provide 100% transfer air for the exhaust from the adjoining space. Coordinate with equipment to be used - if conditions warrant it provide NFPA 96 kitchen hood exhaust system.													
LAUN1: Patient Laundry	NA	NA	NA	NA	NA	NA	4	2	Exhaust (S)	40	(-)	No	VAV
Note 1 - Exhaust System Provide Dryer Exhaust System. Coordinate with equipment to be used.													

SPINAL CORD INJURY/DISORDERS CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN							
	F	C	F	C								TEMP	FLOW
Acute Care Unit Patient Area and Long Term Care Unit Patient Area (continued)													
OFDC2: Quiet Room	72	22	82	28	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
Patient Area													
DAYR1: Multipurpose Room	72	22	82	28	60	30	6	2	Return	40	(o)	Yes	VAV
Note 1 - Room Temperature Control Where the room is equipped with folding partitions, provide individual air supply, air return, and room temperature control on either side of the partition.													
Note 2 - Energy Conservation Initiative Evaluate the feasibility of using a carbon-dioxide (CO2) and/or occupancy sensor to conserve energy during part load conditions. The control sequence must be project-specific. Follow requirement in ASHRAE Standard 62.1 -2016 or latest approved edition.													
XXYYC: Internet Cafe	72	22	82	28	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
RAMR1: Meditation Room:	72	22	82	28	60	30	6	2	Return	35	(+)	Yes	VAV
Note - None													
OFD03: Patient Education	72	22	82	28	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
FSCD1: Resident Dining/Serving	72	22	82	28	60	30	6	2	Return	40	(-)	Yes	VAV
Note - None													
BTSCI: Tub Room	78	26	82	28	NA	NA	10	NA	Exhaust (S)	40	(-)	Yes	CV
Note 1 - Exhaust System Provide a dedicated or a common wet exhaust system with welded stainless steel ductwork.													

SPINAL CORD INJURY/DISORDERS CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
Patient Area (continued)													
TRGM1: Exam/Treatment Room	72	22	82	28	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
PTWT1: Hydrotherapy	78	26	82	28	NA	NA	10	NA	Exhaust (S)	40	(-)	Yes	CV
Note 1 - Exhaust System Provide a dedicated or a common wet exhaust system with welded stainless steel ductwork.													
SCI/D Patient Clinic Area													
TRGS1: Exam/Treatment Room	72	22	82	28	60	30	6	2	Return	35	(o)	Note 1	VAV
Note 1 - Temperature Controls If one room is provided provide it with temperature control. If more than one room is provided follow Chapter 2 requirements.													
SCI/D Patient Clinic Area - Urodynamics													
EXUD1: Exam/Treatment Room	72	22	82	28	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
XDCY1: Cystoscopy	66	19	66	19	60	30	15	3	Return	35	(+)	Yes	VAV
Note 1 - Unoccupied Mode Provide a two-position air terminal unit to deliver 50% supply air during unoccupied mode while maintaining positive air balance.													
Note 2 - Air Distribution Provide unidirectional air distribution with overhead supply and floor level return. Locate return air registers at opposite ends at 8 in [200 mm] above the floor.													
Note 3 - Instrumentation Provide temperature and relative humidity sensors for trending of indoor design conditions.													

SPINAL CORD INJURY/DISORDERS CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
SCI/D Patient Clinic Area - Urodynamics (continued)													
SRS01: Instrument Cleaning Room / Storage	66	19	72	22	55	30	10	10	Exhaust (G)	40	(- -)	Yes	CV
Note 1 - Exhaust System Connect the room exhaust to a dedicated or a common general exhaust system and transfer air from the Storage Room and Corridor.													
RRSS1: Recovery Room	72	22	82	28	60	30	6	2	Return	35	(o)	Yes	VAV
Note - None													
DR001: Dressing Room/Cubicle	72	22	82	28	60	30	6	2	Return	40	(o)	Yes	VAV
Note - None													
NSTA1: Nurse Station	72	22	82	28	60	30	6	2	Return	40	(o)	Yes	VAV
Note - None													
OFD01: Urologist Office	72	22	82	28	60	30	4	2	Return	40	(o)	Note 1	VAV
Note 1 - Temperature Controls If one room is provided provide it with temperature control. If more than one room is provided follow Chapter 2 requirements.													
UCCL1: Outpatient Urodynamics Clinic Clean Utility Room	70	21	70	21	55	30	4	4	Return	40	(+)	Yes	CV
Note 1 - Room Air Balance Provide supply air from adjoining air terminal unit.													

SPINAL CORD INJURY/DISORDERS CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S				
	F	C	F	C								TEMP	FLOW
SCI/D Therapy Rooms													
PTES1: Physical Therapy / Kinesiology Therapy	72	22	82	28	60	30	6	2	Return	40	(o)	Yes	VAV
OTEV1: Occupational Therapy	72	22	82	28	60	30	6	2	Return	40	(o)	Yes	VAV
XXYYC: PT / OT /KT Occupational Therapy	72	22	82	28	60	30	6	2	Return	40	(o)	Yes	VAV
OTDL1: Activities of Daily Living	72	22	82	28	60	30	6	2	Return	40	(o)	Yes	VAV
Note - None													
XXYYC: Home Environment Learning Bathroom	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (G)	40	(-)	No	CV
XXYYC: Home Environment Learning Bedroom	72	22	82	28	60	30	4	2	Return	35	(o)	Yes	VAV
XXYYC: Home Environment Learning Kitchen	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (G)	40	(-)	No	CV
XXYYC: Home Environment Learning Living/Dining	72	22	82	28	60	30	4	2	Return	35	(o)	Yes	VAV
Note 1 - Bedroom and Living/Dining Bedroom and Living/Dining can be served by a common terminal unit if the rooms are located on the same exposure as shown in the SCI Design Guide dated June 2008 with 2011 Revision.													
Note 2 - Kitchen Exhaust room air outdoors if the kitchen equipment or room exhaust has an outdoor air connection.													
XXYYC: Horticulture Therapy	72	22	82	28	60	30	6	2	Return	40	(o)	Yes	VAV
Note - None													

SPINAL CORD INJURY/DISORDERS CENTER - ROOM DATA SHEET

<table>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN EXHAUST G EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td colspan="14"></td></tr>
<tr><td colspan="14">SCI/D Therapy Rooms (continued)</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>PTWT1: Therapeutic Pool</td><td>80</td><td>27</td><td>85</td><td>29</td><td>65</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust (S)</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Energy Considerations
Provide system with air flow setback capability for operation during un-occupied periods.</td></tr>
<tr><td colspan="14">Note 2 - Exhaust System
Provide 100% exhaust with a dedicated or a common wet exhaust system with welded stainless steel ductwork. Evaluate the pool water evaporation load and adjust air flows to maintain space relative humidity below 65%.</td></tr>
<tr><td colspan="14">Note 3 - Air Distribution
Direct supply air towards surfaces prone to condensation and located exhaust grills so as not to promote short circuiting of supply.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>DR001: Therapeutic Pool Dressing Room (One male, one female)</td><td>78</td><td>26</td><td>82</td><td>28</td><td>NA</td><td>NA</td><td>6</td><td>2</td><td>Exhaust (G)</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Air Balance
Provide 100% exhaust and adjust supply and transfer air volumes as required to meet the exhaust requirements of the shower, toilet, and lockers.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td colspan="14">SCI/D Specific Support Spaces</td></tr>
<tr><td>SRLW1: Litter Storage</td><td>78</td><td>26</td><td>70</td><td>21</td><td>NA</td><td>NA</td><td>6</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Exhaust System
Transfer air from the adjoining spaces to maintain negative air balance.</td></tr>
<tr><td colspan="14">Note 2 - Room Temperature Control
Individual room temperature control is optional. The room can be served by a common air terminal unit with similar load characteristics.</td></tr>
<tr><td colspan="14"></td></tr>
</table>

SPINAL CORD INJURY/DISORDERS CENTER - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S				
	F	C	F	C								TEMP	FLOW
SCI/D Specific Support Spaces (continued)													
SRE01: Transfer Equipment Storage	78	26	70	21	NA	NA	4	NA	Exhaust (G)	40	(-)	Yes	CV
Note 1 - Exhaust System Connect exhaust to a general exhaust system serving other spaces. Transfer air from the adjoining spaces to maintain negative air balance.													
Note 2 - Room Temperature Control Individual room temperature control is optional. The room can be served by a common air terminal unit with similar load characteristics.													
TLTS1: Patient (Litter) Bathroom	75	24	70	21	NA	NA	15	NA	Exhaust (G)	40	(-)	Yes	CV
Note 1 - Exhaust System and Temperature Control Unlike other patient bathroom these bathrooms will only get part of the makeup air from the exterior space. Each bathroom must have its own constant volume temperature control terminal which must provide enough makeup air to keep the bathroom a minimum of 30% negative relative to the patient room.													

STANDALONE SMOKING FACILITY - AIR HANDLING UNIT

AHU System Data Sheet

Air Handling Type	Dedicated (Par 6.2), Constant Volume
Indoor Design Temperature - Cooling	77 F [25 C]
Indoor Design Temperature - Heating	70 F [21 C]
Indoor Design Relative Humidity - Dehumidification	60%
Indoor Design Relative Humidity - Humidification	Not Required
Minimum Total Air Changes Per Hour	6
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	Yes (Intermittently)
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filter (PF-1)	PF 1 = MERV 7
Cooling Source	Chilled Water or DX
Heating Source	Steam and/or Hot Water, Electric
Humidification Source	Not Required
General Exhaust System Required	Yes
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Yes
Room Air Balance	Negative (-)

Note 1 - VHA Directive

Per VHA Directive (2003-035 dated July 1, 2003), smoking is permitted for long term care patients and mental health patients. Indoor smoking must not interfere with the safety of non-smokers.

Note 2 - HVAC System Details and Controls

The HVAC system selection shall be project specific - either a chilled water or direct-expansion (DX) system.

(a) Chilled Water System

Provide a modulating chilled water control valve.

(b) DX System

Provide at least two independent refrigeration circuits, if available for the required capacity.

Note 3 - Suggested Control Sequences

(a) Unoccupied Mode

The system shall cycle (on/off) with the outdoor air damper closed to maintain a night-setback temperature at 60 F [16 C].

(b) Purge Cycle

A dedicated exhaust fan shall operate intermittently during occupied mode to flush smoke-laden air outdoors.

Note 4 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

STERILE PROCESSING SERVICES (SPS) - AIR HANDLING UNIT	
AHU System Data Sheet	
Air-Handling Type	Dedicated (Par 6.2), Variable Air Volume
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	No
Exhaust Air Required	Yes
Air Economizer Cycle Required	No
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	Yes
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - Listed Rooms and Their Names

Room names and criteria shown in the attached Room Data Sheets are based on the VA Design Guide for Logistics Service and Sterile Processing Services dated October 1, 2015 on Chapter 285: Sterile Processing Service in PG-18-9 Space Planning Criteria dated March 2008 and revised October 3, 2016; and on VHA Directive 1116 dated March 23, 2016. See other sections of Chapter 6 for the miscellaneous and support rooms, such as, Housekeeping Aide's Closet (HAC), Attic Space, Crawl Space (Pipe Basement), Exterior Stairs, Mechanical/Electrical Rooms, etc.

Note 2 - General Coordination

Coordinate equipment heat gain and utility requirements with the selected equipment. The abator is supplied with the ETO Sterilizer. Mechanical drawings must indicate duct, pipe and utility connections.

Note 3 - General Exhaust System

Provide a dedicated, general exhaust system for the spaces identified in the Room Data Sheets. Provide the main general exhaust system with N+1 fan capability and controls to bring on the lag fan upon Lead fan failure. Interlock AHU fan with exhaust air flow.

Note 4 - Wet Exhaust System

Provide a dedicated (space) exhaust system for the Manual Equipment Wash and Automatic Cart Washer Rooms.
Detail the duct system installation to prevent and / or drain low spots in the ductwork which may accumulate water.

Note 5 - Wet Exhaust System (Automatic Cart Wash Equipment)

Provide a dedicated (equipment) exhaust system for the Automatic Cart Wash Equipment. The system capacity must be based on the actual selected equipment. Prevent and / or drain low points in the duct system which may accumulate water during operation.

STERILE PROCESSING SERVICES (SPS) - AIR HANDLING UNIT

AHU System Data Sheet

Note 6 - Ethylene Oxide (ETO) Exhaust System

(a) General - New Construction and Major Renovations of the SPS Department

Per VHA (Veterans Health Administration) Directive, under processing and concurrence, the following measures must be implemented:

For all new construction and major renovations, provide an Abator for each Ethylene Oxide (ETO) sterilizer to convert the ETO exhaust into water vapor and carbon-oxide. Per Directive in all existing ETO sterilizer installations, abators must be installed by 2015. No ETO sterilizers must be used without abators after 2015.

(b) Abator

Abator is a pollution control device. Vent line from each ETO sterilizer is connected to its own abator to split ethylene-oxide into water vapor and carbon-oxide by an exothermic reaction. Per VHA direction, each sterilizer must be equipped with its own abator to avoid a single point of failure and facilitate on-line maintenance.

(c) Exhaust System

The dedicated exhaust system serving the ethylene oxide sterilizer installation must include exhaust through the sterilizer room, abator, and the flammable storage cabinet required to house the ETO canisters.

(d) ETO Sterilizer Room Exhaust

Exhaust through or over the sterilizer by an integral plenum is not required, as the VA Standard Operating Procedure permits opening of the sterilizer door only after the specified time limit has expired at the end of each operating cycle. Provide ceiling-mounted exhaust register over the sterilizer door to exhaust the room at 10 air changes per hour.

(e) Exhaust through the Abator

Each abator admits 50 cfm [24 L/s] room air through its intake nozzle and discharges it through its exhaust nozzle at very high temperature, approximately at 480 F [250 C]. Room air is mixed at the rate of 150 cfm [70 L/s] with the hot air discharge discharged by the abator to dilute the hot air. This is accomplished by a three-way mixing nozzle supplied by the equipment manufacturer.

(f) Exhaust through the Flammable Storage Cabinet

Admit room air into the cabinet through the cabinet doors and connect the cabinet exhaust nozzle to the exhaust system. Ensure that enough air is exhausted to create -0.06 in [-15 Pa] negative air pressure. The approximate nozzle size is 4 in [100 mm] and the exhaust air volume is 40 to 50 cfm [19 to 24 L/s].

(g) Abator Vent Pipe

Each abator is equipped with its own vent pipe, operative during emergency only when the intended chemical reaction to break the ETO into water and CO2 does not materialize. Coordinate vent pipe size, material, fittings, and equivalent length limitation with the ETO manufacturer. Coordinate vent termination details with the equipment manufacture.

(h) Exhaust Fan and Ductwork

Provide a non-ferrous, spark-proof construction centrifugal fan with a backward inclined wheel. The fan motor must be mounted outside the exhaust air stream. Maintain complete exhaust air ductwork under negative air balance. Provide an airflow control valve to ensure accurate air balance. Locate the fan and abator vent exhaust pipe at least 25 ft [8 m] from any outdoor air intake, unsealed doors and windows, driveways, and walkways. Modify the discharge requirements if so recommended by the dispersion analysis.

STERILE PROCESSING SERVICES (SPS) - AIR HANDLING UNIT

AHU System Data Sheet

Note 7 - Air Distribution Requirements

(a) Air distribution system design is vital to ensure contamination control. The design should demonstrate the directions and magnitude of the supply, exhaust, and make-up air flows. Provide automatic airflow control valves, as required, to accomplish the design objective. It is vital to ensure that the supply air inlets and exhaust air outlets are judiciously located.

(b) Strategically locate exhaust grills, or where advantageous provide local capture exhaust hoods at high humidity and / or high heat locations. For example above the inlet and outlet sides of washer disinfectors and at the loading end of steam sterilizers.

(c) See Sterile Processing Service Air Flow Relationships Diagram next page.

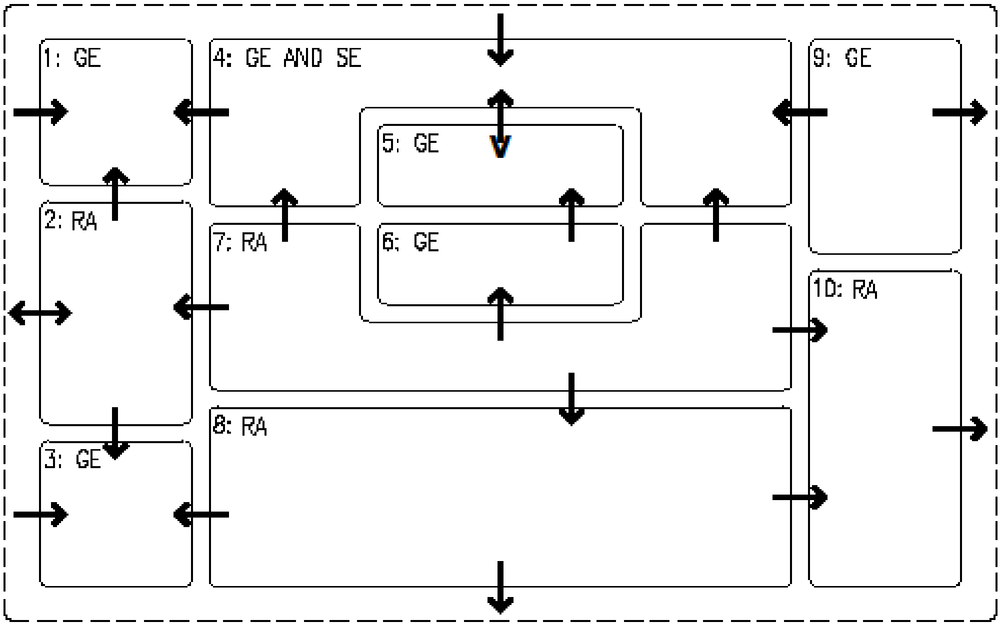
Note 8 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

STERILE PROCESSING SERVICE AIR FLOW RELATIONSHIPS



LEGEND

1: TNPG1 / LR002: TOILETS / LOCKERS (--)
2: OFA09 / OFA07 / CFR01 /SL001 ETC.: STAFF AND ADMINISTRATIVE AREAS (0)
3: TNPG1 / LR002: TOILETS / LOCKERS (--)
4: CSDE1: DECONTAMINATION WORK AREA (--)
5: CSSD1: SCOPE DECONTAMINATION ROOM (--)
6: CSSP1: SCOPE PROCESSING ROOM X(*)X (-)
7: CSIA1 / CSSS1 ETC.: STERILIZATION, PREPARATION, AND ASSEMBLY AREA (++)
8: SRSO5: STERILE DURABLES STORAGE (+)
9: CSCR1: SOILED TRANSITION / DROP OFF ANTE ROOM (+)
10: CHC01: DISPATCH AREA (+)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST (WET EXHAUST / ETO EXHAUST)
RA: RETURN AIR
AIR FLOW DIRECTION BETWEEN SPACES →
NEUTRAL AIR FLOW ↔
PEDESTRIAN CIRCULATION - - - - - - - - - -

STERILE PROCESSING SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
General: The rooms and their relative locations with adjoining spaces are based on information given in the VA Sterile Processing Service Design Guide dated October 1, 2015; VHA Directive 1116 Dated March 23, 2016 and in the VA PG-18-9 Space Planning Criteria Chapter 285 dated March 2008 and revised October 3, 2016. The design documents must include a space pressure and air flow diagram to indicate all required pressure relationships. Provide room differential pressure monitoring devices for the following spaces: Decontamination area , Packaging & Preparation area, Clean Workroom & Storage area, Anteroom and Dispatch areas. These devices must be provided at all openings in common walls between these areas and adjacent spaces.													
Decontamination Area													
CSCR1: Soiled Transition / Drop Off Ante Room	66	19	72	22	60	30	10	10	Exhaust (G)	40	(-)	Yes	CV
Note - None													
CSPE1: PPE Alcove	66	19	72	22	60	30	10	10	Exhaust (G)	40	(+)	Yes	CV
Note - None													
CSDE1: Decontamination Work Area	66	19	72	22	60	30	6	6	Exhaust (G)	40	(--)	Yes	CV
Note - None													
CWSH2: Automatic Cart Washer	NA	NA	NA	NA	NA	NA	Note 1	Note 1	Exhaust (S)	45	(-)	No	CV
Note 1 - Special Exhaust System Coordinate exhaust and makeup air from automatic cart washer with the basis of design cart washer system. Provide with welded stainless steel wet exhaust system.													

STERILE PROCESSING SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN							
	F	C	F	C								TEMP	FLOW
Decontamination Area (continued)													
CWSH3: Manual Cart Wash	75	24	70	21	NA	NA	10	10	Exhaust (S)	40	(-)	Yes	CV
Note 1 - Air Terminal Unit Provide a cooling only dedicated air terminal unit to serve the Manual Equipment Wash room. Specify this unit as stainless steel construction with copper fins on copper tube chilled water coil.													
Note 2 - Special Exhaust Systems Provide a dedicated wet exhaust system to serve this space and the Automatic Cart Washer room.													
CSWT1: Water Treatment and Detergent Storage Room	NA	NA	NA	NA	NA	NA	10	10	Exhaust (G)	40	(-)	No	CV
Note 1 - Individual Room Temperature Control Individual room temperature control of 72 F (22 C) cooling and heating with supply air is required if the space is occupied.													
JANC2: Housekeeping Aides Closet (HAC)	75	24	75	24	NA	NA	10	10	Exhaust (G)	40	(- -)	No	CV
Note - None													

STERILE PROCESSING SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
Scope Processing Area													
CSAR1: Scope Processing Anteroom	66	19	72	22	60	30	10	10	Exhaust (G)	40	(-)	Yes	CV
Note 1 - Room Air Balance Provide supply air from an adjoining air terminal unit, as individual room temperature control is not required. Direct air flow towards interior doors. Do not exhaust air from this room.													
CSPE1: PPE Alcove	66	19	72	22	60	30	10	10	Exhaust (G)	40	(+)	Yes	CV
CSSD1: Decontamination Room	66	19	72	22	60	30	6	6	Exhaust (G)	40	(--)	Yes	CV
CSSP1: Scope Processing Room	66	19	72	22	60	30	6	6	Exhaust (G)	40	(-)	Yes	CV
CSST1: Scope Staging Room	66	19	72	22	60	30	4	4	Exhaust (G)	40	(+)	Yes	CV
Preparation and Assembly Area													
CSIA1: Clean Workroom Instrument Set Assembly	66	19	72	22	60	30	4	4	Exhaust (G)	40	(+ +)	Yes	CV

STERILE PROCESSING SERVICE - ROOM DATA SHEET													
ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S				
	F	C	F	C								TEMP	FLOW
Preparation and Assembly Area (continued)													
SRSP1: Sterile Processing Supplies Storage	66	19	75	27	60	30	4	4	Exhaust (G)	40	(+)	Yes	CV
Note - None													
Sterilization Area													
CSSS1: Steam Sterilization Area	66	19	75	24	60	30	10	10	Exhaust (G)	40	(+ +)	Yes	CV
CSSS1: Sterilizer Equipment Room	85	NA	NA	NA	NA	NA	10	10	Exhaust (G)	45	(-)	No	CV
Note 1 - General Coordinate the canopy hood (generally provided for the capture of vapor) design with the architectural and equipment drawings.													
CSLT1: Low Temp Sterilization Area	66	19	75	24	60	30	10	10	Exhaust (G)	40	(+ +)	Yes	CV

STERILE PROCESSING SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
Sterilization Area (continued)													
CSE01: ETO Sterilizer Room	66	19	75	24	60	30	10	10	Exhaust (S)	40	(-)	Yes	CV
CSE02: ETO Abator Room	66	19	75	24	60	30	10	10	Exhaust (S)	40	(-)	Yes	CV
Note 1 - General Provide a dedicated exhaust system to serve the ETO Sterilizer Room and abator. See AHU System Data Sheet for details. In most cases the abator will be located in the ETO sterilizer room.													
Note 2 - Flammable Storage Cabinet Provide exhaust ventilation through the flammable storage cabinet. The cabinet exhaust must be connected to the ETO exhaust system. Ensure compliance with NFPA 30 and applicable OSHA Regulations.													
Note 3 - Alarms and Controls Provide an alarm panel outside the ETO Sterilizer Room to sound a local alarm and remote alarm at the ECC in the event of loss or interruption of exhaust airflow. Integrate ETO gas leakage alarm with the exhaust system alarm.													
CHC01: Cart Return Area	66	19	75	24	60	30	10	10	Exhaust (G)	40	(+ +)	Yes	CV
CHC01: Unloading / Cooling Area	66	19	75	24	60	30	10	10	Exhaust (G)	40	(+ +)	Yes	CV
Note 1 - General These areas at the sterilizer unloading area are part of the larger room. Provide exhaust grills and / or exhaust hoods at the sterilizer loading and unloading ends to capture heat and moisture as directly as possible.													
CSCG1: Clean Steam Generator Equipment	85	NA	NA	NA	NA	NA	10	10	Exhaust (G)	45	(-)	No	CV
Note 1 - General Coordinate the canopy hood (generally provided for the capture of vapor) design with the architectural and equipment drawings.													

STERILE PROCESSING SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
Receiving, Storage and Dispatch Area													
SRS01: Vendor Drop-Off / Pick-up Area	75	24	70	21	60	30	6	6	Exhaust (G)	40	(+)	Yes	CV
Note 1 - None													
CHC01: Dispatch Area	75	24	70	21	60	30	4	4	Exhaust (G)	40	(o)	Yes	CV
Note - None													
OFA07: Case Cart Dispatch Workstation	75	24	70	21	60	30	4	4	Exhaust (G)	40	(+)	Yes	CV
Note 1 - None													
SRS05: Sterile Durables (RMEs) Storage	66	19	72	22	60	30	4	4	Exhaust (G)	40	(+)	Yes	CV
Note 1 - None													
CSCQ1: Case Cart Assembly Area	66	19	75	24	60	30	4	4	Exhaust (G)	40	(+)	Yes	CV
Note 1 - None													
SRS04 Sterile Consumables (Soft Goods) Storage	66	19	72	22	60	30	4	4	Exhaust (G)	40	(+)	Yes	CV
Note 1- Temperature and Humidity Control Depending on the size and location of the satellite storage it may or may not be possible to achieve the listed temperature and relative humidity conditions. This will depend on the proximity of an air handling unit with the adequate level of dehumidification and humidification.													
Note 2- Filtration Even if temperature and humidity requirements cannot be met, ensure filtration levels meet or exceed the SPS air handling unit requirements.													
Note 3 - Pressure Control Due to the small size of satellite storage areas 4 air changes per hour may not be adequate to provide a measurable pressure drop in the room. The designer must analyze the room characteristics and increase design air flow as necessary to maintain 0.02 inch water column between the room and the adjoining corridors.													

STERILE PROCESSING SERVICE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
Receiving, Storage and Dispatch Area (continued)													
JANC2: Housekeeping Aides Closet (HAC)	NA	NA	NA	NA	NA	NA	10	10	Exhaust (G)	40	(- -)	No	CV
Staff and Administrative Area													
OFA09 Sterile Processing Service (SPS) Chief Office	75	24	70	21	60	30	4	4	Exhaust (G)	35	(o)	Yes	VAV
Note - None													
OFA09 Sterile Processing Service (SPS) Assistant Chief Office	75	24	70	21	60	30	4	4	Exhaust (G)	35	(o)	Yes	VAV
Note - None													
OFA07 Clerical Workstation	75	24	70	21	60	30	4	4	Exhaust (G)	40	(o)	No	VAV
Note 1 - Room Air Balance Provide supply air from an adjoining air terminal unit.													
CFR01: Staff Training Room	75	24	70	21	60	30	6	6	Exhaust (G)	35	(o)	Yes	VAV
Note - None													
RPR01: Copier / Office Supply Room	75	24	70	21	60	30	4	4	Exhaust (G)	40	(o)	No	VAV
Note 1 - Room Air Balance Provide supply air from an adjoining air terminal unit.													
SL001 Staff Lounge	75	24	70	21	60	30	6	6	Exhaust (G)	35	(o)	Yes	VAV
Note 1 - Exhaust **Exhaust if food preparation odors are expected. Otherwise return.**													

STERILE PROCESSING SERVICE - ROOM DATA SHEET													
ROOM NAME	**INDOOR TEMPERATURE**				**INDOOR RELATIVE HUMIDITY**		**MIN TOTAL ACH**	**MIN OA ACH**	**ROOM AIR** **RETURN EXHAUST G EXHAUST S**	**MAX NOISE LEVEL NC**	**ROOM AIR BALANCE**	**INDIVIDUAL ROOM CONTROL**	
	COOLING		**HEATING**		**% RH MAX**	**% RH MIN**						**TEMP**	**FLOW**
	F	**C**	**F**	**C**									
Staff and Administrative Area (continued)													
TNPG1: Staff Toilet (male and female)	NA	NA	NA	NA	NA	NA	10	10	Exhaust (G)	40	(--)	No	CV
LR002: Male Locker / Changing Room	75	24	70	21	NA	NA	6	6	Exhaust (G)	40	(-)	No	CV
Note 1- Room Air Balance Maintain locker rooms under negative air balance with respect to PPE and positive air balance with respect to the connecting Clean Toilet/Showers - Women.													
LR002: Female Locker / Changing Room	75	24	70	21	NA	NA	6	6	Exhaust (G)	40	(-)	No	CV
Note 1- Room Air Balance Maintain locker rooms under negative air balance with respect to PPE and positive air balance with respect to the connecting Clean Toilet/Showers - Women.													
TSSU1: Male Toilet / Shower	NA	NA	NA	NA	NA	NA	10	10	Exhaust (G)	40	(--)	No	CV
TSSU1: Female Toilet / Shower	NA	NA	NA	NA	NA	NA	10	10	Exhaust (G)	40	(--)	No	CV

SURGICAL SUITE - AIR HANDLING UNIT

AHU System Data Sheet

Air-Handling Type	Dedicated Variable Air Volume (paragraphs 3.2.3, 6.2 and 6.4)
Indoor Design Temperature	Room Data Sheets
Indoor Design Relative Humidity	Room Data Sheets
Minimum Total Air Changes per Hour	Room Data Sheets
Minimum Outdoor Air Changes per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes (Normal Mode)
Exhaust Air Required	Yes (Emergency Mode)
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Per-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Filtration - After-Filter (AF)	AF = MERV 14
Filtration - Final-Filter (FF)	See Note 10
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant Steam or "Clean Steam"
General Exhaust System Required	Yes
Special Exhaust System Required	Yes (Emergency Mode)
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets
Compliance	NFPA 99

Note 1 - Listed Rooms and Their Names

Listed rooms, their names, codes, and design conditions found in the RDS sheets that follow this air handling unit are based on the VA Surgical Service Design Guide dated April 2016. See other RDS sheets for general purpose support and clinical spaces found in multiple areas of medical facilities.

Note 2 - Air Handling Unit System Features

(a) Occupied/Unoccupied Modes

Provide two-position (occupied/unoccupied), pressure-independent, supply air terminal units and matching return air terminal units.

(b) Variable Speed Drives

Provide variable speed drives for the supply and return air fans to adjust the fan speeds in unison during all modes of operation while still maintaining the design minimum outside air volume.

(c) Coil Fins

Provide copper fins for ALL coils (pre-heat, cooling, and terminal reheat coils) at ALL locations. Copper fins possess anti-microbial property and anti-corrosive property that is useful in resisting corrosion in high-humidity locations and locations with industrial pollution.

Note 3 - Emergency Epidemic Air-Handling Unit

Refer to Par 6.4 DESIGNATED EMERGENCY EPIDEMIC AIR-HANDLING UNITS for additional specific requirements, including 100% OA delivery during emergency mode.

Note 4 - Humidifier

(a) Provide unit-mounted steam humidifier. The preferred location for the dispersion tubes is between the preheat coil and cooling coil. This section of the air handling unit must have a properly slopped stainless steel drain pan to drain out excess moisture. The humidifier controls must be routed through a high limit humidistat set at a maximum of 80% RH.

(b) See paragraph 6.5.1.1 for humidifier capacity.

SURGICAL SUITE - AIR HANDLING UNIT

AHU System Data Sheet

Note 4 - Ductwork

(a) Flexible Duct

Use of flexible duct is NOT permitted in the distribution system.

(b) Acoustic Sound Lining and Sound Attenuations

Use of acoustic sound lining in ducts, air terminals, sound attenuators, and other equipment is prohibited. Refer to Chapter 2, paragraph 2.3.1.2 for more information.

(c) Duct Pressure Classification

Calculate the duct pressure classification for the supply air ductwork from the air-handling unit to the air terminal units. With terminal HEPA filters on the downstream side of each terminal unit, the expected pressure classification may range from 3 in [747 Pa] to 4 in [996 Pa].

(d) Duct Velocity

All ductwork must be low-velocity type with maximum duct velocity not exceeding 1,500 fpm [8 m/s]. Provide lower velocity if recommended by the acoustic analysis.

(e) Duct Fabrication

All ductwork must be fabricated from galvanized steel with the following exception:

For Operating Rooms, Cystoscopy Rooms and Clean Core, supply air ductwork and distribution system must be fabricated of stainless steel with welded joints downstream of the final filters.

Note 5 - Final Filters

Final filters must be provided downstream of ALL air terminal units, served by the Surgical Suite AHU. For spaces other than Operating and Cystoscopy Rooms, the use of a final HEPA filter ensures a balanced pressure drop at all air terminal units.

Note 6 - Air Distribution (Operating Rooms and Cystoscopy Rooms)

(a) Supply Air

Supply air through laminar flow diffusers in a central array located above and around the surgical field.

(b) Return Air

Provide four return air inlets, fabricated from aluminum, to pick-up return air at approximately 7 in [175 mm] above the floor level. The inlets must be located diagonally across from one another.

(c) Supply Air Terminal Units

All supply air terminal units must be 100% fabricated from stainless steel and without integral acoustic lining.

(d) Return Air Terminal Units

All return air terminal units can be conventional variable air volume boxes or airflow control valves (AFCV) and without acoustical lining.

Note 7 - Air Distribution (All Other Spaces)

(a) Supply, Return and Exhaust Air

Provide conventional overhead supply, return, and exhaust air ductwork with painted steel or aluminum air outlets and inlets.

(b) Supply and Return Air Terminal Units

All supply air terminal units must be fabricated from galvanized steel and must be the standard product of the manufacturers. The return air terminal units can be conventional variable air volume boxes or airflow control valves (AFCV).

SURGICAL SUITE - AIR HANDLING UNIT

AHU System Data Sheet

Note 8 - Temperature and Relative Humidity Controls

(a) Room Temperature Control

Provide individual room temperature control for Operating Rooms, Cystoscopy Rooms, and other spaces identified in the Room Data Sheets. Provide trend logging capability at the ECC in EXCEL type spreadsheet format.

(b) Room Humidity Sensors

Provide room humidity sensors for each Operating and Cystoscopy Room to measure and record the space relative humidity. While the space relative humidity is controlled by the cooling coil leaving dew-point temperature in the dehumidification mode and by the central humidifier in the humidification mode, the DDC control system shall poll the space relative humidity sensors to initiate the corrective actions.

(b.1) Dehumidification Mode

The relative humidity is not directly controlled but maintained within the range by controlling the dew-point temperature between 47 F to 48 F [8 C to 9 C], based on the psychometric analysis at 66 F [19 C] and 55% RH with 60% RH as the high limit. Upon rise in relative humidity above 60%, initiate alarms (local visible and remote at the ECC) and project-specific corrective actions.

(b.2) Humidification Mode

Upon drop in space relative humidity below 30%, measured by any space relative humidity sensor, the central humidifier shall be activated to maintain the set point.

(b.3) Additional Information

See chapter 6 paragraph 6.4.1.1 for additional information.

(c) Space Pressure Differential Control

See Chapter 6 paragraph 6.5.2 AIR BALANCE.

Note 9 - Special Chilled Water Requirement

Uninterrupted supply of chilled water (at the design chilled water supply temperature) shall be available on demand. In the event the central chilled water plant can not meet this requirement, provide a dedicated chiller (N+1) on emergency power. Provide cross connections between the central chilled water plant and the dedicated chiller(s) to ensure flexibility in operation.

Note 10 - Filtration - Final-Filter (FF)

(a) Final filters will not be required if the following conditions are met:

1. The After Filter in the AHU is changed from a MERV 14 filter to a MERV 17 filter (HEPA) and properly in-situ tested.

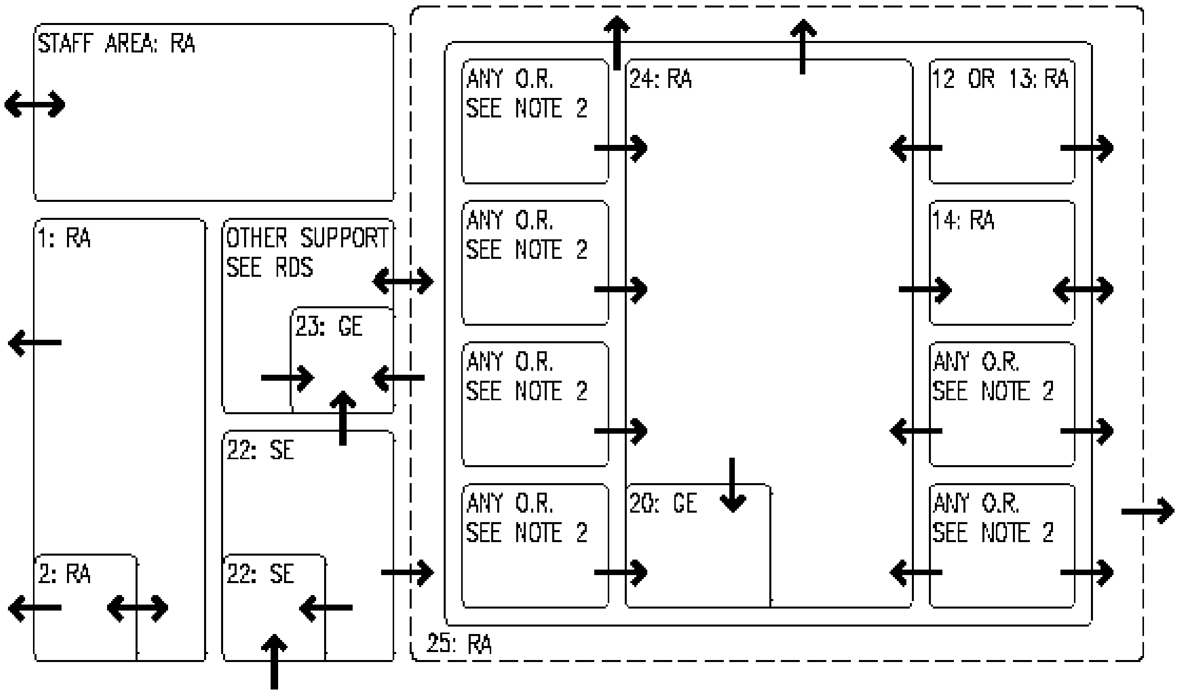
(b) If final filters are used the following conditions must be met:

1. Filter units must be located outside the operating rooms and clean core and downstream of the terminal units.
2. The filter unit must be designed and installed with all necessary hardware and accessibility to allow for in-situ DOP testing of HEPA filters.
3. All ductwork, and ductwork appurtenances and equipment in contact with supply air-stream downstream of the HEPA filters must be made of stainless steel.

Note 11 - Maximum Number of Operating Rooms

Wherever practical the design must include a maximum of 4 to 6 operating rooms per air handling unit. The purpose of this requirement is to improve the reliability of the surgical suite and to allow for future contingencies such as air handling unit replacements.

SURGICAL SUITE AIR FLOW RELATIONSHIPS



NOTES:

1. THIS AIR FLOW RELATIONSHIP DIAGRAM DOES NOT SHOW ALL POSSIBLE TYPES OF ROOMS FOUND IN A SURGICAL SUITE. REFER TO ROOM DATA SHEETS AND SURGICAL AND ENDOVASCULAR SERVICES DESIGN GUIDE ON TIL FOR OTHER ARRANGEMENTS.
2. IN GENERAL OPERATING ROOMS OF ALL TYPES LISTED IN THE LEGEND CONFIGURED AROUND THE CLEAN CORE AND SHALL BE POSITIVE BY 0.06 INCH W.C. TO 0.08 INCH W.C. [15.0 TO 20.0 PASCAL] RELATIVE TO SEMI RESTRICTED CORRIDOR. OPERATING ROOMS ARE PROVIDED WITH FOUR RETURN GRILLES AT THE FLOOR LEVEL (ONE IN EACH CORNER OF THE ROOM).
3. SEE LEGEND ON THE FOLLOWING SHEET.

SURGICAL SUITE AIR FLOW RELATIONSHIPS (CONTINUED)

LEGEND
1: RRPR1: PRE-OPERATIVE HOLDING / PHASE II RECOVERY PATIENT BAY (+)
2: RRPR2: PRE-OPERATIVE HOLDING / PHASE II RECOVERY PATIENT ROOM (+)
3: ANCW2: ANESTHESIA CLEAN ROOM (0)
4: ORGS1: GENERAL OPERATING ROOM (+)
5: OROS1: ORTHOPEDIC OPERATING ROOM (+)
6: ORCS1: UROLOGY / CYSTOSCOPY OPERATING ROOM (+)
7: ORCT1: CARDIOTHORACIC OPERATING (+)
8: ORHL1: CARDIOTHORACIC / HYBRID OPERATING ROOM (+)
9: ORNS1: NEUROSURGICAL OPERATING ROOM (+)
10: ORRB1: ROBOTIC OPERATING ROOM (+)
11: ORTR1: TRANSPLANT OPERATING ROOM (+)
12: ORHY1: MONOPLANE HYBRID OPERATING ROOM (+)
13: ORHY2: BIPLANE HYBRID OPERATING ROOM (+)
14: ORCH1: HYBRID OR CONTROL ROOM (0)
15: XCCE1: CARDIAC CATHETERIZATION LABORATORY (+)
16: XCEP1: ELECTROPHYSIOLOGY PROCEDURE ROOM (+)
17: TRTE1: TRANSESOPHAGEAL ECHOCARDIOGRAPH (TEE) PROCEDURE ROOM (-)
18: TRTE2: TEE PROVE DECONTAMINATION (-)
19: TRTE3: CLEAN TEE PROBE STORAGE (-)
20: ORSR1: IMMEDIATE USE STERILIZATION ROOM (--)
21: RRBP1: PHASE I RECOVERY PACU PATIENT BAY (+)
22: RRIR1: AIRBORNE INFECTION ISOLATION (AII) PHASE I RECOVERY PACU PATIENT ROOM (--)
23: USCL7: SURGICAL SOILED UTILITY ROOM (--)
24: XXXX: CLEAN CORE (+)
25: XXXX: SEMI-RESTRICTED CORRIDOR (0)
GE: GENERAL EXHAUST
SE: SPECIAL EXHAUST (WET EXHAUST)
RA: RETURN AIR
AIR FLOW DIRECTION BETWEEN SPACES ➞
NEUTRAL AIR FLOW ⟷
PEDESTRIAN CIRCULATION – – – – – – – – – –

SURGICAL SUITE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL		UNOCCUPIED ACH
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G					
	F	C	F	C	MAX	MIN			EXHAUST S			TEMP	FLOW	
General: The rooms and their relative locations with adjoining spaces are based on information given in the VA Design Guide for the Surgical Service dated April 2016.														
RRPR1 Pre-Operative Holding / Phase II Recovery Patient Bay	75	24	70	21	60	30	6	2	Return	35	(+)	Yes	CV	6
Note 1 - Size reheat coils to allow space heating to 86F / 30 C in demand.														
RRPR2 Pre-Operative Holding / Phase II Recovery Patient Room	75	24	70	21	60	30	6	2	Return	35	(+)	Yes	CV	6
Note 1 - Size reheat coils to allow space heating to 86F / 30 C in demand.														
ANCW2 Anesthesia Clean Room	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	CV	6
Note - None														
Operating Rooms														
ORGS1: General Operating Room	66	19	75	24	60	30	20	4	Return	40	(++)	Yes	CV	10
Note 1 - Air Balance Positive with respect to clean core during occupied and unoccupied modes of operation.														
OROS1: Orthopedic Operating Room	66	19	75	24	60	30	20	4	Return	40	(++)	Yes	CV	10
Note 1 - Air Balance Positive with respect to clean core during occupied and unoccupied modes of operation.														
ORCS1: Urology / Cystoscopy Operating Room	66	19	75	24	60	30	20	4	Return	40	(++)	Yes	CV	10
Note 1 - Air Balance Positive with respect to clean core during occupied and unoccupied modes of operation.														

SURGICAL SUITE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL		UNOCCUPIED ACH
	COOLING		HEATING		% RH MAX	% RH MIN								
	F	C	F	C								TEMP	FLOW	
ORCT1: Cardiothoracic Operating Room	66	19	75	24	60	30	20	4	Return	40	(++)	Yes	CV	10
Note 1 - Air Balance Positive with respect to clean core during occupied and unoccupied modes of operation.														
ORHL1: Cardiothoracic / Hybrid OR Pump Room	66	19	75	24	60	30	20	4	Return	40	(++)	Yes	CV	10
Note 1 - Room Air Balance Positive with respect to clean core during occupied and unoccupied modes of operation.														
ORNS1: Neurosurgical Operating Room	66	19	75	24	60	30	20	4	Return	40	(++)	Yes	CV	10
Note 1 - Air Balance Positive with respect to clean core during occupied and unoccupied modes of operation.														
ORRB1: Robotics Operating Room	66	19	75	24	60	30	20	4	Return	40	(++)	Yes	CV	10
Note 1 - Air Balance Positive with respect to clean core during occupied and unoccupied modes of operation.														
ORTR1: Transplant Operating Room	66	19	75	24	60	30	20	4	Return	40	(++)	Yes	CV	10
Note 1 - Air Balance Positive with respect to clean core during occupied and unoccupied modes of operation.														
ORHY1: Monoplane Hybrid Operating Room	66	19	75	24	60	30	20	4	Return	40	(++)	Yes	CV	10
Note 1 - Air Balance Positive with respect to clean core during occupied and unoccupied modes of operation.														
Note 2 - Diffusers Use only laminar flow diffusers in this room.														
Note 3 - Sterile Field Carefully design large sterile field to keep velocity low enough to preclude the possibility of turbulent flow over the imaging equipment gantry. Mechanical engineer is responsible for maintaining sterile flow aseptic field and minimizing turbulence.														

<table>
<tr><th colspan="15">SURGICAL SUITE - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN
EXHAUST G
EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2">INDIVIDUAL ROOM CONTROL</th><th rowspan="3">UNOCCUPIED ACH</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th><th rowspan="2">TEMP</th><th rowspan="2">FLOW</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th></tr>
<tr><td>ORHY2: Biplane Hybrid Operating Room</td><td>66</td><td>19</td><td>75</td><td>24</td><td>60</td><td>30</td><td>20</td><td>4</td><td>Return</td><td>40</td><td>(++)</td><td>Yes</td><td>CV</td><td>10</td></tr>
<tr><td colspan="15">Note 1 - Air Balance
Positive with respect to clean core during occupied and unoccupied modes of operation.</td></tr>
<tr><td colspan="15">Note 2 - Diffusers
Use only laminar flow diffusers in this room.</td></tr>
<tr><td colspan="15">Note 3 - Sterile Field
Carefully design large sterile field to keep velocity low enough to preclude the possibility of turbulent flow over the imaging equipment gantry. Mechanical engineer is responsible for maintaining sterile flow aseptic field and minimizing turbulence.</td></tr>
<tr><td>ORHC1: Hybrid OR Control Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>8</td><td>2</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>VAV</td><td>4</td></tr>
<tr><td colspan="15">Note - None</td></tr>
<tr><td>XCCE1: Cardiac Catheterization Laboratory</td><td>66</td><td>19</td><td>75</td><td>24</td><td>60</td><td>30</td><td>20</td><td>4</td><td>Return</td><td>40</td><td>(++)</td><td>Yes</td><td>CV</td><td>10</td></tr>
<tr><td colspan="15">Note 1 - Air Balance
Positive with respect to clean core during occupied and unoccupied modes of operation.</td></tr>
<tr><td colspan="15">Note 2 - Diffusers
Use only laminar flow diffusers in this room.</td></tr>
<tr><td colspan="15">Note 3 - Sterile Field
Carefully design large sterile field to keep velocity low enough to preclude the possibility of turbulent flow over the imaging equipment gantry. Mechanical engineer is responsible for maintaining sterile flow aseptic field and minimizing turbulence.</td></tr>
<tr><td>XCEP1: Electrophysiology Procedure Room</td><td>66</td><td>19</td><td>75</td><td>24</td><td>60</td><td>30</td><td>20</td><td>4</td><td>Return</td><td>40</td><td>(++)</td><td>Yes</td><td>CV</td><td>10</td></tr>
<tr><td colspan="15">Note 1 - Air Balance
Positive with respect to clean core during occupied and unoccupied modes of operation.</td></tr>
<tr><td colspan="15">Note 2 - Diffusers
Use only laminar flow diffusers in this room.</td></tr>
<tr><td colspan="15">Note 3 - Sterile Field
Carefully design large sterile field to keep velocity low enough to preclude the possibility of turbulent flow over the imaging equipment gantry. Mechanical engineer is responsible for maintaining sterile flow aseptic field and minimizing turbulence.</td></tr>
</table>

SURGICAL SUITE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL		UNOCCUPIED ACH
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW	
	F	C	F	C										
TRTE1: Transesophageal Echocardiograph (TEE) Procedure Room	75	24	70	21	60	30	10	2	Return	35	(-)	Yes	CV	10
TRTE2: TEE Probe Decontamination Room	69	20	69	20	55	30	10	10	Exhaust (G)	40	(--)	Yes	CV	10
TRTE3: Clean TEE Probe Storage	70	21	70	21	55	30	4	2	Return	35	(o)	Yes	CV	4
Note 1 - Air Balance Decontamination room negative to semi-restricted corridor during occupied and un-occupied operation.														
ORSR1: Immediate Use Sterilization Room	69	20	69	20	60	30	10	2	Exhaust (G)	40	(- -)	Yes	CV	10
Note 1 - Room Exhaust Transfer room air to the Sterilizer Equipment Room and connect to the general exhaust system. This room is positive with respect to the equipment room.														
RRBP1: Phase I Recovery PACU Patient Bay	75	24	70	21	60	30	6	2	Return	35	(+)	Yes	CV	6
Note 1 - Room Temperature Control Size the terminal reheat coil to maintain 86 F [30 C] room temperature on demand.														
Note 2 - Filtration Requirements For PACUs not served by the Surgical Suite AHU, provide terminal HEPA filters on the downstream side of each air terminal unit otherwise use same filtration in OR. See Surgical AHU filtration notes.														
RRIR1: Airborne Infection Isolation (AII) Phase I Recovery PACU Patient Room	75	24	70	21	60	30	12	2	Exhaust (S)	35	(--)	Yes	CV	6
Note 1 - General See Airborne Infection Isolation (AII) room data sheets for additional requirements for the AII room and the anteroom.														
LBUL1: Frozen Section Laboratory	75	24	70	21	60	30	6	2	Exhaust (G)	40	(-)	Yes	CV	6
Note - None														

SURGICAL SUITE - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL		UNOCCUPIED ACH
	COOLING		HEATING		% RH MAX	% RH MIN						TEMP	FLOW	
	F	C	F	C										
USCL7: Surgical Soiled Utility Room	NA	NA	NA	NA	NA	NA	12	NA	Exhaust (G)	45	(- -)	No	CV	12
Note 1 - Room Exhaust Transfer air from the adjoining spaces for exhaust.														
Clean Core	75	24	70	21	60	30	8	2	Return	40	(+)	Yes	VAV	4
Note 1 - Air Balance Negative with respect to the Operating and Cystoscopy Rooms during occupied and unoccupied modes of operation.														
Gas Cylinder Storage Room	NA	NA	NA	NA	NA	NA	6	NA	Exhaust (G)	40	(- -)	No	CV	6
Note 1 - Room Exhaust Transfer air from adjoining spaces for exhaust. Do not supply air under positive air pressure.														
Heart Lung Machine Preparation	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV	3
Note - None														
Nerve Block Induction Room	75	24	70	21	60	30	6	2	Return	40	(+)	Yes	VAV	5
Note 1 - Room Air Balance Positive during occupied and unoccupied modes of operation.														
Plaster Splint Storage	NA	NA	NA	NA	NA	NA	6	NA	Exhaust (G)	40	(-)	No	CV	6
Note - None														
Radiographic Film Processing Room	75	24	70	21	60	30	8	2	Exhaust (G)	40	(-)	Yes	CV	8
Note 1 - Room Air Return Return air is not permitted if chemicals are used in film processing.														
Semi-Restricted Corridor	75	24	70	21	60	30	8	2	Return	40	(o)	Yes	VAV	4
Note 1 - Room Air Balance Maintain negative air balance with respect to the Operating and Cystoscopy Rooms and positive to other adjoining spaces.														
Sub-Sterile Room	75	24	70	21	60	30	6	2	Exhaust (G)	40	(- -)	Yes	CV	6
Note 1 - Room Exhaust Transfer room air to the Sterilizer Equipment Room and connect to the general exhaust system. This room is positive with respect to the equipment room.														

MINIMUM VENTILATION AIR - AIR HANDLING UNIT	
AHU System Data Sheet	
Air Handling Type	Non Dedicated (Par 6.3), Constant Volume
Indoor Design Temperature - Cooling	Not Applicable
Indoor Design Temperature - Heating	Not Applicable
Indoor Design Relative Humidity - Dehumidification	60% RH
Indoor Design Relative Humidity - Humidification	20% RH
Minimum Total Air Changes Per Hour	Not Applicable
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	No
Exhaust Air Required	Yes
Air Economizer Cycle Required	Not Applicable
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 11
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant or "Clean" Steam
General Exhaust System Required	Yes
Special Exhaust System Required	No
Emergency Power Required	No
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - Application

The minimum ventilation air unit is used when spaces are served by heating and cooling terminal units, such as, fan coil units, ground source heat pumps, etc.

Note 2 - Minimum Outdoor Air Unit

See individual Room Data Sheets for required outdoor air changes.

Note 3 - Control Strategy

See Chapter 3 for the recommended ventilation air control strategy.

Note 4 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

MINIMUM REQUIREMENTS FOR AIR HANDLING UNITS SERVING NON-PATIENT CARE AREAS

AHU System Data Sheet

Air Handling Type	Non-dedicated (Par 6.3) Variable Air Volume
Indoor Design Temperature - Cooling	Room Data Sheets
Indoor Design Temperature - Heating	Room Data Sheets
Indoor Design Relative Humidity - Dehumidification	Room Data Sheets
Indoor Design Relative Humidity - Humidification	Room Data Sheets
Minimum Total Air Changes Per Hour	Room Data Sheets
Minimum Outdoor Air Changes Per Hour	Chapter 2 and Room Data Sheets
Return Air Permitted	Yes
Exhaust Air Required	No
Air Economizer Cycle Required	ASHRAE Standard 90.1 - 2016, or latest approved edition
Energy Recovery System Required	See paragraph 3.6.4 ENERGY RECOVERY SYSTEMS
Filtration - Pre-Filters (PF-1 and PF-2)	PF-1 = MERV 7 and PF-2 = MERV 14
Cooling Source	Chilled Water
Heating Source	Steam and/or Hot Water
Humidification Source	Plant or "Clean" Steam
General Exhaust System Required	Yes
Special Exhaust System Required	Room Data Sheets
Emergency Power Required	Yes
Individual Room Temperature Control Required	Room Data Sheets
Room Air Balance	Room Data Sheets

Note 1 - VAV Air-Handling Units

The all-air VAV system describe here can be used for applicable spaces such as offices, lobbies, classrooms, examination rooms, conference rooms, etc. The number of air handling units shall be determined by practical design considerations such as available mechanical room spaces, available above ceiling space for ductwork and terminals, functional space grouping, occupancy schedules etc. Spaces requiring constant volume shall be served by constant volume air terminals.

Note 2 - Listed Rooms and Their Names

Listed rooms, their names and codes are based on information in the various Design Guides and VA PG18-9.

Note 3 - Relative Humidity

See paragraph 6.5.1.1 for:

(a) Indoor Design Relative Humidity for required high and low relative humidity control strategies.

(b) Humidifier capacity.

<table>
<tr><th colspan="14">NON PATIENT ROOMS - SUPPORT AREAS - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN EXHAUST G EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td>XXXX: Admission</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Return</td><td>40</td><td>(0)</td><td>Yes</td><td>CV</td></tr>
<tr><td>XXXX: Barber Shop</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>(-)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Exhaust Requirements
Per ASHRAE 62.1 - 2016 (or latest approved edition), the barber shop should be exhausted at the rate of 0.5 cfm/sf [2.5 L/s/m2], while returning the remaining air, if any.</td></tr>
<tr><td>Chapel</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Dedicated Air-Handling Unit
For chapels requiring 5,000 cfm [2,360 L/s] and higher supply air volume, provide a dedicated air-handling unit to facilitate energy conservation initiatives.</td></tr>
<tr><td>Class Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Energy Conservation Initiative
Evaluate the feasibility of using a carbon-dioxide (CO2) and/or occupancy sensors to conserve energy during part load conditions. The control sequence must be project-specific. Follow requirements in ASHRAE Standard 62.1 -2016 or the latest approved edition.</td></tr>
<tr><td>Conference Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>35</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note 1 - Energy Conservation Initiative
Evaluate the feasibility of using a carbon-dioxide (CO2) and/or occupancy sensors to conserve energy during part load conditions. The control sequence must be project-specific. Follow requirements in ASHRAE Standard 62.1 -2016 or the latest approved edition.</td></tr>
<tr><td>Corridors</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Supply Air Volume
Increase the supply air volume, as required, to meet the transfer air demands of the adjoining spaces, such as, toilets, janitor closets, soiled utility rooms, laboratories, spaces requiring negative air balance, and exterior doors requiring ex-filtration.</td></tr>
</table>

NON PATIENT ROOMS - SUPPORT AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH							
	F	C	F	C	MAX	MIN						TEMP	FLOW
Dressing Room	NA	NA	NA	NA	NA	NA	4	NA	Return	35	(o)	No	VAV
Note 1 - Room Supply Supply air from an adjoining air terminal unit with similar load characteristics.													
Gift Shop (Retail Store)	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note - None													
Library	75	24	70	21	60	30	4	2	Return	35	(O)	Yes	VAV
Note - None													
Locker Room (with Toilets)	75	24	70	21	60	30	10	NA	Exhaust (G)	40	(-)	Yes	CV
Note 1 - Room Air Balance Transfer supply air to the toilets and showers. Maintain locker rooms under negative air balance with respect to the adjoining spaces.													
Locker Room (without Toilets)	75	24	70	21	60	30	6	NA	Exhaust (G)	40	(-)	Yes	CV
Note 1 - Room Air Balance Maintain locker rooms under negative air balance with respect to the adjoining spaces.													
Lounge	75	24	70	21	60	30	4	2	Exhaust (G)	40	(-)	Yes	CV
Note 1 - Room Air Return air is permitted if the lounge is not equipped with vending machines, microwave, refrigerator, etc., otherwise follow requirements in ASHRAE Standard 62.1 -2016 or the latest approved edition.													

NON PATIENT ROOMS - SUPPORT AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH	% RH			RETURN EXHAUST G EXHAUST S				
	F	C	F	C	MAX	MIN						TEMP	FLOW
Medical Media Service (MMS)													
Audio Visual Storage/Checkout	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Camera Copy	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Client Review Room	75	24	70	21	60	30	4	2	Return	35	(o)	Yes	VAV
Computer Imaging System Network	75	24	70	21	60	30	6	2	Return	40	(o)	Yes	VAV
Darkroom (Printing/Enlarging)	75	24	70	21	60	30	6	2	Exhaust (G)	35	(-)	Yes	VAV
Expanded Core - Illustration Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Expanded Core - Stat Camera	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Photo Finishing	75	24	70	21	60	30	6	2	Exhaust (G)	35	(-)	Yes	VAV
Photo Studio/Audio Visual Recording	75	24	70	21	60	30	6	2	Return	30	(o)	Yes	VAV
Photomicrography	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Video Editing CCTV Control Room	75	24	70	21	60	30	6	2	Return	35	(o)	Yes	VAV
Note 1 - Darkroom (Printing/Enlarging) and Photo Finishing Exhaust room air if chemicals are used for film processing.													
Medical Records	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note - None													
Medication Room	75	24	70	21	60	30	4	2	Return	40	(+)	Yes	VAV
Note - None													
Multipurpose Room	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note 1 - Energy Conservation Initiative Evaluate the feasibility of using a carbon-dioxide (CO2) and/or occupancy sensors to conserve energy during part load conditions. The control sequence must be project-specific. Follow requirements in ASHRAE Standard 62.1 -2016 or the latest approved edition.													
Note 2 - Folding Partitions Where the room is equipped with folding partitions, provide individual room temperature control, supply diffusers and return grills on both sides of the partition.													

NON PATIENT ROOMS - SUPPORT AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR RETURN EXHAUST G EXHAUST S	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN							
	F	C	F	C								TEMP	FLOW
Offices	75	24	70	21	60	30	4	2	Return	40	(o)	Yes	VAV
Note 1 - Room Temperature Control See Chapter 2 for individual room temperature control requirements.													
Pool Dressing/Toilet/Shower - Male/Female	75	24	70	21	60	30	4	NA	Exhaust (G)	45	(-)	Yes	CV
Note - None													
Toilets - Public (Interior)	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (G)	40	(- -)	No	CV
Note - None													
Toilets - Public (Perimeter)	NA	NA	68	20	NA	NA	10	NA	Exhaust (G)	40	(- -)	Yes	CV
Note 1 - Perimeter Heating For toilets with an exterior wall subject to heat loss, provide thermostatically-controlled (closed-loop, local control) terminal heater(s) to maintain set point.													
Waiting Rooms	75	24	70	21	60	30	6	2	Return	40	(0)	Yes	VAV
Note 1 - General See below for waiting rooms in Emergency Department and Radiology Waiting Rooms.													
Waiting Rooms in Emergency Department and In Radiology	75	24	70	21	60	30	12	2	Exhaust (G)	40	(-)	Yes	CV
Note 1 - General The 100% exhaust requirement applies to Emergency Department Waiting Rooms and to Radiology Waiting Rooms programmed to hold patients who are waiting for chest X-rays for diagnosis of respiratory disease.													
Note 2 - Alternative Design Per ASHRAE Standard 170 - 2013 (or latest approved edition) the design may use HEPA filtration in lieu of 100% exhaust.													

<table>
<tr><th colspan="14">NON PATIENT ROOMS - MISCELLANEOUS AREAS - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th>ROOM AIR</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th><th rowspan="2">RETURN
EXHAUST G
EXHAUST S</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td>Attic Space</td><td>NA</td><td>NA</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>10</td><td>10</td><td>Exhaust (G)</td><td>45</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Heating System
Provide a thermostatically controlled (closed-loop, local control) heating system utilizing terminal unit heaters or a central heating system. Ensure uniform heat distribution. Minimum outdoor ACH is not required in heating mode. The ventilation system must be inoperative when the heating system is enabled.</td></tr>
<tr><td colspan="14">Note 2 - Ventilation System
Provide an exhaust ventilation system (closed-loop, local control either thermostatically or manually operated) to prevent excessive heat build up. The exhaust ventilation system must consist of exhaust fan(s) and exhaust/intake air louvers with motorized dampers. Provide direct-drive fan(s) to reduce maintenance. If a central, supply air heating system (Note 1) is the selected option, exhaust (relief) arrangement must be compatible with the central heating system.</td></tr>
<tr><td colspan="14">Note 3 - Access
Coordinate access to the mechanical equipment with the architectural discipline.</td></tr>
<tr><td>Audiology Instrument Calibration and Repair Shop</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>(+)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
<tr><td>Battery Charging Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>8</td><td>2</td><td>Exhaust (S)</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Special Exhaust System
Provide a dedicated, special exhaust system where lead batteries (Automatic Transport System and Wheel Chairs Charging Areas) are charged.
Exhaust system is not required where Ni-Cad batteries are charged. Provide a spark-proof construction exhaust fan, explosion-proof motor, and welded stainless steel ductwork. Provide emergency power for the fan motor. Provide local and remote (at ECC) alarm capabilities for fan status and airflow interruption.</td></tr>
<tr><td>Biomedical Instrument Repair Shop</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>6</td><td>2</td><td>Exhaust (S)</td><td>40</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Dedicated Exhaust System
(a) Provide a dedicated exhaust system where chemicals, such as, xylene and iodine are used. Evaluate the use of a canopy hood or a general purpose fume hood. The system start can be manually operated by a fan switch or automatically operated by remote DDC controls.
(b) Provide a spark-proof construction exhaust fan with bearings mounted outside the exhaust air stream and an explosion-proof motor on emergency power.
(c) Provide local and remote alarms in the event of fan failure or exhaust airflow interruption.
(d) Provide an airflow control valve in the exhaust air duct to ensure constant exhaust airflow.</td></tr>
<tr><td colspan="14">Note 2 - Alternate Return Air Pick-Up
Provide an alternate return air connection with a motorized damper when the exhaust fan is not in use.</td></tr>
</table>

<table>
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<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN
EXHAUST G
EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th><th rowspan="2">TEMP</th><th rowspan="2">FLOW</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th></tr>
<tr><td>Clean Utility/Storage Room</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>4</td><td>NA</td><td>Return</td><td>40</td><td>(+)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="13">Note 1 - HVAC Treatment
(a) For a small, 100 sf [9 m$_2$] and smaller, unoccupied room, individual room temperature control is not required. Room can be supplied from any adjoining constant- volume air terminal unit serving similar interior or perimeter space. Ducted return air pick-up is also not required, as the room air can ex-filtrate into adjoining spaces, such as, a non-exit corridor (NFPA 90A).
(b) Individual room temperature control is required for a large, more than 100 sf [9 m$_2$], occupied room. Provide a minimum of 2 ACH outdoor air.</td></tr>
<tr><td colspan="13">Note 2 - Logistics Service Storage Rooms
(a) For Logistics Service Sterile Consumables (Soft Goods) Storage requirements refer to SRSO4: Steerile Consumables (Soft Goods) Storage in Sterile Processing Service Room Data Sheets (RDS).
(b) For Logistics Service storage rooms with non-sterile materials, provide proper room conditions based on the actual materials stored.</td></tr>
<tr><td>Computer Lab Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>VAV</td></tr>
<tr><td colspan="13">Note - None</td></tr>
<tr><td>Copy/Printing Room (Large)</td><td>75</td><td>24</td><td>70</td><td>21</td><td>NA</td><td>NA</td><td>6</td><td>2</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="13">Note - None</td></tr>
<tr><td>Copy/Printing Room (Small)</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>6</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(-)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="13">Note 1 - Usage
Copy/Printing Room (Small) is a local room serving a single department only, with no more than 2 machines.</td></tr>
<tr><td colspan="13">Note 2 - Conditioning
Conditioned air is drawn from other areas to ventilate the room and reduce the heat load.</td></tr>
</table>

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<tr><th>F</th><th>C</th><th>F</th><th>C</th></tr>
<tr><td colspan="14"></td></tr>
<tr><td>Crawl Space (Pipe Basement)</td><td>NA</td><td>NA</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>6</td><td>6</td><td>Exhaust (G)</td><td>45</td><td>NA</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Compliance
This space must comply with PG-18-3 (Design and Construction Procedures), Topic 5 - Pipe Basements April 2001, available in the VA Technical Information Library.</td></tr>
<tr><td colspan="14">Note 2 - Exhaust Ventilation System
Provide a thermostatically-controlled (closed-loop, local control), or manually-operated, exhaust system to minimize excessive heat build-up. The system must consist of an exhaust fan(s), exhaust air louver, intake louver, and motorized intake and exhaust air dampers (two-position, open/close type). Select a direct-drive exhaust fan to minimize maintenance.</td></tr>
<tr><td colspan="14">Note 3 - Heating System
Provide thermostatically-controlled (closed-loop, local control) terminal heaters to ensure uniform heat distribution. The ventilation system must be inoperative when the heating system is enabled.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td colspan="14">Electrical Equipment Rooms (EER)</td></tr>
<tr><td>Electrical Equipment Closets without Internal Heat Gain</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="14">Note 1 - HVAC
Electrical closets without internal heat gain do not require HVAC.</td></tr>
<tr><td>Satellite and Main Electrical Rooms with Internal Heat Gain</td><td>86</td><td>30</td><td>40</td><td>5</td><td>NA</td><td>NA</td><td>NA</td><td>Note 2</td><td>Return</td><td>45</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Equipment Heat Gain
Estimate transformer heat dissipation at the rate of 3% of the anticipated actual peak demand. Do not use the rated nameplate capacity for equipment heat gain.</td></tr>
<tr><td colspan="14">Note 2 - Mechanical Cooling
(a) Provide a dedicated mechanical cooling unit using chilled water or refrigerant direct expansion (DX) as the cooling medium. Cooling shall be available on demand.
(b) Use economizer cycle (ASHRAE Standard 90.1 - 2106 or latest approved version) or exhaust ventilation in mild weather.
(c) Provide minimum outdoor air (ASHRAE Standard 62.1 - 2016 or latest approved version) in the mechanical cooling mode.
(d) Avoid installing mechanical cooling units within the electrical room to prevent possible damage due to water leakage and/or overflow of condensate drain pans.</td></tr>
<tr><td colspan="14">Note 3 - Heating
Provide thermostatically-controlled heating system only if the space heat gain cannot offset the design heat loss.</td></tr>
<tr><td colspan="14">Note 4 - Controls
Provide a DDC sensor to monitor the space temperature and initiate local and remote alarms in the event space temperature exceeds 95 F [35 C]. Provide a DDC sensor for monitoring and alarm with local control loop.</td></tr>
<tr><td colspan="14"></td></tr>
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<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td colspan="14"></td></tr>
<tr><td>Elevator Machine Room</td><td>77</td><td>25</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>Return</td><td>45</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Equipment Heat Gain
Coordinate equipment heat dissipation with the elevator equipment manufacturer.</td></tr>
<tr><td colspan="14">Note 2 - Mechanical Cooling Unit
(a) Provide dedicated, thermostatically-controlled mechanical cooling. Use chilled water or direct-expansion (DX) or a dedicated air terminal unit from a nearby air- handling unit in use year-round.
(b) Avoid installation of the chilled-water or DX mechanical cooling units within the elevator machine room to prevent possible damage due to water leakage and/or overflowing of the condensate drain pans.</td></tr>
<tr><td colspan="14">Note 3 - Controls
Provide a DDC sensor to monitor the space temperature and initiate local and remote alarms in the event the space temperature exceeds 95 F [35 C]. DDC sensor for monitoring and alarm is required with local control loop.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>Engineering Control Center Room</td><td>75</td><td>24</td><td>70</td><td>21</td><td>60</td><td>30</td><td>4</td><td>2</td><td>Return</td><td>40</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - HVAC Unit
Provide a dedicated HVAC unit to provide cooling and heating as required using available sources, such as, chilled water, steam or hot water, or a DX cooling unit.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>Engineering Shops (Maintenance)</td><td>80</td><td>27</td><td>68</td><td>20</td><td>NA</td><td>NA</td><td>6</td><td>2</td><td>Return
Exhaust (G)</td><td>45</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - General
The engineering shops include Carpentry Shop, Electrical Shop, Machine Shop, Paint Shop, Plumbing Shop, and Welding Shop. HVAC requirements and design approach for the shops differ based on the site location (high-humidity or low-humidity) and the specific program requirements.</td></tr>
<tr><td colspan="14">Note 2 - Room Temperature Control
Provide individual room temperature control for the shops served by mechanical cooling and/or heating systems. Provide mechanical cooling for high-humidity locations and evaluate the use of 100% outdoor air for ventilation for low-humidity locations.</td></tr>
<tr><td colspan="14">Note 3 - Welding Shop
Provide a dedicated exhaust system for the welding shop.</td></tr>
<tr><td colspan="14">Note 4 - Paint Shop
For the paint shop, a dedicated exhaust ventilation system may be required to dilute the paint shop fumes. Coordinate with the paint booth supplier if a packaged, dedicated ventilation system is furnished by the paint booth supplier.</td></tr>
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<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td>Exterior Stairs</td><td>NA</td><td>NA</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>Yes</td><td>NA</td></tr>
<tr><td colspan="14">Note 1 - Heating
Provide a dedicated, thermostatically-controlled terminal heater with closed-loop, non-DDC temperature control.</td></tr>
<tr><td>Housekeeping Aid Closet (HAC)</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(- -)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
<tr><td>Kitchenette</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>6</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(- -)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
<tr><td>Litter Storage</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>6</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(- -)</td><td>No</td><td>CV</td></tr>
<tr><td colspan="14">Note - None</td></tr>
<tr><td>Loading Dock</td><td>NA</td><td>NA</td><td>60</td><td>15</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>Return</td><td>45</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Heating System
Provide an air curtain with a heating element. Interlock the air curtain start with the loading dock door operating mechanism. Activate heating when the ambient temperature drops below 45 F [7 C] temperature.</td></tr>
<tr><td>Maintenance Garages</td><td>NA</td><td>NA</td><td>60</td><td>15</td><td>NA</td><td>NA</td><td>-</td><td>100%</td><td>Exhaust (S)</td><td>50</td><td>(-)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Ventilation (100% Outdoor Air)
Provide a ventilation system complete with fan(s), exhaust and/or supply, and air inlet and outlet connections equipped with motorized dampers. Size and select the system to move air at the rate of 1.5 cfm/sf [7.6 L/s/m$_2$].</td></tr>
<tr><td colspan="14">Note 2 - Heating
Provide thermostatically-controlled heat delivered either by the supply air system or individual air terminal units. During heating mode, reduce the outdoor air to minimum as mandated by ASHRAE Standard 62.1-2016 or latest approved edition and other applicable documents.</td></tr>
<tr><td colspan="14">Note 3 - Compliance and Reference
The HVAC system must be in compliance with the American Council of Government Industrial Hygienists (ACCIH) and NFPA 88B. Refer to the ASHRAE Handbook of Applications for further information.</td></tr>
</table>

<table>
<tr><th colspan="14">NON PATIENT ROOMS - MISCELLANEOUS AREAS - ROOM DATA SHEET</th></tr>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th rowspan="3">ROOM AIR
RETURN
EXHAUST G
EXHAUST S</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2" rowspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th>% RH</th><th>% RH</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th><th>MAX</th><th>MIN</th><th>TEMP</th><th>FLOW</th></tr>
<tr><td colspan="14"></td></tr>
<tr><td colspan="14">Mechanical Equipment Rooms (MER)</td></tr>
<tr><td>Air Handling Equipment Rooms</td><td>84</td><td>29</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>6</td><td>2</td><td>Return</td><td>45</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - HVAC (All Locations)
Provide a dedicated supply air takeoff (from the air-handling unit located in the MER) to circulate conditioned air at 0.5 cfm/sf [2.5 L/s/m$_2$]. Circulated air can be returned back to the unit. Thermostatically-controlled terminal heater may be required to maintain the winter set point, where the AHU is not in operation round-the-clock.</td></tr>
<tr><td>Heating Rooms</td><td>86</td><td>30</td><td>40</td><td>5</td><td>NA</td><td>NA</td><td>6</td><td>2</td><td>Return</td><td>45</td><td>(o)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Heating Rooms
Heating Rooms are the designated mechanical equipment rooms where steam enters the building for space heating, domestic hot water production, process heating, etc. The Heating Room is equipped with heat exchangers, PRV stations, circulating pumps, and other steam and hot water specialties.</td></tr>
<tr><td colspan="14">Note 2 - High Humidity Locations
(a) HVAC Systems
Provide mechanical cooling, during peak summer season, by a thermostatically-controlled, dedicated chilled water or direct-expansion (DX) unit. The room can also be served by a thermostatically-controlled, air terminal unit from a nearby air-handling unit in operation round-the-clock.
(b) Heating Requirement
Verify the need for heating. Generally heating is not required as the heat produced within the space is sufficient enough to maintain above freezing temperatures.</td></tr>
<tr><td colspan="14">Note 3 - All Other Locations
(a) Ventilation Option
For low-humidity (dry) locations, in mild weather, exhaust and/or supply air ventilation system can be used to keep the space temperature below 86 F [30 C]. The system must consist of fans, inlet and outlet connections with motorized dampers, ductwork, and thermostatic controls. If using this option, increase minimum total ACH to 10.
(b) Mechanical Cooling
Provide mechanical cooling, during peak summer season, by a thermostatically-controlled, dedicated chilled water or DX unit. The room can also be served by a thermostatically-controlled, air terminal unit from a nearby air-handling unit in operation round-the-clock.
(c) Heating
Verify the need for heating. Generally heating is not required as the heat produced within the space is sufficient enough to maintain above freezing temperatures.</td></tr>
<tr><td colspan="14"></td></tr>
</table>

NON PATIENT ROOMS - MISCELLANEOUS AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S			TEMP	FLOW
	F	C	F	C									
Refrigeration Equipment Rooms	86	30	40	5	NA	NA	6	NA	Return	45	(o)	Yes	CV

Note 1 - High Humidity Locations

(a) General

Provide a dedicated mechanical cooling unit, complete chilled water or direct-expansion (DX) coil and minimum MERV 7 filters. Provide minimum outdoor air per ASHRAE Standard 15 - 2013 (or latest approved edition) and capability to operate at 100% outdoor air during emergency refrigerant evacuation mode. Provide a variable speed drive to facilitate system operation in the normal and emergency modes.

(b) Capacity - Mechanical Cooling Unit

Base the capacity on the maximum of:

Internal heat gain (note that the heat dissipated by open chillers is much higher than hermetic chillers) Exhaust air volume required to dilute the refrigerant spill - see ASHRAE Standard 15 - 2013 (or latest approved edition).

Note 2 - All Other Locations

Provide an exhaust ventilation system or a dedicated air-handling system, generally as described above under Note 1, and equipped with an economizer cycle, if feasible. Evaporative cooling can be used, in lieu of mechanical cooling, for low humidity locations.

Note 3 - Emergency Refrigerant Leak Evacuation System

Provide a refrigerant leak detection system complete with field-installed refrigerant detection sensors, wiring and local control panel per ASHRAE Standard 15 (or latest approved edition). Provide an open protocol BACnet interface with the building ECC system. Provide local alarm requirements per ASHRAE Standard 15 - 2013 (or latest approved edition). Provide remote alarms at the ECC.

Note 4 - Emergency Exhaust System

Upon activation by the leak detection system, the room air must be exhausted outdoors by an emergency exhaust system and supply air system must operate in 100% outdoor air mode. Provide exhaust air inlets in accordance with the recommendations of ASHRAE Standard 15 - 2013 (or latest approved edition) and chiller manufacturer. Activation of the leak detection system must also trigger local and remote alarms. Provide emergency power for the emergency exhaust and supply fans and associated controls.

Reagent Grade Water Treatment Room	75	24	70	21	60	30	8	2	Exhaust (G)	40	(-)	Yes	CV

Note - None

Soiled Utility and Storage Room	NA	NA	NA	NA	NA	NA	10	NA	Exhaust (G)	40	(- -)	No	CV

Note - None

NON PATIENT ROOMS - MISCELLANEOUS AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S				
	F	C	F	C								TEMP	FLOW
Standby Generator Room	80	29	40	18	NA	NA	4	NA	Return	NA	(o)	Yes	CV

Note 1 - Design Requirements

Design requirements listed above are for when the engine is not operating. During engine operation, exhaust air is required and room air balance is negative. During operation, room temperature must not exceed maximum ambient temperature recommended by engine manufacturer.

Note 2 - Damper Requirements

Provide motorized dampers for all louvers. Dampers must fail-open on loss of power.

Note 3 - Analysis Requirement

(a) Submit a detailed analysis showing all options and systems selected to provide proper ventilation and cooling of the standby generator space.

(b) Numerous design considerations must be included in the analysis. Once the size of the generator plant has been determined and the number of units selected then various manufacturers must be consulted to ascertain the range of heat rejection from the various components. See Figure 6-1, Standby Generator Room, for the average heat rejection values. Assuming the prime movers are reciprocating diesel engines, consideration must be given to the required radiator flow rates when the unit is naturally aspirated, turbocharged or is a lean burn unit. Airflow rates required for unit mounted radiators can vary substantially from one type to another and manufacturer to manufacturer.

Note 4 - Configuration Options

(a) The electrical equipment including the generator and onboard or nearby electrical equipment can be specified for wet locations, or remote radiators can be used thereby drastically reducing the louver area requirement.

(b) A system with a mix of unit mounted radiators and remote units can be proposed.

(c) The analysis must compare unit mounted radiators to remote radiators. The analysis shall include cost of louvers and control devices. Louvers in areas prone to hurricanes or wind-debris hazards shall be meet the following Florida Building Code tests: Uniform Static Air Pressure Test, Cyclic Wind Pressure Test, Large Missile Impact Test, and Wind Driven Rain Resistance Test for Dry Areas, Enclosed.

(d) A separate detailed acoustic analysis shall be submitted for the final design of the standby generator facility.

Note 5 - Design Considerations

(a) The switchgear and control rooms shall be fully air-conditioned. If remote radiators are used and only minimal louvers are required for combustion air ventilation, consideration should be given to air conditioning the engine bay. The louvers are fitted with electrically controlled actuators to open as needed. Do not provide air conditioning during operation of the generator.

(b) If remote radiators are used, consideration of glycol addition to the system is required in freezing areas.

(c) Engine exhaust must be safely conveyed from the engine through the piping and any auxiliary equipment to the atmosphere within allowable pressure drops.

(d) Maintain separate exhaust for each engine. Provide individual silencers or mufflers for each exhaust system.

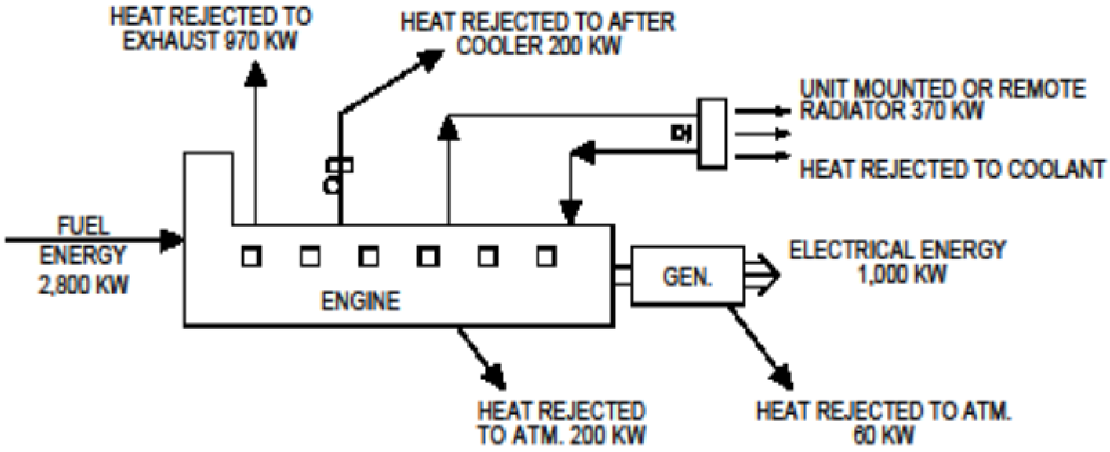
(e) Exhaust systems must use welded tube turns with radius of 4 pipe minimum diameters.

(f) See VA Master Specification 26 32 13 ENGINE GENERATORS for additional information.

HVAC DESIGN MANUAL

APPENDIX 6/ STANDBY GENERATOR
FIGURE 6-1

ENERGY BALANCE COMPRESSION IGNITION ENGINE



DIESEL - STAND BY GENERATOR CAPACITY DATA

1	60 HZ 1800 RPM 480 VOLTS	300 KW	500 KW	750 KW	1000 KW	1500 KW	2000 KW
2	FUEL CONSUMPTION FULL LOAD DIESEL GAL/HR	23	34	53	72	108	142
2.1	FUEL ENERGY INPUT, KW	880	1,320	2,020	2,700	4,080	5,400
3	AIR FLOW ACROSS RADIATOR, CFM	25,000	30,000	42,000	55,000	75,000	100,000
4	COMBUSTION AIR FULL LOAD, CFM	900	1,300	1,900	2,900	4,400	5,800
5	EXHAUST GAS FLOW RATE, FULL LOAD, CFM @ 950° F	2,500	3,700	5,400	7,900	12,100	16,100
6	HEAT REJECTION TO COOLANT, KW	200	200	340	370	700	820
7	HEAT REJECTION TO EXHAUST, KW	230	450	700	970	1,550	2,100
8	HEAT REJECTION TO AFTER COOLER, KW	N/A	N/A	110	230	350	420
9	HEAT REJECTION TO ATMOSPHERE FROM ENGINE, KW	70	100	160	200	240	280
10	HEAT REJECTION TO ATMOSPHERE FROM GENERATOR, KW	22	30	35	60	80	90
11	DELTA T ACROSS RADIATOR, ° F (#6x3413)/(#3x1.08)	25	21	26	21	29	26
12	ROOM VENT RATE @ 15° F ROOM RISE, CFM (#10+#9)x3413)/(15x1.08)	19,382	27,388	41,082	54,777	67,417	77,951
AVERAGE, MID RANGE VALVES, VERIFY ALL QUANTITIES WITH AT LEAST (3) MANUFACTURES							

STANDBY GENERATOR ROOM

Not to Scale

NON PATIENT ROOMS - MISCELLANEOUS AREAS - ROOM DATA SHEET

<table>
<tr><th rowspan="3">ROOM NAME</th><th colspan="4">INDOOR TEMPERATURE</th><th colspan="2">INDOOR RELATIVE HUMIDITY</th><th rowspan="3">MIN TOTAL ACH</th><th rowspan="3">MIN OA ACH</th><th>ROOM AIR</th><th rowspan="3">MAX NOISE LEVEL NC</th><th rowspan="3">ROOM AIR BALANCE</th><th colspan="2">INDIVIDUAL ROOM CONTROL</th></tr>
<tr><th colspan="2">COOLING</th><th colspan="2">HEATING</th><th rowspan="2">% RH MAX</th><th rowspan="2">% RH MIN</th><th rowspan="2">RETURN EXHAUST G EXHAUST S</th><th rowspan="2">TEMP</th><th rowspan="2">FLOW</th></tr>
<tr><th>F</th><th>C</th><th>F</th><th>C</th></tr>
<tr><td colspan="14"></td></tr>
<tr><td>Trash Collection Room</td><td>NA</td><td>NA</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>10</td><td>NA</td><td>Exhaust (G)</td><td>40</td><td>(- -)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Exhaust System
Provide a dedicated general exhaust system, if a common general exhaust system is not available in the vicinity. Exhaust system must be manually operated and must run continuously.</td></tr>
<tr><td colspan="14">Note 2 - Heating
Provide a thermostatically-controlled heating system if wet sprinkler piping and/or any other building service piping passes through the room.</td></tr>
<tr><td colspan="14"></td></tr>
<tr><td>Vestibules</td><td>NA</td><td>NA</td><td>50</td><td>10</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>40</td><td>(+)</td><td>Yes</td><td>CV</td></tr>
<tr><td colspan="14">Note 1 - Heating
Provide a thermostatically-controlled terminal heater. Coordinate heater type and location with the architectural discipline. Floor-mounted cabinet unit heaters with bottom horizontal supply and top return have proven effective in counter-acting cold air settling at the floor level.</td></tr>
<tr><td colspan="14">Note 2 - Space Pressurization
Supply 1.0 cfm/sf [5.1 L/s/m$_2$] air under positive pressure from an adjoining air terminal unit serving the lobby to maintain positive air pressure by allowing air to ex- filtrate outdoors.</td></tr>
<tr><td colspan="14"></td></tr>
</table>

NON PATIENT ROOMS - MISCELLANEOUS AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING						RETURN EXHAUST G EXHAUST S				
	F	C	F	C	% RH MAX	% RH MIN						TEMP	FLOW
Walk-in Refrigerator and Freezers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note 1 - Specifications

Coordinate equipment installation and design with the VA Master Specifications and Standard Details. Revised specifications are:

Walk-In Coolers and Freezers - Section 11 41 21
Laboratory Refrigerators - Section 11 53 23
Mortuary Refrigerators - Section 11 78 13

Note 2 - Constant Temperature Rooms

Rooms covered under VA Master Specification Section 13 21 29 are used for laboratories and research facilities. Generally, the mechanical contractor does not furnish these items. Provide DDC temperature sensors for these rooms to sound local and remote alarms at the ECC. Provide ventilation air requirements per ASHRAE 62.1 - 2016 or latest approved edition only if building is pursuing LEED certification.

Note 3 - Frost Prevention

Include provisions to prevent frost formation and subsequent floor heating for equipment mounted on grade or above grade with fill. Provide heating cables in coordination with the electrical discipline to prevent freezing below grade or concrete sub-floor. Evaluate the possibility of using waste heat for anti-frost system, to conserve energy.

Note 4 - Emergency Power

Provide emergency power for the equipment and controls serving refrigerators and freezers.

Note 5 - Heat Gain Factors

Use ASHRAE recommendations for heat gain factors, load calculations and compressor running time while selecting equipment to maintain the temperatures listed below:

Dairy Freezers: -20 F [-29 C]
Ice Cream Freezers: -20 F [-29 C]
Meat Freezers: -12 F [-24 C]
Fresh Meat Refrigeration: 32 F [0 C]
Walk-In Refrigerators: 36 F [2 C]
Autopsy (Mortuary) Cold Room: 36 F [2 C]
Subsistence Storage (Supply Service): 36 F [2 C]

NON PATIENT ROOMS - MISCELLANEOUS AREAS - ROOM DATA SHEET

ROOM NAME	INDOOR TEMPERATURE				INDOOR RELATIVE HUMIDITY		MIN TOTAL ACH	MIN OA ACH	ROOM AIR	MAX NOISE LEVEL NC	ROOM AIR BALANCE	INDIVIDUAL ROOM CONTROL	
	COOLING		HEATING		% RH MAX	% RH MIN			RETURN EXHAUST G EXHAUST S				
	F	C	F	C								TEMP	FLOW
Warehouse (Central) with Pharmacy	80	27	68	20	60	NA	4	2	Return	45	(o)	Yes	VAV

Note 1 - HVAC Systems - Warehouse

Provide mechanical cooling and heating for high-humidity locations. Provide ventilation and heating for all other locations. Base the system selection on the warehouse size and availability of the utilities. With the mechanical cooling option, provide two sets of pre-filters (MERV 7 and 11). With the ventilation option, MERV 7 pre-filter can be used.

Note 2 - HVAC Systems - Pharmacy

Provide a thermostatically-controlled mechanical cooling unit to maintain 75 F [24 C] with 60% RH in cooling mode and 70 F [21 C] with 30% RH in heating mode.

Chapter 7: CLIMATIC DATA

7.1 CLIMATIC CONDITIONS

Table 7-1: CLIMATIC CONDITIONS

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
ALABAMA													
Birmingham	Birmingham Municipal AP	33.56	630	95.5	74.9	20.5	93.0	74.5	24.8	78.4	77.5	97.9	12.9
Montgomery	Montgomery Dannelly Fld	32.30	203	96.8	76.1	24.3	94.5	76.0	27.6	79.7	78.6	99.8	17.0
Tuscaloosa	Tuscaloosa Regional AP	33.21	187	97.0	76.0	21.9	94.3	75.9	26.2	79.5	78.5	99.8	14.8
Tuskegee	Tuskegee AP	32	195	93.9	74.3	23.5	91.4	74.2	27.6	78.0	77.0	96.2	16.3
ALASKA													
Anchorage	Anchorage Intl AP	61.18	131	71.5	58.9	-9.3	68.3	57.4	-4.8	60.4	58.9	76.4	-14.1
ARIZONA													
Phoenix	Phoenix Sky Harbor Intl AP	33.44	1106	110.3	69.6	38.7	108.3	69.4	41.6	75.8	75.0	114.5	34.2
Prescott	Ernest A Love Fld	34.65	5052	94.4	60.8	17.7	91.5	60.2	20.7	66.5	65.4	98.8	10.4
Tucson	Tucson Intl AP	32.13	2556	106.0	66.2	31.6	103.6	66.0	34.3	7.26	71.8	110.1	26.1

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
ARKANSAS													
Fayetteville	Fayetteville Drake Fld	36.01	1260	95.1	74.9	10.0	92.5	74.6	16.2	77.9	76.8	98.7	3.5
Little Rock	Little Rock AFB	34.92	312	99.5	77.4	17.5	96.7	77.6	21.7	81.1	80.1	102.5	9.6
N. Little Rock	North Little Rock/Adams Fld	34.83	568	95.4	76.6	18.5	93.0	76.3	23.3	79.1	78.1	98.6	13.2
CALIFORNIA													
Fresno	Fresno Air Terminal	36.78	328	103.5	70.9	31.4	100.8	69.3	33.7	73.5	71.9	108.3	28.1
Livermore	Livermore Municipal AP	37.69	397	99.0	67.8	30.2	94.9	66.6	33.5	70.1	68.1	106.2	26.5
Loma Linda	March AFB/Riverside	33.9	1535	100.2	67.0	32.1	98.8	65.6	35.6	71.5	70.2	106.9	27.5
Long Beach	Long Beach/LB Airport	33.83	39	91.1	66.7	41.3	87.6	66.5	43.6	72.0	70.5	100.8	36.0
Los Angeles	Los Angeles Intl AP	33.94	325	83.7	63.3	44.5	80.4	63.6	46.4	69.9	68.7	94.1	39.7
Sacramento/ Mather	Sacramento Mather	38.55	95	101.6	68.8	29.7	98.7	67.3	32.0	70.9	69.2	107.9	25.8
Palo Alto	Norman Y Mineta San Jose Intl AP	37.36	49	91.6	66.1	35.8	88.2	65.6	37.7	69.0	67.7	99.8	31.8
Menlo Park	Norman Y Mineta San Jose Intl AP	37.36	49	91.6	66.1	35.8	88.2	65.6	37.7	69.0	67.7	99.8	31.8

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
San Diego	San Diego Lindbergh Fld	32.74	30	83.1	65.0	44.8	80.2	65.4	46.8	71.0	69.8	92.2	41.0
San Francisco	San Francisco Intl AP	37.62	20	82.8	62.9	39.1	78.1	91.9	41.4	65.5	64.0	93.8	35.4
Sepulveda	Burbank/Glendale AP	34.20	732	97.7	67.4	38.6	93.8	66.7	41.0	72.4	70.9	105.4	33.2
COLORADO													
Denver	Denver Stapleton Intl AP	39.75	5289	93.9	60.7	-1.4	91.2	60.0	5.1	64.5	63.4	99.7	-10.4
Ft. Lyon	La Junta Municipal AP	38.05	4216	99.6	64.1	1.6	97.1	63.8	7.8	68.5	67.5	104.5	-5.4
Grand Junction	Grand Junction/Walk	39.13	4839	97.7	61.5	5.1	95.1	60.6	10.2	65.1	64.0	101.5	0.1
CONNECTICUT													
Newington	Hartford/Brainard Fld	41.74	20	90.7	73.2	8.5	88.2	72.4	12.2	76.9	75.3	96.2	3.2
West Haven	Meriden Markham Municipal AP	41.51	105	90.6	73.8	5.2	88.1	73.0	9.8	76.6	75.1	95.0	-1.5
DELAWARE													
Wilmington	Wilmington New Castle Co AP	39.67	79	91.9	75.0	13.3	89.4	73.9	17.3	78.0	76.7	96.3	7.7
DISTRICT OF COLUMBIA													
Washington DC	Washington/National DC Reagan AP	38.87	66	94.5	95.7	17.3	91.8	74.8	20.7	78.5	77.4	98.3	12.0

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
FLORIDA													
Bay Pines	St. Petersburg Clearwater AP	27.91	10	92.1	77.8	42.4	91.0	77.7	45.4	81.7	80.6	95.0	34.4
West Palm	West Palm Beach	26.69	20	91.4	77.6	43.9	90.4	77.7	48.0	80.0	79.5	94.6	37.5
Gainesville	Gainesville Regional AP	29.69	164	93.4	76.4	29.6	91.9	76.2	33.4	79.7	78.7	97.3	23.4
Lake City	Gainesville Regional AP	29.69	164	93.4	76.4	29.6	91.9	76.2	33.4	79.7	78.7	97.3	23.4
Miami	Miami Intl AP	25.82	30	91.8	77.6	47.6	90.8	77.6	51.9	80.3	79.7	95.0	41.6
Orlando	Orlando Jetport AP	28.43	105	93.8	76.5	37.8	92.5	76.2	42.3	79.6	78.8	96.7	31.3
Tampa	Tampa Intl AP	27.96	10	92.6	77.2	38.8	91.4	77.2	42.9	80.5	79.9	95.3	32.1
GEORGIA													
Atlanta	Atlanta Hartsfield Intl AP	33.64	1027	93.9	74.2	21.5	91.7	73.9	26.4	77.3	76.4	967	14.1
Augusta	Augusta Bush Fld	33.37	148	97.3	76.0	22.5	94.8	75.9	26.1	79.5	78.4	100.6	16.2
Dublin	Dublin AP	32	215	96.9	75.6	23.9	94.5	75.3	27.4	79.0	78.1	99.6	17.1
Decatur	Atlanta Hartsfield Intl AP	33.64	1027	93.9	74.2	21.5	91.7	73.9	26.4	77.3	76.4	96.7	14.1
HAWAII													
Honolulu	Honolulu Intl AP	21.33	16	89.9	74.0	62.0	88.9	73.6	63.9	77.2	76.3	91.3	58.4

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
IDAHO													
Boise	Boise Air Terminal	43.57	2867	98.6	63.9	8.7	95.4	62.9	15.5	66.2	64.7	104.2	3.5
ILLINOIS													
Chicago W. Side	Chicago O'Hare Intl AP	41.99	673	91.4	74.3	-1.5	88.7	73.2	3.7	77.8	76.0	96.0	-8.0
Chicago Lakeside Clinic	Chicago O'Hare Intl AP	41.99	673	91.4	74.3	-1.5	88.7	73.2	3.7	77.8	76.0	96.0	-8.0
Danville	University of Illinois	40.04	764	92.0	76.0	-0.5	90.0	75.0	4.2	79.6	77.7	95.7	-9.7
Hines	Chicago Midway AP	41.79	617	91.5	76.4	0.2	89.5	73.3	5.4	78.0	76.0	96.9	-6.3
Marion	Mt. Vernon (AWOS)	38.32	479	93.4	76.4	5.4	91.2	76.0	11.5	80.3	78.3	97.4	-5.9
INDIANA													
Ft Wayne	Ft. Wayne Intl AP	41.01	827	90.8	74.3	-0.7	88.2	73.1	5.0	77.6	75.9	94.5	-6.7
Indianapolis	Indianapolis Intl AP	39.71	807	91.0	75.1	2.0	88.7	74.0	8.1	78.2	76.8	94.3	-5.3
Marion	Delaware Co Johnson	40.23	948	90.0	73.5	1.2	97.9	73.2	7.3	77.1	75.5	91.6	-3.8
IOWA													
Des Moines	Des Moines Intl AP	41.54	965	92.5	76.4	-5.3	89.6	754.1	-0.2	78.5	77.1	96.8	-11.4
Iowa City	Iowa City Municipal AP	41.63	669	91.1	75.9	-4.1	89.6	75.6	0.5	79.6	77.8	95.0	-12.8
Knoxville	Des Moines Intl AP	41.54	965	92.5	76.4	-5.3	89.6	75.1	-0.2	78.5	77.1	96.8	-11.4

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
KANSAS													
Leavenworth	Kansas City Intl AP, MO	39.30	1024	95.8	76.8	2.0	92.5	76.2	7.2	79.8	78.3	99.7	-4.5
Topeka	Topeka/Billard Municipal AP	39.07	886	97.1	76.2	3.1	93.9	75.9	8.7	79.0	77.8	101.1	-4.0
Wichita	Wichita/Mid-Continent AP	37.65	1339	100.1	73.7	7.4	97.0	73.8	12.2	77.7	76.5	128.5	72.9
KENTUCKY													
Lexington	Lexington Bluegrass AP	38.04	988	91.6	73.9	8.3	89.6	73.6	13.6	77.3	76.1	127.5	73.1
Louisville	Louisville	38.18	489	93.8	76.3	10.2	91.5	75.0	15.9	78.7	77.5	97.1	3.2
LOUISIANA													
Alexandria	Alexandra Intl AP	31.34	79	97.2	77.1	27.4	94.7	77.3	29.3	80.7	79.8	100.2	21.5
New Orleans	New Orleans Lakefront AP	30.04	10	93.3	78.7	35.6	91.8	78.2	38.6	81.4	80.6	96.9	29.7
Shreveport	Shreveport Regional AP	32.45	259	98.5	76.2	25.2	96.0	76.3	28.4	79.4	78.6	101.3	19.3
MAINE													
Togus	Augusta AP	44.32	361	87.5	70.9	-3.2	83.8	69.3	1.3	73.5	71.6	108.3	69.1

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
MARYLAND													
Baltimore	Baltimore-Washington Intl AP	39.17	154	94.0	74.9	14.0	91.3	74.1	17.9	78.1	76.8	98.2	6.9
Perry Point	Baltimore-Washington Intl AP	39.17	154	94.0	74.9	14.0	91.3	74.1	17.9	78.1	76.8	98.2	6.9
MASSACHUSETTS													
Bedford	Boston Logan Intl AP	42.36	30	90.6	72.7	8.1	87.6	71.7	13.0	75.9	74.3	95.4	2.8
Jamaica Plain - Boston	Boston Logan Intl AP	42.36	30	90.6	72.7	8.1	87.6	71.7	13.0	75.9	74.3	95.4	2.8
Brockton	Taunton Muni	41.88	43	90.4	73.4	6.6	87.6	72.3	10.2	76.5	74.9	95.9	0.1
Leeds	Chicopee Falls/West	42.20	246	91.0	72.0	-0.2	88.0	70.9	5.1	75.4	73.9	97.0	-8.8
West Roxbury	Boston Logan Intl AP	42.36	30	90.6	72.7	8.1	87.6	71.7	13.0	75.9	74.3	95.4	2.8
MICHIGAN													
Ann Arbor	Ann Arbor Municipal AP	42.22	840	89.8	73.4	0.4	87.5	72.6	4.9	24.8	22.0	92.3	-10.1
Allen Park	Detroit Metro AP	42.22	663	90.4	73.8	2.9	87.6	72.6	8.0	76.9	75.0	95.0	-2.7
Battle Creek	W K Kellogg AP	42.31	938	89.8	72.9	2.5	86.5	71.4	7.2	75.8	74.2	93.4	-5.6
Detroit	Detroit Metro AP	42.22	663	90.4	73.8	2.9	87.6	72.6	8.0	76.9	75.0	95.0	-2.7

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
Iron Mountain	Iron Mountain/Ford	45.82	1181	88.2	71.2	-10.7	84.2	68.8	-6.3	73.7	71.5	93.1	-19.0
Saginaw	MBS International AP	43.53	669	89.9	73.3	0.4	86.6	71.6	4.6	76.2	74.2	95.1	-5.7
MINNESOTA													
Minneapolis	Minneapolis/St. Paul Intl AP	44.88	837	90.9	72.9	-11.2	88.0	71.9	-6.2	76.8	74.8	95.9	-17.2
St. Cloud	St. Cloud Regional AP	45.55	1024	89.9	72.5	-17.2	86.6	70.8	-11.4	76.2	74.1	95.1	-24.4
MISSISSIPPI													
Jackson	Jackson Intl AP	32.32	331	96.4	76.4	23.2	94.0	76.2	26.7	79.8	78.7	99.4	17.1
Biloxi	Keesler AFB/Biloxi	30.41	33	93.5	79.8	30.7	91.6	79.2	35.1	83.2	81.9	97.5	22.4
Gulfport	Keesler AFB/Biloxi	30.41	33	93.5	79.8	30.7	91.6	79.2	35.1	83.2	81.9	97.5	22.4
MISSOURI													
Columbia	Columbia Regional AP	38.82	899	94.2	76.4	2.8	91.3	76.0	8.6	79.3	77.9	98.7	-3.8
Kansas City	Kansas City	39.30	1024	95.8	76.8	2.0	92.5	76.2	7.2	79.8	78.3	99.7	-4.5
Poplar Bluff	Poplar Bluff (AMOS)	36.77	328	93.9	77.6	11.7	91.5	76.8	17.2	80.5	79.1	98.3	5.3
St. Louis (JBO)	St. Louis Lambert Intl AP	38.75	709	95.5	76.8	6.6	93.0	76.1	11.7	79.4	78.1	99.9	0.7
MONTANA													
Ft. Harrison	Helena Regional AP	46.61	3868	92.9	61.5	-13.0	89.8	60.7	-6.6	64.5	62.9	98.6	-20.3

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
Miles City	Miles City Municipal AP	46.43	2635	98.5	65.6	-16.0	94.5	64.8	-9.2	69.6	67.9	103.6	-22.5
NEBRASKA													
Grand Island	Grand Island Central NE Region	40.96	1857	95.7	74.1	-4.3	92.4	73.2	1.1	77.4	75.8	101.6	-11.5
Lincoln	Lincoln Co	40.83	1188	96.9	75.1	-3.5	93.2	74.5	1.5	78.3	76.9	101.9	-10.4
Omaha	Omaha Eppley Airfield	41.31	981	94.5	76.4	-4.3	91.4	75.2	0.6	79.3	77.6	99.3	-10.8
NEVADA													
Las Vegas	Nellis AFB	36.24	1867	109.2	67.6	27.7	107.1	66.9	30.9	72.2	71.0	113.4	20.1
Reno	Reno/Cannon Intl AP	39.48	4400	96.3	61.6	12.1	93.4	60.2	17.6	64.0	62.3	100.9	5.3
NEW HAMPSHIRE													
Manchester	Manchester AP	42.93	233	91.1	71.9	1.4	88.5	70.6	7.1	75.5	73.8	96.9	-5.1
NEW JERSEY													
East Orange	Newark International AP	40.68	30	94.2	74.6	12.3	91.1	73.1	16.6	77.7	76.3	99.0	7.5
Lyons	Newark International AP	40.68	30	94.2	74.6	12.3	91.1	71.1	16.6	77.7	76.3	99.0	7.5
NEW MEXICO													
Albuquerque	Albuquerque	35.04	5315	95.3	60.1	18.2	92.9	59.8	21.6	65.3	64.4	99.5	10.9

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
NEW YORK													
Albany	Albany Co AP	42.75	292	89.2	73.0	-0.9	86.2	71.2	3.9	75.5	74.0	93.9	-8.0
Batavia	Rochester-Monroe Co	43.12	554	88.7	73.2	2.9	85.6	71.2	6.9	75.4	73.5	92.3	-2.7
Bath	Elmira Corning Regional AP	42.16	955	89.9	71.9	-0.3	86.5	70.0	4.7	74.7	72.8	94.5	-9.7
Bronx	NYC/John F. Kennedy Intl AP	40.66	23	89.8	72.9	13.8	86.5	71.8	17.8	76.7	75.4	95.7	8.8
Brooklyn	NYC/John F. Kennedy Intl AP	40.66	23	89.8	72.9	13.8	86.5	71.8	17.8	76.7	75.4	95.7	8.8
Buffalo	Greater Buffalo Intl AP	42.94	705	86.4	71.3	3.6	83.9	70.1	7.4	74.8	73.2	90.7	-1.8
Canandaigua	Rochester-Monroe Co	43.12	554	88.7	73.2	2.9	85.6	71.2	6.9	75.4	73.5	92.3	-2.7
Wappingers Falls - Castle Point Campus	Dutchess Co AP	41.63	161	91.4	73.8	1.7	88.7	72.6	7.5	76.7	75.1	96.1	-5.9
Montrose	Stewart AFB	41.50	492	90.2	72.9	4.6	86.4	71.9	9.5	76.0	74.4	93.9	-2.0
New York City	NYC/John F. Kennedy Intl AP	40.66	23	89.8	72.9	13.8	86.5	71.8	17.8	76.7	75.4	95.7	8.8
Northport	Long Island Mac Arthur AP	40.79	98	88.5	73.4	11.5	85.7	72.2	15.7	76.6	75.3	94.8	5.9
Syracuse	Syracuse/Hancock Intl AP	43.11	417	89.2	73.2	-1.2	86.3	71.3	4.3	75.3	73.6	93.3	-8.7

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
St. Albans	Syracuse/Hancock Intl AP	43.11	417	89.2	73.2	-1.2	86.3	71.3	4.3	75.3	73.6	93.3	-8.7
NORTH CAROLINA													
Durham	Raleigh Durham Intl AP	35.87	436	94.8	75.7	19.6	92.4	75.2	23.6	78.3	77.3	98.7	12.6
Fayetteville	Fort Bragg Simmons AAF	35.13	243	97.0	746.3	21.9	94.7	75.9	25.8	79.4	78.2	101.1	14.3
Asheville (Oteen)	Asheville Municipal AP	35.43	2169	88.3	71.2	14.7	85.9	70.6	18.9	73.9	72.8	91.4	6.8
Salisbury	Smith Reynolds AP	36.13	971	92.9	73.6	18.9	90.6	73.0	23.3	76.4	75.3	96.8	11.9
NORTH DAKOTA													
Fargo	Fargo Hector Intl AP	46.93	899	90.7	72.0	-19.3	87.6	70.4	-14.5	75.4	73.4	95.9	-24.9
OHIO													
Columbus	Columbus/Port Columbus International AP	39.99	817	91.1	73.6	5.0	89.0	72.9	10.4	76.8	75.3	94.2	-1.0
Chillicothe	Columbus/Port Columbus International AP	39.99	817	91.1	73.6	5.0	89.0	72.9	10.4	76.8	75.3	94.2	-1.0
Cincinnati	Cincinnati Municipal AP Lunki	39.10	499	92.8	74.5	8.1	90.3	74.2	13.4	78.0	76.7	96.3	0.5

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
Cleveland	Cleveland Hopkins Intl AP	41.41	804	89.7	73.7	4.1	87.0	72.4	9.7	76.2	74.7	96.6	-2.0
Dayton	Dayton Intl AP	39.91	1004	90.4	73.5	2.0	88.0	72.8	8.1	76.5	75.1	93.6	-4.6
OKLAHOMA													
Muskogee	Muskogee	35.66	610	99.4	76.5	16.4	96.9	76.6	19.2	80.5	79.0	102.9	8.8
Oklahoma City	Oklahoma City Will Rogers World AP	35.39	1306	99.6	74.2	14.1	96.9	74.2	18.9	77.8	76.9	102.7	7.5
OREGON													
Portland	Portland Intl AP	45.59	108	91.4	67.3	25.2	87.5	66.5	29.5	69.5	67.9	99.2	20.9
Roseburg	Roseburg AP	43.24	509	93.2	67.6	27.6	90.1	66.7	30.0	70.0	68.2	102.4	22.0
White City	Medford-Jackson Intl AP	42.39	1329	99.2	66.9	23.1	95.6	65.8	26.1	688	67.4	104.9	17.9
PENNSYLVANIA													
Altoona	Altoona Blair Co AP	40.30	1470	88.3	71.8	5.9	85.6	70.8	10.0	74.7	73.1	92.4	-0.7
Butler	Butler Co (AWOS)	40.78	1247	88.1	71.9	3.2	84.5	70.3	8.8	74.5	72.9	91.0	-2.2
Coatesville	Lancaster	40.12	404	90.9	75.0	10.1	88.4	73.4	15.5	77.3	75.6	94.3	4.7
Erie	Erie Intl AP	42.08	738	86.7	73.0	6.8	84.2	71.8	10.4	75.3	73.9	92.0	1.2
Lebanon	Harrisburg Capital City AP	40.22	348	92.5	73.8	10.7	89.9	72.6	15.4	76.6	75.3	96.4	5.8
Philadelphia	Philadelphia Intl AP	39.87	30	93.4	75.1	13.8	90.8	74.4	18.0	78.3	77.0	97.5	9.0

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
Pittsburgh	Greater Pittsburgh Intl AP	40.50	1204	89.7	72.4	5.2	87.0	71.1	9.9	75.2	73.7	92.4	-1.1
Wilkes-Barre	Wilkes-Barre Scranton Intl AP	41.34	961	89.3	71.9	4.4	86.2	70.3	9.1	74.9	73.2	93.1	-1.1
PUERTO RICO													
San Juan	San Juan Intl AP	18.42	13	91.0	77.7	69.4	89.4	77.8	70.4	80.4	79.9	93.8	67.7
RHODE ISLAND													
Providence	Providence/TF Green State	41.72	62	90.1	73.3	8.5	86.7	71.9	12.9	76.4	74.9	94.4	2.9
SOUTH CAROLINA													
Charleston	Charleston Municipal AP	32.90	49	94.3	78.2	27.3	92.1	77.6	30.4	80.8	79.9	98.5	20.8
Columbia	Columbia Metro AP	33.94	226	97.2	75.2	22.8	94.8	75.0	26.5	78.5	77.7	100.8	16.5
SOUTH DAKOTA													
Ft. Meade	Rapid City Regional AP	44.05	3169	97.2	65.8	-9.2	93.0	65.5	-3.4	70.9	69.2	103.1	-17.0
Hot Springs	Rapid City Regional AP	44.05	3169	97.2	65.8	9.2	93.0	65.5	-3.4	70.9	69.2	103.1	-17.0
Sioux Falls	Sioux Falls Foss Fld	43.58	1427	92.2	73.6	-12.3	88.9	73.0	-7.3	77.2	75.4	97.6	-19.1

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
TENNESSEE													
Memphis	Memphis Intl AP	35.06	331	96.7	77.2	18.7	94.3	76.6	22.9	80.0	79.0	99.3	12.6
Mountain Home	Bristol-Tri-City AP	36.48	1526	90.5	71.8	12.9	88.2	71.5	17.7	75.1	74.0	92.9	4.6
Murfreesboro	Nashville/Metropolis	36.12	604	94.8	74.9	14.8	92.4	74.7	19.3	78.2	77.2	97.8	7.6
Nashville	Nashville Intl AP	36.12	604	94.8	74.9	14.8	92.4	74.7	19.3	78.2	77.2	97.8	7.6
TEXAS													
Amarillo	Amarillo Intl AP	35.22	3606	97.3	66.2	9.8	94.7	66.3	15.6	71.3	70.2	101.6	2.4
Big Spring	San Angelo/Mathis	31.35	1893	100.4	70.3	21.9	98.7	70.1	25.9	75.3	74.3	104.8	14.7
Bonham	Cox Field, Paris, TX	33.64	548	99.3	76.1	20.8	97.0	75.9	25.2	79.2	78.2	100.3	13.6
Dallas	Dallas-Fort Worth Intl AP	32.90	597	100.5	74.6	23.0	98.6	74.7	27.3	78.6	77.8	103.8	17.5
Houston	Houston Bush InterContinental AP	29.99	105	97.2	76.6	30.3	95.2	76.7	33.8	80.2	79.4	100.6	25.6
Kerrville	San Antonio Intl AP	29.53	810	99.0	73.5	29.2	97.2	73 7	32.7	78.1	77.4	102.2	23.0
Harlingen	Valley International AP	26.23	36	98.8	78.6	36.7	97.2	77.6	40.8	81.3	80.4	100.9	31.5
San Antonio	San Antonio Intl AP	29.53	810	99.0	73.5	29.2	97.2	73.7	32.7	78.1	77.4	102.2	23.0

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
Temple	Draughon-Miller Central Regional AP	31.15	682	99.7	74.2	25.0	98.0	74.2	28.0	78.2	77.4	103.1	19.2
Waco	Waco Regional AP	31.61	509	100.5	75.0	24.6	99.0	75.1	28.1	78.7	78.1	104.1	18.8
UTAH													
Salt Lake City	Salt Lake City Intl AP	40.79	4226	97.7	62.8	9.6	95.1	62.2	14.2	66.3	65.1	101.6	2.9
VERMONT													
White River Junction	Edward F. Knapp State AP	44.20	1122	85.1	69.8	-10.2	82.2	68.0	-5.5	72.5	70.7	89.8	-17.7
VIRGINIA													
Hampton	Norfolk Intl AP	36.90	30	93.7	76.7	22.5	91.3	76.0	26.2	79.1	78.0	98.3	17.4
Richmond	Dinwiddie Co	37.18	194	97.3	77.3	16.1	94.6	76.4	19.3	80.7	79.2	100.7	6.2
Salem	Roanoke Regional AP	37.32	1175	92.3	72.8	15.7	90.0	72.2	19.6	75.4	74.5	96.1	8.4
WASHINGTON													
Seattle	Seattle-Tacoma International AP	47.46	433	85.3	65.2	25.2	81.6	63.7	29.6	66.8	65.0	93.1	21.2
Spokane	Fairchild AFB	47.62	2461	92.9	62.1	6.8	90.1	61.3	11.7	64.5	63.0	N/A	N/A
Vancouver	Portland Intl AP	45.59	108	91.4	67.3	25.2	87.5	66.5	29.5	69.5	67.9	99.2	20.9
Walla Walla	Walla Walla City Co AP	46.10	1204	98.7	66.2	10.4	94.6	65.1	18.0	68.4	66.6	104.9	8.3

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
WEST VIRGINIA													
Beckley	Beckley Raleigh Co MEM AP	37.80	2513	84.8	69.7	6.8	82.6	68.8	11.5	72.5	71.3	87.9	-1.5
Clarksburg	Elkins-Randolph Co Regional AP	38.89	1978	87.0	70.5	1.3	84.4	69.7	7.5	73.4	72.3	90.5	-10.2
Huntington	Huntington Tri-State AP	38.38	837	91.9	73.5	10.1	89.6	72.2	15.5	77.3	75.9	95.1	2.0
Martinsburg	Eastern WV Regional AP	39.40	535	93.1	73.6	11.5	90.4	72.9	15.8	76.8	75.4	97.8	2.4
WISCONSIN													
Madison	Madison Dane Co Regional AP	43.14	866	89.6	74.2	-7.0	86.6	72.6	-1.6	77.0	75.0	93.8	-13.9
Tomah	La Crosse Municipal AP	43.88	656	91.7	74.8	-9.3	88.88	73.0	-4.5	77.9	75.7	97.4	-16.2
Milwaukee	Milwaukee Mitchell Intl AP	42.95	692	90.0	74.3	-1.4	86.5	72.4	3.2	76.8	74.9	95.2	-7.9
WYOMING													
Cheyenne	Cheyenne/Warren AFB	41.16	6142	89.7	58.3	-3.7	86.8	57.7	2.9	62.6	61.5	93.8	-12.5
Sheridan	Sheridan Co AP	44.77	3967	95.3	63.8	-10.7	91.7	62.9	-4.1	67.5	65.7	100.7	-19.3

NOTE:

The climatic conditions table data is based on the 2013 ASHRAE Handbook of Fundamentals. The data is taken from the weather station closest to the VA facility. User should use the approved latest edition of ASHRAE Handbook of Fundamentals for the HVAC load calculations.

7.2 HIGH HUMIDITY LOCATIONS

Dew-point temperature > 60 F [15.6 C] for a minimum of 4000 hours per year.
Data based on 5-year averages.

Table 7.2: HIGH HUMIDITY LOCATIONS

Location	Annual Dew-Point Hours
Bay Pines	5406
Biloxi	4114
Charleston	4368
Gainesville	4774
Honolulu	7951
Houston	5152
Lake City	4774
Miami	7020
New Orleans	5104
Orlando	5703
Panama City	5037
Pensacola	4838
San Juan	8474
Tampa	5788
Viera	6025
West Palm Beach	6606

7.3 LOW HUMIDITY LOCATIONS

Dew-point temperature < 35 F [1.7 C] for a minimum of 3500 hours per year.
Data based on 5-year averages

Table 7.3: LOW HUMIDITY LOCATIONS

Location	Annual Dew-Point Hours
Albuquerque	5211
Anchorage	4947
Cheyenne	5556
Denver	5115
Fargo	4099
Las Vegas	5083
Phoenix	3674
Minneapolis	3893
Tucson	4063

NOTE:

Calculate and compare humidification loads in the cooling and heating modes of the system operation. Size and select the humidification equipment based on the higher value.

Chapter 8: ABBREVIATIONS AND REFERENCES

8.1 ABBREVIATIONS

ABBREVIATION	DESCRIPTION
ΔT	Delta T
AC/HR	Air circulation per hour
A/E	Architect Engineer
AB	Air Blender
ACH	Air Changes Per Hour
ADPI	Air Diffusion Performance Index
AF	After-Filter
AFCV	Air Flow Control Valve
AHU	Air-Handling Unit
AII	Airborne Infection Isolation
APD	Air Pressure Drop
B-AAC	BACnet Advanced Application Controller
B-ASC	BACnet Application Specific Controller
B-AWS	BACnet Advanced Workstation
B-BC	BACnet Building Controller
bhp	Brake Horsepower
BIM	BIM Building Information Modeling
BLCC	Building Life-Cycle Cost
BMT	Bone Marrow Transplant
BROS	Blind Rehabilitation Outpatient Specialist
BSC	Biological Safety Cabinet
BSL1	Biological Safety Level 1
BSL3	Biological Safety Level 3
Btu	British Thermal Unit
Btuh	British Thermal Unit per Hour
C	Celsius
CAD	computer-aided design and drafting
CAFM	Computer Aided Facilities Management
CC	Cooling Coil
CCTV	Closed Circuit Television
CD	Construction Documents
CFC	Chlorofluorocarbon
CFD	Computational Fluid Dynamics
cfm	Cubic Feet Per Minute
CFM	Office of Construction and Facilities Management
CH	Chiller
CLC	Community Living Centers
cm	Centimeters

ABBREVIATION	DESCRIPTION
CO	Contracting Officer
CO2	Carbon-dioxide
COR	Contracting Officer Representative
CPM	Critical Path Method
CRAC	Computer Room Air Conditioner
CT-#	Cooling Tower
CT	Computerized Tomography
CV	Constant Volume
CWR	Chilled Water Return
CWS	Chilled Water Supply
D	Damper
DB	Dry Bulb
DD	Design Development
DDC	Direct Digital Control
DEMARC	Demarcation Room
DOAS	Dedicated Outside Air System
DOM	Domiciliary
DOP	Dispersed Oil Particulate
DDC	Direct Digital Controls
DOAS	Dedicated Outdoor Air System
DPA	Differential Pressure Assembly
DX	Direct Expansion
ECC	Engineering Control Center
EEG	Electroencephalography Laboratory
EER	Energy Efficiency Ratio
EER	Electrical Equipment Room
EMG	Electromyography
EPAct	Energy Policy Act
ERCP	Endoscopic Ultrasound Procedure
ETO	Ethylene Oxide
F	Fahrenheit
F&T	Float and Thermostatic
FF	Final Filters
FM	Flowmeter
FMS	Facility Maintenance Service
fpm	Feet Per Minute
fps	Feet Per Second
ft	Foot/Feet
GE	General Exhaust
gpm	Gallons Per Minute

ABBREVIATION	DESCRIPTION
GSHP	Ground Source Heat Pump
h	Hour
H-18-8	VA Handbook 18-8 Seismic Design Requirements
HAC	Housekeeping Aid Closet
HCFC	Hydro chlorofluorocarbons
HEPA	High-Efficiency Particulate Arrestance
HFC	Hydrofluorocarbons
HFO	Hydrofluoro-Olefins
Hp	Horsepower
HPS	High-Pressure Steam
HVAC	Heating, Ventilation and Air Conditioning
HVU	Heating and Ventilation Units
HX	Heat Exchanger
ICU	Intensive Care Unit
IAQ	Indoor Air Quality
IMRT	Intensity-Modulated Radiation Therapy
in	Inch
I/O	Input/Output
IR	Infrared Radiation
IT	Information Technology
kg	Kilograms
kPa	KiloPascal
KT	Kinesiology Therapy
kWh	kilowatt hour
lb	Pound
L	Length
L/s	Liters per Second
LCC	Life Cycle Cost
LCCA	Life Cycle Cost Analysis
lin	Linear
LPG	Liquid Propane Gas
LPS	Low-Pressure Steam
LWT	Leaving Water Temperature
m	Meter
M2	Square Meter
m/s	Meters per second
MB	Mixing Box
MBH	1000 btu’s per hour
MER	Mechanical Equipment Rooms
MERV	Minimum Efficiency Reporting Valve

ABBREVIATION	DESCRIPTION
MH	Mental Health
mm	Millimeters
MMS	Medical Media Service
MOU	Memorandum of Understanding
MPS	Medium-Pressure Steam
MRI	Magnetic Resonance Imaging
N+1	Number of chiller 1 installed chiller
NC	Noise Criteria
NC	Normally Closed
NEC	National Electrical Code
NICU	Neonatal Intensive Care Unit
NO	Normally Open
NPSHA	Net Positive Suction Head Available
NPSHR	Net Positive Suction Head Required
NRM	Non-Recurring Maintenance
NTP	Notice to Proceed
OA	Outdoor Air
OCAMES	Office of Capital Assets Management, Engineering and Support
ODP	Ozone Depletion Potential
OIT	Office of Information Technology
OT	Occupational Therapy
OR	Operation Room
ORP	Oxidation Reduction Potential
P-#	Pump
Pa	Pascal
PACT	Patient Aligned Care Team
PACU	Post Anesthesia Care Unit
PAO	Poly Alpha Olefin
PC	Personal Computer
PE	Protective Environment
PEC	Primary Engineering Controls
PET	Positron Emission Tomography
PF	Pre-Filter
pH	*Potential Of Hydrogen*
PHC	Preheat Coil
POC	Point of Contact
PPE	Personal Protective Equipment
ppm	Parts Per Million
PRV	Pressure Reducing Valve
PSDM	Physical Security Design Manual

ABBREVIATION	DESCRIPTION
psig	Pounds per Square Inch-Gage
PSS	Primary Secondary System
PT	Physical Therapy
PTAC	Packaged Terminal Air-Conditioners
PTRP	Polytrauma Transitional Rehabilitation Program
PTSD	Post Trauma Stress Disorder
QA/QC	Quality Assurance/Quality Control
R	Refrigerant
RA	Return Air
RAM	Random Access Memory
RANS	Reynolds-Averaged Navier Stokes
RDS	Room Data Sheets
RF	Return Fan
RH	Relative Humidity
RRTP	Residential Rehabilitation Treatment Program
SA	Supply Air
SCI	Spinal Cord Injury
SCR	Silicon Controlled Rectifier
SE	Special Exhaust
SD	Smoke Detector
SDR	Smoke Damper (Return)
SDS	Smoke Damper (Supply)
sf	Square Foot
SF	Supply Fan
SFO	Solicitation for Offers
SH	Steam Humidifier
sm	Square Meter
SPS	Sterile Processing Service
TB	Tuberculosis
TAB	Testing, Adjusting and Balancing
TEE	Transesophageal Echocardiograph
TER	Telephone Equipment Room
TES	Thermal Energy Storage
TIL	Technical Information Library
TLCC	Total Life Cycle Cost
TOR	Telephone Operators Room
TR	Telecommunications Room
UPS	Uninterruptible Power Supply
V	Valves
VA	Veteran’s Affairs

ABBREVIATION	**DESCRIPTION**
VAHBS	VA Hospital Building System
VAV	Variable Air Volume
VBA	Veteran's Benefits Administration
VFD	Variable Frequency Drive
VHA	Veteran's Health Administration
VPS	Variable Primary System
VSD	Variable Speed Drive
W	Watts
WC	Water Class
WG	Water Gage
WPD	Water Pressure Drop
W/sf	Watts Per Square Foot

8.2 REFERENCES

ABBREVIATION	FULL DESCRIPTION OF REFERENCE
AAALAC	Association for Assessment and Accreditation of Laboratory Animal Care
AABC	National Environmental Balancing Bureau
ACGIH	American Council of Government Industrial Hygienists
AHRI	Air Conditioning, Heating, and Refrigeration Institute
AMCA	Air Movement and Control Association International
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	The American Society of Mechanical Engineers
BMBL	Bio-Safety in Microbiological and Biomedical Laboratories
CDC	U.S. Centers for Disease Control and Prevention
CTI	Cooling Tower Institute
DHHS	U.S. Department of Health and Human Services
DIACAP	DoD Information Assurance Certification and Accreditation Process
DOE	U.S. Department of Energy
EEG	Electroencephalogram
EGD	Esophagogastroduodenoscopy
EMG	Electromyography
EPA	U.S. Environmental Protection Agency
ERCP	Endoscopic Retrograde Cholangiopancreatogram
FDA	U.S. Food and Drug Administration
FEMP	U.S. Federal Energy Management Program
IMC	International Mechanical Code
IPC	International Plumbing Code
IBC	International Building Code
ISO	International Organization for Standardization
LEED	Leadership in Energy and Environmental Design
NEC	National Electric Code
NEBB	National Environmental Balancing Bureau
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standard and Technology
NSF	National Science Foundation
NSPE	National Society of Professional Engineers
OSHA	Operational Safety and Health Administration
SMACNA	Sheet Metal and Air-Conditioning Contractors' National Association
TABB	Testing Adjusting and Balancing Bureau

ABBREVIATION	FULL DESCRIPTION OF REFERENCE
TIL	VA Technical Information Library (www.cfm.va.gov/TIL/)
UL	Underwriters Laboratories
USP	United States Pharmacopeia