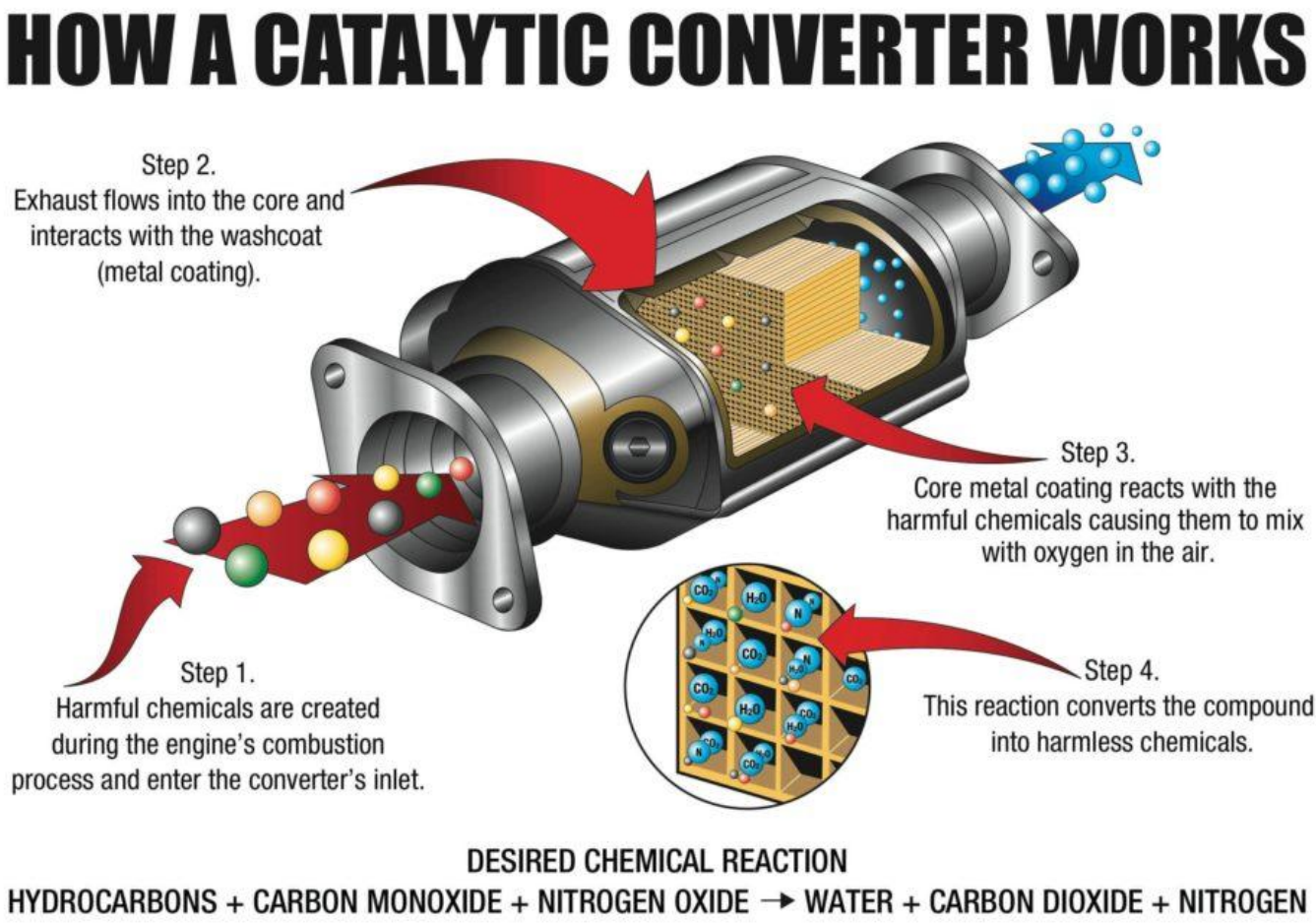
What is a Catalytic Converter: Types & Its Working

3-way catalytic converter is a sophisticated device used in the exhaust system of many modern petrol engine vehicles. It converts harmful gases in the engine exhaust to relatively harmless gases.

Why should we use three-way catalytic converters?

The exhaust gases from an engine contain harmful substances such as oxides of nitrogen (NOx), carbon monoxide (CO) and Hydrocarbons (HC). These substances produce extreme environment hazards. 3-way catalytic converters convert these harmful substances to less harmful nitrogen (N2), carbon-di-oxide (CO2) and water (H2O).



What happens inside the converter?

Inside the converter, the gases flow through a dense honeycomb structure made from a ceramic and coated with the catalysts. The honeycomb structure means the

gases touch a bigger area of catalyst at once, so they are converted more quickly and efficiently.

Typically, there are two different catalysts in a catalytic converter:

- One of them tackles nitrogen oxide pollution using a chemical process called **reduction** (removing oxygen). This breaks up nitrogen oxides into nitrogen and oxygen gases (which are harmless, because they already exist in the air around us).
- The other catalyst works by an opposite chemical process called **oxidation** (adding oxygen) and turns carbon monoxide into carbon dioxide. Another oxidation reaction turns unburned hydrocarbons in the exhaust into carbon dioxide and water.

In effect, three different chemical reactions are going on at the same time. That's why we talk about **three-way catalytic converters**. (Some, less-effective converters carry out only the second two (oxidation) reactions, so they're called **two-way catalytic converters**.) After the catalyst has done its job, what emerges from the exhaust is mostly nitrogen, oxygen, carbon dioxide, and water (in the form of steam).

Working:

A three-way catalytic converter makes use of two catalysts to convert harmful gases to harmless gases. They are:

1. Reduction Catalyst and
2. Oxidation Catalyst

The reduction catalyst is made of platinum and rhodium while the oxidation catalyst is made of platinum and palladium. Both the catalysts have a ceramic honeycomb structure.

Stage 1 – Reduction Catalyst:

The exhaust gases are first sent over the reduction catalyst (which is made of platinum and rhodium). It converts oxides of nitrogen (NOx) to nitrogen (N2) and oxygen (O2). The following reactions take place when the exhaust gases pass over the reduction catalyst.

$2NO \rightarrow N_2 + O_2$

$2NO_2 \rightarrow N_2 + 2O_2$

The reduction catalyst simply rips off nitrogen and oxygen from the oxides of nitrogen. As you might know, nitrogen and oxygen are harmless gases while oxides of nitrogen are really harmful to the environment.

Stage 2 – Oxidation Catalyst:

Exhaust gases that are free of oxides of nitrogen (NOx) are then sent over the oxidation catalyst (made of platinum and palladium). The oxidation catalyst coverts carbon-monoxide (CO) and hydrocarbons (HC) in the gases into carbon-di-oxide (CO2) and water (H2O).

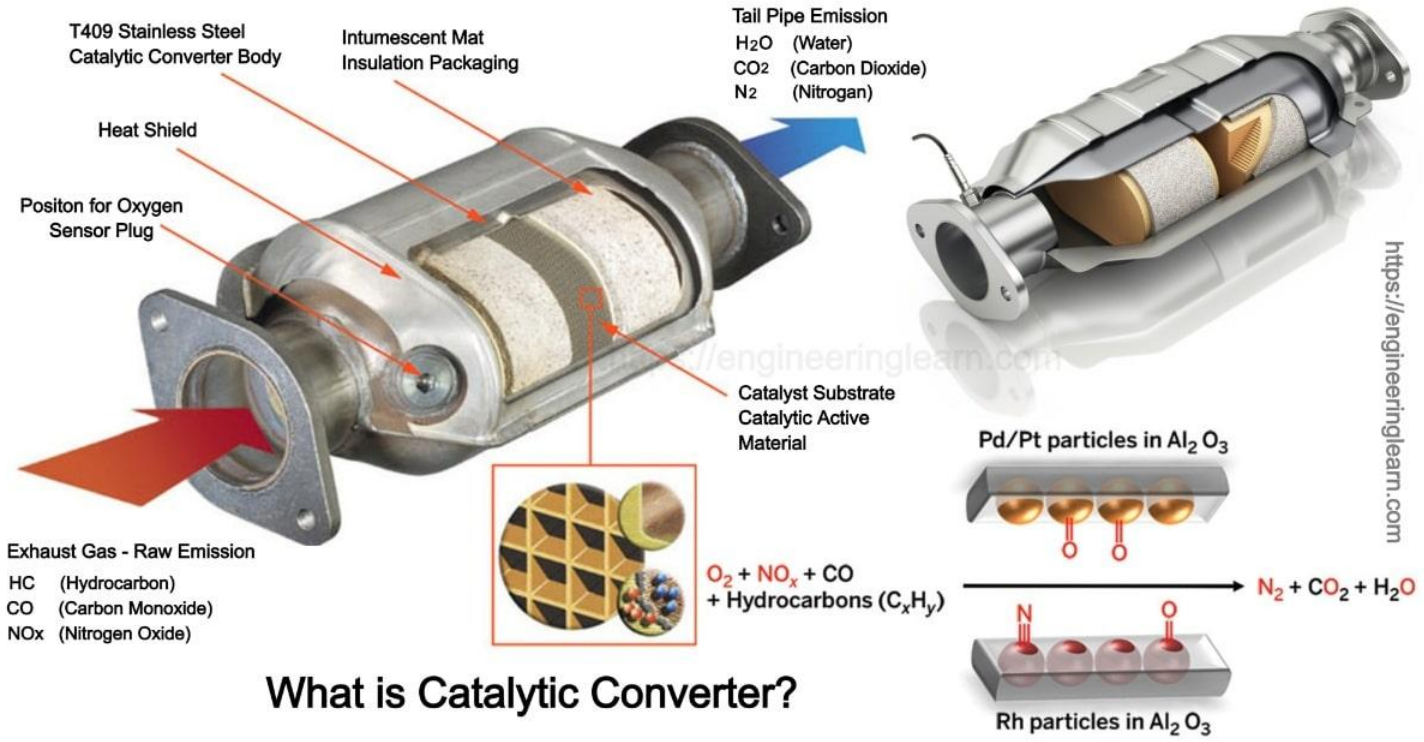
The following reactions takes place when the exhaust gases pass over the oxidation catalyst:

$2CO + O_2 \rightarrow 2CO_2$

$HC + O_2 \rightarrow CO_2 + H_2O$

Note: The second reaction (above) is a generalized reaction. In it, HC stands for hydrocarbon. HC might be methane, ethane or other hydrocarbon.

The gases that finally come out of the catalyst chamber are N2, CO2, and H2O. 3-way catalytic converters are so named because they are capable of eliminating three pollutants – NOx, CO and HC.



What does a Catalytic Converter Do?

These are mainly accountable for reducing harmful compounds to less like O2, CO2, Ni, & H2O water. This can be done through a chemical procedure that quickly reduces the compounds before they go away from the car.

These converters include catalysts that convert the harmful compounds. Generally, the normal method takes too much time. Catalysts within the converter will make the procedure very quicker & reduces different compounds in very little time. In modern cars, 3 stage converters are majorly used.

In catalytic converters, both the stages like the first and second mainly involve both reduction & oxidation catalysts. Generally, the reduction catalyst comes from platinum & radium whereas the oxidation comes from platinum & palladium. As you can observe, platinum is mainly used in different areas through catalytic converters which reduce harmful compounds.

The last phase comprises the engine with an oxygen sensor & it detects how much oxygen is within the exhaust system. Here, fuel injection mainly depends on this procedure when the engines increase/decrease then how much fuel is infused into the gas chambers.

For instance, if the oxygen is presently less and the converter needs more time, then low fuel will be infused until the levels of oxygen are superior. This balances the complete pollutants which are generated from the exhaust system. There is also a two-phase catalytic converter that performs differently. The primary phase is particularly decreased NiO2 whereas the secondary phase decreases CO & hydrocarbons.

Bad Catalytic Converter Symptoms

The signs of a **clogged catalytic converter** mainly include the following.

- Waning fuel efficiency
- Verify warning light
- Car Smells like rotten eggs
- Engine issues
- Less acceleration
- The emission test will be failed
- Engine Light will be ON
- A Rattling Noise within the Engine
- Getting fewer miles for each gallon
- Car Jerks ahead
- Fuel loss throughout acceleration
- The engine will be misfired

Changing a bad catalytic converter is the main repair in cars which is related to a check engine warning light. Generally, this converter replacement mainly takes hours and is also

expensive based on the cars. When catalytic converter damages then it causes on poor performance, fuel bill will be high & potential inside damage.

How to Clean a Catalytic Converter?

The catalytic converter can be cleaned in two ways like without cleaning it and cleaning it but the following things must be considered before cleaning this converter.

- The converter is packed full or not
- Need to check the slack parts
- Purify catalyst
- Consumption of oil

The required equipment to clean the catalytic converter are; hand gloves, goggles for eyes safety, tub, degreaser, oil, Jack stand, wrenches, pressure washer, oxygen sensor wrench, shop towels, etc.

Clean Catalytic Converter without Removing It

- This converter mainly functions as a cleaner to obtain all cleaned up. If you believe that it is an extended task for cleaning your converter without detaching it.
- At first, safety checks are very significant if you want to clean the converter without detaching it from the car & if you believe the whole thing is okay then you can attempt the following techniques.
- Make sure that the cleaner is best or not
- Stay until the converter tank includes the correct quantity of fuel
- The cleaner should add to the converter tank
- Ride your car
- Refill converter tank when almost empty

Clean Catalytic Converter by Removing It

These are used as a cleaner to get it all cleaned up. Provided the cleaner for this converter does not function correctly, then the other cleaning technique will command by removing & soaking it.

- Let the car get cool & jack It
- Place the converter
- Eliminate oxygen sensor
- Detach converter
- Clean the converter
- Soak it
- Wash it & dry
- Again reinstall it & go for a test drive

Catalytic Converter Theft

This converter is an extremely special type of filter used in the exhaust system of cars that decreases dangerous emissions. This kind of converter is bolted under the car & it's susceptible to thieves as it includes different expensive metals. So day by day, the converter robberies have been increasing & the devices are costly to put back. The following steps might assist you in protecting your vehicle from stealing a catalytic converter.

- Robbers mainly focusing on catalytic converters as they include valuable metals
- These devices are in danger as they are easy to steal.
- These are costly to put back.
- The following methods are used to defend against this converter theft
- Need to fetch the car's license plate number onto the converter.
- The car must be parked in lighting areas.
- Fix an anti-theft appliance.

Catalytic Converter Lock

These are mainly used in cars to stop dangerous emissions from exhaust systems through rotating pollutants into safe gasses. The theft rates of these devices are very high as they include expensive metals such as palladium, platinum, rhodium, etc.

So to take appropriate action on the converter theft, there are different catalytic converter locks are available from different manufacturers. This is one kind of security device used to give protection for the converter. The designing of this security device can be done by using stainless steel with marine grade to stop the robbery of catalytic components in vehicles.

Generally, catalytic converter lock is used in expensive vehicles like vans, pick-up trucks, the Toyota Prius. & Honda Jazz.

How to Choose a Catalytic Converter?

The catalytic converter device controls the emission which is connected to the exhaust system of a car. In many countries, a yearly inspection for emission is necessary to renovate the registration of your vehicle. If your car is failed annual inspection for emission, so there is a chance to replace the unit of the catalytic converter.

Selecting the correct catalytic converter can be hard for your vehicle. So to make it simple, the following points need to follow for the replacement of a catalytic converter for your car.

- Check the model, making year and model
- Recognize the level of emission for your vehicle
- Recognize the exact converter grade
- Choose the configuration for the installation
- Check the oxygen sensor

Advantages & Disadvantages

The **advantages of catalytic converter** mainly include the following. If we remove the catalytic converter then there are some benefits like the following.

- Catalytic converters reduce 87% of hydrocarbon emissions, 85% carbon monoxide & 62% nitrous oxide throughout the expected car life.
- The catalytic converter is an essential device in gas-fueled cars. If the car generates emissions, it requires this converter.
- It reduces harmful emissions from the cars
- Once a catalytic converter is removed, then the horsepower in some cars will be increased. As a result, we can produce more horsepower without it.
- This converter should work very hard to get similar energy. If we remove this, it will reduce the burden & you can attain better gas mileage.
- Exhaust sounds can be removed once it is removed.
- Engine performance can be enhanced

The **disadvantages of catalytic converte**r mainly include the following.

- In some countries like the USA, removing a catalytic converter is illegal without reason otherwise you have to follow some procedure to remove this. Otherwise, you will get some fines.
- The fault code may be activated within your vehicle by detaching a catalytic converter.
- Harmful gases can be leaked within the atmosphere, so they can affect your health.
- The catalytic converter reduces fuel consumption. If we remove this, you have to pay for the fuel.
- Detaching this converter may cause low-end torque loss while operating the car.
- Noise can be generated while driving
- Without a catalytic converter, you can utilize more gasoline
- Visual inspection can be failed for cars

Veerapandian.K
Assistant Professor/Mech
www.pandianprabu.weebly.com

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