SECTION 226219 - VACUUM EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

Revise this Section by deleting or inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section Includes:

Reciprocating vacuum pumps.

Liquid-ring vacuum pumps.

Oil-sealed, rotary-screw vacuum pumps.

Rotary, dry-claw vacuum pumps.

Rotary, sliding-vane vacuum pumps.

Turbine exhausters.

Diaphragm vacuum pumps.

Dental vacuum pumps.

Dental vacuum pump control panels.

* + - * 1. Related Requirements:

Retain subparagraph below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Section 226400 "Medical Gas Alarms" for vacuum equipment local alarms.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. Actual Air: Air delivered at vacuum producer inlet. Flow rate is air measured in acfm.
				2. HVE: High-volume oral evacuation for dental applications in healthcare facilities.

Equipment for laboratory vacuum systems in "Laboratory Vacuum Equipment" paragraph below is not required to comply with NFPA 99.

* + - * 1. Laboratory Vacuum Equipment: Vacuum producers and accessories for nonmedical laboratory facilities.
				2. Medical Vacuum Equipment: Includes [**medical**] [**WAGD**] [**dental**] [**HVE**] [**and**] [**healthcare laboratory**] vacuum producers and accessories for healthcare facilities.
				3. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.
				4. WAGD: Waste anesthetic gas disposal for medical-surgical applications in healthcare facilities.
			1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.
				5. Shop Drawings: For vacuum producers.

Include plans, elevations, sections, and [**mounting**]details.

Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

Include diagrams for power, signal, and control wiring.

Coordinate "Qualification Data" paragraph below with qualification requirements and as may be supplemented in "Quality Assurance" Article.

* + - * 1. Qualification Data: For [**Installer**] [**and**] [**testing agency**].

Retain "Seismic Qualification Certificates" paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Certificates: For vacuum producers, accessories, and components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For vacuum equipment to include in operation and maintenance manuals.
			2. MAINTENANCE MATERIAL SUBMITTALS
				1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Belts: [**One**] [**Two**] <**Insert number**> for each belt-driven vacuum producer.

* + - 1. QUALITY ASSURANCE
				1. Installer Qualifications:

Retain "Laboratory Vacuum Equipment for Nonmedical Laboratory Facilities" subparagraph below for equipment in nonmedical laboratory facilities.

Laboratory Vacuum Equipment for Nonmedical Laboratory Facilities: An employer of workers trained and approved by manufacturer.

Retain "Medical Vacuum Equipment for Healthcare Facilities" subparagraph below for equipment in healthcare facilities.

Medical Vacuum Equipment for Healthcare Facilities: Qualify installers according to ASSE 6010.

Retain "Testing Agency Qualifications" paragraph below if Contractor selects testing agency or if Contractor is required to provide services of a qualified testing agency in "Field Quality Control for Healthcare-Facility Medical Vacuum Equipment" Article.

Retain "Testing Agency Qualifications" paragraph for medical vacuum system equipment.

* + - * 1. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum equipment testing indicated, that is[**a member of the Medical Gas Professional Healthcare Organization or is**] an NRTL, and that is acceptable to authorities having jurisdiction.

Qualify testing personnel according to ASSE 6020 “Medical Gas System Inspector” for inspectors and ASSE 6030 “Medical Gas System Verifier” for verifiers.

1. PRODUCTS

See Editing Instruction No. 1 in the Evaluations for cautions about named manufacturers and products.

Where the term "simplex" is used in this Section, it means one of the indicated items; "duplex" means two; and "multiplex" means more than two.

* + - 1. PERFORMANCE REQUIREMENTS

Retain "Delegated Design" paragraph below if Contractor is required to assume responsibility for design.

* + - * 1. Delegated Design: Engage a qualified Director’s Representative to design vacuum equipment mounting.

Retain "Seismic Performance" paragraph below with "Seismic Qualification Certificates" paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Vacuum producers[**and accessories**] shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

Retain first subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the vacuum producer [**and**] [**receiver or separator**] will remain in place without separation of any parts when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: [**1.5**] [**1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

<**Insert requirements for Component Amplification Factor and Component Response Modification Factor**>.

* + - 1. GENERAL REQUIREMENTS FOR VACUUM PUMPS
				1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “Standard for Electrical Safety in the Workplace”, by a qualified testing agency, and marked for intended location and application.
				2. Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems.
				3. Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.
				4. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty vacuum pumps and receivers.
				5. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 “Industrial Control and Systems Controllers, Contractors and Overload Relays Rated 600 Volts” and UL 508 “Standard for Safety for Industrial Control Equipment”.

Enclosure: NEMA ICS 6 “Industrial Control and Systems: Enclosures”, Type 12 control panel unless otherwise indicated.

Motor Controllers: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.

Control Voltage: 120-V ac or less, using integral control power transformer.

Motor Overload Protection: Overload relay in each phase.

Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.

Retain first subparagraph below for duplex and multiplex vacuum producers.

Automatic control switches to [**alternate lead-lag vacuum pumps for duplex**] [**and**] [**sequence lead-lag vacuum pumps for multiplex**] vacuum pumps.

Instrumentation: Include vacuum pump inlet and receiver vacuum gages, hour meter, vacuum pump discharge-air and coolant temperature gages, and control transformer.

Alarm Signal Devices: For connection to alarm system to indicate when backup vacuum pump is operating.

* + - * 1. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1; bearing appropriate code symbols.

Interior Finish: Corrosion-resistant coating.

Accessories: Include vacuum relief valve, vacuum gage, and drain.

Retain "Mounting Frames" paragraph below for projects in seismic areas.

* + - * 1. Mounting Frames: Fabricate base and attachment to vacuum pump and components with reinforcement strong enough to resist movement during a seismic event when base is anchored to building structure.
			1. RECIPROCATING VACUUM PUMPS

See the table at the end of the Evaluations for a list of manufacturers' products. Use this table in combination with manufacturers' catalogs or product data to insert series, type, model, and designations of other characteristics for each product required.

Copy "Reciprocating Vacuum Pumps" paragraph below and re-edit for each type of reciprocating vacuum pump required.

Insert drawing designation for each product required. Use these designations on Drawings to identify each reciprocating vacuum pump.

* + - * 1. Reciprocating Vacuum Pumps <**Insert drawing designation**>:

Description: Packaged unit.

Vacuum Pump(s): Lubricated, reciprocating-piston type.

Inlet filters.

Low-lubrication oil pressure switches, submerged gear-type oil pumps, and oil filters.

Belt guards totally enclosing pulleys and belts.

Receiver: ASME construction steel tank with vacuum relief valve.

Outlet silencers and oil-mist separators on discharge piping.

If Project has more than one type or configuration of vacuum producer (or vacuum pump), delete "Capacities and Characteristics" paragraph below and schedule vacuum producers (or vacuum pumps) on Drawings.

Coordinate data specified in "Capacities and Characteristics" paragraph below with piping systems in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" and with alarm systems in Section 226400 "Medical Gas Alarms."

* + - * 1. Capacities and Characteristics:

Vacuum Service: [**Medical**] [**WAGD**] [**Dental**] [**Medical laboratory**] [**Nonmedical laboratory**] <**Insert service**> vacuum.

Vacuum Pump(s): [**One**] [**Two**] [**Three**] <**Insert number**>.

Retain one of or both "Standard-Air Capacity of Each Vacuum Pump" and "Actual-Air Capacity of Each Vacuum Pump" subparagraphs below.

Standard-Air Capacity of Each Vacuum Pump: <**Insert scfm**> free air.

Actual-Air Capacity of Each Vacuum Pump: <**Insert acfm**> expanded air delivered.

Vacuum Required: [**20 in. Hg**] [**26 in. Hg**] <**Insert value**>.

Mounting: [**Freestanding**] [**Tank mounted**].

Motor (Each Vacuum Pump):

Horsepower: <**Insert value**>.

Speed: [**1750**] [**3400**] <**Insert speed**> rpm.

Electrical Characteristics:

Volts: <**Insert value**>.

Phase(s): [**Single**] [**Three**].

Hertz: [**60**] <**Insert value**>.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

Receiver:

Orientation: [**Horizontal**] [**Vertical**] arrangement.

Capacity: <**Insert gal.**>.

Pressure Rating: [**100 psig**] <**Insert value**> minimum.

Interior Finish: [**Epoxy**] [**Epoxy or galvanized**] [**Galvanized**] <**Insert coating**>.

Drain: [**Automatic**] [**Manual**] valve.

* + - 1. LIQUID-RING VACUUM PUMPS

See the table at the end of the Evaluations for a list of manufacturers' products. Use this table in combination with manufacturers' catalogs or product data to insert series, type, model, and designations of other characteristics for each product required.

Copy "Liquid-Ring Vacuum Pumps" paragraph below and re-edit for each type of liquid-ring vacuum pump required.

Insert drawing designation for each product required. Use these designations on Drawings to identify each liquid-ring vacuum pump.

* + - * 1. Liquid-Ring Vacuum Pumps <**Insert drawing designation**>:

Description: Packaged unit.

Vacuum Pump(s): Nonpulsating, rotary, liquid-ring type.

Construction: [**Cast-iron body and**] [**Cast-iron body with bronze**] [**Bronze body and**] rotor.

Coupling: Nonlubricated, flexible type.

Sealing Fluid: Potable water with up to 90 percent recirculation.

Receiver: ASME construction steel tank with vacuum relief valve.

Outlet silencers and water-vapor separators on discharge connections.

If Project has more than one type or configuration of vacuum producer (or vacuum pump), delete "Capacities and Characteristics" paragraph below and schedule vacuum producers (or vacuum pumps) on Drawings.

Coordinate data specified in "Capacities and Characteristics" paragraph below with piping systems in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" and with alarm systems in Section 226400 "Medical Gas Alarms."

* + - * 1. Capacities and Characteristics:

Vacuum Service: [**Medical**] [**WAGD**] [**Dental**] [**Medical laboratory**] [**Nonmedical laboratory**] <**Insert service**> vacuum.

Vacuum Pump(s): [**One**] [**Two**] [**Three**] <**Insert number**>.

Retain one of or both "Standard-Air Capacity of Each Vacuum Pump" and "Actual-Air Capacity of Each Vacuum Pump" subparagraphs below.

Standard-Air Capacity of Each Vacuum Pump: <**Insert scfm**> free air.

Actual-Air Capacity of Each Vacuum Pump: <**Insert acfm**> expanded air delivered.

Vacuum Required: [**8 in. Hg**] [**10 in. Hg**] [**12 in. Hg**] <**Insert value**>.

Mounting: [**Freestanding**] [**Tank mounted**].

Motor (Each Vacuum Pump):

Horsepower: <**Insert value**>.

Speed: [**1750**] [**3400**] <**Insert speed**> rpm.

Electrical Characteristics:

Volts: <**Insert value**>.

Phase(s): [**Single**] [**Three**].

Hertz: [**60**] <**Insert value**>.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

Receiver:

Orientation: [**Horizontal**] [**Vertical**] arrangement.

Capacity: <**Insert gal.**>.

Pressure Rating: [**100 psig**] <**Insert value**> minimum.

Interior Finish: [**Epoxy**] [**Epoxy or galvanized**] [**Galvanized**] <**Insert coating**>.

Drain: [**Automatic**] [**Manual**] valve.

* + - 1. OIL-SEALED, ROTARY-SCREW VACUUM PUMPS

See the table at the end of the Evaluations for a list of manufacturers' products. Use this table in combination with manufacturers' catalogs or product data to insert series, type, model, and designations of other characteristics for each product required.

Copy "Oil-Sealed, Rotary-Screw Vacuum Pumps" paragraph below and re-edit for each type of oil-sealed, rotary-screw vacuum pump required.

Insert drawing designation for each product required. Use these designations on Drawings to identify each oil-sealed, rotary-screw vacuum pump.

* + - * 1. Oil-Sealed, Rotary-Screw Vacuum Pumps <**Insert drawing designation**>:

Description: Packaged unit.

Vacuum Pump(s): Single-stage, oil-sealed, rotary, helical-screw type.

Coupling: Nonlubricated, flexible type.

Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package prepiped to unit; with air-pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal-bypass valve.

Air/Coolant Receiver and Separation Systems: 150-psig- rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal-bypass valve.

Capacity Control: Capacity modulation between zero and 100 percent vacuum delivery. Include necessary control to hold constant vacuum. When vacuum demand is zero, unload unit by using vacuum switch and blowdown valve.

Receiver: ASME construction steel tank with vacuum relief valve.

Outlet silencers on discharge connections.

If Project has more than one type or configuration of vacuum producer (or vacuum pump), delete "Capacities and Characteristics" paragraph below and schedule vacuum producers (or vacuum pumps) on Drawings.

Coordinate data specified in "Capacities and Characteristics" paragraph below with piping systems in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" and with alarm systems in Section 226400 "Medical Gas Alarms."

* + - * 1. Capacities and Characteristics:

Vacuum Service: [**Medical**] [**WAGD**] [**Dental**] [**Medical laboratory**] [**Nonmedical laboratory**] <**Insert service**> vacuum.

Vacuum Pump(s): [**One**] [**Two**] [**Three**] <**Insert number**>.

Retain one of or both "Standard-Air Capacity of Each Vacuum Pump" and "Actual-Air Capacity of Each Vacuum Pump" subparagraphs below.

Standard-Air Capacity of Each Vacuum Pump: <**Insert scfm**> free air.

Actual-Air Capacity of Each Vacuum Pump: <**Insert acfm**> expanded air delivered.

Vacuum Required: [**20 in. Hg**] [**26 in. Hg**] <**Insert value**>.

Motor (Each Vacuum Pump):

Horsepower: <**Insert value**>.

Speed: [**1750**] [**3400**] <**Insert speed**> rpm.

Electrical Characteristics:

Volts: <**Insert value**>.

Phase(s): [**Single**] [**Three**].

Hertz: [**60**] <**Insert value**>.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

Receiver:

Orientation: [**Horizontal**] [**Vertical**] arrangement.

Capacity: <**Insert gal.**>.

Pressure Rating: [**100 psig**] <**Insert value**> minimum.

Interior Finish: [**Epoxy**] [**Epoxy or galvanized**] [**Galvanized**] <**Insert coating**>.

Drain: [**Automatic**] [**Manual**] valve.

* + - 1. ROTARY, DRY-CLAW VACUUM PUMPS

See the table at the end of the Evaluations for a list of manufacturers' products. Use this table in combination with manufacturers' catalogs or product data to insert series, type, model, and designations of other characteristics for each product required.

Copy "Rotary, Dry-Claw Vacuum Pumps" paragraph below and re-edit for each type of rotary, dry-claw vacuum pump required.

Insert drawing designation for each product required. Use these designations on Drawings to identify each rotary, dry-claw vacuum pump.

* + - * 1. Rotary, Dry-Claw Vacuum Pumps <**Insert drawing designation**>:

Description: Packaged unit.

Vacuum Pump(s): Single-stage, rotary, dry-claw type.

Coupling: Nonlubricated, flexible type.

Cooling System: Air cooled.

Capacity Control: Capacity modulation between zero and 100 percent vacuum delivery. Include necessary control to hold constant vacuum. When vacuum demand is zero, unload unit by using vacuum switch and blowdown valve.

Receiver: ASME construction steel tank with vacuum relief valve.

Outlet silencers on discharge connections.

If Project has more than one type or configuration of vacuum producer (or vacuum pump), delete "Capacities and Characteristics" paragraph below and schedule vacuum producers (or vacuum pumps) on Drawings.

Coordinate data specified in "Capacities and Characteristics" paragraph below with piping systems in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" and with alarm systems in Section 226400 "Medical Gas Alarms."

* + - * 1. Capacities and Characteristics:

Vacuum Service: [**Medical**] [**WAGD**] [**Dental**] [**Medical laboratory**] [**Nonmedical laboratory**] <**Insert service**> vacuum.

Vacuum Pump(s): [**One**] [**Two**] [**Three**] <**Insert number**>.

Retain one of or both "Standard-Air Capacity of Each Vacuum Pump" and "Actual-Air Capacity of Each Vacuum Pump" subparagraphs below.

Standard-Air Capacity of Each Vacuum Pump: <**Insert scfm**> free air.

Actual-Air Capacity of Each Vacuum Pump: <**Insert acfm**> expanded air delivered.

Vacuum Required: [**20 in. Hg**] [**26 in. Hg**] <**Insert value**>.

Motor (Each Vacuum Pump):

Horsepower: <**Insert value**>.

Speed: [**1750**] [**3400**] <**Insert speed**> rpm.

Electrical Characteristics:

Volts: <**Insert value**>.

Phase(s): [**Single**] [**Three**].

Hertz: [**60**] <**Insert value**>.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

Receiver:

Orientation: [**Horizontal**] [**Vertical**] arrangement.

Capacity: <**Insert gal.**>.

Pressure Rating: [**100 psig**] <**Insert value**> minimum.

Interior Finish: [**Epoxy**] [**Epoxy or galvanized**] [**Galvanized**] <**Insert coating**>.

Drain: [**Automatic**] [**Manual**] valve.

* + - 1. ROTARY, SLIDING-VANE VACUUM PUMPS

See the table at the end of the Evaluations for a list of manufacturers' products. Use this table in combination with manufacturers' catalogs or product data to insert series, type, model, and designations of other characteristics for each product required.

Copy "Oil-Free, Rotary, Sliding-Vane Vacuum Pumps" paragraph below and re-edit for each type of oil-free, rotary, sliding-vane vacuum pump required.

Insert drawing designation for each product required. Use these designations on Drawings to identify each oil-free rotary, sliding-vane vacuum pump.

* + - * 1. Oil-Free, Rotary, Sliding-Vane Vacuum Pumps <**Insert drawing designation**>:

Description: Packaged unit.

Vacuum Pump(s): Nonpulsating, oil-free, rotary, sliding-vane type.

Cleanable inlet screens.

Outlet silencers on discharge connections.

Copy "Oil-Sealed, Rotary, Sliding-Vane Vacuum Pumps" paragraph below and re-edit for each type of oil-sealed, rotary, sliding-vane vacuum pump required.

Insert drawing designation for each product required. Use these designations on Drawings to identify each oil-sealed, rotary, sliding-vane vacuum pump.

* + - * 1. Oil-Sealed, Rotary, Sliding-Vane Vacuum Pumps <**Insert drawing designation**>:

Description: Packaged unit.

Vacuum Pumps: Nonpulsating, oil-sealed, rotary, sliding-vane type.

Cleanable inlet screens.

Outlet silencers and oil-mist separators on discharge connections.

Receiver: ASME construction steel tank with vacuum relief valve.

If Project has more than one type or configuration of vacuum producer (or vacuum pump), delete "Capacities and Characteristics" paragraph below and schedule vacuum producers (or vacuum pumps) on Drawings.

Coordinate data specified in "Capacities and Characteristics" paragraph below with piping systems in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" and with alarm systems in Section 226400 "Medical Gas Alarms."

* + - * 1. Capacities and Characteristics:

Vacuum Service: [**Medical**] [**WAGD**] [**Dental**] [**Medical laboratory**] [**Nonmedical laboratory**] <**Insert service**> vacuum.

Vacuum Pump(s): [**One**] [**Two**] [**Three**] <**Insert number**>.

Retain one of or both "Standard-Air Capacity of Each Vacuum Pump" and "Actual-Air Capacity of Each Vacuum Pump" subparagraphs below.

Standard-Air Capacity of Each Vacuum Pump: <**Insert scfm**> free air.

Actual-Air Capacity of Each Vacuum Pump: <**Insert acfm**> expanded air delivered.

Vacuum Required: [**20 in. Hg**] [**26 in. Hg**] <**Insert value**>.

Mounting: [**Freestanding**] [**Tank mounted**].

Motor (Each Vacuum Pump):

Horsepower: <**Insert value**>.

Speed: [**1750**] [**3400**] <**Insert speed**> rpm.

Electrical Characteristics:

Volts: <**Insert value**>.

Phase(s): [**Single**] [**Three**].

Hertz: [**60**] <**Insert value**>.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

Receiver:

Orientation: [**Horizontal**] [**Vertical**] arrangement.

Capacity: <**Insert gal.**>.

Pressure Rating: [**100 psig**] <**Insert value**> minimum.

Interior Finish: [**Epoxy**] [**Epoxy or galvanized**] [**Galvanized**] <**Insert coating**>.

Drain: [**Automatic**] [**Manual**] valve.

* + - 1. TURBINE EXHAUSTERS

Copy "Turbine Exhausters" paragraph below and re-edit for each type of turbine exhauster required.

Insert drawing designation for each product required. Use these designations on Drawings to identify each turbine exhauster.

* + - * 1. Turbine Exhausters <**Insert drawing designation**>:

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “Standard for Electrical Safety in the Workplace”, by a qualified testing agency, and marked for intended location and application.

Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems.

Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.

Description: Factory-assembled, -wired, -piped, -tested, and -packaged; electric-motor-driven; air-cooled; continuous-duty turbine exhausters and separators suitable for HVE applications and capable of producing not less than [**12 in. Hg**] <**Insert value**>.

Control Panel: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 “Industrial Control and Systems Controllers, Contractors and Overload Relays Rated 600 Volts” and UL 508 “Standard for Safety for Industrial Control Equipment”.

Enclosure: NEMA ICS 6 “Industrial Control and Systems: Enclosures”, Type 12 control panel unless otherwise indicated.

Motor Controller: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.

Control Voltage: 120-V ac or less, using integral control power transformer.

Motor Overload Protection: Overload relay in each phase.

Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.

Retain first subparagraph below for duplex turbine exhausters.

Automatic control switches to alternate lead-lag turbine exhausters for duplex turbine exhausters.

Instrumentation: Include inlet turbine exhauster and separator vacuum gages, hour meter, discharge-air temperature gage, and control transformer.

Alarm Signal Device: For connection to alarm system to indicate when backup turbine exhauster is operating.

Air-Water Wet Separator: Vertical, steel tank constructed according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1; bearing appropriate code symbols; and shall withstand not less than [**25 in. Hg**] <**Insert value**>.

Airflow Inlet: Tangential, in sidewall near top.

Wash-Down Assembly: Electric timer with devices to operate water spray nozzle.

Water Spray Nozzle: Water inlet connection and nozzle in top head.

Airflow Outlet: Centered, in top head.

Cleanout: Handhold, in sidewall near bottom.

Drain: Automatic type, and check valve in sidewall at bottom.

Safety Valve: Vacuum relief valve.

Gage: Vacuum gage, tank mounted or furnish for piping mounting.

Directional Flow Valve: For installation in separator inlet piping.

Silencer: For installation in turbine exhauster outlet piping.

Miscellaneous Devices: Safety valves, inlet vacuum gages, and shutoff valves.

Retain "Mounting Frame" paragraph below for projects in seismic areas.

Mounting Frame: Fabricate base and attachment to separator with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

If Project has more than one type or configuration of turbine exhauster, delete "Capacities and Characteristics" paragraph below and schedule turbine exhausters on Drawings.

Coordinate data specified in "Capacities and Characteristics" paragraph below with piping systems in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" and with alarm systems in Section 226400 "Medical Gas Alarms."

* + - * 1. Capacities and Characteristics:

Vacuum Service: [**HVE**] <**Insert service**> vacuum.

Turbine Exhauster(s): [**One**] [**Two**].

Retain one of or both "Standard-Air Capacity of Each Turbine Exhauster" and "Actual-Air Capacity of Each Turbine Exhauster" subparagraphs below.

Standard-Air Capacity of Each Turbine Exhauster: <**Insert scfm**> free air.

Actual-Air Capacity of Each Turbine Exhauster: <**Insert acfm**> expanded air delivered.

Vacuum Required: [**8 in. Hg**] [**10 in. Hg**] <**Insert value**>.

Motor (Each Turbine Exhauster):

Horsepower: <**Insert value**>.

Speed: [**1750**] [**3400**] <**Insert speed**> rpm.

Electrical Characteristics:

Volts: <**Insert value**>.

Phase(s): [**Single**] [**Three**].

Hertz: [**60**] <**Insert value**>.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

Separator:

Capacity: <**Insert gal.**>.

Pressure Rating: [**100 psig**] <**Insert value**> minimum.

Interior Finish: [**Epoxy**] [**Epoxy or galvanized**] [**Galvanized**] <**Insert coating**>.

Liquid-Level Sensors: [**Automatic electric**] [**Automatic electric or mechanical float switch**] [**Mechanical float switch**] to operate drain valve.

* + - 1. DIAPHRAGM VACUUM PUMPS

Diaphragm vacuum pumps typically have extremely low capacities and do not have a receiver. Verify that manufacturers and units can produce volume of air at vacuum required.

See the table at the end of the Evaluations for a list of manufacturers' products. Use this table in combination with manufacturers' catalogs or product data to insert series, type, model, and designations of other characteristics for each product required.

Copy "Diaphragm Vacuum Pumps" paragraph below and re-edit for each type of diaphragm vacuum pump required.

Insert drawing designation for each product required. Use these designations on Drawings to identify each diaphragm vacuum pump.

* + - * 1. Diaphragm Vacuum Pumps <**Insert drawing designation**>:

Description: Simplex, single-stage, oil-free, diaphragm vacuum pump.

Retain "Option" subparagraph below if these types are acceptable.

Option: Construction may be articulating-piston, reciprocating-piston, or rotary-sliding-vane type.

Control: Adjustable vacuum switch.

Cleanable inlet screen.

Outlet silencer and oil-mist separator on discharge.

Mounting: Freestanding.

If Project has more than one type or configuration of vacuum producer (or vacuum pump), delete "Capacities and Characteristics" paragraph below and schedule vacuum producers (or vacuum pumps) on Drawings.

Coordinate data specified in "Capacities and Characteristics" paragraph below with piping systems in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities."

* + - * 1. Capacities and Characteristics:

Vacuum Service: [**Medical laboratory**] [**Nonmedical laboratory**] <**Insert service**> vacuum.

Vacuum Pump:

Retain one of or both "Standard-Air Capacity of Each Vacuum Pump" and "Actual-Air Capacity of Each Vacuum Pump" subparagraphs below.

Standard-Air Capacity of Each Vacuum Pump: <**Insert scfm**> free air.

Actual-Air Capacity of Each Vacuum Pump: <**Insert acfm**> expanded air delivered.

Vacuum Required: [**10 in. Hg**] [**12 in. Hg**] <**Insert value**>.

Motor:

Horsepower: <**Insert value**>.

Speed: [**1750**] [**3400**] <**Insert speed**> rpm.

Electrical Characteristics:

Volts: <**Insert value**>.

Phase(s): [**Single**] [**Three**].

Hertz: [**60**] <**Insert value**>.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

* + - 1. DENTAL VACUUM PUMPS

Retain this article only for small (typically up to four workstations) office's dental equipment. Dental vacuum equipment in this article is of limited capacity. A separator is not required.

See the table at the end of the Evaluations for a list of manufacturers' products. Use this table in combination with manufacturers' catalogs or product data to insert series, type, model, and designations of other characteristics for each product required.

Copy "Dental Vacuum Pumps" paragraph below and re-edit for each type of dental vacuum pump required.

Insert drawing designation for each product required. Use these designations on Drawings to identify each dental vacuum pump.

* + - * 1. Dental Vacuum Pumps <**Insert drawing designation**>:

Description: Factory-assembled, -tested, and -packaged; [**simplex**] [**duplex**]; automatic, dental vacuum system; suitable for dental applications and capable of producing not less than [**12 in. Hg**] <**Insert value**>.

Retain "Simplex Vacuum Pump" or "Duplex Vacuum Pumps" subparagraph below that matches option in "Description" paragraph above.

Simplex Vacuum Pump: For mounting on base or on floor.

Vacuum Pump: Brass water-injection or liquid-ring type with rubber isolators on feet. Include fitting and tubing for circulation of approximately 80 percent of water through vacuum pump.

Cabinet: Enameled steel; open construction[**with sound-insulated cover**]. Include control panel with adjustable vacuum control, manual on-off switch, on light, and vacuum gage.

Retain "Dual-Voltage Control" subparagraph below only if required.

Dual-Voltage Control: Conversion unit for connection to 208- or 230-V ac power.

Water Filter: For installation in inlet water supply.

Backflow Preventer: Integral with unit or separate reduced-pressure-zone type for field installation in inlet-water supply piping. See Section 221119 "Domestic Water Piping Specialties" for separate backflow preventers.

Check Valve: For installation in vacuum pump suction.

Vacuum Relief Valve: For installation in vacuum pump suction.

Air-Water Separator: With integral control to release wastewater when unit is shut off.

Waste Muffler: For installation in vacuum pump waste piping.

Duplex Vacuum Pumps: For mounting on base or on floor.

Vacuum Pumps: Brass water-injection or liquid-ring type with rubber isolators on feet. Include fitting and tubing for circulation of approximately 80 percent of water through vacuum pump.

Cabinet: Enameled steel; open construction[**with sound-insulated cover**]. Include control panel with alternator, adjustable vacuum control for each vacuum pump, manual on-off switches, on light, and vacuum gage.

Retain "Dual-Voltage Control" subparagraph below only if required.

Dual-Voltage Control: Conversion unit for connection to 208- or 230-V ac power.

Water Filter: For installation in inlet water supply.

Backflow Preventer: Integral with unit or separate reduced-pressure-zone type for field installation in inlet-water supply piping. See Section 221319 "Sanitary Waste Piping Specialties" for separate backflow preventers.

Check Valves: For installation in each vacuum pump suction.

Vacuum Relief Valves: For installation in each vacuum pump suction.

Air-Water Separators: With integral control to release wastewater when unit is shut off.

Waste Mufflers: For installation in each vacuum pump waste piping.

If Project has more than one type or configuration of dental vacuum pump, delete "Capacities and Characteristics" paragraph below and schedule dental vacuum pumps on Drawings.

Coordinate data specified in "Capacities and Characteristics" paragraph below with piping systems in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" and with alarm systems in Section 226400 "Medical Gas Alarms."

* + - * 1. Capacities and Characteristics:

Vacuum Service: Dental [**vacuum**] [**HVE**] <**Insert service**>.

Vacuum Pumps: [**One**] [**Two**].

Retain one of or both "Standard-Air Capacity of Each Vacuum Pump" and "Actual-Air Capacity of Each Vacuum Pump" subparagraphs below.

Standard-Air Capacity of Each Vacuum Pump: <**Insert scfm**> free air.

Actual-Air Capacity of Each Vacuum Pump: <**Insert acfm**> expanded air delivered.

Vacuum Required: [**10 in. Hg**] [**12 in. Hg**] <**Insert value**>.

Motor (Each Vacuum Pump):

Horsepower: <**Insert value**>.

Speed: [**1750**] [**3400**] <**Insert speed**> rpm.

Electrical Characteristics:

Volts: <**Insert value**>.

Phase(s): [**Single**] [**Three**].

Hertz: [**60**] <**Insert value**>.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

* + - 1. DENTAL VACUUM PUMP CONTROL PANELS

Retain this article only for small (typically up to four workstations) office's dental equipment.

Copy "Dental Vacuum Pump Control Panels" paragraph below and re-edit for each type of dental vacuum pump control panel required.

Insert drawing designation for each product required. Use these designations on Drawings to identify each dental vacuum pump control panel.

* + - * 1. Dental Vacuum Pump Control Panels <**Insert drawing designation**>:

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “Standard for Electrical Safety in the Workplace”, by a qualified testing agency, and marked for intended location and application.

Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems.

Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.

Description: Wall-mounted type with visual indicators to indicate equipment in operation and to perform the following:

Shut off dental vacuum equipment.

Shut off water supply to dental vacuum equipment. Include solenoid-operated valve for installation in water piping.

* + - * 1. Control panels may be combined with dental air compressor control panels in single dental equipment control panels.
			1. MOTORS

Default motor characteristics are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

* + - * 1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

Verify enclosure types with manufacturer of specified equipment. Delete "Enclosure" subparagraph below if included in schedule on Drawings or in "Capacities and Characteristics" paragraphs.

Enclosure: [**Open, dripproof**] [**Totally enclosed, fan cooled**] [**Totally enclosed, air over**] [**Open, externally ventilated**] [**Totally enclosed, nonventilated**] [**Severe duty**] [**Explosion proof**] [**Dust-ignition-proof machine**].

Retain "Enclosure Materials," "Motor Bearings," "Unusual Service Conditions," "Efficiency," "NEMA Design," and "Service Factor" subparagraphs below if options are available from equipment manufacturers and are different from default requirements specified in Section 220513 "Common Motor Requirements for Plumbing Equipment." Consider each subparagraph and retain only those that vary from default requirements.

Enclosure Materials: [**Cast iron**] [**Cast aluminum**] [**Rolled steel**].

Motor Bearings: <**Insert requirements**>.

Unusual Service Conditions:

Ambient Temperature: <**Insert deg C**>.

Altitude: <**Insert feet**> above sea level.

High humidity.

<**Insert conditions**>.

Efficiency: Premium efficient.

NEMA Design: <**Insert designation**>.

Service Factor: <**Insert value**>.

Retain "Electrical Characteristics" subparagraph below if characteristics are not indicated on Drawings or in "Capacities and Characteristics" paragraphs.

Electrical Characteristics:

Horsepower: <**Insert horsepower**>.

Volts: [**120**] [**208**] [**230**] [**460**] <**Insert value**>.

Phase: [**Single**] [**Poly**].

Hertz: 60.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

1. EXECUTION
	* + 1. PREPARATION

Retain this article only if required. Vacuum system equipment and other components typically are not required to be cleaned.

* + - * 1. Clean vacuum equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for [**laboratory vacuum**] [**and**] [**medical vacuum**] applications, according to CGA G4.1, "Cleaning Equipment for Oxygen Service."
			1. VACUUM EQUIPMENT INSTALLATION
				1. Install vacuum equipment for healthcare facilities according to ASSE 6010 “Medical Gas System Installer” and NFPA 99 “Health Care Facilities Code”.
				2. Equipment Mounting:

Retain first subparagraph below to require equipment to be installed on cast-in-place concrete equipment bases.

Install [**vacuum producers**] [**vacuum producers, except diaphragm vacuum pumps,**] <**Insert vacuum producer types**> on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

Retain one of two subparagraphs below. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device type and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment.”

Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

* + - * 1. Install vacuum equipment anchored to substrate.
				2. Orient equipment so controls and devices are accessible for servicing.
				3. Maintain manufacturer's recommended clearances for service and maintenance.
				4. Install the following devices on vacuum equipment:

Thermometer, Vacuum Gage, and Pressure Relief Valve: Install on each vacuum pump receiver.

Drain Valves: Install on [**receivers**] [**and**] [**separators**]. Discharge receiver condensate over nearest floor drain. Discharge separator oral evacuation fluids by direct connection into sanitary waste piping system.

Retain "Dental Vacuum System Equipment Installation" paragraph below for dental vacuum system equipment in a small dental office.

* + - * 1. Dental Vacuum System Equipment Installation:

Install according to ASSE 6010 “Medical Gas System Installer” and NFPA 99 “Health Care Facilities Code”.

Install dental vacuum system units [**directly on floor**] [**on concrete bases**] with [**restrained**]elastomeric mounts with a minimum deflection of <**Insert deflection**>. Vibration isolation devices and installation requirements are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

Maintain manufacturer's recommended clearances for service and maintenance.

Install control panels for dental vacuum equipment on wall near [**equipment**] [**office entrance**] <**Insert location**>.

* + - 1. CONNECTIONS

Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Comply with requirements for water-supply piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
				2. Comply with requirements for drain piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
				3. Comply with requirements for vacuum piping specified in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.
				4. Where installing piping adjacent to equipment, allow space for service and maintenance.
				5. Connect vacuum piping to vacuum equipment, accessories, and specialties with shutoff valve and union or flanged connection.
				6. Connect water supply to vacuum equipment that requires water. Include backflow preventer. Backflow preventers are specified in Section 221119 "Domestic Water Piping Specialties."
			1. IDENTIFICATION
				1. Identify nonmedical laboratory vacuum equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
				2. Identify medical vacuum equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment." and with NFPA 99 “Health Care Facilities Code”.
			2. FIELD QUALITY CONTROL FOR HEALTHCARE-FACILITY MEDICAL VACUUM EQUIPMENT

Retain "Testing Agency," "Manufacturer's Field Service," and "Perform the following tests and inspections" paragraphs below to identify who shall perform tests and inspections. If retaining second option in "Testing Agency" paragraph or if retaining "Manufacturer's Field Service" or "Perform the following tests and inspections" paragraph, retain "Field quality-control reports" paragraph in "Informational Submittals" Article.

* + - * 1. Testing Agency: [**Director’s Representative will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Field Advisor per OGS Spec Section 014216 to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" paragraph below to require Contractor to perform tests and inspections.

* + - * 1. Perform the following tests and inspections[**with a Company Field Advisor per OGS Spec Section 014216**]:

Medical Vacuum Equipment Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum equipment concurrently with tests, inspections, and certification of [**medical compressed-air equipment**] [**medical compressed-air piping**] [**medical vacuum piping**] [**and**] [**medical gas piping**] systems.

Tests in "Preparation" subparagraph below are required by Installer before verification by testing agency.

Preparation: Perform medical vacuum equipment tests according to requirements in NFPA 99 “Health Care Facilities Code” for the following:

System operation test.

<**Insert additional requirements**>.

Equipment Verification: Comply with requirements in ASSE 6020 “Medical Gas System Inspector”, ASSE 6030 “Medical Gas System Verifier”, and NFPA 99 “Health Care Facilities Code” for verification of medical vacuum equipment.

Replace damaged and malfunctioning controls and equipment.

Revise "Testing Certification" subparagraph below for exact certification material required.

Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

Inspections performed.

Procedures and materials used.

Test methods used.

Results of tests.

* + - * 1. Components will be considered defective if they do not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. STARTUP SERVICE
				1. [**Engage a Company Field Advisor per OGS Spec Section 014216 to perform**] [**Perform**] startup service.

Complete installation and startup checks according to manufacturer's written instructions.

Check for lubricating oil in lubricated-type equipment.

Check belt drives for proper tension.

Verify that vacuum producer outlet piping is clear.

Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.

Check safety valves for correct settings.

Retain first subparagraph below if seismic restraints are required.

Check for proper seismic restraints.

Drain [**receiver**] [**and**] [**separator**] tank(s).

Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

Test and adjust controls and safeties.

* + - * 1. Verify that vacuum equipment is installed and connected according to the Contract Documents.
				2. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in electrical Sections.
				3. Prepare written report documenting testing procedures and results.
			1. DEMONSTRATION
				1. [**Engage a Company Field Advisor per OGS Spec Section 014216 to train**] [**Train**] Director’s Representative's Facility’s maintenance personnel to adjust, operate, and maintain vacuum producers.

END OF SECTION 226219