

DIRECT GAS-FIRED HEATING, VENTILATING AND MAKE-UP AIR SYSTEMS

PART 1: GENERAL

1.1 SUMMARY

- A. Provide self-contained, packaged direct gas fired industrial air handlers including casing, insulation, burner, manifold, fan, motor, mixing chamber, dampers, controls, {roof mounting curb}, inlet hood and all other component parts reasonably required to provide a complete system.
- B. Refer to Equipment Schedule on drawings.

1.2 References

- A. American National Standards Institute (ANSI): Establishes requirements to certify direct gas-fired heating & ventilating equipment.
- B. ETL Testing Laboratories: Independent testing facility certifies conformance to applicable ANSI standards.
- C. National Electric Code (NEC): Establishes electrical standards.
- D. Underwriters Laboratory (UL): Independent testing facility certifies code conformance.
- E. National Fire Protection Agency (NFPA): Establishes fire prevention standards.
- F. Factory Mutual Global Insurance (FMG): Certifies gas manifold compliance to owner's insurance carrier.
- G. Industrial risk Insurance (IRI): Certifies gas manifold compliance to owner's insurance carrier.

1.3 Submittals

- A. Manufacturer shall provide {submittal, record} drawings indicating:
 - 1. dimensions
 - 2. weights
 - 3. fan curves and data
 - 4. coil data (if applicable)
 - 5. filter data (if applicable)
 - 6. required clearances

7. duct connection sizes
8. service connection sizes and locations
9. assembly details
10. wiring diagrams
11. sequence of operation
12. installation guide and instructions
13. operation and maintenance data
14. parts listings including recommended spares

B. Product Data including technical product data, performance charts, rated capacities, furnished specialties and any accessories.

1.4 Quality Assurance

A. Provide direct gas-fired heater that include ETL/AGA design certification and listed to be in conformance to the [ANSI Z83.4-2017 and CSA 3.7-2017 standards (100% Outside Air type)] [Z83.18b-2008 standards (recirculating OA/RA type)].

B. Heater shall be factory assembled, wired and tested.

C. Manufacturer shall make its facility available to the customer for equipment inspection prior to shipment.

PART 2: PRODUCTS

2.1 Acceptable Manufacturers

AbsolutAire, Inc. (Kalamazoo, MI) Phone: 269-382-1875 Fax: 269-382-5291

2.2 Direct Gas-Fired Heaters

A. Provide a direct gas-fired {Rooftop/Horizontal/Suspended/Upright} heater with {variable outdoor air feature for building pressurization} {100% O.A. capability, constant volume} {100% O.A. capability including variable volume accomplished with a variable frequency drive (VFD) and building pressure controls}.

B. Provide self-contained, packaged heater(s) which shall include; casing; modulating burner; non-overloading fan; motor, mixing chamber; {positive position variable outdoor-air/return-air dampers} {motorized inlet damper}; and automatic controls for temperature {and pressure}.

{C. R300 Model. Provide a casing of 16 gauge aluminized steel, welded to structural steel framing. All exterior casing seams are to be 100%

weather-tight. All interior and exterior surfaces will be cleaned of all oil and grease. Painted exterior will consist of a high-quality prime coat and a finish coat of machinery enamel with rust inhibitors. Color chosen by owner. {All interior surfaces will be lined with 1-inch, 1-1/2 pound density, coated fiberglass insulation. The insulation shall comply to UL standard 181 for erosion and NFPA 90A for fire resistance. Exposed edges will be coated to eliminate erosion. Insulation will be held in place with adhesive and welded pins}. {All interior surfaces will be lined with 20 gauge aluminized steel and sandwich 2-inch, 3 pound density, fiberglass insulation. The insulation shall comply to NFPA 90A for fire resistivity. Insulation will be held in place with adhesive and welded pins}}.

- {C. R400 Model. Provide an exterior casing of 20 gauge aluminized steel standing seam construction. Siding sections shall be attached with zip screws to an internal 18 gauge welded mild steel structural tube frame {prime painted – single wall construction} {unprimed – double wall construction}. structural steel framing. All exterior casing seams are to be 100% weather-tight. All interior and exterior surfaces will be cleaned of oil and grease. {Painted exterior will consist of a high-quality wash primer coat and a finish coat of machinery enamel with rust inhibitors. Color chosen by owner}. {All interior surfaces will be lined with 1-inch, 1-1/2 pound density, coated fiberglass insulation. The insulation shall comply to UL standard 181 for erosion and NFPA 90A for fire resistance. Exposed edges will be coated to eliminate erosion. Insulation will be held in place with adhesive and welded pins}. {All interior surfaces will be lined with 20 gauge aluminized steel and sandwich 2-inch, 3 pound density, fiberglass insulation. The insulation shall comply to NFPA 90A for fire resistivity. Insulation will be held in place with adhesive and welded pins}}.
- D. Provide {a filter mix box to provide filtration of all outdoor and return air through the same filter media (85/15 Model)} {an outside air (OA) filter section only (100% OA Model)}. Filters shall be polyester replacement media in galvanized locking frames. {Manufacturer shall provide a clogged filter warning (light/alarm/photohelic)}.
- E. Provide a gas burner which shall be Type NP-I or NP-II as manufactured by Maxon Burner Company, (or its approved equivalent) specifically designed to burn natural or propane gas below the maximum non-contaminating levels required by OSHA and the American Conference of Governmental Industrial Hygienists. Burner shall have non-clogging, stainless steel baffles attached to a non-corrosive aluminum cast gas supply section with no moving parts. The burner shall have a 25-to-1 turndown ratio and be designed for 100% thermal efficiency for the life of the equipment.

- F. Provide outdoor air velocity across the burner which shall be a constant 3,000 feet per minute through the burner profile. The burner velocity shall be constant at all times throughout the operation of the heater. No air from the indoor space shall be allowed to recirculate across the burner at any time.
- G. Provide a blower wheel which shall be built-in, single-width, single-inlet, centrifugal-type, airfoil-design, plenum-type, non-overloading, and belt driven for required air capacity. A precision-formed inlet cone shall be provided for streamlined airflow into the fan wheel to ensure full and even loading of the fan blades. All system air shall pass through only one fan inlet. The motor shall be {ODP} {TEFC} {EPACT} {Premium Efficiency}, with a minimum efficiency of _____% mounted on an adjustable slide base with a safety factor of 1.15. The motor be suitable for continuous service at 120 degrees F. ambient, and wired for the selected voltage, nominal 1750 rpm and standard NEMA frame. Fan discharge velocity shall not exceed 2,200 FPM. Blower, motor and drive shall be factory-tested to provide the specified air delivery (per ANSI standards) at the design total static pressure. Fan shaft shall be connected to the motor by a multi V-belt drive, capacity designed for 50% over the motor nameplate horsepower. Fan shaft shall be turned, ground and polished. A protective coating shall be applied to the fan shaft to minimize oxidation. Fan wheel and bearings shall be supported from reinforced structural steel framework. Bearings supported from only the fan or heater housing are unacceptable. Bearings shall be ball bearings and/or spherical roller bearings with locking collars and shall be rated L10 for 100,000 hours or greater. Fan bearings shall have extended lube lines, which shall terminate at the heater exterior wall so that all lubrication can be performed without shutting down the system. Sound power shall not exceed _____ DbA at distance of 10 feet from a discharge opening at full airflow. Provisions shall be made for measurement of fan RPM without entering the unit housing.

2.21 Provide the Following Control System

(Choose "A" Analog or "B" DDC):

A. ANALOG CONTROLS

1. The Control Panel

The heater control panel shall be similar to NEMA 3R and contain all standard electrical components, such as fused disconnect switch; motor starter; 120-volt and 24-volt transformers; control circuit fuse; flame relay and a full number-coded terminal strip. Heater controls shall be protected by a hinged-door weather enclosure. Eleven (11) labeled pilot lights shall indicate the operation of all primary control components. Pilot lights shall indicate the following:

- a. Power on
- b. Fan on
- c. High-temperature limit switch
- d. Fan airflow switch
- e. Low gas-pressure switch
- f. High gas-pressure switch
- g. Pilot valve open
- h. Power to valves
- i. Valves open
- j. Burner lockout alarm
- k. Low temperature alarm

The control enclosure shall be lighted with a minimum 25 watt incandescent light bulb, able to operate with the main disconnect switch in the off or on position. The heater control panel shall have a burner flame supervision module to lock out the gas flow from the main gas valve in a burner lock-out or other adverse condition. A remote relay reset push-button shall allow personnel to reset a burner lock-out condition at the remote control panel. The complete control and safety system as well as the burner and gas manifold shall be factory tested.

2. Temperature Control

{Space Temperature Control. A solid-state temperature control system, located inside the control panel, shall have a sensing thermistor located in the space as shown on the plans. The thermistor senses and controls the room temperature in the occupied mode. One thermistor, mounted in the heater discharge, controls the maximum and minimum discharge air temperature in response to burner modulation}.

{Discharge Temperature Control. A solid-state temperature control system, located inside the control panel, shall have a sensing thermistor located in the heater discharge. The thermistor senses and controls the minimum and maximum discharge temperature based on the setting of the discharge temperature selector located at the remote control panel}.

3. {Automatic Building Pressure Control {with Manual Override}}

The heater shall incorporate a separate outdoor-air/return-air mixing chamber, containing two (2) sets of 16-gauge galvanized multi-blade dampers, interlinked to work opposite each other. Each damper shall control up to 85% of the total heater fan volume. These dampers shall provide a total outdoor air turndown ratio of 6.67 to 1 by proportional control means as outlined herein. Outdoor air {and return air} damper(s) will be controlled with a {manual potentiometer control} {automatic building pressure control}. {An automatic pressure control, linked to the {outdoor air} {and return air} damper(s), is used to sense the

difference between outdoor ambient and room pressure. The {diaphragm} {photohelic} switch is mounted in a control cabinet at the heater. The pressure-sensing range shall be 0.01 to 0.20 with a null of .02 to .03 (factory set at +.01" w.c.). {A manual/auto selector switch is provided to allow selection of manual or automatic pressure control. This manual control potentiometer shall be located inside the remote control panel}.

4. The Remote Control Panel

A remote control and monitoring panel shall be provided and will incorporate the remote operating switches and pilot lights. The remote control panel shall be vented as needed and will be {NEMA 12 rated, painted mild steel} {NEMA 4X rated polycarbonate} {NEMA 4X rated stainless steel}. It shall enclose the temperature selector(s) {occupied/unoccupied}, {the manual/auto pressure control selector switch}, {the 7-day time clock}. Wiring to the remote panel from the main control panel shall be accomplished in the field (by others) with low voltage (24 volt maximum) and shielded cable with a drain wire for the temperature controls. The remote control panel shall provide each heater the following (choose items as needed):

- a. a manual pressure-control potentiometer
- b. an occupied room temperature stat.
- c. a room-temperature unoccupied cycle stat.
- d. a programmable 7-day time clock with a minimum of four (4) programmable on/off schedules per day, with a battery back-up.
- e. a burner alarm horn with silence switch,
- f. a {tamper-proof, key-operated} SUMMER-OFF-WINTER switch,
- g. a {tamper-proof, key-operated} remote burner-flame reset switch,
- h. a {tamper-proof, key-operated} manual/auto building-pressure selector switch, and
- i. These system pilot lights:
 - a. Power on
 - b. Fan on
 - c. High-temperature limit switch
 - d. Fan airflow switch
 - e. Low gas-pressure switch
 - f. High gas-pressure switch
 - g. Pilot valve open
 - h. Power to valves
 - i. Burner on
 - j. Burner lockout alarm
 - k. Low temperature alarm

B. DIRECT DIGITAL CONTROLS (DDC)

The DDC Control System will be a factory installed and tested open protocol

JeneSys® type consisting of system compatible control boards, sensors and program logic necessary to provide the features described as follows.

1. I/O Modules: Each I/O module shall have an LED status indication and be individually fused and replaceable.
2. External Control Interface: Via an external internet connection, the equipment can be monitored or controlled as if on-site.
3. Information and Control Functions: Individual unit controllers shall be capable of communicating information to and receiving control instructions from an on-site remote device or internet connection. The following control functions and instructions shall be available:
 - a. Space Temperature set point for occupied and unoccupied periods
 - b. Occupied and unoccupied scheduling with up to 21 on periods per week per H&V unit.
 - c. Building pressure set point, status, control, and history
 - d. OA and RA damper status and control
 - e. Humidity control enable/disable, status, and set point (optional)
 - f. Low temperature limit set point and shut down temperature
 - g. Maximum and minimum discharge air set point
 - h. Discharge air temperature, current and history (adjustable)
 - i. Return air temperature, current and history
 - j. Space temperature set point, current and history
 - k. Actual space temperature, current and history
 - l. Outside air temperature, current and history
 - m. Error reporting display and log capability of last 20 errors, including date and time of each occurrence:
 - 1) Set points out of range
 - 2) OA damper failure
 - 3) RA damper failure
 - 4) Low temperature limit shut down
 - 5) High temperature limit shut down
 - 6) Digital I/O check
 - 7) Burner air damper failure
 - 8) Fan start up failure
 - 9) Low gas pressure switch failure
 - 10) High gas pressure switch failure
 - 11) Low airflow switch shut down
 - 12) High airflow switch shut down
 - 13) Clogged filter alarm
 - 14) Block or safety gas valve failure
 - 15) Over-pressure alarm
 - n. Personnel-Machine Interface: When the unit controller(s) are connected with a XXX communication cable per the

manufacturer's instructions to a Windows® based computer, the following visual display and control features are available:

- 1) Fan Status
- 2) Burner Status
- 3) Occupied/Unoccupied Status (heat, vent/flush)
- 4) Space Temperature set point and status
- 5) Building Pressure set point and status
- 6) Manual Damper set point and status
- 7) Outdoor air temperature
- 8) OA/RA damper position
- 9) Filter status (clear/clogged)
- 10) Time and Date
- 11) Gas and electric usage (status and logged last 3 months)
- 12) Fan run time (cumulative)
- 13) Number of fan starts
- 14) Time and date of last power up
- 15) Optional customer designated points
- 16) Selection of up to 21 operating periods per week
- 17) Flame relay reset
- 18) Low Temperature limit reset
- 19) Relief control status
- 20)

The DDC controls shall be housed in a control enclosure that is lighted with a minimum 25 watt incandescent light bulb, able to operate with the main disconnect switch in the off or on position.

2. Temperature Control

{Space Temperature Control. A solid-state temperature control system, located inside the control panel, shall have a sensing RTD located in the space as shown on the plans. The RTD senses and controls the room temperature in the occupied mode. One RTD, mounted in the heater discharge, controls the maximum and minimum discharge air temperature in response to burner modulation}.

{Discharge Temperature Control. A solid-state temperature control system, located inside the control panel, shall have a sensing RTD located in the heater discharge. The RTD senses and controls the minimum and maximum discharge temperature based on the setting of the discharge temperature selector located at the remote control panel}.

3. {Automatic Building Pressure Control {with Manual Override}}

The heater shall incorporate a separate outdoor-air/return-air mixing chamber, containing two (2) sets of 16-gauge galvanized multi-blade dampers, interlinked to work opposite each other. Each damper shall control up to 85% of the total heater fan volume. These dampers shall provide a total outdoor air turndown ratio of 6.67 to 1 by proportional control means as outlined herein. Outdoor air {and return air} damper(s) will be controlled with a {manual potentiometer control} {automatic building pressure control}. {An automatic pressure control, linked to the {outdoor air} {and return air} damper(s), is used to sense the difference between outdoor ambient and room pressure. The {diaphragm} {photohelic} switch is mounted in a control cabinet at the heater. The pressure-sensing range shall be 0.01 to 0.2 with a null of .02 to .03 (factory set at +.01" w.c.). {A manual/auto selector switch is provided to allow selection of manual or automatic pressure control. This manual control potentiometer shall be located inside the remote control panel}.

4. Optional DDC Items

5. The Low-Temperature Limit Switch

This switch turns the fan motor off when cold air is being discharged from the heater. The minimum discharge temperature may be selected from 0° to 70° F. The switch is factory-set at 40° F. A separate timer shall by-pass this switch for five (5) minutes on initial start-up.

6. The High-Temperature Limit Switch

This switch turns the burner off when the discharge air temperature exceeds 120° F. The burner must then be manually reset at the heater.

- I. Provide a gas manifold sized for the rated BTU capacity of the heater and minimum and maximum inlet gas pressure, as scheduled on the drawings. The gas manifold enclosure shall be illuminated with a minimum 25 Watt incandescent light bulb, able to operate with or without the main disconnect switch in the on position. The gas manifold will be constructed in conformance to:
 1. Factory Manual (FM) insurance requirements or
 2. Industrial Risk Insurers (IRI) insurance requirements.
- J. Provide high and low gas-pressure switches. The high gas-pressure switch, to be located on the burner end of the manifold, shall turn the burner off when the gas pressure is too high. The maximum gas-pressure range will be from 3" W.C. to 21" W.C. (Factory Set at " W.C.). The low gas-pressure switch, to be located on the inlet end of the manifold, shall turn the burner off when the gas pressure is too low. The minimum gas pressure range will be from 3" W.C. to 21" W.C. (Factory Set at " W.C.).

2.3 Accessories (Select accessories as desired)

Manufacturer shall provide the following accessories:

ROOF-MOUNTED HEATERS

A. Roof Curb

Each heater shall have a full-perimeter, 20" high curb, formed of 14-gauge galvanized (G-90 coated) or aluminized steel. Contractor shall shim the curb so that it is level {and shall install a cant strip and wood nailer} per detail on the plans.

B. Inlet Hood

An inlet hood (galvanized or aluminized steel) shall be provided to mount on the outdoor-air-intake of the heater. Average inlet velocities shall not exceed 500 FPM.

C. Louvered Outdoor-Air Intake Plenum

All outdoor-air intake plenums shall be manufactured with galvanized or aluminized steel and shall have horizontal, drainable-blade louvers. The louvers shall be mounted on the front and both sides of the plenum. The average face velocity of the louvers shall not exceed 1,000 FPM. A bird screen shall be affixed to the inside face of each louvered side of the plenum. The floor of the intake plenum shall be drainable to the roof of the building. A hinged access shall be provided for entry into each plenum.

D. Walk-In Weather Enclosure

A walk-in weather enclosure with corrosion resistant 16-gauge multi-grip floor plate shall be provided as specified, with the physical size shown on the plan. The weather enclosure shall provide the operator with weather protection and allow for easy access to the heater controls and components. All piping or mechanical system apparatus shall be installed to allow for maximum clearance through the walkway to allow for a full-size door with window and locking hardware. A factory-wired ground fault circuit with transformer, prior to the main disconnect switch, will be provided with a GFI convenience outlet. All factory wiring shall be 600-volt-rated type of MTW/THWN-stranded copper, enclosed in EMT or liquid-tight (maximum of 3 feet) conduit in accordance with NEC. Manufacturer shall provide a vapor-proof incandescent overhead light. All junction boxes shall be UL/CSA approved.

INDOOR SUSPENDED and UPRIGHT HEATERS

Service Platform.

Each heater shall be furnished with a service platform, running the full {length} {width} of the heater, and shall include corrosion resistant 16-gauge multi-grip floor plate with an OSHA-approved handrail, kick-plates, and safety chains at each entrance end.

INDOOR SUSPENDED

A. Vibration Isolators

Vibration isolators shall consist of a steel housing and an isolation element, molded entirely of a colored oil-resistant neoprene stock for easy identification of capacity. The hangers shall have a deflection of 1/4" or less and will be supplied by the heater manufacturer.

B. Steel Channels

Structural steel channels shall support the heater and service platform as one. {Channels and} Hangers and miscellaneous hardware will be furnished by the installing contractor.

ROOF MOUNTED or INDOOR SUSPENDED

Discharge Plate

A discharge plate shall be provided, as shown on the plans. This plate is constructed of 16-gauge corrosion resistant steel, reinforced with angle iron as needed, and painted by the manufacturer. Contractor shall supply all necessary hanger rods and shall install discharge plate in accordance with manufacturer's recommendations.

Discharge Head

Manufacturer shall provide a {single deflection discharge head with adjustable horizontal air deflection blades} {double deflection discharge head with adjustable horizontal and vertical air deflection blades} {90 degree} {180 degree} {360 degree} configuration, as detailed on the plans. The discharge head shall be constructed of aluminized or galvanized steel. The housing will be painted, blades are unpainted. The adjustable and locking blades will be provided to control direction of the airflow.

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