

Technical Specifications For Hypersonic Wind Tunnel Compressed Air Supply System

Prepared by
GLHN Architects and Engineers
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ENCLOSED AIR COMPRESSORS AND AUXILIARY EQUIPMENT

PART 1.- GENERAL

1.1. DESCRIPTION

- A. The following specification details the minimum requirements for equipment and structure for a complete factory assembled High Pressure Compressed Air Packaged Plant System
- B. The Packaged System shall be factory fabricated, tested, and delivered to site by the manufacturer as a complete unit containing all of the items listed under Products. Field fabrication of the Packaged System is not acceptable. The Packaged System shall only require compressed air piping, supply and return chilled water connections, 460V and 120/230V electrical power connections, a data (fiber) connection, a building automation system connection, and drain piping connections as required.
- C. Acceptable manufacturers include:
 - 1. Garner Denver/Reavell
 - 2. Denair
 - 3. LMF
 - 4. Engineer-approved equal.

1.2. PRODUCTS

- A. The following components are to be included as part of this Packaged System:
 - 1. Structural Steel Base
 - 2. Weatherproof, acoustical wall and roof system with equipment access panels
 - 3. Ventilated, Air Conditioned (electric heat and chilled water fan coil cooled)
 - 4. Enclosure LED Lighting System (Interior and Exterior)
 - 5. Ventilation System (fan to be Greenheck or approved equal)
 - 6. Fan Coil Units (Price or approved equal)
 - 7. Electric Resistance Unit Heaters (Reznor or approved equal)
 - 8. Convenience Electrical Outlet System (interior and exterior)
 - 9. Automatic Controls, Alarms and Safety Interlocks
 - 10. Valves, Gauges, and Piping Accessories
 - 11. Interconnecting Pipe and Pipe Supports
 - 12. Vibration Isolation
 - 13. Inlet Silencer and Filter
 - 14. High Pressure Air Compressors
 - 15. Desiccant Air Dryers
- B. The Packaged System shall be designed to conform to the project specifications and plans. No equipment or systems shall be procured prior to explicit direction by the general. All equipment and systems shall be arranged to fit the space proposed and allow for manufacturer-recommended and NEC required equipment service internal and external to the package.

1.3. SCOPE OF WORK: A complete packaged compressed air facility per the general scope of work description below

- A. The University of Arizona is requesting proposals for a Packaged High Pressure Compressed Air Supply System for application in a Blowdown Wind Tunnel Facility at the Aerospace and Mechanical Engineering building (AME). Procurement, installation, and commissioning of this System is an element in a multiphase University plan to augment the research range and duration of this facility.
- B. Two industrial high pressure air compressors along with dryers and associated components are to be housed in a waterproof enclosure that will be located within a new equipment yard adjacent to the north west exterior wall of the building. Manufacturer scope includes detailed design and construction of the enclosure along with furnishing and installing the equipment within. Fabrication is to occur offsite, within a controlled factory environment. Manufacturer will deliver the unit(s) to the site in Tucson, AZ. The unit(s) will be offloaded, set on foundations and connected to building utility services under a separate University contract with their Installation Contractor. Following preliminary testing of mechanical and electrical utility connections, the Manufacturer will participate in Start Up and Commissioning of the equipment, provide Operation and Maintenance Training and provide extended Warranty on the enclosure and compressed air system.

1.4. SUBMITTALS AND OPERATION MANUALS

- A. Submit, with the RFP Proposal response, the following as a minimum:
 - i) Equipment Supplier and Enclosure Manufacturer Name, Address
 - ii) Package dimensions, and general arrangement drawing in three dimensions including an overall 3D isometric drawing.
 - iii) Electrical power requirements including full load amps, all terminations and connections by others.
 - iv) Equipment submittals for all major components including but not limited to: Inlet Air Silencer/filter, High Pressure Air Compressors, Desiccant Air Dryers,
 - v) Narrative description of location of regional equipment parts, sales, service and support organization that will provide project warranty services and ongoing technical support after conclusion of warranty period.
- B. Within 3 weeks of Receipt of Purchase Order following Award Submit the following as a minimum:
 - i) Description of system operation.
 - ii) Plan, section and elevation drawings package fully dimensioned, and general arrangement drawing depicting overall 3D isometric views.
 - iii) Electrical power (Full-Load Amperes:, Minimum Circuit Ampacity: Maximum Overcurrent Protection) and control wiring diagram indicating all terminations and connections by others.
 - iv) Equipment submittals for all major components including but not limited to: Air Compressors and Desiccant Air Dryers
 - v) Shop drawings for each switchboard, panelboard, and related equipment.

- vi) Submittal/catalog information on pipe, valves, fittings, strainers, and piping components specific to this project.
 - vii) Piping schematic (P&ID / Flow Diagram) of the Packaged System's components showing equipment and valve tags, pipe sizes, connections types, gauges, piping specialties, and instrumentation tags.
 - viii) Enclosure details including wall, base, and roof construction. Base point loads and corresponding locations shall be provided.
 - ix) Structural and Piping system welding procedures.
 - x) Control submittal including: points list and drawing with sequence of operation.
- C. Prior to fabrication, Submit Operation and Maintenance manuals that include the following as a minimum:
- i) All of the items contained in the submittal section above.
 - ii) Installation and maintenance manuals for OEM's products integral to the Package.
 - iii) Bill of material as supplied.
- D. No materials are to be provided without approval through a submittal review process.
- E. Submittals and operation and maintenance manuals shall be assembled in a neat and orderly manner, and submitted in electronic (PDF) form.

1.5 QUALITY AND PERFORMANCE ASSURANCE

- A. HYDROSTATIC TEST: Once the Packaged System is fully assembled, all piping shall be hydrostatically pressure tested in the factory before shipping in accordance with ASME B31.1 and not less than at 1.5 times normal working pressure for a period of 2 hours without a drop in pressure. Pressure testing of individual pipe spools or sub-assemblies is not acceptable.
- B. STRUCTURAL REQUIREMENTS: The base, wall, and roof structural steel framework, and sheet metal enclosure shall be designed to meet or exceed the structural loading requirements (seismic, wind, snow, live and dead loading, lifting) for this project. At a minimum, the package structure should withstand 150MPH winds and a roof loading of 40lb/sq-ft. The manufacturer must provide documentation demonstrating that this requirement will be met at the owner's request.
- C. PANELBOARD SOURCE LIMITATIONS: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- D. Comply with UL 467 for grounding and bonding materials and equipment.
- E. PAINTING: All bases, enclosure floors and exteriors are to be factory painted in accordance with this specification. At the owner's request, submit the paint specification demonstrating that it will withstand 500 hour exposure to the salt spray test specified in ASTM B 117.

1.6 PROJECT MANAGEMENT / SITE SUPPORT

- A. The packaged compressed air plant manufacturer shall provide sufficient site project management and support services throughout the entire project duration, including, but not limited to, final system design meetings/coordination, submittal phase, installation, startup, site acceptance testing, and commissioning processes (as applicable). On-site attendance and/or participation in three (3) periodically scheduled project meetings is expected.
- B. The manufacturer shall support the University of Arizona project design and construction team, and the Installing Contractor(s) as required to ensure that the packaged plant is properly coordinated with the site and other building systems.
- C. During installation (rigging/reconnection, etc.) of the packaged plant, the manufacturer shall provide on-site factory "installation support / technical direction of installation" to the Installing Contractor(s). This support effort will commence prior to the shipment of the package with review of the rigging plan and drawings, and continue throughout the rigging/reconnection process until the package is fully operational and any punch-list items are completed.

1.7 WARRANTY

- A. The entire Packaged System shall be guaranteed for parts and workmanship for a period of 12 months from start-up or 18 months from shipment from the supplier's facility, whichever comes first. The entire structure; including roof, walls, floor, and base; of the Packaged System shall be warrantied for materials and workmanship for a period of 5 years from start-up or 5 years and 6 months from shipment from the supplier's facility, whichever comes first.

1.8 EXCEPTIONS

- A. Adherence to the requirements of the Products section of this specification, will be required. If the manufacturer wishes to take exception to any of the requirements set forth, the exception must be identified at the time of Proposal and again at each Submittal, clearly referencing section numbers, and stating alternative approach/method/specification.

PART 2 - PRODUCTS

Furnish and install the following equipment as part of a factory assembled Packaged System. The Packaged System shall be within the outline indicated in this RFP and shall have sufficient service clearance for equipment as outlined by the manufacturer and as required by NEC.

2.1 STRUCTURAL STEEL BASE

- A. The steel base shall consist of a welded structural steel perimeter with intermediate structural steel members at a minimum height of 6". A minimum 3/16" checkered plate steel floor shall be welded to the base and serve as an integral part of the structure. The floor shall be insulated as described in Section 2.2.
- B. The base shall be designed for a maximum deflection of L/240 when the unit is fully operational and supported only at the perimeter and at unit/module splits.

- C. The base frame shall be welded to a factory certified procedure that shall conform to the requirements of AWS D1.1.
- D. The wall and roof structural framework shall incorporate lifting locations so that the entire Packaged System can be lifted from the roof

2.2 PACKAGE ENCLOSURE

- A. All mechanical and electrical equipment shall be housed inside a factory fabricated double wall enclosure. The enclosure shall be fabricated by the same manufacturer as the steel base, pipe work, and pipe supports to ensure structural integrity of the entire Packaged System. The use of a self-framing or sheet metal building that does not incorporate a structural steel wall framework, structural steel roof framework, and roof mounted lifting lugs is not acceptable.
- B. The components of the enclosure shall be:
 - C. Floor: shall be a minimum of 3/16" steel checker plate. When used with an enclosure, the perimeter of the floor shall be broken (turned) upward to form a water dam and the corner seams shall be seal welded to form a watertight floor.
 - D. Exterior Enclosure Panels: Wall and roof panels shall be fabricated from 16ga satin coat steel and sealed. Wall panel shall be 2" thick .Exterior roof panels shall be 4" thick. Wall and roof exterior panels shall wrap around wall and roof structural framework to ensure thermal break.
 - E. Structural Steel Base: The perimeter members shall be, at a minimum, 8" x 6" x 0.188" hollow structural steel tube (HSS). The use of a c-channel or wide-flanged steel perimeter is permitted provided the base is at least 12" deep.
 - F. Wall and Roof Structural Steel Framework: an integral structural steel framework of hollow structural steel tube (HSS) shall support the walls and roof. The framework members shall be, at a minimum, 3" x 3" x 0.188" HSS at 10-foot centers. The roof steel shall also support all pipe in the Packaged System located higher than four feet from the floor or base level. The framework shall be primed and finish painted
 - G. Roof Mounted Lifting Locations: The Wall and Roof Structural Steel Framework will be extended through the roof of the enclosure and incorporate lifting lugs so that the entire package can be lifted from the roof.
 - H. Insulation: Walls, roof, and base shall be insulated with no less than 4" of 4.1 lb/cu-ft density rigid or semi-rigid board type insulation equivalent to R-16. Floor insulation thickness will be no less than (i) the smallest structural steel member used to support the floor or (ii) 4", and shall have a minimum insulating value of R-16. All insulation shall be rated non-combustible for continuous service at 1200F and shall be non-wicking with a moisture absorption rating of <1%.
 - I. Floor Drain Pans: Fabricate floor drain pans as required at a minimum of 12" x 18" x 2" deep from 18ga stainless steel that is seal welded and covered with 1" x 3/16" painted steel floor grating. The drain pans shall be sloped at a minimum of 1% to a 2" diameter drain hole that shall be piped to the exterior side of the unit and finished with a 2" male NPT connection. The use of drain holes in the floor is not acceptable.
 - J. Roof: The roof covering shall utilize standing seam panels.
 - K. Monorails for equipment service & maintenance: Provide monorails/I-beams above major equipment motor, compressor as overhead space allows to aid in regular service & maintenance activities.

- L. Access Doors / Service & Maintenance Access Panels: Provide an ample number of Access Doors (minimum 36" width) and hinged access panels for personnel entry/egress and access for regular service and maintenance of equipment. Service clearances for all equipment shall be provided inside the footprint of the enclosure, and regular maintenance of the plant shall be able to be performed without opening access panels. Hinged access panels shall be provided for major service events. Install removable access hatches above compressors for future compressor removal if necessary.
- M. The enclosure shall have the following minimum structural ratings:
- a. A minimum snow/static load rating of 40 pounds per square foot.
 - b. A minimum wind load rating of 150MPH.
- N. All bases, structural steel members, enclosure floors, steel piping, and exteriors shall be factory epoxy-primed and finish painted. All structural steel members shall be blast cleaned to Sa2½ (ISO 8501-1:1988) near white-metal to remove oxidation & foreign materials.
- O. The finish-paint top coat is a nonisocyanate two-component system acrylic enamel
- P. Ventilation louvers and dampers (for Intake and General Ventilation): Install stationary, storm proof louvers and motorized dampers for forced ventilation of the enclosure. Louvers shall be 6 inches deep with extruded aluminum blades and frame and 19 gauge galvanized ½" x ½" bird screen. Damper blades shall be 4 inches deep, thermally broken with high-density polyurethane injected insulation. Air leakage through a 48" x 48" damper shall not exceed 10.5 CFM/SQFT against 4" w.g. differential static pressure @ standard air. Operating temperature range shall be -40° to +200°F. Supply an actuator to modulate the damper open or close
- Q. Exhaust Fans: Install exhaust fans for forced ventilation of the enclosure to maintain a minimum of 1 CFM/SF and interlock with the ventilation damper actuator. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. Fan shall be enclosed in minimum 18 gauge galvanized steel wall housing with factory installed shutter and inlet guard.
- R. Fan Coil Units: Install chilled water fan coil units sized for 65 F supply cooling water to maintain internal enclosure temperature at 85 degrees F with an outside air temperature of 115 degrees F. Interlock the ventilation damper actuator with the exhaust fan and the fan coils to a combination heat/cool thermostat. The use of Packaged DX systems to provide space cooling is not acceptable.
- S. Electric Unit Heaters (as required): Install unit heaters sized to maintain internal enclosure temperature at 60 degrees F with an outside air temperature of 30 degrees F. Interlock the ventilation damper actuator with the exhaust fan and the unit heater to combination heat/cool thermostat.

2.3 HIGH PRESSURE, LUBRICATED, RECIPROCATING AIR COMPRESSORS

- A. Compressor(s): Lubricated, reciprocating-piston type with lubricated compression chamber and crankcase.
1. Submerged gear-type oil pump.
 2. Oil filter

3. Combined high discharge-air temperature and low lubrication-oil pressure switch.
4. Belt guard totally enclosing pulleys and belts.
- B. Capacities and Characteristics:
 1. Air Compressor(s): **Two units**; each multiple stage.
 2. Intercooler between stages of multiple stage units.
 - A. Standard-Air Capacity of Each Air Compressor: 245 scfm free air.
 - B. Discharge-Air Pressure: 2500 psig
 - C. Intake-Air Temperature: 110 deg F .
 3. Mounting: **Freestanding**
 - A. Motor (Each Air Compressor)
 - B. Horizontal, foot mounted
 - C. 150 KW
 - D. Speed: 1750 rpm.
 - E. IP55
 4. Drive: Compressor Grooved Flywheel
 - A. Motor Grooved Pulley
 - B. V-Belts
 - C. V-Belt Drive Guard
 5. Base: Fabricated steel base frame with anti vibration mounts
 6. Electrical Characteristics:
 - A. Volts: 480 V.
 - B. Phase(s): Three.
 - C. Hertz: 60
 - D. Full-Load Amperes: TBD
 - E. Minimum Circuit Ampacity: TBD
 - F. Maximum Overcurrent Protection: TBD.
 7. Instrument Panel with
 - A. Pressure gauges for all stages
 - B. Oil Pressure gauge
 - C. Temperature gauges for all stages
 - D. Relief Valve on all stages
 - E. Pressure and Temperature sensors on all stages/cylinders
 8. Water cooled inter and final stage cooler with integral separator
 - A. Water valve fitted to water inlet
 - B. Stage mechanical separators fitted on appropriate stages
 9. Mechanical Lubricator with low oil level protection
 - A. Forced lubrication system with oil pump, filter and system pressure gauge
 - B. Crankcase oil filler and crankcase oil level sight glass
 10. Electrical controlled automatic unloader/drainage system(solenoid valve controlled)
 11. Low oil pressure protection
 12. non-return valve for final air delivery
 13. Delivery back pressure maintaining valve
 14. Starter/Control Panel
 - A. IP 55 Industrial Start Delta starter/control panel complete with
 - B. Door Interlocked isolator
 - C. Thermal overloads protection
 - D. Control fuses and control circuit transformer
 - E. Lamps for mains and faults
 - F. Stop/Start buttons and fault reset push button
 - G. Hours run meter

H. Timed drainage

I. Control relays

15. Control: The compressor shall be arranged for auto stop / start control using the pneumatic pressure sensor operating in conjunction with the above starter / control panel. The compressor is fitted with integral after-coolers and separators on all stages fitted with solenoid operated auto diaphragm unloaders and condensate drain. The control panel is fitted with a drain timer which will ensure the condensate is drained from the separators periodically during extended runs. The mixture of air and drained condensate is piped to a de-mister and condensate collection system and drained from enclosure
16. Cooling: The compressor unit will be arranged for direct, chilled water cooling piped from a building chilled water utility connection. The building supplied water supply shall be minimum of 65 F, with a supply to return pressure differential of 15 psi. Each compressor shall be provided a maximum of 50 gpm, and return, at full load, a return water temperature of minimum 18 F higher than supply. Provide suitable wye strainer at inlet connections and ball valve isolation at inlet and outlet connection to compressor. The outlet shall be provided with a two-way modulating motorized water flow control valve set to control minimum return water temperature.

2.4 INLET-AIR FILTER SILENCER

- A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.
- B. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
- C. Capacity: Match capacity of air compressor, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.

2.5 COMPRESSED-AIR DRYERS

- A. Beko Drypoint or Engineer Approved Equal
- B. Description: Twin-tower unit with purge system, mufflers, and capability to deliver minus 40 deg F, 2500-psig air pressure dew point at outlet. Include dew point controlled purge, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.
- C. **Components**
Stainless steel prefilter to remove particles and droplets
Sedimentation chamber with separator and storage
Adsorption Dryer – cold regenerated, high pressure (2500 psi)
Final filter
- D. Capacities and Characteristics:
1. Standard-Air Capacity of Each Compressed-Air Dryer: 250 SCFM free air.
 - a. Pressure: 2500 psi. Entering-Air Temperature: 122 F
 2. Leaving-Air Temperature: -40 F
 3. Leaving-Air Dew Point Temperature: -40 F

4. Ambient-Air Temperature: 110 F
5. Maximum Air-Pressure Drop: 100 psi
6. Inlet Filter: .001 micrometers.
7. Outlet Filter: 1.0 micrometer(s).
8. Electrical Characteristics:
 - a. Volts: 120
 - b. Phase(s): Single
 - c. Hertz: [60].
 - d. Full-Load Amperes:TBD.
 - e. Minimum Circuit Ampacity: TBD

Maximum Overcurrent Protection: TBD. 2.4 UNLOADER/CONDENSATE DE MISTER SYSTEM

Furnish and install condensate unloader, demister for each air compressor

Each assembly has three de-mister vessels to assist liquid separation; these are rectangular, fabricated steel assemblies, mounted above a single, horizontal, cylindrical collection tank. The assembly shall be free standing unit for floor mounting close to its compressor. The connection from the compressor unloading system discharge is piped to the condensate collecting system inlet. The installation and inter-connection are within the enclosure.

At the point of unloading, internal pressure, along with any condensate from the system separators is discharged to the three de-mister vessels where pressure dissipates to atmospheric pressure. Liquid separated in the de-mister is allowed to drain to the lower tank where condensate can collect prior to disposal as part of a site maintenance program. The condensate collection tank is supplied with a simple liquid level indicator and a manual drain valve for draining purposes

2.6 VALVES, GAUGES AND PIPING ACCESSORIES Valves shall meet the material, fabrication and operating requirements of ASME B31.1. All valves shall be located such that the removal of their bonnets is possible. All flanged valves in horizontal lines with the valve stem in the horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be of threaded or flanged type. All bronze and iron body gate and globe valves shall be the product of one manufacturer. Manufacturers of other types may not be mixed, i.e., all butterfly valves shall be of one manufacturer, all ball valves shall be of one manufacturer, etc. No yellow brass valves will be allowed. Wafer style valves (except check valves) are not allowed.

2.7 PIPING

- A. All pipe used in the assembly shall be fabricated in accordance with this specification
 1. 1.Unless otherwise indicated Compressed Air Piping shall be stainless steel

2. Pipe welding shall be in accordance with ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessel Code, Section IX. Ensure complete penetration of deposited metal with base metal. Manufacturer shall provide filler metal suitable for use with basemetal. Keep inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process employing a shielded metallic arc process (SMAW) or gas metal arc welding process (GMAW / MIG). Inside of pipe shall be free of excessive reinforcement. The use of backing plates is not acceptable. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during the welding operation.
3. In no cases shall Schedule 40 pipe be welded with less than three passes including one stringer/ root, one filler and one lacer.
4. Each weld shall be uniform in width and size throughout its full length. In addition, the cover pass (final weld layer) shall be free of coarse ripples, grooves, overlaps, abrupt ridges and valleys/ under cut. The surface smoothness of the finished weld shall be suitable for the proper interpretation of non-destructive examination of the weld.
5. Each weld layer or pass shall be visually free of slag, inclusions, cracks, porosity and lack of fusion. Grinding to meet this criteria and elimination of defects and surface preparation of welds shall be done in a manner as not to gouge, groove or reduce the adjacent base material thickness below the minimum required.
6. All butt welds shall be full penetration with uniform crown, with reinforcement blending smoothly into the base material. Concavity on the root side of a single welded circumferential butt weld is permitted with the resulting thickness of the weld at least equal to the thickness of the thinner member of the sections being joined.
7. Socket welds shall have a gap of approximately 1/16" minimum to 1/8" maximum between the bottom of the socket and the end of the pipe prior to welding.
8. Visually inspect all welds for compliance with this section. Welds found to be lacking penetration, or containing excessive porosity or cracks must be removed and replaced with an original quality weld as specified herein.
9. All screw joints shall be made with tapered threads, properly cut. Joints shall be made with Teflon or dope applied to the pipe threads only and not to fittings. All threaded fittings shall conform to ASTM B16.3.
10. Copper pipe shall be fabricated of Type L conforming to ASTM specifications for copper water tube. Copper pipe shall only be joined using non-lead-solder such as 95-5 silver or antimony solder (95 percent tin and 5 percent silver or antimony).
11. All internal pipe shall be painted with a machine enamel in the Manufacturer's standard color prior to assembly. All pipe exposed to weather shall be sand blasted and painted using the system described in section 2.02-D.

12. Piping shall be installed to facilitate drainage and/or condensate management. Install drain valves at low points in piping, at equipment and at section isolating valves. Install air vents at high points in each piping system.
13. Pipe supports shall be used to support pipe under all conditions of operation and prevent excessive stresses and vibration from being introduced into pipe work or connected equipment. Chilled Water piping up to and including 8" diameter shall be supported using Behringer Heavy Series pipe clamps. For Chilled Water piping above 8" diameter, Behringer Heavy 4.0 Series pipe clamps shall be used. Internal Condenser Water piping lines and gas piping may be supported using Behringer Pipe Clamps and/or U-bolts without insulation spacers for all line sizes. All chilled water and ice storage system piping shall be provided with thermal pipe shields to mitigate condensation buildup.
14. Fabricate equipment supports not provided by equipment manufacturer(s) from structural grade steel. As necessary, provide removable angle iron blocking and bracing to prevent movement of pipe work and equipment during shipping.

2.8 VIBRATION ISOLATION

- A. An integral all-welded steel vibration isolation base mounted on spring isolators shall be provided for air compressor and motors
- B. Provide open spring mounts with iso stiffening springs, sound deadening pads, and leveling bolts. Spring deflection shall be 2".

2.9 POWER DISTRIBUTION SYSTEM

- A. Approved vendors for Electrical Power Distribution equipment (e.g., panelboards):
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Square D; a brand of Schneider Electric.
- B. All Electrical fabrication and installation work shall be in compliance with NEC and UL requirements, as adapted and amended by the Authority Having Jurisdiction.
- C. All wiring shall be copper.
- D. All installed equipment loads shall be wired to panelboards within the enclosure. All panelboards, and UPS shall be secured to the Packaged System's structural base and/or to the structural steel wall framework
- E. Provide appropriately-sized 480-to-208/120 transformers as required to provide 208/120 power for the enclosure.
- F. All installed low voltage UPS-supported loads (i.e., controls) shall be wired to a 208/120V Low Voltage Panel.

- G. All installed low voltage loads not supported by UPS (i.e. lights, ventilation dampers, convenience outlets, etc.) shall be wired to a separate 208/120 Low Voltage Panel System (i.e., Mechanical, Non-mechanical).
- H. Divide the loads on the Non-mechanical and life safety distribution systems so that half of the load is on each 208/120V panelboard.
- I. All electrical enclosures shall be NEMA rated for the installed environment. Provide NEC clearances for all electrical panels.
- J. All wiring shall be sized and installed in accordance with NEC in rigid galvanized steel conduit. Conduit shall be sized as per NEC and shall permit the easy removal of the power conductors at any time. All connections to motors and vibrating equipment shall use liquid tight flexible metal conduit to a maximum length of 36". RGS conduit shall be bent in such a manner as not to reduce the original diameter of the conduit. All conduits shall be mounted on "uni-strut" or equivalent channel-type support.
- L. All service, feeder, branch or control circuit conductors shall be housed in rigid steel conduit.
- M. All conductors and terminations used shall have a minimum temperature rating of 90 degree C. Conductor ampacity shall be based on 75 degree C rating
- N. Separate conduits shall be used to house power, control, and signal conductors.
- O. Provide a minimum of eight (8) GFI receptacles on inside and outside of enclosure. Each receptacle shall have weatherproof enclosures to prevent any water penetration. All GFI receptacles shall be wired to the Non-Mechanical Low Voltage Panels.
- P. All electrical equipment and devices shall be properly identified by lamaroid nameplates. Nameplates will be white faced with black engraved or thermal printed lettering.
- Q. All equipment 50V and greater line-to-ground shall carry an arc flash label, showing PPE category required. Perform all calculations necessary to provide labels showing incident energy at each location.

2.10 LIGHTING SYSTEM

- A. Provide minimum four (4) overhead LED lighting fixtures sufficient to provide 70 foot-candle average throughout the enclosures. Provide two exterior lighting fixtures centered on the long axis of the enclosure.
- B. Light Switches shall have weatherproof enclosures to prevent any water penetration.

- C. Provide the following for convenience: Unswitched LED exit signs at all unit entrance doors complete with battery operated LED emergency lights, and exterior lighting (with motion detectors) over each access door to the package.

2.11 BUILDING AUTOMATION AND CONTROL SYSTEM

N/A

PART 3 – EXECUTION

3.1 INSPECTION AND TESTING

- A. Include all test data and reports as required by this section as part of the Operation and Maintenance manual, including:
 - 1. Manufacturer's Inspection and Test Report verifying compliance with this specification on an item by item basis.
 - 2. NEC, ETL, UL and OSHA certified compliance reports.
 - 3. Pneumatic or Hydrostatic pressure test results.
 - 4. Electrical and Controls point-to-point continuity test reports.
 - 5. Structural calculations as required.

3.2 SHIPPING PREPARATION

- A. Piping shall be provided with external painting to provide corrosion protection. If a hydrostatic test is performed, the interior of all piping shall be flushed with a water-soluble corrosion inhibitor and then drained to prevent freezing.
- B. All equipment and components shall be identified with equipment number specified to assist field assembly and erection. All items shipped shall be accompanied by instructions for storing and protecting.
- C. All equipment shall be sealed to prevent entry of water, dirt or other foreign matter. Seals used on piping connections shall not affect threads, weld preparation or flange faces. Each section of the Enclosure System shall be shrink wrapped with a minimum 10 mil plastic shrink wrap. All equipment and components shipped loose or on skids shall be properly packaged to withstand recommended method of shipment without damage. Each package shall be clearly labeled on the outside as to its contents.
- D. Include a complete packing list and bill of material.
- E. Provide consumables required during the installation for all equipment furnished including, but not limited to, flange bolts and gaskets, structural bolts, sheet metal screws, sheet metal sealing/trim strips, caulking, etc.
- F. Shipping shall be FOB

3.3 COORDINATION WITH INSTALLATION CONTRACTOR

THE INSTALLING CONTRACTOR SHALL BE RESPONSIBLE FOR THE FOLLOWING, UNLESS OTHERWISE NOTED:

- A. Removal of protective wrapping such as shrink-wrap, wood crating, and packing.
- B. Receiving (including interior and exterior inspection).
- C. Inspect interior and exterior and report any obvious damage, or equipment shifting that may have taken place between the time the unit left the factory and arrived at jobsite.
- D. Hoisting and rigging the section(s) into final location as per the instructions supplied with the unit.
- E. Join the sections/modules following the instructions enclosed with the unit.
- F. Re-install any equipment, piping, and enclosure trim shipped loose due to shipping constraints.
- G. Leveling, shimming as needed, and as per manufacturer's instructions.
- H. Tighten all mechanically fastened connections that may have vibrated loose during shipping.
- I. Re-align and level equipment including compressors.
- J. Flushing and filling the system with lubricating oil.
- K. Install all life safety equipment as needed.
- L. All field connections to the unit including piping, electrical, and drainage (connections to systems outside of the enclosure).
- M. Connection of all utilities needed for the packaged system including chilled water, drainage, and electricity.
- N. Install any field-installed equipment (i.e. roof-mounted exhaust fans). A list of field-installed equipment will be supplied along with the installation instructions.
- O. Touchup and paint any minor scratches and/or dents that occurred during hoisting and rigging.
- P. Permits and inspections needed for system startup.
- Q. Coordination of Startup of system with the supervision of manufacturer personnel.

3.4 MANUFACTURER COMMISSIONING

A. Equipment Manufacturer shall be responsible to provide assistance in Start Up and Commissioning of the Compressed Air System. Timing of these activities to be coordinated by University of Arizona.

- 1. Two 8 hours days of start up and commissioning
- 2. One 8 hour day to Operation and Maintenance training

SPECIFICATION ATTACHMENTS

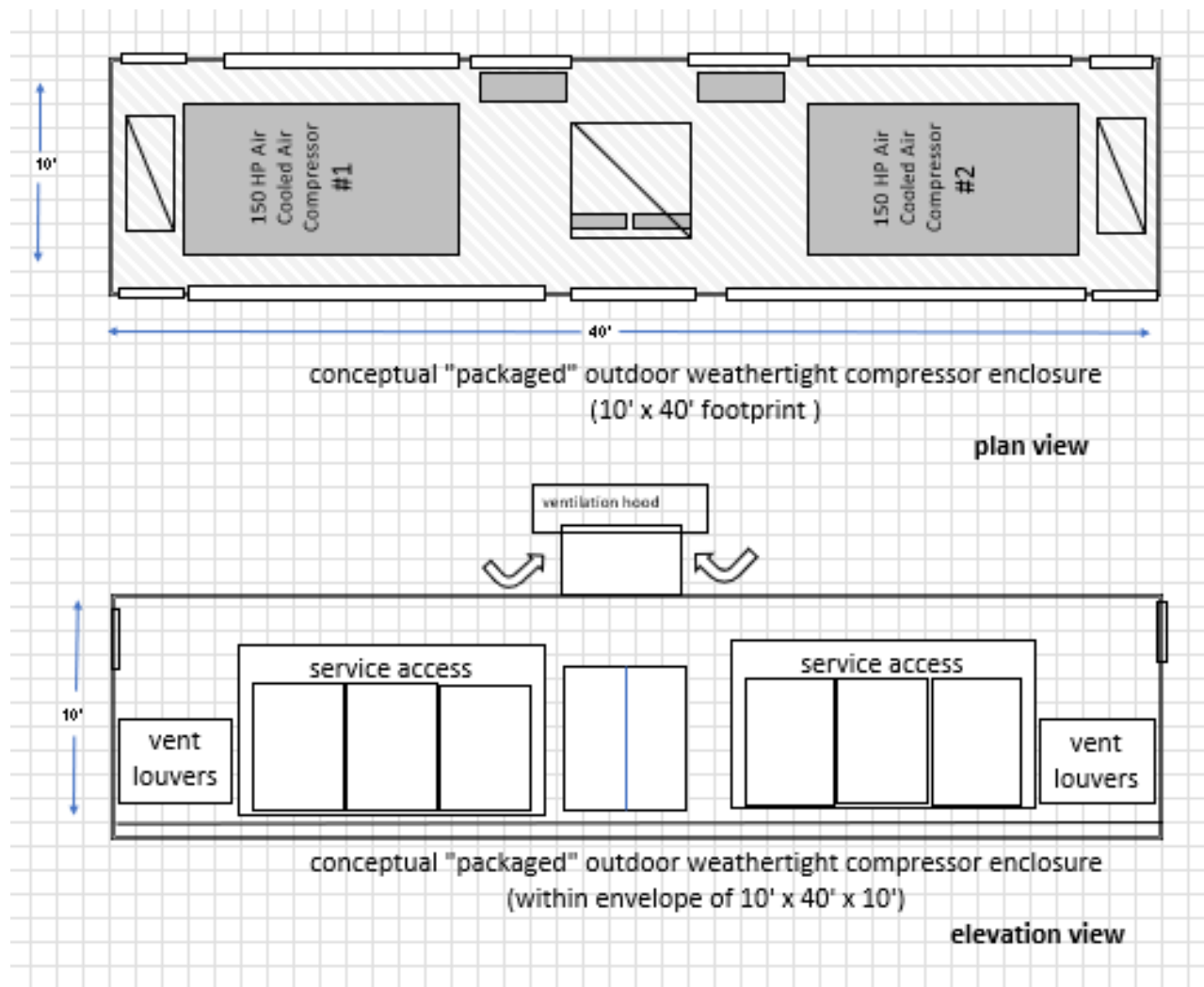
- A. The following documents are provided as attachments to this specification:
Conceptual general arrangement, elevation and enclosure cut-away examples.

END OF SECTION 133419-A

Conceptual High Pressure Air Compressor and Dryer Enclosure Sketches



points of interface with site installation contractor			
concrete foundation			anchor bolts
electric power compressor circuits			480 V (x 2)
electric power lighting, convenience, dryer			120/208 V (x 3)
monitoring and alarm			24 VDC
chilled water supply and return			3" flanged
condensate drain			2" screwed
high pressure compressed air			2" socket (x 2)



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