April 2010

PLUMBING DESIGN MANUAL

For:

- New Hospitals
- Replacement Hospitals
- Ambulatory Care
- Clinical Additions
- Energy Centers
- Outpatient Clinics
- Animal Research Facilities
- Laboratory Buildings

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CHAPTER 1: BASIC REQUIREMENTS

1.0 INTRODUCTION

NOTE: The Department of Veterans Affairs (VA) has adopted many National CAD standards abbreviations as well as retained many older VA legacy abbreviations. In the first Instance in which an abbreviation occurs, the full phrase is written followed by the abbreviation in parentheses. Subsequent occurrences of the phrase will use the abbreviation. For the full list of abbreviations, see DETAILS, PG-18-04.

This Plumbing Design Manual is revised to incorporate numerous changes due to:

1 Energy Conservation 2005 and Department of Energy (DOE) – Final Rule)

2 Energy Conservation Executive Order No. 13423 Dated January 24 2007: Strengthening Federal Environmental, Energy, and Transportation Management)

3 Memorandum of Understanding (MOU): Federal Leadership In High Performance and Sustainable Buildings

4 Physical Security Requirements

5 Sustainable Design Considerations

6 Commissioning

This manual is intended for use by the Architect/Engineer (henceforth referred to as the A/E) and others engaged in the design and renovation of the VA facilities. These facilities include but are not limited to:

1 New Hospitals

2 Replacement Hospitals

3 Ambulatory Care

4 Clinical Additions

5 Energy Centers

6 Outpatient Clinics

7 Animal Research Facilities

8 Laboratory Buildings

It is expected that plumbing systems designed with the use of this manual will meet the primary objective of promoting a sanitary work environment for veterans, employees, and visitors, and support the medical mission of the Department of Veterans Affairs. The plumbing system design package shall be complete, coordinated, and technically correct. In addition, the plumbing systems shall be safe, easily accessible for repairs and maintenance, energy-efficient, and in compliance with the prescribed codes.

Deviations can be made from the stipulations of this manual to accommodate engineered plumbing systems, new concepts, and design enhancements. However, such deviations shall be subject to review and approval by the VA Project Manager in consultation with the VA Facilities Quality Service (Office of Construction & Facilities Management) and shall not conflict with any applicable federal regulations, public law, executive order, or the needs of the end-users.

Throughout this manual, the phrase, “VA Authorities”, is used. The “VA Authorities” are defined as the VA Project Manager. If approval is required by the local VA Medical Center, it is so noted in this manual.

1.1 ENERGY AND WATER CONSERVATION

The need to conserve energy is mandated by the federal government by both executive order and federal law. In addition, 21 federal agencies have signed a Memorandum of Understanding (MOU) outlining specific goals and targets for energy conservation and sustainable design. The VA is one of the signatory agencies. In the following paragraphs, references and details of various requirements are given. In general, the plumbing engineer shall analyze the various options for providing domestic hot water. The design shall comply with pertinent sections of ASHRAE 90.1-2007 for pipe insulation, equipment efficiencies, and ASHRAE 90.1-2007, Chapter 7, Serving Water Heating.

1.2 DOE FINAL RULE

In the Federal Register (Volume 72, No. 245), dated December 21, 2007, the Department of Energy (DOE) issued mandatory energy conservation guidelines as the final rule for implementing provisions in the Energy Policy Act EPACT 2005).

1.3 EXECUTIVE ORDER 13423 DATED JANUARY 26, 2007

Mandatory energy conservation requirements are also published in the above executive order. The MOU is mentioned in Section 2, paragraph f of the executive order. The MOU was signed under the Federal Leadership in High Performance and Sustainable Buildings.

1.4 COMMISSIONING

VA guidelines for commissioning are under preparation and will be issued soon. In the interim, the A/E shall employ total building 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 are met. This shall include a VA-designated commissioning authority to perform the following:

1 Include commissioning requirements in construction documents

2 Provide commissioning plan

3 Verify the installation and performance of systems to be commissioned

4 Provide commissioning report

1.5 MEASUREMENTS AND VERIFICATION

Domestic water and gas utility meters shall be installed in new major construction and renovation projects to track energy and water usage. Meters shall be located at the building water service entrance, building gas service entrance, landscaping system connections, cooling tower makeup water, and other high water uses or consumers.

1.6 COMPLIANCE

The International Plumbing code (IPC) and International Fuel Gas Code (IFGC) are the major referenced standard used in the VA plumbing manual. The latest International Plumbing code can be obtained from the International Code Council, 5203 Leesburg Pike, Suite 600; Falls Church, VA; 22041. Unless specifically stated otherwise, the latest adopted edition shall be used. Additionally, Chapter 13, International Plumbing code lists standards that are referenced in various sections of the International Plumbing Code and VA master plumbing specifications. These references are also given in the text of this manual where appropriate.

A list of plumbing abbreviations and symbols can be found on the VA.gov Technical Information Library under standard details.

1.7 VA HOSPITAL BUILDING SYSTEM

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 (called the Redbook) and the 2006 Supplement. Additional details are included in Appendix 1-A.

1.8 VA HOSPITAL BUILDING SYSTEM DESIGN IMPLICATION

Due to the modular concept of the VA Hospital Building System, the A/E will find that plumbing schematic/design development decisions occur much earlier in the overall planning/design process when compared to a conventional design process . Equipment selection and main distribution sizing should be evaluated as soon as the size and number of modules is determined.

1.9 PERTINENT STANDARDS

Note: The A/E shall submit to the VA a list of all applicable documents, posted in the Technical Information Library (TIL), and listed below along with the dates that were in effect on date of contract award. The TIL is the VA depository for facility technical information and requirements.

Major standards are described in this section.

1.10 DESIGN MANUALS (PG-18-10)

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Conveys the general and specific VA design philosophy for medical and support facilities.

The manuals accomplish this by:

1. Explaining specific design methodologies
2. Listing acceptable system types
3. Codifying certain code interpretations
4. Listing values for design parameters
5. Referencing certain sections of the Master Specification and Standard Details
6. Containing examples of certain design elements

1.11 DESIGN SUBMISSION REQUIREMENTS (PG-18-15)

Located in Architect/Engineer Contract Information
http://www.cfm.va.gov/contract/aeDesSubReq.asp

The submission requirements for plumbing have been expanded to include the requirements found in Appendix 1-C.

Purpose
Provides a staged list of tasks in various design categories to define the A/E scope and encourage thorough and timely completion of the final design package and bid documents.

The instructions accomplish this by:

1 Progressively listing tasks at Schematic, Design Development, and Construction Documents stages

2 Requiring task completion and submission for each stage according to a Critical Path Method (CPM) calendar

3 Requiring implementation of a QA/QC process to assure a quality design product

4 Requiring life-cycle analysis of alternatives in order to optimize the design/cost tradeoff

5 Listing and detailing all the drawings, calculations, and specifications required for a complete design package

6 Indicating the final distribution of bid documents

Note: The A/E shall submit specifications at the Construction Documents (CD1) submittal to include an electronic version of the VA Master Specifications with tracked changes or modifications displayed.

1.12 MASTER SPECIFICATIONS (PG-18-1)

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Defines a standardized method for the A/E to assure that the contractors provide equipment and systems that meet the design intent in terms of performance, quality, and cost.

The specifications accomplish this by:

1 Providing specific narrative descriptions of required equipment, salient elements, and system construction

2 Listing applicable standards and codes and references

3 Requiring individual submittal of equipment and systems for review and approval prior to contractor purchase

4 Defining specific installation methods to be used

1.13 ARCHITECT ENGINEER REVIEW CHECKLIST

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Provides the VA Peer Reviewer with a minimum list of critical items which must be included in each A/E submission.

The checklist accomplishes this by:

1 Referring to all VA design tools which pertain to the specific project

2 Detailing certain life safety and coordination requirements

1.14 DESIGN ALERTS, Type 1

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Communicates current design issues and solutions.

The design alerts accomplish this by:

1 Publishing periodic alert memos

2 Summarizing design solutions

1.15 QUALITY ALERTS, Type 2

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Communicates quality deficiencies from recent A/E design submissions.

The quality alerts accomplish this by:

1 Publishing checklists of design details often missed

2 Including references to technical resources

1.16 DESIGN GUIDES (PG-18-12)

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Provides 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:

1 Publishing design information

2 Including functional diagrams and layout plates

3 Listing standards

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

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Establishes minimum consistent design/construction practices.

The procedures section accomplishes this by:

1. Referencing applicable codes and policies
2. Describing standard drawing formats
3. Listing security strategies
4. Including miscellaneous design details

1.18 NATIONAL CAD STANDARDS (NCS) AND DETAILS (PG-18-4) AND CAD DELIVERABLES GUIDELINES (PG-18-4)

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Promotes standardization of CAD documents submitted to the VA Authorities.

The standards section accomplishes this by:

1. Providing downloadable equipment schedules
2. Listing symbols and abbreviations
3. Providing downloadable standard details in .dwg or .dwf format
4. Providing guidelines 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 the VA Authorities.

1.19 PHYSICAL SECURITY DESIGN MANUAL FOR VA FACILITIES – MISSION CRITICAL FACILITIES AND LIFE SAFETY PROTECTED FACILITIES (FORMERLY CD-54)

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Sets 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:

1. Setting objectives for physical security
2. Providing strategies for use in design and construction to provide protection to VA facilities
3. Providing cost-effective design criteria

Two independent water sources are required. The two sources may consist of two independent services from an off-site provider or a single source from an off-site provider and an on-site water well with a treatment system meeting the requirements of the Safe Drinking Water Act (SDWA) and National Sanitary Foundation (NSF) Requirements for potable water.

1.20 COST ESTIMATING MANUAL

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Conveys the general and specific VA cost estimating philosophy for medical facilities.

The manual accomplishes this by:

1 Explaining specific estimating methodologies

2 Providing examples of certain design elements

1.21 SUSTAINABLE DESIGN FOR DESIGN AND CONSTRUCTION OF VHA FACILITIES, VBA FACILITIES, AND NCA FACILITIES

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Incorporates 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:

1 Prescribing the use of integrated design practices

2 Providing strategies for optimization of energy performance

3 Providing strategies for protection and conservation of water resources

4 Providing strategies for enhancement of indoor environmental quality

5 Providing strategies for reduction of environmental impact of materials

LEED Water Use Reductions

The plumbing designer shall implement the Sustainable Design Manual as dictated by the project requirements or Owner's Project Requirement Document. At a minimum, major new construction and renovations shall achieve a 20% water use reduction as compared to the baseline established by EPACT 1992. The plumbing design shall investigate water use reduction strategies with the VA project manager or medical center. Dual flush, low flow (1.1 to 1.28 gallons per flush) water closets and 0.5 gallon per flush (low flow) urinals may be used to achieve Leadership in Energy and Environmental Design (LEED) WE 3-1 and WE 3-2 credits with the prior approval of the medical center. See the Sustainable Design Manual, Appendix A for further discussion.

1.22 SEISMIC DESIGN REQUIREMENTS (H-18-8)

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Sets the requirements for seismic design in new facilities and for rehabilitation of existing facilities.

The manual accomplishes this by:

1 Defining critical and essential facilities
2 Prescribing code compliance with modifications
3 Prescribing occupancy categories

1.23 FIRE PROTECTION DESIGN MANUAL

Located in Technical Information Library (TIL)
http://www.cfm.va.gov/til/

Purpose
Provides the fire protection engineering design criteria for all categories of VA construction and renovation projects.

The manual accomplishes this by:

1 Mandating code and standard compliance2Defining water supply requirements
3 Defining fire extinguishing and fire alarm system requirements

1.24 COMPUTER AIDED FACILITIES MANAGEMENT REQUIREMENTS (CAFM)

The VA intends to implement Computer Aided Facility Management (CAFM) systems in all new and replacement hospital construction, and where feasible in all existing hospitals. The CAFM concept requires that all pertinent data regarding a facility be contained in a master digital database, accessible by facilities personnel at their workstations for use in operations, energy/cost management, and maintenance and for planning modifications in facility infrastructure due to space utilization changes.

In Appendix 1-B, additional information about format, utilization, and calculations is given.

---END OF SECTION---

APPENDIX 1-A: VA HOSPITAL BUILDING SYSTEM

1-A.1 DESCRIPTION OF MODULES

1-A.1.1 Introduction

The Redbook proposes a systematic or modular approach to the design of new hospital buildings where building systems are integrated into the planning modules from the start. Service modules are defined as one-story units of building volume with a footprint of approximately 10,000 square feet (sq ft) [3048 square meters (sq m)]. More recent designs have used service modules in the range of 20,000 sq ft [6096 sq m]. Each module is comprised of structural bays, a service zone, and a functional zone (often subdivided into space modules). Each service module is completely self contained or with one or more other modules in a fire compartment.

1-A.1.2 Structural Bays

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

1-A.1.3 Service Zones

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.

1-A.1.4 Functional Zones

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

1-A.1.5 Fire Compartmentation

A fire compartment is a unit of area enclosed by a two-hour rated fire-resistant construction on all sides, from which there are at least two different exits.

1-A.1.6 Plumbing Utilities

The Redbook describes the plumbing supply and return risers being grouped together at one end of the service bay.

The horizontal sanitary waste pipes drain toward the service bays and connect to two or more waste stacks located in the service bay.

The storm drain follows the same concept as the sanitary waste.

1-A.2 ZONING OF PLUMBING SYSTEMS

The hot water heaters are centrally located in one or more equipment rooms at or below grade.

The medical air, oxygen, and medical vacuum systems are usually located at the medical center’s central utility building or basement mechanical room.

1-A.3 REFERENCES

1 Development Study-VAHBS (Red Book – revised 1976)

2 Supplement to Development Study (2006)

---END OF SECTION---

APPENDIX 1-B: COMPUTER AIDED FACILITIES MANAGEMENT (CAFM)

1-B.1 CAFM AND EQUIPMENT SCHEDULE UTILIZATION

1-B.1.1 Introduction

The requirement for access to a master digital database drives the need to compile all architectural/engineering design data (not limited to plans, specifications, calculations, equipment selection, equipment submittal, commissioning/balance reports, and job-related communications), whether in letter or email format, in a digital, electronic format from the very start of a project. Thus, this need for digital data will affect the requirements for submission (see Design Submission Requirements).

1-B.1.2 Submission Requirements

While the VA may not have determined the complete software architecture defined yet for the ultimate CAFM configuration, the A/E is to begin the digital submission process now.

1-B.1.3 Electronic Documentation

The electronic documentation and copies of the calculations, equipment selections, operations and maintenance manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template (VPAT) made available for review by the VA and included as part of the submittal requirements. All available accessibility functions listed in the VPAT shall be enabled in the prepared electronic files. Because Adobe Acrobat is a common industry format for such documentation. It is recommended that the A/E review and follow as a miniumum requirement, the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge.

1-B.1.4 Schedules

(a) The equipment and other schedules that previously appeared in the VA Technical Information Library (TIL) under the National CAD Standards as either .dwf or .dwg files have been converted into Excel spreadsheet files (.xls), and are still located in the CAD section of the TIL. The schedules shall be downloaded for use.

(b) The schedules all have a similar layout for consistent data presentation. Notes for special requirements are listed below. Positioning the cursor over column headings will cause pop-up notes to appear which contain recommended methodologies for determining the information to be input into that column. Columns may be hidden for use later in the design/construction process, and throughout the life of the equipment. The first few hidden columns will be filled out by the contractor and include data such as the equipment make, model and serial numbers. Other columns will be filled out by the test and balance agent and include the belt and sheave information.

(c) Initial use of the schedules is for equipment selection and listing. Completed schedules can then be inserted into project CAD drawings. Copies of the Excel files will be given to the successful contractor to fill in data from approved submittals, equipment suppliers, or bills of material. These modified schedules will then be inserted into the final as-built CAD drawings, to become part of the ultimate CAFM database. The hidden columns can be revealed by the facilities management group for their purposes.

(d) Full calculation sets for equipment selection are called for in the A/E Submission Requirements. These calculations will also appear in the pop-up data boxes to provide easy access later when used in the CAFM system.

(e) The Excel schedule files and CAFM data shall formalize version tracking throughout all successive iterations.

---END OF SECTION---

APPENDIX 1-C: A/E SUBMISSION REQUIREMENTS AND PLUMBING DESIGN MANUAL COORDINATION

1-C.1 GENERAL

1-C.1.1 Introduction

In this appendix, specific tasks outlined in the A/E Submission Requirements for Major New Facilities, Additions, and Renovations, (Program Guide, PG-18-15) at various submittal stages of the design process are presented and related to the contents of this design manual. This effort substantiates and supplements the submission requirements, while providing in-depth insight into the submission needs.

1-C.1.2 Coordination

Coordination between the submission requirements and the design manual is mandatory. Variations and deviations from the prescribed submission task may be permitted on a case-by-case basis, if and where deemed necessary to meet the project-specific scope of work. Such variations and deviations must be submitted in writing for prior approval by the VA Authorities.

1-C.1.3 Compliance Requirements

For each submittal, the A/E shall forward to the VA Authorities a detailed list of the submission requirements with notations indicating full or partial compliance. The list shall also detail the A/E's justification for any deviation from the requirements.

1-C.1.4 Specific Drawing Requirements

Where applicable, the contract drawings shall include those listed below. For uniformity, drawings shall be arranged in the order listed. See the VA NCS Application Manual for more organization detail.

1 PP – 0xxx General Notes, Abbreviations, and Symbols (VA-Compliant)

2 PD – 1xxx Demolition of Existing Plumbing Work, Floor Plans, If Applicable. Minor Demolition May Be Shown on New Construction Drawings. Extensive Demolition Requires Drawings for Demolition Only

3 PS – 1xxx Plumbing Site Plan

4 PP – 1xxx Plumbing Supply Distribution, Cold Water, Hot Water, Hot Water Return, Medical Air, Vacuum, Gas, Softened Water, Filtered Water, RO, and DI Water

5 PP – 2xxx Plumbing Piping Large-Scale Partial Plans of Kitchens, Laboratories, Bathrooms, Restrooms, and Other Areas with Dense Plumbing Services and Connections

6 PP – 3xxx Plumbing Piping Riser Diagrams, Sections for Supply and Return Piping

7 PP – 4xxx Plumbing Standard Details (VA-Compliant)

8 PP – 5xxx Plumbing Standard Schedules (VA-Compliant)

9 PP – 6xxx Plumbing Flow Diagrams for Medical Air, Medical Vacuum, and RO Systems

10 PP – 7xxx Plumbing System Control Diagrams, Sequence of Operations, and Points Lists

11 PL – 1xxx Plumbing Waste, Drain, and Vent Piping

12 PL – 2xxx Plumbing Waste, Drain, and Vent Isometrics

Room numbers and names shall be shown on the plumbing plans at every review stage, including schematic submission. Where there is insufficient room on the plan view to show room names, room numbers only may be shown on the plan, with the room number and name tabulated on the drawing.

1-C.1.5 Equipment Schedules

Where used, equipment schedules shall be listed in the following order, vertically, from right to left, to facilitate checking and future reference. The schedules would be placed on the sheet starting at the right edge of the sheet since the drawing set in bound on the left side. Refer to Appendix 1-B for equipment schedule utilization. For each item in a schedule, show the basis of design, including the manufacturer and model number selected.

1 Plumbing Fixture Schedule
2 Water Filter Schedule
3 Water Softener Schedule
4 Domestic Water Thermal Expansion Tank Schedule
5 Plumbing Pump Schedule
6 Plumbing Package Booster Pump Schedule
7 Storage Tank Schedule
8 Electric Water Heater Schedule
9 Gas-Fired Water Heater Schedule
10 Steam to Hot Water Heat Exchanger Schedule
11 Liquid to Liquid Heat Exchanger Schedule
12 Storage Tank with Heat Exchanger Schedule
13 Steam Booster Hot Water Heat Exchanger Schedule
14 Package Reverse Osmosis Schedule
15 Deionization Package Schedule
16 Gas Pressure Regulator Schedule
17 Food Service Steam/Gas Demand Schedule
18 Equipment Connection Schedule
19 Compressor Air System Schedule
20 Vacuum Pump System Schedule
21 Gas Manifold Systems
22 Vibration Isolation Schedule

1-C.1.6 Schematic Level 1 (S1) Submission Requirements

The following describes the submission requirements for schematic level 1 (S1):

(a) Where the following systems are required, obtain diurinal and seasonal water pressure, natural gas information, sanitary sewer disposal information, and storm water sewer and disposal information.

(b) **Code Review, Summary:** Perform a code review summary narrative, including requirements for grease traps and storm water management systems. For most projects, the International Plumbing Code shall be used.

(c) Obtain existing and finished grades on a topographical plan, as well as temporary or intermediate grades used for any purpose.

(d) Obtain soil boring information, including ground water level.

(e) Based on schematic level 1 architectural programming information, create a schematic level S1 fixture count schedule. For specialized fixtures and equipment, obtain maximum instantaneous flow rates. Obtain S1 level maximum instantaneous flow rates for items such as landscaping (if supplied by building water), cooling tower, and mechanical equipment makeup. Calculate the S1 level water supply fixture unit water load and convert it to a gallons per minute (gpm) flow rate.

(f) If required for a direct connection to a municipal water connection and in concert with the project civil engineer, prepare a formal letter to the water utility requesting the following information for the project files:

1. site plan from the utility company showing all water mains adjacent to the site
2. depth of the bury of the water mains based on the datum taken from the site plan
3. static and residual pressure in the water main
4. requirements for location of domestic meter assembly installations
5. requirements for pipe material
6. breakdown of work performed by the utility and any work required by the contractor
7. requirements for backflow preventers
8. minimum depth of bury acceptable for water mains in the jurisdictions

(g) Assess the need for increasing water pressure in the facility and required floor space for any required booster pumping package.

(h) Select meter and backflow preventer assembly locations.

(i) Select oxygen tank location, if required.

(j) Determine whether domestic hot water heat source will be steam or natural gas.

(k) Describe building supply piping pressure zoning design.

(l) Describe the concept for storm sewer system design.

For renovation projects, the plumbing engineer shall submit a narrative describing the existing plumbing utilities and services and making recommendations for replacement or reconditioning of fixtures.

For all projects, conduct a formal meeting with operations staff to determine the capacity for medical center campus medical air, vacuum, and other specialized services.

Prepare a utility study that summarizes the available capacity of all utilities and services required for the project. Interviews and anecdotal evidence shall not form the basis for engineering decision making. Tests shall be conducted to determine available utility capacity.

The utility study should include design decisions for the type of sensor operated faucets, scope of safety showers, eyewash stations, etc. The scope for demolition shall be defined in the study. The status of salvaged equipment, owner furnished equipment, owner installed equipment, pre-purchased equipment, seismic requirements, ADA requirements.

1-C.1.7 Schematic Level 2 (S2) Submission Requirements1

The following describes the submission requirements for schematic level 2 (S2):

1 An updated design narrative that addresses comments from the schematic level 1 (S1)

2 Plumbing floor plans at 1/8 (1:100) scale that indicates room names and number, room function, locations of new and existing plumbing fixtures, and equipment using standard VA fixture numbers

3 Identify zones where acid waste would be installed

1-C.1.8 Design Development Level 1 (DD1) Submission Requirements

The following describes the submission requirements for Design Development level 1 (DD1):

(a) An updated design narrative that addresses comments from the schematic level 2 (S2).

(b) Update design narrative to reflect building programming changes. :

(c) On plumbing plans, identify sources for medical air, gas, and vacuum. :

(d) On plumbing plans, identify riser and stack locations.

(e) On plumbing plans, identify locations where utilities enter building and where sanitary sewer and storm sewer will exit the building.

(f) Prepare discipline coordination document provides the following information to other design team members:

1 Natural gas loads to Civil Engineer

2 Building service water line size and water supply fixture unit totals to Civil Engineer.

3 Building sanitary and storm sewer line size and waste fixture unit totals to Civil Engineer

4 Plumbing equipment electrical requirements to Electrical Engineer

5 Oxygen demand to Medical Center

6 Medical gas and vacuum demand to Medical Center

7 Compressed air demand to Medical Center

8 Space requirements to Architect

9 Available water makeup line location to Mechanical Engineer

10 EMCS point data to Mechanical Engineer

1-C.1.9 Design Development Level 2 (DD2) Submission Requirements

The following describes the submission requirements for Design Development level 2 (DD2):

(a) An updated design narrative that addresses comments from the design development level 1 (DD1).

(b) Update design narrative to reflect building programming changes.

(c) On plumbing plans, update sources for medical air, gas, and vacuum from DD1.

(d) On plumbing plans, update riser and stack locations from DD1.

(e) On plumbing plans, update locations where utilities enter building and where sanitary sewer and storm sewer will exit the building.

(f) Submit equipment calculations and basis of design equipment cut-sheets.

(g) Submit outline specifications with important notes specific to the project.

(h) Submit riser diagrams for domestic (or laboratory) cold, hot, and hot water return piping, medical air, medical gas, medical vacuum, and natural gas. The riser diagrams shall include all fixtures, equipment, and rooms where plumbing fixture and equipment are located.

(i) Submit stack diagrams for waste and vent systems. Distinguish between normal waste and vent and acid waste and vent systems.

1-C.1.10 Construction Document Level 1 (CD1) Submission Requirements

An updated design narrative that addresses comments from the design development level 2 (DD2):

Complete plumbing plans that includes the following data:

1 All piping sized and labeled

2 Completed demolition plans

3 Completed and cross-referenced water supply riser diagrams with room numbers, plumbing fixtures, and equipment identified

4 Legend, notes, and details

5 Final plumbing calculations and narrative

6 Plumbing specifications based upon a redlined set of VA Master Specifications. The redlined set shall clearly identify modifications, deletions, and insertions. All deviations from the master specifications shall be submitted to the VA Authorities for approval with explanations for the deviations

---END OF SECTION---

CHAPTER 2: SCOPE OF PLUMBING DESIGN

2.1 BASIC DESIGN PARAMETERS

The following systems when used or applicable shall be shown on the plumbing drawings.

1 Domestic water, cold, hot, hot water return
2 Laboratory water, cold, hot, hot water return
3 Industrial water, cold, hot, hot water return
4 Sewer/vent/waste inside buildings (5 feet outside of the building)
5 Acid waste and vent systems
6 Acid waste and vent systems
7 Roof drains and drain leaders
8 Reagent water, hemodialysis, and other pure water systems
9 Demineralization (sometimes called deionization) water treatment
10 Natural gas
11 Medical gases
12 Medical vacuum
13 Compressed air
14 Dental air
15 Oral evacuation systems
16 Pool piping
17 Potable water treatment
18 RO water treatment
19 Sub soil drainage (Coordinate with Civil for responsibility)
20 Equipment pads
21 Seismic restraint systems

Additional systems may be required.

Most VA plumbing fixture units for use in waste and vent sizing comply with equivalent water supply and drain fixture units, with a few specific exceptions (see Article 4.1, Plumbing Fixture Schedules).

Investigate whether credit can be obtained from the public utility company for water consumed, but not discharged into the sanitary sewerage system. If credit is available and adequate water pressure is available, provide meters connected to the building energy management and control system for these water consumers. Examples of users are the irrigation system, cooling towers, boiler make-up, and possibly vacuum pumps.

Each building water supply shall be metered and connected to the campus energy management and control system.

2.2 TESTS PRIOR TO DESIGN

During the schematic phase, a testing agency shall be enlisted to conduct a water analysis test and a hydrant test of the two nearest water hydrants. At a minimum, total dissolved solids, static and residual pressures, and a water quality analysis shall be conducted. The paragraphs pertaining to the specialized pure water systems and specifications shall be researched to defined necessary testing parameters.

2.3 NEW SERVICES

Investigate and, if feasible, connect new services to existing; otherwise, provide new services.

2.4 EQUIPMENT PADS

All floor-mounted equipment shall be placed on concrete housekeeping pads.

2.5 PIPING

Plumbing over operating rooms; food preparation, serving and storage areas; and electrical rooms containing main distribution panels or motor control centers shall be avoided where possible. Supply piping over such areas can be made only after approval from the medical center. When piping is necessary in these areas, indicate leakage protection on drawings or in specifications.

Plumbing riser or stack floor (not floor drains) penetration sleeves should extend 2 in [50 mm] above the floor and 1 in [25 mm] below the floor and include a built-in water stop and appropriate seal. All penetrations shall be protected according to the latest edition of the International Building Code.

2.6 PIPE SUPPORT DESIGN

The designer shall be responsible for the design of the plumbing support system so as to prevent strains and stresses that might result in a failure of the system. The contract documents shall indicate all supports and other provisions designed to protect piping from damage resulting from expansion, contraction, structural settlement pipe movement, building movement, etc.

Hubless waste and vent systems shall be supported on both sides of the joint.

2.7 FREEZE CONDITIONS

Where a project is subject to freeze conditions, the designer shall make provisions to protect pipes placed outside of the building, in attics and crawl spaces, or concealed in outside walls with insulation or heat tracing.

Where a project is subject to freeze conditions, horizontal overhead roof drain leaders shall be insulated to prevent condensation from damaging building finishes.

2.8 LEGIONELLA MITIGATION IN VA FACILITIES

2.8.1 Background

Legionella bacterial amplification occurs when bio-films exist in water storage tanks and dead legs which allow for growth sites, and when temperature and pH levels are optimal for growth. Infection is thought to occur when patients inhale atomized droplets while showering, drinking, or receiving respiratory treatment.

In spite of the fact that there are no EPA rules governing the levels of Legionella bacteria in potable water systems, experts believe these systems are a highly probable source of nosocomial Legionella infection. Municipal water supplies and wells will carry Legionella; therefore, the bacteria will be introduced into the hospital potable water system. The challenge is to limit the amplification of the bacteria from obtaining lethal levels.

The VA has published two directives regarding domestic hot water temperature limits and Prevention of Legionella. VHA Directive 2008-010*, PREVENTION OF LEGIONEELA DISEASE*, and VHA Directive 2009-009, *DOMESTIC HOT WATER TEMPERATURE LIMITS FOR LEGIONELLA PREVENTION AND SCALD CONTROL*, define policy for domestic hot water temperature limits and Legionella prevention and the effects and requirements on the operation and design of plumbing equipment and systems.

Transplant and patient care facilities where at least five post transplant patients per year are cared for within three months of the transplant procedure shall have plumbing design capable of thermal eradication, copper/silver ionization, thermal eradication, ozone, ultraviolet light, or a combination of the above eradication methods permanently installed and the space for such equipment programmed.

Other high risk patient populations such as intensive care or cardiac surgery suites shall be evaluated at the Schematic Design Level 1 Phase on a case by case basis for a permanent Legionella disinfection system. At a minimum, these instances shall have provisions built into the plumbing system that allows for a future copper/silver ionization system connection.

The preferred design for VA facilities is a copper/silver eradication system. Other options that can be explored are thermal eradication, ozone, ultraviolet light, and chlorine dioxide. The least desirable eradication methods are chlorine and mono-chloramines injection systems. Chloramines and mono-chloramines injection systems can be approved only with the written approval of the medical center.

2.8.2 Disinfection Methods (see ASHRAE paper CH-03-3-2 for details)

Tthe plumbing water treatment, pipe flushing, water quality testing, and chlorination specifications may need to be expanded to include Legionella mitigation in the scope of work.

The following disinfection methods shall be reviewed for transplant care facilities. The disinfection methods have been ranked from the most preferred to the least preferred methods.

1 **Copper/Silver ionization**: effective when introduced in concentrations of .2 to .4 ppm. Water must be circulated past ionizer. If this system is selected, the plumbing designer shall design and select the necessary equipment and associated piping and controls and provide the space for the equipment.

2 **Thermal eradication**: requires potable water in the system to be raised to 170-145° F [77-63° C] and flushed through all outlets for 30 minutes. See the section on Piping design guidelines for Legionella mitigation below.

3. **Chlorine Dioxide**: a gas produced by reaction of chlorine gas and sodium chlorite. If this system is selected, the plumbing designer shall design and select the necessary equipment and associated piping and controls and provide the space for the equipment

4 **Ozone:** effective in concentrations dictated by the EPA. If this system is selected, the plumbing designer shall design and select the necessary equipment and associated piping and controls and provide the space for the equipment.

5 **Ultraviolet light:** effective where suspended solids are less than 60 ppm. Water must be circulated past light source. If this system is selected, the plumbing designer shall design and select the necessary equipment and associated piping and controls and provide the space for the equipment

6 **Chlorine**: effective when introduced at concentrations of 2 to 4 ppm and circulated throughout the system. This form of eradication is the least desirable from a facility standpoint. Designing a chlorine injection system shall be installed only upon the approval of the medical center and shall be used only in a temporary basis not lasting more than a period of 30 days for emergency eradication

7 **Mono-chloramines**: produced by a molecular combination ratio of chlorine and ammonia and circulated throughout. This is considered a temporary measure.

2.9 PIPING DESIGN GUIDELINES FOR LEGIONELLA MITIGATION DESIGN AND HIGH RISK PATIENT WARDS

The following design practices shall be followed for all high risk patient care facilities (high risk patients include organ transplant, immune deficient patients, cardiac and other high risk operation and recovery).

(a) Provide access for whatever treatment method is employed. Provide access to clean the interior of all water storage tanks. Provide a means to flush all lines through outlets.

(b) The domestic hot water supply mains shall run directly over the lavatories, showers, and other plumbing fixtures requiring hot water. Dropping the domestic hot water branch for the fixture in the plumbing chase or wall cavity and providing a domestic hot water return line connection with circuit setter or similar flow control device to ensure water is always circulating is one preferred method for minimizing dead-legs in pipe systems.

(c) Provide means to easily remove and disinfect all outlet devices, such as showerheads, Aerators shall not be used. Utilize self-draining showerheads, constructed from metal. Plastic showerhead components shall not be allowed.

(d) Plastic hoses shall NOT be used for any purpose in domestic cold, hot and hot water return lines. Copper or chrome plated brass hoses shall be used to connect to such equipment as laboratory equipment.

(e) Mix hot/cold water as near the showerhead as possible.

(f) The need to circulate the domestic cold water supply shall be evaluated at the schematic phase. Legionella can propagate in temperatures exceeding 68° F [20° C]. If the domestic cold water supply cannot be maintained at temperatures lower that 68° F [20° C], the domestic cold water return shall have a recirculation line that is piped back to the storage tank.

(g) Minimize plumbing supply pipe dead-legs. A dead-leg is a length of pipe with one end open to the system and the other end terminating at a cap, closed valve or fitting, or a plumbing fixture. The maximum dead-leg pipe length, including the line to a plumbing fixture, is limited to 10 feet.

(h) Control potable water temperatures to < 68° F [20° C] or > 130° F [54° C]. The minimum temperature at any fixture is 120° F [49° C]. See VHA Directive 2009-009, *DOMESTIC HOT WATER TEMPERATURE LIMITS FOR LEGIONELLA PREVENTION AND SCALD CONTROL*.

(i) See Article 4.1, Plumbing Fixtures for faucet and showerhead material requirements.

(j) If thermal eradication method is selected, provide a means to heat and flush all branch lines. The plumbing domestic hot water booster heaters need to be sized to handle the increased temperature rise for thermal treatment and need to be located near the high risk patient ward

2.10 INSPECTIONS AND WITNESS OF TESTS

The inspection plan needs the approval of the medical center. Frequency and requirements for inspections and testing must be added to the construction documents. Regarding inspections and test witnessing, the plumbing drawings and specifications shall coordinate with the Veterans Affairs Manual on Systems Commissioning and the project's commissioning specifications.

2.11 SPECIAL EQUIPMENT

2.11.1 Dialysis Machines

Dialysis machines shall be provided a special dialysis wall box with indirect waste, funnel drain type floor drain, floor sink, and cold water hose bib with vacuum breaker. Dialysis water system shall be protected by a reduced pressure backflow preventer located between the potable water system and the input to the pretreatment components of the dialysis water system.

2.11.2 Heart and Lung Machines

Heart and lung machines shall be provided a funnel type drain. If the apparatus is located in the operating room, an indirect waste is required.

2.11.3 Producing Distilled Water

Stills for producing distilled water shall be provided with a cold water connection with a vacuum breaker and floor sinks or funnel drains.

2.11.4 Sterilizers

Sterilizers shall be provided an acid-resistant floor sink or funnel type floor drain, a backflow-protected water supply and steam and condensate connections.

2.11.5 Film Processing Areas

Film processing areas shall be provided an acid-resistant floor sink or funnel drains for indirect waste; and a hot, cold, and/or tempered water supply operating between 40° F and 90° F (4.4° C and 32.2° C). Brass or copper drain piping is not allowed for photo-developing equipment. Polypropylene, high silica cast iron, corrosion-resistant piping and drains are the only options.

2.11.6 Chemical Fume Hoods

The plumbing drawings shall indicate in schedule format the cold and hot water, vacuum, compressed air, natural gas, chemical drain and vent, and medical vacuum and gases connections for chemical fume hoods. The plumbing plans shall show fume hood equipment and connections and shall cross-reference the scheduled data and equipment drawings.

2.11.7 Kitchen Equipment

The plumbing drawings shall indicate in schedule format the natural gas, steam, condensate, cold and hot water, drain, indirect drain, and vent connections for kitchen equipment. The plumbing plans shall show kitchen equipment and connections in 1 in equals 1 ft [1:10] dimensional format and shall cross-reference the scheduled data and equipment drawings. The plumbing designer shall coordinate connections with the equipment supplier.

2.12 SEISMIC REQUIREMENTS

2.12.1 General

Earthquake-resistive design for plumbing equipment and piping shall comply with the requirements of VA Publication H-18-8, ASCE-7, SMACNA Seismic Restraint Manual, and the International Building Code (IBC).

Structures assigned to Seismic Design Category C,D, E, or F, permanent non-structural components and their attachments, and the structure-supported attachments of permanent equipment shall be designed to resist total design forces prescribed in ASCE-7 and as modified by this document. Categories C, D, E, and F are defined in ASCE-7.

2.12.2 Exceptions

Seismic restraint may be omitted for the following installations:

(a) Gas and medical air piping less than 1 in [25 mm] inside diameter.

(b) Piping in boiler and mechanical equipment rooms less than 1.25 in [32 mm].

(c) All other plumbing piping less than 2.5 in [64 mm], except for medical air and oxygen.

(d) Plumbing equipment weighing less than 400 pounds [180 KG] supported and attached directly on the floor.

(e) Plumbing equipment weighing less than 20 pounds [9 KG] suspended from the roof or floor, or hung/supported from the wall.

2.12.3 Conformance With SMACNA

SMACNA does not cover all conditions, including items such as providing bracing details for seismic restraint of equipment, details of flexible joints when crossing seismic or expansion joints, or bracing of in-line equipment, etc. Also, in locations of very high seismicity, listed in H-18-8, SMACNA details should be used with special care. Although SMACNA lists conditions under which seismic bracing may be omitted, the A/E may revoke these omissions on an individual project basis.

2.12.4 Calculations

Unless otherwise shown by SMACNA, provide required details and structural calculations to completely address seismic bracing requirements. Unless otherwise shown by SMACNA, provide detailed structural calculations for VA's review and approval on the design of hangers, supports, anchor bolts, welds, and connections. Show sizes, spacing, and length of securing equipment, piping, and ductwork to structural members. The design calculations shall be prepared and certified by a registered structural engineer.

2.13 DRAWINGS

2.13.1 General

Where SMACNA details are incomplete or not applicable, provide necessary seismic restraint details. Coordinate mechanical, architectural, and structural work.

2.13.2 Piping Plans and Sections

Show locations of required restraints with reference to SMACNA or special restraint details, whichever is applicable.

2.13.3 Equipment Restraints

Provide special details (not covered by SMACNA), where required. Provide special attention to the seismic provision for the suspended equipment.

2.14 PLUMBING COMMISSIONING PLAN

Plumbing systems shall be integrated into the commissioning plan. The commissioning plan shall define:

(a) Pressure test procedures for all pipe systems

(b) Shower or bathroom basin leakage tests

(c) Plumbing fixture carrier installation

(d) Plumbing fixture flow rate adjustment

(e) System chlorination and flush

(f) Booster pump package

(g) Domestic, laboratory, and industrial hot water systems

(h) Domestic, laboratory, and industrial hot water heater circulating pumps

(i) Thermostatic mixing valves

(j) Vacuum system

(k) Medical air system

(l) Laboratory air system

(m) Compressed gas system

(n) Oral evacuation system

(o) Dental compressed air system

(p) Natural gas and fuel system

(q) Pure water systems

(r) Perchloric acid hood automatic wash down system

(s) Kitchen hood automatic wash down system

2.15 CONTRACT DRAWINGS

2.15.1 General

(a) Show plumbing work on drawings using a minimum scale of 1:100 (1/8" = 1' 0"). Exceptions shall be indicated at a scale of 1:50 (1/4" = 1' 0").

(b) Plumbing design and plumbing seismic design shall only be indicated on "PL-Series drawings (see VHA National CAD Standard Application Guide).

(c) Piping shall be shown on the same plan as the fixtures being served

(d) Pipe size shall be indicated on both floor plan and riser diagrams.

(e) Identify rooms on plans with name and number

(f) The following shall be indicated on the plumbing drawings:

i. Show drainage area in square meters for each roof drain and totals for building at outside building wall.

ii. Show fixture unit count at base of each soil and waste stack and for each sanitary sewer at outside building wall.

iii. Show inverts elevations for all sewers at outside building wall.

iv. Show dimension from adjacent column line to sanitary and building service water at building entrance. This dimension must then be coordinated with site utilities.

v. Show centerline elevation for all pressure systems at outside building wall.

vi. Show floor elevation at each level. Show public sewer rim elevation of nearest upstream manhole.

2.15.2 Plumbing Fixture Numbers

Identify on the plumbing drawings all equipment requiring connections to the plumbing systems by appropriate symbol number (example, P-103). Do not use the designation N.I.C. on the drawings.

2.15.3 Cross Sections

Due to the space requirements of plumbing systems and ductwork, closely coordinate the layout of these systems. Where areas of interference are apparent, prepare cross sections resolving utility conflicts.

2.15.4 Stack and Riser Diagrams

Provide diagrams for the following systems installed within the buildings: soil, waste and vent; reagent grade water; cold water; hot water; hot water return; medical gas and vacuum; medical gas and vacuum alarms; medical gas low voltage wiring; laboratory gas and vacuum; laboratory gas and vacuum alarms; fuel gas; storm water; and oral evacuation systems.

Riser diagrams for these systems: water, natural gas, medical gases, medical vacuum, and dental systems may be shown in Plan view and two-dimensional plumbing pipe riser representation showing relative vertical position. Sanitary and acid waste and vent systems shall be shown in isometric projection. Show story heights, size of all horizontal and vertical piping, fixture numbers being served, room locations, and means of connection between fixtures and the stacks and mains. Show each system complete and continuous.

2.16 EQUIPMENT SCHEDULES

Provide plumbing schedules, including capacity, control settings, services, and sizes for all plumbing equipment and other equipment requiring plumbing services. The plumbing schedules shall be organized on the construction documents in the following order:

(a) Plumbing Fixture Schedule

(b) Water Filter Schedule

(c) Water Softener Schedule

(d) Domestic Water Thermal Expansion Tank Schedule

(e) Plumbing Pump Schedule

(f) Plumbing Package Booster Pump Schedule

(g) Storage Tank Schedule

(h) Electric Water Heater Schedule

(i) Gas Fired Water Heater Schedule

(j) Steam to Hot Water Heat Exchanger Schedule

(k) Liquid to Liquid Heat Exchanger Schedule

(l) Storage Tank with Heat Exchanger Schedule

(m) Steam Booster Hot Water Heat Exchanger Schedule

(n) Package Reverse Osmosis System Schedule

(o) Deionization Package Schedule

(p) Gas Pressure Regulator Schedule

(q) Food Service Steam/Gas Demand Schedule

(r) Equipment Connection Schedule

(s) Compressed Air System Schedule

(t) Vacuum Pump System Schedule

(u) Gas Manifold Systems

(v) Vibration Isolation Schedule

The plumbing designer shall follow the schedule drawing format and organization as defined in this manual.

2.17 INTERDISCIPLINE COORDINATION

The plumbing designer shall coordinate the following:

(a) Building plumbing fixture count

(b) Plumbing chase wall inside dimension and construction type for adequate water closet carrier clearances

(c) Plumbing fixture heights and clearances, especially for ADA accessibility

(d) Access doors shown on plans for water hammer arrestors, valves, and vents

(e) Shower pan construction (solid surface or tile)

(f) Fire-stopping for plastic pipe and other piping systems

(g) Floor drains and supply connections for mechanical equipment

(h) Fire protection drains

(i) Electrical power requirements for plumbing equipment

(j) Interface with energy management and control systems

2.18 CALCULATIONS AND REVIEW SUBMITTALS

Plumbing engineering calculations shall be submitted at various stages in the submission process. Refer to the submission requirements for what shall be submitted at each stage. Submit calculations required under the contract and submission requirements to include the following systems and equipment:

Binder Divisions	Submission Requirements
Tab 1	Building service water pipe size calculations. Peak building water demand calculation.
Tab 2	Pressure zone design calculations.
Tab 3	Cold water (potable, laboratory, and industrial) pipe size calculations.
Tab 4	Hot water pipe size calculations.
Tab 5	Water softening equipment demand and pipe size calculations. Basis of design equipment selection, cut-sheets.
Tab 6	Reverse osmosis equipment demand and pipe size calculations. Basis of design equipment selection, cut-sheets.
Tab 7	Water demineralization (deionization equipment demand calculations.
Tab 8	Hot water re-circulating and boosters pump size calculation. Pump basis of design cut-sheet and pump curves.
Tab 9	Hot water generation calculations, heat exchanger equipment size calculations, and hot water storage calculations. Hot water generation and heat exchanger equipment cut-sheets and basis of design.
Tab 10	Thermal expansion, hot water storage, and pure water buffer tank size calculations.
Tab 11	Booster heater demand calculations for areas such as Dietetics. Basis of design hot water generation and heat exchanger equipment selection cut-sheets.
Tab 12	Therapeutic pool (filtering and heating demand calculations).
Tab 13	Soil, waste, and vent pipe size calculations.
Tab 14	Storm drainage pipe sizing calculations with roof or drainage areas identified.
Tab 15	Grease, hair, oil interceptor size calculations. Interceptor basis of design equipment selection and cut-sheets.
Tab 16	Sump pump system design calculations, sump basis of design equipment selection and cut-sheets.
Tab 17	Fuel gas pipe sizing.

Binder Divisions	Submission Requirements
Tab 18	Medical vacuum demand, pipe size, and equipment size calculations. Medical vacuum basis of design equipment selection, cut-sheets.
Tab 19	Medical air demand, pipe size, and equipment size calculations. Medical air basis of design equipment selection, cut-sheets.
Tab 20	Oxygen storage demand and pipe size calculations.
Tab 21	Shop and lab compressed air pipe size calculations. Air compressor basis of design equipment selection, cut-sheets.
Tab 22	Shop and lab vacuum pipe size calculations. Vacuum pump basis of design equipment selection, cut-sheets.
Tab 23	Nitrogen and other compressed gas storage demand and pipe size calculations.
Tab 24	Nitrous oxide pipe size calculations.
Tab 25	Oral evacuation and dental system calculations, basis of design equipment selection, cut-sheets.
Tab 26	Silver recovery piping.

Provide submittal showing recommendation regarding the necessity for installing insulation on the domestic water and horizontal storm drainage piping for the prevention of condensation.

Provide a water quality report showing water analysis, including pH, total hardness as CaCO3, total dissolved solids, and alkalinity. This water quality report shall also identify recommended water treatment design concepts for specialized demands such as building humidification, dialysis, and other needs.

2.19 PLUMBING FOR BIOLOGICAL SAFETY LEVEL 3 LABORATORIES

(a) All laboratory valves, gas cylinder manifold stations, vacuum system filters, and other plumbing 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 from the laboratory and not 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 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 a valve bypass prior as close as possible to the laboratory. Some 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 the 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 a 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.

2.20 PLUMBING FOR ANIMAL CARE (VIVARIUM) FACILITIES

(a) A floor or trench drain with an automatic water system shall be provided for large animal rooms. Holding rooms designed to accommodate fishtanks and/or rodent swim tanks shall be provided with a wall hydrant.

(b) Both potable and non-potable (industrial) water systems shall be provided. Backflow preventers shall be installed on the industrial water to protect the potable water supply.

(c) The minimum pressure at the farthest plumbing fixture is 35 psig (240 kPa). A pressure-reducing valve shall limit maximum pressure at any plumbing fixture to 60 psig (420 kPa). All water fittings shall be equipped with vacuum breakers.

(d) Potable water shall connect to all non-animal plumbing fixtures, emergency showers, and eye washers.

(e) The designer shall investigate the animal watering requirements for the facility. Unless directed otherwise, the minimum level of water treatment shall be done using a reverse osmosis process. Other treatment requirements may include ultraviolet (UV) sterilized, chlorination, and acidification processes.

(f) Oxygen, medical vacuum, and medical air shall be provided for the vivarium exam, treatment, and preparation rooms. Vivarium surgery rooms shall have oxygen, medical vacuum, medical air, nitrous oxide, and nitrogen. Necropsy shall be provided with oxygen and laboratory air.

2.21 HEMODIALYSIS WATER DISTRIBUTION SYSTEM DESIGN

2.21.1 General

It is critical that the water distribution system for hemodialysis meet the water quality guidelines of the Association for the Advancement of Medical Instrumentation (AAMI) found in ANSI/AAMI RD62. During the design process, the plumbing designer must coordinate with the medical center and the medical director for the hemodialysis unit.

2.21.2 Hemodialysis Water Treatment System Description

(a) The incoming water supply temperature for dialysis treatment shall be elevated to a minimum temperature of 77° F [25° C]. The thermostatic mixing valve shall have a thermometer, normally closed bypass valve, and be accessible for maintenance and daily monitoring of supply temperature.

(b) Downstream of the thermostatic mixing valve, the water supply shall be protected by a reduced pressure backflow prevention device.

(c) A duplex booster pump package with lead/lag sequence control function may be necessary to maintain minimum supply pressure. This booster pump shall be controlled by a pressure switch.

(d) A water analysis may require an acid injection system to lower water pH level and maintain a pH level between 7.0 and 8.0. The acid injection system, if required, shall be placed upstream of the multi-media filtration equipment.

(e) After the backflow prevention device and booster pump package, the water shall enter a multi-media filtration system to remove particulate matter.

(f) Once the multi-media filtration equipment removes the fine particulate, the water shall pass through a water softener to reduce hardness and prolong life of the reverse osmosis membrane that is located further downstream.

(g) Upon leaving the multi-media filtration equipment, the water shall pass through primary and polishing carbon filters to remove chlorine and chloramines from the water.

(h) After the carbon filters, the water shall be treated by a reverse osmosis (RO) package and delivered into a RO buffer tank. A low level condition at the buffer tank shall engage the RO equipment to fill the tank to the high level position.

(i) A pure water re-circulating pump shall draw water from the tank and through an ultra-filtration system that includes ultra-violet (UV) light disinfection system to destroy and remove the remaining bacteria.

2.21.3 Hemodialysis Water Treatment System Monitoring

The hemodialysis water treatment equipment shall be installed to facilitate daily monitoring of equipment and alarm status. Some water quality parameters shall be monitored at the start of each shift. The following points shall be monitored:

Equipment	Local Monitoring	Remote monitoring
Reduced pressure backflow preventer	Pressure drop, local inlet and outlet pressure gauges	
Thermostatic mixing valve	Local thermometer	
Acid feed system	pH level local indicator	Remote pH level indication at EMCS
Multimedia filtration package	Pressure drop, local inlet and outlet pressure gauges	High pressure drop alarm
Water softener	Hardness level and salt level	Equipment status
Primary and polishing carbon tanks	Local indication of chlorine and chloramines levels, local alarm indication	Remote indication of chlorine and chloramines levels
Reverse osmosis package	Local indication of equipment status	Remote indication of equipment status
Deionizer/demineralizer package	Pressure drop, local inlet and outlet pressure gauges across each tank, equipment status	Remote indication of equipment status

2.22 PHARMACY PLUMBING REQUIREMENTS

(a) Floor drains and floor sinks shall not be installed in Pharmacy clean rooms.

(b) A foot, elbow, or automatically operated sink for hand washing shall be located near the exit door of the anteroom. The controls shall have battery backup or be placed on emergency power.

---END OF SECTION---

CHAPTER 3: PLUMBING SYSTEMS AND EQUIPMENT

3.1 PLUMBING FIXTURES

3.1.1 General

(a) At the schematic design stage, review the design and equipment guides located in the Technical Information Library (TIL) for pertinent requirements for sensor-operated faucets. In lavatories where infection control is of primary concern, sensor-operated faucets are required. The faucet timing shall be sufficient to deliver water at a temperature range between 85° F [30° C] and 102° F [39° C]. The faucet spout shall be gooseneck style to allow for fingers-up rinsing. The sensor-operated faucets shall be electrically hardwired and on emergency power.

(b) Aerators shall be not specified.

(c) Plumbing fixtures with the flow rates defined in the following table are allowed for VA projects. Low flow fixtures must be used in order to meet the minimum sustainable design requirements.

1.	Commercial water closet	1.6 gallons per flush
2.	Dual flush water closet	1.6 gallons per flush or 0.8 gallons per flush
3.	Low flow water closet	1.1 gallons per flush
4.	Commercial urinal	1.0 gallons per flush
5.	Low flow urinal	0.5 gallons per flush
6.	Commercial public lavatory	2.5 gallons per minute
7.	Private patient room lavatory	0.8 to 1.5 gallons per minute
8.	Clinical sink	2.5 gallons per minute
9.	Other sink	2.5 gallons per minute

(d) Plumbing fixture numbers, description, fixture units, and minimum branch sizes are indicated in Article 4.1, Plumbing Fixture Schedules.

(e) Plumbing fixtures shall be located where indicated by VA Program Guide 7610, Equipment Guide List, and other programming design guides. In addition to the locations indicated in Program Guide 7610, emergency showers and eye/face wash fixtures shall be provided in laundries (near exterior filling pipes for liquid supply storage tanks and at exterior central liquid supply area); pesticide storage and mixing areas; and other areas where hazardous chemicals are used, such as boiler rooms, cooling towers, and some water treatment areas.

(f) Faucets shall have a laminar flow device of brass, monel metal, or stainless steel trim. Showerhead internal construction shall be of brass, monel metal, or stainless steel.

(g) Hand-free controls (foot or knee operated) shall be employed for staff use and for scrub-up sinks, BSL-3 laboratories, and Pharmacy clean rooms, among other functions.

(h) Emergency eyewash or combination eyewash and shower stations shall meet ANSI Z358.1, Plumbing Fixtures (Shower Bath and Emergency Eye and Face Wash Guidelines). Water supply shall be delivered within the temperature range of 60° F [16° C] and 100° F [38° C]. If a waste pipe is available within five feet of a floor drain, provide a floor drain adjacent to the combination eyewash shower station.

(i) Where required to meet the 20% water use reduction requirement waterless urinals may be used after approval by the VA authorities. The baseline used to calculate water use reduction is EPACT 1992

3.1.2 Bariatric Plumbing Fixtures

(a) For public or private bathrooms fixtures intended to serve bariatric patients, the water closet and water closet carrier shall be designed to carry a patient weighing 1,000 pounds [454 Kilos].

(b) The bariatric water closet shall comply with ASME/ANSI A112.12.2M and be rated for 1,000 pounds [454 Kilos] when tested in accordance with ASME/ANSI A112.12.2M.

(c) The bariatric water closet shall be identified by its own fixture (P-#) number. The drawing shall have an installation note that identifies the bariatric water closet and alerts the contractor to the special fastening and installation requirements.

(d) It is recommended that space on both sides of the fixture shall be 21 in [533 mm] between the wall and the fixture for staff to assist the patient.

(e) Lavatories shall not be installed within 6 ft [1.8 m] of a bariatric water closet.

3.1.3 Plumbing Fixture Schedules

See Article 4.1, Plumbing Fixture Schedules, for fixture units and minimum fixture branch sizes.

3.2 WATER DISTRIBUTION SYSTEMS

3.2.1 Water Hammer Arrestors

Size the piping for the hot and cold water systems not to exceed the maximum velocity allowed by the International Plumbing Code, latest edition. Provide necessary water hammer arrestors in accordance with the American Society of Sanitary Engineers Standard 1010, Water Hammer Arrestors. Size and locate arrestors per Plumbing Drainage Institute (PDI) Standard PDI-WH 201, Water Hammer Arrestors, latest edition, requirements. Show quantity and type of water hammer arrestors on plans and riser diagrams. Water hammer arrestors shall be installed with inlet isolation valves.

3.2.2 Trap Primers

All floor drains and floor sinks shall have a single or manifold electronic trap primer supply. The trap primer control box shall be recessed. Traps located 50 ft [15 m] from the control box shall be piped to that control box unless shown otherwise on the construction documents.

3.2.3 Wall Hydrants

Provide wall hydrants a maximum of 200 ft [60 m] apart at loading docks and at building entrances, with a minimum of one wall hydrant on each exterior wall.

3.2.4 Minimum Pressure

Maintain a minimum pressure of 35 psi (240 kPa) at the highest plumbing fixtures. In minimum pressure calculations, use residual pressure at design flow. Monitor for diurnal pressure fluctuations experienced by the building water supply and modify starting pressures accordingly. Provide a pressure gauge on the top floor branch adjacent to the riser.

3.2.5 Coordination

Coordinate electrical supply to electronic faucets and flush valves.

3.2.6 Solenoid Valve

Provide a solenoid valve on cold water supply to the dental utility junction centers with a control switch located in the reception area.

3.2.7 Backflow Preventer

Provide cold water connection and/or treated water with a backflow preventer to the controlled temperature room humidification system.

All laboratory and industrial water systems shall have a reduced pressure backflow prevention device installed.

There shall be a reduced pressure backflow prevention device on the water supply to all pure water systems, hemodialysis, and reagent water distribution systems.

3.2.8 Minimize the Use of Pressure-Reducing Valves

Minimize the use of pressure-reducing valves by providing separate domestic hot water heating systems for each pressure zone.

3.3 HOT WATER BRANCH LINES

Provide a means to “heat and flush” the domestic hot water branch lines by providing a ¾ in [20 mm] drain and shut off valve extended to a floor sink.

3.4 DOMESTIC WATER BOOSTER SYSTEM

3.4.1 Hospital Buildings

(a) Use a three-pump system.

(b) Size one pump for approximately one-third of the total water demand.

(c) Each of the other pumps shall be sized for approximately two-thirds of the total demand.

(d) Each of the smaller pumps will operate until water demand exceeds the pump’s capacity, at which point that pump shall stop and one of the other larger pumps shall start.

(e) When the demand exceeds the capacity of the larger pump, the smaller pump shall restart and both pumps shall operate together.

(f) The other large pump shall be a standby and alternate with the first large pump.

(g) Provide a pneumatic tank and "NO-FLOW" shutdown controls.

(h) Provide emergency power.

(i) Discharge pressure shall be controlled using PWM-based variable frequency drives through a packaged booster pump controller.

(j) Install a hydro-pneumatic tank on the booster system discharge.

(k) Use spring-loaded swing check valves on pump discharge.

(l) The domestic water booster pump package shall be on emergency power.

3.4.2 Other Buildings

Use a two pump system. Size each pump for 75% of the total water demand. Pumps shall alternate. When the demand exceeds the capacity of one pump, both pumps shall operate. Provide a pneumatic tank and "NO-FLOW" shutdown controls. Provide emergency power.

3.5 DOMESTIC HOT WATER SYSTEMS

3.5.1 Buildings Housing Patients, Research Buildings, and Ambulatory Care

3.5.1.1 Entire Building

Provide duplex shell and tube central water heaters with the capacity of generating the flow demand at 160° F [71° C] with each heater sized to supply 100% of demand. However, the heater discharge temperature shall be set at 145° F [63° C]. Provide a water temperature alarm system on heater discharge or where water enters the piping system. Temperature limit stop of type T/P combination temperature and pressure balancing valves shall be set at 105° F [40° C] at shower head. The use of plate and frame heat exchangers will be considered by the medical center. Use a re-circulating system.

3.5.1.2 Dietetic Equipment

Provide duplex shell and steam coil booster heaters to generate the flow demand at 160° F [71° C] with each heater sized to supply 50% of demand. The use of plate and frame heat exchangers will be considered by the medical center. Use a re-circulating system.

3.5.1.3 Hydrotherapy Equipment

Provide simplex shell and tube booster heater capable of 160° F [71° C] at point of use. The use of plate and frame heat exchangers will be considered by the medical center.

3.5.1.4 Exception

Heaters serving non-patient care areas can be sized for 75% of peak demand in a duplex arrangement.

3.5.2 Laundries

Laundry equipment heaters are designed and provided by separate contract (VA will furnish and install in conjunction with laundry equipment). The remainder of the laundry building shall be served with a simplex heater as described in Article 3.4.2, Other Buildings.

3.5.3 Other Buildings

Provide simplex shell and tube steam, electrical or gas central heater with the capacity of generating the flow demand at 160° F [71° C]. However, heater discharge shall be 145° F [63° C]. The use of plate and frame heat exchangers will be considered by the medical center. Consider Legionnaires disease, energy consumption, and initial cost when selecting a circulating system. For buildings of less than 15,000 sq ft [4572 sq m] with no shower facilities, provide electric instantaneous hot water heaters instead of shell and tube central heaters.

3.5.4 Therapeutic Pools

See Article 3.15, Therapeutic Pool Equipment.

3.5.5 Size Heaters

Size each heater based on the modified Hunter's Curve (Hot and Cold Water Section or other approved method contained in the ASHRAE Handbook, Applications, Service Water Heating or American Society of Plumbing Engineers, Volume 2 Data Book, Plumbing Systems, Domestic Water Heating Systems). Plumbing fixture unit counts are indicated in Article 4.1, Plumbing Fixture Schedules. Special equipment demands such as dishwashers, sterilizers, and laboratory glass washers must be added to the water heater load at 100% diversity.

Where required for thermal treatment of plumbing systems, include thermal flushing at an elevated temperature of 180 degrees F in the heater sizing calculations.

3.5.6 Hot Water Supply and Return Lines

Size the hot water supply and return lines by the heat loss method as outlined in the ASHRAE Applications Handbook, Service Water Heating or American Society of Plumbing Engineers, Volume 2 Data Book, Plumbing Systems, Domestic Water Heating Systems. The system heat loss shall not exceed 10° F [6° C]. Insulation thickness shall be governed by ASHRAE 90.1-2007. Insulation thickness and re-circulating pump size shall also be selected in order to limit the domestic hot water system temperature loss to 10° F [6° C].

Pipe distribution system “dead ends” (“dead legs”) shall be minimized. Maximum length for deadlegs is 5 feet unless terminated at a plumbing fixture.

3.5.7 Shut-Off and Balancing Valves

Provide a separate shut-off valve and balancing device with a Pete’s plug for inserting a thermometer well in the hot water return circulating lines at the point of connection with the domestic hot water distribution system. Provide notes to the water balance agency to set flow to 1 gpm [3.79 liters/min] for every 30 water supply fixture units served by that return branch. This balancing valve shall be a circuit setter.

3.5.8 Heat Traps

Install heat traps (either valve type or loops) on the cold water makeup inlet and outlet connection of all hot water storage tanks.

3.6 DEVICE CALIBRATION

Provide Pete’s plugs for access at all temperature and pressure indicating devices, where analog (gauges and thermometers) and digital (sensors for the EMCS system) devices are used.

3.7 ELECTRIC WATER COOLERS

Provide wall-hung, self-contained, electric, wheelchair-accessible water coolers. Provide dual hi-low units in areas where only one unit is provided.

Centralized drinking water cooling systems are not allowed for new construction or major renovation projects. Replace the centralized drinking water fountains with self contained electric water coolers whenever the opportunity exists. Existing centralized drinking water cooling systems should be decommissioned and replaced with de-centralized electric water coolers.

3.8 SANITARY AND AREA/ROOF DRAINAGE SYSTEMS

3.8.1 Pipe Design

Sanitary pipe design slope in accordance with International Plumbing Code, IPC Table 710.1(1).

3.8.2 Floor Drains

Floor drains shall not be installed in private or individual toilet rooms with a single water closet. Provide floor drains with trap primers in public toilet rooms containing two or more water closets or a combination of one water closet and one urinal.

Instead of trap primers, under special circumstances and with approval from the office of Construction and Facility Maintenance and the medical center, hose bibs may replace trap primers on floor drains.

In all cases, floor drains are to be installed in bathrooms with shower fixtures.

3.8.3 Fixture Units and Waste/Vent

See Article 4.1, Plumbing Fixture Schedules, for fixture units and waste/vent minimum fixture branch sizes.

3.8.4 Sanitary and Storm Connections

Provide an adequate number of sanitary and storm connections from a building. Design each sanitary sewer connection not to exceed 12 in [300 mm] diameter and provide at least two connections from each building with the following exception: one sewer is adequate for a building that can be served by a 6 in [150 mm] or less diameter pipe. Maximum allowable size for storm drain is 12 in [300 mm]. Storm frequency shall be based upon the local International Plumbing Code.

3.8.5 Grease Removal System

Kitchen waste shall be provided with a grease removal system. Kitchen sanitary and vent shall be cast iron piping.

3.8.6 Outside Building Sub-Soil Drain Tile

Sumps and associated pumps serving outside building sub-soil drain tile to an interior sump pump, if required, shall be located outside of the building with sufficient service clearance.

3.8.7 Chemical-Resistant Pipe

Provide chemical-resistant pipe for all waste and vent piping serving laboratory fixtures and photographic developing equipment. When fusion joint plastic piping systems are used, mechanical joints shall be installed at traps and trap arms for maintenance reasons. Chemical drainage shall pass through an acid-neutralizing tank before connecting to the building sanitary drainage system. Install chemical-resistant vent pipe independently through the roof.

3.8.8 Reduced-Pressure Backflow Preventers

Where reduced pressure backflow preventers are required, provide positive drainage to a floor sink or sump capable of handling peak discharge flow.

3.8.9 Cast Iron Piping

Cast iron is the preferred material for sanitary and vent piping. With written approval from the VA Authorities, solid core PVC can be used in low temperature, horizontal, buried soil and waste pipe in buildings under 15,000 sq ft [4572 sq m]. Switch to cast iron above grade.

3.8.10 Cleanouts

Show and identify the type of cleanouts on the plans and stack and riser diagrams. Cleanouts shall be extended to the floor where the fixture(s) served are located. For example, extend a cleanout serving a floor drain to the same floor level of the drain. Do not locate cleanouts above ceilings or in crawl spaces. In addition

to the requirements of the International Plumbing Code, provide a cleanout at the top and bottom of all waste and soil stacks, install “end of run” cleanouts for a group of fixtures. Cleanouts shall extend above the flood rim elevation of any fixture located near the cleanout and be connected to the same waste line.

Cleanout intervals shall be spaced according to the International Plumbing Code.

3.8.11 Waste and Vent Systems

Sovent or other alternative combination waste and vent systems are not allowed.

3.8.12 Insulate Roof Drain Leaders

In locations were the ASHRAE winter 1% dry bulb temperature is below 32° F [0° C], insulate and heat trace the roof drain basins, roof drain leaders and overflows above lay-in or hard ceilings.

3.8.13 Calculations

The plumbing designer shall submit sizing calculations for area/roof drain systems.

3.9 SILVER RECOVERY SYSTEM (IF REQUIRED)

3.9.1 Automatic Film Processor

Each automatic film processor, except those serving dental x-rays, shall be connected to a central silver recovery system. An exception is that an isolated processor may be served by an individual recovery unit.

3.9.2 Silver Recovery Equipment

Silver recovery equipment is not in the contract and will be furnished by the medical center. This equipment includes a holding tank and silver recovery tanks with platforms, rectifier units with shelf, storage cabinet, and worktable. This equipment will be housed in one room. Coordinate your work with the medical center.

3.9.3 Pipe Stub

Provide 1.5 in [40 mm] pipe stub 6 in [150 mm] above the floor at each automatic film processor to receive silver solution. Where possible, combine the silver solution piping into a single pipe for transport to the holding tank in silver recovery room. Pipe shall be capped 6 ft [1.8 m] above finished floor where the holding tank is scheduled to be installed.

3.9.4 Interior Fuel Gas System

Design in accordance with NFPA 54, National Fuel Gas Code.

Provide a solenoid valve in the natural gas supply line to the dental laboratory and the dental clinic operatories with an emergency shut-off at the exit for each area.

Provide a solenoid valve in the gas supply to the kitchen area with an emergency shut-off located in the area. In addition to the kitchen emergency shutoff valve, a solenoid valve with automatic fire protection systems is required for automatic gas shutoff at each kitchen gas appliance served by a hood. Coordinate with the kitchen equipment drawings

3.10 MEDICAL GAS AND VACUUM SYSTEMS

3.10.1 Oxygen, Medical Compressed Air, Medical Vacuum, Nitrous Oxide, and Nitrogen Systems

Design oxygen, medical compressed air, medical vacuum, nitrous oxide, and nitrogen systems in accordance with current editions of NFPA 50, Bulk Oxygen Systems at Consumer Sites and NFPA 99, Healthcare Facilities, Compressed Gas Association Publication, Guide for Medical Supply Systems at Consumer Sites, Master Specification 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES and Master Specification 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES (15488, LABORATORY (NONFLAMABLE) GAS AND VACUUM SYSTEMS).

3.10.2 Water Testing

Test water or obtain analysis from the medical center to determine if additional water treatment is required for water-cooled equipment. If so, describe additional requirements in the specifications. Suitable water quality for no treatment is:

- pH – 7.0 minimum
- Chlorides – 10 ppm (mg/L) maximum
- Hardness – 200 ppm (mg/L) maximum
- Total dissolved solids – 200 ppm (mg/L) maximum

Establish water pressure at the pump and compressor locations to determine if booster water pumps are necessary. If pressure is less than 50 psi [345 kPa], the pump or compressor may not perform adequately. Investigate several manufacturers' requirements to maintain competition and to reduce the incidence of change orders.

3.10.3 Renovation Projects

In renovation projects, survey the medical center to ascertain the type of existing medical gas station outlets and medical vacuum terminal inlets. The master specification requires that new outlets and inlets match the existing terminal connections. In the case where existing station outlets or terminal inlets are not U.L.-approved, or not gas-specific, as defined in NFPA 99, the contract specification shall include provisions for competitive bids on new outlets and inlets. This may require that the medical center dictate the connectors on existing medical devices and equipment, which normally connect to the existing outlets and inlets.

3.10.4 Central Supply Systems

Design medical gas and vacuum systems to deliver the following pressures at the points of use:

(a) Oxygen, nitrous oxide, and medical air: 50 psi [345 kPa]. In designing oxygen systems with adult ventilators, size the piping system based on the instantaneous demand based on 7 standard cfm [3.3 liters/sec] for each ventilator from the outlet back to the source.

(b) Nitrogen 210 psi [1448 kPa].

(c) Medical Vacuum 15 in Hg [50 Pa].

3.10.4.1 Sizing the Systems

Size medical compressed air system to provide 100 psi [690 kPa] discharge from compressor to dryers.

In sizing the vacuum system, increase the cubic feet per minute (cfm) load by 25% to accommodate future system expansion. Include waste anesthetic gas disposal system terminal inlets and piping in appropriate projects; connect to the medical vacuum system above the corridor ceiling after the valve box. Check to see if an anesthetic and respiratory analysis system (such as SARA) is to be included in the project, and if so, provide two 1 in [25 mm] conduits from each ceiling column assembly to above corridor ceiling in each operating room.

3.10.4.2 System Setup

(a) Place a source shut-off valve for each medical gas and vacuum system at the immediate outlet (or inlet, in the case of vacuum) of the source of supply, so that the entire supply source, including all accessory equipment, can be isolated from the entire pipeline system.

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(b) nclude sufficiently sized and properly constructed storage space for the gas cylinders with manifold systems. Primary and reserve banks are required for cylinder gas sources.

(c) The medical air compressors and medical vacuum pumps shall serve the medical air and medical vacuum systems only.

(d) Locate compressors and pumps in a clean, relatively cool environment (i.e., not with steam equipment, not to exceed 100° F [38° C] ambient temperature). Locate equipment in an area where it can be monitored regularly.

(e) Medical air compressors and vacuum pumps shall be multiplexed with single receivers. Size compressors and pumps such that 100% of the design load is carried with the largest single unit out of service. Provide three-way valve bypass at receiver.

(f) Liquid oxygen containers shall either:

1. Comply with appropriate requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Unfired Pressure Vessels; insulation surrounding the liquid oxygen container shall be noncombustible material.

2. Be designed, constructed, tested, and maintained in accordance with the U.S. Department of Transportation (DOT) Specifications and Regulations for 4L containers.

(g) High-pressure gaseous oxygen containers shall either:

1. Be designed, constructed, and tested in accordance with appropriate requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Unfired Pressure Vessels.

2. Be designed, constructed, tested, and maintained in accordance with U.S. Department of Transportation (DOT) Specifications and Regulations.

(h) The preferred location for manifold systems is indoors adjacent to the loading dock. The room shall have a minimum of 10 air changes per hour of outside ventilated air with a maximum temperature of 90° F. There shall be no doors, vents, or other direct communication between the anesthetizing location or the storage location and any combustible agents. The room shall be properly labeled and secured.

(i) In designing a system where adult ventilators are used, for each ventilator in use, add the ventilator requirement of 3.5 cfm [100 L/min] to the compressor sizing. Size the piping system based on the instantaneous demand of 7 cfm [200 L/min] for each ventilator from the outlet back to the source.

(j) Air compressors shall be a type that provides "Medical Compressed Air," as defined by NFPA 99.

(k) Design air dryers, filters, and pressure regulators for the medical air system in duplex, each sized for 100% of the load using duplex twin tower desiccant dryers. Include continuous line dewpoint and carbon monoxide monitoring with sample connections on the discharge piping downstream of the filters and regulators. Locate monitors at the pump control panel or integrated with the control panel.

(l) Locate the medical air compressor system intake outdoors above the roof or downstream of the air handler final filter. Intake shall be located at least 25 ft [7.5 m] (may be more depending upon prevailing wind direction and velocity) from any building opening or other intake, and where no contamination from engine exhausts, fuel storage vents, vacuum system discharges, particulate matter, or odor of any type is anticipated. Air that is already filtered for ventilation system use is an acceptable source of air for medical air compressors. Combined intakes must be sized for no restriction while flowing the maximum intake possible, and provided with an isolation valve at the header for each compressor served.

(m) Combine discharge from each medical vacuum pump into one discharge pipe, sized for no restriction while flowing the maximum discharge possible, and provide an isolation valve at the header for each pump served. Exhaust discharge at the highest point of the building, above and at least 25 ft [7.5 m] horizontally (may be more depending upon prevailing wind direction and velocity) from any intake, door, window, louvered or ventilating opening of the building.

(n) Central supply systems for oxygen, medical air, nitrous oxide, carbon dioxide, and all other patient medical gasses shall NOT be piped to, or used for, any purpose except patient care applications. Prohibited uses of medical gases include but not limited to: fueling torches, blowing down or drying any equipment (such as laboratory equipment, endoscopes or other scopes), or any other purposes. Also prohibited is using oxygen or medical air to raise, lower, or otherwise operate booms or other devices in operating rooms (ORs) or other areas.

3.10.5 Piping Systems

(a) Design pressure piping systems not to exceed 5 psi [35 kPa] loss from source to point of use. Design vacuum piping systems not to exceed 3 in Hg [10 Pa] from source to point of use.

(b) Provide main line supply line with a shut-off valve. Locate valve to be accessible by authorized personnel only, downstream of the source valve, and outside of the source room, enclosure, or area where the main valve enters the building. Identify this valve. A main line valve is not required when the source shut-off valve is accessible within the building.

(c) Each branch or riser supplied from the main line shall have an in-line shut-off valve adjacent to the main. Each branch supplied from a riser shall have an in-line shut-off valve. Adjacent to the riser. Conceal in-line shut-off valves (e.g., above ceiling with ceiling tag, or in a locked equipment room) and make a provision to lock them open.

(d) Include a zone valve in a cabinet with other medical gas zone valves, for all anesthetizing locations and branches serving station outlets and inlets in conformance with NFPA 99. Provide additional service valves above ceiling to subdivide areas for maintenance.

(e) Combine anesthesia evacuation piping with the medical vacuum system piping above ceiling and after zone valve.

(f) Except for nitrogen systems, medical gas station outlets and vacuum station inlets in new buildings shall be quick coupler type. Where building alterations or additions occur, station outlets and inlets shall be compatible with those of the existing building, without the use of secondary adapters.

(g) All nitrogen station outlets are required to be DISS-type, and shall be located inside nitrogen control panel (NCP) within the room being served.

(h) Locations of piped medical gas station outlets and vacuum station inlets are indicated in VA Program Guide 7610, Equipment Guide List, under "Outlets."

(i) Provide a protective pipe enclosure for exterior oxygen line. Burial depth shall be a minimum 2 ft [0.6 m] below grade.

(j) Coordinate the requirement for the use of adult ventilators, in the Operating Rooms, Cardiac Care, ICU, and Recovery Area with the medical center. Design the oxygen and medical air systems to accommodate the ventilators. For pipe sizing, the demand for adult ventilators is 7.0 cfm [200 L/min].

- **Oxygen System:** Minimum design flow rate for any pipe section is 7 cfm [200 L/min].
- **Vacuum System:** Minimum design flow rate for any pipe section is 4 cfm [100 L/min].
- **Medical Air System:** Minimum design flow rate for any pipe section is 7 cfm [200 L/min.

3.10.6 Alarms

To ensure continuous responsible observation, two master system alarms, in separate warning locations, are required for each medical gas and vacuum system.

The primary warning location shall be supervised by engineering personnel and shall be located at one of the following (in order of priority): boiler plant control office, engineering control center, or in the office or principal working area of the individual responsible for the maintenance of the medical gas system. The primary alarm point shall be an alarm point in the direct digital control system and a physical, labeled, visual alarm indicator inside the primary warning location.

The secondary warning location shall be situated to ensure continuous surveillance during the working hours of the facility. Suitable secondary warning locations may include: intensive care nursing unit, fire station, telephone switchboard, security office, or other continuously-staffed location.

Coordinate both master alarm panel locations with the user facility and the other design services. When deciding upon alarm locations, consider emergency power circuits, engineering control center data relay interface locations, and the facility's established procedures for monitoring alarm signals. Provide the following on plumbing drawings:

- Low voltage wiring and pressure switches associated with master alarm signals and panels (on floor plans).

- Low voltage wiring diagram associated with master alarm signals and panels.
- Tubing and/or communication cable runs from the sensor locations to area alarm panels (on floor plans and medical gas and vacuum system diagrams).

Include an area alarm for each system at the nurse's station in all areas where medical gas and vacuum station outlets and inlets are installed.

3.10.7 Connections to Existing Medical Gas Systems

(a) Install a shut-off valve at the connection of the new line to the existing line. The valve assembly should be fabricated and brazed onto the connecting line.

(b) Coordinate time for shut down of any existing medical gas system with the medical center.

(c) All oxygen zone valves and gas riser valves should be shut off if the section to which they connect cannot be totally isolated from the remainder of the system.

(d) Prior to any work being done, the new pipeline should be checked for particulate or other forms of contamination.

(e) Ensure that the correct type of pipe tubing and fittings are being used. All medical gas and oxygen shall be cleaned for oxygen service.

(f) A spot check of the existing pipelines in the facility should also be made to determine the level of cleanliness present.

(g) Reduce the pressure to 0 psig [0 Pa] and make the tie-in as quickly as possible.

(h) After the tie-in is made and allowed to cool, the source gas, i.e., oxygen, is slowly bled back into the pipeline. The work area is tested for leaks with soapy water and any leaks are repaired.

(i) After any leaks are repaired and the line is fully recharged, blow down and testing are performed. The zone closest to the main is opened to the system, the closest outlet to the work is accessed, and the main blown through the outlet. After the outlet blows clear into a white cloth, an oxygen analyzer is used to determine that only oxygen is present. An additional check is made at the zone most distant from the site of the work.

(j) The use of shape memory alloy couplings is recommended when making connections to existing medical gas systems

3.11 RESEARCH AND CLINICAL LABORATORY GAS AND VACUUM SYSTEMS

Design laboratory compressed air, laboratory vacuum, natural gas, and miscellaneous laboratory cylinder gas systems in accordance with current editions of NFPA 54 and 99, Master Specification 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES and Master Specification 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES, and the following:

3.11.1 Central Supply Systems

(a) Provide minimum 100 psi [690 kPa] laboratory air at the compressor discharge. Run 100 psi [690 kPa] air to a storage room (or other non-working or unfinished space) in the laboratory area being served. Valve and cap the 100 psi [690 kPa] air line for future connection. Tee off the 100 psi [690 kPa] line and locate a pressure-regulating valve to reduce the air pressure to 50 psi [345 kPa]. Run 50 psi [345 kPa] air to all outlets in laboratory hoods and benches.

(b) If specifications for laboratory equipment being purchased by the medical center are known, and the equipment requires higher air pressures, provide additional tee, regulator, and piping to that equipment at the required pressure.

(c) Natural gas and manifold laboratory gas system pressures shall be determined on a project basis.

(d) Design laboratory vacuum systems to deliver 15 in Hg [50 Pa] of vacuum at the point of use.

(e) Place a source shut-off valve for each laboratory gas and vacuum system at the immediate outlet (or inlet, in the case of vacuum) of the source of supply, so that the entire supply source, including all accessory equipment, can be isolated from the entire pipeline system.

(f) In facilities where manifold laboratory gases occur, ensure that adequately sized and properly constructed storage space is provided for the gas cylinders. Primary and reserve banks are required for cylinder gas sources.

(g) Laboratory air compressors and vacuum pumps shall serve the laboratory air and vacuum systems only.

(h) Locate laboratory air compressors and vacuum pumps in a clean, relatively cool environment (i.e., not with steam equipment, exceeding 100° F [38° C] ambient temperature). Locate equipment in an area where it can be monitored regularly.

(i) Laboratory air compressors and vacuum pumps shall be multiplexed with single receivers. Compressors and pumps shall be sized such that 100% of the design load is carried with the largest single unit out of service. Provide three-way valve bypass at receiver.

(j) Laboratory air compressors shall be a type that provides "Medical Compressed Air," as defined by NFPA 99.

(k) Design air dryers, filters, and pressure regulators for the laboratory air system in duplex, each sized for 100% of the load using duplex twin tower desiccant dryers. Include continuous dewpoint monitoring downstream of the regulator and carbon monoxide monitoring with sample connections on the discharge piping after the filters and regulators. Locate monitors adjacent to the control panel or integrated with the control panel.

(l) Locate the laboratory air compressor system intake outdoors above roof level or downstream of air handler final filter. Intake shall be located at least 25 ft [7.5 mm] (may be more depending upon prevailing wind direction and velocity) from any building opening or other intake, and where no contamination from engine exhausts, fuel storage vents, vacuum system discharges, particulate matter, or odor of any type is

anticipated. Air that is already filtered for ventilation system use is an acceptable source for laboratory air compressors. Combined intakes must be sized for no restriction while flowing the maximum intake possible, and provided with an isolation valve at the header for each compressor served.

(m) Combine discharge from each laboratory vacuum pump into one discharge pipe, sized for no restriction while flowing maximum discharge possible, and provide an isolation valve at the header for each pump served. Exhaust discharge at the highest point of the building, above and at least 25 ft [7.5 m] horizontally (may be more depending upon prevailing wind direction and velocity) from any door, window, or louvered or ventilating opening of the building.

3.11.2 Piping Systems

(a) Design natural gas piping systems in accordance with the International Fuel Gas Code. Design other pressure piping systems not to exceed 5 psi [35 kPa] loss from source to point of use. Vacuum piping system pressure drop shall be designed not to exceed 3 in Hg [10 Pa] from source to point of use.

(b) Provide main line supply line with a shut-off valve. Locate valve to be accessible by authorized personnel only, downstream of the source valve, and outside of the source room, enclosure, or area where the main valve enters the building. Identify this valve. A main line valve is not required when the source shut-off valve is accessible within the building.

(c) Each branch and riser supplied from the main line shall have an in-line shut-off valve adjacent to the main. Each branch supplied from a riser shall have an in-line shut-off valve adjacent to the riser. Conceal in-line shut-off valves (e.g., above ceiling with ceiling tag, or in a locked equipment room). Comply with applicable codes and standards for concealed valves of flammable gases.

(d) Include a zone valve in a cabinet with other laboratory gas zone valves for branches serving laboratory gas outlets. Locate separate natural gas zone valve cabinets adjacent to other laboratory gas zone valve cabinets. Provide additional service valves above ceiling to subdivide areas for maintenance.

(e) Laboratory gas outlets and vacuum inlets shall be standard needle valves.

(f) Locations of piped laboratory gas outlets and vacuum inlets are indicated in VA Program Guide 7610, Equipment Guide List, under "Outlets."

(g) Provide an emergency natural gas solenoid valve for each laboratory area. Locate emergency shut-off switch adjacent to exit.

3.11.3 Alarms

To ensure continuous responsible observation, two master system alarms, in separate warning locations, are required for each laboratory gas and vacuum system.

The primary warning location shall be supervised by engineering personnel and shall be located at one of the following (in order of priority): boiler plant control office, engineering control center, or in the office or principal working area of the individual responsible for maintenance of the laboratory gas system.

The secondary warning location shall be situated to ensure continuous surveillance during the working hours of the facility. Suitable secondary warning locations may include: fire station, telephone switchboard, engineering control center, security office, or other continuously-staffed location.

Coordinate both master alarm panel locations with the user facility and the other design services. When deciding upon alarm locations, engineering control center data relay interface locations, and the facility's established procedures for monitoring alarm signals. Provide the following on the plumbing drawings:

- Low voltage wiring and pressure switches or sensors associated with master alarm signals and panels (on floor plans).
- Low voltage wiring diagram associated with master alarm signals and panels.
- Tubing and/or communication cable runs from the sensor location to area alarm panels (on floor plans and laboratory gas and vacuum system diagrams

3.12 ORAL EVACUATION SYSTEM

Design the oral evacuation system in accordance with Master Specification 22 62 19.74, DENTAL VACUUM AND EVACUATION EQUIPMENT (15489, ORAL EVACUATION SYSTEMS), and the following:

3.12.1 High Volume Oral Evacuation (HVE) Systems Outlets

Locate HVE system outlets in floor-mounted utility junction centers. A utility junction center (UJC) is a grouping of specific utilities brought to a designated location in each dental operatory to provide convenient points of connection to the dental operating unit equipment, which will be furnished by the VA. A single 2 in [50 mm] diameter wall outlet shall be provided in each recovery room.

3.12.2 Airflow and Vacuum Requirements

(a) Design airflow of 7 standard cubic feet per minute (scfm) [3.3 L/sec] at each UJC.

(b) Design airflow of 7 standard cubic feet per minute (scfm) [3.3 L/sec] at wall outlet in recovery rooms.

(c) System shall develop and maintain a vacuum of 8 in [27 Pa] of mercury.

3.12.3 Vacuum Relief Valves

Provide a vacuum relief valve at the end of each trunk line.

3.12.4 High Volume Oral Evacuation (HVE) Systems

(a) Provide automatic alternating duplex turbine-type vacuum producers, installed in parallel, each capable of carrying 70% of the design load. Locate remote from dental facilities at an elevation lower than UJCs.

(b) Provide duplex high efficiency, continuous duty, positive displacement or sealed rotary vane pumps with automatic continuous oil flow to all moving parts.

(c) Combine exhausts into a common pipe sized for one vacuum producer. Discharge exhaust pipe to outdoors above roof of portion of building where located. Do not discharge within a 10-ft [3-m] radius of any door, window, air intake, or ventilation opening.

(d) Increase airflow demand as follows to compensate for friction losses:

UJC	% Increase
9 to 20	10
21 to 44	15

(e) Select vacuum producer as follows:

SCFM at 8 in [27 Pa] of Mercury	Hp	L/min at 1 Pa	kW
165	7.5	173	5.6
220	10	230	7.5
350	15	367	11.2
475	20	498	14.9
600	25	630	18.6

(f) Install separators ahead of each vacuum producer. Quantity and size shall be as follows:

UJC	Quantity	Size gallon [L]
6	2	20 [75] each
7-10	2	40 [150] each
11 and above	2	80 [300] each

3.12.5 Solenoid Valve

Provide solenoid valve on the cold water supply to the utility junction centers in the dental area

3.13 DENTAL COMPRESSED AIR SYSTEM

Design central piped dental compressed air distribution system in accordance with current editions of NFPA 99, Compressed Gas Association Standards, Master Specification 22 61 13.74, DENTAL COMPRESSED-AIR PIPING and 22 61 19.74, DENTAL COMPRESSED-AIR EQUIPMENT (DENTAL COMPRESSED AIR SYSTEM), and the following:

3.13.1 Dental Compressed Air Systems and Equipment

Dental compressed air systems and equipment shall be completely independent of the medical and laboratory air systems and equipment.

3.13.2 Central Supply System Pressure Requirements

(a) Verify the pressure requirements for the dental clinic with the VA medical center, and design the system accordingly.

(b) Dental air compressors shall be designed specially to produce 125 psi [860 kPa] air with a single stage, without excess noise and vibration. The system shall be capable of producing medical gas grade air.

(c) Dental air compressors shall be duplex with a single receiver. The compressors shall be sized such that 100% of the design load is carried by the largest single unit out of service.

(d) Include primary and secondary air dryers, filters, pressure regulators, and continuous line dew point and carbon monoxide monitoring, all with a valve bypass.

(e) Locate compressors in a clean, relatively cool environment (i.e., not with steam equipment, not to exceed 100° F [38° C] ambient temperature). Locate equipment in an area where qualified personnel can monitor it regularly.

(f) Place a source shut-off valve at the immediate outlet of the source regulator, so that the entire supply source, including all accessory equipment, can be isolated from the entire pipeline system.

(g) Locate the dental air compressor system intake outdoors above roof level, or downstream of air handler final filter. Intake shall be located at least 25 ft [7.5 m] (may be more depending upon prevailing wind direction and velocity) from any building opening or other intake, and where no contamination from engine exhausts, fuel storage vents, vacuum system discharges, particulate matter, or odor of any type is anticipated. Air that is already filtered for ventilation system use is an acceptable source of air for dental air compressors. Combined intakes must be sized for no restriction while flowing the maximum intake possible, and provided with an isolation valve at the header for each compressor served.

(h) Dental air system design shall comply with Level 2 medical gas system.

3.13.3 Piping Systems

(a) Design pressure system to deliver a regulated 100 psi [690 kPa], not to exceed 5 psi [35 kPa] loss from source to point of use.

(b) Provide a ½ in [13 mm] riser for each utility junction center (UJC) in the dental treatment rooms. Connect riser to branch or main line.

(c) Each branch riser supplied from the main line shall have an in-line shut-off valve adjacent to the main. Conceal in-line shut-off valves (e.g., above ceiling with ceiling tag, or in a locked equipment room).

(d) To minimize piping, locate multiple air pressure regulators in or near the dental suite as required.

(e) Locations of piped dental air outlets are indicted in VA Program Guide 7610, Equipment Guide List.

(f) Supply cold water to the dental junction boxes through a solenoid control valve that shall be activated by the control panel in the administrator’s office.

(g) Provide an emergency gas solenoid valve on the gas line to the treatment rooms and laboratory areas.

(h) Air volume and pressure requirements, and simultaneous use factors are as follows:

AREA	EQUIPMENT	VOLUME scfm [L/ min]	PRESSURE psi [kPa]
Exam and general treatment operatory	Needle valve wall outlet	0.25 [0.12]	50 [345]
Exam and general treatment operatory	Utility Junction Center (UJC)	3 [1.4]	140 [965] 100 [690]
Exam and general treatment operatory	Hygiene UJC	3 [1.4]	140 [965] 100 [690]

AREA	EQUIPMENT	VOLUME scfm [L/ min]	PRESSURE psi [kPa]
Oral Surgery	DISS outlet to surgical hand piece	10 [4.7]	140 [965] 100 [690]
Oral Surgery	UJC	3 [1.4]	140 [965] 100 [690]
Oral Surgery	X-ray needle valve to x-ray chair base	0.25 [0.12]	50 [345]

AREA	EQUIPMENT	VOLUME scfm [L/ min]	PRESSURE psi [kPa]
Prosthetics laboratory	Needle valve in benches and casework	0.25 [0.12]	50 [345]
Prosthetics laboratory	Quick coupler for lab blowgun	0.25 [0.12]	50 [345]
Prosthetics laboratory	Quick coupler for lab hand piece	3 [1.4]	50 [345]
Prosthetics laboratory	Threaded valve for shell blaster or sandblaster	10 [4.7]	140 [965] 100
Prosthetics laboratory	Threaded valve for microblaster	3 [1.4]	140 [965] 100 [960]

QUANITY OF OUTLETS	DIVERSITY, PERCENT SIMULTANEOUS
1 through 3	100
4 through 6	90
7 through 9	80
10 through 12	70
13 through 16	60
17 and over	50

3.14 SHOP COMPRESSED AIR SYSTEM

Provide simplex air compressor to serve equipment and a minimum of one outlet on each wall in shop areas. The shop compressed air system shall include intake silencer, filter, refrigerated dryer, and receiver. Interior outlets shall be no farther apart than 25 ft [7.5 m].

3.15 THERAPEUTIC POOL EQUIPMENT

3.15.1 Water Treatment System

3.15.1.1 Pipes and Equipment

Use corrosion-resistant piping and equipment. Identify piping material on drawings.

3.15.1.2 Filter

Provide a high rate (15 to 20 gpm per sq ft [16 to 23 L/min per sq m] of filter surface area) sand type, pressure filter.

3.15.1.3 Water Heater

Simplex shell and water coil heater shall heat pool water capacity from 40 to 94° F [4 to 34° C] in 24 hours with water entering the pool at not more than 120° F [49° C]. Pool temperature shall be maintained between 75 and 80° F [24 and 27° C] for recreation purposes and between 86 and 94° F [30 and 34° C] for therapeutic purposes.

3.15.1.4 Disinfection

Feed calcium hypochlorite solution into pool with influent water by adjustable pump to maintain a free chlorine residual between 1.0 and 1.5 ppm [mg/L].

3.15.1.5 pH Balancing

pH shall be maintained between 7.2 and 7.8.

3.15.1.6 Recirculating Pump

Re-circulate entire contents of pool in 6 hours.

3.15.1.7 Equipment Room

Locate pool equipment in enclosed space one floor below pool room elevation. Entrance to pool equipment room should be from pool apron and be lockable.

Provide means to change water in the pool.

3.15.2 Vacuum Cleaning Equipment

VA medical center will provide portable vacuum cleaning equipment. Do not design pool re-circulating pump for cleaning

3.16 LAUNDRY

3.16.1 Laundry Equipment

All laundry equipment, including water treatment and heaters, is provided by the medical center. Provide utilities to serve the laundry equipment and toilet areas. The water supply for laundry use shall be provided with a meter.

3.16.2 Floor Sinks and Floor Drains

Provide a minimum of one floor sink and one floor drain for the laundry facility, regardless of size.

3.16.3 Dedicated Sump

For laundry facilities or rooms with more than three washing machines, provide a dedicated sump with duplex grinder pumps. The sump discharge would then be hard-piped into the sanitary sewer.

3.17 WATER SOFTENING SYSTEM

3.17.1 Softener

Design vertical, pressure-type, sodium cycle water softeners to comply with the following and Master Specification 22 31 11, WATER SOFTENERS. Regeneration shall occur no more than once per day. Provide bypass.

3.17.2 When Water Softener Required

(a) Entire medical center: Provide softening equipment when total hardness exceeds 170 ppm 170 mg/L as CaCO3. Blend equipment effluent to a hardness of approximately 50 ppm [50 mg/L].

(b) Steam cooking equipment and boiler feed-water make-up: Provide softening equipment when total hardness exceeds 5 ppm [mg/L].

(c) Pretreatment to reverse osmosis package.

(d) Medical center use: Design triplex softeners, each furnishing 50% of the maximum flow rate and exchange capacity. Provide a hard water bypass.

(e) Steam cooking equipment: Design simplex softener and a hard water bypass. Locate regeneration alarm in office of dietitian.

(f) Boiler use: Design triplex softeners, each furnishing 50% of the maximum flow rate at an exchange capacity required for peak boiler feed-water make-up. Locate regeneration alarm in office of boiler plant operator.

3.17.3 Salt Storage

When softened water is needed for the entire medical center, a storage facility with exterior access shall be provided. Ensure total capacity is large enough to accommodate a three-month supply of salt. Locate the salt storage facility adjacent to a service road, preferably adjacent to the softener room.

When soft water is required for dietetic or boiler use, designate/reserve interior floor space in the dietectics storage area for 400 pounds [180 kg] of salt near softeners.

3.17.4 Dealkalizing Equipment

As water analysis dictates, design a single chloride-anion pressure-type water-dealkalizing tank for boiler feed-water make-up to follow water softening equipment. Provide soft water bypass. System shall comply with Master Specification 22 67 21, WATER DEALKALIZING SYSTEM and the following:

3.17.4.1 Dealkalizer Tank

Dealkalizer tank shall provide 30 gpm [110 L/min] maximum flow rate with a capacity of 10,000 gallons [37,850 L] per day to reduce alkalinity to 20 ppm [mg/l].

3.17.4.2 Brine and Caustic Soda Tanks

Design a separate measuring tank of sufficient size to furnish amount of saturated salt and caustic soda solution required for one regeneration. Caustic soda shall be approximately 10% by weight of total solution. Designate interior floor space for caustic storage.

3.17.4.3 Miscellaneous

(a) Locate regeneration alarm bell in boiler plant office.

(b) Provide emergency shower and eye/face wash (P-707) adjacent to equipment

3.18 REAGENT GRADE WATER SYSTEM

3.18.1 Floor Space for Central Reagent Grade Equipment

As water analysis dictates, provide floor space for central reagent grade equipment. Design the piping system from the equipment room to the outlets. Equipment (pretreatment, reverse osmosis, buffer tank, deionizer, or a combination) shall be furnished as part of the project for every significant upgrade or new installation project. Design piping to provide continuous loop to within 6 in [150 mm] of outlet, or to the base of the faucet.

3.18.2 Floor Space for Regenerant Chemicals

Assign floor space for storing 30 days supply of regeneration chemicals.

3.18.3 Emergency Shower and Eye/Face Wash

Provide emergency shower and eye/face wash in equipment room.

3.18.4 Negative Pressure Ventilation

Coordinate with HVAC to provide adequate negative pressure ventilation.

3.18.5 Chemical-Resistant Piping and Drains

Provide chemical resistant piping and drains.

3.18.6 TRASH ROOM/LOADING DOCK

Provide a steam gun (steam and water mixer) with hose for this area. At a minimum a trench drain and floor sink with a minimum 3” outlet is required for all loading dock areas. A floor drain with removable strainer and integral cleanout is required for a trash room.

---END OF SECTION---

CHAPTER 4: SUPPORT DATA

4.1 PLUMBING FIXTURE SCHEDULES

Use the following data for design of water and drainage systems, in conjunction with and superseding data found in the reference plumbing code. Plumbing fixtures are described in Master Specification 22 40 00, PLUMBING FIXTURES (PLUMBING FIXTURES AND TRIM).

P-Number	Description	WFU	CW SFU	HW SFU	Total SFU	Waste Pipe Size	Vent Pipe Size	CW Pipe Supply Size	HW Pipe Supply Size
101-105, 107, 110-113, 115	Water Closet, Flush Valve, Public	6	10	–	10	4 [100]	2 [50]	1.25 [32]	–
106	Water Closet, Tank Type	4	3	–	3	4 [100]	2 [50]	3/4 [20]	–
201-202	Urinal, Siphon Jet	2	3	–	3	2 [50]	1.5 [40]	.75 [20]	–
302, 307	Bathtub	2	1.5	2	2	1.5 [40]	1.5 [40]	0.5 [15]	0.5 [15]
304	Bathtub, End Type	2	1.5	2	2	1.5 [40]	1.5 [40]	0.5 [15]	0.5 [15]
305	Perineal Bath (Sitz)	2	1.5	2	2	1.5 [40]	1.5 [40]	0.5 [15]	0.5 [15]
401-409, 411, 413-415, 417-420	Lavatory	1	0.75	0.75	1	1.5 [40]	1.5 [40]	0.5 [15]	0.5 [15]
412	Wash fountain, Semi-Circular	2	1.5	2	2	2 [50]	1.5 [40]	0.5 [15]	0.5 [15]
501-503	Service Sink	2	3	3	4	3 [75]	1.5 [40]	1 [25]	1 [25]
505	Clinic Service Sink	5	3	3	4	4 [100]	2 [50]	1 [25]	1 [25]
507	Plaster Sink	3	1.5	1.5	2	2 [50]	1.5 [40]	.75 [20]	.75 [20]
508-518, 524, 528-531	Sink, CRS	3	1.5	1.5	2	1.5 [40]	1.5 [40]	.75 [20]	.75 [20]

P-Number	Description	WFU	CW SFU	HW SFU	Total SFU	Waste Pipe Size	Vent Pipe Size	CW Pipe Supply Size	HW Pipe Supply Size
519, 520	Surgeons Scrub Sink	3	1.5	1.5	2	1.5 [40]	1.5 [40]	.75 [20]	.75 [20]
521, 522, 527	Laundry Tub	2	3	3	4	1.5 [40]	1.5 [40]	.75 [20]	.75 [20]
604, 605, 608	Electric Water Cooler	0.5	0.5	–	0.5	1.5 [40]	1.5 [40]	.5 [15]	–
606	Drinking Fountain	0.5	0.75	–	0.75	1.5 [40]	1.5 [40]	.5 [15]	–
701-704, 711	Shower	2	1.5	1.5	2	2 [51]	1.5 [40]	.5 [15]	.5 [15]
705	Individual Fixture Thermostatic Mixing Valve	–	3	3	4	–	–	.75 [20]	.75 [20]
706	Emergency Shower	–	–	–	–	–	–	1.5 [40]	–
707, 712	Emergency Shower Eye & Face Wash	–	–	–	–	–	–	1.5 [40]	–
708	Emergency Eye & Face Wash	–	–	–	–	–	–	.75 [20]	–
709	Emergency Eye & Face Wash (Pedestal Mounted)	–	–	–	–	–	–	.75 [20]	–
710	Emergency. Eye & Face Wash (Fully Recessed, WM)	–	–	–	–	–	–	.75 [20]	–
801	Wall Hydrant	–	–	–	–	–	–	.75 [20]	–

P-Number	Description	WFU	CW SFU	HW SFU	Total SFU	Waste Pipe Size	Vent Pipe Size	CW Pipe Supply Size	HW Pipe Supply Size
802-805	Hose Bibb	–	–	–	–	–	–	.75 [20]	.75 [20]
806	Lawn Faucet	–	–	–	–	–	–	.75 [20]	–
807	Regent Grade Water Faucet	–	–	–	–	–	–	1 [25]	–
808	Washing Machine	3	3	4	4	2	1.5 [40]	.5* [15]	–
	Supply/Drain Unit	–	–	–	–	2	1.5 [40]	.75 [20]	.75 [20]
809	Dialysis Box	–	–	–	–	2**	2**	.5* [15]	–
810	Thermo Steam/Water Mixing Valve	–	2.25	–	2.25	–	–	.75 [20]	–
811	Cuspidor	1	1	–	1	1.5 [40]	1.5 [40]	.5 [15]	–

Note: * Reagent Grade Water

** Chemical-Resistant Pipe

4.2 SCHEDULE OF FLOOR DRAINS

Indicate the size and type of all floor drains on the plans and diagrams. See Master Specification 22 13 00, FACILITY SANITARY SEWERAGE for floor drain descriptions.

Animal Areas	Type	Size in/[mm]	Sewer	Remarks
- Cubicle Housing	F	4 [102]	S	
- Large Animal Conventional	J	4 [102]	S	Flushing rim, stainless steel trench with grate
- Receiving & Examination	F	3 [76]	S	
Cage Wash Room	F	3 [76]	S	
Cage Washer	I	4 [102]	S	
Dark Room	X	3 [76]	S	

Animal Areas	Type	Size in/[mm]	Sewer	Remarks
Infectious Animal Suite:	N	4 [102]	S	
Sterilizer	**?**	**?**	**?**	
Necropsy	K	4 [102]	S	Sealable FD – flushing rim
Post Operative Intensive Care	K	4 [102]	S	Sealable FD – flushing rim
Quarantine Room	F	3 [76]	S	

Dietetic Areas	Type	Size in/[mm]	Sewer	Remarks
Can Crusher	S	3 [76]	S	
Can Wash Pit	S	4 [102]	S	
Canteen	S	3 [76]	S	Modify w/2 in [50 mm] hole in grate
Dining Room Serving Line	S	3 [76]	S	Modify w/2 in [50 mm] hole in grate
Dishwashing Room Floor	S	3 [76]	S	
Food Conveyer Belt	S	2 [51]	S	Under belt with ½ in [15 mm] grate
Hood Washdown	none	3 [76]	S	Stub up to 3 in [80 mm] pipe 6 in [150 mm] AFF
Hot Food Table	S	3 [76]	S	With ½ in [15 mm] grate
Kitchen, Main	S	3 [76]	S	
Kitchen, Main	S	3 [76]	S	At kettles and cooker
Kitchen, Serving	S	3 [76]	S	With ½ in [15 mm] grate
Platform Scale Pit	S	3 [76]	S/ST	
Pot Sink	S	3 [76]	S	No grate
Prep, Meat and Dessert	S	3 [76]	S	At each kettle w/sediment basket
Prep, Vegetable	S	3 [76]	S	With ½ in [15 mm] grate
Pulper	S	4 [102]	S	With 2 in [50 mm] hole in grate

Dietetic Areas	Type	Size in/[mm]	Sewer	Remarks
Refrigerator, Chilled Vegetable	S	3 [76]	S	Inside, w/air gap
Refrigerator, Garbage	S	3 [76]	S	Inside
Refrigerator, Machine Room	S	3 [76]	S/ST	
Refrigerator, Walk-In	S	3 [76]	S	Outside refrigerator door w/depressed grate
Scullery	S	3 [76]	S	For portable sink, w/depressed grate
Tray Make-Up	S	3 [76]	S	W/2 in [50 mm] hole in grate
Trayveyor Shafts	S	3 [76]	S	W/2 in [50 mm] hole in grate
Vending Machine Room	S	3 [76]	S	

Film Processing Areas:*	Type	Size in/[mm]	Sewer	Remarks
Cardiac Cath. Dark Room	T	2 [51]	S	At XP-6 w/full flow thru funnel
Processing Unit	T	3 [76]	S	W/full flow thru funnel
Roll Processing	T	2 [51]	S	
Chemical Storage Sump	X	2 [51]	S	
*When WSF flooring is used, provide Type "F" epoxy coated w/full flow funnel.				

Hospital Areas	Type	Size in/[mm]	Sewer	Remarks
Aide-A-Bath	M	3 [76]	S	
Autopsy Room	J	3 [76]	S	Flushing rim type
Bldg. Management/Storage	D	3 [76]	S	
Cart Storage Room	C	2 [51]	S	
Cart Wash	R	4 [102]	S	
Clean Work Area	C	3 [76]	S	
Congregate Bath	C/S	2 [51]	S	
Cysto Room	L/S	3 [76]	S	At foot of table
Deep Therapy Equipment Room	M	2 [51]	S/ST	

Hospital Areas	Type	Size in/[mm]	Sewer	Remarks
Glasswasher	R/S	3 [76]	S	
Hydrotherapy Area (stainless steel)	C	2 [51]	S	Adjacent to tub
Hydrotherapy Congregate Bath	O	3 [76]	S	With ¾ in [20 mm] grate or (stainless steel) 2 in [50 mm] hole in grate
Ice Machine	M	2 [51]	S	
Laboratory	F	3 [76]	S	
Linear Accelerator	C	2 [51]	S/ST	
Perennial Bath	C	2 [51]	S	
Shower, Double	C/D	3 [76]	S	
Shower, Single	C/D	2 [51]	S	
Soiled Linen Collection Room	D	3 [76]	S	
SPD Sterilizers	R/S	4 [102]	S	
Trash Collection Room	D	3 [76]	S	
Washer Sterilizers	R	4 [102]	S	2 in [50 mm] hole in grate

Laundry Areas	Type	Size in/[mm]	Sewer	Remarks
Laundry	B/F	3 [76]	S	F for seamless vinyl
Lint Collector	H	4 [102]	S/ST	

Mechanical Equipment Areas:	Type	Size in/[mm]	Sewer	Remarks
Boiler House	B	3 [76]	S	With ½ in [15 mm] grate
Boiler Water Column Drain	V	4 [102]	S	One for each boiler
Compressor Room	B	3 [76]	S	Modify with funnel
Fan Room	B	3 [76]	S/ST	With ½ in [15 mm] grate
Incinerator Room	E	4 [102]	S	
Machine Room	B	3 [76]	S/ST	

Mechanical Equipment Areas:	Type	Size in/[mm]	Sewer	Remarks
Mechanical Equipment Room	B	4 [102]	S	With ½ in [15 mm] grate when adjacent to equipment
Paint Spray Booth	H	4 [102]	S	
Steam Service Entrance Pit	B	3 [76]	S/ST	
Water Softener	R	4 [102]	S	

Miscellaneous Areas:	Type	Size in/[mm]	Sewer	Remarks
Finished Walk Areaway	B	4 [102]	ST	
Window Well Areaway	B	3 [76]	ST	
Silver Recovery Room	T	3 [76]	S	

Legend:

S = Sanitary Sewer

ST = Storm Sewer

CI = Cast Iron

NB = Nickel Bronze

Types:

B – CI W/NB Grate

C – Finished Areas

D – Latex Mastic Floors/Thin Set Tile

E – 12 in [300 mm] CI W/Sediment Bucket

F – Seamless Vinyl Floors

G – Porcelain Enamel Interior w/NB Frame and Grate

H – 12 in x 6 in [300 mm x 150 mm] deep CI

I –

J–

K –

L – Flushing Rim

M – NB Funnel Strainer

N – NB Extended Rim

O – 12 in [300mm] Square

P – 12 in [300 mm] Square w/Grate

R – 8 in [200 mm] Square

S – 12 in [300 mm] Square w/Grate

T – CRP w/Funnel

V – CI w/Funnel

X – CRP

NOTES:

1. Floor drains for general floor drainage are located by architect. Use Type "C" in finished areas.
2. Connect cooling tower drain, overflow and blowdown to the sanitary sewer.

3. Provide hub at floor level for ethylene oxide sterilizer fitting. Caulk fitting tight in hub.
4. Provide trap primer for all drains not receiving a direct discharge.

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4.3 SCHEDULE OF BASE AND VIBRATION ISOLATORS

See Master Specification 23 05 41, Noise and Vibration Control for HVAC Piping and Equipment (23 05 41 Noise and vibration control), for base and isolator description.

	Equip On Grade - Base Type	Equip On Grade - Isol Type	Equip On Grade - Min Defl	Equipt On 20 ft [6 m] Floor Span - Base Type	Equipt On 20 ft [6 m] Floor Span - Isol Type	Equipt On 20 ft [6 m] Floor Span - Min Defl	Equip On 30 ft [9 m] Floor Span - Base Type	Equip On 30 ft [9 m] Floor Span - Isol Type	Equip On 30 ft [9 m] Floor Span - Min Defl	Equip On 40 ft [12 m] Floor Span - Base Type	Equip On 40 ft [12 m] Floor Span - Isol Type	Equip On 40 ft [12 m] Floor Span - Min Defl	Equip On 50 ft [15 m] Floor Span - Base Type	Equip On 50 ft [15 m] Floor Span - Isol Type	Equip On 50 ft [15 m] Floor Span - Min Defl
Compressors & Vacuum Pumps up to 1200 W Over 1200 W	--	D,L,W	--	--	D,L,W	--	--	D,L,W	--	--	D,L,W	--	--	D,L,W	--
Compressors & Vacuum Pumps 500 - 750 RPM	--	D	--	--	S	43	--	S	63	--	S	63	--	S	89
Compressors & Vacuum Pumps Over 750	--	D	--	--	S	25	--	S	43	--	S	63	--	S	89
Close Coupled Circulating Pumps up to 1200 W	--	--	--	--	*D,L.W*	--	--	*D,L,W*	--	--	*D,L,W*	--	--	*D,L,W*	--
Close Coupled Circulating Pumps over 1200 W	--	--	--	*I*	*S*	*25*	*I*	*S*	*25*	*I*	*S*	*43*	*I*	*S*	*43*

	Equip On Grade - Base Type	Equip On Grade - Isol Type	Equip On Grade - Min Defl	Equipt On 20 ft [6 m] Floor Span - Base Type	Equipt On 20 ft [6 m] Floor Span - Isol Type	Equipt On 20 ft [6 m] Floor Span - Min Defl	Equip On 30 ft [9 m] Floor Span - Base Type	Equip On 30 ft [9 m] Floor Span - Isol Type	Equip On 30 ft [9 m] Floor Span - Min Defl	Equip On 40 ft [12 m] Floor Span - Base Type	Equip On 40 ft [12 m] Floor Span - Isol Type	Equip On 40 ft [12 m] Floor Span - Min Defl	Equip On 50 ft [15 m] Floor Span - Base Type	Equip On 50 ft [15 m] Floor Span - Isol Type	Equip On 50 ft [15 m] Floor Span - Min Defl
Base Mounted Circulating Pumps up to 7500 W	--	--	--	--	D,L,W	--	--	D,L,W	--	--	D,L,W	--	--	D,L,W	--
Base Mounted Circulating Pumps 10 kW to 30 kW	I	S	25	I	S	25	I	S	43	I	S	43	I	S	43
Base Mounted Circulating Pumps over 30 kW	I	S	25	I	S	25	I	S	43	I	S	63	I	S	63
Diesel Engines up to 19 kW	*I*	*N*	*7.6*	*I*	*N*	*7.6*	*I*	*S*	*43*	*I*	*S*	*63*	*I*	*S*	*63*
Diesel Engines 10 kW to 75 kW	*I*	*N*	*7.6*	*I*	*N*	*43*	*I*	*S*	*63*	*I*	*S*	*89*	*I*	*S*	*89*
Diesel Engines over 75 kW	*I*	*N*	*7.6*	*I*	*N*	*63*	*I*	*S*	*89*	*I*	*S*	*114*	*I*	*S*	*114*

Notes:

1. For suspended floors lighter than 4 in [100 mm] concrete, select deflection requirement from next higher span.
2. If equipment is located in a building separated from the buildings that house patients, isolator pads are not required.
3. Directly bolt fire pumps to concrete base. Provide pads (D) for domestic water booster pump package.
4. This chart applies to non-seismic areas. If project is located in VA Seismic Area A or B, substitute DS for D, and SS for S.
5. SI conversion to English: 0.3” = 7.6 mm, 1” = 25 mm, 1.7” = 43 mm, 2.5” = 63 mm,
   3.5” = 89 mm, 4.5” = 114 mm. 1.5 hp = 1120 Watts, 10 hp = 7.5 kW, 15 hp = 11 kW,
   25 hp = 19 kW, 30 hp = 20 kW, 40 hp = 30 kW, 100 hp = 75 kW

---END OF SECTION---

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