PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 220500 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.2 SCOPE

A. Work includes, but is not necessarily limited to, the following:
1. Liquid-ring vacuum pump system

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 220500: Basic Plumbing Materials and Methods.

1.4 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)
1. CEC California Electrical Code
2. ANSI/NFPA 99C Gas and Vacuum Systems
3. ANSI/NFPA 101 Life Safety Code

B. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Code

C. American Society for Testing and Materials (ASTM)
1. ASTM B32 Standard Specification for Solder Metal
2. ASTM B819 Standard Specification for Seamless Copper Tube for Medical Gas Systems
3. ASTM B88 Standard Specification for Seamless Copper Water Tube
4. ASTM B828 Standard Practice for Making Capillary Joints by Soldering Copper and Copper Alloy Tube and Fittings

D. American Welding Society (AWS):
1. A5.8 Specification for Filler Metals for Brazing
2. B2.2 Standard for Brazing Procedure and Performance Qualifications

E. The Copper Development Association (CDA) Publication: Copper Tube Handbook.

F. Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
1. SP-58 Pipe Hangers and Supports - Materials and Design, 1997 edition
2. SP-69 Pipe Hangers and Supports - Selection and Application, 1997 edition

1.5 SUBMITTALS

A. Prior to construction, submit for approval all materials and equipment in accordance with Division 01 requirements.

B. Product Data: Submit manufacturer's standard technical product data indicating conformance to the stipulated reference specifications, construction materials, construction details, and test and operating pressures. Submit manufacturer's product data on the following:
   1. Liquid-ring vacuum pump

C. Shop Drawings: Provide piping layout drawings, drawn to a scale of not less than 3/8" to one foot showing the proposed layout of piping systems including valves, fittings, equipment, pumps, hangers, grading, high points, low points, drain points, anchors, and expansion devices.

D. Standards Compliance: Provide test reports and documentation.

1.6 WARRANTY

A. Provide 10-year unconditional replacement warranty on vacuum pump system, 5-year unconditional replacement on all other items listed in this Section.

PART 2 - PRODUCTS

2.1 LIQUID-RING VACUUM PUMP SYSTEM

A. Description: Packaged unit, factory assemblies, with all piping, valves, controls and electrical wiring as required for a complete and operational system.

B. Vacuum Pump(s): Nonpulsating, rotary, liquid-ring type.
   1. Construction: Cast Iron body and rotor.
   2. Coupling: Nonlubricated, flexible type.
   3. Sealing Fluid: Potable water with up to 90 percent recirculation.

C. Receiver: ASME construction steel tank with vacuum relief valve.

D. Outlet silencers and water-vapor separators on discharge connections.

E. Characteristics:
   1. Vacuum Service: Nonmedical laboratory vacuum.
   2. Vacuum Pumps: Two.
   3. Mounting: Freestanding or tank mounted.

F. Receiver:
   1. Orientation: Horizontal or vertical arrangement.
   2. Capacity: Minimum 120 gallons.
   3. Pressure Rating: 100 psig minimum.
   4. Interior Finish: Epoxy coating.
   5. Drain: Automatic valve.

G. Manufacturer: BeaconMedaes, Gardner Denver Nash, Medical Air Pumps, Busch, Squires Cogswell, or equal.

PART 3 - EXECUTION

3.1 PERFORMANCE OF WORK

A. Examine areas and conditions under which materials are to be installed. Lay out the system to suit the different types of construction and equipment as indicated on the drawings and in accordance with the aforementioned codes and standards.

B. Coordinate with other trades as necessary to properly interface components of the plumbing system.

3.2 VACUUM SYSTEM TESTING

A. Blowing Out: Before installation of vacuum pumps, alarm switches and outlet valves, blow out lines clear with clean, oil-free air or oil-free nitrogen.

B. Leak Tests: After installation of outlet valves, but before installing vacuum pumps and alarm switches, pressurize each section of each system with oil-free dry nitrogen to 25 psi and test with soap solution. Repair all leaks and retest.

C. Cleaning: Carefully wipe off soapsuds and seal openings against contamination until tanks or equipment are connected.

D. Final Pressure Tests: Pressurize system with oil-free dry nitrogen to 25 psi for 24 hours. No pressure drop, except due to temperature change, will be accepted. Allow for ambient temperature change in accordance with the relationship PF - 14.7 = (P1 + 14.7) (T2 + 460) / (T1 + 460), in which T and P represent Fahrenheit temperature and gauge pressure, respectively, and PF is the calculated final pressure. If PF exceeds the measured final pressure, retest each section individually, and apply a soap solution to all joints of each section in which a reduction in pressure occurs after allowing for ambient temperature change. Repair leaking joints and repeat test until no reduction in pressure occurs. Use a test gauge calibrated in one psi increments and readable to 1/2 psi in performing the tests.

E. Vacuum Tests: After the installation of alarm switches, evacuate each system to 17 inches Hg, or to the indicated inches Hg. for oral evacuation system, and test each outlet's pressure (vacuum) with a test gauge calibrated in one inch Hg. increments and readable to 1/2 inch Hg.

3.3 ALARM, SWITCHOVER, PRESSURE SWITCH, AND EQUIPMENT TESTS

A. Operationally test alarm controls, alarms, switchovers, pressure switches and equipment, submit test reports.

3.4 OPERATION MANUALS, START-UP SERVICE, WARRANTIES, ACCEPTANCE AND GUARANTEES

A. Provide in accordance with Division 01 and Section 220500.

END OF SECTION