

**SECTION 22 61 19.74
DENTAL COMPRESSED-AIR EQUIPMENT**

SPEC WRITER NOTES:

1. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the Section and renumber the paragraphs.
2. References to pressure in this section are gauge pressure.
3. Edit for 965 kPa (140 psig) system for dental surgical air driven equipment or 689 kPa (100 psig) system to regulate air pressure to user requirement. See VA Plumbing Design Manual for air pressures required.
4. Coordinate remote alarms for outpatient facility with user and NFPA 99.
5. Edit testing required for outpatient facility.
6. Edit type dryer project is using and if duplex is required.
7. Coordinate with use if duplex filters, pressure regulating valves, relief valves are required.
8. Edit type air compressor used for 689 kPa (100 psig) system.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The section describes the requirements for central dental compressed air equipment, including all control panels, air compressors, electric motors and starters, receivers, air dryers, filters, pressure regulators, and all necessary parts, accessories, connections and equipment.
- B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- E. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.//
- F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

- G. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT:
Electric motors.
- H. //Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//
- I. Section 22 61 13.74, DENTAL COMPRESSED-AIR PIPING.
- J. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- K. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- L. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- M. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- N. Section 26 29 11, MOTOR CONTROLLERS: Motor starters.

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all plumbing systems. Publications that apply to all plumbing systems may not be specifically referenced in the body of the specification but shall form a part of this specification.

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.
- B. American Society of Mechanical Engineers (ASME):
ASME Boiler and Pressure Vessel Code
BPVC Section VIII-1-2019 Rules for Construction of Pressure Vessels, Division 1
- C. American Society of Sanitary Engineering (ASSE):
6000-2018.....Professional Qualifications Standard for Medical Gas Systems Personnel
6010-2018.....Medical Gas Systems Installers
6020-2018.....Medical Gas Systems Inspectors
6030-2018.....Medical Gas Systems Verifiers
- D. American Society for Testing and Materials (ASTM):
B819-2019.....Standard Specification for Seamless Copper Tube for Medical Gas Systems

- E. Compressed Gas Association (CGA):
 - C-9-2019.....Standard Color Marking of Compressed Gas Containers for Medical Use
 - G-4.1-2018.....Cleaning Equipment for Oxygen Service
 - G-10.1-2016.....Commodity Specification for Nitrogen
 - P-9-2015.....The Inert Gases: Argon, Nitrogen and Helium
 - V-1-2019.....Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections
 - V-5-2019.....Standard for Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)
- F. International Code Council (ICC):
 - IPC-2018.....International Plumbing Code
- G. National Association of Architectural Metal Manufacturers (NAAMM):
 - AMP 500-2006.....Metal Finishes Manual
- H. National Electrical Manufacturers Association (NEMA):
 - ICS 6-1993(R2016).....Industrial Control Systems: Enclosures
- I. National Fire Protection Association (NFPA):
 - 70-2020.....National Electrical Code (NEC)
 - 99-2018.....Health Care Facilities Code
- J. Underwriter Laboratories Inc (UL):
 - 60601-1-2003(R2006).....Medical Electrical Equipment, Part 1: General Requirements for Safety
- K. Department of Veterans Affairs (VA):
 - PG-18-10.....Plumbing Design Manual

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 61 19.74, DENTAL COMPRESSED-AIR EQUIPMENT", with applicable paragraph identification.
- C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Air control panels.

2. Air compressor systems (Provide certified compressor test data at startup):
 - a. Compressors: Manufacturer and model.
 - b. Characteristic performance curves.
 - c. Compressor operating speed (RPM).
 - d. Capacity: Free air delivered at indicated pressure (SCFM).
 - e. Type of bearing in compressor.
 - f. Type of lubrication.
 - g. Type and adjustment of drive.
 - h. Electric motors: Manufacturer, frame and type, speed of motors (RPS) (RPM).
 - i. Current characteristics and horsepower of motors.
 - j. Receiver capacity and pressure rating.
 - k. Air silencer: Manufacturer, type and model.
 - l. Air filters: Manufacturer, type, model and capacity.
 - m. Pressure regulators: Manufacturer and capacity.
 - n. Dew point monitor: Manufacturer, type and model.
 - o. Air dryers: Manufacturer, type, model and capacity (Standard L/min) (SCFM).
 - p. Carbon monoxide monitor: Manufacturer, type, model.
 - q. Local Alarms and Master Alarms.
 - r. Air compressor noise generation, db.
 3. Wiring diagrams.
- D. For station outlets and inlets, a letter shall be submitted from the manufacturer stating that outlets and inlets are designed, manufactured, and complies with NFPA 99. Outlets and inlets shall bear label of approval as assembly of Underwriters Laboratories, Inc. or Associated Factory Mutual Research Corporation. In lieu of above labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer (COR), certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.
- E. Completed systems shall be certified that the installation, testing, final purge and inspected in accordance with the requirements of this specification and NFPA 99. Certification shall be provided on letterhead of the testing agency.

- F. Qualification of the Installer: Provide the names and qualifications of each person completing the installation. Include documented evidence of equivalent product installed at three installations similar to this project that has been in satisfactory and efficient operation for 3 years.
- G. Provide testing agency qualifications, including names and qualifications of each person performing the testing, detailed testing procedures, and references from completed similar projects involving similar scope.

SPEC WRITER NOTE: Coordinate O&M Manual and commissioning requirements with Section 01 00 00, GENERAL REQUIREMENTS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

- H. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:
1. Include complete list indicating all components of the systems.
 2. Include complete diagrams of the internal wiring for each item of equipment.
 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- I. //Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//
- J. //Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

1.5 QUALITY ASSURANCE

- A. Installer qualifications shall meet those qualifications stated in ASSE 6010 and documented technical qualifications and previous experience in installing medical gas equipment on three similar projects shall be submitted for review. Names and addresses of referenced projects shall be included in the documentation. Documented evidence of equivalent product installed at three installations similar to this project shall be submitted that has been in satisfactory and efficient operation for three years. Names and addresses shall be included in the documentation indicating where the product is installed.

- B. Dental compressed air equipment shall be furnished by the equipment manufacturer(s) or supplier(s) who shall be familiar with the proper application of the equipment and shall supervise its installation. Material and equipment shall be standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years.
- C. Medical Gas System Testing Organization:
1. The testing shall be conducted by a party technically competent and experienced in the field of medical gas pipeline and medical/dental compressed air equipment testing. Such testing shall be performed by a party other than the installing contractor.
 2. The testing personnel shall be qualified according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.
 3. Names of three projects where testing of medical gas systems has been performed by the testing agency shall be submitted for review. The name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification shall be included in the documentation for review.
 4. The testing agency's detailed procedure to be followed in the testing of this project by contractor shall be submitted. These procedures shall be in compliance with NFPA 99 and shall include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm tests, purity tests, as required. Data on test methods, types of equipment to be used, and calibration sources and method references for purity tests procedures shall be submitted.
- D. Certification documentation shall be provided prior to submitting request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.
- E. The electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70 by a testing agency and marked for its intended use.
- F. All work and equipment shall comply with NFPA 99.

- G. All work and equipment shall comply with UL 60601-1 for medical and compressed air equipment.
- H. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <https://www.biopreferred.gov>.
- I. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

- A. Comply with requirements in Paragraph AS-BUILT DOCUMENTATION of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.7 PROJECT CONDITIONS

- A. Interruption of existing medical air systems shall not be made without the coordination of the Medical Center. The Medical Center shall be notified 14 days in advance of proposed interruption. The interruption shall not be made without the written permission from the Medical Center.

PART 2 - PRODUCTS

SPEC WRITER NOTE: Coordinate and assure that the electrical characteristics specified below are clearly shown on appropriate drawings. Coordinate with Electrical Engineer.

2.1 DENTAL COMPRESSED AIR CONTROL PANEL (ORAL SURGERY 965 KPA (140 PSIG) AIR)

- A. For oral surgery rooms, the dental compressed air control panel shall consist of a line pressure control regulator, inlet and outlet line pressure gauges, DISS service outlet, and supply valve, assembled and rigidly mounted in a roughing-in assembly, provided with a metal cover plate, and shall comply with NFPA 99 and UL 60601-1. The plate shall include color coded label to indicate which gas the control panel was designed for. The DISS outlet shall be a Diameter Index Safety System (DISS) for air service outlet for maximum delivery pressure 1380 kPa (200 psig). Maximum supply pressure 1724 kPa (250 psig). The unit shall be factory tested and cleaned for intended gas service.
- B. Manifold Assembly shall be mounted to a steel support bracket, factory assembled and tested, ready for installation in the roughing-in assembly.

1. Supply valve, bronze bodied, double seal, full flow, ball type, shall be designed for working pressure of 2070 kPa (300 psig), with chrome plated brass ball which seals in both directions, requiring only a quarter turn of the knob from open to closed position.
 2. Line pressure control regulator shall be self-relieving, diaphragm type, with high-flow precision adjustment and working pressure in 69 to 1725 kPa (10 to 250 psig).
 3. Line pressure gauges shall monitor the air inlet and outlet line pressures, calibrated from 0 to 2070 kPa (0 to 300 psig) in increments of 69 kPa (10 psig).
 4. Air service outlet shall be DISS type as specified in CGA V-5, with a self-sealing dust plug, having a working pressure of 1380 kPa (200 psig) maximum.
 5. Two 146 mm (5-3/4 inch) lengths of 10 mm (3/8 inch) outside diameter type "K" copper tubing for connection to air service supply line and to remote outlet line. Inside the panel, tubing shall be copper tubing.
 6. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. The rough-in assembly shall be designed for recessed installation, consisting of a prime painted steel fabricated back box with mounting flanges on all four sides, with provisions to securely anchor the back box to wall construction. The roughing-in assembly shall be equipped with a crossover "U" tube to facilitate testing of the dental compressed air system prior to the manifold installation, and a plaster shield to prevent dust or other foreign matter from contaminating internal parts prior to final assembly.
- D. The cover plate assembly shall be chromed cast metal, aluminum powder coated or NAAMM, Number 4 satin finished stainless-steel panel with provisions for line pressure gauge(s), dental compressed air outlet, regulator and supply valve knobs, attaching directly to the roughing-in assembly by means of four Number 6 - 32 mm by 38 mm (1-1/4 by 1-1/2 inches) long mounting screws, with plaster adjustments up to 19 mm (3/4 inch).
- E. Panel shall be shown and installed on the "Room" side of the wall, not on the corridor side.

F. Control panels may be combined with dental vacuum pump control panel in a single dental equipment control panel.

2.2 //DENTAL AIR COMPRESSOR SYSTEMS (ORAL SURGERY 965 KPA (140 PSIG) AIR)

- A. The dental air compressors shall provide compressed medical air for dental use only in compliance with NFPA 99. All components shall be factory packaged and tested (prewired and pre-piped) on a steel base, or tank mounted. Completed system installation shall be compatible with pneumatically operated surgical hand pieces, and shall provide dental air quality equal to or better than the quality specified under paragraph TESTS AND VERIFICATION.
- B. //Dental Air Reciprocating Compressors: Dental air compressors shall be oil free duplex type, such that design load is provided with one unit out of service. The dental air compressor piping, pipe accessories and controls shall be designed to 1200 kPa (175 psig) maximum allowable working pressure. Each compressor shall be provided with automatic check valves as required for proper operation and the prevention of loss of pressure through the compressor. Manual shut-off valve shall be provided downstream of the check valve for service to check valve and compressor without total system shut down. Noise levels of not more than 88 dB(A) at one meter and no detectable vibration 152 mm (6 inches) from operating position.//
- C. Motor and starters shall comply with NEMA designation with temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT. Each motor shall be provided with an automatic, fully enclosed, magnetic starter of type specified in Section 26 29 11, MOTOR CONTROLLERS.
- D. Controls:
1. Controls shall automatically operate compressors to maintain an adjustable receiver pressure set point. The control system shall automatically alternate lead and lag compressors based upon a time schedule.
 2. An automatic unloading device shall unload compressor under all startup conditions including following current failure while operating, as well as protect against receiver back pressure.
 3. High temperature shutdown sensor shall monitor compressor discharge air temperature and shutdown affected compressor if a temperature above 107 degrees C (225 degrees F) is detected. An audible alarm

- and compressor circuit reset button shall be provided on the control panel.
4. The control panel shall be housed in a NEMA 250 ICS 6, Type 12, listed, dustproof enclosure; prewired to include all specified electrical, electronic and electro-pneumatic devices. Wiring diagrams and operating descriptions in the cabinet. The following shall be included:
- a. Breaker disconnects for each compressor and one non-fused main disconnect with external operators.
 - b. Hand-off-automatic selector switch for each compressor.
 - c. Redundant 120 volt control circuit transformers.
 - d. Magnetic motor starter for each compressor with integral overload protection and short circuit protection.
 - e. Hour meter for each compressor.
 - f. Lubricant temperature gauge.
 - g. Air pressure gauge.
 - h. External visual (lights, red for running, green for off) and audible (horn/buzzer) signals. The signals provided include:
 - 1) Compressor in operation (visual only).
 - 2) High temperature shutdown (audible).
 - 3) Low lubricant shutdown (audible) for lubricated compressor only.
 - 4) Cancel button, which will silence an audible alarm, reactivate should a second alarm occur while the audible is silenced, and reset automatically upon correction of the original condition.
 - 5) Lag In Use where there are multiplexed compressors.
 - 6) Auxiliary contacts for remote alarming of signals 1 thru 4.
- E. The receiver tank shall be welded steel, galvanized, in compliance with ASME BPVC Section VIII-1, 1724 kPa (250 psig) working pressure stamped and certified. The receiver tank shall be equipped with a safety relief valve set at 1270 kPa (185 psig), motorized automatic drain system and manual drain system for tank, sight glass and pressure gauge. A receiver of sufficient capacity to ensure practical on/off operation of compressors shall be provided. The receiver shall have a full size three valve by pass for servicing.
- F. The air silencer shall be finned dry type inlet filter/muffler, enclosed in a housing allowing easy removal of the element for inspection or replacement, with a nominal retention of 40 microns or

less, and muffling by a series of silencer tubes. A filter of sufficient size shall be provided to minimize backpressure. For noise and vibration requirement, refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

- G. Duplex final air filters shall be provided piped in parallel and provided with three valve bypass. The filter set shall be provided for no greater than 34 kPa (5 psig) differential pressure at 1200 kPa (175 psig) inlet and the stated capacity.
1. Pre Filter: A pre filter shall be installed with a maximum 2.5 micron filter, with automatic drain located on the inlet side of the //refrigerated air dryer// //desiccant dryer// and receiver.
 2. Final Filter Package: The final filter package shall consist:
 - a. 0.01 micron coalescing filter with automatic drain.
 - b. Activated carbon filter at the 0.01 micron level with odor and hydrocarbon absorption.
- H. Duplexed pressure regulating valves shall be provided in parallel, valved for maintenance shut-down without service interruption:
1. Brass or bronze body and trim, reduced pressure range 34 to 1724 kPa, (5 to 250 psig) adjustable, spring type, diaphragm operated, relieving. Delivered pressure shall vary not more than 34 kPa (5 psig) for each 345 kPa (50 psig) variation in inlet pressure.
- I. Air Dryers:
1. //The air dryer shall be sized for 100 percent of the design load. The air dryer shall be self-contained, refrigerated type, with counter current heat exchanger, automatic drain, and all internal wiring included The air dryer shall have a non-cycling design with moisture separator housed in a factory standard corrosion resistant cabinet with access doors or panels as required for ease of service and maintenance. The air dryer shall be properly sized to produce 2 degrees C (35 degrees F) or better dew point at design pressure under full load conditions at site. At high temperature operation, the system cools outgoing air to a temperature of 21 degrees C (70 degrees F) plus or minus 5 degrees.//
 2. //The dryer shall be a heatless regenerative type, desiccant air dryer. The dryer shall be an ASME code welded twin drying tower unit using spherical-particle, non-corrosive activated alumina desiccant as drying media. A continuous supply of dry air shall be provided by an automatically cycled operation of the drying vessels, including

drying, pressure stabilization and reactivation. Automatic cycling shall be controlled by a solid state timer. Purge air control system shall include mufflers to reduce the noise level of the purge air exhaust to within OSHA standards, and shall be designed to provide a continuous, minimum flow of purge air should then purge air control regulating valve fail. Dryer shall include //gauges showing in each drying tower, // switch for power "on-off", and indicating light signaling power "on". Dryer shall be provided with local visual alarm contacts to signal failure of //tower cycling, and// high dew point. An alarm circuit to compressed air system disconnect switch panel shall be provided to indicate a local alarm condition. All interconnecting power and alarm wiring shall be provided between compressed air system disconnect panel and air dryer. Water vapor shall be eliminated to a pressure dew point of -68 degrees C (-90 degrees F).//

- J. A combination dew point hydrometer/CO monitor shall be mounted, pre-piped and wired. The dew point hydrometer/CO monitor shall be a ceramic type with integral chemical type CO sensor and include remote alarm contacts. System range accuracy shall be plus or minus 2 degrees C (3.6 degrees F) for dew point and 2 PPM for carbon monoxide. Dew point alarm shall be factory set at 2 degrees C (35 degrees F) per NFPA 99, and the CO alarm shall be factory set at 10 PPM. Both set points shall be field adjustable. Aluminum oxide sensors are not acceptable.//

2.3 //DENTAL AIR COMPRESSOR SYSTEMS (LOW PRESSURE 689 KPA (100 PSIG) SYSTEM)

- A. The dental air system shall be of a modular base mounted design consisting of //triplex// //duplex// compressor, a dryer/control, and an air receiver. Each unit shall be fully compliant with NFPA 99. Manual shut-off valves shall be provided downstream of the check valve for service to the check valve and compressor without total system shutdown.
- B. //The compressors shall be continuous duty rated, "oil-less" type with permanently lubricated, sealed bearings. The compressors shall be of a single stage design, air cooled, reciprocating type with corrosion resistant reed type valves with stainless-steel reeds. Both the compression rings and rider rings shall be made from a long life, fluororesin material designed for continuous duty operation. The crankshaft shall be constructed of a durable nodular graphite cast-iron and designed to be fully supported on both ends by heavy duty ball

bearings permanently lubricated and sealed. The crankcase shall be constructed of gray cast-iron. Maximum heat dissipation shall be achieved through cast aluminum alloy cylinders treated for optimum corrosion and wear resistance. Cylinder sleeves shall not be required. Additionally, heat transmission from the piston wall to the piston pin needle bearing shall be minimized by an insulated "heat cut" piston pin. The connecting rod shall be of a one piece design for maximum reliability.//

- C. //Dental air compressor shall be oil-less scroll air compressor, single stage, air cooled, rotary, oscillating-volute type of construction that prohibits oil from entering the compression chamber. Scroll housing shall be constructed of die cast aluminum. Delivering dental air to a maximum pressure of 830 kPa (120 psig).//
- D. Compressor drive and motor shall be V-belt driven through a combination flywheel/sheave and steel motor sheave with tapered bushing and protected by an OSHA approved, totally enclosed belt guard. Belt tensioning shall be achieved by a pivoting motor mounting base that is fully adjustable through twin adjusting screws. The motor shall be a NEMA rated, open drip-proof, //1800// //3600// RPM, with 1.15 service factor suitable for "208/230/460V" electrical service, as specified in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- E. A pre-piped intake manifold shall be provided with one replaceable finned dry type air filter enclosed in housing allowing for easy removal of the element for inspection or replacement, with collection efficiency of 99 percent retention of particles less than //10// //40// micrometers and muffling by series of silencer tubes. A filter of sufficient size shall be provided to minimize back pressure. For noise and vibration requirements, refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT. The inlet air filter shall have threaded opening for remote intake connection. The filter housing shall be isolated from the intake manifold with a braided 304 stainless-steel flex connector.
- F. An integral air cooled aftercooler designed for a maximum approach temperature of -11 degrees C (12 degrees F) shall be provided complete with moisture separator and timed automatic solenoid drain valve with a manual drain valve by-pass. Each cylinder head shall be provided with a pre-wired high discharge air temperature shutdown switch. A flex discharge connector, safety relief valve, and check valve shall be

included. The compressor discharge line piping shall be of ASTM B819 copper tubing, brass, and/or stainless-steel. The discharge flex connector shall be braided 304 stainless-steel.

- G. The compressor and monitor shall be vibrationally isolated from the main compressor module base by means of a four point, heavy duty, spring isolation system for a minimum of 95 percent isolation efficiency.
- H. A NEMA 12 enclosure, U.L. labeled control system shall be provided. A //duplexed// desiccant drying system, //duplexed// final line filters, //duplexed// final line regulators, and combination dew point/CO monitor shall also be included. Unit shall be pre-wired and pre-piped in accordance with NFPA 99 and include valving to allow complete air receiver by-pass, as well as air sampling port.
- I. //Each// desiccant dryer shall be sized for the peak calculated demand and capable of producing -12 degrees C (10 degrees F) pressure dew point. Dryer purge flow shall be minimized through an on-demand purge saving control system. A mounted pre filter rated for 0.01 micron with automatic drain and element change indicator shall be provided on the inlet of each dryer.
- J. A mounted and pre-wired control system shall be NEMA 12 and UL labeled. Automatic lead/lag control sequencing shall be provided with circuit breaker disconnects for each compressor, one non-fused main disconnect with external operators, full voltage magnetic motor starters with overload protection, redundant 120V control circuit transformers, visual and audible reserve unit alarm with isolated contacts for remote alarm, hand-off-auto lighted selector switches, automatic alternation of the compressors with provisions for simultaneous operation if required, automatic activation of reserve unit if required, visual alarm indication for high discharge air temperature shutdown with isolated contacts for remote alarm, and run time hour meters.
- K. Fully //duplexed// final line filters rated for 0.01 micron with element change indicators shall be factory mounted and pre-piped, along with //duplexed// factory mounted and pre-piped final line regulators and //duplexed// safety relief valves.
- L. //Duplexed// pressure regulating valves shall be provided //in parallel, valved for maintenance shut-down without service interruption//:

1. Brass or bronze body and trim, reduced pressure range 34 to 1724 kPa, (5 to 250 psig) adjustable, spring type, diaphragm operated, relieving. Delivered pressure shall vary not more than 34 kPa (5 psig) for each 345 kPa (50 psig) variation in inlet pressure.
- M. A mounted, pre-piped and wired, combination dew point hydrometer/CO monitor shall be of the ceramic type with integral chemical type CO sensor. System range accuracy shall be plus or minus 2 degrees C (3.6 degrees F) for dew point and 2 PPM (at 10 PPM) for carbon monoxide. Dew point alarm shall be factory set at 2 degrees C (35 degrees F) per NFPA 99, and the CO alarm shall be factory set at 10 PPM. Both set points shall be field adjustable.
- N. Air Receiver: A vertical, galvanized ASME Code stamped, National Board Certified air receiver shall be provided, rated for minimum 1034 kPa (150 psig) design pressure, a sight gauge glass and timed automatic solenoid drain valve. A three valve bypass on shall be provided on the air receiver supply.//

2.4 ALARMS

- A. All low voltage wiring, except for wiring from alarm relay interface control cabinet to Engineering Control Center (ECC) shall be provided as required for complete proper functioning system, in conformance with Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Run wiring in conduit, in conformance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
1. Dental Compressed Air Alarms shall include:
 - a. Dew point alarm shall activate when the operating dew point rises above 2 degrees C (35 degrees F) at system delivery pressure and receives signal from dew point monitor. The dew point alarm shall receive data from a dew point monitor.
 - b. Filter set alarm shall operate when the pressure drop across the filter set increases more than 14 kPa (2 psig) over the pressure drop for new filters. The filter set alarm shall operate by a differential pressure switch.
 - c. Pressure alarms shall operate when system pressure downstream of main shutoff valve drops below a threshold of 20 percent below normal operating line pressure (plus or minus 2 psig) or increases 20 percent above normal operating line pressure. The pressure alarms shall operate by pressure switches.

- d. High temperature shutdown alarm shall operate when the discharge air temperature exceeds 107 degrees C (225 degrees F), the high temperature shutdown alarm shall disable the affected compressor.
- e. Low lubricant shutdown shall operate when the lubricant level drops to a low alarm set low point.
- f. High carbon monoxide level alarm shall operate when carbon monoxide level rises above 10 mg/L (10 parts per million).
- g. Lag compressor in use.
- h. Motor overload.
- i. Desiccant dryer malfunction.

SPEC WRITER NOTE: See standard detail SD226119_74-01.DWG available at <https://www.cfm.va.gov/til/sDetail.asp>.

B. Alarm Panels:

1. The alarm panel shall have a modular design and be easily serviceable. Alarms shall operate on direct current (DC) low voltage control circuit. The required number of transformers shall be provided for efficient functioning of a complete system. Alarm panels shall be integral units, reporting dental air services.
2. The alarm panel shall be flush mounted, sectional or one piece constructed of corrosion resistant material. The alarm panel shall be of a size to accommodate the required number of service functions for each location, and for one audible signal in each panel. //The alarm panel shall be seismically anchored according to the project location.//
3. Cover plates shall be designed to accommodate the required number of signals, visual and audible, for each location, and containing adequate operating instructions within the operators view. Bezel shall be extruded aluminum, chrome plated metal, or plastic. The cover plate shall be secure to the alarm panel with chrome plated or stainless-steel countersunk screws.
4. Service indicator lights shall be red translucent plastic of LED with proper service identification inscribed thereon. The number of lights and service instructions shall be as required for each location. The service indicator lights shall be provided with a green test button of the same material, inscribed thereon with "PUSH TO TESTS" or similar message.

5. An audible signaling device shall be provided with the alarm panel and connected electrically with all service indicator light functions.
6. Controls:
 - a. When an alarm condition occurs, each individual service indicator light shall activate, which cannot be canceled until such condition is corrected.
 - b. An audible alarm shall give an audible signal upon circuit activation of any visual signal. The audible signal shall be continuous until silenced by pushing a reset button. This action shall cancel and reset the audible alarm only, and not affect the visual signal. After silencing, subsequent alarms shall reactivate the audible alarm.
 - c. A test button or separate normal light shall be continuously lighted to indicate electrical circuit serving each individual alarm activated. Pushing the test button shall temporarily activate all visual signals and sound audible signal, thereby providing desired indications of status of system.
- C. Alarm relay interface shall be designed to transfer the closed circuit alarm signals through relays to a set of terminals for monitoring signals at the ECC without interrupting the closed circuit system. The alarm relay interface shall be constructed of 1.9 mm (14 gauge) steel, conforming with NEMA ICS 6, Type 1 enclosures. The alarm relay interface shall be provided with both normally open and normally closed contacts for output signals, with number of circuits required for a full alarm capability at the ECC. Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for compatibility.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.
- B. Install in accordance with NFPA 99 and NFPA 70.
- C. Coordinate with electrical drawings and the Electrical Engineer and all wiring and conduit for motors shall meet requirements of NFPA 70.
- D. Valves and other equipment shall be rigidly supported to prevent strain on tube or joints.

- E. Pressures and vacuum switches, transmitters and gauges shall be installed where the devices are easily accessed. An access panel shall be installed where devices are installed above a plaster ceiling. Pressure switches and sensors shall be installed for gas specific DISS demand check valves.
- F. The compressor intake shall be piped to a source of clean ambient air as indicated in NFPA 99.
- G. After initial leakage testing is completed, Piping shall be pressurized with testing gas until testing agency performs final tests.
- H. Install pressure regulators on compressed-air piping where reduced pressure is required.
- I. Provide spring isolators for mounting air compressor.
- J. Engage factory authorized service representative to perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Check belt drives for proper tension.
 3. Verify inlet filter and piping are clear.
 4. Check safety devices for correct setting.
 5. //Check for proper seismic restraints.//
 6. Drain received tank.
 7. Check lubricating levels.
 8. Operational test: After circuitry has been energized, start units to confirm proper unit operation.
 9. Test and adjust controls.
- K. Provide manufacturer's nameplate data in accordance with Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

3.2 TESTS AND VERIFICATION

- A. An initial test for the system shall consist of initial blow down, initial piping purge test, initial pressure test for positive-pressure gas systems and copper Level 3 vacuum piping, initial cross-connection test, and initial standing positive-pressure gas piping tests. Tests shall be conducted as required by NFPA 99 for a Category 3 compressed air system with documentation.
- B. System verification and final testing shall be conducted comprising of a system verifier standing pressure test, verifier cross-connection test, verifier Level 3 warning system test, verifier piping purge test, verifier final tie-in test, verifier operational pressure test,

verifier piping particulate test, verifier piping purity test, labeling, and source equipment verification test shall be performed for a Category 3 compressed air system as required by current NFPA.

3.3 STARTUP AND TESTING

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. The tests shall include system capacity, control function, and alarm functions.
- C. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- D. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.

3.4 //COMMISSIONING

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

3.5 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //4//
// // hour//s// to instruct each VA personnel responsible in operation and maintenance of the system.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

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