

Data Collection and Analysis of Noncertified AirCare Repairs

Final Report

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- soliciting respondents' participation in providing copies of invoices for
- emissions-related repairs performed on vehicles prior to the inspection; and
- collating repair invoices with the appropriate registration numbers.

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- the printing of solicitation materials that were distributed by ETC;
- data entry and analysis; and,
- writing the final report on the project.

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Table of Contents

Table of Contents.....	i
1.0 Executive Summary	1
1.1 Background	1
1.2 Data Collection Project	1
1.3 Observations	1
2.0 Introduction	3
3.0 Project Plan.....	4
3.1 Project Design	4
3.2 Schedule.....	4
3.3 Estimated costs	4
3.4 Participant Solicitation	4
4.0 Data Analysis	6
4.1 Cost of Repairs.....	6
4.1.1 Total Repair Cost.....	6
4.1.2 Diagnostic Fees and Non-Emission Repairs	7
4.2 Repair Actions	7
4.3 Repair Success Rates	9
4.4 Non-Reported Repairs from Certified Shops	10
4.5 DIY Repairs	10
4.6 Other Observations	10
Appendices	a

1.0 Executive Summary

1.1 Background

The AirCare program identifies light duty vehicles with excessive emissions and requires the vehicles to have repairs performed to the emission control system to pass a re-inspection. Motorists whose vehicles are repaired at an AirCare Repair Centre are eligible for a conditional pass even though all repairs have not been completed at the time of re-inspection.

Emissions reductions and program effectiveness can be calculated by using emissions factors for repairs performed by AirCare Repair Centres. However, the AirCare Repair Centres only account for approximately forty percent of the number of repair facilities in the lower mainland. There is a risk that the emissions reductions and program effectiveness has been understated in that no consideration or credit has been given to repairs performed by the no-certified repair facilities.

A pilot project was initiated to collect invoices from motorists who had repairs performed at noncertified repair facilities. The motorists were offered a token amount for their participation. The data from the invoices were then analyzed and compared to the data from the AirCare Repair Centres.

1.2 Data Collection Project

For a period of sixteen months beginning in January 2005, PVTT asked ETC to provide hand-outs to motorists who were having their vehicles inspected to solicit participation in a data collection project by providing copies of their repair invoices. Motorists who participated were given a toonie. Approximately 1676 invoices were collected over this period and the data analyzed by PVTT staff.

1.3 Observations

The following observations are drawn from the analysis of the data provided:

- Motorists go to noncertified repair facilities to avoid paying the charge for a diagnostic check to determine functionality of emissions control components or system;
- The difference between the average cost of repairs between a non-certified repair facility and an AirCare Repair Centre is approximately equal to the average cost of a diagnostic check;
- Repairs performed by noncertified repair facilities are as effective in reducing emissions as those performed by AirCare Repair Centres;
- Only half of the vehicles in the sample passed their first re-inspection. Another quarter required one more attempt. And the remaining quarter averaged between 5 and 6 attempts before finally passing or conditionally passing.

- Many motorists perform self-diagnosis on their vehicles before having repairs performed at noncertified repair shops;
- Do-It-Yourself (DIY) repairs are often not effective and commonly result in subsequent visits to AirCare Repair Centres;
- Typical DIY repairs include regular maintenance items such as spark plugs, ignition wires, distributor cap/rotor and air filter.
- Approximately sixteen percent of the total repairs were performed by AirCare Repair Centres of which approximately sixty percent of the repairs had no Repair Data Forms (RDF) submitted with the repairs.

2.0 Introduction

The AirCare program has a fleet of approximately 1.2 million vehicles within the program area. These vehicles are subject to periodic emissions inspections and must pass or conditionally pass as a condition of licence and insurance renewal. A mechanism is in place that enables a vehicle to be eligible for a conditional pass even though not all repairs have been performed on the vehicle. This mechanism is only available for emissions-related repairs that are performed at AirCare Repair Centres and Repair Data Forms (RDF) are submitted by AirCare Repair Centres.

The number of RDFs submitted by the AirCare Repair Centres have been decreasing at a dramatic rate: RDFs were submitted for approximately forty eight percent of the failed vehicles in 1993/1994 but only approximately twenty three percent of the failed vehicles in calendar year 2005. This marked decrease in the number of RDFs submitted suggested that an increasing number of vehicles were being repaired by the noncertified repair facilities within the program area or by vehicle owners themselves.

Although it appears that more than half of all repairs performed as a result of the AirCare program are done at noncertified repair shops, to date no data has been available on what these repairs are or what they cost. The existing assumption has been that their costs and effectiveness are about the same as certified repairs but, this is not backed up by any real evidence. In fact their cost-effectiveness could be better than the cost effectiveness of certified repairs, or it could be worse. This can make a significant difference in the overall AirCare Program cost-effectiveness, and therefore in the perception of whether the program continues to be worthwhile.

By collecting a sample of noncertified repair data, we were able to assess how important these repairs are to the program and how they compare to certified repairs. The project findings could result in modified policies pertaining to the repair industry, certification, monitoring, and conditional passes.

3.0 Project Plan

BCCARF, ETC and PVTT jointly funded this project to solicit repair invoices from vehicle owners who had repairs performed at noncertified repair facilities. ETC and PVTT provided in-kind contributions to the project while BCCARF provided direct funding for a maximum of six thousand dollars for three thousand repair invoices. Vehicle owners who participated in the program were give a token incentive of two dollars.

3.1 Project Design

When a vehicle initially failed its inspection, a flyer explaining this project was included in the documents given to the driver. These documents already explained what to do after failing and how to arrange repair; and they included a rated list of all certified repair centres. The flyer encouraged those customers that do not use the certified industry, to bring some repair invoice/work order documentation when they returned for re-inspection.

At re-inspection those vehicles that have had certified repairs are already identified by the system. The owners of those that have not had such repairs were asked whether they have relevant invoices or work orders. This was done at the beginning of the re-inspection process. Vehicle owners who wished to participate in the project provided the inspection centre manager with the relevant documentation. The inspection centre manager then made copies and hand over the \$2.00 incentive allowance. All documentation was periodically collected by ETC and forwarded to PVTT for data entry.

3.2 Schedule

The project started on January 3, 2005 and data entry and analysis was completed by May 31, 2006.

3.3 Estimated Costs

The operational costs of collecting repair documentation from customers, validating it, and collating it into a form suitable for data entry was borne entirely by Envirotech Canada. ETC also administered the disbursement of the incentive allowance to customers, and kept a detailed account that could be cross-checked with the repair documentation collected.

PVTT covered its own internal costs for data entry, analysis, reporting, and presentation. BCCARF will be invoiced for \$3352.00 as their contribution to the project at a rate of \$2 for each invoice copied.

3.4 Participant Solicitation

Participants were solicited on a random basis throughout the inspection network. The solicitation hand-out was included with the "What to Do if Your Vehicle Doesn't Pass" brochure which is handed out to every motorist whose vehicle had

failed the inspection. A copy of the hand-out appears as Appendix A to this report.

There were 1676 respondents to the solicitations which were made to approximately 13 thousand motorists for a 12 percent response rate.

4.0 Data Analysis

It was expected that some data would come from repairs that were actually performed by certified repair shops, but which had not been entered into the repair data system, for some reason. It was also expected that some repairs would be DIY. However, most data was expected to be derived from repairs done at shops that were not certified, and this was indeed the case. The following analyses will treat the certified; noncertified and DIY repairs separately. Of the 1648 records over three quarters (78%) were for repairs performed by non-certified shops; one sixth (17%) were from certified shops that had not submitted data through the RepairNet; and just one in twenty (5%) were DIY repairs.

Data analysis was conducted to examine the following issues:

- the cost of noncertified repairs;
- the types of repairs undertaken by the noncertified repair facilities;
- the incidence of repairs performed by AirCare Repair Centres with no RDF submission; and,
- the incidence of DIY repairs
- the quality of noncertified and DIY repairs in comparison to certified.

4.1 Cost of Repairs

4.1.1 Total Repair Cost

There is little difference in the total cost of the repairs from Certified and Noncertified shops. They averaged to \$441 and \$436 respectively, and both compare well to an average value of \$436 for all certified repairs where data was submitted through the RepairNet in the same period. However, the average cost of DIY repairs was less than half these levels, and illustrates that cost is naturally an important motivator for DIY repairs.

Repair Costs	# of repairs	Total Reported Cost	
		mean	median
certified	276	\$ 441	\$ 300
noncertified	1282	\$ 436	\$ 335
DIY	89	\$ 178	\$ 150
all	1648	\$ 423	\$ 325

4.1.2 Diagnostic Fees and Non-Emission Repairs

The main data-entry phase of the project did not attempt to identify whether repairs shops were charging a separately identifiable diagnostic fee, or to identify how much of the total reported cost was for non-emission related repair actions. However, anecdotal appreciation of the individual invoices suggested that these issues may be important, so samples of first 50, and then 100 records were analysed to these ends. A sample of 100 showed similar overall average costs as the complete dataset.

Over a quarter (27%) of the sample did include an identifiable diagnostic fee. The number of such fees were about equally split between certified and noncertified shops, which means that it is much more common for certified shops. The level of the fee was higher for certified shops.

100Sample	# of repairs	mean	median
all	99	\$ 455	\$ 325
diagnostic fee	27	\$ 88	\$ 88
non-emission repairs	17	\$ 755	\$ 400

diagnostic fee	# of repairs	mean	median
certified	13	\$ 94	\$ 99
noncertified	14	\$ 82	\$ 82

From the sample of 100, only 17 cases included non-emission repairs. Some of these repairs were very expensive, totaling over \$3000, and their mean cost was \$755.

4.2 Repair Actions

The RepairNet allows data input for 91 different repair items. The same listing was used for this project. Each item identified was noted as either Replaced (R) or Serviced (S). Appendix B of this report is a table that shows the frequency all of repair actions. The following sections only consider the repair actions that were most frequent. The tables are sorted in ranked order, with the ranking determined by adding Replaced and Serviced actions for each item. Items that were identified as Defective (i.e. in need of repair) but not actually repaired are also shown.

By far the most common repairs were for the catalytic converters and for oxygen sensors. These are also the only items which repair shops commonly reported as defective even when they did not repair/replace them.

Repairs from Certified Shops

repair action	certified			
	D	R	S	R+S
66 Catalytic Converter	16	78		78
40 Oxygen Sensor	14	68	3	71
1 Spark Plugs		49	3	52
84 Oil Contamination		36		36
9 Air Filter		25		25
22 Fuel Injection Other		19	5	24
2 Ignition Wires		17	2	19
4 Distributor Cap/ Rotor		18		18
27 Carburetor	1	14		14
69 PCV System	2	11	2	13
7 Ignition Timing			12	12
72 EGR Valve	2	9	2	11
16 Idle Speed			10	10
17 Idle Mixture			10	10
21 Throttle Body			6	6
43 Coolant Temperature Sensor	1	5		5
79 Manifolds/ Gaskets		4	1	5
39 MAP/ BARO Sensor		1	3	4
77 Cylinder Head		3	1	4
6 Ignition Coils		1	2	3
14 Vacuum/ Air Leak		1	2	3

D=Defective, R=replaced, S=Serviced

Repairs from Noncertified Shops

repair action	noncertified			
	D	R	S	R+S
66 Catalytic Converter	23	524	6	530
40 Oxygen Sensor	18	254	12	266
84 Oil Contamination		248		248
1 Spark Plugs		237	9	246
9 Air Filter		169	3	172
4 Distributor Cap/ Rotor		125		125
2 Ignition Wires		108	2	110
22 Fuel Injection Other		65	26	91
69 PCV System		73	1	74
72 EGR Valve	3	60	5	65
27 Carburetor		7	32	39
7 Ignition Timing	2	0	31	31
16 Idle Speed			31	31
17 Idle Mixture			31	31
86 Thermostat	1	31		31
14 Vacuum/ Air Leak		7	18	25
79 Manifolds/ Gaskets	2	20	3	23
20 Fuel Injector	1	9	10	19
77 Cylinder Head		11	8	19
42 Air Flow Sensor	1	12	6	18
78 Block		11	4	15

D=Defective, R=replaced, S=Serviced

Do-It-Yourself Repairs

repair action	DIY			
	D	R	S	R+S
40 Oxygen Sensor		32		32
66 Catalytic Converter		27		27
1 Spark Plugs		20		20
2 Ignition Wires		17		17
9 Air Filter		16		16
69 PCV System		10		10
84 Oil Contamination		8		8
27 Carburetor		4		4
11 Air Ducting		1		1
21 Throttle Body		1		1
39 MAP/ BARO Sensor		1		1
72 EGR Valve		1		1
81 Combustion Deposit		1		1
86 Thermostat		1		1
3 Distributor				0
4 Distributor Cap/ Rotor				0
5 Ignition Control Module				0
6 Ignition Coils				0
7 Ignition Timing				0
8 Spark Advance				0
10 Thermostatic Air Cleaner				0

D=Defective, R=replaced, S=Serviced

4.3 Repair Success Rates

In terms of the inspection results achieved, DIY repairs were not as successful as other repairs. However, there is little difference in the success rates between repairs from certified and noncertified shops, both gave a better than 9 out of 10 chance of passing inspection. For information, the overall pass rate for repairs that were submitted through RepairNet in the same period was only 79%, but this is a rate which is heavily influenced by the availability of a conditional pass for such repairs, and such conditional passes are commonly used to mitigate the need for expensive repairs. In contrast, all the repairs in this project must have been intended to achieve a full pass, because the conditional pass was not available in these circumstances.

The DIY repairs had only an 8 out of 10 chance of passing. This is quite good when their costs are considered, and suggests that the additional cost of improving the odds to 9 out of 10 is comparatively high.

	Inspection Pass Rate
certified repair shops	91%
noncertified repair shops	94%
DIY repairs	82%

None of the vehicles in this project were eligible for a conditional pass on the basis of the repair data collected, so in order to be re-licenced, all those that failed inspection would have needed further repairs. The subsequent inspection data indicates that many chose to use certified repair shops and/or have the repair data entered into the RepairNet.

4.4 Non-Reported Repairs from Certified Shops

This project was the first chance we have had to see how common it is for certified shops to not enter data to the RepairNet. There are a number of possible reasons for such a decision, such as:

- Customer did not specify that the repair was for AirCare
- Vehicle was fully expected to pass, and therefore not need the possibility of conditional pass.
- Vehicle was tested just to see if a first attempt at repair was good enough

We know that only about 40% of all vehicles which fail inspection have repair data entered to RepairNet, which has been taken as an indication of how many repairs are undertaken by the certified shops. However, because 17% of the project data was for repairs at certified shops, this suggests that another 10.2% ($=0.60 \times 0.17$) of failed vehicles are actually using the certified shops, and brings their total to about 50% of all failed vehicles.

4.5 DIY Repairs

The costs for DIY repairs, and the limited range of repair items, suggests that they are most commonly attempted when there is a high level of confidence about what problem should be tackled, without entering into a sophisticated analysis. This approach of simply replacing the most likely components works 8 times out of 10, and because only parts costs are incurred, it certainly saves the vehicle owner money. This is not to say that the same odds of success would apply if the same approach were used for all repairs. For more obscure problems it may just waste time and money by replacing components that still function correctly.

4.6 Other Observations

The following observations have been made from reviewing the invoices provided and discussions with several AirCare Repair Centres:

- DIY repairs tend to attract motorists who have some mechanical aptitude and the parts are purchased from retailers who offer employee discounts, typically thirty percent off list pricing;
- A small segment, approximately two percent, of motorists have repairs performed at noncertified repair facilities because the components installed by the repair facilities have failed and are within the defined warranty period;
- A still smaller segment of motorists use AirCare Repair Centres to avail themselves of the conditional pass. These motorists apparently do not have any customer loyalty and are only interested in spending up to the Repair Cost Limits to be eligible for a conditional pass.

Appendices

A 1 Noncertified Repairs Data Collection Hand-Out

We need your Assistance!

Are you planning to have your vehicle repaired at a facility that is not an AirCare Certified Repair Centre? The AirCare program is interested in collecting your repair data.

To participate, all you have to do is present your repair invoice to the first AirCare lane inspector when you arrive for your AirCare re-test with this flyer attached. The inspector will photocopy the invoice and return the original with a Toonie (\$2) for your assistance.

Please note that AirCare is only interested in the repair data. Every effort will be made ensure your anonymity and protect your privacy. All photocopies will be destroyed once the project is completed.

We thank you for your participation in this project.

A 2

Frequency of all Repair Actions

repair action	all			certified			noncertified			DIY		
	D	R	S	D	R	S	D	R	S	D	R	S
1 Spark Plugs		306	12		49	3		237	9			20
2 Ignition Wires		142	2		17	2		108	2			17
3 Distributor		7	2		1	1		6	1			
4 Distributor Cap/ Rotor		155			18			125				
5 Ignition Control Module		1						1				
6 Ignition Coils	1	4	2		1	2		2	2			
7 Ignition Timing		2	43			12	2		31			
8 Spark Advance			2						2			
9 Air Filter		210	3		25			169	3			16
10 Thermostatic Air Cleaner			1					1				
11 Air Ducting	2	1		2								1
12 Heat Riser												
13 Turbo/ Super Charger			3						3			
14 Vacuum/ Air Leak		8	20		1	2		7	18			
15 EFE system	1			1								
16 Idle Speed			41			10			31			
17 Idle Mixture			41			10			31			
18 Fuel Pressure Regulator		4	2		1			3	2			
19 Fuel Pump		6	1					3	1			
20 Fuel Injector	1	9	12			2	1	9	10			
21 Throttle Body		3	14			6		2	8			1
22 Fuel Injection Other		84	31		19	5		65	26			
23 Choke												
24 Float												
25 Power Valve												
26 SPARE												
27 Carburetor	1	11	46	1	14			7	32			4
28 Carburetor Other												
29 Alternative Fuel Mixer			11						11			
30 Alternative Fuel Regulator												
31 Fuel Lock-Off												
32 Vapourizer												
33 Alternative Fuel Controls												
34 Alternative Fuel System Other												
35 Power Control Module	2	9	2		3		2	6	2			
36 PROM/ flash/CAL PACK												
37 Trouble Codes						1			6			
38 Computer Other												
39 MAP/ BARO Sensor	1	7	4		1	3	1	5	1			1
40 Oxygen Sensor	32	354	15	14	68	3	18	254	12			32
41 Throttle Position Sensor		5			1			4	0			
42 Air Flow Sensor	2	13	8	1	1	2	1	12	6			
43 Coolant Temperature Sensor	1	19		1	5			14				
44 EGR Sensor		1			1							
45 Air Temperature Sensor	1	6		1				6				
46 Vehicle Speed Sensor		1						1				
47 Input Other		3	1					3	1			
48 Data Output/ MIL	1	8				1	1		7			
49 Fuel Injector												
50 Mixture Control Solenoid		1			1							
51 EGR Controls												
52 Idle Air Control		4	5		2	1		2	4			
53 Electronic Air Controls												
54 Transmission Controls												
55 Outputs Other	1	3			1		1	2				
56 Power Wiring								1				
57 Ground Wiring												
58 Relays												
59 Alternative Fuel Electronics												
60 Feedback System												
61 Dual Curve Module												
62 Computer FIX												
63 Alternative Fuel Other												
64 Air Pump System		2	1					2	1			
65 Pulse Air System		1						1				
66 Catalytic Converter	39	629	6	16	78		23	524	6			27
67 Vacuum Controls		1						1				
68 Evap System		1						1				
69 PCV System	2	94	3	2	11	2		73	1			10
70 EM Control Other												
71 EGR System		2	11					2	11			
72 EGR Valve	5	70	7	2	9	2	3	60	5			1
73 EGR Passage	4	1	7	3	1	1	1	1	6			
74 Vacuum Switch		6			1			5				
75 EGR Controls	1	15			1		1	14				
76 EGR Other		1						1				
77 Cylinder Head		14	9		3	1		11	8			
78 Block		12	6		1	2		11	4			
79 Manifolds/ Gaskets	2	24	5		4	1	2	20	3			
80 Compression			4			1		3				
81 Combustion Deposit		1	13			3			10			1
82 Valve Adjustment			4			1			3			
83 Valve Timing		7	3		1	1		6	2			
84 Oil Contamination		292			36			248				8
85 Engine Mechanical Other												
86 Thermostat	3	35		2	3		1	31				1
87 Cooling Fan		1						1				
88 Fan Controls												
89 Radiator		6	4		2			4	4			
90 Major Leaks	1	1		1				1				
91 Coolant System Other		3	1					3	1			