Effective Catalytic Converter Replacement Programs for Gasoline-Powered Vehicles

A Key Element of a Successful Mobile Source Emission Control Program

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EXECUTIVE SUMMARY

A number of countries with established motor vehicle emission control programs where catalytic converters have been installed on gasoline-powered passenger cars and light-duty trucks are now considering the implementation of catalytic converter replacement programs for older vehicles that have damaged converters or for vehicles where the original converter was removed. An effective replacement catalytic converter program for gasoline-powered vehicles is an important element of a comprehensive motor vehicle emission control program. The Manufacturers of Emission Controls Association (MECA) has prepared this White Paper on converter replacement programs in response to a growing number of inquiries received from government officials and others around the world for information about effective converter replacement programs. The White Paper focuses on replacement converter programs regulating the sale of new, replacement converters.

Passenger Cars and Light Trucks Contribute to Serious Urban Air Pollution Problems

Pollution from gasoline-powered passenger cars and light-duty trucks (e.g., pick-up trucks and small delivery vans) is a major contributor to urban air quality problems throughout the world. These vehicles, if left uncontrolled, emit high quantities of hydrocarbons (HC) and oxides of nitrogen (NOx) that contribute to urban smog, as well as carbon monoxide (CO) which causes respiratory and heart problems. Controlling exhaust pollution from gasoline-powered vehicles is absolutely essential to improving air quality and protecting the public’s health.

Catalytic Converter Technology Has Helped to Dramatically Reduce Motor Vehicle Pollution

Catalytic converter technology has been successfully employed to significantly reduce the harmful exhaust pollutants from gasoline-powered vehicles around the world and, as a result, significant progress has been made in dramatically improving urban air quality in such places as the United States, Canada, Europe, and Japan. Over the past 25 years, catalytic converters have been installed on nearly 500 million vehicles around the world and today over 85 percent of the new passenger cars manufactured worldwide are equipped with catalytic converters. Worldwide, catalytic converter equipped vehicles have reduced motor vehicle pollution by over three billion tons.

The concept behind a catalytic converter is that it causes a chemical reaction to occur without the catalyst being changed or consumed. Therefore, with proper maintenance, use, and fueling, it will perform its function for the life of the vehicle. For example, in the United States, catalytic converters have continued to provide excellent control of pollutants on vehicles with well over 100,000 miles.

Catalytic converters can be designed to control hydrocarbons (HC) and carbon monoxide (CO) (oxidation catalytic converters) or to control HC and CO as well as oxides of nitrogen (NOx) (three-way catalytic converters). In addition to controlling HC, CO, and NOx emissions,
catalytic converters are extremely effective in reducing exhaust emissions that are considered toxic such as benzene, formaldehyde, acetaldehyde, and 1,3 butadiene.

**Why Replacement Converter Programs Are Needed**

As noted, catalytic converters can be designed to be very durable. However, catalytic converters can be damaged or destroyed if the vehicle is not properly fueled or maintained. For example, misfueling a catalytic converter-equipped vehicle with leaded gasoline will quickly destroy the pollution control capability of the converter. Similarly, poor vehicle maintenance can lead to excessive oil burning or engine misfires, both of which can adversely affect converter performance. Converters can also be physically damaged if a vehicle is in an accident. Finally, in some instances, vehicle owners have intentionally removed converters under the mistaken belief that such action will improve vehicle performance.

**Established Replacement Converter Programs**

About ten years after catalytic converters were first introduced in the United States, the first country to employ the use of converters, air quality officials determined that a replacement catalytic converter program was needed. The owners of vehicles with damaged or missing converters generally were unwilling to pay the high costs of purchasing a converter equivalent to the vehicle’s original converter (an “original equipment” or “OE” converter). Also, vehicle owners were often unable to locate OE converter replacements at the retail level. A market for replacement or “aftermarket” converters began to develop, but some of these aftermarket converters were inferior products, offering little or no pollution control capability.

The U.S. Environmental Protection Agency (EPA), working with the catalytic converter industry, developed a program that established specific emission control performance requirements, durability demonstrations, warranty requirements, and reporting requirements. The program went into effect in 1986. The program resulted in the manufacture and sale of high quality products that provided important emission reductions at a reasonable cost. Also, because the program allowed a specific replacement converter model to be used on multiple vehicles, replacement converters were readily available at the retail level and consumers were able to receive prompt service.

The State of California adopted its own program the same year using elements of the EPA program, except that the emission performance requirements for some converters were more rigorous and the approval process was different. In 1998, countries in the European Union implemented a converter replacement program and, in 1999, Mexico City introduced a program for replacement converters.

While the U.S., Europe and Mexico City are different, they all contain common elements that are necessary to have an effective program. The elements of these programs are discussed in more detail in the body of the report text.
Importance of an Effective Converter Replacement Program

The legitimate need for replacement converters eventually will occur in any country with catalytic converter-equipped vehicles for the reasons discussed above. Without an effective program, two unacceptable results will likely occur. First, many vehicles with damaged or missing converters will not be repaired and will continue to emit high levels of pollution. Second, inferior replacement converters, which will provide little or no pollution reduction benefit, will start to be sold in the marketplace. The consequences of these events will 1) hamper efforts of air quality officials and others to reduce auto pollution and 2) cause the general public to lose confidence in motor vehicle emission control programs and emission control technology. The experience in the United States, which has the longest running program, demonstrates that an effective program can be established and that significant emission reduction benefits can be achieved.

Elements of an Effective Program

Any country considering the implementation of a replacement converter program will need to consider the specific factors unique to its situation. These factors include air quality needs and which pollutants are of the most concern, the enforcement infrastructure, the age of vehicles and types of OE converters installed on those vehicles, the availability of unleaded gasoline for sale in the country, and many other considerations. However, MECA believes there are a number of common elements that should be present in an effective converter replacement program.

These key elements include:

- A government-administered application review and approval process
- Clearly defined performance-based emission reduction requirements demonstrated over an approved certification test procedure
- Clearly defined durability testing and performance requirements
- Requirement for permanently affixed labels on each converter sold
- Requirement for emission performance and mechanical integrity warranties
- Ability of government to conduct confirmatory testing
- Clearly defined installation requirements (i.e., situations when installation is authorized)
- Record-keeping requirements
- Field inspections by government officials
- Education programs for repair facilities and the vehicle owners
1.0 INTRODUCTION

A growing number of countries worldwide have implemented, or are in the process of implementing, programs to substantially reduce emissions from new passenger cars and light-duty trucks. To comply with the programs, catalytic converters have been installed on nearly 500 million vehicles worldwide. Today, over 85 percent of the new automobiles manufactured are equipped with catalytic converters and this remarkable technology has contributed to the reduction of over three billion tons of motor vehicle pollution worldwide.

Over time, the emission reduction effectiveness of a catalytic converter may be severely degraded or completely destroyed. Misfueling with leaded gasoline, lack of proper vehicle maintenance, or improper vehicle operation each can cause catalyst failures. In addition, converters can be structurally damaged in vehicle accidents or if the vehicle hits an obstruction such as a large rock or debris on the road. Countries with established motor vehicle emission control programs where catalytic converters have been utilized have recognized the need for replacement converter programs to maintain the effectiveness of these programs. These countries include the United States, Mexico, and countries in the European Union. In the U.S., a catalyst replacement program has been in place since 1986 and it has resulted in the replacement of over 20 million converters that were damaged, destroyed, or removed. As a result, millions of tons of harmful pollutants that would have otherwise been emitted were effectively controlled by new, replacement converters.

The Manufacturers of Emission Controls Association (MECA) has received inquiries from around the world regarding the feasibility, advisability, and benefits of establishing a replacement converter program. This document was prepared to provide information on technical and administrative issues related to establishing an effective catalyst replacement program.

2.0 CATALYTIC CONVERTER TECHNOLOGY

Before discussing issues related to a catalytic converter replacement program, a brief review of catalytic converter technology is appropriate. The concept behind a catalyst is that it causes chemical reactions to occur without being either changed or consumed. Therefore, a catalyst on a properly maintained and fueled vehicle will perform its function for the life of the vehicle.

The catalytic converter contains a catalyst in a honeycomb form and is housed in a stainless steel canister. There are no moving parts, just large areas of interior surfaces coated with catalytic metals within the honeycomb structure. A thin porous catalyst layer is applied to the interior surfaces. Within this layer are small sites of catalytic metal -- platinum (Pt), rhodium (Rh), and/or palladium (Pd).

The catalyst layer is thin and only a few grams of the precious metals are used. The exact combinations of these precious metals differ according to whether the particular converter is intended to control only carbon monoxide (CO) and hydrocarbons (HC) or must also control oxides of nitrogen (NOx). In any case, by the time most of the harmful gases that enter the
catalyst emerge from the other end, they have been changed to harmless water vapor, carbon dioxide, and nitrogen.

2.1 Oxidation Catalytic Converter (Two-Way Converter)

The first type of converter introduced in the United States was the oxidation converter, which is designed to oxidize only hydrocarbons and carbon monoxide. It is called an oxidation catalytic converter because the transformation of harmful pollutants into harmless gases is accomplished by oxidation -- as in combustion. The substrate surfaces inside the converter are covered with a thin porous catalytic layer that contains a combination of platinum and/or palladium. The hydrocarbon, carbon monoxide, and oxygen molecules are adsorbed within the catalytic layer and react to form carbon dioxide and water vapor, which go out the tailpipe.

2.2 Three-Way Catalytic Converter

As its name implies, a three-way catalytic converter (TWC) can simultaneously remove all three major pollutants -- oxides of nitrogen, as well as carbon monoxide and hydrocarbons. It does this by reducing the NOx to nitrogen and oxygen, while oxidizing the CO and HC to carbon dioxide and water vapor. To accomplish these different chemical reactions, the air/fuel mixture has to be precisely metered so that it is at the perfect ratio needed to complete combustion without an excess of either air or fuel. An engine management system (sometimes referred to as computer command) is needed to monitor the air/fuel ratio and control the fuel metering system. Feedback (closed loop) control is provided by an oxygen sensor that provides a signal to indicate the air/fuel (A/F) ratio to adjust the fuel metering system according to the perfect A/F mixture. Using fuel injection and feedback engine management, it is possible to use a three-way converter to control HC, CO, and NOx. The three-way converter needs only one catalyst bed, using a combination of platinum, rhodium, and/or palladium. Since the early 1980s, three-way converters have been installed on most U.S. new cars, usually in conjunction with electronic fuel injection systems.

2.3 Three-way Catalytic Converter/Oxidation Converter

With carburetor fuel metering systems, it is more difficult to attain the precise air/fuel ratio necessary, and consequently, the converter sometimes is divided into two beds; the first bed is used primarily for reduction of NOx and the second bed for oxidation of HC and CO with air injected between the two beds.

3.0 WHY CATALYTIC CONVERTER REPLACEMENT PROGRAMS ARE NECESSARY

As noted, catalytic converters can be designed to be very durable. A converter equipped on a vehicle that is properly used and maintained will continue to provide excellent exhaust emission control for well over 100,000 miles. However, improper maintenance, vehicle accidents, and/or use of leaded fuel can damage or destroy the converter so that the vehicle is unsafe, noisy, or can no longer meet applicable exhaust emission standards. For example, misfueling a catalytic converter equipped-vehicle with leaded gasoline will quickly destroy the pollution control
capability of the converter. Similarly, poor vehicle maintenance can lead to excessive oil burning or engine misfires, both of which can damage converter performance. Converters can also be physically damaged if a vehicle is in an accident.

Finally, in some countries, vehicle owners have intentionally removed converters under the mistaken belief that such action will improve vehicle performance or fuel economy. In those cases where a catalytic converter has been damaged, destroyed, or removed, exhaust emissions can increase by up to 10 times.

About ten years after catalytic converters were first introduced in the United States, the first country to employ the use of converters, air quality officials determined that a replacement catalytic converter program was needed. The owners of vehicles with damaged or missing converters generally were unwilling to pay the high costs of purchasing a converter equivalent to the vehicle’s original converter (an “original equipment” or “OE” converter). The U.S. EPA estimated that the cost of purchasing a new OE converter could range from $300 to $1000. Also, vehicle owners were often unable to locate OE converter replacements at the retail level or the consumer had to wait weeks for the part to be ordered and delivered. A market for replacement or “aftermarket” converters began to develop, but some of these aftermarket converters were inferior products, offering little or no pollution control capability. Also, OE converters from vehicles destroyed in accidents were resold, but there was no way to determine whether these converters were still performing properly or whether they were being installed on the right vehicles. In response, EPA established its highly successful aftermarket regulatory program.

4.0 ESTABLISHED REPLACEMENT CATALYTIC CONVERTER PROGRAMS

A growing number of countries and regions where catalytic converter have been equipped on vehicles for a number of years have established replacement converter programs to insure that proper emission control performance is maintained throughout the life of the vehicle. As noted above, programs have been established in the United States, California, Mexico, and Europe. The elements of the programs, which vary, are discussed below.

4.1 United States

The U.S. Environmental Protection Agency (EPA) administers the U.S. program. The program is based on a performance-based requirement stated in terms of the catalytic converter’s pollution control efficiencies (HC—70%, CO—70%, and NOx—30%).

EPA allows the same replacement converters to be sold for use on a wide variety of makes and models, provided that the converter manufacturer has demonstrated that the performance standards can be met for all of the vehicles to which the converter is offered for sale. This demonstration is made by testing the converter on a vehicle in which meeting the emission control requirements would be the most difficult (called the “worst case vehicle), as discussed below. Elements of the EPA program are described below. A copy of the U.S. requirements is available from MECA.
Since the replacement converter program was introduced in 1986, over 20 million replacement converters have been manufactured for sale in United States. The program is widely viewed as a success and has helped reduce automotive pollution by many tons.

**When Replacement of Converters is Allowed** – Replacement converters that meet the performance requirements described above may be installed in the following situations: (1) if the vehicle is missing a converter; (2) if a state or local inspection program has determined that the existing converter has been lead-poisoned, or damaged or otherwise needs replacement; or (3) the vehicle is beyond the applicable vehicle warranty (e.g., five years or has more than 50,000 miles and a legitimate need for replacement has been established and documented).

The third situation normally would include only plugged converters or those damaged to the point where unrepairable exhaust leaks are present. Documentation of the need for replacement must be made by the installer and includes such information as the customer’s name, address, make and model of the vehicle, vehicle mileage and the stated reason for replacement. These records must be maintained for a specified period.

**Testing Requirements** – To demonstrate compliance with the emission control performance requirements for replacement oxidation catalysts (70% HC and 70% CO) or three-way catalytic converters (70% HC, 70% CO and 30% NOx), the converter manufacturer must conduct vehicle testing on prototype converters. The vehicles for which the converter is an appropriate installation are defined by the converter manufacturer (called an “application category”). If a manufacturer intends to make the replacement converter available for more than one make or model of vehicle, it must test its prototype on the vehicle representing the “worst case” for the application covered. EPA defines “worst case” as the model with the highest test weight/largest engine displacements with the application category.

Two vehicles equipped with prototype converters in each application category must be tested. The EPA program requires that the manufacturer demonstrate, by testing over a specified testing protocol, that the emission performance requirements can be met after 25,000 miles of vehicle aging.

**Information Reported to EPA** – Once a converter has met the applicable testing and performance requirements, the converter manufacturer is required to provide EPA with documentation prior to introducing the product for sale.

The type of information EPA requires includes verification of testing, the makes and models of vehicles to which the application category applies, and a detailed description of the qualified converter in all material respects.

**EPA Confirmatory Testing** – EPA reserves the right to conduct confirmatory testing of any replacement converter offered for sale in the U.S. Failure to successfully pass the confirmatory testing can result in an EPA order to cease sale of the product.

**Warranties** – The converter manufacturer must warrant that the converter will meet the applicable emission control efficiencies for 25,000 miles, that the external converter shell,
including the end pipes, will last for five years or 50,000 miles (whichever occurs first), and that the converter will not constitute a safety hazard.

EPA requires that manufacturers enclose in the packaging for each converter the specific vehicle applications of that converter and a warranty application card to be returned to the converter manufacturers. Converter manufacturers are required to retain the warranty cards and submit reports to EPA twice a year.

**Converter Labeling** – Each converter must have a visible, permanent, non-destructible label or stamp that will identify the manufacturers code (issued by EPA), the month and year of manufacture, and other information.

**Installation Requirements** – EPA established installation and record-keeping requirements for the installer to insure that converters are installed only under the conditions specified above and that the replacement converter is the proper application for the vehicle involved.

**Notification to EPA** – Converter manufacturers that market converters under EPA’s program must notify EPA of its intent to do so thirty days prior to the actual introduction of each product line. Converter manufacturers must include or have submitted a summary of the test results including the vehicles tested, method of mileage accumulation, name and location of the testing facilities, its location, test results, and intended vehicle applications.

### 4.2 California

In 1988, the State of California adopted a replacement converter program that is administrated by the Air Resources Board. The program is based in large part on the U.S. program, including such elements as the types of emission testing, durability demonstration requirements, applications, when replacement converter installation is authorized, warranty coverage, and installation requirements. The differences between the two programs are summarized below.

**Emission Performance Requirements** -- Like the U.S., the California program is based on performance-based requirements stated in terms of the catalytic converter’s pollution control efficiencies. However, California’s NOx control efficiencies are more stringent than the U.S. requirements. For three-way dual bed converters with air injection between the two catalyst beds, the NOx efficiency requirement is 50 percent and for three-way single-bed converters the NOx efficiency requirement is 60 percent.

**Quality Control Measures** – California requires quality assurance measures be implemented by the converter manufacturers. A converter manufacturer may seek approval from ARB of a quality control procedure (QCP). If a manufacturer does not have an approved QCP, it must, at a minimum, test one out of every 5,000 production converters pursuant to prescribed procedures. The U.S. program does not have a quality control measure.
4.3 European Union

The European Union (EU) adopted requirements for the type approval of replacement converters as separate technical units by Annex XIII of the Commission directive 98/77/EC in October 1998. In 1999, an estimated 1.3 million replacement converters were sold.

The EU requirements regarding emissions, like the U.S., are performance-based, but rather than having a specific percent reduction for each pollutant as in the U.S., the EU program requires that the emission reduction performance of the replacement converter to be equal or better to the OE converter for CO, NOx+HC, and particulates. Two sets of back-to-back emission tests to compare the emission control efficiency of the replacement converter to original equipment (OE) converter. The testing includes one vehicle that represents the “worst case” application for the converter and another vehicle that is representative of the vehicle applications on which the replacement converter will be utilized. The tests are conducted over the EU driving cycle. The emission requirements for each pollutant are as follows:

1) the mean value of three tests with the replacement converter shall be less than or equal to 0.85 times the mean value of three tests with the original catalytic converter plus 0.4 times the EU limit value according to the type approval of the vehicle divided by, if applicable, the deterioration factor

2) the mean value of three tests with the replacement converter shall be less than or equal to the EU limit value according to the type approval of the vehicle divided by, if applicable, the deterioration factor

The converter manufacturer is required to demonstrate durability by one of two prescribed approaches. First, the manufacturer may apply an assigned deterioration factor of 1.2 for CO and HC+NOx for spark-ignition engines and a deterioration factor of 1.1 for CO, 1.0 for HC+NOx, and 1.2 for PM for compression-ignition engines. The second approach is to verify the durability of the device by conducting an aging test for 80,000 km.

In addition to these emission-related requirements, the replacement catalytic converter also has to comply with general construction specifications and requirements regarding noise and exhaust backpressure (Annex II to directive 70/157/EEC).

The EU also requires that the converters are labeled and that the manufacturer completes an application process and receives an official approval.

Converter manufacturers who fail to manufacture products that conform to the approval granted, can lose their approval certificate.

4.4 Mexico City

In 1999, Mexico City introduced a voluntary converter replacement program for 1993 model-year passenger cars. The Governments of Mexico City and the State of Mexico administer
the program. The program was designed to give an incentive to vehicle owners to replace converters in order to obtain a “zero sticker” that would allow them to drive on all days of the week.

In 2000, the program was extended to cover model years 1994 and 1995. Also, participation in the replacement program became mandatory for anyone wishing to obtain a zero sticker.

There is a formal approval process that includes a requirement that converter manufacturers have their converters tested at an approved, independent testing facility. The converters must meet minimum emission reduction performance requirements of 70% for CO, 70% for HC and 60% for NOx. Currently, the authorities also require that the replacement converter contain a minimum content of precious metals (20 grams per cubic foot) and a 0.7 grams per converter minimum precious metal content. There is no durability demonstration requirement, but the program requires a physical integrity warranty of 60,000 kilometers (km) or two years whichever occurs first. The program in Mexico City requires that converters be labeled and also that a bond be posted as a condition for receiving an approval. Failure to produce converters meeting the program requirements could result in forfeiture of the 1,000,000 pesos bond.

Since the program replacement converter program began, authorities estimate that over 230,000 replacement converters have been installed.

5.0 KEY ELEMENTS OF AN EFFECTIVE CATALYTIC CONVERTER REPLACEMENT PROGRAM

Any country considering the implementation of a converter replacement will need to consider the specific factors unique to its situation. These factors include air quality needs and which pollutants are of the most concern, the enforcement infrastructure, the age of vehicles and types of OE converters installed on those vehicles, the availability of unleaded gasoline for sale in the country, and many other considerations. However, MECA believes there are a number of common elements that should be present in an effective converter replacement program. These key elements are discussed below.

5.1 Government-Administered Application Review and Approval Process

Perhaps the most critical element of a successful replacement converter program is to have active involvement and oversight by the government entity charged with implementing the replacement program. MECA recommends that a clearly defined application be established and that formal approval of the application be issued by the governmental body in charge prior to allowing the sale of replacement converters. The California program can serve as a model for an application/approval process. Without active involvement by the government, a serious risk exists that some products will be introduced that do not meet the applicable emission control, labeling, and warranty requirements of the program. Non-complying products in the marketplace can result in the following adverse results: 1) reduction in pollution will be lost; 2) the public, having
paid for inferior or non-performing replacement, will lose faith in the program; and 3) manufacturers who are manufacturing and selling converters that meet the program requirements will be placed at an economic disadvantage.

5.2 Clearly Defined Performance-Based Emission Reduction Requirements Demonstrated Over an Approved Certification Test Procedure

Performance-Based Standards -- An effective program should be based on clearly defined performance-based emission reduction requirements stated in terms of the converter’s minimum emission control performance compared to engine out emissions (i.e., without the converter installed) for each of the pollutants being addressed. The converter efficiency or performance specified in the program will depend on considerations such as: 1) the vehicle model year and type of system installed as original equipment (e.g., most pre-1980 automobiles in the U.S. were equipped with oxidation converters which controlled only HC and CO); 2) the exhaust pollutants of concern (e.g., the U.S. EPA established a lower NOx control efficiency (30%) than California (50% to 60%) in part because in 1988 EPA was less concerned with NOx emissions than California); 3) the relative cost of the converter (as a general matter, as the control efficiencies of a converter increase, the cost of the converter also increases).

Prescribed Test Procedure – The emission control performance of the replacement converters should be demonstrated over an established test procedure. MECA recommends that the test procedure utilized be the same procedure used to evaluate and certify the emission control performance of new motor vehicles for the particular country implementing the replacement converter program. Both California and EPA base the emission test procedures on the Federal Test Procedure, which is used to certify new passenger cars and light trucks sold in California and the entire U.S.

5.3 Prescribed Durability Demonstration as Part of the Approval Process

To help insure that replacement converters offered for sale not only meet the applicable emission performance requirements when new, but also provide effective emission control performance during the required performance period (typically stated in terms of miles/kilometers or months/years), a converter performance durability demonstration requirement should be part of the program. MECA recommends that such a durability demonstration be conducted by equipping a converter on a vehicle and operating it for a specified period (e.g., 25,000 miles over an approved driving cycle) or by accelerated aging of the converter using an approved accelerated aging procedure. Automobile manufacturers in the U.S. and elsewhere increasingly are using accelerated aging procedures to demonstrate the durability of catalyst systems used in new vehicle certification. These aging procedures can be adapted for use in replacement converter durability demonstrations.

5.4 Requirement for Permanently Affixed Labels on Each Converter Sold

The replacement converter programs in the U.S., the EU, Mexico and California all require that each individual replacement converter be labeled in accordance with a specified coding system. Typically the label consists of a series of letters and numbers each representing a particular piece of information. The types of information that are covered by the label should include at a
minimum the following information: the manufacturer, the vehicle application or part number, and
the month and year of manufacture. MECA recommends that the label be permanently stamped on
the converter at a designated location (e.g., center of the top converter shield).

5.5 Requirement for emission performance and mechanical integrity warranties

Warranties on replacement converters are important to protect the consumer’s investment
in a new replacement converter. Warranties also provide additional incentives for the
manufacturer to provide products that will meet applicable requirements for the designated
periods. All replacement converter programs require some type of warranty from the converter
manufacturer, although the type and scope of the warranty varies. MECA recommends both an
emission performance and structural integrity warranty requirement. The U.S. program could
serve as a model. It requires that a manufacturer warrant that the device will meet EPA’s
emission performance standards for 25,000 miles and that the converter and end pipes have a 5-
year/50,000 mile structural warranty. These warranties are enforceable only if the vehicle is
properly used, fueled, and maintained.

5.6 Ability of government to conduct confirmatory testing

An important element in the effective enforcement of a replacement converter program is
for the regulatory authority administering the program to have the ability to conduct confirmatory
testing of replacement converters being offered for sale. The ability to test converters at either
the approval stage or after the converters have entered the marketplace is an important
enforcement tool to help guarantee that converters meet the applicable emission reduction
performance requirements.

5.7 Clearly defined situation when catalyst replacement is authorized

The catalyst replacement program should define the situation under which a replacement
converter may be installed. A replacement converter should not be installed unless there is clear
evidence that the OE converter is either missing or is no longer functioning effectively. Material
structural damage to the converter or failure of an approved emission test can serve as evidence
that the OE converter is no longer providing the desired emission control. Also, a replacement
converter should not be used if the original equipment converter is still covered by a warranty.

Under the current U.S. and California programs, a replacement converter may be installed under the following situations:

1. If the converter is missing from the vehicle when brought in for exhaust system
   repair; or
2. If a government run emission inspection program determines the existing converter
   has been lead poisoned, damaged or otherwise needs replacement; or
3. If the vehicle is still under the auto manufacturer’s warranty and a legitimate need
   for replacement has been established and appropriately documented (e.g., a
   plugged converter or an unrepairable exhaust leak).
5.8 Clearly defined instruction concerning proper installation

The governing authority should define and the replacement converter manufacturer should be required to provide instructions regarding proper replacement converter installation instructions. Those instructions should include:

1. The circumstances under which replacement converters may be installed (see Section 5.7 above);
2. That the location where the replacement converter is installed is as close to the location of the original converter as possible;
3. That the replacement converter be the same type of converter as the original converter (i.e., oxidation, three-way, or three-way plus oxidation); and
4. That the replacement converter is the proper converter for the vehicle application as specified by the converter manufacturer.

5.9 Record-keeping requirements

If possible, established record-keeping requirements for both the converter manufacturer and the installation facility can be an important tool to assist enforcement officials in determining that only replacement converters meeting the emission control requirements are being sold, that replacement converters are only being installed when they are needed, and that the replacement converter installed on the vehicle is designed and approved for that specific vehicle model and year.

Converter manufacturers – Should be required to retain emission testing results and other documents related to the approval of each replacement converter model it is selling. The manufacturers should also retain information related to warranty claims received. These records should be retained for a period specified by the governing authority

Installers – Should be required to retain records related to the sale and installation of the converter. These documents could include a copy of the invoice, which should contain the customer’s name address and the vehicle’s make, model year and mileage, as well as the reason for replacement. The documents should be retained for a period specified by the governing authority. The U.S. EPA requires that these documents be retained for six months.

The U.S. EPA also requires that a replaced converter be retained for 15 days and that it be marked as to which customer’s car they came from.

5.10 Field inspections by government officials

To insure that replacement converters are being installed properly and only in accordance with the applicable requirements, field inspections by government officials can be an effective tool, particularly during the period immediately after the program first goes into effect. For example, the U.S. EPA during the first several years of program implementation conducted numerous inspection visits and vigorously prosecuted violators. This aggressive enforcement program served to deter intentionally installing a replacement converter in violation of the requirements and helped educate installers on the proper way to meet the program requirements.
As the instances of mis-installation of replacement converters decreased, EPA was able to reduce its field enforcement activities.

Field inspections can be either regularly scheduled or unannounced inspections. The field inspector can review documentation required to be maintained by the installation facility and the replaced converters, if their retention by the installer is required.

## 5.11 Education programs for repair facilities and the vehicle owners

Education is an extremely critical element to the success of a replacement converter program. First, the consumers must understand the important air quality benefits of installing a replacement converter when it is needed, as well as the important benefits of properly fueling, maintaining, and using their motor vehicle. Second, the installer must have a clear understanding of their obligations under the program, how to properly select and install the correct replacement converters, and the consequences of their failure to comply with the requirements of the program.

When the replacement converter program was implemented in the United States, the U.S. EPA conducted an extensive public education program. The agency published and distributed easy-to-understand guidelines for complying with the program and gave them wide distribution. EPA also authored articles for trade journals, like *Undercar Digest*, whose readership included the auto service industry. Finally, EPA enlisted the participation of the associations representing the converter manufacturers, replacement parts industry, and the auto service industry to help disseminate information regarding the U.S. replacement converter program.

## 6.0 CONCLUSION

A properly designed and implemented replacement converter program can be an important element of an effective motor vehicle emission control program. Several excellent examples of effective programs already exist that can assist countries interested in developing a program.

Each replacement converter program should be designed to meet the specific needs and circumstances that exist in the country in which it is implemented. To be effective, a replacement converter program should have at a minimum the following program elements:

- Government administered application review/approval process
- Performance-based emission reduction requirements
- Defined durability testing and performance requirements
- Emission and mechanical integrity warranties
- Enforcement initiatives
- Record-keeping requirements

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