



Exhaust System Guide

EXHAUST



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Introduction

Over the years, the exhaust system has been given more responsibility and its job has grown. Originally, it was a relatively simple duct system designed to prevent toxic exhaust gases from entering the driver's cab. Today, the modern diesel exhaust system reduces noise and even lends a hand with increasing a vehicle's fuel economy, power and overall driveability.

Yes, it's another story of change. Changes throughout the industry. Changes in governmental regulation. Changes in consumer demands.

In the United States during the past 30 years, federal, state and local governments have introduced noise pollution control. The Federal Noise Control Act of 1972 was the first nationwide law to regulate truck noise levels. This regulation, which first went into effect in October 1975, limited total truck noise levels to 86 dB(A), measured at 50 feet (15.24 m) for speeds less than 35 mph (56.35 km/h). In January 1978, this noise level was reduced to 83 dB(A); followed by another reduction in January 1988, when the noise level regulation was lowered to the current 80 dB(A) level.

According to Australia design rule 28/01 in 2006, noise regulation is based on a different testing method. The sound measurement is taken at 24.61 feet (7.5 m) for speeds of 31.07 mph (50 km/h). Depending on the vehicle's horsepower, the sound requirement ranges from 81-87 dB(A) for heavy goods vehicles.

In Europe, the noise regulation has been updated many times since 1970. The latest amendment was June 6, 2007, which specified that for heavy duty trucks with an engine horse power of not less than 150 kW, the noise level can not exceed 80 dB(A) measured at 24.61 feet (7.5 m) for speeds of 31.07 mph (50 km/h), according to Directive 70/157/EEC.

In China, for trucks with an engine over 150 kW produced after January 1, 2005, the noise levels can not exceed 84 dB(A). The sound measurement is taken at 24.61 feet (7.5 m) for speeds of 31.07 mph (50 km/h).

Besides the noise, other bi-products of engine combustion are exhaust particles and gases emitted into the exhaust system. Legislation to control the levels of these emissions occurred in 1988, 1990, 1991, 1994, 2004, and 2007. Each regulatory change reduced the acceptable levels of combustion-related gases which could be allowed to exit the exhaust system.

To meet these emission laws, Cummins Filtration works closely with all engine and truck manufacturers to provide exhaust system components. As the global leader in exhaust design, Cummins Filtration develops and provides highly specialized Fleetguard exhaust systems that reduce noise and minimize harmful gases.



5 Ways To Reduce Noise Level

There are five primary sources that contribute to the noise level of a highway truck.

Fan Noise

Excessive fan speed is a common contributing noise source. This can be controlled by the use of a temperature controlled or thermostatic fan. Other noise concerns are bent fan blades and broken or missing shrouds.

Air Intake

Both the type of system and the location of the inlet affect the truck noise level. Air inlets that open to the side are generally noisier than those that do not. Intake air silencers are available for problem applications.

Mechanical Noise

The engine and drivetrain are also a source of noise. Operating speed, type of engine and drivetrain all affect the total noise level. Shielding the exposed areas with acoustic barriers will reduce noise levels. Generally, any part of the engine or drivetrain that can be seen while standing away from the truck will contribute to the total vehicle noise level.

Tires

Many times this is the major noise source for highway trucks traveling at high speeds. The condition of the tires and the tread pattern affect the noise level. At low speeds, this is not a large noise source.

Exhaust System

Worn or inadequate exhaust systems are the largest and the most frequent contributor to high noise levels. A visual inspection and repair of leaking connections or replacement of failed components will noticeably reduce noise levels. If the noise level is still too high, the addition of resonators, packed stacks or a change in mufflers is recommended.

Objectives Of This Manual

Most of us have a good idea of how the exhaust system works and why. Even so, you may not realize that incompatible or inferior exhaust system parts can shorten component life, interfere with proper vehicle function and may even cause serious damage. High quality replacement parts are critical and in the pages ahead you'll learn why. In this guide, you will also:

- Master a basic understanding of the heavy and medium duty exhaust system.
- Learn how specific exhaust components and related parts affect overall vehicle performance and fuel efficiency.
- Refresh your basic knowledge about EPA regulations related to exhaust noise.
- Review the Fleetguard line of exhaust system products and related items.

For More Information

At the same time, you may have questions about specific applications. In that case, we encourage you to visit our website at cumminsfiltration.com.

An Opportunity To Test Yourself

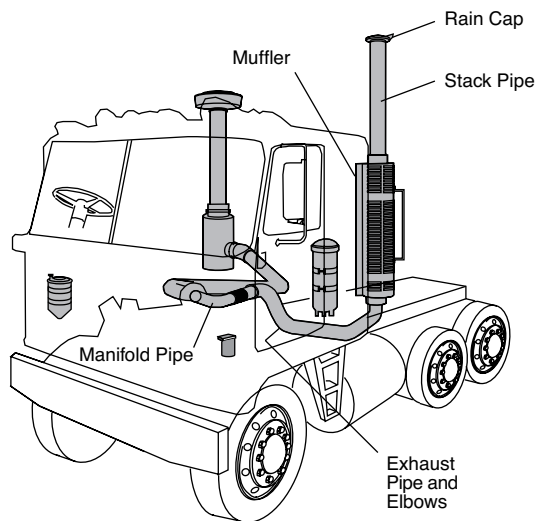
You will find study questions at the end of each chapter. These questions are provided as a tool to help you review the material and commit the information to memory.

You will also find the Final Review Exercise at the back of the manual. This multiple-choice review provides some additional practice and checks your memory on the subject matter.

Exhaust System Overview

How The Exhaust System Works

The primary purpose of the exhaust system is to expel burned gases—or exhaust—to the rear of the vehicle and to dampen the sound of engine combustion.



Manifold

Although the **manifold** is often thought to be a part of the engine, it is a key component of the exhaust system. The exhaust manifold is the component, usually made of cast iron, that gathers all the exhaust as it comes out of the head into a single collector. The manifold then delivers the burned gases into exhaust pipes.

The primary purpose of the **exhaust pipes** is to serve as an enclosed route for the burned gases to exit the system. While exhaust pipes are joined to the manifold by a **manifold pipe/connector**, there are a variety of ways to assemble the “route” or system.

For example, a vertical dual exhaust system would utilize a manifold pipe with a splitter tee adapter to route the exhaust in two different directions. On the other hand, a **Wye Connector** would be used in a V-type engine application, typically a medium duty truck. There are also mufflers which feature two inlets—one for each half of a V-type engine—leading to one outlet.

Exhaust System Components

The major parts of a diesel truck exhaust system include:

- Manifold
- Manifold pipe and connector
- Exhaust pipes and elbows
- Muffler
- Stack pipe or tail spout
- Clamps
- Resonators

Let's review the primary components of the exhaust system—and how they work together to expel exhaust, reduce noise and assist in smoother running operation.

Exhaust Pipes and Elbows

Exhaust pipes and elbows have several important purposes. Exhaust gas is toxic, and these exhaust pipes serve to contain the exhaust and route it towards the rear of the vehicle as quickly and efficiently as possible. The pipes and elbows are used to create an effectively sealed pathway to guide the exhaust gas safely from the engine to the exterior of the tractor/trailer.

Exhaust pipes are manufactured in a wide variety of shapes and sizes, although there are basically two types:

- Regular pipe
- Flexible pipe

Regular exhaust pipe is solid, typically available in straight lengths, bent configurations and elbows.

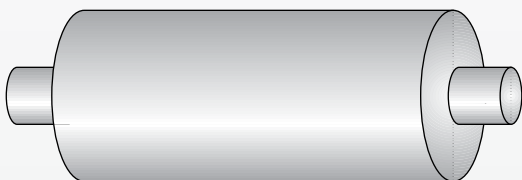
Certain applications also require flexibility because the connection must be sealed tightly. At the same time, the exhaust system must be flexible enough to bend with road conditions and accommodate thermal expansion of the system; otherwise the pipe or a connection may snap or break. That is why **flexible exhaust pipe** is commonly used in larger diesel exhaust systems, heavy duty applications and severe service vehicles.

The exhaust system may be sealed by welding joints. Alternatively, instead of welding, **exhaust clamps** can be used in place of welding as a simple, effective way to seal overlapping pipes. Aside from school bus applications, which include some extremely strict requirements and regulations, the method for sealing the system is a personal preference of the owner or fleet manager.

There are also applications where **resonator(s)** are used to begin to dampen the noise before it reaches the muffler.

Muffler

The **muffler** is the primary component within the exhaust system that reduces the noise made by the engine during combustion; as sound waves enter the muffler chamber, they are broken up and the noise dissipates.



Some types of mufflers include chambers with holes, while others are padded with fiberglass or plates to dampen noise levels. The technical challenge is to use a method that most effectively breaks up sound waves without producing excessive back pressure. Some mufflers start with a more efficient design than others, use heavier gauge materials and rely on better manufacturing processes—and these all make a noticeable difference in quality, maintenance costs and vehicle performance.

The Importance Of Correct Back Pressure

Exhaust gases are passed through the muffler to reduce the noise of engine combustion. At the same time, back pressure causes exhaust gases to remain in the engine cylinder after the exhaust stroke. While a certain amount of back pressure is vital to optimum performance, too much back pressure can result in loss of horsepower and excessive engine/ turbocharger operating temperatures. When this happens, performance and fuel economy suffer. It may not take much to alter the balance or to affect engine operation.

Always replace components in the exhaust system with like components. When the vehicle was designed, product engineers selected specific exhaust system components and parts to achieve a high performance balance, including the proper amount of back pressure. Replacing an exhaust system part with a like component assures the most efficient performance.

How To Replace The System

When you consider replacing a muffler, that's the time to think about replacement pipe, new clamps or other related items. If a new muffler or pipe is installed and there is still an exhaust leak, the problem is not fixed.

The best way to select a muffler is to use the OE part number cross reference. If the OE number is not available, use a "Muffler Application By Engine" reference. Many mufflers have the same exterior size but vastly different interior construction and performance.

There are several other items you need to consider before any exhaust system installation or repair.

- **Use new clamps anytime a muffler or pipe is replaced.** This is also a good time to double-check all other clamps and joints within the exhaust system.
- **Thoroughly review the system for special needs,** such as rain caps (for a straight stack pipe) to prolong the life of the system. Make sure an existing rain cap is still in place and in good condition.
- **On a vertical system, check to ensure that the heat guard around the muffler is in place and secure.** If there is no heat shield—you may want to consider adding one.
- **Check the system for other components that may need to be replaced.**
- **Examine the flex pipe** (if it is used) to make sure it's in good condition and will perform properly.
- Starting at the front, **do a leak check** all the way back. The manifold pipe/connector needs to be checked every time any work is done on the exhaust system.
- **Once the system is assembled, it should be checked for leaks** after new clamps are put into place and/or welding is complete.

Welding Aluminized Steel

Oxyacetylene Welding Filler Metal

Use a mild steel filler metal, 3/32" (2.38 mm) diameter, free of rust (American Welding Society classification A5.2). Do not use copper coated filler material.

Welding equipment: Use a number 3 or 4 tip. Observe instructions of the equipment manufacturer when adjusting the operating pressures at the gas regulators.

Procedure: Clean the parts to be welded thoroughly. Incline the torch at a 45° angle from the direction of travel. Use the forehand welding technique. Keep the torch flame on the tip of the filler rod, not in the center of the puddle.

Shielded Metal-Arc (Stick Electrode)

Any one of the following rods are recommended:

- E6011
- Low hydrogen: E7018
- Stainless: 309 or 310

Gas Metal-Arc (MIG)

- Wire: ER70S-3 or ER70S-6
- Shield gas: Carbon Dioxide or 75% Argon 25% Co2

Study Questions

1. Each of the following is one of the five primary sources that contribute to the noise level of a highway truck except: (Reference, pg. 2)

- A) Engine and drivetrain
- B) Fuel system
- C) Exhaust system
- D) Air intake

2. The _____ is the primary component within the exhaust system that reduces the noise made by the engine during combustion; as sound waves enter the _____ chamber, they are broken up and the noise dissipates. (Reference, pg. 4)

- A) Manifold
- B) Wye connector
- C) Resonator
- D) Muffler

3. When specifying replacement parts, one of the most important "rules" to remember is this: Always replace components with like components. Why is this so important? (Reference, pg. 4)

- A) It is a mandatory ruling of the Federal Noise Control Act of 1972.
- B) OEM-specified mufflers are the only legal application in certain states.
- C) Mufflers could have the same exterior size but have very different interior construction and performance.
- D) There is little difference between mufflers.

Final Review Exercise Answers:
1.D 2.A 3.A 4.C 5.B
6.C 7.B 8.B 9.D 10.A

Fleetguard Exhaust System Components

Top Quality Construction

Heavy duty, medium duty, and most recently, light duty exhaust products are manufactured by Cummins Filtration, the largest OEM supplier of exhaust systems and a leader in engine exhaust noise technology. You can count on Fleetguard exhaust system products for OE quality along with consistent:

- Quiet operation
- Low back pressure
- Fuel efficiency

As the global leader in the design of exhaust systems that maximize performance and minimize environmental impact, Cummins Filtration provides the industry's highest quality products under its Fleetguard brand. Fleetguard exhaust systems are designed for durability and custom tuned to meet current noise level regulations. The Fleetguard product line includes mufflers, non-chrome tubes, stacks and elbows—all premium components constructed of top-grade steel. The steel is **aluminized**, which means it is treated to resist the corrosive action generated by heavy duty exhaust systems, even in high temperature conditions.

There are numerous design features that make Fleetguard mufflers top rate. Perhaps the most important is the floating baffle design, patented by Cummins Filtration, that relies on a series of small partitions (or baffles) to impede sound waves for maximum noise reduction with optimal back pressure. The perforated tubes and resonator chambers on the inside of the muffler keep noise levels down without restricting the flow of exhaust gas.

Fleetguard mufflers are constructed of heavy gauge aluminized steel to:

- Resist hot, corrosive exhaust gases
- Deter rust
- Extend service life

Many of the small diameter horizontal mufflers also feature a heavy duty crimp construction on both ends. This unique feature, approved by OEMs, makes a high-strength, backfire-proof and rust-free seal. Vertical mufflers have special edge welding to provide a strong joint that is also appealing in appearance. Besides this smooth edge, the muffler has a domed head which, on vertical application, prevents moisture from collecting at the top of the muffler.

Fleetguard also offers an economy muffler that goes head-to-head with the competition, featuring heavier gauge flanges as well as internal flanges for support. The illustration on the following page shows the difference between Fleetguard OE and Fleetguard economy mufflers.

Whether you need the full-feature performance of an OE replacement or you're looking for a lower cost solution, the best choice is Fleetguard.

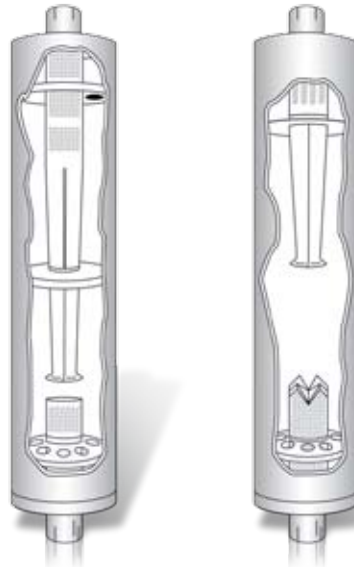


Original Equipment vs. Economy

The choice is yours:

Fleetguard
OE

Fleetguard
Economy



- Original equipment mufflers reduce exhaust noise to level required to meet EPA truck noise limits.
- Original equipment mufflers can be quieter (more than 3 dBA) than economy versions, depending on make of engine.
- Original equipment mufflers are covered by Fleetguard's 500,000 mile (804,672 km) or 4-year warranty.

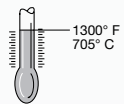
- Fleetguard has 16 gauge (ASTM A463 and ASTM A924) end flange. (Some competitors are lighter.)
- Local noise laws should be checked before using economy version.
- Economy mufflers are not covered by 500,000 mile (804,672 km) or 4-year warranty, only by the general warranty.
- Fleetguard includes an internal support flange. (Some competitors do not.)

- All aluminized steel construction

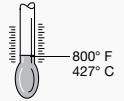
The Fleetguard Difference

Aluminized Steel

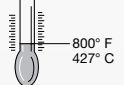
Why are Fleetguard mufflers so much better than will-fit mufflers? Why should you buy a Fleetguard OEM approved muffler instead of an aftermarket noncertified copy? The answer starts with the steel. The average exhaust system temperatures of gas and diesel applications range from 800° F (427° C) to 1400° F (760° C).



Aluminized steel holds its strength characteristics up to 1300° F (705° C). Fleetguard aluminized steel also resists oxidation much longer than unprotected mild steel.



Unprotected mild steel used by many will-fit companies begins to rust as soon as it is exposed to everyday field conditions, regardless of its thickness. This mild steel also loses its strength after exposure to minimum exhaust temperatures.



Galvanized steel begins to give off extremely toxic fumes at the minimum 800° F (427° C), and immediately loses its rust resistant characteristics.

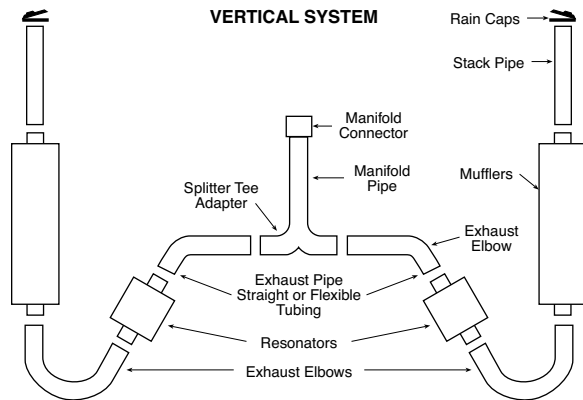
The superiority of aluminized steel is why Cummins Filtration uses all aluminized steel construction for its exhaust mufflers, nonchrome tubes, stacks and elbows.

Applications

When it comes to exhaust systems, there are two basic configurations—vertical and horizontal. If you compare actual components in the sketches of these two systems, you'll see that there is little variation in parts.

Vertical Applications

With today's vertical application, the muffler is bolted to a mast structure. In the past, mufflers were bolted to the back of the cab or tractor; however, this resulted in a great deal of noise transfer. That's why the majority of trucks now use a mast structure with separate supports off the frame for mounting.

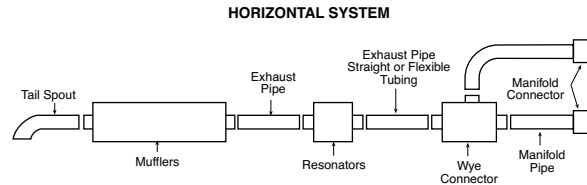


This schematic shows the “plumbing”—or all of the components and exhaust system parts needed for a vertical application. Although this shows a dual exhaust configuration, this kind of exhaust system can also be installed as a single exhaust configuration.

You may prefer this vertical stack system as a way to get any objectionable exhaust odor away from ground level. However, there is no regulation or technical requirement for one configuration over the other; this choice is simply a matter of personal preference.

Horizontal Applications

In recent years, the industry has begun to focus more on aerodynamics, so it has become more popular to use a horizontal exhaust system. Mufflers and stack pipes that stick up (as in a vertical application) cause parasitic drag and can detract from fuel mileage. So, in some cases, the choice is made to put the exhaust system underneath the tractor trailer. Again, this is strictly a personal preference.



In some cases, there simply may not be enough room between a tractor and the box in a straight truck to install a vertical exhaust system. At these times, a horizontal configuration is the ideal solution.

What's important to remember is that it is possible to find a vertical and a horizontal application in any truck class. One configuration may better suit a particular truck due to space constraints, but in many cases, this is a choice based on past experience and/or an individual preference.

School Bus Applications

School bus applications are an exception to the matter of personal preference. In fact, there are some very stringent local regulations for school bus exhaust systems, possibly including requirements for:

- A horizontal application
- Rear exit
- A totally leak free system

Cummins Filtration offers the most complete product coverage in the bus aftermarket with the flexibility to meet your most rigorous requirements, including the high quality assurance and long life vital to this specialized market.

Off-road Exhaust Systems and Special Mufflers

We also offer a series of mufflers and accessories for off-highway equipment tailoring OEMs. Please see our Exhaust Catalog LT32002 for details.

How To Troubleshoot The Exhaust System

Following are guidelines to help you locate and identify problem areas in the vehicle's exhaust system.

- **Mufflers.** Inspect the area around clamps for breakage, cracks and rust-through. In addition to excess noise, a leak in the muffler can cause cleanup expenses when soot escapes and discolors the cab or trailer. Most importantly, a leaking muffler may allow exhaust gases to escape to the driver compartment causing sleepiness and even death through carbon monoxide poisoning.
- **Elbows, Stacks and Exhaust Pipes.** Dents or crushed portions of any tubing create exhaust flow restriction and increase back pressure significantly. Even relatively small dents will cause decreased fuel economy and increased turbo wear. If dents are relatively large, increased bearing and lower cylinder wear will occur due to increased exhaust temperature. In such cases, significant decreases in fuel economy will result.
- **Rain Caps.** Although Fleetguard mufflers are designed to prevent rain, melted snow and sleet from passing beyond the muffler to the engine, rain caps are recommended. Water entering the muffler will create a slurry of soot to be blown on the trailer causing significant cleanup expense. A curved exhaust stack is an acceptable alternative to a rain cap but may not be 100 percent effective in hard rains.
- **Clamps.** Check band clamps for cracking periodically. Reuse of any clamps is not recommended.
- **Flexible Tubing.** Do not patch. Replace entire section. Stainless steel is recommended as the best value.
- **Mounting.** The exhaust system should be secured to eliminate vibration. The muffler brackets should fit securely to the muffler and to the mast or truck frame. The muffler brackets should not squeeze the muffler body and the mast must not vibrate or wiggle.

Exhaust System Products Warranty

Perhaps the most commonly replaced exhaust system component is the muffler. In fact, industry data indicate that heavy duty mufflers are replaced every three to four years, while medium duty truck mufflers in certain vocational applications may be replaced as often as every two years.

The Fleetguard muffler warranty is the best in the industry. Please contact us for warranty details.

Chrome plated exhaust system products are warranted, as well, against peeling and blistering within the twelve month warranty period, beginning on final sale date to the end-user owner.

Note: This warranty does not cover exhaust system parts that rust out or are blown out by backfire or other faulty conditions. This warranty does not cover exhaust system products damaged or destroyed resulting from incorrect installation, application or operation.

Study Questions

1. There are some very stringent local regulations for school bus exhaust systems, and you may be faced with all of the following requirements except: (Reference, pg. 8)

- A) Horizontal application
- B) A totally leak free system
- C) Vertical application
- D) Rear exit

2. Dents or crushed portions of any tubing (elbows, stacks or pipes) create exhaust flow restriction and significantly increase back pressure. Even relatively small dents will cause: (Reference, pg. 9)

- A) Decreased fuel economy and increased turbo wear
- B) Decreased bearing wear
- C) A slow leak
- D) Excessive soot buildup

3. The exhaust system component that is most commonly replaced is the muffler. According to statistics, heavy duty mufflers are replaced every three to four years, while medium duty truck mufflers in certain vocational applications may be replaced as often as every ____ years. (Reference, pg. 9)

- A) 2
- B) 3
- C) 4
- D) 5

Related Items

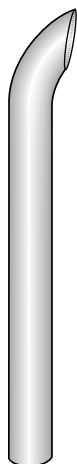
Fleetguard Exhaust Products Line

Let's review the extensive line of Fleetguard exhaust accessories and related items.

Stack Pipes



Straight Stack



Curved Stack

There are curved and straight stack pipes in popular lengths, available in mirror quality chrome plated (part number suffix "C") and aluminized steel (part number suffix "A"). People who are serious about the appearance of their truck generally buy chrome stacks, while aluminized stacks are functional and will hold up for the longer haul.

Keep in mind that while many of the competitive alternatives are cheaper, they are often of extremely poor quality. The chrome finishes on these inferior products tend to rust or peel in a relatively short time due to poor manufacturing processes. Mild steel stacks and elbows may be less costly to buy, but because of short service life, they cost more per mile than aluminized steel products.

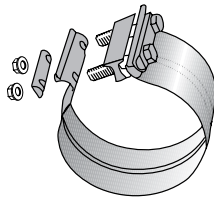
Cummins Filtration uses an excellent nickel plated, chrome finishing process—and that guarantees the highest quality. Sure, you can buy cheaper alternatives, and they may look good for a short period of time. Simply remind yourself that if you invest a little more in good quality, it is far more cost effective in the long run.



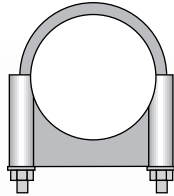
Exhaust Clamps

Anytime a muffler or exhaust pipe is replaced, the related clamps should always be changed. Heavy duty clamps made by Torca™ are designed for fast, easy and accurate installation, as well as maximum clamping force without crushing pipes. Some of the most widely used options include:

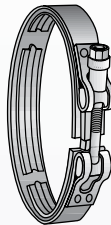
Wide Band Clamp – minimizes exhaust system leaks and holes, protecting the driver in the cab from odorless, poisonous gases which can seep in from the system. This clamp reduces the need for welding the pipe and makes a tight seal without damaging the pipe diameter. It also works for butt and lap installations using either solid-to-solid tubing or flex-to-solid tubing.



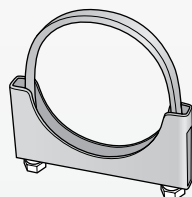
Guillotine Clamp – the most common fastening device on pipes of 2" (50.8 mm) to 6" (152.4mm) diameters.



V-band Clamp – connects the manifold or turbocharger to the exhaust system. This type of clamp is available to cover the majority of engine applications and sizes.

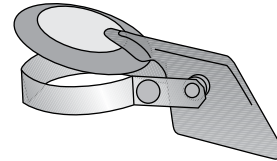


Flat Band Clamp – available either zinc or chrome plated in 3" (76.2 mm) to 6" (152.4 mm) pipe diameters.



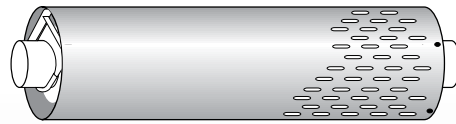
Rain Caps

If you have straight stacks, Cummins Filtration offers a selection of aluminized steel or chrome rain caps, all featuring single bolt mounting and heavy duty welded assembly for long life. Fleetguard rain caps are also precision balanced to keep the rain out, protect the muffler and exhaust system from rust and get rid of carbon residue for good.



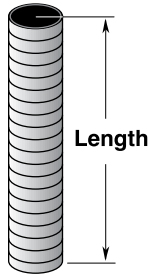
Heat Guards and Grab Handles

Fleetguard heat guards are available in both aluminized steel and bright stainless steel with various degrees of wrap and hole patterns—all engineered to protect the driver and others from a hot muffler. Cummins Filtration can even personalize heat shields and mufflers with a custom punched pattern, name or logo right into the steel.



A universal chrome plated grab handle is also available to make it easier to enter the cab.

Flexible Tubing



Like many of its competitors, Cummins Filtration offers **galvanized flex** for those who need a product at a very low price.

Cummins Filtration also offers stainless steel flex for first class, long life application. Because of the high price of stainless steel, the company now

offers a long life aluminized steel flex. This provides a quality option with affordable pricing, much closer to that of the galvanized tubing than to the stainless steel flex hose.

With these three different materials, Cummins Filtration's new catalog features an expanded line of diameters and lengths.

Characteristics Of Fleetguard Flex

Galvanized flex hose will withstand up to approximately 600° F (316° C) before heat breakdown of the coating starts. At this point, the material begins to degrade and rust begins to form.

On the other hand, **aluminized coating** will withstand conditions over 1200° F (649° C) before the aluminum coating starts to soften.

Of course, **stainless steel flex tubing** is designed to withstand high temperatures, such as those found in gasoline engine applications. Its only drawback is a tendency to turn different colors when exposed to very high temperatures, a cosmetic change with no effect on performance.

Measuring Flex

When it comes to measuring flex tubing, there is a certain amount of disagreement. Different people measure it in different ways; since it's sold by the foot, disputes can crop up about how much was shipped versus what was ordered.

To prevent any misunderstandings, Cummins Filtration recommends a standard method for measuring flex. Since the natural lie of flex is halfway between fully extended and fully compressed, Fleetguard flex is currently supplied in fully extended lengths plus 2" (50.8 mm) extra on 10 foot (3.05 m) lengths, or 6" (152.4 mm) extra on 25 foot (7.62 m) lengths.

To properly measure flex, coil the tubing in as tight a radius as possible. Now, measure the outside parameter of the coil; this will give the overall, fully extended length of the section of flex.

Since flex is generally sold in extended lengths throughout the marketplace, it's important that accurate measurements be provided by all competitors and distributors. **Remember: the extended length is generally 1.2 times the compressed length.** This is only an estimate and should not be used as an accurate form of measurement.

Cutting Flex

There are several ways to cut flex tubing. The method most accepted by the industry is to tack weld the flex on both sides of the cut before actually cutting. With this done, there is no way for the flex to unravel after it is cut. This will also keep the diameter of the flex within tolerances so that it cannot become uncoiled once the part has been cut.

The best and easiest method for cutting flex is **plasma cutting**, which:

- Leaves a smooth end with no burrs
- Requires little or no trimming
- Does not require hard clamping (which can deform the flex ribs)

The **band saw** (or hack saw) cutting method is commonly used to cut flex to proper lengths. This method:

- Leaves very rough edges
- Requires the removal of sharp burrs before use
- Requires additional work on the ends to be sure the flex does not grow in diameter

Another method, not often used, relies on a **pipe cutter**. This type of flex cutting is:

- Not popular or widely accepted
- Needs several different sizes of cutters, depending on the variety of diameters of flex
- Leaves sharp edges which require trimming

Study Questions

1. The best and easiest method for cutting flex is _____. This method leaves a smooth end with no burrs, requires little or no trimming and doesn't require hard clamping, either. (Reference, pg. 12)

- A) The use of a pipe cutter
- B) The use of a hack saw
- C) Band saw cutting
- D) Plasma cutting

2. Flex tubing is generally sold in extended lengths throughout the marketplace, so it's important to get accurate and consistent measurements. The extended length is generally how many times the compressed length? (Reference, pg. 12)

- A) 1.5
- B) 1.2
- C) 3
- D) 2

3. Cummins Filtration provides three different flexible tubing options—and a range of quality and pricing—to meet every need and application. These flexible tubing options include all of the following except: (Reference, pg. 12)

- A) Galvanized
- B) Aluminized coating
- C) Chrome
- D) Stainless steel

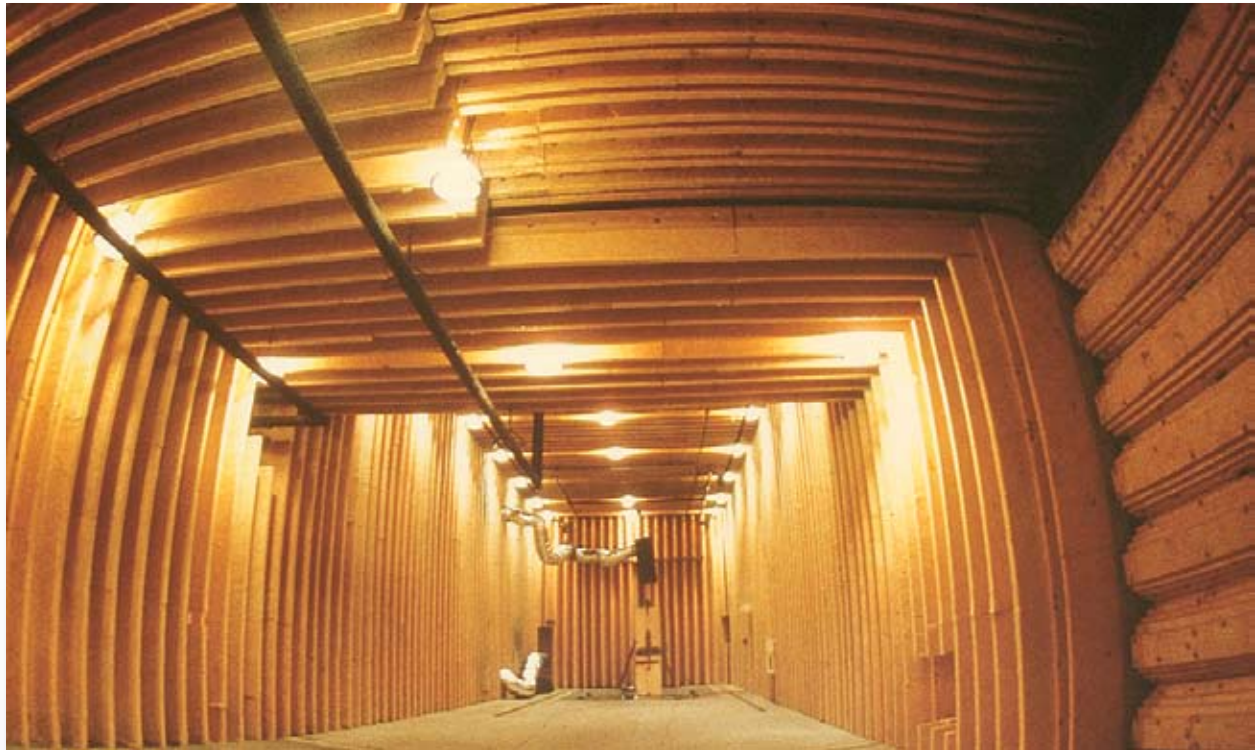
Cummins Filtration: The Industry Leader

Cummins Filtration offers the **broadest exhaust product coverage in the industry**—more than 1,800 exhaust and air intake parts—from monster stacks to V-band clamps to complete school bus systems. Exhaust system components are available for all makes, yet **competitively priced**.

Most importantly, Cummins Filtration guarantees performance and fit on all parts, as well as conformance to all sound ordinances on **OE approved** mufflers. Fleetguard mufflers are designed and engineered for maximum exhaust performance and tested extensively in Cummins Filtration's state of the art research facilities in Stoughton, Wisconsin.

Acoustic Testing

The Cummins Filtration Technical Center has a complete acoustical laboratory to test exhaust systems on a wide range of engines to optimize all aspects of product performance. The laboratory includes a sound analysis room, two semi-anechoic chambers, and multiple engine cells. Measurements of sound level, exhaust restriction, temperature, horsepower and fuel consumption can be performed simultaneously. Computers control all phases of testing, including engine operation, data acquisition and storage, report generation and frequency analysis.



Anechoic Chamber

Glossary Of Terms

Aluminized Steel

The top grade steel used during production of mufflers and exhaust system products is specially treated—or aluminized—to resist corrosion, even in high temperature conditions.

Back Pressure

Exhaust gases must be pushed through the exhaust system by the engine. The amount of force it takes to do this is called exhaust back pressure. Excessive back pressure causes poor engine performance, loss of horsepower, poor fuel economy and high engine operating temperatures.

Flat Band Clamp

A heavy duty exhaust system clamp, available either zinc or chrome plated in 3" (76.2 mm) to 6" (152.4 mm) pipe diameters.

Guillotine Clamp

A heavy duty exhaust system clamp that forms a solid seal on pipes of 2" (50.8 mm) to 6" (152.4 mm) diameters.

Horizontal Application

With the industry focus on aerodynamics, it has become more popular to use a horizontal configuration that puts the exhaust system underneath the tractor/trailer. In some cases, there simply may not be room between a tractor and the box in a straight truck to install a vertical exhaust system. A horizontal configuration is then the ideal solution.

Muffler

A key component of the exhaust system which reduces the noise made by the engine during combustion and exhaust. Attached to the exhaust pipe or elbow, the muffler provides a chamber where exhaust gases expand, cool and dissipate—which decreases the noise.

Strap Clamp

A heavy duty exhaust system clamp that minimizes exhaust system leaks and holes, protecting the driver in the cab from odorless, poisonous gases which can seep in from the system. This type of clamp reduces the need for welding the pipe and makes a tight seal without damaging the pipe diameter. It also works for butt and lap installations using either solid-to-solid tubing or flex-to-solid tubing.

Vertical Application

With a vertical application, the muffler is bolted to a mast structure off the frame rail (or to the back of the cab). Some prefer this vertical stack system as a way to get any objectionable exhaust odor up away from ground level. However, there is no regulation or technical requirement for one configuration over the other; this choice is simply a matter of personal preference.

Final Review Exercise

This Final Review Exercise is a good way to review and practice using the information found in this manual. By completing all of the multiple choice questions, you will discover which areas you understand best and which topics need a little more attention. Once you feel confident with your answers, you'll be ready to discuss Fleetguard mufflers and exhaust system components. You can check your answers against the Answer Key on page 5.

1. One of the most important "rules" to remember when specifying replacement parts is this: Always replace components with like components. Why is this so important? (Reference, pg. 4)

- A) It is a mandatory ruling of the Federal Noise Control Act of 1972.
- B) There is little difference between mufflers.
- C) OEM specified mufflers are the only legal application in certain states.
- D) Mufflers could have the same exterior size but have very different interior construction and performance.

2. You may prefer a vertical exhaust system as a way to get any objectionable exhaust odor up away from ground level. With this type of vertical application, the muffler must be bolted to: (Reference, pg. 8)

- A) A mast structure off the frame rail or to the back of the cab.
- B) Only to the back of the cab.
- C) Only to a mast structure.
- D) A Wye connector.

3. The first nationwide regulation on truck noise required total truck noise levels to be less than 86 dBA measured at 50 feet (15.24 m) for speeds less than 35 mph (56.33 km/h). This regulation, modified in 1978 and lowered to the current 80 dBA noise level in 1988 was the: (Reference, pg. 1)

- A) Federal Noise Control Act of 1972
- B) Diesel Noise Regulation of 1972
- C) Truck Noise Level Control Act of 1970
- D) Federal Noise Emissions Act of 1970

4. There are some very stringent local regulations for school bus exhaust systems, and you may be faced with all of the following requirements except: (Reference, pg. 8)

- A) Horizontal application
- B) A totally leak free system
- C) Vertical application
- D) Rear exit

5. The _____ clamp reduces the need for welding the pipe and makes a tight seal without damaging the pipe diameter. This clamp would be used to minimize exhaust system leaks and holes, and to protect the driver in the cab from odorless, poisonous gases which can seep in from the system. It is the: (Reference, pg. 11)

- A) Guillotine clamp
- B) Strap clamp
- C) V-band clamp
- D) Flat band clamp

6. The average exhaust system temperature of gas and diesel applications range from 800° F (427° C) to 1,400° F (760° C). Fleetguard aluminized steel not only resists oxidation much longer than unprotected mild steel, it holds its strength characteristics up to: (Reference, pg. 7)

- A) 800° F (427° C)
- B) 1,000° F (538° C)
- C) 1,300° F (704° C)
- D) 1,400° F (760° C)

7. Flex tubing is typically sold in extended lengths throughout the marketplace, so it's important to get accurate and consistent measurements. The extended length is generally how many times the compressed length? (Reference, pg. 12)

- A) 1.5
- B) 1.2
- C) 3
- D) 2

8. Exhaust gases must be pushed through the exhaust system by the engine. The amount of force it takes to do this is called _____. Too much causes poor engine performance, loss of horsepower, poor fuel economy and high engine operating temperatures. (Reference, pg. 4)

- A) Exhaust pressure
- B) Back pressure
- C) Resonation
- D) Wye force

9. Fleetguard provides three different flexible tubing options — in a range of quality and pricing — to meet every need and application. These flexible tubing options include all of the following except: (Reference, pg. 12)

- A) Galvanized
- B) Aluminized coating
- C) Stainless steel
- D) Chrome

10. There are numerous design features that make Fleetguard mufflers top rate. Perhaps the most important is the floating baffle design, patented by Cummins Filtration, that relies on a series of small partitions (or baffles) to impede sound waves with maximum noise reduction with minimum back pressure. All of the following are also key advantages of Fleetguard mufflers except: (Reference, pg. 6)

- A) Exclusive back pressure valve
- B) 500,000 mile (804,672 km) warranty
- C) OE approved
- D) Aluminized steel construction

REAL™ Protection.

REAL Warranty Coverage That Goes Beyond The Competition

Providing customers the best warranty coverage in the industry is Cummins Filtration's ongoing promise that we want to be your supplier for life. As the only filtration manufacturer with a non-prorated warranty, Cummins Filtration guarantees to always be there after the sale.


For detailed information on the **Cummins Filtration Warranty**, refer to the Cummins Filtration warranty brochure and statement, available online at cumminsfiltration.com.



For more information about our exhaust products, see our Exhaust Product Guide (LT32002) available on cumminsfiltration.com.



For more information, visit cumminsfiltration.com

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