

# Parts Professional 65

Diesel Particulate Filter



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**PARTS PROFESSIONAL**

Diesel Particulate Filter

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## INTRODUCTION

**Cummins Emission Solutions (CES)** is a wholly owned business unit of Cummins Inc. and a global leader in designing, manufacturing and integrating exhaust aftertreatment technology and solutions for the commercial on and off-highway light-duty, medium-duty, heavy-duty, and high-horsepower engine markets. Dedicated to innovation and dependability in meeting global emissions regulations, CES develops and produces various emissions solutions. These solutions utilize innovative technologies to meet all emissions standards worldwide and make Cummins engines the most reliable around the globe.



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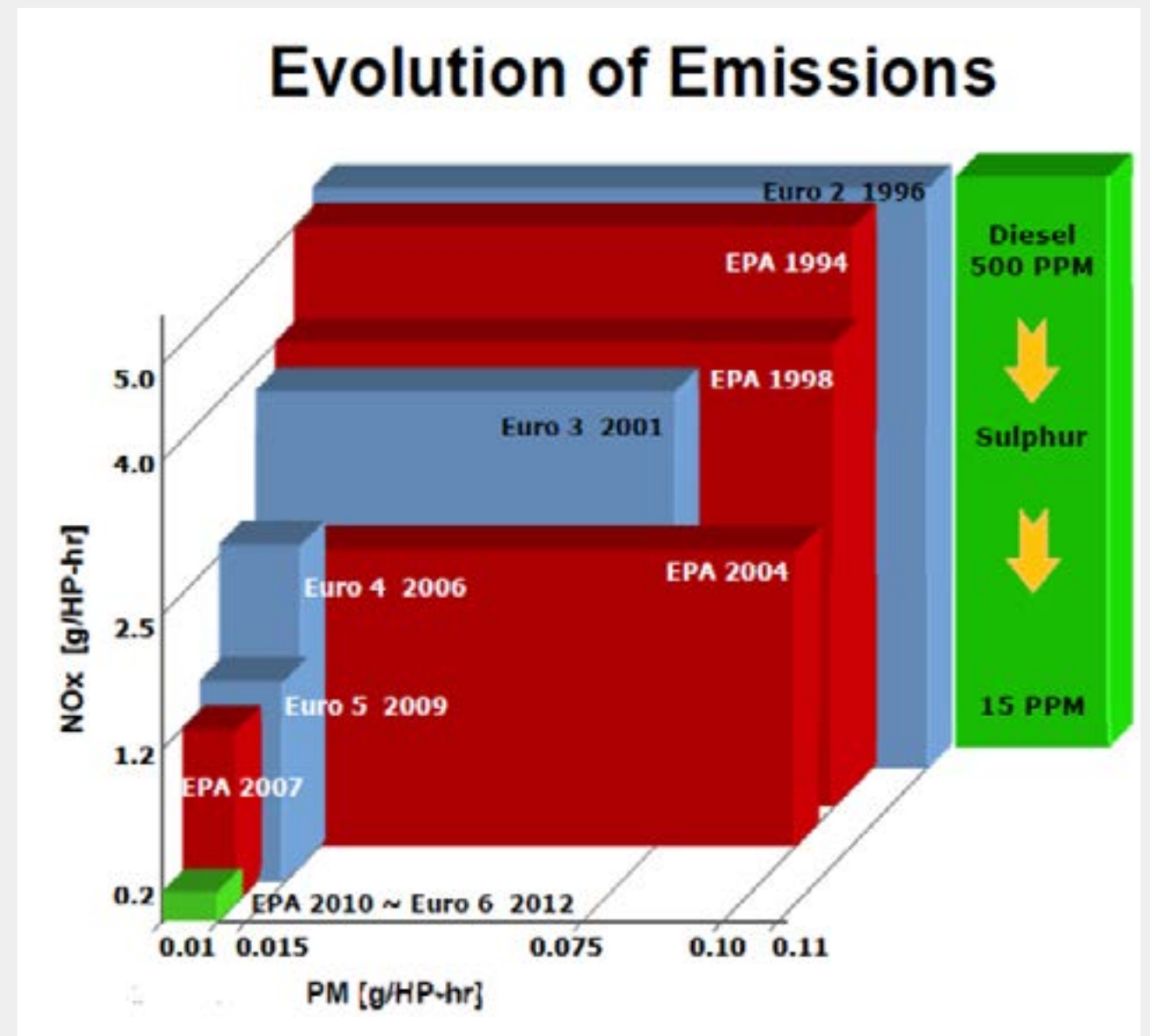
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## AFTERTREATMENT TECHNOLOGY

CES produces the aftertreatment technology which enables Cummins engines to reduce emissions and meet government standards.

The entire system, both engine and aftertreatment system, work seamlessly together as an integrated solution to yield the best overall engine performance. With continually evolving emissions regulations in the U.S., as well as the rest of the world, Cummins has continued to develop innovative technologies to meet them.





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## CES PRODUCT TIMELINE

To meet evolving global emissions standards over the years, CES has continued to create innovative solutions. This brief product timeline offers an overview of some of the solutions CES offers to meet those standards.



**Business Founded  
Retrofit Products  
Introduced**

2002



**Euro IV Selective  
Catalytic Reduction  
System Launch**

2006



**EPA 2007 Diesel  
Particulate Filter  
System Launch**

2007



**Euro V Selective  
Catalytic Reduction  
System Launch**

2008



**EPA 2010 Launch  
Euro IV/NS IV Product  
Introduced in China**

2010



**Tier 4 Product Launch  
EcoFit Urea Dosing  
System (UA2) Launched**

2011



**Euro V Launch Brazil  
EcoFit Urea Dosing  
System (UL2) Launched**

2012



**Euro VI and  
EPA 2013 Launch**

2013

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## EMISSIONS REGULATIONS

Different regions of the world have adopted new emissions standards at different times. As these standards have evolved, CES has continuously improved the technology to provide the right aftertreatment components needed to meet them. See the chart below to see what engines possess what aftertreatment components for EPA, EURO and Tier 4 standards.

Emissions Regulations	Aftertreatment		
	DOC	DPF	SCR
Euro IV			●
Euro V			●
EPA 2007	●	●	
EPA 2010	●	●	●
Tier 4 Interim / Stage III B	●	●	
EPA 2013	●	●	●
Tier 4 Final (QSM12 and QSX15)	●	●	●
Euro VI (a likely architecture)	●	●	●

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## WHAT IS THE CUMMINS AFTERTREATMENT SYSTEM COMPRISED OF?

The three key components that make up the Cummins Aftertreatment System are the **Cummins Particulate Filter**, the **Decomposition Reactor**, and the **Selective Catalytic Reduction (SCR) Catalyst**. *To learn more about these components, click on each section below.*

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## WHAT IS THE CUMMINS AFTERTREATMENT SYSTEM COMPRISED OF?

The three key components that make up the Cummins Aftertreatment System are the

**Cummins Particulate Filter**

**Catalytic Reduction (SCR)**

*each section below.*

The **Decomposition Reactor** connects the DPF and SCR catalyst, and includes the Diesel Exhaust Fluid (DEF) dosing valve. On all EPA 2007, 2010, and 2013, EURO VI and Tier 4 Engines.



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## WHAT IS THE CUMMINS AFTERTREATMENT SYSTEM COMPRISED OF?

The three key components that make up the Cummins Aftertreatment System are the **Cummins Particulate Filter**, the **Decomposition Reactor**, and the **Selective Catalytic Reduction (SCR)**. *each section below.*

The **SCR** system reduces NOx levels by converting the DEF/exhaust mixture to nitrogen and water. On all Euro IV, Euro V, Euro VI and EPA 2010 and 2013 Engines.

X



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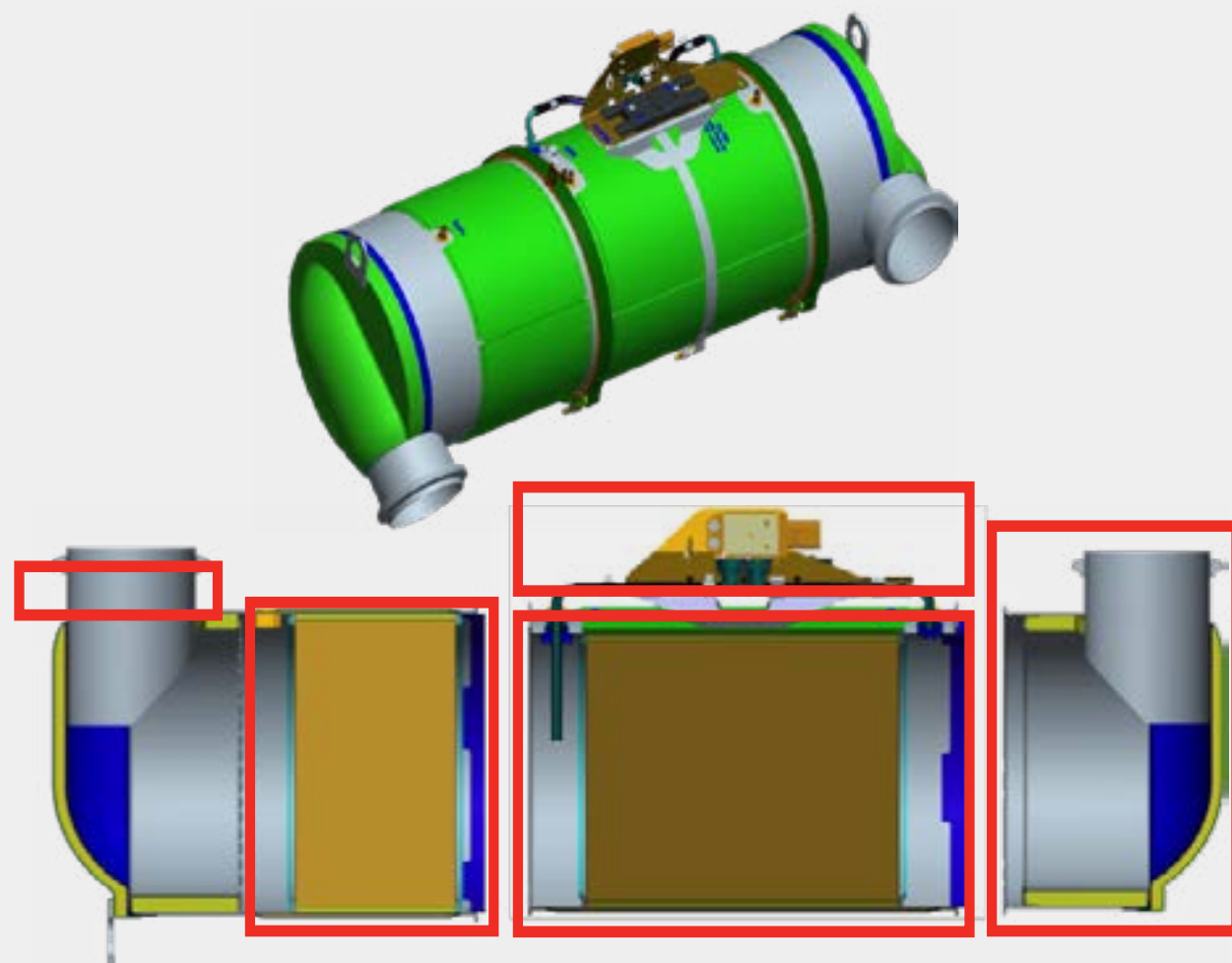
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## A CLOSER LOOK AT THE DPF

Starting in 2007, Cummins began placing the Cummins Particulate Filter System on all on-highway engines in the U.S. The Cummins Particulate Filter is made up of four primary elements. *Click on each section below to reveal each element.*



- **Inlet/Oxidation Catalyst (DOC):**  
Provides heat for regeneration and helps reduce emissions
- **Diesel Particulate Filter (DPF):**  
Collects and oxidizes carbon to remove particulate matter (PM) from the exhaust
- **Outlet:** Exhaust flow exit point
- **Sensor Table and Sensors:** Connects information to the Electronic Control Module

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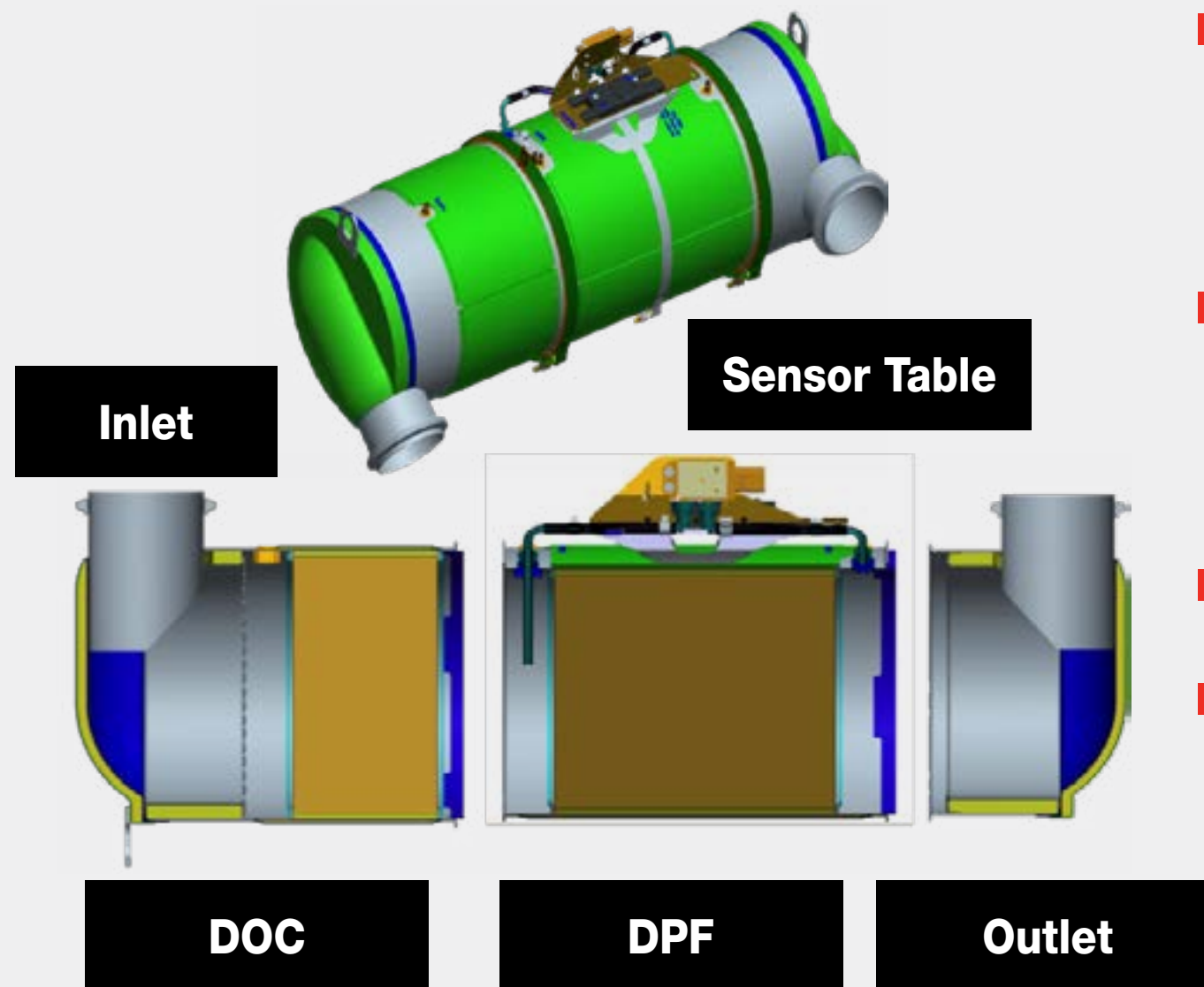
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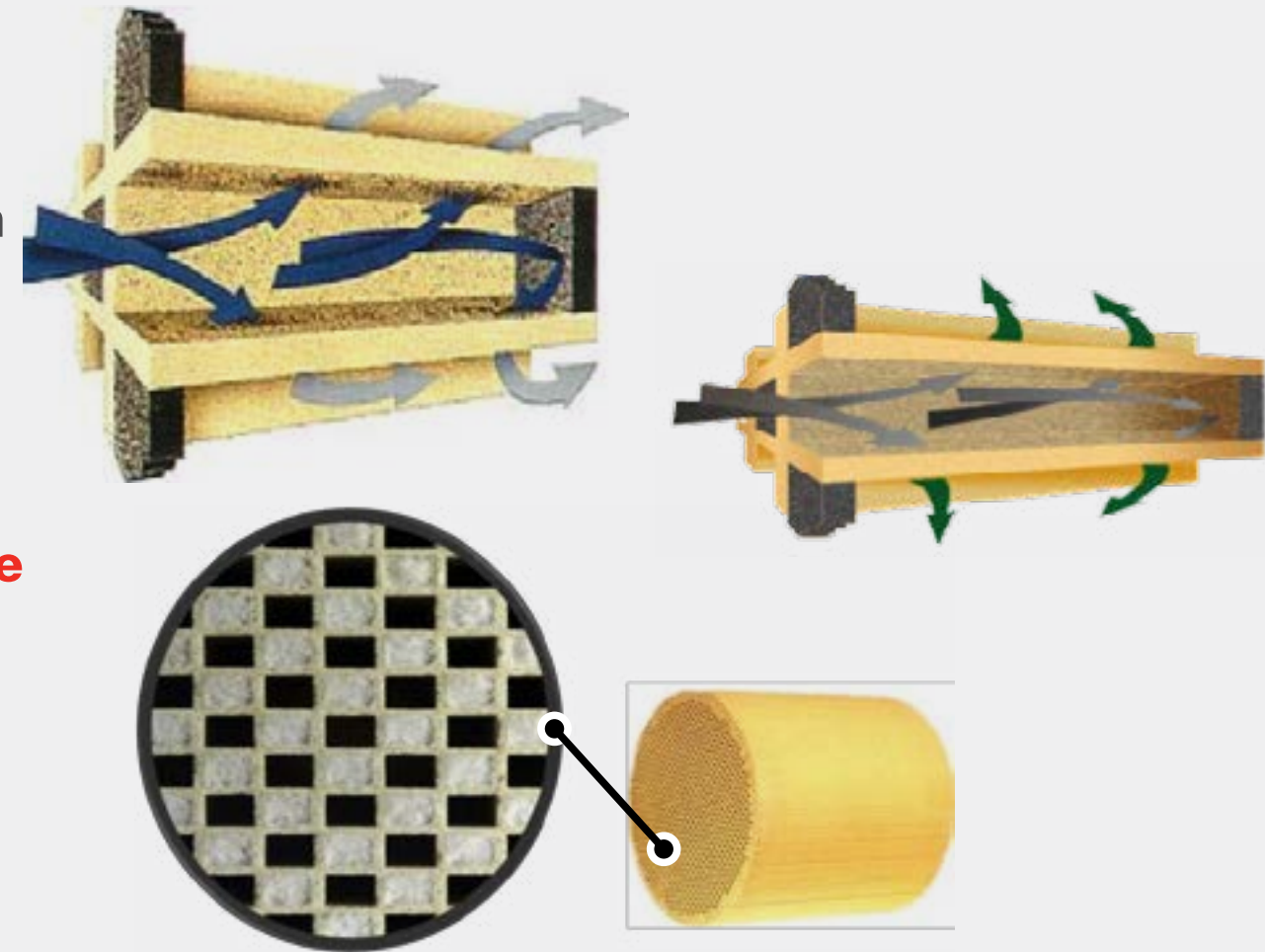
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## DPF: HOW IT WORKS

*The DPF is the portion of the Cummins Aftertreatment System that works to filter out soot, ash and particulate matter (PM) that comes out of the engine. To do this it utilizes a very durable filter called a Wall Flow Filter.*

- What does “wall flow” filter mean?
  - The DPF uses this type of technology to close every other channel, forcing exhaust gas through the walls of the filter to trap particles/ash.
- It contains an insulated, optimally sized engineered ceramic **substrate**
  - Typically made of **cordierite** or **silicon carbide**
  - Material and construction of substrate are carefully selected to meet system durability and **backpressure requirements**
- The ceramic material is coated with precious metals to aid in catalytic function





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## DPF: HOW IT WORKS

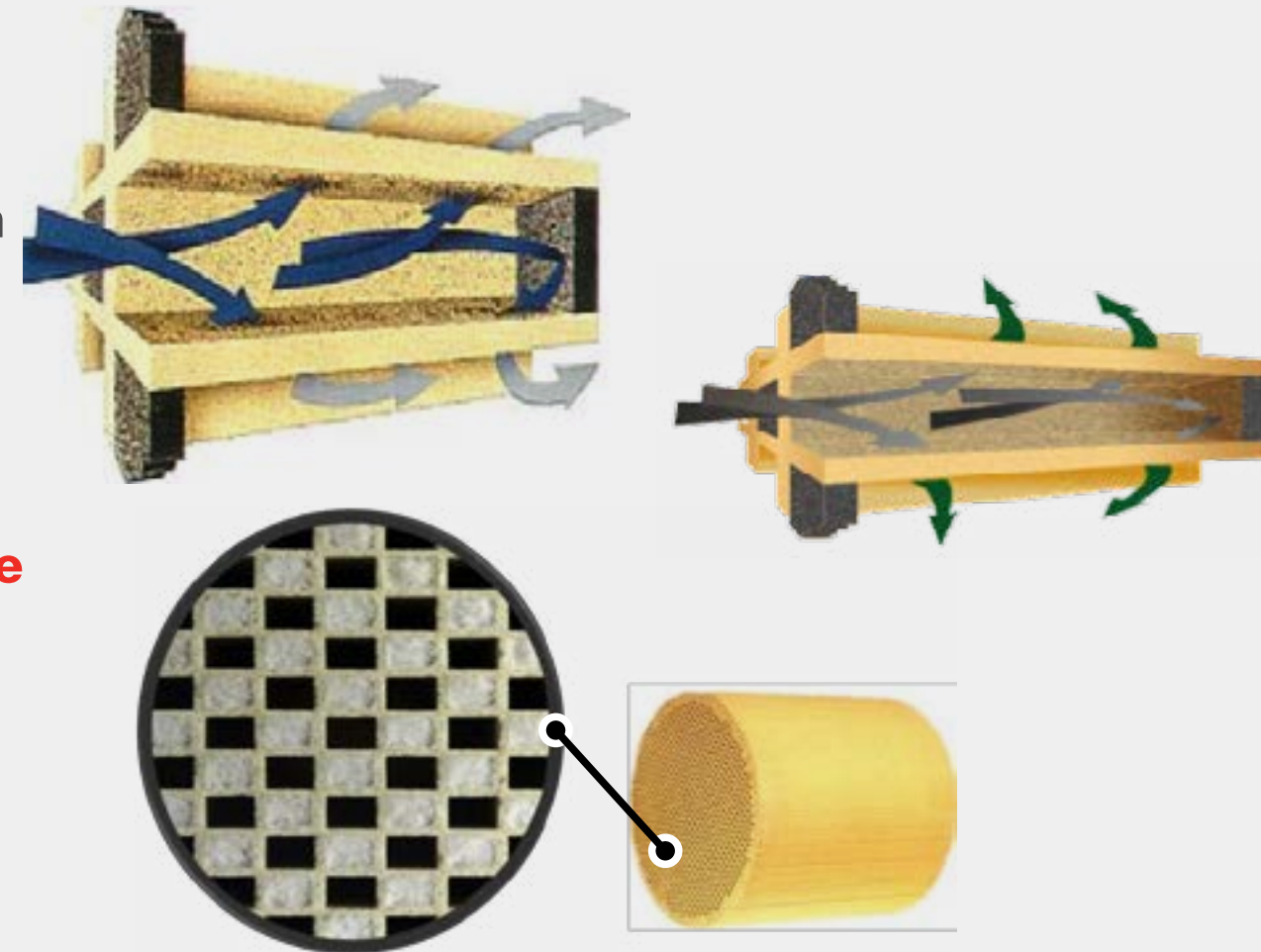
### SUBSTRATE

The ceramic brick within the DPF; typically honeycomb or spirally wound and is porous allowing air to flow through.

The DPF is the part of the aftertreatment system that filters out soot, ash and particulates. It is a very durable filter capable of withstanding high temperatures.

to filter out soot, ash and particulates. This it utilizes a ceramic substrate.

- What does “wall flow” filter mean?
  - The DPF uses this type of technology to close every other channel, forcing exhaust gas through the walls of the filter to trap particles/ash.
- It contains an insulated, optimally sized engineered ceramic **substrate**
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## DPF: HOW IT WORKS

The DPF is the portion of the Cummins Aftertreatment System that works to filter out soot, ash and particulate matter (PM) that comes out of the engine. To do this it utilizes a very durable filter called a Wall Flow Filter.

### ■ What does “wall flow” filter mean?

- The DPF uses this type of filter where air flows through every other channel and the walls of the filter.

### ■ It contains an insulated ceramic **substrate**

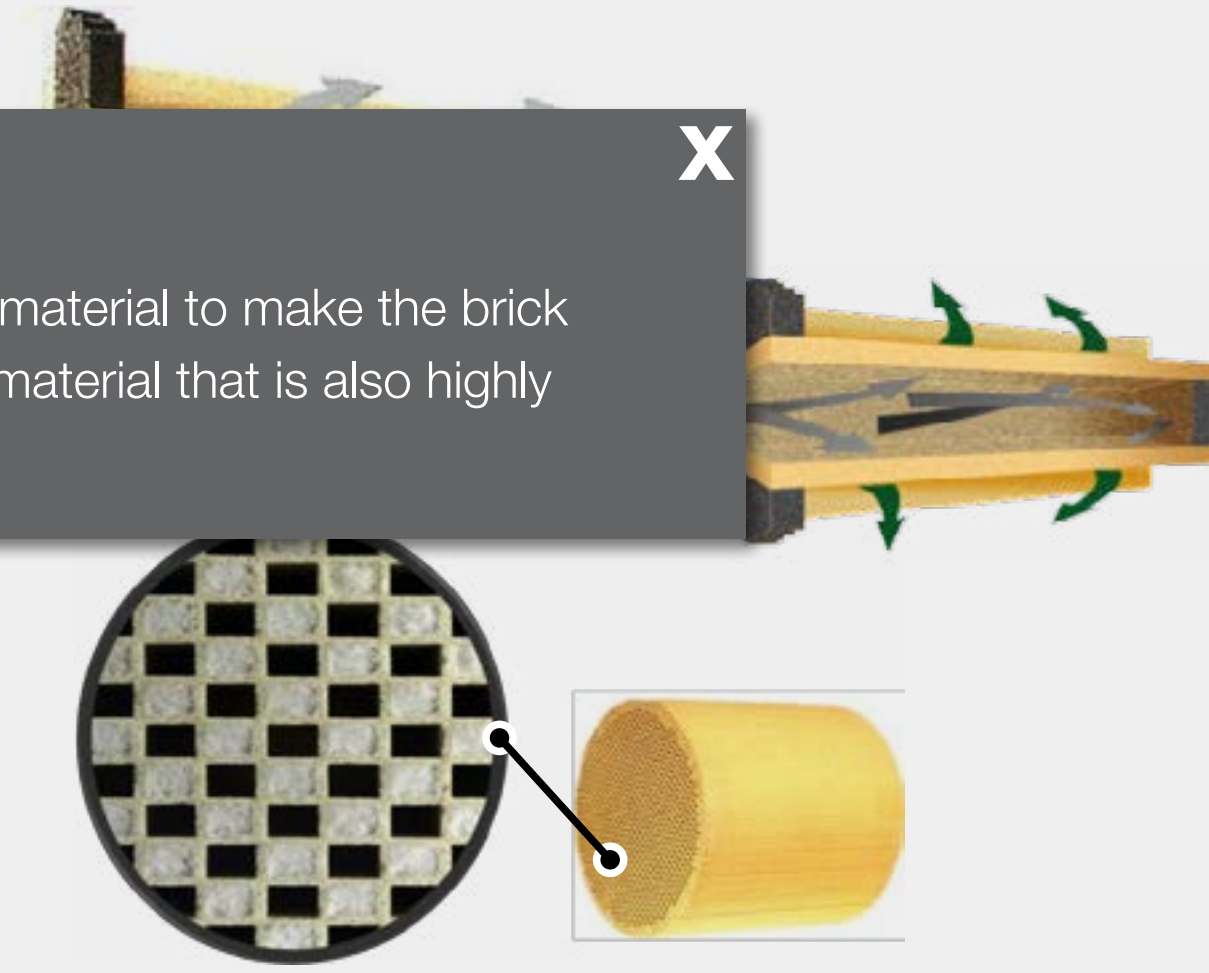
- Typically made of **cordierite** or **silicon carbide**
- Material and construction of substrate are carefully selected to meet system durability and **backpressure requirements**

### ■ The ceramic material is coated with precious metals to aid in catalytic function

Click on Terms in red above

**CORDIERITE**

Most commonly used ceramic material to make the brick in the DPF. It is a cost efficient material that is also highly compatible with the catalyst.





## DPF: HOW IT WORKS

The DPF is the portion of the Cummins Aftertreatment System that works to filter out soot, ash and particulate matter (PM) that comes out of the engine. To do this it utilizes a very durable filter called a Wall Flow Filter.

### ■ What does “wall flow” filter mean?

- The DPF uses this type of technology where exhaust flows through every other channel, forcing exhaust to pass through the walls of the filter to trap particulate matter.

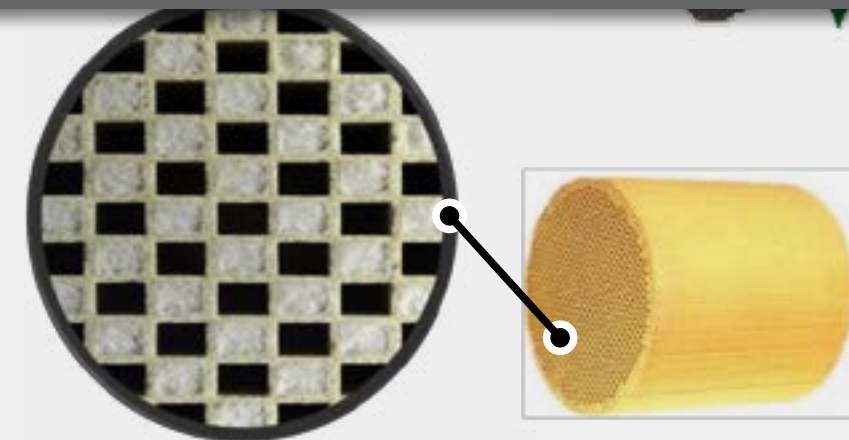
### ■ It contains an insulated, optimally sized ceramic **substrate**

- Typically made of **cordierite** or **silicon carbide**
- Material and construction of substrate are carefully selected to meet system durability and **backpressure requirements**

### ■ The ceramic material is coated with precious metals to aid in catalytic function

### SILICON CARBIDE

Another commonly used ceramic material to produce the DPF. It has a higher heat capacity than cordierite.

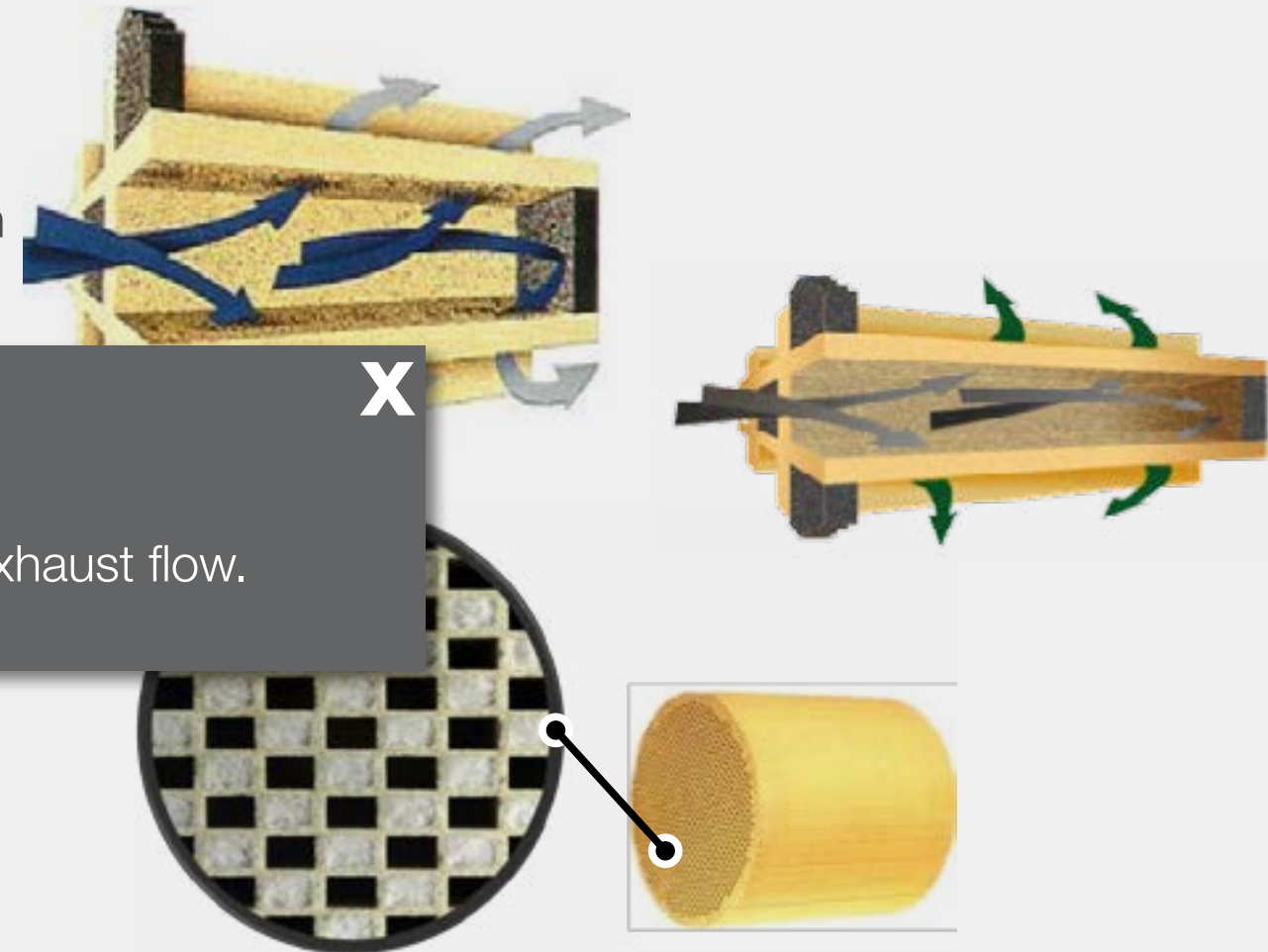


## DPF: HOW IT WORKS

The DPF is the portion of the Cummins Aftertreatment System that works to filter out soot, ash and particulate matter (PM) that comes out of the engine. To do this it utilizes a very durable filter called a Wall Flow Filter.

### ■ What does “wall flow” filter mean?

- The DPF uses this type of technology to close every other channel, forcing exhaust gas through the walls of the filter to trap particles/ash.



### ■ It consists of ceramic

#### BACKPRESSURE REQUIREMENTS

- Requirements to combat pressure from the exhaust flow.
- Material and construction of substrate are carefully selected to meet system durability and **backpressure requirements**

### ■ The ceramic material is coated with precious metals to aid in catalytic function

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## DPF SOOT CAPTURING PROCESS

*Now that you have an understanding of what makes up the DPF, we will now look at what takes place inside of it. There are three basic steps to the process.*

*Click on the steps below to learn more about the DPF soot capturing process:*

**STEP 1**

**STEP 2**

**STEP 3**

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## DPF SOOT CAPTURING PROCESS

### STEP 1

Porous ceramic walls capture soot, PM and ash from the exhaust as the exhaust flows through the filter.

**X** After we've wrapped up the DPF, we will now look at

the next steps to the process.

*DPF soot capturing process:*

**STEP 1**

**STEP 2**

**STEP 3**

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## DPF SOOT CAPTURING PROCESS

Now the

what to

Click on

### STEP 2

Soot is removed by periodic regeneration (active/passive).

- If soot accumulation > soot oxidation, plugging of the filter may occur.
- If left unchecked it could result in uncontrolled regeneration.



at



STEP 1

STEP 2

STEP 3



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## DPF SOOT CAPTURING PROCESS

*Now that you have an understanding of what makes up the DPF, we will now look at what takes place inside of it. There are three steps to the soot capturing process.*

*Click on the steps below to learn more.*

### STEP 3

Ash accumulates and the filter requires removal and cleaning at periodic intervals.



**STEP 1**

**STEP 2**

**STEP 3**

## FILTER REGENERATION

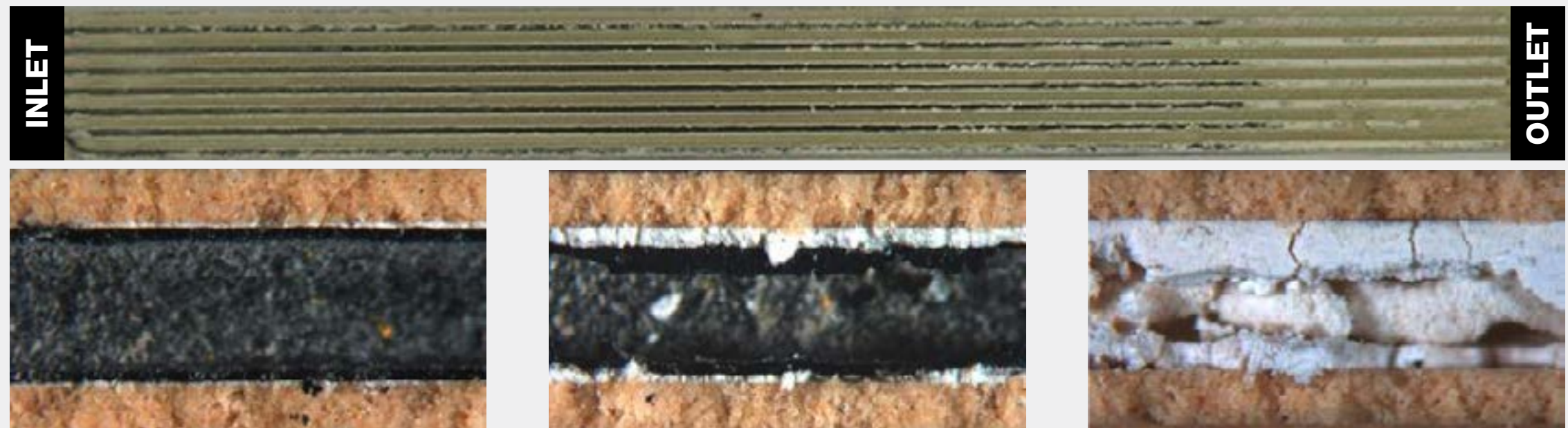
### WHAT IS REGENERATION?

Regeneration is the process where the filter is heated (like a self-cleaning oven), oxidizing the soot, and leaving only a small amount of ash. Over time and miles, ash builds up inside the filter, and will eventually inhibit the performance of the aftertreatment system.

### WHAT IS ASH?

Ash is incombustible material that can only be removed by cleaning.

*Click on each step to see the effects of regeneration on a filter.*



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## THE CYCLE

*Particulate Matter* ➡ *Regeneration* ➡ *Ash*

*The cycle of the soot being collected and oxidized, regeneration taking place, and ash collecting in the filter, repeats itself within the DPF until eventually it is so full of ash that the DPF will need to be cleaned or replaced.*

*When this happens you have a couple of options.....*

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## MAINTENANCE OPTIONS

*Now that you know what the DPF is and how it functions to meet emissions standards and improve fuel efficiency, you now must know how to take care of it.*

(Click on the tabs below to see what your options are in each circumstance.)



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## REPLACING THE DPF

If the DPF is cracked or melted it can not be cleaned and must be replaced. In this instance a new or ReCon DPF can be purchased. Cummins engines were built with components that work together seamlessly. The DPF is a part of this system and the Cummins Aftertreatment System as a whole should be equipped with Genuine Cummins Parts.

- Exchange Option: Owners of the EPA 2010 ISX12 and ISX15 should participate in the DPF Exchange Program. For future references, exchange opportunities are constantly being improved to benefit Cummins Engine Owners. To learn more about the current exchange program go to this link [https://quickserve.cummins.com/ppc/users/ppc\\_customer\\_view.html?ppc\\_number=4638](https://quickserve.cummins.com/ppc/users/ppc_customer_view.html?ppc_number=4638)
- Alternative Option: If an engine was manufactured prior to 2010, owners can purchase a Genuine DPF from a Cummins Distributor or Authorized Dealer.

**Melted DPF Core**



**Cracked DPF Core**



**New DPF**



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## CLEANING THE DPF

Over time ash builds up and the DPF needs to be cleaned. A filter cleaning is recommended every 200,000 miles. If the filter is not cleaned it can inhibit the performance of the engine.

- The DPF can be cleaned by a machine at a Cummins Distributor or Authorized Dealer. Exchange options should be discussed as well since some DPFs should be exchanged and not cleaned locally (EPA 2010 ISX).
- The DPF can be cleaned multiple times, however, there are times when internal breaks or damage are discovered during cleaning. In these cases, the DPF will need to be replaced.



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## WHY BUY GENUINE CUMMINS AFTERTREATMENT PARTS?

As global emissions standards continue to change and become more stringent, CES utilizes the technology to provide the right solutions for customers.

Below are some of the benefits that these solutions provide.

### ■ FLEXIBILITY

- CES provides full system integration of designs which includes the benefits of products being built to specifications, testing support and catalyst sizing optimization.

### ■ TIME AND MONEY SAVINGS

- The solutions balance key product characteristics, including performance, fuel economy, reliability, packaging sizes and precious metal loadings.

### ■ GLOBAL REACH

- CES has 11 manufacturing facilities and seven Engineering Centers across five continents.

### ■ RESOURCEFUL

- There is a holistic understanding of function in each element as well as the ability to leverage expertise in a broad range of applications.

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## WRAP-UP SUMMARY

- Cummins Emission Solutions has established itself as a global leader in developing technology to meet the most stringent emissions standards around the world.
- The Cummins Aftertreatment System is produced by CES and enables Cummins engines to reduce emissions and meet emissions standards.
- The Cummins Particulate Filter is comprised of four key elements: Inlet/Oxidation Catalyst (DOC), Diesel Particulate Filter (DPF), Outlet, Sensor Table and Sensors.
- The Diesel Particulate Filter, a key component of the Cummins Aftertreatment System, is responsible for capturing soot and ash.

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## WRAP-UP SUMMARY

- The DPF uses a wall flow filter made of ceramic material to close every other channel, forcing exhaust gas through the walls of the filter to trap particles/ash.
- If the DPF is cracked or melted it should be replaced with a new or ReCon DPF. It can be exchanged for credit whether damaged or not.
- The DPF should be cleaned as ash accumulates. This cleaning can take place at a Cummins Distributor or Authorized Dealer location.

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# CONGRATULATIONS!

You have completed **Parts Pro 65.**

**Now let's test your knowledge with a quiz.**





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## QUIZ

Cummins Emission Solutions (CES) produces the aftertreatment system in order to help:

- (a)** Meet EPA regulations
- (b)** Reduce emissions
- (c)** Optimize engine performance
- (d)** All of the above

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## QUIZ

The DPF captures which of the following:

- (a)** Particulate matter
- (b)** Soot particles
- (c)** Ash Particles
- (d)** All of the above

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## QUIZ

The Diesel Particulate Filter (DPF) collects and oxidizes carbon to remove particulate matter (PM) by more than \_\_\_\_%.

**(a)** 50

**(b)** 90

**(c)** 85

**(d)** 75

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## QUIZ

The \_\_\_\_\_ connects the DPF and SCR catalyst, and includes the Diesel Exhaust Fluid (DEF) dosing valve.

- (a)** Particulate Filter
- (b)** Diesel Oxidation Catalyst
- (c)** Decomposition Reactor
- (d)** Sensor Table



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## QUIZ

Cummins began placing DPF's on all engines in the U.S. starting in:

**(a)** 2007

**(b)** 2002

**(c)** 2010

**(d)** 1995



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## QUIZ

The DPF has a \_\_\_\_\_ filter that closes every other channel, and forces exhaust gas through walls of the filter to trap particles/ash.

- (a)** Oxidation Catalyst
- (b)** Wall Flow
- (c)** Dosing Valve
- (d)** Sensor Table



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## QUIZ

Soot is removed from the filter through

\_\_\_\_\_.

**(a)** Condensation

**(b)** Regeneration

**(c)** Reduction

**(d)** Advancement

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## QUIZ

Ash is\_\_\_\_\_.

- (a)** Left in the filter permanently
- (b)** Used by the engine
- (c)** Incombustible material that can only be removed by cleaning
- (d)** Not harmful to the DPF



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## QUIZ

When the DPF is completely full of ash it should be \_\_\_\_\_?

- (a)** Cleaned or replaced
- (b)** Destroyed
- (c)** Nothing
- (d)** Both (b) and (c)

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## QUIZ

Cleaning of the DPF can be done where?

- (a)** Authorized Dealerships
- (b)** Cummins Distributor
- (c)** Nowhere
- (d)** Both (a) and (b)



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