

**SECTION 22 62 19.74
DENTAL VACUUM AND EVACUATION EQUIPMENT**

SPEC WRITER NOTE: Delete between //----//
if not applicable to project. Also delete
any other item or paragraph not
applicable in the section and renumber
the paragraphs.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies central piped high volume oral evacuation (HVE) system for dental operatories, including piping, valving, vacuum producers, separators, electric motors, starters, controls and installation and startup.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- //D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- E. Section 07 84 00, FIRESTOPPING: Sealing around pipe penetrations to maintain the integrity of time rated construction.
- F. Section 07 92 00, JOINT SEALANTS: Sealing around pipe penetrations through the floor to prevent moisture migration.
- G. Section 09 91 00, PAINTING: Piping system identification.
- //H. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.//
- I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General requirements and items common to more than one Section of Division 22.
- J. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT: Electric Motors.
- K. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Valves (as required for water).
- //L. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//
- M. Section 22 11 00, FACILITY WATER DISTRIBUTION: Strainers (as required for water).
- N. Section 26 29 11, MOTOR CONTROLLERS: Motor Starters.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
- A13.1-2007 (R2013).....Scheme for the Identification of Piping System
 - B1.20.1-2013.....Pipe Threads, General Purpose, Inch
 - B16.3-2011.....Malleable Iron Threaded Fittings: Classes 150 and 300
 - B16.22-2013.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
 - B40.100-2013.....Pressure Gauges and Gauge Attachments
- C. American Society for Testing and Materials (ASTM):
- A47/A47M-1999 (2014)....Standard Specification for Ferritic Malleable Iron Castings
 - A53/A53M-2012.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - A536-1984 (2014).....Standard Specification for Ductile Iron Castings
 - B306-2013.....Standard Specification for Copper Drainage Tube (DWV)
 - D1785-2012.....Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120
 - D2564-2012.....Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
 - D2466-2013.....Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
 - D3311-2011.....Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
- D. National Fire Protection Association (NFPA):
- NFPA 99-2015.....Health Care Facilities Code
- E. Underwriters' Laboratories, Inc. (UL):
- 60601-1-2003 (R2006)....Medical Electrical Equipment, Part 1: General Requirements for Safety

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 62 19.74, DENTAL VACUUM AND EVACUATION EQUIPMENT", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Piping.
 - 2. Vacuum producer.
 - 3. Vacuum cleaning inlet.
 - 4. Vacuum gage.
 - 5. Separator.
 - 6. Vacuum relief valve.
 - 7. Butterfly valve.
 - 8. Directional flow valve.
 - 9. Anti-surge valve.
 - 10. Exhaust Silencer.
 - 11. Separator Drainage Pump.
 - 12. Control Panel.
- //D. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//
- //E. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

1.5 QUALITY ASSURANCE

- A. System: The minimum system demand shall be based on 198 L/min (7 SCFM) per dental chair and at an operating pressure of 21 to 27 KPa (6 to 8 inches Hg). A minimum of vacuum of 21 kPa (6 inches Hg) shall be maintained at the most distant outlet. System pressure drop shall be a maximum of 3 kPa (1 inches Hg) at the calculated demand flow.
- B. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA

recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.

1.6 WARRANTY

- A. System shall have a ten-year warranty against pump wear-out or failure. This warranty is beyond the typical warranty as referenced in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Guaranty: Warranty of Construction, FAR clause 52.246-21.

1.7 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 00, GENERAL REQUIREMENTS. O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be // in electronic version on compact disc or DVD // inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version //____// provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

SPEC WRITER NOTE: Update material requirements to agree with applicable requirements (types, grades, classes, and other related items) specified in the reference applicable publications. Where installation requires extra strength or higher class pipe, adjust the following.

2.1 PIPING

- A. PVC: ASTM D1785, Type 1 (normal impact), Grade 1 (chemical resistance), Schedule // 40 // 80 // pipe. Provide socket ASTM D2466 fittings and ASTM D2564 PVC solvent cement with PVC primer recommended by manufacturer. Provide DWV (drain-waste-vent) pipe fittings. Use long radius fittings for turns and wye fittings for branching, as defined in Section 22 13 00, FACILITY SANITARY AND VENT PIPING. Minimum pipe size for distributing piping in or below slab is 50 mm (2 inches).
- B. Galvanized Steel: Use only for discharge from vacuum producer, as per manufacturer's instructions.
1. Pipe: ASTM A53/A53M, standard weight.
 2. Fittings:
 - a. Flexible groove type, malleable iron, ASTM A47/A47M, or Ductile iron, ASTM A536.
 - b. Malleable iron threaded, ASME B16.3, ASME B1.20.1.
- C. Cleanouts: Same size and material as pipe. Provide accessible and easily removable cleanouts as defined in Section 22 13 00, FACILITY SANITARY AND VENT PIPING.
- D. Apply piping identification per ASME A13.1.

//2.2 DENTAL ORAL EVACUATION VACUUM PUMPS // (SELECT 2.2 OR 2.3)//

- A. Provide a completely packaged, continuous duty dental vacuum // duplex // multiplex // system as shown in the contract documents.
- B. Each vacuum producer shall be sized to produce 27 kPa (8 inches Hg) at an inlet airflow of 423 L/min. (15 SCFM).
- C. Duplex or multiplex systems shall consist of two or more separate high efficiency positive displacement oil sealed, rotary vane pumps with

automatic continuous oil flow to all moving parts. Operation shall be waterfree.

- D. Duplex or multiplex systems shall be powered by two separate standard NEMA frame motors with V-belt drives enclosed in a UL approved guard.
- E. Provide two (2) 190 liters (50 gallons) fiberglass wet separator tanks. Tanks shall be pressure tested and certified for 61 kPa (18 inch Hg). Tanks shall be freestanding with legs. Provide tank drain with check valve to drain to sanitary sewer.
- F. Provide an electronic moisture alarm system capable of detecting liquid or foam overflows. Moisture sensors shall be located outside the wet tank. Connect moisture sensor(s) to BAS.
- G. 3 Phase motor control center shall be complete with motor starters, overload protection, single phasing protection and control transformers.
- H. Controls shall be DDC with LED status indicators for "power" and "motor on"; and solid state moisture alarm circuitry, moisture detector, wiring harness, manual start-stop switch, bypass for moisture alarm and remote on-off circuitry, and indicator for required maintenance.
- I. System shall be UL 60601-1 Dental Vacuum System listed and a FDA Registered Medical Device.

//2.3 VACUUM PRODUCER //

- A. Duplex or multi-plex self-governing, multi-stage, centrifugal, turbine type of outboard design with bearings on both ends of the exhauster shaft, maximum speed of 3600 rpm, two self-aligning radial bearings sealed with grease fitting or with oil-cup lubrication, connected to its driving motor by flexible coupling. Vacuum produced shall be substantially constant throughout the operating range. Bio-based materials shall be utilized when possible.
- B. Cylindrical turbine cases, constructed of heavy gauge sheet steel with continuous welds at all seams or sections. Inlet and exhaust connections tangential to the casing and sized to allow air to move freely (within operational range) through the turbine without air restriction of any kind. Turbine shall have not less than 3.2 mm (0.125 inch) internal clearance throughout.
- C. Motor and Starter:
 - 1. Maximum 40 degrees C (104 degrees F) ambient temperature rise motor, ball or roller bearing for operating with current, voltage, phase and cycle as specified in Section 22 05 12, GENERAL MOTOR

- REQUIREMENTS FOR PLUMBING EQUIPMENT; open drip-proof construction, continuous duty rated with service factor of 1.15 or greater; sufficient capacity to drive turbines without exceeding the nameplate rating of the motor.
2. Provide each motor with automatic, fully enclosed, magnetic starter of type specified in Section 26 29 11, MOTOR CONTROLLERS.
- D. Controls:
1. Power and control panel shall include circuit breaker disconnects, starters, running hour meter, start-stop button, operational lights, warning light, audible alarm, calibrated ammeter in amperes, current transformers and heavy duty automatic alternators.
 2. Complete low voltage control function with low voltage remote control panel of single design containing an on/off switch pilot lights for water and oral evacuation supply to the dental operatories. Locate remote panel // in the office of the dental clinic. // Where indicated on drawing.// Provide solenoid valve on water supply to the dental separators.//

2.4 CENTRAL SEPARATOR (DUPLEX)

- A. Freestanding, bottom pitched to drain at low end, hot-dipped galvanized steel or fiberglass construction with smooth interior walls, and able to withstand a constant negative pressure of 61 kPa (18 inch Hg). Provide optional 360 degree solid state auto flush assembly, with positive protection against flush operation with vacuum producer running, solid-state high-low liquid sensor and corrosion resistant effluent pump to drain the tank. Adjust one tank to sense 90 percent and the other tank to sense 100 percent of its water capacity, to allow for non-simultaneous discharge and, therefore, uninterrupted HVE function to the clinical facility. Provide a sensor operated (120 VAC) solenoid valve to control the outgoing airstream for adjustments between five and 180 seconds. Cold water supply to the autoflush unit shall contain an in-line filter equipped with 40-mesh stainless-steel screens 0.0425 cm (0.0165 inch) opening size. Provide a vacuum switch to prevent the wash down solenoid from operating when system is under a vacuum. Provide pressure reducing valve to maintain water pressure not to exceed 345 kPa (50 psig).

2.5 VACUUM RELIEF VALVE (PROVIDE FOR BACKWARD CURVE IMPELLER DESIGN EXHAUSTERS)

- A. Mechanically operated, placed at the end of each trunk-line, to automatically sense negative pressure in the system to maintain movement of liquids through the piping system to the separator when inlet branches are closed. Valve connector shall be 15 mm (1/2 inch NPT). Equip with a silencer to reduce air noise to below 85 decibels.

2.6 PIPE ISOLATORS

- A. Flexible rubber, couple band, sealed clamps to isolate the turbine from the piping. Size coupling in accordance with the turbine's intake and output connections and provide steel coupling guards.

2.7 BUTTERFLY VALVE

- A. Inlet: Built-in or located near the first stage of the turbine to prevent turbine overload through the operational range.
- B. Exhaust: Flanged, wafer-style, installed at exhauster output flange for equipment isolation.

2.8 DIRECTIONAL FLOW VALVE

- A. Non-restrictive on turbine inlet to prevent back-flow of air.

SPEC WRITER NOTE: Design Engineer to note operational level of draw.

2.9 ANTI-SURGE VALVE

- A. Mechanically or electrically operated valve that shall operate automatically throughout the turbine's designed range. Valve shall continually sense the negative pressure within the turbine and maintain a predetermined, operational level of x kPa (x inches Hg) draw. Equip with a silencer to reduce air noise to below 85 decibels.

2.10 EXHAUST SILENCER

- A. Open-bore expansion type to reduce air noise to below 85 decibels with interior baffling or shrouding.

2.11 REPLACEMENT PARTS

- A. Furnish a turbine bearings and coupling kit to include one set of turbine bearings and one complete motor/turbine flexible coupling, all of the same size and design as those supplied with the turbine.
- B. Provide complete installation instructions for repair kit items.

2.12 SEPARATOR DRAINAGE PUMP (OPTIONAL IF GRAVITY DRAIN NOT AVAILABLE)

- A. Provide high-pressure corrosion resistant inline jet pump dedicated for the separator system. Install between separator and gate or swing-type check valve normally installed at separator drain outlet. Outlet air

solenoid valve between separator and turbine is prohibited. Pumps shall be controlled by liquid level sensors in the separator.

2.13 SEPARATOR DRAIN AND VENT

- A. Construct in accordance with NFPA 99, 5.3.3.10.1.3 for Drainage from Vacuum Equipment and 5.3.3.10.1.4 for Vacuum Exhaust.

2.14 VACUUM CLEANING INLET

- A. Use only in oral surgery recovery rooms. Provide recessed wall inlet valve with 40 mm (1-1/2 inch NPS) male hose repair coupling with 15 mm (1/2 inch NPS) outside diameter aluminum tube stub 50 mm (2 inches) long.

2.15 VACUUM GAGE (DUAL SCALE)

- A. In remote control panel: ASME B40.100, 40 mm (1-1/2 inch) dial with decorative ring and a dial range of 0 to 100 kPa (0 to 29.5 inches Hg).

SPEC WRITER NOTE: Delete the following paragraph if no separator.

- B. In piping near separator: ASME B40.100, with metal case, 115 mm (4-1/2 inch) dial with a dial range of 0 to 100 kPa (0 to 29.5 inches Hg).

2.16 PVC BODY BALL VALVES

- A. PVC Body double-seal ball valves with replaceable neoprene or TFE seat seals. Provide valves suitable for at least 690 kPa (100 psig), cold water, non-shock working pressure. Designed especially for vacuum service. Operating parts of valve shall be removable without removing from line.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Place vacuum producers on insulating pads furnished with the equipment. Do not bolt or anchor equipment to the floor slab.
- B. Cut pipe square, with burrs removed and install with minimum obstructions to air flow. Use DWV (drain-waste-vent) long-radius fittings for turns and wye type for branches.
- C. Slope horizontal piping not less than 2 mm per 1 m (1/4 inch per 10 feet) toward the separator tanks.
- D. All fittings shall be DWV (drain-waste-vent) long-radius bend types for turns and wye types for branching. For small bore piping for which long-radius bends are not available, two 45-degree bends shall be substituted for 90-degree turning.
- E. All risers to all HVE inlet locations shall be 40 mm (1-1/2 inch NPS). Risers shall connect to trunk-lines whose nominal pipe sizes shall be

determined by head loss calculations that yield a system designed for no more than 1.7 kPa (0.5 inches Hg) worse case head loss. Piping no smaller than 40 mm (1-1/2 inch NPS) shall be used.

- F. The cross-sectional area of all trunk-lines shall be graduated, increasing toward the vacuum source. The cross-sectional area at any point along the trunk-line shall equate to the sum of the riser cross-sectional areas connected prior to that point. Individual trunk-lines shall terminate with connection to the manifold of the separators.

SPEC WRITER NOTE: Delete the following three paragraphs if wet-type system is specified.

- G. If backward curve impeller design turbine is installed, terminate the most distant end from the separator of each trunk-line with a vacuum relief valve.
- H. Install separators level and anchored to the floor slab.
- I. Startup shall be by factory representative and observed by COR.
- J. Penetrations:
1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Completely fill and seal clearances between raceways and openings with the fire stopping material.
 2. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.

3.2 STARTUP AND TESTING

- A. Pipe Leakage Test: Test in accordance with NFPA 99, 5.3.12.2.5 Category 3 Plastic Vacuum Piping Systems. Exhaust complete piping system to a vacuum of not less than 27 kPa (8 inch Hg) after the pipe line is dried out initially. Vacuum shall not decrease by more than 1.4 kPa (0.4 inch Hg) in one hour. If the vacuum does not hold, repair the leaks and retest.
- B. Air Volume and Vacuum Tests:
1. Tests shall confirm that the system shall meet air volume and vacuum requirements at aspirator tips and that vacuum producer(s) shall produce the total capacity required as specified in paragraph

"Quality Assurance". Perform tests after all oral evacuation equipment is properly installed and piping is cleaned and proved tight.

2. Install HVE tips into the designed number of the facility's HVE valves. Close all remaining HVE valves.
 3. With all hoses fully closed, start the system. Fifteen minutes after startup, measure the current draw of the motors with ammeter and record the reading of the vacuum gage. Fully open HVE valves with HVE tips in them and record the current and vacuum values again. Amperage measurements shall not exceed the motor full load amperage rating.
 4. Check entire system and ensure the minimum flow stated in paragraph "Quality Assurance" is achieved.
- C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to startup or testing.
- D. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with NFPA 99 and the procedures set forth in pre-qualification documentation.

//3.3 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.4 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //four// // // hours to instruct VA Personnel in operation and maintenance of the system.
- //B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

- - - E N D - - -