PLYMOVENT®
clean air at work

DESIGNING A HEALTHIER WORK ENVIRONMENT

Vehicle Exhaust Extraction System Design Guide

THE HAZARDS OF DIESEL EXHAUST

Exhaust fumes and pollutants can impair health as well as safety. Specifically, diesel exhaust (as soot or chemical extracts) has been found to cause changes in cells' DNA. International Agency for Research on Cancer (IARC), part of the World Health Organization (WHO), classifies diesel engine exhaust as "carcinogenic to humans," based on sufficient evidence that it is linked to an increased risk of lung cancer.

The US National Institute for Occupational Safety and Health (NIOSH), part of the CDC, has determined that diesel exhaust is a "potential occupational carcinogen."

HOW TO USE THIS GUIDE

For more than 40 years, Plymovent has been a global leader in developing systems and expertise to ensure your facility selects the right equipment for source capture ventilation.

Plymovent offers Construction Specifications Institute (CSI) format, Division 23 exhaust system specifications. We support architects and engineers with public works garages, mass transit servicing areas, vocational schools, truck and heavy equipment repair, military repair, airport servicing areas, and others. In addition, Plymovent provides expertise and guides to help you with fire station and EMT facility design and installation.

As you examine a facility to determine the most effective way to capture and extract dangerous exhaust, you can rely on Plymovent experts to share their experience with installing thousands of systems in a wide range of buildings.

In this guide we provide a design checklist you can use to determine requirements and determine proper air flow, hoses, ductwork and fans. We walk through the many challenges you may face as you determine the needs of for your particular facility.

Plymovent and our distributor network have the experience and knowledge to help you work through these questions and offer a solution to almost any application. We invite you to contact Plymovent and our authorized distributors with any questions you have.

INSIDE THIS GUIDE

WHY DIESEL EXHAUST EXTRACTION SO IMPORTANT

Diesel engines produce a mixture of toxic gases and particulates from the combustion process. These hazardous vehicle exhaust emissions in a garage or storage facility represent the most significant cancer health risk and a serious legal liability to the owners and operators of these buildings. It is essential to create healthy and safe working conditions by reducing these risks. Protective measures are an important aspect of this effort.

High-quality exhaust removal systems are recommended for existing and new facilities, to make sure that legal exposure limits are not exceeded. Plymovent is a global leader in providing systems that capture, extract and remove gas and diesel exhaust emissions, creating a cleaner and healthier work environment.

GATHER FACILITY AND USER DETAILS

1. What type and size vehicles will be serviced?

2. Are there multiple-sized vehicles being serviced within the facility?
   a. Does the facility provide dedicated service bays for cars, light trucks and other areas for larger vehicles?

3. What are the engine operating conditions?
   a. How long and under what conditions will the engines be run? Generally speaking, 10 to 15 minutes running at idle do not present temperature problems.
   b. Are the engines placed under load while testing AC units, transmissions, hydraulic testing or other Power Take Off operations? These will all increase exhaust volume and temperatures.
   c. What type of fuel is being used? For example, vehicles fueled by Compressed Natural Gas (CNG) can present a number of challenges.

4. How big are the work areas?
   a. Service bays for cars (or "small work areas") do not generally require long hoses. However, open plan service areas ("large work areas") may require a boom arm or motorized hose reels with long exhaust hoses.

5. How many mechanics are there vs. the number of service bays? Do you need exhaust flow for every service bay at once?
   a. Can a single hose / hose reel serve two work areas that are side by side?

6. Gather data on ceiling height, light fixtures, HVAC ductwork, overhead cranes and the type of building structure; all of these need to be considered when laying out and selecting equipment.

7. Understand height requirements. Generally spring recoil hose reels are mounted at 12-16' AFF; motorized hose reels can be mounted higher. It may make sense to initially mount the reel lower so a shorter hose can be used, thereby lowering future hose replacement cost if needed.

8. How many fans will you need? Will a fan be provided with each hose or hose reel? Or is a centrally located fan the better choice? Should the fan be located inside or outside? Keep in mind that while an outside-mounted fan reduces noise, it may be more difficult to service.

9. Determine fan start/stop options and automated fan speed controls. Proper controls provide required ventilation where and when it is needed. This is done with a combination of high-quality motorized dampers, pressure transmitters and a variable frequency drive control box.

GATHER FACILITY AND USER DETAILS (CONTINUED)

Simple systems with two to five hoses could be set up with a single fan and 100% usage; larger systems will typically only have a 35-40% usage factor and lend themselves to automated airflow controls with Plymovent DCV fan controllers. This type of control system can handle a large number of hoses/hose reels with a much smaller fan. Consider adding a DCV controller and dampers to an older system, or expand an existing fan capability.

10. Tailpipe adaptors - what kind of tailpipes does the fleet have?
    a. Undercarriage?
    b. Rear of vehicle?
    c. Underneath chassis, behind the cab?
    d. Vertical Stack exhaust? (Single stack or dual stacks?)
    e. Combination of these tailpipes?
    f. Are tailpipes accessible?
    g. What are the tailpipe diameters and shapes? Can you connect with one standard nozzle, are multiple tailpipe adapters needed, or is a custom solution needed?

11. Where are the equipment mounting points?
    a. Consider the wall or column to which you can attach the hose reel or boom arm. Steel columns and masonry walls are ideal for mounting hose reels or boom arms because of their strength and stiffness. Sheet metal structures may be problematic for mounting boom arms due to the bending torque of the boom to the mounting point. Very high ceilings and overhead cranes may present a challenge, as well as ductwork, piping and other obstructions.

12. How much electrical power is available?
    a. Do you have sufficient amperage and slots for new breakers in the electrical panel? Keep in mind that DCV controllers only operate on three-phase power.

HOW TO ACHIEVE ENERGY EFFICIENCY WITH A DCV SYSTEM

Consider a 20 hose drop system, operating at 500 cubic feet per minute (CFM) per hose. This would require a fan that could exhaust 10,000 CFM. The same system with a Demand Control Ventilation (DCV) controller and designed at a 40% usage factor (eight hoses in use at once) would need a fan suitable for 4,000 CFM.

In this way, the DCV controller reduces energy costs and overall operational costs:

- Reduced exhausted conditioned air.
- Reduced fan horse power and electrical consumption.
- Smaller diameter ductwork.
- Reduced sound levels.
- Smaller air make up unit.

CALCULATE AIRFLOW VOLUMES

Airflow volumes are typically based on the types of vehicle being serviced. Below are vehicle types with hose diameter and exhaust volume recommendations.

Automotive:

An automotive repair shop typically requires 275-300 CFM through a 4 in. hose. In most cases, automotive garages do not have excessive exhaust temperatures, given that the exhaust must flow all the way down the tailpipe before it gets to the hose and nozzle. This volume can also be applied to pick-up trucks.

> General Recommendation: Plymovent EG hose (350°F / 170°C continuous - 400°F / 205°C Spike) is the typical hose used for automotive shop conditions.

Motorcycles:

Motorcycle repair facilities typically require 600-650 CFM through a 6 in. hose (This may be split into two five-inch legs for dual exhaust).

> General Recommendation: Plymovent EG type hose (350°F / 170°C continuous, 400°F / 205°C Spike) is the typical hose recommended. If the repair team loads the engine or is Dyno testing, then the EF2/SNF-2 hose (550°F / 260°C continuous, 660°F / 350°C Spike) can be used.

Note: Two cycles make twice the exhaust volume as four cycle engines.

PLYMOVENT AIRFLOW RECOMMENDATIONS

Our recommendation is that the airflow through the hoses exceed the exhaust volume of the vehicle. We want to ensure that our systems properly capture both the exhaust fumes AND ambient shop air into the hose.

This additional airflow ensures that exhaust from the engine is captured and the additional air flow provides cooling as it mixes with the hot exhaust fume. Too much airflow through the hose is far better than too little.

These items should be considered when designing and laying out a Vehicle Exhaust removal system. Plymovent experts can help you select the right system based on your exhaust volume.

CALCULATE AIRFLOW VOLUMES (CONTINUED)

Trucks:
Repair garages could include public works (DPW), department of transportation (DOT) garages, rental fleets, delivery fleet repair, etc. These typically require 500-550 CFM through a 5 in. hose.

General Recommendation: Plymovent EF2 or SNF-2 (550°F / 260°C continuous, 660°F / 350°C Spike) hose is often recommended. However, diesel engine repair shops may conduct tests that generate higher temperatures. Engine loading for operation of the power take-off (PTO) to power hydraulic pumps or AC unit testing can raise the temperature and volume, as the engine is under load. It's important to learn how much time the engines are tested under load before determining the right hose.

Heavy Duty Trucks:
This would include over the road tractors, Kenworth/Detroit Allison/ Cummings/ Mack truck repair garages.

General Recommendation: These facilities often demand 650-800 CFM through a 6 in. hose. Plymovent EF2 or SNF-2 hoses will meet these airflow and temperature requirements. Exhaust temperatures may be higher if the engines are under load during shop operations (this could be caused when the PTO is operating hydraulic pumps, A/C unit testing, or brake or transmission testing). In these cases, the facility may require combination hoses, such as 20 ft. of the EF2 or SNF-2 hose coupled to a lower section of 5-10 ft. of HT-750 hose.

Off-Road Equipment and Construction Equipment:
Examples of these facilities are construction equipment, compressor/generator/ pump repair shops, etc.

General Recommendation: These facilities demand a 6 in. hose at 700-800 CFM through the hose. For larger applications an 8 in. hose can be utilized. You must confirm the exhaust temperatures to determine the proper hose, fan and airflow selection. The 8 in. hose supports exhaust volumes up to 1200-1400 CFM. Whenever engines are operating under load, the exhaust flow and temperature increase dramatically.

Dyno Testing:
Dyno testing requires a much larger volume exhaust system as it often generates extremely high temperatures within the hoses and the fan. The text box on the right provides more details.

DYNO TESTING QUESTIONS

Dyno testing involves running an engine under its own power coupled to a controlled amount of resistance. Here are questions you can ask to determine the exhaust extraction equipment needed for a Dyno testing environment:

- Is the Dyno for front wheel drive, rear wheel drive, four wheel drive?
- Are you dealing with an engine dyno, or chassis dyno?
- Where are the tailpipes located in relation to the Dynometer drum(s)?
- Is the exhaust coming from short engine headers or vehicle tailpipes?
- What are temperatures and exhaust volumes? These can vary wildly depending on the application.
- Generally you cannot place a tailpipe adapter directly onto the tailpipe as this may decrease the back pressure in the vehicle exhaust system which in turn may change the engine mapping and skew the test results.
- How long does each test take?

SELECT THE RIGHT EXHAUST REMOVAL SYSTEM

When to Consider a Fixed Extractor System

The Fixed Extractor, sometimes referred to as the Retractable Hose Drop or Hose Dropper, is often appropriate for small to mid-size service areas in which cranes and other equipment are not an issue. Hose drop systems are typically available in two types:

Winch or Rope and Pulley systems: mounted several feet away from the hose location, these systems are used to pull the hose up and away via two pulleys connected to the ceiling structure. This is the less expensive option, and while more difficult to use, they can support longer and heavier hoses than other options.

Spring Recoil Balancer: a spring cassette pulls the hose up and away when not in use. This is the more popular option. Hose lengths are typically 16 to 20 ft. long, but longer hoses are available. The hose's weight and length need to be considered when selecting the correct recoil balancer, so that it can fully lift the exhaust hose and tailpipe adapter when not in use.

FIXED EXTRACTORS: TWO QUESTIONS TO ASK

Q. What if there is limited space?

A. Include a fan and mounting bracket. Plymovent provides a fixed extractor system (FEF) that includes a fan and mounting bracket. These are useful for small work areas and limited space. For example, a service garage may want to locate the hose drop between two garage doors.

Q. How can I extend the reach of the system?

A. Use the Fixed Extractor on a pivoting boom. You can increase the reach and coverage of the hose by connecting it to a swing boom. The FEB swing boom positions the hose 15 to 26 feet out, away from the column or wall mounting point. This swing boom is an ideal selection within these facilities:

- A prefabricated building that has no interior columns;
- Facilities that use overhead cranes, which require that hoses reach underneath
- Facilities that have no defined work bays.

The Plymovent Fixed Extractor with Boom (FEB) system utilizes a double articulated boom with a Fixed Extractor at the end. When mounted to a column, the articulated boom version can cover almost a 270 degree arc around the mounting point. In some cases, depending on where the tailpipe is located, the swing boom can nearly cover a 360 degree arc around the column.

SELECT THE RIGHT EXHAUST REMOVAL SYSTEM (CONTINUED)

When to Consider a Hose Reel System

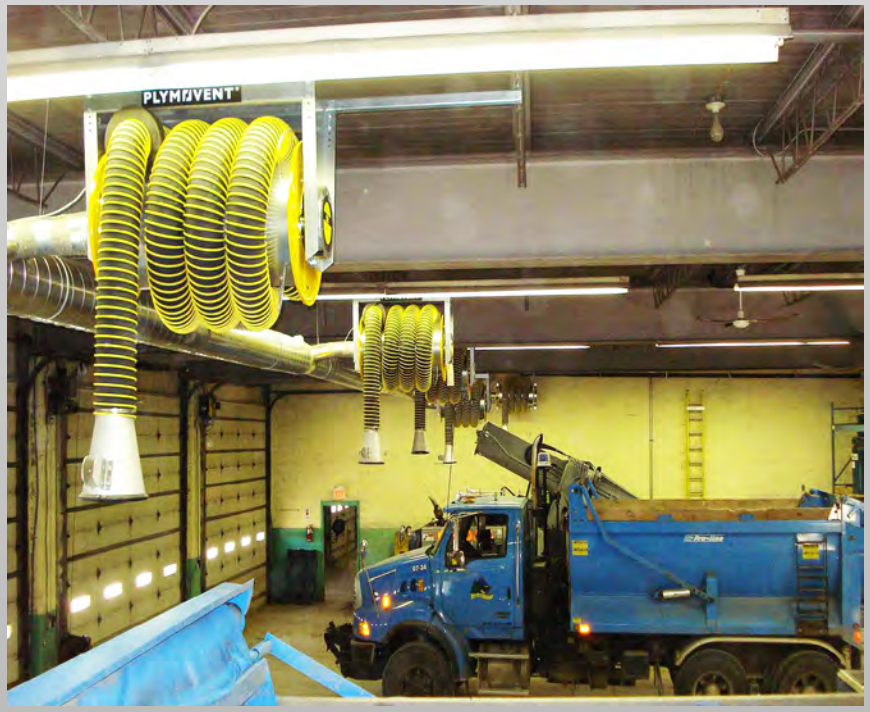
Hose reels are ideal for facilities where hoses need to be stored above the service area when not in use. Here are general guidelines for choosing the right hose reel:

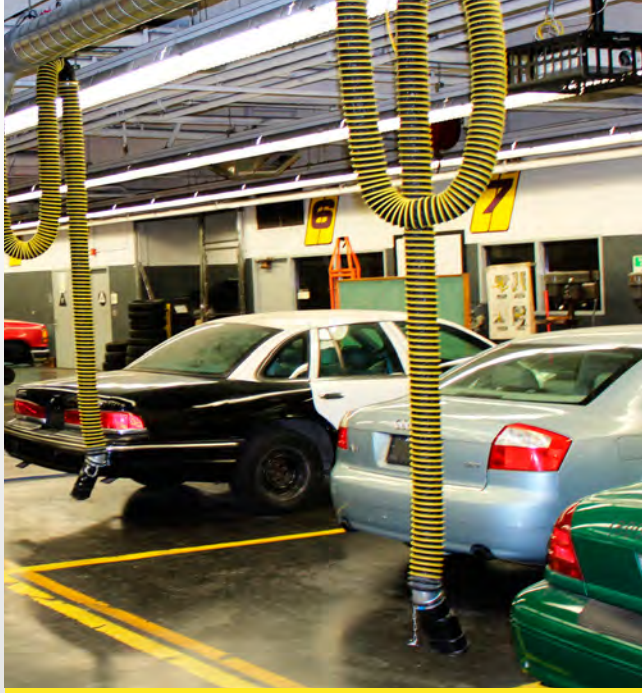
Small Workshop with Multiple Service Areas: We recommend a spring recoil hose reel, depending on the hose length and mounting elevation. An operator pulls down the exhaust hose and attaches the nozzle to the vehicle and pulls on the hose again to smoothly retract the hose.

Medium Workshop with Wide Service Areas: We recommend a spring recoil hose reel on a boom arm, which is designed to cover a wide area and keep the hose out of the way when not in use. The boom arm can be attached to a central fan system or connected to a direct-mounted fan depending on the workshop situation.

Heavy Duty Vehicle Workshop with Overhead Cranes: We recommend a motorized hose reel, in some cases on a boom, which retracts the hose with the assistance of a high-torque electrical motor. We recommend this hose reel in service areas where hoses and nozzles are heavy and/or overhead cranes and other obstacles may exist.

Note: Plymovent does not manufacture or recommend underground exhaust removal systems. All Plymovent exhaust systems are "above ground" ducted systems.





WHEN TO CONSIDER A RAIL SYSTEM

To reduce the number of hose drops that cover a maintenance or servicing area, consider an extraction rail system. This systems is made with an extruded aluminum profile that has an open slot on the underside. The slot is sealed off with rubber "lip" material that allows a travelling crab or trolley to move along the rail length. The rail becomes a section of ductwork, and can accommodate future expansion by adding additional trolleys or hose reels as needed.

Extraction rails are made from sections which are field spliced together into the final length required. Generally the longer the extruded sections are, the more rigid the entire assembly is and the less chance for leakage at the splice points.

Based on the rail length and airflow needs, the manufacturer will recommend how many duct connection taps are needed into the top of the rail. Rail systems can use either fixed extractors or spring recoil hose reels.

Consider issues such as preventing "lip loss" at the sliding trolley to lip point, "airflow loss" through the lips and balancing the system.

SELECT THE PROPER HOSE

All exhaust hoses used on these type systems require a fan to draw air through them. Insufficient airflow through hoses can lead to hose failure. Plymovent recommends an airflow velocity of 3500 FPM (plus/minus) through the hose.

Plymovent offers hoses in a variety of temperature ranges, different diameters and several standard lengths, based on the application needed. Hose type selection can be made as the designer determines what the actual operational conditions are, how the vehicles are operated in the garage and the duration of the operation.

General Recommendation: Select a hose made of special-coated high temperature fabric, with an external helix made of galvanized steel and where possible having a plastic abrasion.

View the table below for recommendations of hoses based on their temperature range capacities.

MANAGING HIGH TEMPERATURES

Some high temperature hoses are actually woven to have small holes in the fabric which allow cooling air to be drawn in through the fabric at our recommended velocities. This provides a cooling effect to the hose fabric. Insufficient airflows may show up as black dots on the exterior of the hose.

If a facility does experience hose failure, simply upgrading to a hose that can endure higher temperatures may not solve the problem.

Insufficient airflow through a hose system may be a key reason that hoses fail. Sharp bends close to the tailpipe and tailpipe adapter may also contribute to hose problems.

Type of Service Facility	Hose Temperature Range
Automobile	300° to 350° Continuous Operation
Diesel Truck Service	500° to 600° Continuous Operation
Off-Road and Construction Equipment	500° to 600° Continuous Operation 750° to 1200° if heavy load testing
Dyno Testing	570° to 2010° depending on type of testing being conducted
Compressor / Generator Testing	750° to 2000° depending on type of testing being conducted

Note: These general recommendations can be changed to suit your particular application or the needs of your particular project.

SELECT AN EXHAUST FAN

The most common type of fan used in vehicle exhaust removal systems is the centrifugal blower, built to Air Movement and Control Association International (AMCA) Class B construction standards. These fans are built with spark resistant materials, such as an aluminum Impeller and a steel fan housing. Backward inclined impellers are often recommended as they offer high efficiency.

Some manufacturers offer belt driven fans, while others offer direct drive. There are benefits to both. Plymovent recommends that you discuss your needs with your exhaust system manufacturer to identify the most appropriate fan.

The fan is the heart of the system and facilities should invest in the best fan possible. You can rely on the performance and sound listings offered by manufacturers like Plymovent that have had their fans tested and listed by AMCA.

Fans should be selected by how much airflow they can move at a given resistance, rather than horsepower, RPM, inlet diameter, etc. Here are three criteria for selecting a fan:

- Volume of air that the fan needs to move at the total system static pressure resistance;
- Exhaust air temperatures;
- Elevation of your building above sea level - the higher the elevation or temperature the less dense the air becomes; the fan size needs to align with these measurements; this is applicable if the facility is located in a mountainous area or temperature exhaust flows are very high.

It's worth noting that UL does not list fans. UL lists and manages electrical devices such as motors, lights, appliances and electrical controls, but not fan assemblies. Only the motor is UL listed. The UL symbol on a motor is a backwards R and an U, as shown below.

Q. How do I determine the best fan location?

A. When selecting a location for the fan keep in mind that it may need servicing from time to time. Make sure a mechanic can access the fan when needed. Direct drive fans typically need less maintenance, especially if the motor has permanently greased and sealed bearings. Belt-driven fans need periodic maintenance for belt tightening and pillow block lubrication.

Flex connectors should be used on the fan inlet and outlet to isolate the fan from the ductwork. Rubber-in-shear or spring vibration isolators should be used to isolate the fan from the building structure. Also, the fan support structure should be suitable for the weight of the fan.

SELECT A TAILPIPE ADAPTER

Understanding the Range of Nozzles Required

Tailpipe adapters are often the most difficult item to select. It is common to have many different tailpipe locations, shapes and diameters within a single fleet. Tailpipes adapters may also be referred to as nozzles, apparatus fittings, or boots.

Most exhaust system manufacturers offer numerous different type and sizes of nozzles, based on the hose diameter as well as tailpipe size/shape/location on the vehicle.

General Recommendation: For truck and vehicles with dual tailpipes, consider a nozzle that takes in ambient cooling air, thereby reducing the exhaust emission temperature. This type of nozzle should be composed of moulded, high temperature resistant rubber, and be equipped with a vise grip or pincher clip to strengthen the connection with the exhaust pipe.

Consider having multiple types of tailpipe adapters available for each hose. In these cases, consider using "Quick Disconnects" so that nozzles can be easily added and swapped on the hoses.

VERTICAL STACK CHALLENGES

Most trucks are made with different stacks based on the chassis and type of body attached to them. For example, a truck chassis used for over the road tractors can have a different vertical stack than if that same chassis is used for a dump truck where the dump body would cover the cab.

As you are selecting tailpipe adapters for your project, you have to inspect your fleet. You may find that you need more than one tailpipe adapter.

For example, Plymovent offers two vertical stack adapters that come with telescopic pole handles so they can be placed onto the vertical stack from ground level. With a telescopic arm, the nozzle can be easily fixed to the tail pipe using a guide bar.

SELECT A FAN STARTER

Fan starters make an exhaust system easier to use because it maximizes the mechanics' time. An exhaust system that automatically starts or stops the exhaust fan as the hose is being used provides convenience for mechanics as they service their vehicles, and ensures consistent use.

When designing the system, the size of the project often determines the type of fan starter that should be installed. On a small system that includes two or three hoses, a manual motor starter located in a convenient position within the work area might be all that's needed.

A larger system with four or more hose reels or fixed extractors may benefit from having a low voltage fan start/stop system included in the design. These generally include a toggle switch of some type located on the hose reel or recoil balancer that sends a start signal whenever a hose is brought down for use.

Determine the Usage Factor

As pointed out on page five, a 20 hose drop system, operating at 500 CFM per hose, would require a fan that could exhaust 10,000 CFM. But many facilities should anticipate a 40% Usage Factor (for example, only eight hoses in use at once). The Usage Factor should be determined before the design is finalized.

DCV systems may add costs at the outset of the project, but a DCV controller can be expected to reduce ventilation, heating, and cooling loads by 10 to 30%.

In the April 2017 issue of Facility Executive, an airside efficiency company calculated that DCV projects can reduce energy by 38% in energy intensive environments such as laboratories.

Q. Why Use Demand Control Ventilation (DCV)?

A. Even a larger system can benefit from having a Demand-Control Ventilation (DCV) fan speed control system installed.

With a DCV system in place, you can downsize the fan and ductwork based on the total number of hoses in use, rather than the total number of hoses on the system. That's because in most facilities, not all the hoses on a system are in use at the same time.

DESIGN THE DUCTWORK SYSTEM

When designing the ductwork for an exhaust removal system, remember that you are dealing with a carcinogenic product that may be damp. Plymovent recommends transport velocities to be as high as is practical given the ductwork diameters which work the best.

General Recommendation: Transport Velocity of 3000 FPM or higher. This may not always be possible based on airflow through the various components and duct connection fittings on the equipment. When installing the ductwork and the possibility of condensation exists, it may be advantageous to slope the duct and include a drain.

Position Exhaust Stack Above the Roof

In some cases a louver located in the side wall of the building is selected for the exhaust system discharge. Plymovent does not recommend the side wall louver because this can allow the exhaust to blow back against the outside of the building - or worse - recirculate back into the building through doors or other penetrations in the building envelope.

General Recommendation: In most projects an exhaust stack on the fan should discharge vertically and terminate well above the roof, away from all air intakes and air handling units.

IMPORTANT PRECAUTIONS

Light duty lock seam HVAC duct and elbows should not be used. This type of ductwork is not strong enough to handle the negative pressure the fan will generate in these types of systems.

Plymovent does not recommend PVC piping as ductwork. Air flowing through a pipe or duct can generate static electricity and PVC is difficult to ground. Static electricity and flammable vapors are not a good mix.

Do not share the ducts of the vehicle exhaust system with common shafts or ducts of other systems, such as welding exhaust systems, as the exhaust system contains flammable vapors.

Follow the Sheet Metal & Air Conditioning Contractors' National Association (SMACNA) guidelines for ductwork design.

CALCULATE STATIC PRESSURE

Static Pressure is the resistance to airflow through all the components within the exhaust system. This includes the hose, hose storage device, ductwork, fan and fan exhaust stack.

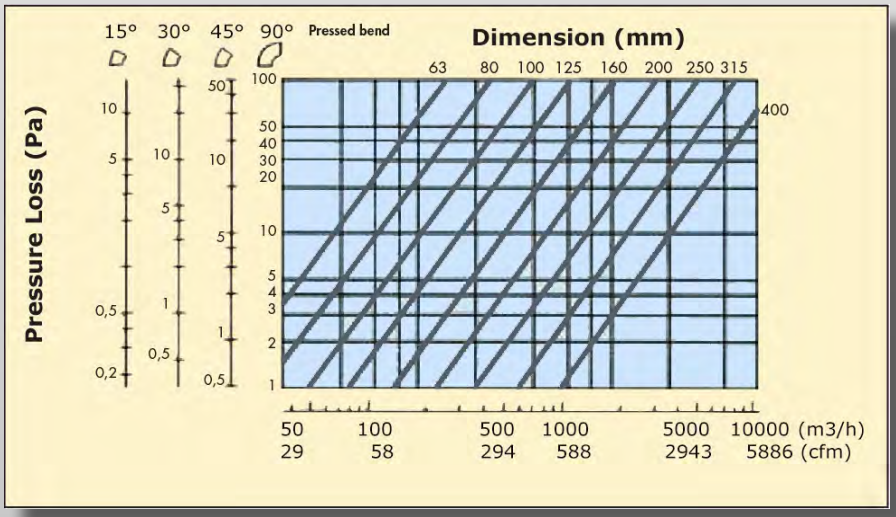
For example, ductwork static pressure is figured as friction loss per 100 feet of duct at a certain CFM. This resistance can be calculated by the design engineer or the exhaust system specialists with which you are working. Pressure is measured in Pascal (Pa) / Inches Water Gauge (w.g.).

Care and the manufacturers' assistance should be sought to make sure the airflow and static pressure is calculated correctly.

When extracting vehicle exhaust, it's important to maintain a relatively high velocity to avoid any liquids and particles from settling in the ducting system.

To calculate how air pressure loss in a duct system, you must know how much air is passing through that duct, factoring in any bends in the system.

Air volume is measured in m3/h (cubic meters per hour) / CFM (Cubic Feet per Minute) or l/s (liters per second). For example, here is a chart that provides duct pressure loss and typical bends, based on the duct dimensions.



CALCUATING EXPECTED EXHAUST FLOW WHEN ENGINES ARE OPERATING UNDER LOAD

Refer to the American Conference of Governmental Industrial Hygienists (ACGIH®) design manual ("Industrial Ventilation: A Manual of Recommended Practice"), which provides design criteria and a formula you can use to calculate the expected exhaust flow at operating conditions when the engine is under load.

You will need the exhaust temperature, RPM and engine size in order to make an accurate calculation (VS-85-01 and VS-85-02).

PLYMOVENT OFFERS TOTAL SOLUTIONS FOR AIR CLEANING

For more than 40 years we have made it our business to ensure clean air in all types of garages and facilities. We provide high-quality products to protect mechanics and employees from exposure to hazardous diesel exhaust, dust and debris. We offer a broad range of exhaust extraction systems, supported by complete engineering services. Contact us to find out what genuine commitment to customer requirements really means.

FROM SCRATCH TO THE RIGHT SOLUTION

Plymovent is not just a manufacturer. We offer professional advice and engineering services to provide a solution tailored to your specific needs and requirements. In addition, our worldwide network of distributors offer service and maintenance to keep your system functioning optimally.

For more information, please contact your authorized Plymovent distributor or visit www.plymovent.com.

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Plymovent Corp. is ISO 9001:2008 Certified.

Your Authorized Plymovent Distributor:

Plymovent cares about the air you breathe. We offer products, systems and services which ensure clean air at work, anywhere in the world.

We respect the environment and we deliver high-quality products. Our expertise gained over many years and our genuine commitment to customer requirements enable us to provide precisely the solutions you need.

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