AirCare - Results and Observations in 2007 and 2008

Abridged Version

This report prepared by S.J. Stewart, D.I. Gourley and J. Wong of Pacific Vehicle Testing Technologies Ltd.

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EXECUTIVE SUMMARY

On January 1, 2007, the third generation of the AirCare program, designated AirCare III, came into effect. The main features of the revised program are as follows:

- 5-year testing contract term, ending December 31, 2011
- Closure of 2 of the 12 inspection centres and a reduction in testing lanes from 42 to 32
- Reduction of the biennial test fee from $47 to $45
- Vehicles less than 8 years old exempt from testing
- Vehicles from model years 1998 and newer with on-board diagnostic (OBD) capability subject to an OBD scan as the primary test mode
- 1992-1997 model year vehicles subject to biennial IM240 testing
- 1991-and-older vehicles subject to annual ASM/Idle testing
- Increased monitoring and collaboration between the program administration and the repair industry to improve effectiveness

This report presents observations and analysis of data for calendar years 2007 and 2008. For certain parameters, figures from earlier reports are provided to give an indication of long-term trends. Overall, the analysis confirms that the exemption of nearly half the registered light-duty vehicle fleet from testing has not had much impact on the program's effectiveness since the vehicles with the highest probability of failure are still included. In the reporting period, 114,878 failing vehicles were identified out of 881,323 tested (13%). Of these, more than 75% were re-inspected and passed. For these vehicles, pre-and post-repair mass emission data was used to quantify the emission reductions achieved. On an impact weighted basis (discounting carbon monoxide emissions by a factor of 7) the percentage reduction in the light duty vehicle emission inventory resulting from AirCare repairs was 7.1% in 2007 and 6.3% in 2008.

There were 22,769 vehicles that did not return for a passing re-inspection after failing. For the 11,506 vehicles that failed in 2007 but did not return to pass within the expected time frame, 9,305 were still not licensed even as of August 2009. Therefore, it can be assumed with some confidence that the non-returning vehicles were effectively removed from use in the AirCare area. The emission reductions resulting from the removal of these vehicles correspond to a further reduction in the light-duty vehicle emissions inventory of 4.6% in 2007 and 4.3% in 2008.

Two other potential benefits of the program are not quantified in this report - pre-inspection repairs and deterrence from tampering with emission control systems. In past years, these effects were thought to be relatively small, however, with the adoption of OBD testing, owners of 1998-and-newer vehicles are pre-warned of failing the test by the Malfunction Indicator Lamp (MIL) on their instrument panel and are more likely to seek repairs before their initial inspection in order to avoid the extra complication of failing and having to be re-inspected. The deterrence effect is unquantifiable, but it is likely that a small fraction of vehicle owners would remove emission control components or make modifications to their vehicles' engines if there were no requirement for periodic emission tests.

AIRCARE BENEFITS

As mentioned previously, there are multiple mechanisms by which the AirCare program can reduce the annual inventory of emissions produced by motor vehicles. Two of the more quantifiable ones are discussed here.

DIRECT BENEFITS FROM VEHICLE REPAIRS

The reduction in emissions attributable to repairs performed on vehicles that have failed an AirCare inspection is a function of the number of repairs, the change in emissions output resulting from those repairs, and the number of kilometres driven per year. For AirCare III, the task of calculating these emissions reductions was more difficult because, for the first time, not all vehicles were subjected to an emission measurement at the time of inspection. For the vehicles that failed an On-Board Diagnostic (OBD) inspection, a sample of supplementary IM240 tailpipe emission data was available to establish a link between the most common OBD defects and tailpipe emissions.

As in previous years, the emission benefits were evaluated using full-duration IM240 emission tests performed on a representative sample of the fleet. "Sample" tests are performed after the mandatory test type has been administered and the pass/fail result determined. A minimum of 5,000 sample tests per year is prescribed in the service contract in order to provide enough examples to characterize the registered vehicle fleet. Additionally, for 1992-1997 vehicles, ***all*** of the failing IM240 tests are full-duration. The lane software requires that all re-inspections of vehicles that failed their initial IM240 test must also be full duration tests. This program feature resulted in more than 20,000 matched pairs of "initial fail" vs. "final pass" results being available on which to base the benefits analysis. The large mass emissions sample set makes it possible to determine average emission outputs for various categories of vehicles based on their inspection results. This includes passing vehicles and the multiple combinations of failure modes observed.

There were 38,882 vehicles in 2007 and 38,403 vehicles in 2008 that were re-inspected and passed after failing their initial inspection. The "Base Inventory", using emission factors from the 10,000+ sample tests and the 20,000+ vehicles with direct before and after emission results, was calculated for the registered light-duty vehicle fleet as of January 1st of calendar years 2007 and 2008. For the "Base" inventory, all registered vehicles were assigned an emission rate based on their age, type, emission control technology, and initial AirCare test result. For vehicles not tested because they were exempt (2001 and newer in 2007 and 2002 and newer in 2008), estimated IM240 emission factors were generated based on new vehicle certification standards. For vehicles that *did* go through the inspection process, the emission factors assigned in the base case were based on the results of the *initial* inspection. The "Base Inventory" takes into account the natural changes in emissions of the light-duty fleet resulting from fleet growth, retirement of older vehicles, and AirCare-related repairs in the previous year. The "Base Inventory" decreases naturally each year because of the combined effects of new emission control technology and retirement of older, high-polluting vehicles. The additional benefits from AirCare repairs in the year being analyzed are calculated by substituting the *fina*l inspection result for each failing vehicle and re-calculating the inventory. Subtracting the smaller, "With Repairs" inventory from the "Base Inventory" provides the mass of emissions reduced from repairs.

The next table shows the overall effect on the inventory of Hydrocarbons (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NO_x), from the repairs performed in 2007 and 2008. The percentage reductions due to repairs in 2007 were 10%, 8% and 4% for HC, CO and NOx respectively. In 2008 the percentage reductions were 9%, 7% and 4%.

Effect of Repairs on In-Use Light-Duty Vehicles Mass Emissions Inventory (tonne/year)

	2007			2008		
	HC	CO	NO_x	HC	CO	NO_x
Base Inventory for Year (tonnes)	9,588	140,896	11,692	8,815	133,070	11,218
Inventory after Repairs	8,675	129,966	11,228	8,054	123,991	10,817
Reduction from Repairs	913	10,929	463	761	9,080	401
% Reduction from Base	10	8	4	9	7	4

The calculation method used establishes the proportional reduction based on warmed-up, transient operating conditions. To calculate the emission reductions corresponding to real-world driving conditions such as cold starts, hill-climbing, speeds higher than 90 km/hr and others, the percentages described above are applied to emission inventory results calculated using a computer model known as MOBILE6.2C.

VEHICLES REMOVED FROM USE AFTER FAILURE

A portion of the vehicles that fail an AirCare inspection, about 23,000 of them in this reporting period, did not re-appear after having failed. Since these vehicles were administratively blocked from licensing for anything more than 3 months after expiration of the license in effect on the date of inspection, it is logical to assume that they would have been removed from use in the AirCare area by being scrapped, placed in storage or registered outside the program area. For the purpose of this analysis, vehicles were considered to be removed from use in a given calendar year if they were not licensed 4 or more months after the date of a failing test result (i.e. fail in January – August, not re-licensed as of December 31st). There were 11,506 such cases in the 2007 calendar year and 11,263 for the 2008 calendar year. Assuming that these vehicles would have continued to operate in the absence of an AirCare program, an emissions benefit can be claimed from taking them off the road sooner than otherwise expected.

Emission Benefits from Removed-from-Use Vehicles in 2007 and 2008 (tonne/year)

	2007			2008		
	HC	CO	NO_x	HC	CO	NO_x
Reduction From Vehicle Removal for Year (tonnes)	600	7,014	301	531	6,090	278

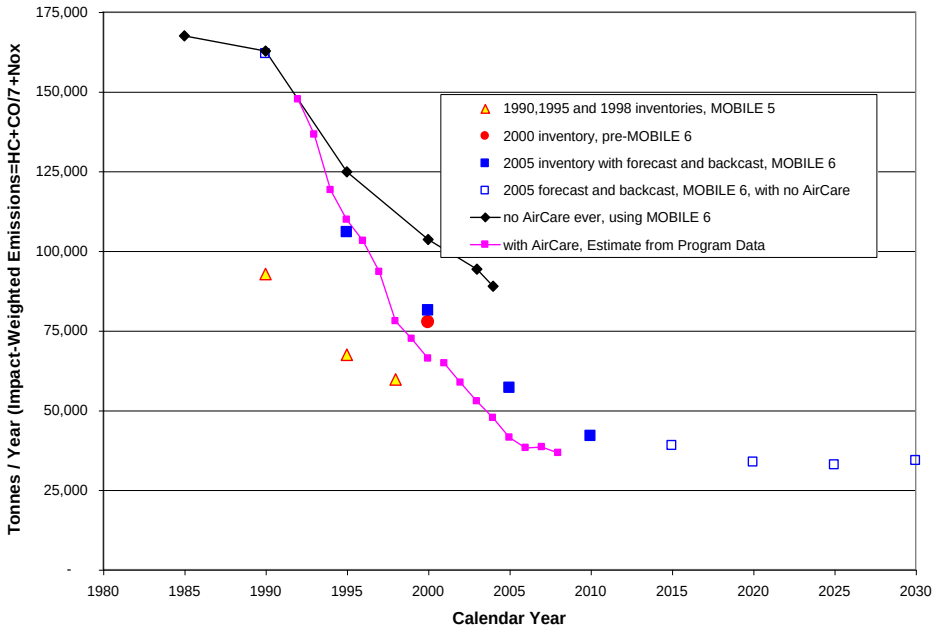
Although it must be recognized that some portion of this group would have been retired anyway, so the program cannot take credit for *all* of these removals from use, a calculation has been performed to determine the total avoided emissions associated with the retirement of these vehicles. The results are shown in the table below.

PRE-AIRCARE REPAIRS

Another mechanism by which the program can generate emission benefits is from repairs made prior to inspection. This is particularly likely for vehicles subject to OBD testing. Owners of vehicles with illuminated MIL's can be virtually assured that their vehicle will fail the AirCare inspection and should be motivated to repair their vehicle prior to its initial inspection. Since these vehicles will simply register as a Pass on their initial inspection, there is no way to determine the number of pre-inspection repairs by using inspection data. As a result, no pre-inspection benefits are included in this report.

"WITH AIRCARE" SCENARIO COMPARED TO "WITHOUT AIRCARE"

The AirCare program has operated in the Lower Mainland since 1992. In the 16 years between program start and the end of the evaluation period, more than 14 million inspections have been performed on more than 2 million individual vehicles, of which 862,000 have failed on at least one occasion. The cumulative effect of the program on vehicle maintenance habits, the ability of the repair industry to effectively diagnose and repair emission-related problems, and public awareness of air quality issues is difficult to quantify but has undoubtedly had a positive impact on the state of air quality in the region. The measure of this impact is ideally represented by a comparison of what the air quality situation actually was in 2008 compared to what it would have been if the AirCare program had never existed.



Changing Inventories and the Effect of AirCare

The fictitious scenario of "No AirCare Ever" can be simulated using the MOBILE emission inventory model. This model, developed by the U.S. EPA and modified by Environment Canada for use in a Canadian context, has been used to estimate the light-duty inventory in the default (imaginary) scenario in which an AirCare program was not implemented in 1992, yet all other factors remained constant. This has been the only available mechanism of establishing a "control" group against which the "with-AirCare" scenario can be compared. However, the MOBILE model has gone through a number of versions since 1992, and is now at version 6.2C. As the model has been refined, inventory estimates have moved up or down quite significantly, necessitating backcasts of historical scenarios whenever the model changed. This means that calculations of AirCare program benefits based on earlier versions of MOBILE (MOBILE4C and 5C) should not be compared. The most current published inventory, for calendar year 2005, includes a backcast and forecast based on MOBILE6.2C. The "Changing Inventories and the Effect of AirCare", illustrates the various published inventory results over the years including the "With" and "Without" AirCare Scenarios.

To interpret the above figure, the blue data points represent the MOBILE6.2C results assuming no AirCare prior to 1993, and no AirCare after 2011. The uppermost black line, stopping at 2005, represents the "No AirCare ever" scenario, based on data supplied by Metro Vancouver in 2005. The blue data points correspond to the most recent emission inventory published by Metro Vancouver. The solid boxes represent points for which the MOBILE model inputs assume the existence of an inspection and maintenance program. The open blue boxes represent points from the same model run but with the inputs changed such that no inspection and maintenance is assumed. For reference, the magenta-coloured line shows the emission inventory estimates based on the registered vehicle population and the emission rates taken from AirCare data. The AirCare-based data follow the MOBILE-calculated values reasonably well, although the resulting inventory is lower. A possible explanation for this is that the built-in assumptions for I/M effectiveness in MOBILE reflect a program with less effectiveness than AirCare. There are no programs in the United States that match the degree of complexity of the AirCare program, so a higher indicated effectiveness for AirCare vs. MOBILE is believable.

From the "Changing Inventories and the Effect of AirCare" figure, a dramatic reduction in total light-duty vehicle emissions between 1990 and 2005 is apparent in all scenarios due to the introduction of cleaner vehicles and the retirement of most vehicles with no or limited emission control technology. It can be seen that the additional, remedial benefits from AirCare cause the inventory trend line to slope downward at a greater rate than the "No AirCare Ever" line. In 2010, the predicted, impact-weighted inventory, "With AirCare" (blue square) is 42,600 tonnes compared to 162,500 tonnes (open blue square) in 1990 before the program started. This represents a reduction of 74% in impact-weighted vehicle emissions over that 20-year period. Beyond 2010, there is less scope for further reductions in the vehicle inventory because the overall vehicle population and kilometres traveled will continue to grow and, the normal emission output for vehicles is now so low that only zero emission vehicles (battery electric or fuel cell) offer any real potential for further reductions in per-kilometre emission rates.

Although it was not available for this analysis, a re-calculation of the "No AirCare Ever" line from 1990 through 2030 would be a valuable addition to this figure. Although the data points represented by the blue, open squares assume no AirCare, it must be borne in mind that, for the purpose of the forecast, the 1992-2011 period *did* include AirCare benefits, so the "No AirCare Ever" data points for dates beyond 2005 would be considerably higher than the ones that appear in this figure. Therefore, while it may appear that the "With AirCare" and "Without AirCare" lines are converging after 2010, a proper "No AirCare Ever" line would show a much greater separation.

The AirCare program still generated significant emission reductions during the review period, and the effect of repairs expressed in percentage terms, is still quite large. However, because the fleet is getting cleaner, the absolute magnitude of the emission reductions is declining. The program has now achieved equilibrium in which the inspection process serves to identify the vehicles that have developed an emission-related defect since their last inspection. These vehicles are then mostly repaired and restored to normal emissions output. This ongoing cycle counteracts the natural degradation of the fleet and potential benefits of inspection and maintenance will persist as long as vehicles are less than 100% reliable.

INSPECTION STATISTICS

In 2007, there were 479,604 inspections performed while, in 2008, the total increased to 528,617 inspections. The jump in 2008 was largely due to the re-introduction of model year 2001 vehicles to the program after being exempt in 2007.

Due to the fact that vehicles may be tested more than once, the number of vehicles tested in any given calendar year is always less than the number of inspections. In 2007, there were 413,777 individual vehicles that were presented for an initial AirCare inspection. In 2008, this number was 467,546 vehicles. Registration data from ICBC suggest that there are about 1.3 million light-duty vehicles registered in the AirCare-eligible area.

A variety of test types can be performed in the inspection lanes. Mandatory OBD inspections appear as a test type for the first time in this report. Due to the fact that OBD tests apply only to 1998-and-newer model year vehicles, the number of OBD tests is expected to grow each year. In 2007, only 1998,1999 and 2000 model year vehicles were eligible for OBD testing, so only 80,000 OBD inspections were performed. In 2008, however, the 2001 model year vehicles came into the program, resulting in a jump to more than 176,000 OBD inspections. Just about 15,000 vehicles failed their OBD inspection – meaning that they were presented for inspection in most cases with the MIL illuminated. This represents about 6% of the vehicles tested using the OBD procedure. The failure rate for IM240 tailpipe tests was about 13% while the failure rate for the oldest vehicles (1991-and-older) was over 20%. The OBD failure rate for 2001 model year vehicles in 2008 (5%) was much higher than the approximately 1% fail rate observed for 2001 model year vehicles when they were first tested according to the IM240 procedure in 2003. This was expected since the OBD system continuously monitors the emission control system over the full range of vehicle operating modes and can store codes and illuminate the MIL at any time, whereas a tailpipe test can only assess performance at the time that the test is performed and only under the specific test conditions.

The inspection data also show that about 24,000 gas caps were flagged as being defective during the reporting period – about 4% of the vehicles tested. Estimating the impact of these repairs is difficult, but a modest estimate of 15 tonnes of hydrocarbons per year has been determined based on an assumed evaporation rate of 5 mL per day per vehicle with a faulty gas cap. OBD-equipped vehicles do not require a gas cap test because the OBD system includes a leak check of the fuel system.

The two tables below show the breakdown by inspection type and result for both 2007 and 2008.

Summary of Inspection Data in 2007 and 2008

	2007	2008
Inspections Performed	479,604	528,617
Vehicles Inspected	413,777	467,546
Failed Test for all Reasons Combined (Vehicles)	72,454 (58,636)	74,435 (56,242)
Failed Test for Emissions Only (Vehicles)	67,076 (47,536)	58,365 (41,241)
Tested According to OBDII (Vehicles)	81,006 (76,850)	176,621 (167,952)
Failed OBDII (Vehicles)	5,210 (4,720)	10,887 (10,098)
Tested According to IM240 Test (Vehicles)	174,094 (150,339)	169,162 (147,772)
Failed IM240 Test (Vehicles)	29,521 (20,112)	28,711 (20,218)
Tested According to ASM/Idle Test (Vehicles)	205,808 (174,746)	164,592 (140,100)
Failed ASM/Idle Test (Vehicles)	43,081 (31,893)	33,599 (25,056)
Tested Idle-Only Test (Vehicles)	3,299 (2,498)	3,493 (2,694)
Failed Idle-Only Test (Vehicles)	945 (678)	1,022 (245)
Diesel Vehicles Inspected (Vehicles)	7.689 (7,411)	8,400 (8,224)
Failed Diesel Opacity Inspection (Vehicles)	286 (249)	213 (194)
Unloaded Diesel Opacity Inspection (Vehicles)	761 (742)	900 (885)
Failed Unloaded Diesel Opacity Inspection (Vehicles)	4 (4)	3 (3)

Summary of Ancillary Tests for 2007 and 2008

	2007	2008
Gas Cap Pressure Tests Conducted	298,013	255,945
Failed Gas Cap Pressure Test	14,012	10,602
Failed Gas Cap Pressure Test (% Fail)	4.70%	4.14%
Failed Catalytic Converter Presence Test (% Fail)	0.08%	0.05%
Catalytic Converter Advisories (1987 and Older Only in %)	4.88%	3.75%

RESPONSE TO FAILED INSPECTION

Vehicles that don't meet AirCare inspection standards must achieve either a Pass or Conditional Pass before they can be licensed and insured. For motorists needing time to complete repairs, a one-time, 3-month licensing option is available and many take advantage of this opportunity, placing a significant delay between the initial failing test and the re-inspection. In order to "close the loop" on the vehicles that failed in any given calendar year, it is necessary to look beyond the first three months of the following year to find associated re-inspections.

Motorists are free to repair their vehicles in any way they choose. A certified repair industry is available, consisting of about 350 repair shops. AirCare Certified Repair Centres (ACRC's) can submit repair data to the program administration via an on-line system called RepairNet. In order to be eligible for a Conditional Pass (the vehicle is allowed to re-license, even though it did not pass re-inspection), repair data must be entered by an ACRC prior to the re-inspection. ACRC's are supposed to submit repair data for every AirCare repair they do, but the number of repair data forms submitted has diminished to about 9,000 in 2007 and 8,600 in 2008, despite a fairly stable volume of failing vehicles.

The table below summarizes the observed responses to a failed inspection in both 2007 and 2008.

Observations on Actions Taken after Failing Inspections

	2007	2008
Vehicles Not Returning for Re-inspection	11,506	11,263
Vehicles Repaired to Pass With Repair Information	7,014	7,092
Vehicles Re-Inspected to Pass Without Repair Information	31,868	31,311
Vehicles issued Conditional Pass	2,057	1,657
Gas Cap Replacements	6,708	5,159

The table shows that about 38,000 vehicles that failed in each year returned and passed a subsequent re-inspection. There were 7,014 vehicles repaired to pass by ACRC's in 2007 and 7,092 in 2008, based on the amount of repair data entered into the RepairNet system. This corresponds to less than 20% of the total "repaired-to-pass" vehicle population. In both years, a much greater fraction of the failing vehicles returned and passed a re-inspection with no associated repair data. These "no-data" vehicles may have been repaired by non-certified repair facilities, by do-it-yourselfers, by certified shops that did not submit repair data, and some may have passed without any repairs having been performed at all. As there was no information available to indicate what transpired between the initial fail and the subsequent pass, it is impossible to categorize these "no-data" repairs. For the purpose of this analysis, however, it was assumed that any vehicle that was re-inspected and passed received some sort of corrective action that generated a reduction in emissions.

As mentioned earlier, only an ACRC can qualify a vehicle for a Conditional Pass. There were 2,057 such results in 2007 and 1,657 in 2008. These are the lowest numbers reported in the

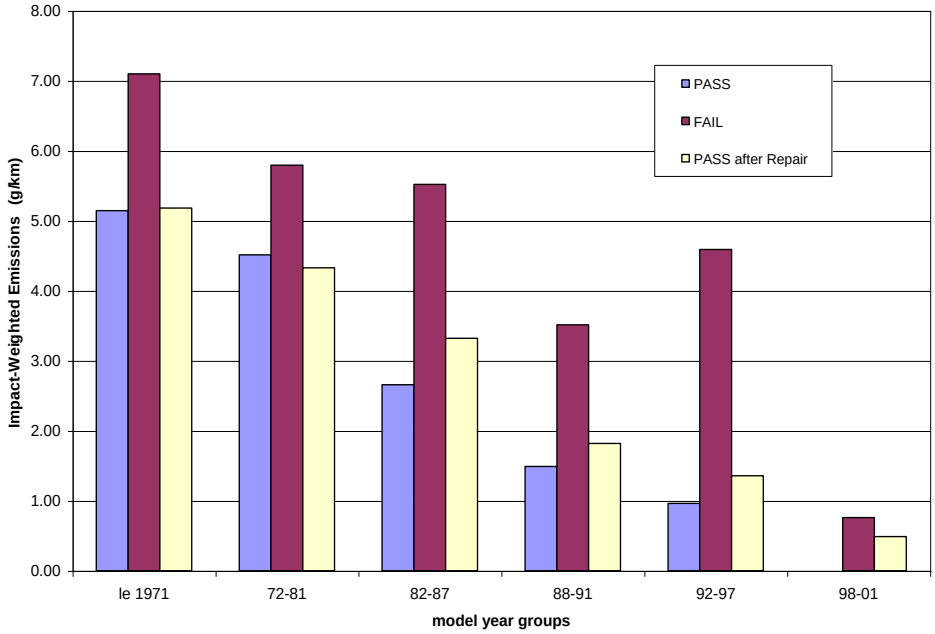
history of the program, meaning that few motorists are taking advantage of the Conditional Pass to continue driving despite not meeting program standards.

EFFECTIVENESS OF REPAIRS

COMPARISON OF MASS EMISSION RATES

The following figure illustrates the relative emission rates for “first-time-pass”, “first-time-fail”, and “repaired-to-pass” vehicles of various age groups and types. It can be seen that the “Repaired to Pass” emission rate is typically slightly higher than the rate for “Initial Pass” vehicles (first bar in each grouping), although not in all cases. This is a result observed in all previous AirCare program analyses and also in other I/M programs across North America. Various explanations have been offered by researchers for this phenomenon, but most agree that the reasons include incomplete diagnoses that leave some emission defects unattended and perhaps the use of non-OEM replacement parts such as catalytic converters.

Another obvious trend is that the emission output of vehicles has decreased dramatically over time as a result of more effective emission control technology. In fact, the emission levels of failing vehicles in the newest segment of the tested fleet are often better than the passing vehicle levels of the older technology vehicles. No tailpipe mass emission data was collected for passing vehicles in the 1998-2001 model year group (OBD passes), so it does not appear on the graph. The vehicles in the 1998-2001 model year group were mostly tested according to the OBD test procedure. When a MIL-commanded-on (OBD fail) situation was identified, a portion of these vehicles received a full-duration IM240 test in order to characterize the emissions output corresponding to the OBD failure mode. A similar process was followed when the vehicle appeared for re-inspection, establishing a post-repair emission rate. This data provided the basis for the two bars shown on the chart.



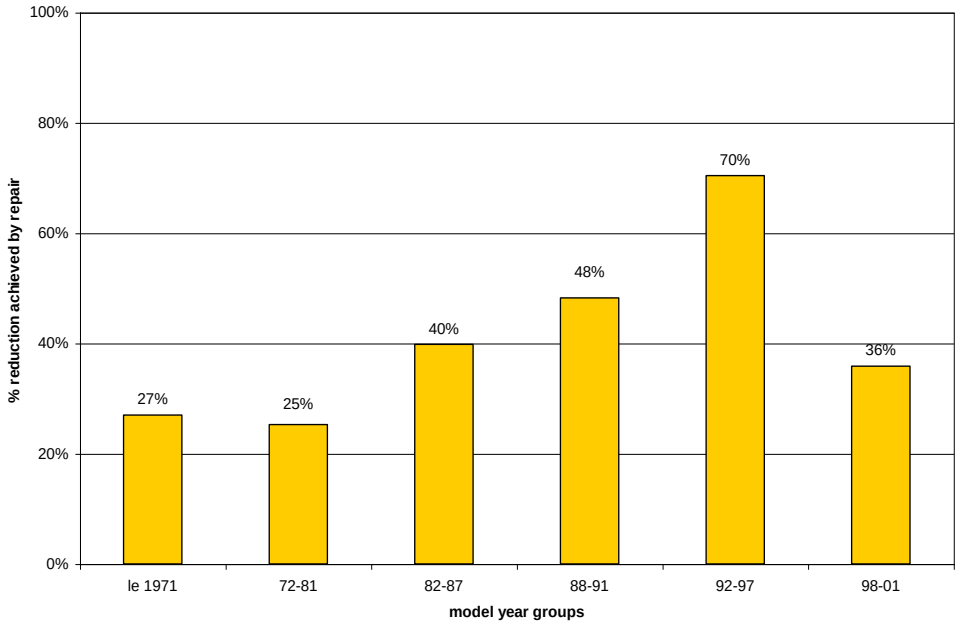
Impact-Weighted Emission Factors (= HC + CO/7 + NOx)

The graphic shows that the average emission rate for *failing* 1998-2001 vehicles is lower than the average for *passing* vehicles from model years 1992-1997. This reflects the strides made by new vehicle manufacturers in reducing tailpipe emissions and improving the durability of vehicle emission control systems in recent years. However, OBD has also increased the stringency of in-use testing, because the system constantly monitors emission related parameters and will set codes and turn on the MIL whenever a fault is detected. Also, the OBD system can act in a preventative manner, flagging potential problems before tailpipe emissions have actually been affected. Some OBD faults, however, are related to the diagnostic system itself, meaning that the repair only restores proper operation of the OBD system with no effect on tailpipe emissions. Regardless, such repairs are legitimate, as it is important that the OBD system be fully functional in order to detect the faults that do increase tailpipe emissions, should they occur.

Due to the fact that the OBD system identifies the problem area, repairs can be more focussed and more efficient. Over 95% of OBD re-inspections were successful during the review period.

EMISSION REDUCTION AS A PERCENTAGE OF INITIAL FAIL RESULT

Another measure of the effectiveness of repairs is to take the initial test results for each vehicle that failed and compare them to the final post-repair result. The next figure shows the emission reductions indicated by this method. All data is from full-duration IM240 tests.



Effect of Repairs % Reduction = (Failed - Repaired) / Failed

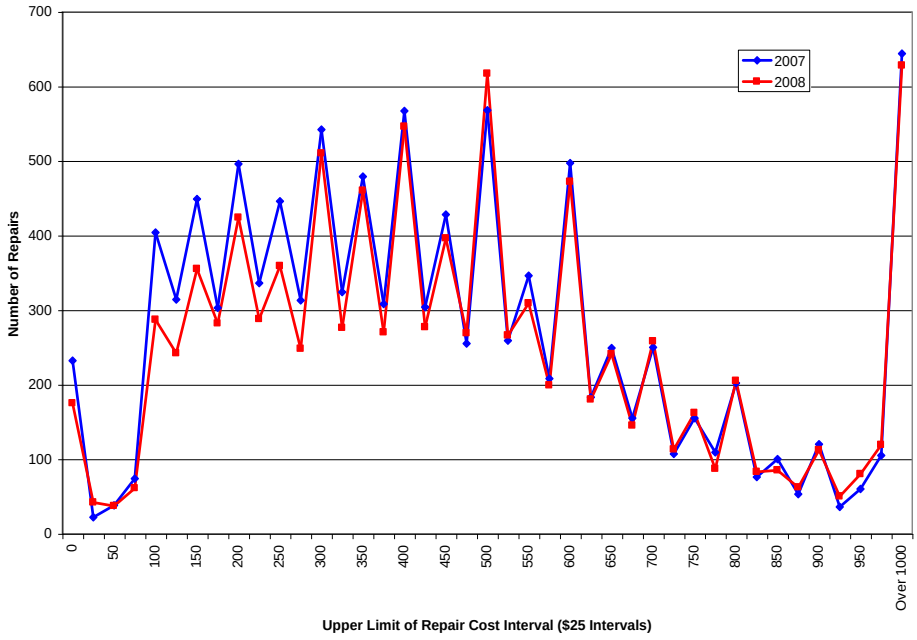
It is apparent that post-repair emission test results vary significantly according to age groupings. Vehicles subject to the IM240 test process showed an average reduction of 70% in emissions after repair. Older vehicles, tested according to the less-rigorous ASM/Idle test, showed lower percentage reductions ranging from 25% to 48%. However, because the older, failing vehicles typically emit 5 to 7 grams per kilometre of impact-weighted pollutants compared to about 4.5

g/km for failing 1992-1997 vehicles, a 40% reduction from 7 g/km is a larger absolute emission reduction (3.36 g/km) than a 70% reduction from 4.5 g/km (3.15 g/km).

For vehicles subject to OBD inspections, the average reduction in tailpipe emissions was 35%. While this may appear small compared to the IM240 test, it must be remembered that there are a number of OBD failure modes that may have no direct effect on tailpipe emissions. Analysis of the available data showed that OBD trouble codes associated with key emission control components like oxygen sensors or catalytic converters were strongly correlated with fairly large emission reductions. These cases, however, were offset by cases where the OBD repair had little or no indicated tailpipe emission benefit.

COST OF REPAIRS

The distributions of reported repair costs in 2007 and 2008 had much the same profile as in previous years. However, the median cost has continued to increase each year - from $360 in 2005 and $400 in 2006, to $400 and $428 in 2007 and 2008. Median values have been used instead of averages to minimize the effect of extreme values reported by repair shops. Many repairs are reported at zero cost, and many with costs well over $1000. It should be borne in mind that the accuracy of this data is compromised: the costs are those reported as part of the repair data submitted by the certified repair industry, and these represent less than 20% of all repairs.

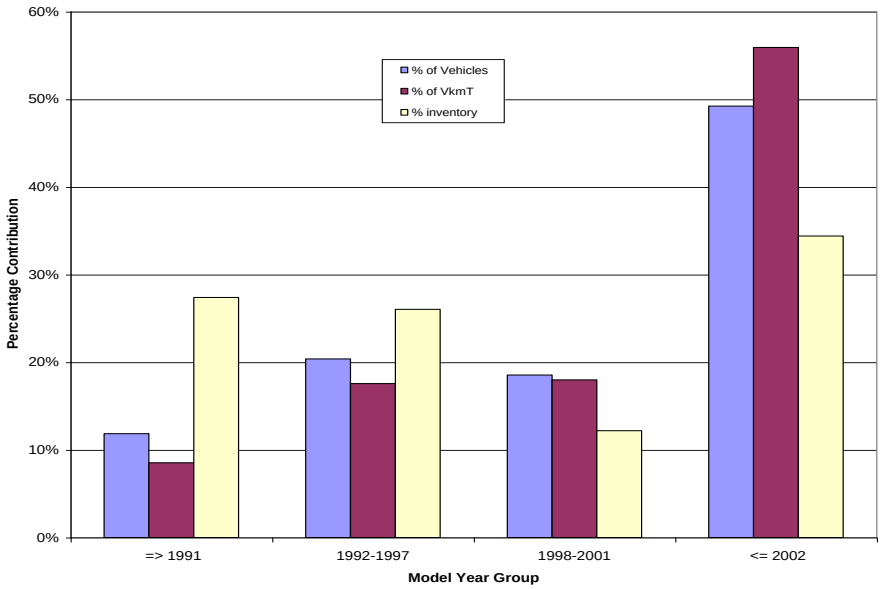


Distribution of Reported Repair Cost in 2007 and 2008

TOTAL EMISSIONS OUTPUT BY AGE GROUP

The total emission output by age/technology group is a function of the number of vehicles in each age group, their annual kilometres traveled, and their rate of emission output. For example, a relatively small population of high-emitting vehicles can contribute a significant

fraction of the overall emissions if the remainder of the population has very low emissions. The next figure shows the relationship between registered population, annual kilometers driven and percent of overall fleet emissions contributed by age group. On one hand, the number of vehicles and kilometres traveled increases steadily from the oldest to the newest age group. On the other hand, the emissions inventory contributions decrease in much the same proportions from old to new. Vehicles from model years 2001 and newer constitute 48% of the fleet and contribute 56% of vehicle-kilometres-traveled, but account for a disproportionately smaller 34% of the total emissions. Conversely, vehicles from the 1991-and-older model year group comprise only 11% of the fleet and contribute an even smaller 8% of the total vehicle-kilometres-traveled, but account for 28% of the total emissions – well out of proportion to their numbers and driving activity. It is quite clear that as long as older, high emitting vehicles remain in the fleet, they will continue to have a disproportionate effect on the overall inventory.



VkmT vs. Emissions Contribution by Model Year Group

Some I/M programs in the United States have gone exclusively to OBD inspections, because 1996 model year vehicles were required by law to be OBD compliant, meaning that 80%+ of the in-use fleet can be tested with OBD. The preceding data show, however, that the majority of excess emissions is attributable to the oldest vehicles in the fleet. It appears that emission control technology is becoming less susceptible to degradation over time but it remains to be seen how these vehicles will perform when they age beyond 10 years. Registration data suggest that the life expectancy of a vehicle is now around 15 years. If major emission control components fail in this timeframe, there will continue to be an indefinite and disproportionate contribution of emissions by the oldest fraction of the fleet.

CONCLUSIONS

- On an impact-weighted basis, repairs related to AirCare failures reduced total light-duty vehicle-generated emissions by 7.1% in 2007 and 6.3% in 2008. A further potential 4.6% and 4.3%, respectively, resulted from a portion of the failing vehicle fleet being removed from use.

- The impact-weighted emissions inventory trend lines from 1990 through 2030 show a large benefit from AirCare in the 1995-2005 period. Good agreement is evident between the MOBILE emission inventory model and estimated fleet emission inventory based on AirCare emission rate data through 2008.
- A new “No AirCare Ever” trend line is needed for the 1990-2030 period in order to establish a reference level for AirCare III. Based on the available data, which goes only to 2005, the actual light-duty emissions inventory according to MOBILE6 was 36.4% lower than the “No AirCare Ever” estimate for 2005. The estimate for 2005 based on AirCare program data suggests a result 53% lower than the “No AirCare Ever” baseline. The true figure is somewhere between these values.
- According to the MOBILE6 model, the impact-weighted emissions attributable to light-duty vehicles decreased from 162,500 tonnes in 1990 to 57,000 tonnes in 2005 (a 65% reduction) with a projected value of 42000 tonnes by 2010 (a 74% reduction). This is the combined effect of new vehicle technology and AirCare.
- The OBD inspection method has been successfully introduced and is showing a high rate of successful repairs. The failure rate for OBD inspections was consistently about 6% during the review period.
- On average, vehicles passing re-inspection had emissions 25%-70% lower than the initial failing result. Reductions on a percentage basis were highest (70%) for the 1992-1997 model year group, but it is necessary to factor in the absolute emission rate in order to determine which group produces the largest inventory reductions
- AirCare continues to accelerate the retirement of excess emitting vehicles. Of the 11,506 vehicles that failed in 2007 and have never appeared for a re-inspection, 81% of them were not licensed in the AirCare operating region as of August 2009.
- The amount of repair data submitted by Certified AirCare Repair Centres continues to decline each year. Less than 20% of re-inspections now have associated repair data.
- The number of Conditional Passes issued each year also continues to fall, reflecting the reduced role of the certified repair industry in the program and perhaps an increasing trend for vehicle owners to authorize the full repair of their vehicle as opposed to seeking only a Conditional Pass (Conditional Passes only allow a 1992-and-newer vehicle owner to license for 1 year whereas a full Pass is good for two years).
- The annual emission benefits related to repairs and removal from use appear to be stabilizing, suggesting a mature program in equilibrium. The cumulative, long-term benefits of AirCare testing have contributed to an accelerated decline in total emissions attributable to light-duty vehicles since the program began. Future projections of the inventory suggest that the trend line is flattening with limited future potential for reductions without significant technological change such as a widespread move to electric vehicles. However, it appears that AirCare has the potential to maintain some of the advantage gained over the past 16 years by identifying and causing the correction of vehicles that develop defects as they age.