

## SECTION 233525

### MRP RAIL VEHICLE EXHAUST REMOVAL SYSTEM Magnetic Grabber®

#### PART 1: GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

##### 1.02 SUMMARY

- A. Provide all labor, materials, and equipment necessary to put in working operation a complete turnkey vehicle exhaust removal system to remove both diesel and automotive exhaust gases and particulate of operating vehicles within the confines of specified fire station(s). All necessary controls, motors, fittings, ductwork, blower(s), labor and all other equipment and materials specified shall be part of the work.
- B. Section Includes:
  - 1. Manufacturer
  - 2. Rail Material
  - 3. Top Mounting Suspension
  - 4. Support Legs
  - 5. Hydraulic Brake System
  - 6. Rail Splicing Joint
  - 7. Middle Rail Duct Connection
  - 8. Trolley Assembly
  - 9. Upper Flexible Hose
  - 10. Mid Hose
  - 11. Lower Hose Assembly
  - 12. Safety Disconnect Coupling Handle
  - 13. Collection Nozzle Assembly
  - 14. Hose Saddle
  - 15. Electrical Controllers
  - 16. Electrical System
  - 17. Air Moving Devices
  - 18. Ductwork System
- C. All items of equipment and materials described in these specifications are to be furnished installed and placed into proper operating condition in accordance with good practice and manufacturer's written or published instructions.
  - 1. The vehicle exhaust removal system shall provide virtually 100 percent complete evacuation of all diesel fumes at the source from start up to exit of the apparatus from the fire station. The vehicle exhaust removal system shall be capable of delivering complete coverage for bays up to 60 ft. (18.3 m) in length. The system must be able to accommodate drive through and back-in bays to meet all the needs of the fire department.

2. System must be designed and installed to NIOSH recommendation, specifying that occupational exposures to carcinogens be limited to the lowest feasible concentration. Exposure in the human breathing zone should be limited to lowest feasible level, without any time delay required for the system to effectively capture the diesel fumes.
3. System must also be capable to provide virtually complete capture and evacuation of carbon monoxide emitted as part of the vehicle exhaust.
4. Systems that solely use filters, in which diesel particulate may accumulate, and that would potentially have to be treated as hazardous materials, will not be accepted.
5. System must meet the guidelines for the International Mechanical code for Source Capture Systems. Such system is defined as a mechanical exhaust system designed and constructed to capture air contaminants at their source and to exhaust such contaminants to the outdoor atmosphere.
6. The system shall not affect personnel boarding the apparatus. Hose loops shall not hang any lower than six feet (1.8 m) from the bay floor. The hose assembly shall not come into contact with the vehicle other than one connection point to the vehicle's tailpipe. The hose assembly shall not touch or drag on the bay floor.
7. The exhaust system shall not block doorways, exits, and aisles in the apparatus bay, which could endanger the welfare of fire personnel or visitors.
8. The exhaust system shall not need to be disconnected from the vehicle while shore lines are connected, during battery charging, or washing of the vehicle, as with other types of systems.
9. To protect the apparatus electrical system from possible damage, the system bid shall not incorporate any type of electromagnetic device that requires the apparatus to be utilized as an electrical ground for systems operation.

When reviewing requests for substitutions are being reviewed, no exception to the following requirement should be allowed.

10. Due to the harmful effects of diesel exhaust, the system must be designed and capable of capturing virtually 100% of the exhaust gas and virtually 100% of the particulate even in the event of a complete power failure. The system shall not detach itself from the apparatus for any reason during a power failure other than normal exiting of the apparatus bay. System shall discharge exhaust outside the station even in the event of a power failure.
11. The system shall capture the exhaust gases and particulate directly from the tailpipe of the apparatus by a direct connected "visible" high temperature rated hose. Particulates emitted from the apparatus are known to be heavier than air and therefore must be captured by a directly connected hose with a tight seal, as loose nozzles or air filters cannot capture these heavy particulates. The particulates have been documented to be the main respirable carcinogen in diesel exhaust, and therefore are the primary concern of the fire department to capture virtually 100% of these particulates.

### **1.03 SUBMITTALS**

- A.** Product Data: Indicate manufacturer's model number, technical data including description of components and static pressure/air flow chart, and installation instructions.
  - 1. Details of wiring for power differentiating between manufacturer-installed and field-installed wiring.
- B.** Closeout Submittals: Operation and Maintenance data manual including spare parts list.

### **1.04 QUALITY ASSURANCE**

- A.** Engage a factory certified installer to perform work of this Section who has completed installations similar in design and extent to that indicated for this Project, and who has a record of successful in-service performance. No Exceptions.
- B.** The manufacturer must be a ISO 9001:2015 certified [www.iso.org](http://www.iso.org) manufacturer with certification issued to a United States facility, this shows a commitment to delivering the highest quality service and products to the end user. Manufacturer shall be UL and CUL Certified [www.ul.com/database/](http://www.ul.com/database/) and certified by the Air Movement and Control Association (AMCA) [www.amca.org/search.htm](http://www.amca.org/search.htm) to ensure quality, consistency and reliability of products. All certification documents shall be provided and attached to the bid proposal. No exceptions.
- C.** The manufacturer shall be DRC Conflict Free. Manufacturers shall only supply products that do not contain minerals that directly or indirectly finance or benefit armed groups in the Democratic Republic of the Congo or an adjoining country. Please refer to the Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 1502.
- D.** Engage a firm experienced in manufacturing vehicle exhaust removal systems similar to that indicated for this project and with a record of successful in-service performance.
- E.** Conduct conference at project site. Review methods and procedures related to vehicle exhaust removal system installation.
  - 1. Review access requirements for equipment delivery.
  - 2. Review equipment storage and security requirements.
  - 3. Inspect condition of preparatory work performed by other trades.
  - 4. Review structural loading limitations.
  - 5. Review that all components specified in this Section and related components specified in other Sections are accounted for.

### **1.05 DELIVERY, STORAGE AND HANDLING**

- A.** Packing, Shipping, Handling and Unloading: Deliver components with protective packaging. Store in original protective crating and covering and in a dry location.

### **1.06 PROJECT/SITE CONDITIONS**

- A.** Existing Conditions: Verify dimensions installation areas by field measurements.

## **1.07 COORDINATION**

- A.** Coordinate layout and installation with other work, including light fixtures, fixed equipment and work stations, HVAC equipment, radiant tube heaters and fire-suppression system components.
- B.** Coordinate location and requirements of service-utility connections.

## **1.08 REFERENCES**

- A.** Air Movement & Control Association International, Inc.
  - 1. AMCA Standard 500-D-98, "Laboratory Methods of Testing Dampers for Rating".
- B.** ASTM International.
  - 1. Stainless Steel:
    - a. A240/A240M-04 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
    - b. Bright, Directional Polish: No. 4 finish.
  - 2. Aluminum:
    - a. B209/209M-04 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
    - b. Powder-Coated Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.
  - 3. Galvanized Steel:
    - a. A653/A653M-04a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 4. ArmorGalv
    - a. Specifications: ASTM A 1059 M
    - b. ArmorGalv is a thermal diffusion galvanizing, duplex coating with galvanic separation/insulation properties.

## **1.09 BIDDER QUALIFICATIONS**

- A.** Bids will only be accepted from companies that have an established reputation in the business of system design, turnkey installation and long-term service of Automatic Emergency Response Vehicle Exhaust Removal Systems for a minimum of no less than five (5) years. Bidder shall be a registered corporation, partnership or sole proprietorship within the State where the installation is to take place. Bidder must have a current and valid state contractor's license, if required by the state for the work that is being bid. Bidder shall show proof that the system specified in this Bid Document has been field tested and proven by supplying a list of references with no less than 50 fire stations with systems installed by bidder (with comparable emergency and non-emergency run rates) within a 200 mile (322 km) radius of municipality seeking bid. References shall be submitted with the Bid Document and shall include phone numbers and contact names.

## 1.10 MANUFACTURER QUALIFICATIONS

- A. Bids shall only be accepted by bidders supplying equipment from manufacturers that have an established reputation in the business of manufacturing Automatic Emergency Response Vehicle Exhaust Removal Systems for a minimum of no less than twenty (20) years. The manufacturer must be a ISO 9001:2008 Certified in the United States [www.iso.org](http://www.iso.org), UL and CUL Certified [www.ul.com/database/](http://www.ul.com/database/) and certified by the Air Movement and Control Association (AMCA) [www.amca.org/search.htm](http://www.amca.org/search.htm) to ensure quality, consistency and reliability of products. Certification documents shall be provided and attached to the bid proposal. No exceptions. Where the requirement calls for a packaged exhaust system to be provided, all items shall be the product of the manufacturer. The product offering must be a product that has been offered by that manufacturer for a minimum period of twenty (20) years. No prototypes or private label products by other manufacturers will be allowed. System bid shall have a life of service of no less than 10 years to establish proof of quality, longevity, and service. No exceptions.

## PART 2: PRODUCTS

### 2.01 RAIL MATERIAL

- A. Rail Material: One-piece continuous extruded aluminum rail in a minimum length of 19 ft. (5.8 m) in an effort to reduce the points of leakage due to joints or connections. The construction profile shall be of a square profile type, width of 5 ¾ inches (146 mm) with a rail thickness of 0.177 inch (4.5 mm). The bottom portion of the rail shall have a continuous slot to accept a rubber lip seal. Rail Material: Aircraft aluminum alloy Type AA-6063 (ASTM B209/B209M). Aluminum Rail: Extruded as a one-piece design to maximize the structural integrity of the rail and to minimize joints. Extruded into the rail profile shall be all necessary mounting guides, which will allow for support of the rail mounting hardware. Mounting Channels: Provided continuously along the top on both sides of the rail extrusion in order the proper positioning of all required mounting supports in accordance with codes. The rail shall allow the trolley/hose assembly to glide to the door threshold in a safe and effective manner. The extruded rail channel shall allow the whole rail to remain rigid and shall provide an area to attach bolts for splicing additional rails together for systems over 19 ft. (5.8 m) long. The overall extruded rail lengths shall be 19 ft. (5.8 m) standard. Rail System: Equipped with a hydraulic braking system that limits travel of flex hose/trolley as the vehicle exits the building. Hydraulic Brake: Incorporated into the end cap of the suction rail.

### 2.02 TOP MOUNTING SUSPENSION

- A. Top Mounting Suspension: Designed to attach with 2 mounting cleats to the mounting slots that are extruded into the top of the rail profile. The top suspension mount support shall consist of 2 triangular plates with a 90-degree brake providing a mounting cleat provided with 2 pre-punched ⅜ inch (10 mm) holes for attaching to the aluminum leg assembly.

## **2.03 SUPPORT LEGS**

- A. Support Leg and Mounting Feet:** Manufactured and provided by the supplier of primary exhaust removal system (Equipment Manufacturer). Leg Material: Aircraft aluminum alloy Type AA-6063 (ASTM B209/B209M). Supports shall come standard in 19 feet (5.8 m) lengths. A minimum of one support with appropriate bracing shall be provided for every 10 linear feet (3.0 m) of track profile. The support legs shall consist of a square tubular profile with dimensions no less than 2-inch (50.8 mm) OD X 0.1 inch (2.5 mm) with  $\frac{3}{8}$  inch (10 mm) fastening hardware provided. Vertical Adjustable Mounting Foot: Capable of attaching the leg assembly to a ceiling with a 30-degree pitch, complete with a slider bar and  $\frac{3}{8}$  inch (10 mm) hardware necessary for mounting the horizontal rail to the mounting channel system. Horizontal Adjustable Mounting Foot: Capable of attaching the leg assembly to a wall, complete with a slider bar and  $\frac{3}{8}$  inch (10 mm) hardware necessary for mounting the horizontal leg to the mounting channel system. Support Leg: Equipped with round tubular zinc-plated steel knee brace with pressed ends in standard lengths of 20 inches (508 mm), 30 inches (762 mm) and 72 inches (1.8 m). Angle completely adjustable to the leg support and mounted perpendicular and parallel to direction of the track. Typical Support Angle: 45 degrees from the centerline of the factory provided support leg. The standard leg shall be capable of meeting a Seismic 4 requirement. "Uni-strut", all-thread rod, and/or chains may not be used in place of a leg assembly as sole support of the system. Vertical support and bracing shall be provided to safely secure the rail profile in accordance with building code and seismic standards which may apply. A minimum of one support with appropriate bracing shall be provided for every 10 (3 m) to 12 linear feet (3.7 m) of rail profile.

## **2.04 HYDRAULIC BRAKE SYSTEM**

- A. Hydraulic Brake System:** Incorporated into the end cap of the suction rail profile. The hydraulic brake system must incorporate a hydraulic shock capable of reducing the forward impact of 1 to 2 suction trolleys which may be installed now or in the future to the exhaust rail system. This hydraulic shock shall be secured to a steel end cap fabricated of a 0.1181-inch (3 mm) steel plate with formed 90-degree side rails for rigidity. End cap shall be secured to the rail with 6- 8 mm bolts with Nyloc nuts (3 on each side). The end cap shall be of a black powder coated finish. The hydraulic shock shall be capable of reducing to a full stop the trolley(s) in less than 4 inches (102 mm), without physical damage to either the rail profile or trolley that it is stopping. The back-end cap shall have an end feed 5-inch duct connection and shall be a black powder coated finish.

## **2.05 RAIL SPLICING JOINT**

- A. Rail Splicing Joint:** Formed steel fitting equal to the internal diameter of the suction rail profile. The splice shall have a wall thickness of no less than 14 gauge (2 mm) in thickness and a length of no less than 7.87 in. (200 mm) from end to end. Rail joint shall be secured by 12- 5/16 in. (DIN 933 M8) bolts with Nyloc nuts in the top and sides of the rail. Self-tapping bolts or screws are not acceptable.

## 2.06 MIDDLE RAIL DUCT CONNECTION

- A. Middle Rail Duct Connection: The rail duct connection shall be rectangular to a 5-inch (125 mm) diameter round transition fitting fabricated from 22 gauge (.8 mm) galvanized steel (ASTM A653/ 1.0330/DC01+ZE). The rectangular slot shall be 19.5 inches (498 mm) long by 1.8 inch (46 mm) wide with a 1/4 inch (6 mm) external flange to slide into the rail profile and secured with self-tapping screws.

## 2.07 TROLLEY ASSEMBLY

- A. Trolley Assembly: Gantry type trolley with sealed bearing loaded wheels designed to roll inside the internal rail profile flange. The trolley chassis shall be aluminum and epoxy coated with a black finish. The chassis shall be fitted with a tapered suction cone. Rubber Sealing Lips: Vulcanized Teflon strip covering 1 ½ inch (40 mm) of the bottom edge of the sealing lip which shall contact with (5) five Teflon rollers on each side of the suction cone to minimize resistance between the suction cone and the rubber sealing lips. The suction cone transition shall be a tapered slot design which shall fit inside the suction rail profile. The tapered slot shall be equal or exceed in area the diameter of exhaust ventilation hose to which it is attached. Trolley Assembly: Equipped with rubber impact bumpers at both the front and rear of the trolley chassis to eliminate metal to metal contact which could damage the trolley assembly. There shall be a system balancer assembly provided to aid in the delivery of the hose to the exit door. Balancer Assembly: Self-adjusting weight spring tension balancer with a lifting capacity of no less than 31 pounds (14 kg). The balancer shall have a minimum diameter steel cable of .080 inch (2 mm) and have a safety link connection.

## 2.08 UPPER FLEXIBLE HOSE

- A. Flexible ST (Standard Temperature) exhaust hose manufactured for the sole purpose of venting high temperature exhaust gases. Flexible Upper Hose: Designed strictly for the harsh environment of rapid response and auto-release of a vehicle exhaust tailpipe. Hose: Shall be 4-inch (100 mm) or 5-inch (125 mm) diameters with a length of 4 ft. (1.2 m), without joining or splicing connections. Hose Material: High temperature synthetic rubber impregnated into a high temperature laminated fabric with a mechanically crimped connection around a coated steel wire. This construction of hose must be capable of operating at continuous temperatures of 400° F (204° C) and intermittent temperatures of 500° F (260° C), such as are experienced when pump checks are performed inside the fire station. Protective Clip Cover: This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an exposed hot metal helix and be provided in a safety yellow color. The bend radius of the high temperature hose shall be no less than 1.5 times the diameter of hose to ensure that hot gases are not restricted as they pass through the system. Hoses utilizing an exposed metal helix will not be acceptable due to potential burn hazard and/or shock hazard from being utilized as a grounded, grounding or current carrying conductor for electromagnet connections. **No exceptions will be allowed.**

- B. Optional Flexible HT (High Temperature) Upper Hose: Flexible 4 inch (100 mm) or 5 inch (125 mm) diameter by 6 feet (1.8 m) long section of yellow and black hose identical in appearance to the mid and lower hose assembly and extending from the metal saddle to the crab hose connection. This construction of hose must be capable of transporting exhaust at continuous temperatures of 900° F (482° C) and intermittent temperatures of 1,050° F (566° C). **An independent third-party test report shall be submitted with bid as proof of claim.** Wire Helix: Bound and protected in laminations of high temperature material. This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an exposed hot metal wire helix. The hose shall further protect the internal wire helix from heat buildup and in turn add increased visibility to personnel. High Temperature Wear Strip: 9/16" inch (14.2 mm) wide and be provided in a safety yellow color. Hoses utilizing an exposed metal helix will not be acceptable due to potential personnel burn hazard. **No exceptions will be allowed.**

## 2.9 MID HOSE

- A. ST (Standard Temperature) Mid Hose: Designed strictly for the harsh environment of rapid response and auto-release from a vehicle exhaust tailpipe. Semi rigid hose: Shall be 4 inch (100 mm) or 5 inch (125 mm) diameter by 10 ft. (3 m) long section of yellow and black hose identical in appearance to the lower hose assembly and extending from the metal saddle to the SDCH. Hose Material: High temperature synthetic rubber impregnated into a high temperature laminated fabric with a minimum overlapping thickness of 2 7/16" inches (62 mm). This construction of hose must be capable of operating at continuous temperatures of 400° F (204° C) and intermittent temperatures of 500° F (260° C), such as are experienced when pump checks are performed inside the fire station. **An independent third-party test report shall be submitted with bid as proof of claim.** Wire Helix: Bound and protected in laminations of hose winding. This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an exposed hot metal helix. The hose shall further protect the internal wire helix from heat buildup and in turn add increased visibility to personnel. Wear Strip: 9/16" inch (14.2 mm) wide and be provided in a safety yellow color. Hoses utilizing an exposed metal helix will not be acceptable due to potential burn hazard and/or shock hazard from being utilized as a grounded, grounding or current carrying conductor for electromagnet connections. **No exceptions will be allowed.**
- B. Optional HT (High Temperature) Mid Hose: Designed strictly for the harsh environment of rapid response and auto-release from a vehicle exhaust tailpipe. Flexible hose: Shall be 4 inch (100 mm) or 5 inch (125 mm) diameter by 10 ft. (3 m) long section of yellow and black hose identical in appearance to the lower hose assembly and extending from the metal saddle to the SDCH. This construction of hose must be capable of transporting exhaust at continuous temperatures of 900° F (482° C) and intermittent temperatures of 1,050° F (566° C). **An independent third party test report shall be submitted with bid as proof of claim.** Wire Helix: Bound and protected in laminations of high temperature material. This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an



an exposed hot metal wire helix. The hose shall further protect the internal wire helix from heat buildup and in turn add increased visibility to personnel. High Temperature Wear Strip: 9/16" inch (14.2 mm) wide and be provided in a safety yellow color. Hoses utilizing an exposed metal helix will not be acceptable due to potential personnel burn hazard. No exceptions will be allowed.

## 2.10 LOWER HOSE ASSEMBLY

- A. ST (Standard Temperature) Lower Hose: Rigid 4-inch (100 mm) or 5-inch (125 mm) diameter by 2 feet (610 mm) long section of yellow and black hose identical in appearance to the mid hose. This construction of hose must be capable of operating at continuous temperatures of 400° F (204° C) and intermittent temperatures of 500° F (260° C) such as are experienced when pump checks are performed inside the station. **An independent third party test report shall be submitted with bid as proof of claim.** Supports the magnetic connection nozzle and stainless steel reducing elbow in a rigid fashion to allow for the operator to place hose collection nozzle onto the tailpipe without bending over. The lower hose is the only section of hose which shall disconnect from the upper hose assembly and act as a safety disconnect in the unlikely event the nozzle gets entangled. Hoses utilizing an exposed metal helix will not be acceptable due to potential burn hazard. **No exceptions will be allowed.**
- B. Optional HT (High Temperature) Lower Hose: Semi rigid 4" inch (100 mm) or 5" inch (125 mm) diameter by 2 ft. (610 mm) long section of yellow and black hose identical in appearance to the upper hose. This construction of hose must be capable of transporting exhaust at continuous temperatures of 900° F (482° C) and intermittent temperatures of 1,050° F (566° C). **An independent third party test report shall be submitted with bid as proof of claim.** Wire Helix: Bound and protected in laminations of high temperature material. This shall be accomplished in a fashion, which eliminates any possibility of personnel coming in contact with an exposed hot metal wire helix. The hose shall further protect the internal wire helix from heat buildup and in turn add increased visibility to personnel. High Temperature Wear Strip: 9/16" inch (14 mm) wide and be provided in a safety yellow color. Shall support the magnetic collection nozzle and stainless steel reducing elbow in a semi rigid fashion to allow for the operator to place hose collection nozzle onto the tailpipe without bending over. The lower hose is the only section of hose which shall disconnect from the upper hose assembly and act as a safety disconnect in the unlikely event the nozzle gets entangled. Hoses utilizing an exposed metal helix will not be acceptable due to potential personnel burn hazard. **No exceptions will be allowed.**

## 2.11 SAFETY DISCONNECT COUPLING HANDLE

- A. Safety Disconnect Coupling Handle (SDCH): An injection molded composite body with a 4-inch (100 mm) or 5-inch (125 mm) diameter hose connection. A 360-degree rubber bumper to protect the vehicle and disconnect from wear shall be incorporated in the design of the system. Coupling: Consists of a aluminum inner flange collar connected by a patented easy reconnect mechanism. The release tension of this device shall be preset at 102 pounds of force (450N) and easily reconnected with only 3 pounds of force (13N).

## 2.12 COLLECTION NOZZLE ASSEMBLY

- A. Collection Nozzle Assembly: Provides a substantially airtight seal around exhaust tail pipe when connected thus allowing for virtually 100% source capture. The seal shall limit escape of life-threatening exhaust gases.
- B. The Magnetic Nozzle shall be engineered and designed with rare earth magnets that are strategically positioned on the face of the collection nozzle. The Magnetic Nozzle shall be coated with a galvanized finish or the optional BlackArmour version high temperature, wear, and corrosion resistant duplex coating, to limit the effects from corrosive road treatment chemicals. The collection nozzle shall also incorporate a protective rubber safety cover to avoid damage to vehicle and surroundings. The magnets shall only make contact with the face of the tailpipe adapter located on the tailpipe. The reducing elbow that connects the flexible hose to the collection nozzle shall be fabricated using continuous welded construction and shall be made from polished 304 stainless steel. The angle of transition shall be no less than or greater than 67 degrees from the centerline of the reducer. The stainless steel reducer shall incorporate a primary expanded metal debris screen, which is permanently affixed by weld joints to the inside opening of collection nozzle. The collection nozzle shall be connected from an upright standing position by the user without bending over. Since this item is a point of safety for both personnel and the system itself. **No exception will be allowed.**
- C. The standard conical tailpipe adapter shall be plated with a galvanized finish to limit corrosion from corrosive road treatment chemicals. The conical tailpipe adapter shall be of a self-aligning "Click and Seal" design for aiding in the connection and release of the collection nozzle from the fire apparatus.
- D. The optional TopGrade conical tailpipe adapter shall be constructed from a high temperature, corrosion resistant, magnetic stainless steel, to limit the effects from extremely aggressive corrosive road treatment chemicals. The conical tailpipe adapter shall be of a self-aligning "Click and Seal" design for aiding in the connection and release of the collection nozzle from the fire apparatus.

## 2.13 HOSE SADDLE

- A. Metal Hose Suspension Saddle: Fabricated of steel and powder coated with a black matte finish specifically manufactured for the sole purpose of suspending high temperature exhaust ventilation hose in a rapid response and auto-release application. The design of the saddle shall smoothly transition the direction of the hose

during its travel along the track. Securing clamps shall be provided including a link fastener, for the purpose of attaching it to the balancer.

## **2.14 ELECTRICAL CONTROLLERS**

- A.** Controller: Built and supplied by a UL and CUL recognized and listed exhaust system manufacturer. Controller shall carry the UL and CUL listing label as an “Enclosed Industrial Control Panel.” Individual components listed by UL and CUL shall not satisfy the above requirement. Manufacturer shall undergo quarterly inspections by UL to verify all requirements and standards are met as outlined by UL and CUL. The controller shall be delivered as an Operating System Three series controller or an approved equal to the specifications to follow.
- B.** Electrical Controllers: Bear a visible UL and CUL listing label as proof of subscribership and shall be validated by UL [www.ul.com/database/](http://www.ul.com/database/) as an “Enclosed Industrial Control Panel”. Certification documents shall accompany bid documents.
1. Manufacturer Name: \_\_\_\_\_
  2. UL File No.: \_\_\_\_\_
  3. Electrical controller and manufacturer shall be recognized and listed by UL and CUL. Controller shall be manufactured in accordance with Underwriters Laboratories standard UL-508A for “Enclosed Industrial Control Panels”. The electrical controller shall include a Class 1 limited energy control circuit. Enclosures shall be NEMA 12 rated and UL listed as Type 12. The electrical control components shall be provided and mounted in an electrical enclosure to restrict access to internal components of the controller by authorized personnel only.
- C.** Controller Performance: Designed to sense the output pressure and/or temperature change inside the ductwork system, which is normally generated by any internal combustion engine designed to propel a motor vehicle. The operating logic shall be designed to complete this cycle. At any point in time when a collection device is connected to a motor vehicle’s exhaust tailpipe, as the operator starts the vehicle, the controller shall automatically sense the engine's output pressure or temperature of the exhaust and in turn energize the electrical contactor which will supply power to the AMCA certified spark resistant fan. Through the use of an adjustable timer the controller shall keep the contactor energized for up to sixty minutes in accordance with the station’s response requirement. If the responding vehicle does not disconnect from the exhaust ventilation system in less than the designated setting, the optional temperature override switch shall override the time delay to ensure continuous system operation. This automated function will work for as long as the exhaust gas temperature is in excess of the setting on the heat sensor located in the ductwork system. This cycle shall not allow the electrical contactor, which energizes the exhaust fan, to short cycle or stop the fan while the system is connected to an operating vehicle.
- D.** Motor Control Contactor: Allen Bradley Industrial Electrical Contactor 100C series. The contactor shall be UL - CUL listed as an approved component.
- E.** Motor Control Overload Relay: Allen Bradley 193 E1 Plus series. Overload relay shall have an adjustable trip range to meet the proper full load amperage of the blower motor.

- F. Soft Touch Controls:** Incorporated on the face or the access door of the controller by the use of an adhesive backed Lexan membrane type label to prevent water infiltration, which would void the NEMA 12 rating. Label: Provided and secured permanently to the exterior of the electrical controller. Label: Includes the name of the manufacturer, address, telephone number, user instructions and any warnings or cautions required by Underwriters Laboratories.
1. Auto Start: This mode of operation shall be strictly for normal day to day use, as it would apply to receiving an emergency call and leaving the station. Any one or combination of the three devices listed below in Paragraph K shall activate the system. The system shall maintain itself in the Auto Start mode and always return there after the Stop sequence has been initiated. The controller shall not have a permanent off position due to the potential health hazards of diesel exhaust components.
  2. Stop: This mode of operation shall be a system override to shut down the system manually. Upon activating this mode of operation, the exhaust system blower shall shut down. After a period not to exceed three seconds the controller shall automatically return to the Auto Start ready mode. This shall be a safety feature to prevent a potential health hazard from carcinogenic diesel exhaust leakage from systems having an undesirable open nozzle.
  3. Manual Run: This mode of operation shall be a system override to run the exhaust system blower continuously for the purpose of running the vehicles indoors for equipment checks during inclement weather. Upon activating this mode of operation the exhaust system blower shall start and run continuously until the Stop mode is activated at which point the system will automatically return to the Auto Start ready mode within a maximum three second time period.
- G. System Indicator LED's:** Show system status at all times.
1. Auto Start Indicator: Indicate the system is in the fully automatic mode of operation and that power is on to the controller.
  2. Fan On Indicator: Indicate that power is being applied to the system blower and the controller is operating normally.
  3. Filter Status Indicator: Indicates, if flashing, excessive pressure loss across the optional filter bank media. Consequently, the filter must be serviced to maintain optimum efficiency of the system.
  4. Stop Indicator: Indicate the fan has been manually de-energized and will return to the Auto Start ready sequence in less than three seconds to prevent the system blower from being left in the Off mode.
  5. Manual Run Indicator: Indicate the fan is operating in a continuous run mode until interrupted by the stop mode activation.
- H. Controller Transformer:** UL listed industrial control circuit transformer sized to properly supply all components so that only one transformer shall be required. Transformer shall be provided with multi-tap primary for 115, 208, 240, 277, 400, 480, and 600VAC, and 24 VAC secondary operating on 50 or 60 hertz with a capacity of 35-volt amperes.
- I. Control Circuit Protection:** By the use of primary and secondary fuses to meet UL and CUL requirements. The primary shall be protected by a pair of FLQ style fuses. A

single GMA style glass fuse rated at 3.15 amps at 250V shall protect the secondary side of the control circuit.

- J. Electronic Control Circuit Card:** Solid state printed circuit board. The soft touch controls shall be an integral part of the control circuit card. The control circuit card shall utilize a potentiometer to adjust the length of the timing cycle up to 60 minutes. It shall incorporate several different modes of operation and optional features.
- K. Activation Devices:**
1. **Engine Start Switch:** An engine pressure sensing type, capable of recognizing the output pressure of any type of motor vehicle exhaust. The electrical contact shall be dry type and not to exceed 24VAC. There shall be one sensor per vehicle.
  2. **Optional Thermal Start Switch:** Temperature sensing switch of the snap disc type and adjustable from 90° F (32° C) to 130° F (55° C) to configure the system based on different exhaust temperatures. There shall be one sensor per vehicle if chosen.
  3. **Optional Wireless Transmitter and Receiver System:** Shall be an optional feature operating on a 2400 MHz frequency. Complies with FCC rule part 15, FCC ID: UY124. The receiver shall utilize 3 independent channels of control and capable of supporting up to 60 transmitters. The receiver shall operate on 12-24 VAC or VDC and enclosed in a non-metallic enclosure with a clear see through lid to view system supervisory functions. The transmitter shall be programmable and shall be powered by a 3-year battery for ease of replacement and cost savings. The transmitter shall have an open field range of 1000 feet (305 m) and shall be initiated by a NO contact closure such as from a pressure switch mounted on the traveling exhaust system trolley or a vehicle powered ignition transmitter mounted in the vehicle.
- L. Clean Filter Indicator Alarm:** Used in conjunction with an optional Unifilter for filtering diesel exhaust particulate before release to the atmosphere. The clean filter indicator shall monitor the pressure loss across the filter bank media. Once the useful life of the filter has been depleted the pressure differential switch will signal a high-pressure loss and flash the "Fan On" indicator while the exhaust blower is running.
- M. Optional System Monitor:** Shall be an optional feature to monitor the system and advise when a preset number of emergency runs or run time on the system have accrued.
- N. Optional No Airflow Alarm:** Shall be an optional feature to monitor the system and advise when the exhaust fan is not functioning properly.
- O. Optional Carbon Monoxide Alarm:** Shall be an optional feature to monitor the carbon monoxide levels inside the apparatus bay area.
- P. Electrical Wiring:** Run in wire channel to allow for easier identification of the wiring circuits and for a neat appearance. All wiring circuitry shall meet National Electric Code and UL and CUL standards for proper size, bending radiuses and terminations.
- Q. Electrical Terminal Block:** 600 V, UL and CUL rated and recognized. It shall provide individual connection points for remote controls, clean filter indicator and power

connections. The primary and secondary control wiring fuses shall be incorporated into the terminal block as one unit.

- R. Product Manual: Shall be provided with each electrical control box supplied. The product manual shall include a description of components with part numbers inclusive to the controller. It shall include a wiring schematic showing all internal circuitry as well as all field installed wiring connections to the controller.
- S. Electrical Interference: To protect the apparatus and communications, designs that allow any possibility of electrical back-feed or induced current which may interfere with a central services communication or onboard vehicle computer logic or navigational equipment will not be accepted.

## **2.15 ELECTRICAL SYSTEM**

- A. Station Electric Supply Panel: The power circuit for the “Emergency Response Vehicle Exhaust Removal System” shall originate in a circuit breaker panel board of the appropriate size to handle the load. Fan circuit shall be supplied by a UL listed, HACR rated circuit breaker (HACR rating is specifically for motor type loads) of the same type as indicated by the manufacturer of the circuit breaker panel or a dual element time delay fuse for fuse style panels. The circuit shall be clearly marked on an engraved ledger plate or in ink on the panel schedule as “Emergency Response Vehicle Exhaust Removal System”.
- B. OS-3 Automatic Controller: Built and supplied by a UL recognized and listed exhaust system manufacturer. Controller shall carry the UL - CUL listing label as an “Enclosed Industrial Control Panel”. Individual components listed by UL shall not satisfy the above requirement. Manufacturer must undergo quarterly inspections by UL to verify all requirements and standards are met as outlined by UL and CUL. The controller shall be delivered as an Operating System Three series controller or an approved equal to the specifications in 2.16 Electrical Controllers. The controller shall be mounted 6 feet (1.8 m) to the top of the cabinet AFF (above finished floor). A safety disconnecting means must be within sight of the controller for servicing and for safety reasons. If the supply panel is not within sight, a separate disconnecting means is required beside the controller (per NEC Code 2020). Safety disconnect shall be capable of being locked in the off position to follow lockout, tag out procedures.
- C. Power Wiring Conduit: Minimum of EMT utilizing fittings for damp locations such as apparatus wash down areas (per NEC Code 2020). Conduit shall be supported with a conduit strap every 10 ft. (3 m) and within 3 feet (1 m) of each box or termination, (per NEC Code 2020).
- D. Power Wiring from Supply Panel to OS-3: THHN stranded copper wire consisting of a flame retardant, heat-resistant thermoplastic insulation with a nylon jacket for abrasion, gas, and oil resistance and rated up to 600 volts or similar.
- E. Low Voltage Control Wiring: Minimum of a 16/2 multi-conductor cable to meet UL standards for the controller’s low voltage field wiring.

- F. Low Voltage Control: Encased in a minimum of ½ inch (12.7 mm) EMT from the OS-3 Controller to the attic or building steel where it shall terminate with a EMT connector with a threaded plastic bushing. Conduit: Supported with a conduit strap every 10 feet (3 m) and within 3 feet (1 m) of each box or termination (per NEC Code 2020). The 16/2 multi-conductor cable shall be supported by the building structure and ran in a manner that the cable will not be damaged by normal building use (per NEC Code 2020), securely fastening it with nylon tie wraps every 24 inches (610 mm) to 36 inches (914 mm). Draping of the cable perpendicular to building steel or support members will be unacceptable.
- G. Power Wiring from OS-3 to Fan Motor: Minimum of EMT utilizing compression type fittings for damp locations such as apparatus wash down areas (per NEC Code 2020). Conduit shall be supported with a conduit strap every 10 ft. (3 m) and within 3 ft. (1 m) of each box or termination (per NEC Code 2020). Conduit shall extend through the outside wall through a hole of the proper size and terminate directly into the back of the safety disconnect with the appropriate connector and sealed with a silicon sealer or cement mortar. (Using fan model number select appropriate wire from Table 1-1).
- H. Fan Safety Disconnect: Non-fusible, NEMA 3R rated for wet locations, mounted adjacent to the AMCA Certified blower. Safety disconnect shall be capable of being locked in the off and on position to follow lockout, tag out procedures (per NEC Code 2020).
- I. Liquid Tight Flexible Metal Conduit: UL listed liquid tight flexible metallic conduit (Sealtite). Conduit will encase the load wires and ground wire from the safety disconnect switch to the blower motor. Conduit length not to exceed 4 feet (1.2 m) from disconnect to blower motor. The appropriate listed terminal fittings shall be used (per NEC Code 2020).
- J. Spark Resistant Blower: AMCA certified, designed and installed as a direct drive spark resistant blower. The motor shall meet current EPACT standards for energy savings. Fans utilizing belt drives and steel impellers will not be accepted.
- K. Optional Temperature Switch: One for each apparatus connected to the system. The temperature switch shall be of the snap disc type and adjustable from 90° F (32° C) to 130° F (54° C). It shall be mounted on the ductwork or on the trolley by drilling a 1-inch (25 mm) hole, sealing the switch with silicone sealant and securing with 2 self-drilling screws. Can be used in conjunction with the optional wireless control system. Electrical connection shall be made with terminals provided or solder less type such as Thomas & Betts part no. 14RB-2577 or equivalent.
- L. Pressure Switch: One for each apparatus connected to the system. The pressure switch shall operate at a maximum of 24VAC, pre-calibrated at .18 in. of water column. Mounting shall be accomplished by drilling a ⅜ inch (9.5 mm) hole into the aluminum rail profile and thread the hole with a ⅛ inch NPT tap, then thread the switch into the rail. For wireless systems, mounting shall be accomplished by drilling a ⅜ inch (9.5 mm) into the hose connection of the trolley and threading the switch into the hole. The electrical connections shall be made with a 0.020-inch (.5 mm) by 0.187-inch (4.8 mm) female quick disconnect terminals, such as Thomas & Betts part no. 14RBD-18277 or equivalent.

## 2.16 AIR MOVING DEVICES

- A. Centrifugal Fans:** Direct drive centrifugal type, high pressure, single width, single inlet as required or indicated. Impeller Wheels: Radial design or backward incline for performance, spark resistant and made of a nonferrous material to prevent static electricity build up. The impeller shall be dynamically and statically balanced and of the non-overloading type to provide maximum efficiency while achieving quiet, vibration-free operation. The fan housing shall be manufactured from a epoxy powder coated galvanized steel or nonferrous material. The outlet configuration shall be top horizontal, bottom horizontal, or up blast. The housing shall be capable of field reconfiguration in the event the mounting position needs to be changed for unforeseen reasons. The exhaust discharge outlet shall be in compliance with International Mechanical Code and ACGIH recommendations (min. of 36 inches (1 m) above roofline). Air intakes, windows, cascade systems, prevailing currents, communication equipment and building aesthetics shall be considered in the final location of the fan. For aesthetic reasons the fan motor and assembly shall be mounted on a epoxy powder coated galvanized steel mounting base to prevent rust stains on the exterior of the building. Belt driven fans are unacceptable due to maintenance reasons and the potential for the fan to be left non-operational without warning.
- B. Fan Motor and Bearing:** All ½ horsepower (373 watts) to 15 horsepower (11 kW) motors shall be totally enclosed fan cooled (TEFC) continuous duty rated. The motors shall be dual voltage where applicable. Motors shall comply with the government mandated “Energy Policy and Conservation Act” (EPACT) as outlined by the Department of Energy. The bearings shall be self-aligned, ball bearing type permanently sealed and lubricated.
- C. Performance:** Lengths of ductwork, hoses, elbows, branches, wyes, etc. which increase the static pressure of the system, shall be taken into account to properly size the fan. The delivered volume shall be calculated taking into account the static regain of the vehicle’s engine exhaust (based on a virtually airtight connection at the tailpipe). The manufacturer’s provided fan(s) shall be performance guaranteed by AMCA certification.
1. **Required Fan Capacity:** The Fan Capacity shall be sized as such as to deliver the required CFM at each hose drop to which the vehicle is attached.
    - a. The 4-inch (100 mm) hose system shall be designed to deliver a minimum of 340 CFM (577 m<sup>3</sup>/h) at a velocity of 4500 FPM (23 m/s) at the hose and nozzle connection.
    - b. The 5-inch (125 mm) hose system shall be designed to deliver a minimum of 540 CFM (917 m<sup>3</sup>/h) at a velocity of 4500 FPM (23 m/s) at the hose and nozzle connection.
- D. Location:** The preferable fan location shall be on the outside of the fire station as far away from any living quarters as possible so that firefighters would not be disturbed by the system activation. No blower fans shall be mounted inside the fire station. Silencers shall be provided when fan sound pressure level exceeds 64 dBA.



## **2.17 DUCTWORK SYSTEM**

- A. Ductwork Type and Materials:** UMC Class 2 or SMACNA Class II product conveying duct, meet or exceed criteria for construction and performance as outlined in Round Industrial Duct Construction Standards, SMACNA. Materials of construction unless otherwise specified for all ductwork and fittings shall be a minimum G-90 galvanized sheet metal (ASTM A653/A653M). Only when specified, Type 304 stainless steel (ASTM A240/A240M) shall be provided.
- B. Ductwork Sizing and Gauges:** Round pipe construction, with the range of available sizes not to exceed 16 inches (406 mm) in diameter. Duct gauge shall depend on diameter and a minimum operating pressure of 8 inches of water gauge (1993 Pa). Acceptable Gauge and Reinforcement Requirements: Inner duct diameter 4 inches (101 mm) through 11 inches (279 mm) diameter shall be 22-gauge standard pipe (International Mechanical Code).
- C. Ductwork Fittings:** Round and have a wall thickness 2 gauges (one even gauge number) heavier than the lightest allowable gauge of the downstream section of duct to which they are connected (International Mechanical Code). Air Duct Branch Entrances: Factory fabricated fittings or factory fabricated duct /tap assemblies. Fittings: Constructed so that air streams converge at angles no greater than 45 degree (International Mechanical Code). All Seams: Continuous stitch welded and if necessary, internally sealed to ensure air tightness. Turning elbows shall be stitch-welded and used for all diameters and pressures. They shall be fabricated of 24 gauge galvanized steel and constructed as two piece with continuous welded seam construction fittings similar to those provided by Lindab Inc. Tapered Body Fittings: Used wherever particular fallout is anticipated and where air flow is introduced to the transport duct manifold.
- D. Ductwork Design Velocities:** Minimum of 3500 FPM (18 m/s) to 4000 FPM (20 m/s) transport velocity. Capture Velocity: 4500 FPM (23 m/s) to 5500 FPM (28 m/s) to extract virtually 100 percent of the exhaust gases.
- E. External Ductwork:** Sized for the exact inlet and outlet of the exhaust fan blower. An exhaust rain cap shall be supplied and manufactured in accordance with EPA standard for free draft rain cap requirements. Included as an integral part of this rain cap shall be a back draft damper to provide protection from rain and other inclement weather.
- F. Exhaust Penetrations:** The core drilling shall be properly sized to reduce the diameter of the opening to the smallest possible size.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas and conditions,** with Installer present, for compliance with requirements for installation tolerances, service-utility connections, and other conditions affecting installation and performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Provide surface/substrate preparation as required by the manufacturer's printed installation instructions. Do not proceed with installation is in proper condition to receive vehicle exhaust system installation.

### **3.03 INSTALLATION**

- A. Install vehicle exhaust system in accord with manufacturer's written instructions, original design and referenced standards.

### **3.04 ADJUSTING**

- A. Adjust vehicle exhaust system for proper operation. Replace any parts that prevent the system from operating properly.

### **3.05 CLEANING**

- A. Remove all debris caused by installation of the vehicle exhaust system. Clean all exposed surfaces to as fabricated condition and appearance.

### **3.06 PROTECTION**

- A. Provide protection of the completed installation until completion of the project. Repair any damage at no additional cost to Owner.

### **3.07 TRAINING**

- A. Provide training to fire department personnel in the daily use and maintenance of the vehicle exhaust removal system that has been installed and specified herein. The fire department shall be notified at least 7 days prior to the date scheduled for the training course. Training shall be for all personnel involved with the operation of the exhaust removal system to include all shifts required to man the particular facility. The Training session shall be performed in person by a recognized representative of the manufacturer of the exhaust removal system, in addition a training video shall be provided to the fire department.
  1. Provide training to all shifts during their normal shift period.

### **3.08 WARRANTY**

- A. Provide a written warranty for a period of five (5) years from date of shipment for all components.

**END OF SECTION 233525**