

SPECIAL SPECIFICATION

SECTION 15461S

PROCESS VACUUM SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Two packaged liquid ring type vacuum pump systems rated 1024 ACFM at 22 inch Hg Vac @ 5500 FASL with following project condition
 - 1. Cooling water temperature: 38-44 degree F
 - 2. Process air temperature: 70 degrees F.
 - 3. Process air conditions: Dry.
 - 4. Chilled water temperature differential: 24 degrees F minimum

- B. The vacuum pump systems include
 - 1. Level control
 - 2. Control panel.
 - 3. Automated isolation valve at vacuum pump inlet.
 - 4. Automated shutoff valve on primary heat exchanger
 - 5. Automated isolation valve at makeup water inlet
 - 6. and installed on inertia base per specification **15070S**

- C. Complete vacuum piping system with a 240 gal stainless steel vacuum receiver

- D. Filter station for make-up water

- E. The piping system includes the piping connecting process vacuum systems, the main, the submain, the vent to general exhaust and the hookup piping.

1.2 REFERENCES/PROJECT REQUIREMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

- B. Requirements of the following Project Specification Sections and Code apply to this section:
 - 1. Section 13085-S – Seismic Protection
 - 2. **Section 13980-S - Controls**
 - 3. Section 15050-S – General Material & Work Requirement - Mechanical
 - 4. Section 15090-S - Polymer Process Piping Systems.

Process Vacuum System

3. Section 15170-S - Motors.
4. Section 15070-S - Vibration **Limits and Controls**.
5. Section 15250-S – **Pipe and Equipment Insulation for the MicroFab**.
6. Section 15401 - Plumbing.
7. Section 16001-S – Electrical Work.
9. Section 16920-S - Motor Control Centers.

1.3 DEFINITIONS

- A. not used

1.4 SUBMITTALS

- A. Submit under provisions of Sections 01300.
- B. Shop Drawings: Indicate dimensions, sizes, weights and point loadings, material thickness, and locations and sizes of field connections. Submit construction layout and details.
- C. Product Data: Provide manufacturers literature and data indicating rated capacities, dimensions, weights and point loadings, accessories, electrical requirements and wiring diagrams, and location and sizes of field connections.
- D. Pump curves with specified operating point clearly plotted.
- F. Submit sound power levels for inlet and outlet rated capacity.
- G. Manufacturer's Installation Instruction: Indicate assembly and installation instructions.
- H. System Startup plan to include:
 1. Cleaning and flushing procedures.
 2. System filling procedure.
 3. Position of automatic and manual valves.
 4. Verification of pump rotation, electrical requirements and VFC control if required.
 5. Heat exchanger and filter requirements.
 6. Final leak check.
 7. System performance curve.
- I. Provide power consumption, pump performance, heat exchanger performance and filter performance at design conditions.
- J. Operation and Maintenance Data :

1. Submit under provisions of Section **01300**.
2. Operation Data: Include instructions for lubrication, motor and drive replacement, spare parts lists, and wiring diagrams.

1.6 QUALITY ASSURANCE

- A. Furnish and installation of entire package to be by a single supplier. Subdividing vacuum pump package into smaller components and parts is not acceptable.
- B. Source Quality Control :
 1. Factory Test: Conduct a factory test per HEI "Performance Standards for Liquid Ring Vacuum Pumps" and supply certified test data upon request. Provide startup by qualified technician. Owner will witness test.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. not used

1.8 PROJECT/SITE CONDITIONS OR SPECIAL CONDITION

- A. Power:
 1. Pumps: 480 VAC, 3 phase, 60 Hz.
- B. Utilities: Necessary utilities to within 30 feet of associated locations will be provided by others, if not included in this scope of work. Utilities includes:
 1. Drains.
 2. Chilled water.
 3. Compressed air.
 4. Make up water from **non-potable water system.**
 5. **Electrical Power**
- C. Drains: Gravity design.
- D. Cooling Water Source:
 1. 38-44 degree Low temperature chilled water supply.
 2. Return water pressure: 22 psi.
 3. Pressure differential at boundary limit: 22 to 45 psi.
- E. Compressed Air: 80 to 130 psig, oil-free.

1.9 SEQUENCING

A. not used

1.10 SCHEDULING

A. not used

1.11 WARRANTY

A. Provide one year manufacturer's warranty under provisions of Section 01700.

1.12 SYSTEM STARTUP

A. Review and verify plan and schedule with Owner to conduct system startup at least two weeks prior to anticipated startup date.

B. Execute startup plan with owner's representative in attendance.

1.13 - 1.15

A. not used

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Packaged Vacuum Pumps:

1. SIHI.
2. NASH.

B. CPVC-Pipe, Fittings and Valves: Nibco, Chemtrol, Fisher, Asahi, Spears or approved equal.

C. Butterfly Valves: Centerline, Grinnell, Keystone or approved equal.

D. Check Valves: Technocheck, Keystone or approved equal.

E. Exhaust duct and damper: refer to general exhaust specification

2.2 EXISTING PRODUCTS

A. not used

2.3 MATERIALS

A. Pipe and Fittings:

1. Process piping and fittings - main: Socket welded Schedule 80 CPVC up to and including 8”.
2. Process piping and fittings – sub-mains: Socket welded Schedule 80 CPVC.
3. Vacuum Pump Exhaust Piping: Socket welded CPVC.
4. Use only one approved manufacturer for all pipe and fittings.

B. Process valves:

1. Sizes 2 inch and smaller: True union ball type CPVC, suitable for vacuum service.
2. Sizes greater than 2 inches: Cast iron body, all internal parts stainless steel, EPDM liner, fully lugged type butterfly with gear indicating operators, suitable for use in vacuum service.
3. Check Valves: Spring type check valves, stainless steel lug type with body, hinge, seat, spring and disk stainless steel.
4. Valves to meet ANSI Class 150

C. Chilled water lines supplying heat exchangers: ASTM A53, Grade B, Schedule 40 carbon steel pipe.

D. Drain lines: Stainless steel ball valves, dielectric unions and Type L Hard Copper Tubing.

E. Insulation:

1. Insulate heat exchanger with 1 inch Armaflex with fiberglass reinforced coating and PVC jacketing.
2. Insulate equipment on pump packages which are susceptible to sweating using the same procedure listed under 42 degree F piping. Use 80 degree F at 80 percent relative humidity for worst-case room ambient design conditions.

I. Local Indicators:

1. Pressure indicators: Glycerin filled, 304 stainless steel wetted parts, 4 inch dial.
2. Temperature indicators: 4-inch dial, scaled in 1-degree F units.
3. Vacuum Indicators: 4-inch dial, scaled in 0.5-inch Hg Vacuum units.

J. Elastomers: Provide full face, EPDM gaskets at flanges and other required locations.

K. Bolting Hardware: All bolts, washers, nuts to be electroplated galvanized.

2.4 MANUFACTURED UNITS

A. not used

2.5 EQUIPMENT

A. Packaged Vacuum Pumps:

1. One pump shall act as a standby.
2. Vacuum pressure transducers and controllers for motor starters will be provided.
3. Mount packaged vacuum pump set on skid together with liquid separator, heat exchanger, interconnecting piping inclusive of accessories, exhaust silencer and disconnect switch. Skid to be low profile arrangement.
4. Vacuum pump control.

B. Pumps:

1. Pump Stages: 2.
2. Type: Liquid Ring.
3. Seals: Mechanical.
4. Speed: 1750 RPM Maximum.
5. Motor: Open Drip Proof, Premium Efficiency, Cast Frame.
6. Power: 480V / 3 phase / 60 Hz.
7. Coupling: Direct drive, flexible, with guard.
8. Vibration: **Isolation per Section 15070.**
9. Casing: Cast Iron

C. Liquid Separator:

1. Material: Stainless steel.
2. Capacity: Sized for Pump.
3. Connections:
 - a. Flanged process connection for level sensing device.
 - b. Water level.
 - c. Sight Glass.
 - d. Inlet connection.
 - e. Outlet connection.
 - f. Exhaust connection.
 - g. Drain connection.
 - h. Cooling water outlet connection.
 - i. Overflow connection.
 - j. Makeup Water connection.
 - k. Sampling Valve connection.
 - l. Tank funnel for chemical treatment injection.

D. Heat Exchanger:

1. Type: Shell and tube with removable tube bundle.
 2. Material: Stainless Steel.
 3. Capacity: Sized for Pump.
 4. Service Liquid: Chilled Water.
 5. Service Liquid Temp: 42 degrees F.
 6. Provide following throttling valve on liquid lines: Heat exchanger primary side return line equal percentage characteristic balancing valve, sized to be approximately 40 percent open at design flow rate
- E. Interconnect Piping Components on pump skid:
1. Furnish and assemble interconnecting piping and valves.
 2. Furnish and install a plug-type balancing valve on the liquid lines.
 3. Materials in cooling liquid lines:
 - a) Pipe, fittings: Pump cooling water to be ASTM A53 pipe. Drain lines to be routed in Type L Hard Copper. Instrument air lines to be copper tubing with final termination made with flexible tubing.
 - b) Ball Valves: Bronze three piece body / stainless steel ball and stem/ teflon seats and stuffing box ring / lever handle / insulation extension threaded ends.
 - c) Check Valves: Bronze, 45 degree swing disc, threaded ends.
 - d) Flow Adjusting Valves: Bronze housing / stainless steel stem.
 - e) Strainers: Screwed brass or iron body with Y pattern and 1/32 inch stainless steel perforated screen.
- F. Insulation of Components on Pump Skid :
1. Insulate heat exchanger with 1 inch Armaflex with fiberglass reinforced coating and PVC jacketing.
 2. Insulate equipment on pump packages which are susceptible to sweating using the same procedure listed under 42 degree F piping. Use 80 degree F at 80 percent relative humidity for worst-case room ambient design conditions.
 3. Refer to Section 15250 Piping Insulation.
- G. Electrical Connections:
1. Provide power from motor control centers for each pump package. Furnish and install wiring and raceway from disconnect switch to pump and controls interconnect; comply with NEC.
 2. Coordinate exact requirements for circuit breakers, motor starters and overload protection with Electrical Contractor.
 3. **Reporting the equipment status per Section 13943**

2.6 - 2.11

A. not used

PART 3 – EXECUTION

3.1 - 3.4

A. not used

3.5 INSTALLATION

A. Vibration Standards: Refer to Sections 15070.

B. Install vibration isolators for each pump inlet and discharge pipe.

C. Insulate and paint supply and return chilled water lines to heat exchangers as follows:

1. Brush, prime and paint vacuum pipes with oil based paint.
2. Insulate piping according to 15250-S.
6. Paint chilled water piping and insulation to match owner color code standard.

F. Provide piping as indicated on the drawing

G. Install isolation valves in following locations:

1. Pump inlets/outlets.
2. Each end of main.
3. Each submain takeoff from main.
4. At each end first level main.
5. Each branch takeoff from submain.
6. Supply and return 42 degree F chilled water to each pump package.
7. Local pressure indicators.
8. Cooling water reservoir drain valve.
8. Two 3/4-inch valves for analog sensing located at end of main on Fab level. Controls for monitoring to be provided by others.

H. Install normally closed control valves in following locations:

- 1. outlets of cooling water.**

I. Install local indicators in following locations:

1. 38-44 degree F supply cooling water temperature.
2. 38-44 degree F return cooling water temperature.

3. 38-44 degree F supply cooling water pressure.
 4. 38-44 degree F return cooling water pressure.
 5. Exchanger discharge temperature (secondary side, each unit).
 6. Pump cooling water flow (secondary side, each unit).
 7. Cooling reservoir sight glass (each).
 8. Pump inlet pressure.
 9. Pump outlet pressure.
- J.** Isolate pressure indicators with stainless steel ball type isolation valves.
- K.** Install temperature indicators in thermal wells.
- L.** Provide power for vacuum pumps. Maximum allowable flexible conduit (sealtight) length is 3 feet.
- M.** Install automatic vents with isolation valves on water piping at system high points.
- N.** Install construction filters at suction of each pump. Mesh size to be 1/32 inches. Construction filters to be removed at the direction of the project engineer.
- O.** Provide strainers on chilled water supply to each heat exchanger as specified.
- P.** Slope exhaust piping from liquid separator back to vacuum pumps, traps not allowed. Socket weld piping; back-welding not allowed. Pipe couplings not allowed in straight runs less than 20 ft in length. Plug or blind flange valves. Provide piping and fittings by single approved manufacturer.
- Q.** Provide a 3/4 inch threaded connection with isolation ball valve at the most remote point on the distribution system for installation of pressure sensor.
- R.** Provide line sized valving at pump headers for future pumps to be installed.
- S.** Drains:
1. Refer to Section 15401-S.
 2. Route drains on housekeeping pads from pumps, heat exchangers or other equipment as needed to adjacent floor drain in Type L, ASTM B88, Hard Copper tubing. Insulate in accordance with Section 15250-S.
- T. Provide drip pan for each plant vacuum machine.**

3.6 - 3.9

A. not used

3.10 FIELD QUALITY CONTROL

A. During Installation :

1. Test every submain immediately upon completion and curing of cement.
2. Use Vacuum Hold Test Method. Pressure decay testing is not acceptable.
3. Provide required vacuum pump and vacuum gauge of sufficient resolution and accuracy.
4. Blind flange submain on either end, and connect vacuum pump to one of the branch valves.
5. Evacuate submain to final vacuum of pump or at least **-18Hg**.
6. Record date, time, operator, submain under test and vacuum level.
7. Check vacuum level after 8 hours holding period.
8. Vacuum degradation shall not exceed 1.2" (40mbar).
9. Sub-mains, which fail test shall be repaired immediately, and test shall be repeated until submain meets above requirements.
10. Use appropriate method to localize leaks.
11. Replace entire submain, if leaks are found in more than three places.

B. Final leak test of entire distribution system :

1. Perform final Leak Testing of entire system using "Vacuum Hold Test Method". Pressure decay testing is not acceptable.
2. Use existing vacuum pump package to generate the required vacuum.
3. Evacuate entire system to the final vacuum of the vacuum pump package (**-18" Hg**).
4. Close isolation valves at pumps for a period of 8 hours.
5. Record date, time, operator, system under test and vacuum level.
6. Vacuum degradation shall not exceed 1.2" (40mbar).
7. In case system fails repairs shall be carried out immediately, and test shall be repeated until system meets above requirements.
8. Use appropriate method to localize leaks.
9. All leaks are to be reported to the owner or Owner's representative, and appropriate repair method shall be decided by Owner on a case by case basis.
10. Plug or cap all branch valves during test period.

3.11 - 3.15

A. not used

END OF SECTION