

PART 3 - EXECUTION

3.01 CLEANUP

- A. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.

3.02 WIRING, CONDUIT, AND CABLE.

- A. See Section 271500, Horizontal Cabling for information.

3.03 INSTALLATION PRACTICES FOR FIELD DEVICES

- A. Well-mounted sensors shall include thermal conducting compound within the well to insure good heat transfer to the sensor.
- B. Actuators shall be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
- C. Relay outputs shall include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
- D. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
- E. For duct static pressure sensors, the high pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.
- F. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube. Pipe the low pressure port to the outside of the building.
- G. Enclosures
 1. For all I/O requiring field interface devices, these devices where practical shall be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
 2. FIPs shall contain power supplies for sensors, interface relays and contactors, safety circuits, and I/P transducers.
 3. The FIP enclosure shall be of steel construction with baked enamel finish, NEMA 1 rated with a hinged door and keyed lock. The enclosure shall be sized for twenty percent spare mounting space. All locks shall be keyed identically.
 4. All wiring to and from the FIP shall be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.
 5. All outside mounted enclosures shall meet the NEMA-4 rating.
 6. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

H. Identification

1. Identify all control wires with labeling tape or sleeves using either words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
2. All field enclosures, other than controllers, shall be identified with a bakelite nameplate. The lettering shall be in white against a black or blue background.
3. Junction box covers shall be marked to indicate that they are a part of the BAS system.
4. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with name plates.
5. All I/O field devices inside FIP's shall be labeled.

I. Location

1. Space humidity or temperature sensors shall be mounted away from machinery generating heat, direct light and diffuser air streams.
2. Outdoor air sensors shall be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
3. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.04 SYSTEM ACCEPTANCE TESTING

- A. All application software shall be verified and compared against the sequences of operation. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint.
- B. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the owner.
- C. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.
- D. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

3.05 TRAINING

- A. Upon completion of the project and commissioning, the BAS Contractor shall provide a minimum of forty (40) hours of on-site training.

END OF SECTION 230900

SECTION 233000

VEHICLE EXHAUST EXTRACTION SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

- 1. Vehicle exhaust extraction system with spring hose reel overhead storage, flexible hoses, exhaust pipe adapters, controls and exhaust fans.

1.03 SYSTEM DESCRIPTION

- A. Spring Hose Reel.
- B. Hose
- C. Exhaust Pipe Adapter
- D. Exhaust Fan

1.04 SUBMITTALS

- A. Product Data: Indicate manufacturer's model number, technical data, and accessories, requirements for access, maintenance, weights and service-connections including dimensions.
- B. Closeout Submittals: Operation and Maintenance data manual including spare parts list.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. Ventaire.
 2. Nederman.
 3. Plymovent.
- B. Spring Hose Reel.
1. The hose reel frame shall consist of steel mounting brackets securely fastened between two steel frame side plates. The frame base mounting brackets shall be constructed of 12 gauge powder coated angular steel. The frame side plates shall be constructed of double reinforced, 12 gauge galvanized steel. The entire assembly shall be capable of being wall or ceiling mounted.
 2. The hose reel drum shall be constructed of 14 gauge reinforced galvanized steel and formed to 18" in diameter. The drum side plates shall be constructed of 16 gauge reinforced steel. The drum side plates shall have a rolled edge with a centered 18" diameter formed groove for additional strength. Four steel support bars shall be mounted inside the drum, fastening the drum sides together while increasing the drum strength.
 3. The hose reel shall have a mitered elbow, constructed of 16 gauge powder coated steel. Elbow assembly shall extend from hose reel inlet to the outlet of the reel. This allows the air velocities to remain constant through the entire reel. Hose assembly shall attach directly to hose reel elbow. Hose reels utilizing a sealed drum as part of the airstream shall not be acceptable.
 4. A hose guide shall be mounted to the drum to ensure proper hose storage while being retracted. A hose stop bar shall extend across the hose reel frame to prevent over rotation.
 5. The heavy-duty springs shall be constructed of carbon steel, coiled inside a 16 gauge steel spring case. The hose reel activation shall be initiated through a locking latch mechanism.
 6. Hose reel must be designed to store 25' of 6" hose.
 7. Hose reel shall be provided with a direct drive pressure blower. Blower to be mounted to hose reel using a fan to reel bracket. Flange mounted blowers are not acceptable.
 8. Hose reel shall be provided with a microswitch for fan control. Microswitch to be powered by control in fan starter. Fan to turn on when hose reel is extended. Fan remains energized until hose reel is retracted.

C. Vehicle Exhaust Hose

1. The hose shall be rated for a continuous operating temperature of 600°F, intermittent exhaust temperature rating of 1000°F. Hose material shall be double ply hose with an inner liner ply of woven fiberglass coated silicone rubber. A helically wound spring steel wire is imbedded between the inner liner ply and an exterior ply of woven Nomex coated with silicone rubber for maximum flexibility. Medium temperature material (polyester, thermoplastic, neoprene) will not be accepted.

D. Exhaust Pipe Adapter

1. Under Chassis Exhaust Pipe Adapter, Ventaire model TS60-VG, or equal.
 - a. Tapered cone with safety edge, constructed of minimum 20 gauge stainless steel. Provide with vise grip.

E. Direct Drive Pressure Blower

1. Cast aluminum housing with cast aluminum radial blade wheel.
2. Provide with fan to reel mounting bracket.
3. Accessories
 - a. Fan Control: Provide fan starter with HOA selector switch, Reset button & 120v control transformer.

2.02 Overview of Project:

- A. Each system above shall be provided with a fan, auto-start system, controls, support track, hoses and ductwork as described on the drawings and specifications.

2.03 General Procedures

- A. The exhaust system shall be designed to vent 100 % of exhaust gases and particulate safely to the outside of the fire station. The exhaust system shall be designed and installed by factory authorized personnel, have been certified by the manufacturer of the exhaust system.
- B. Manufacturers shall be ISO 9001 and ISO 140001 certified and be required to have a minimum of five years of proven manufacturing and distribution experience in the business of emergency vehicle exhaust extraction equipment.

2.04 General Design of Exhaust System

- A. The suction rail system shall be designed to be installed within 18 inches of the side of the vehicle and not take up more than 20 inches of space from the side of the vehicle and nearest obstacle. The value of this trim line approach keeps the ceiling and aisles clear of obstructions.

2.05 Routine or Daily Maintenance

- A. The system shall be able to also be used for common maintenance inside the fire station. The standard requirement of pump checking is for 5 minutes @ 1300 RPM. The idle time for the system shall be continuous for undetermined period of time.

2.06 Vehicle Airflow Requirements

- A. Exhaust system shall be designed to extract vehicle exhaust particulate and gases by a continuance of negative pressure from vehicle tailpipe to the outside of fire station. The exhaust system shall pull exhaust into the nozzle by inducing ambient air, without the need of an airtight seal at vehicle tailpipe. The system shall be designed entirely for a negative pressure vacuum method of exhaust extraction. At no point in exhaust system will ducting be under positive pressure. Systems that allow for positive pressure generated by vehicle engine shall not be accepted.

2.07 Complete Package

- B. Complete exhaust system including the exhaust fan, control box, ductwork, and extraction unit shall be proven and field-tested for a minimum of 5 years. All system components shall be labeled with manufacturer identification.

2.08 Air Testing of Exhaust System:

- A. The overall design shall include individual systems for each apparatus that are specifically designed for the output CFM of the apparatus engine.
- B. Testing shall be accomplished two ways:
 - 1. At conclusion of installation of exhaust system all vehicles in facility will be operated for a period of 15-minutes to ensure that extraction hose, ducting, and fan have been sufficiently sized for all the vehicles operating in fire station.
 - 2. Air balancing shall be performed to ensure that the designed CFM requirements are met for each bay.

2.09 Control Operation Overview:

- A. The exhaust control system shall be designed to operate in complete symmetry with the operation of the vehicle engine, while it is inside the fire station. Exhaust fan energizes before vehicle starts and shall work in conjunction with the vehicle engine, no matter how long vehicle operates inside fire station. (Time-related shutoff switches shall not be accepted to avoid timing out of the exhaust fan while vehicle engine is still operating.)
- B. No panic buttons or activation switches that incorporate door and/or alarm operation shall be accepted. System operation shall be initiated prior to the start up of the vehicle without any human intervention.

2.10 Method of Nozzle Attachment:

- A. The system shall be designed so that attachment of exhaust hose is accomplished by the operator standing completely erect, and with one simple motion connect system to vehicle. The system attachment shall be a one step process and no bending shall be required. This will prevent exposure of exhaust to the breathing zone of the operator and possible strain to the lower back. At no time shall the exhaust nozzle fit underneath the emergency apparatus to ensure that system nozzle will be free from snagging the underside of vehicle chassis and wheels.

2.11 Method of System Release

- A. The system shall not use the “pull-off” release, but rather a fall-away style of system disconnects. Systems that stretch the hose to its limit in order to disconnect from the fire apparatus will not be allowed.

2.12 Structural Support System

- A. The exhaust system shall be suspended from the building structure by means of plated or painted steel strut designed to eliminate sway of overall exhaust system.

2.13 The System Track

- A. The exhaust system shall be equipped with a lightweight track support system to convey the exhaust hose from door threshold to vehicle park position. This track must be designed for the specific use of fire station exhaust ventilation and be engineered to carry the specific weight of all exhaust system components attached to the track as well withstand the pull forces placed upon system when vehicle exits the station. System track must be supported a minimum of every 10 ft and no more than 4 ft of track shall be cantilevered from the end of the first and last support. A minimum of 3 supports shall be required.
- B. The track shall be attached to the structure in a fashion that allows for side-to-side motion in the advent the fire apparatus is parked more than 2 feet away from track system. This sway will in no way affect the overall structural integrity of whole track and hose system.
- C. System shall have specific compartments for the sole use of splicing support tracks together without using external splice plates.

2.14 The System Balancer:

- A. The balancer shall be reducing torque style and shall use a total amount of 27 feet of cable. The hose balancer cable shall be capable of stretching to a minimum of 4 ft from outside of threshold of bay door for an outside connection to the fire apparatus provided that the suction rail system is terminated within 2 feet of exiting door. This system attachment shall be performed outside the station house bay door will ensure that no vehicle exhaust gases will enter the station house. The system balancer shall be designed with the capability of replacing cable without having to change out complete balancer unit

2.15 Hydraulic Shock Absorber

- A. The track system end stop shall be an adjustable hydraulic shock piston that will absorb the trolley / balancer assembly inertia at point of disconnection from vehicle. This function shall be able to resist shock for speeds of vehicle up to 20 mph. The shock absorber shall be designed to receive these system release impacts without bouncing or jamming up at end of the track system. The shock absorber piston must be designed to receive 100,000 impacts before service.

2.16 Electronic Sensor System

- A. An electronic device shall be designed to release the exhaust hose from the accelerating apparatus. The electronic sensing unit shall be equipped with a circuit board that can be programmed to disconnect the exhaust system at the threshold door despite the varying speeds of the emergency apparatus. Exhaust hose system shall not use the exhaust pipe to carry the exhaust system to the threshold door.

2.17 Permanent Magnet

- A. The release mechanism of the hose disconnect shall be free of electronic connectors or other sources of power so that repositioning of disconnect point is accomplished without the use of tools.

2.18 Horizontal Hose

- A. The exhaust system shall be designed with a flex hose able to withstand exhaust temperatures of 340 degrees minimum. The complete operation of exhaust system shall have the proven experience of 100,000 releases of apparatus.
- B. The flexible hose shall be designed to expand and retract along the track height without any portion of the flexible horizontal hose hanging down more than 12 inches from bottom of track profile. This method of carrying the horizontal hose shall incorporate a sliding device that attaches to the top of horizontal hose every 12 inches. Multiple attachments to the horizontal hose shall be required to keep all the horizontal hose up and out of the way of station aisle way. No hoses shall be acceptable that are glued together neoprene-coated polypropylene fabric with wire helix structure.

2.19 Galvanized 90 degree Elbow

- A. The exhaust system shall include a fixed method of turning exhaust gases at the suspension point of hose system. A minimum of 45 degree elbow shall be incorporated at the suspension point to avoid premature wear due to excessive pulling or tugging upon release of exhaust hose from accelerating fire apparatus.

2.20 Vertical Hose

- A. The system hose shall be designed to withstand temperatures up to 370 degrees intermittent, and 340 degrees for continuous operation. The hose is fabricated using a mechanical clinch and is designed to wear a minimum of 1 year no matter how many runs the vehicle makes.
- B. The vertical hose shall not be used as the structural member of the exhaust system, but rather, hang from the rail without having to carry the weight of the entire vertical and lower hose assembly.

2.21 Handle

- A. The exhaust system shall have a handle incorporated into the overall design of the hose system, which has been specifically designed to eliminate bending or stooping, over when system is attached to the vehicle. The system handle shall be made from a soft foam material incapable of scrapping the side of fire apparatus. Handle must be permanently attached to hose system in such a way so that the connection requires no twisting or turning of operator wrists and arms to make a correct attachment to the vehicle.
- B. The attachment method shall be a one-step method. No twisting of forearms and wrists to grab, also no leaning forward pull to the system to the door threshold shall be accepted. The disconnection of the ergonomic handle from vehicle shall be accomplished in an easy fashion by pressing a small toggle by right thumb of operator. A plastic shield to avoid accidental malfunction protects release toggle on handle.

2.22 Nozzle

- A. The nozzle shall have a high temperature rubber gasket attached to its outer edge to prevent the nozzle from scrapping the side of the vehicle. The face of the nozzle shall incorporate three 10 gage anodized steel bars that act as a combination debris screen and backer surface to hold nozzle against outside edge of tail pipe.
- B. The nozzle shall have a flexible internal leaf spring to adapt to a variety of tail pipe styles including both internal and external to the chassis. The nozzle shall also be a minimum of 8" diameter to enable ambient air induction when the vehicle is in operation. This will keep temperatures inside exhaust hose at a minimum. This feature also eliminates the need for explosion proof motors.

2.23 Lower Hose:

- A. The lower hose shall be designed to withstand a 500°F engine temperature in conjunction with induced ambient air for cooling.
- B. The lower hose shall be utilized in an ambient air-cooled design that will eliminate the need for short cycle replacement, resulting from high pulling stresses representative of sealed system designs. The lower hose shall not be glued, but rather stitched so that the hose does not pull apart or fatigue due to high temperature.

2.24 Anchor Plate

- A. Anchor plate shall be instrumental in the method of release and form two-point connection with its primary pulling point at the side of the vehicle.

2.25 Exhaust Fan

- A. The exhaust fan shall be sized for a minimum of 600 CFM per extraction unit. Total exhaust fan CFM requirement is required and must be validated by certified air balancer because of ambient air induction method of exhaust extraction which creates a longer lasting system.

2.26 Ductwork

- A. Exhaust ducting shall be spiral G-90 galvanized pipe and shall be a minimum of 24 gage. The seals on the connection shall be with 400-degree silicone. Brazing and welding at joints are not required because duct system is designed for 4" of negative pressure and at these pressures the silicone sealant is sufficient to seal the system. The lateral fittings shall be brazed or welded and must be designed with a minimum 45 degree branch taps for a smooth convergence of two or more air streams.

2.27 Auto-Start Control System:

- A. The Electronic control shall incorporate a transmitter in the vehicle to ensure that the exhaust fan energizes before vehicle engine starts up. Control unit shall be FCC-approved and shall not interfere with radio communications garage doors or on-board computers. The transmitter shall be mounted on the dash in a nonpermanent fashion so that minor changes in orientation can be made without making permanent changes to the vehicle dashboard.
- B. The control shall create a direct link between the engine operation and the exhaust fan operation no matter how long apparatus is running inside fire station.
- C. Any control method that is initiated by the door operation shall not be accepted.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Test for proper operation and adjust until proper operation is achieved.
- C. Before acceptance, conduct a demonstration in the presence of the Owner's representative that all equipment operates properly in every aspect. Conduct a detailed user/operator training session at time and place agreed upon by Owner's representative.

3.02 ADJUSTING AND BALANCING

- A. Adjust and balance system for proper ventilation.

3.03 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before substantial completion.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to inspect the installed assembly, start-up and train Owner's maintenance personnel to adjust, operate, and maintain vehicle exhaust extraction system.

END OF SECTION 233000