

# **SURVEY OF FLEET EXPERIENCE WITH HEAVY VEHICLE ABS OPERATION**

Prepared for the  
Transportation Development Centre  
Safety and Security  
Transport Canada

FINAL REPORT  
April, 1996



**Beauchemin - Beaton - Lapointe Inc.**  
CONSULTING ENGINEERS

2045, Stanley Street, Montréal, Québec H3A 2V4



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Un sommaire en français de ce rapport est inclus avant la Table des matières.



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16. Abstract <p>This report results from a project entailing a survey of fleets operating ASS-equipped heavy vehicles to obtain data on their in-service experience with these systems. The survey included an initial written questionnaire followed by telephone inquiries to obtain clarifications on responses as well as complementary information.</p> <p>The overall objective of the survey was to determine fleet operators' general perception of ASS performance, benefits and costs. Consequently, it focused on the following aspects of operator experience:</p> <ul style="list-style-type: none"> <li>.Operational performance and durability of ASS</li> <li>.Accident reduction and potential adverse effects of ASS</li> <li>Availability of ASS parts, service and technical support</li> <li>Vehicle and ASS maintenance</li> <li>Cost impact of ASS</li> </ul> <p>The questionnaire generated responses from ten fleets, from all major regions of Canada, operating a total of some 10000 non-ASS and 1 250 ASS units, each travelling an average of 1 00 000 km during the six-month period covered by the survey.</p>					
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16. Résumé <p>Ce rapport résulte d'un projet qui consistait essentiellement en l'exécution d'une enquête au près de flottes opérant des véhicules lourds équipés de systèmes de freinage ABS, afin d'obtenir des données sur leur expérience opérationnelle de ces systèmes. L'enquête comportait un questionnaire écrit ainsi que des contacts téléphoniques subséquents permettant d'obtenir des précisions sur les réponses reçues et des informations complémentaires.</p> <p>L'objectif global de l'enquête était l'obtention d'un aperçu de la perception générale par les opérateurs de flottes de la performance des freins ABS ainsi que des bénéfices et des coûts qui y sont associés. Par conséquent, l'enquête s'est concentrée sur les aspects suivants de l'expérience des opérateurs :</p> <ul style="list-style-type: none"><li>la performance opérationnelle et la durabilité des systèmes ABS;</li><li>la réduction des accidents et l'effet contraire potentiel des systèmes ABS;</li><li>la disponibilité des pièces, du service et du support technique;</li><li>l'entretien des véhicules et des systèmes ABS;</li><li>l'impact des systèmes ABS sur les coûts.</li></ul> <p>Le questionnaire a été complété par dix flottes, situées dans toutes les principales régions du Canada, opérant un total de quelque 10 000 unités à freinage conventionnel et 1 250 unités équipées de freins ABS, chacune ayant parcouru une distance d'environ 100 000 km durant les six mois couverts par l'enquête.</p>					
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Mr Sesto Vespa, Transportation Development Centre  
Mr Jim White, Transport Canada

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## SUMMARY

This report results from a project entailing a survey of fleets operating ABS-equipped heavy vehicles to obtain data on their in-service experience with these systems. The survey included an initial written questionnaire followed by telephone inquiries to obtain clarifications on responses as well as complementary information.

The overall objective of the survey was to determine fleet operators' general perception of ABS performance, benefits and costs. Consequently, it focused on the following aspects of operator experience:

- Operational performance and durability of ABS
- Accident reduction and potential adverse effects of ABS
- Availability of ABS parts, service and technical support
- Vehicle and ABS maintenance
- Cost impact of ABS

The questionnaire generated responses from ten fleets, from various regions of Canada, operating a total of some 10 000 non-ABS and 1 250 ABS units, each travelling an average of 100 000 km during the six-month period covered by the survey. The main conclusions supported by the survey results are as follows:

- Fleet operators appear to have a generally positive perception of ABS as useful, reliable, durable and relatively trouble-free equipment that is more and more frequently installed on new vehicles and is becoming a trucking industry standard.
- In terms of road safety, respondents to the survey acknowledge that ABS reduce vehicle stopping distances and increase vehicle stability during braking. Three respondents identify the capacity of ABS to prevent jack-knife incidents as a very significant contribution to road safety.
- The availability of ABS parts, service and technical support is perceived by fleet operators as improving, but still requiring further efforts, particularly in smaller centres of operation.
- Survey respondents estimated the cost impacts of ABS as follows:
  - Increase in unit purchase prices: 2-5 %.
  - Increase in unit maintenance costs: 0-1 % and 2-5 % each by an equal number of respondents
  - Increase in total vehicle operating costs: approximate average of 1 %.

## SOMMAIRE

Ce rapport résulte d'un projet qui consistait essentiellement en l'exécution d'une enquête auprès de flottes opérant des véhicules lourds équipés de systèmes de freinage ABS, afin d'obtenir des données sur leur expérience opérationnelle de ces systèmes. L'enquête comportait un questionnaire écrit ainsi que des contacts téléphoniques subséquents permettant d'obtenir des précisions sur les réponses reçues et des informations complémentaires.

L'objectif global de l'enquête était l'obtention d'un aperçu de la perception générale par les opérateurs de flottes de la performance des freins ABS ainsi que des bénéfices et des coûts qui y sont associés. Par conséquent, l'enquête s'est concentrée sur les aspects suivants de l'expérience des opérateurs :

- la performance opérationnelle et la durabilité des systèmes ABS;
- la réduction des accidents et l'effet contraire potentiel des systèmes ABS;
- la disponibilité des pièces, du service et du support technique;
- l'entretien des véhicules et des systèmes ABS;
- l'impact des systèmes ABS sur les coûts.

Le questionnaire a été complété par dix flottes, situées dans diverses régions du Canada, opérant un total de quelque 10 000 unités à freinage conventionnel et 1 250 unités équipées de freins ABS, chacune ayant parcouru une distance d'environ 100 000 km durant les six mois couverts par l'enquête. Les principales conclusions supportées par les résultats de l'enquête sont les suivantes :

- les opérateurs de flottes semblent, de façon générale, considérer les systèmes ABS comme de l'équipement utile, fiable et relativement peu exigeant qui est de plus en plus fréquemment installé sur les véhicules neufs et qui devient un standard dans l'industrie du camionnage;
- en termes de sécurité routière, les participants à l'enquête reconnaissent que les freins ABS réduisent les distances de freinage et augmentent la stabilité des véhicules durant le freinage. La capacité des systèmes ABS de prévenir le phénomène de « mise en portefeuille » a été identifiée par trois opérateurs comme étant une importante contribution à la sécurité routière;
- les opérateurs de flottes considèrent que la disponibilité de pièces, de service et de support technique s'améliore, mais que des efforts additionnels sont requis particulièrement dans les centres secondaires;
- l'impact des systèmes ABS sur les coûts se situe à l'intérieur des fourchettes suivantes :
  - augmentation des prix d'achat des véhicules : 2-5 %
  - augmentation des coûts d'entretien : 0-1 % et 2-5 % chacune par un nombre égal de participants
  - augmentation des coûts totaux d'opération d'un véhicule : moyenne approximative de 1 %

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## 1.0 INTRODUCTION

This document constitutes the final report resulting from a project titled "Survey of Fleet Experience with Heavy Vehicle ABS" conducted by Beauchemin-Beaton-Lapointe Inc., consultants, for the Transportation Development Centre of Transport Canada during the last quarter of 1995 and the first quarter of 1996.

The project entailed a survey of fleets operating ABS-equipped heavy vehicles to obtain data and information on their in-service experience with these systems. The survey included an initial written questionnaire followed by telephone interviews to obtain clarifications and complementary information.

The subsequent chapters of this report provide:

- A description of the characteristics of the survey conducted under this project in terms of: its objectives, the methods utilised to obtain information and the criteria used to select respondents.
- The survey findings in relation to:
  - Fleet characteristics and their use of vehicles
  - Operational durability and safety performance of ABS
  - Maintainability of ABS
  - Impact of ABS on vehicle operating costs.
- The conclusions and recommendations derived from the analysis of the survey findings.



## **2.0 SURVEY CHARACTERISTICS**

The "Fleets Survey of Heavy Vehicle ABS Operation" project is part of ongoing Transportation Development Centre programs designed to address vital issues in highway freight transportation and road safety. This specific project is focused on anti-lock braking equipment, which has the potential of significantly improving safety, and its impact on freight transportation as perceived by fleet operators on the basis of their in-service experience of these systems installed on heavy vehicles.

### **2.1 Survey Objectives**

The first part of the survey, which consisted of a printed questionnaire sent to pre-selected respondent fleets, had the following stated objective:

"... to obtain feedback from Canadian motor carriers operating heavy vehicles with installed ABS in order to determine their experience with ABS technology as it relates to vehicle braking performance and accident rates as well as ABS performance, durability, maintainability and impact on vehicle operating cost."

The objective of the subsequent telephone survey of the same respondents was to obtain clarifications on their written responses as well as complementary information on specific issues raised by the initial analysis of the responses to the questionnaire received from all participating fleets.

The overall objective of the survey, as indicated by the type of questions submitted to the respondents, was to determine the general perception by fleet operators of ABS performance, benefits and costs on the basis of their in-service experience over the previous six-month period. Consequently, it was indicated to the respondents that high levels of accuracy were not essential and that their answers would be aggregated to provide an indication of the average industry-wide perception and opinion of ABS technology.

### **2.2 Survey Questionnaire**

The actual questionnaire submitted to the pre-selected respondents is provided as Appendix A to this report. Its two main features are as follows:

- To ensure respondent willingness to participate in the survey, it was designed to be simple to complete: space for answers was pre-formatted and multiple choice questions were used.
- To allow respondents to provide all the information that they may consider pertinent to the survey and to fully express their opinions, the questionnaire frequently suggests and provides space for additional "comments and information".

### 2.3 **Survey Respondents**

A total of ten (10) respondents were selected for this survey. The list of participating fleets, in alphabetical order, is provided as Appendix B to this report.

The selection criteria were as follows:

- The operation of significant numbers of comparable heavy vehicles equipped both with ABS and conventional braking systems to enable valid comparisons.

All participating fleets, except one, operate between 50 and 300 ABS-equipped units.

- To ensure Canada-wide sample representation, participation was sought from fleets in various regions.

The regional distribution of respondents is as follows: Maritimes 3; Quebec 4; Ontario 2; Western 1.

- The willingness of contacted fleets to participate in the survey.

The gracious participation of respondents is gratefully acknowledged.

The initial aim of the project was to survey a representative sample of 10 to 15 fleets and, as a result of this limitation, not all potential respondents in Canada were asked to participate. Consequently, absence of any given fleet from the list of respondents should not be considered as an indication of its refusal to participate in this survey.

### 2.3 **Telephone Inquiries**

Following a preliminary analysis of the responses generated by the survey questionnaires, each respondent was contacted by telephone and asked to provide answers to a series of questions. The purposes of these inquiries were to obtain clarifications of specific written



answers as well as complementary information on the experience of the respondents with ABS installed on heavy vehicles.

The detailed responses to these telephone inquiries are provided in Appendix C while pertinent information is included in related sections of 3.0 - SURVEY FINDINGS hereafter.

### 3.0 SURVEY FINDINGS

This chapter provides, both in summarised text form and in detailed table form the responses obtained from the participating fleets to the initial written questionnaire as well as, in italic script, the clarifications and complementary information obtained in subsequent telephone inquiries.

#### 3.1 Fleet Characteristics

The detailed information obtained from respondents is provided in Table 1. This information can be summarised as follows:

- Number of Heavy Vehicles in Fleet
  - The 10 respondents to the survey constitute an aggregate sample of 11 230 units of which 1 247 or 11.1% are ABS-equipped.
  - ABS equipment is substantially more common on tractors (843 of 2 935 units or 28.7 %) than on heavy trucks (95 of 546 units or 5.7 %) and semi-trailers (294 of 7 341 units or 4.0 %). Consequently, it appears that many units are being operated in an ABS(tractor)/non-ABS(trailer) configuration.

- Number of Heavy Vehicle Drivers with ABS Experience

It appears, though the responses on this item are quite incomplete, that the majority of drivers have had the opportunity to acquire experience with ABS.

- Description and Number of ABS

Again the responses on this item were incomplete but they indicate clearly that one manufacturer has the lion's share of the market with 76.7% of ABS while the other two manufacturers identified follow with shares of 19.7% and 3.6% respectively.

*Subsequent telephone inquiries confirmed the frequency of mixed ABS/non-ABS vehicle configuration and that drivers are not generally provided with formal training on ABS-equipped vehicles. However, they may, if they wish, experiment with ABS in the fleets' yards and attend occasional showings of videos on ABS performance produced and made available by manufacturers of ABS.*

**Table 1  
FLEET CHARACTERISTICS**

**Question # 2.1      Number of Heavy Vehicles in Fleet**

		RESPONDENTS									TOTALS
		A	B	C	D	E	F	G	H	I	
Heavy Trucks:	Conventional Braking	300		20				130		1	451
	ABS Equipped	15		10				70			95
Tractors:	Conventional Braking	50	155	3	250	100	540		956	38	2092
	ABS Equipped	15	10	47	130	150	133	91	192	75	843
Semi-Trailers : (excluding A and B trains)	Conventional Braking	40	475	87	536	1000	2219		2463	227	7047
	ABS Equipped	15		48	32	7	70	10	112		294
A-Train trailers:	Conventional Braking			2			39			1	42
	ABS Equipped										
B-Train trailers:	Conventional Braking	10			21	5	290	10		15	351
	ABS Equipped			6				5		4	15
Other: _____	Conventional Braking										0
	ABS Equipped										
<b>Totals</b>	<b>Conventional Braking</b>	400	630	112	807	1105	3088	140	3419	282	9983
	<b>ABS Equipped</b>	45	10	111	162	157	203	176	304	79	1247

**Question # 2.2      Number of Heavy Vehicle Drivers with ABS Experience**

		RESPONDENTS									TOTALS
		A	B	C	D	E	F	G	H	I	
No experience with ABS:								60		15	
Less than 1 year of experience with ABS:			10		> 100			40		105	
1 to 2 years of experience with ABS:				15	100to200			40		40	
More than 2 years of experience with ABS:				73				120		90	
<b>Total</b>			10	88				260		250	

**Question # 3      Description and Number of ABS Systems**

ABS System Manufacturers		RESPONDENTS									TOTALS
		A	B	C	D	E	F	G	H	I	
Manufacturer # 1		45	10	111	130	150	30	168		79	723
Manufacturer # 2						7	173	6			186
Manufacturer # 3					32			2			34
<b>Total</b>		45	10	111	162	157	203	176		79	943

### **3.2 Fleet Vehicle Use**

The detailed information obtained from respondents is provided in Table 2. This information can be summarised as follows:

- Distance Travelled

There does not appear to be any significant difference in the distances travelled by ABS and non-ABS units.

- Types of Products Hauled

There does not appear to be any significant difference in the types of products hauled by ABS and non-ABS units.

- Types of Hauling Environments

There does not appear to be any significant difference in the types of hauling environments for ABS and non-ABS units.

Consequently, it appears that fleet managers do not differentiate between ABS and non-ABS units and that this difference is not a factor in the assignment of vehicles to specific operations. The slight variations noted in the responses may be attributable to the fact that ABS units are probably newer on average and thus more likely to be assigned to long distance intercity hauling.



### 3.3 Operational Performance and Durability of ABS

The detailed information obtained from respondents is provided in Table 3. This information can be summarised as follows:

- ABS Operational Performance

When asked to rate the performance of ABS with respect to:

- Reliability and consistency of operation
- Stopping distance reduction
- Increased vehicle stability during braking
- Adequacy of warning light feature
- Reduction in premature tire wear
- Reduction in brake system wear

respondents almost unanimously chose HIGH (24/51 responses) and SATISFACTORY (23/51 responses) with only three responses being LOW and one NO OPINION for reduction in tire and brake system wear.

One respondent specifically reported positive comments by drivers with respect to performance on ice and snow.

- Durability of ABS

Respondents rated HIGH (3/9 responses) and SATISFACTORY (4/9 responses) the durability of ABS while two respondents had not formed an opinion.

*In subsequent telephone inquiries, respondents were asked if their drivers had reported any impact on the operational performance of ABS or specific problems associated with mixed ABS/non-ABS unit configurations. They all indicated never having received such reports from their drivers.*

*Respondents B, C, D, E, F, G, H and I indicated that, while their operational experience with ABS fully supports their opinion that ABS contributes significantly to tire and braking systems wear reduction, they have not extracted from their fleets' records actual hard data which quantifies the impact of ABS on these vehicle maintenance items.*



### 3.4 Accident Reduction / Adverse Effect of ABS

The detailed information obtained from respondents is provided in Table 4. This information can be summarised as follows:

- Accident Rate and Severity Reduction

When asked to rate the performance of ABS with respect to their potential for accident rate and severity reduction, the following answers were obtained:

- 3/9 respondents rated this potential as HIGH while commenting that the prevention of jack-knife incidents is a most important feature of ABS systems performance.
- 1/9 expressed a rating of MODERATE.
- 1/9 expressed a rating of NOT SIGNIFICANT while he indicated that he could not give a single example of a situation where ABS has prevented or reduced the severity of an accident.
- 4/9 indicated that they had NO OPINION, which was quite surprising since they had all previously stated that in their opinion ABS reduced stopping distances and increased vehicle control to HIGH and SATISFACTORY levels.

- Potential Adverse Effect

Two respondents indicated that, in their opinion, ABS could have an adverse effect on bumpy gravel roads and in emergency situations requiring the shortest possible stopping distance (one of these respondents had, however, previously indicated that in his opinion ABS reduces stopping distances).

None of the fleets has ABS equipped with turn-off switches allowing the drivers to disable the systems if they so desire.

*In a subsequent telephone interview, one of the NO OPINION respondents indicated that their introduction of ABS coincided with other safety promotion programs: driver training, driver safety awareness, substance abuse control, etc.; and that, while their accident record has substantially improved, he cannot rate with certainty the impact of ABS.*

*Respondents B, C, H and I indicated that, while their operational experience with ABS fully supports their opinion that ABS contributes significantly to the reduction of accident rate and severity, they have not extracted from their fleets' records actual hard data which quantifies the impact of ABS on road safety.*



**Table 4  
ACCIDENT REDUCTION / ADVERSE EFFECT OF ABS**

**Question # 6      Accident Rate and Severity Reduction**  
Please provide your best estimate of the potential of ABS to reduce accident rate and severity.

	RESPONDENTS									NUMBERS
	A	B	C	D	E	F	G	H	I	
<b>Accident Rate Reduction</b>										
High		X	X						X	3 / 9
Moderate								X		1 / 9
Low										
Not Significant				X						1 / 9
No Opinion	X				X	X	X			4 / 9
<b>Accident Severity Reduction</b>										
High		X	X						X	3 / 9
Moderate								X		1 / 9
Low										
Not Significant				X						1 / 9
No Opinion	X				X	X	X			4 / 9
Give examples, if any, of situations where ABS caused an accident to be avoided or reduced its severity.	Yes	X	X	X			X	X	X	
	No	X			X	X				

- (B) Prevents panic jackknife on icy roads. (Translation)
- (C) Avoids trailer jackknife.
- (D) None.
- (G) Cannot state with integrity.
- (H) Bobtail on wet road - prevents lock up.
- (I) Our experience over 4 years, since our trucks are ABS-equipped, is not a single jackknife occurrence. (Translation)

**Question # 7      Potential Adverse Effect**

	RESPONDENTS									TOTALS
	A	B	C	D	E	F	G	H	I	
7 Please indicate if there were situations or conditions in which ABS may have had the reverse effect of reducing safety.  If "Yes", please provide details.	Yes	X						X		2 / 8
	No		X	X	X	X	X		X	6 / 8
	Provided	X						X		
	Not provided									
7 Please indicate if your fleet's ABS are equipped with turn-off switches.  If "Yes", were there situations or conditions in which they were used by drivers?  If "Yes", please provide details.	Yes									
	No	X	X	X	X	X	X	X	X	9 / 9
	Yes									
	No									
Provided										
Not provided										

- (B) Gravel or bumpy road with a washboard-type surface. (Translation)
- (H) Vehicle stopping suddenly in front of truck.

### **3.5 Availability of ABS Parts, Service and Technical Support**

The detailed information obtained from respondents is provided in Table 5. This information can be summarised as follows:

The responses obtained on this aspect of ABS operation are quite scattered, ranging from EXCELLENT to VERY POOR. A more detailed analysis of the responses revealed, however, that the lower ratings were generally from respondents operating in smaller centres while fleets from larger metropolitan areas seem to be more satisfied with the availability of service and support.

There appears to be a need for additional efforts by the ABS manufacturers to increase the availability of parts, service and technical support, particularly in the smaller centres, which seem to feel neglected at the present time. This situation should, however, become less acute as ABS become more common and standard equipment on heavy vehicles. The resulting increase in service and support requirements will obviously justify a corresponding increase in their availability.

**Table 5**  
**AVAILABILITY OF ABS PARTS, SERVICE AND TECHNICAL SUPPORT**

Question # 12      Availability of ABS Parts, Service and Technical Support

		RESPONDENTS									TOTALS			
		A	B	C	D	E	F	G	H	I				
12.1	Please rate, on the basis of global fleet experience with ABS during the last six months, the availability from ABS manufacturers and distributors of the following:													
		Replacement parts			X			X		X	X		1/9	
													4/9	
					X					X			2/9	
						X							1/9	
				X									1/9	
			Specialized maintenance equipment			X	X		X		X	X		1/9
											X		5/9	
											X		1/9	
							X						1/9	
				X									1/9	
			Maintenance service and assistance			X			X		X	X		1/9
							X				X		4/9	
								X			X		2/9	
							X						1/9	
				X									1/9	
			Technical support			X			X		X	X		1/9
					X				X		4/9			
						X			X		2/9			
						X					1/9			
		X									1/9			
	Training programs for mechanics			X			X		X	X		1/9		
					X				X		4/9			
					X				X		2/9			
						X					1/9			
		X									1/9			
12.2	Please rate the availability in your area(s) of operation of the following:													
		Adequately trained maint. personnel				X		X		X	X		1/9	
						X				X		4/9		
				X						X		2/9		
							X					1/9		
				X								1/9		
			Specialized maintenance shops			X	X				X		1/9	
											X		3/9	
							X		X	X			3/9	
		X				X					2/9			
Please provide further comments	<b>Provided</b>			X					X					
	<b>Not Provided</b>	X			X	X	X	X		X				

(C) ABS shops in smaller centres such as Western Canada are few and far between.

(H) ABS is relatively new and not all commercial shops are up to speed.

### 3.6 Vehicle and ABS Maintenance

The detailed information obtained from respondents is provided in Tables 6 and 7. This information can be summarised as follows:

- Vehicle Maintenance and Where Performed

The responses obtained do not indicate any significant difference as to where vehicle, braking system and ABS maintenance is performed. They also indicate that the same persons generally perform braking system and ABS maintenance.

The only exception to the above is a reduction, in the case of ABS, of maintenance contractors' involvement. This may be because, ABS being relatively recent, contractors are reluctant to commit to their maintenance, since lack of experience makes reliable estimation of associated costs difficult.

- ABS Maintenance Complexity

The majority of respondents rate the maintenance of ABS as relatively complex or relatively simple. Those fleets that have the greater numbers of ABS-equipped units and have been operating them for longer, generally provided the "simple" ratings. Consequently, it appears, as it very often does, that complexity is inversely proportional to familiarity and knowledge.

- ABS Maintenance Policy

The majority of respondents (6/10) indicated that a defective ABS is, according to fleet policy and procedures, repaired prior to the unit's next dispatch while two other fleets correct the situation within one day. The remaining two fleets do not provide repairs until the unit's next scheduled maintenance.

- ABS Maintenance Requirements

Only four respondents provided records of the maintenance requirements of their ABS. These four fleets, operating a total of 753 ABS-equipped units, reported 32 maintenance requirements over a six-month period or, approximately 1 repair per 10 system-year. This extremely low level of maintenance requirement, equivalent to one repair in the life of a system, supports the comment of one respondent who has noted improved reliability over his five years of experience with ABS.

It should be noted that only 3 ECU (Electronic Control Unit) failures were reported while most maintenance requirements were associated with relatively inexpensive components of the systems: speed sensors (9) and cables & connectors (13).

**Table 6**  
**VEHICLE AND ABS MAINTENANCE**

**Question # 5 Vehicle Maintenance and Where Performed**  
( As percentages of total fleet maintenance expenditures )

	RESPONDENTS									AVERAGE
	A	B	C	D	E	F	G	H	I	
<b>5.1 Vehicle Maintenance</b>										
Performed in own facilities:	5%	100%	25%	65%	60%	100%	100%	85%	90%	70%
Performed in specialised shops:			10%	10%				14%	10%	5%
Performed by maintenance contractors:	95%		65%	25%	40%			1%		25%
<b>5.2 Braking Systems Maintenance</b>										
Performed in own facilities:	5%	100%	5%	65%	60%	100%	100%	93%	90%	69%
Performed in specialised shops:				10%				5%	10%	3%
Performed by maintenance contractors:	95%		95%	25%	40%			2%		29%
<b>5.3 ABS Maintenance</b>										
Performed in own facilities:		100%	5%	65%	60%	100%	100%	95%	90%	68%
Performed in specialised shops:	100%			10%				5%	10%	14%
Performed by maintenance contractors:			95%	25%	40%					18%
5.4 Are ABS maintenance and general braking systems maintenance performed by the same persons?										
<b>Yes</b>	X	X		X	X	X	X	X	X	8 / 9
<b>No</b>			X							1 / 9

**Question # 13 ABS Maintenance Complexity**  
Please indicate the perceived level of complexity of ABS maintenance.

	RESPONDENTS									TOTALS
	A	B	C	D	E	F	G	H	I	
by Fleet Management	Very complex									
	Relatively complex	X			X			X		3 / 10
	Relatively simple						X	X	X	3 / 10
	Simple			X				X		2 / 10
	No opinion		X			X				2 / 10
by Vehicle Maintainers	Very complex									
	Relatively complex	X			X	X		X		4 / 10
	Relatively simple						X	X	X	3 / 10
	Simple			X				X		2 / 10
	No opinion		X							1 / 10
Please provide further comments	<b>Provided</b>						X			
	<b>Not Provided</b>	X	X	X	X	X	X	X	X	

(G) One training course and it's a breeze.

**Question # 8 ABS Maintenance Policy**  
If a unit's ABS is defective, please indicate, on the basis of your fleet's policy and procedures, when the situation would be corrected.

	RESPONDENTS									TOTALS
	A	B	C	D	E	F	G	H	I	
Prior to the unit's next dispatch		X	X	X		X		X	X	6 / 10
Within a period of:							X	X		2 / 10
1 day										
1 week										
1 month										
At the unit's next scheduled maintenance					X		X			2 / 10

**Table 7  
ABS MAINTENANCE REQUIREMENTS**

**Question # 11 ABS Maintenance Requirements**

Please indicate ABS maintenance requirements by writing in the appropriate boxes below the total numbers of maintenance activities performed on all ABS equipped fleet vehicles. You are asked to provide a breakdown of these activities by System Component, Cause of Failure and Nature of Repair.

Failed Component of ABS	Source / Cause of Component Failure	Nature of Maintenance Activity	RESPONDENTS									TOTALS	
			A	B	C	D	E	F	G	H	I		
ECU	Equipment failure				2	1						3	
		Adjustment			2	1						3	
		Repair			2							2	
	External damage	Replacement				1						1	
		Adjustment											
		Repair											
	Speed Sensors	Equipment failure	Replacement			2							2
			Adjustment			2					7		9
			Repair								5		7
External damage		Replacement			2					1		1	
		Adjustment								4		6	
		Repair								2		2	
Pressure Modulating Valves		Equipment failure	Replacement										
			Adjustment			1	1						2
			Repair			1	1						2
	External damage	Replacement			1	1						2	
		Adjustment											
		Repair											
	Cables & Connectors	Equipment failure	Replacement										
			Adjustment							10	3		13
			Repair								1		1
External damage		Replacement											
		Adjustment							10	2		12	
		Repair							5			5	
Warning Light		Equipment failure	Replacement										
			Adjustment			3	2						5
			Repair			3	2						5
	External damage	Replacement			3	1						4	
		Adjustment											
		Repair											
	Please provide further comments	Replacement											
		Adjustment											
		Not provided			X	X				X	X		

(G) Systems are becoming more and more reliable over 5 year experience with ABS.

(H) One speed sensor failure resulted from water infiltrating a cable connector.

### 3.7 Cost Impact of ABS

The detailed information obtained from respondents is provided in Table 8. This information can be summarised as follows:

- Impact of ABS on Vehicle Purchase Price

Most respondents to the survey (6/10) estimate that the impact of ABS on vehicle purchase prices, as a percentage of additional ABS cost over the purchase price of an identical vehicle without ABS, is in the 2% to 5% range. The lower values in this range are likely to apply to motorised units (trucks and tractors) having a higher purchase price while the higher values apply to the less expensive trailers.

- Impact of ABS on Vehicle Maintenance Costs

The impact of ABS on vehicle maintenance costs, as a percentage of additional maintenance costs associated with ABS over the total maintenance costs of identical vehicles without ABS, was estimated to be inferior to 5% by 7/8 respondents with 3 estimating a value inferior to 1% and one commenting that he has not incurred any significant repair costs.

- Impact of ABS on Total Vehicle Operating Costs

The impact of ABS on total vehicle operating costs, as a percentage of additional operating costs of the vehicle generated by ABS over the total operating costs of identical vehicles without ABS, was estimated at:

- Under 0.5% by 3/6 respondents, one of whom commented on reduced tire wear and increased brake life.
- Between 1% and 2% by 2/6 respondents.
- Over 5% by one respondent.
- One respondent indicated a **reduction** of 1% to 2.5% in overall costs.

**Table 8  
COST IMPACT OF ABS**

**Question # 14 Impact of ABS on Vehicle Purchase Prices**

Please indicate, on the basis of your more recent purchases of vehicles, the impact of ABS on vehicle purchase prices. Indicate this as a percentage of additional ABS cost over the purchase price of an identical vehicle without ABS. Use an average figure based on the types of units in your fleet.

	RESPONDENTS									TOTALS
	A	B	C	D	E	F	G	H	I	
Less than 1%	X						X			2 / 10
1 % to 2%										
2% to 5%		X	X	X		X	X		X	6 / 10
5% to 10%								X		1 / 10
More than 10%					X					1 / 10

**Question # 15 Impact of ABS on Vehicle Maintenance Costs**

Please indicate the impact of ABS on vehicle maintenance costs. Indicate this as a percentage of additional maintenance costs associated with ABS over the total maintenance costs (excluding vehicle down-time) of identical vehicles without ABS. Use an average figure based on the type of units in your fleet.

	RESPONDENTS									TOTALS
	A	B	C	D	E	F	G	H	I	
Less than 1%			X	X				X		3 / 8
1 % to 2%									X	1 / 8
2% to 5%					X		X	X		3 / 8
More than 5%						X				1 / 8
Please provide further comments	<b>Provided</b>							X		
	<b>Not provided</b>			X	X	X	X	X	X	

(H) I have not incurred any significant repair costs.

**Question # 16 Impact of ABS on Total Vehicle Operating Costs**

Please indicate your best overall estimate of the impact of ABS on total vehicle operating costs. An average figure should be given that is representative of the types of units in your fleet. Indicate this as the percentage of additional operating costs of the vehicle generated by ABS over the total operating cost (including all fleet management and overhead as well as vehicle down-time) of identical vehicles without ABS.

	RESPONDENTS									TOTALS
	A	B	C	D	E	F	G	H	I	
Less than 0.5%				X			X	X		3 / 6
0.5 % to 1%										
1% to 2%					X				X	2 / 6
2% to 5%										
More than 5%						X				1 / 6
Please provide further comments	<b>Provided</b>		X				X			
	<b>Not provided</b>				X	X	X		X	

(C) Reduced overall costs by 1% to 2%.

(G) Tire saving, brake life.



### **3.8 Further Comments and Information**

Five of the respondents to this survey provided further comments and information relative to their experience with ABS, which they considered pertinent to the survey and its stated objectives. These comments, which are quoted in Table 9, can be summarised as follows:

- An almost unanimous statement that company policy dictates the provision of ABS equipment on all new vehicles added to the fleet, particularly with respect to motorised units. One respondent even considers that ABS should become a trucking industry standard.
- Two respondents call upon the ABS manufacturers to make further efforts to provide more accessible training courses for both drivers and mechanics, as well as to standardise testing equipment.
- Two respondents mention the high level of acceptance of ABS by their drivers.
- One fleet operator states that ABS appear to be trouble-free, while another sees no difference in the maintenance costs of ABS and non-ABS units.
- Finally, one respondent considers that the provision of ABS on relatively less expensive units, such as trailers, requires an investment effort which his company is still not ready to make.

**Table 9  
FURTHER COMMENTS AND INFORMATION**

**Question # 17 Further Comments and Information on ABS**

Please use this page and, if necessary, additional pages to provide further comments and information on ABS and issues you believe need to be further addressed, that you consider pertinent to this survey and its stated objectives.

	RESPONDENTS								
	A	B	C	D	E	F	G	H	I
<b>Provided</b>		X	X				X	X	X
<b>Not provided</b>	X			X	X	X			

(B) ABS should be a trucking industry standard. (Translation)

Manufacturers should provide more accessible training courses for both drivers and mechanics.(Translation)

(C) We have had great success with ABS brakes and are in the process of retrofitting all our trailers.

We are now ordering power units (tractors and straight trucks) with ABS as company specs.

(G) Our policy is for all new vehicle acquisitions to be equipped with ABS.

(H) Our corporate standard is to put ABS on all new tractors and trailers; this has been our standard for two years.

From comments of the drivers the ABS is well liked. The systems appear to be trouble-free.

Testing equipment needs to be universal in order that mechanics don't have to be trained on various systems.

(I) ABS systems appear to be very efficient on all trucks. (Translation)

The majority of drivers appreciate ABS. (Translation)

With respect to maintenance, it is too early to provide exact costs, but it (the maintenance of ABS-equipped vehicles) does not appear to be more costly than for vehicles without ABS. (Translation)

All new trucks purchased by our company will be ABS-equipped. (Translation)

With respect to trailer purchases, we are not ready to make the necessary investment since, for trailer manufacturers, there is a very high cost associated with the purchase of ABS equipment. (Translation)

## **4.0 CONCLUSIONS AND RECOMMENDATIONS**

This last chapter contains the conclusions derived from, and the recommendations supported by, the results of this survey of the experience of Canadian motor carriers with respect to the performance, durability and maintainability of Antilock Braking Systems installed on heavy vehicles, as well as of the impact of these systems on vehicle operating costs.

### **4.1 Conclusions**

The results of this survey, as they appear in the detailed tables and summaries provided in Section 3.0, support the following conclusions with respect to the experience of fleet operators with ABS installed on heavy vehicles.

- Fleet operators appear to have a generally positive perception of ABS as useful, reliable, durable and relatively trouble-free equipment that is more and more frequently installed on new vehicles and is becoming a trucking industry standard.
- In terms of road safety, respondents to the survey acknowledge that ABS reduce vehicle stopping distances and increase vehicle stability during braking, but half of these respondents cannot qualify the level of ABS impact with respect to accident rate and severity reduction. Three respondents identify the capacity of ABS to prevent jack-knife incidents as a very significant contribution to road safety.
- The availability, from ABS manufacturers or through specialised maintenance shops, of parts, service and technical support is perceived by fleet operators as improving but still requiring further efforts, particularly in smaller centres of operation.
- Survey respondents estimated the cost impacts of ABS as follows:
  - Increase in unit purchase prices: 2-5 %.
  - Increase in unit maintenance costs: 0-1 % and 2-5 %, each range reported by an equal number of respondents
  - Increase in total vehicle operating costs: approximate average of 1 %.

## 4.2 Recommendations

The survey results and the above conclusions justify the following recommendations with respect to furthering knowledge of in-service performance and impact of ABS on the operations of heavy vehicle fleets.

- The experience with ABS of the fleets participating in this survey is relatively recent, at most five years and in some cases limited to one or two years.

Consequently, similar surveys should be conducted at yearly intervals, with the same and possibly additional participants, to detect changes in experience and perception as the ABS equipment ages, ABS becomes more generalised and personnel (operators, drivers and maintainers) become more familiar with ABS.

- The costs associated with vehicle maintenance in general and ABS in particular, as denoted by the variance of the survey responses received, do not appear to be readily available, with a reliable level of accuracy, from fleet records.

Consequently, if a more accurate estimate of actual ABS maintenance costs was determined to be of interest, it could be established through a specific study which would monitor fleet records on a detailed and regular basis. It is estimated that acceptable levels of accuracy and reliability could be achieved through monitoring on a monthly basis (while memory of specific incidents is still available), over a period of at least one year (to take into account the seasonal variations in weather and driving conditions) and of approximately 200 ABS systems of various makes, types and ages.

- The fleet operators responding to this survey could not quantify the impact of ABS on road safety in terms of actual reduction in accident rate and severity. This lack of specific data is not surprising since, accidents being a relatively rare occurrence, few fleets have sufficient numbers of ABS and non-ABS units to generate statistically valid samples. Furthermore, fleet operators have no direct incentive to collect and analyse the amount of data required to reliably quantify this impact of ABS.

Consequently, if a reliable and valid quantification of safety benefits associated with ABS was determined to be of interest, it could be defined as the objective of a specific study which would compile and analyse the safety and accident records of a large number of ABS and non-ABS units over a period of time sufficiently long to produce a representative and reliable sample. This study should take into account the frequency and severity, in terms of personal and property damages, of all reported accidents in which stopping distance and/or stability during braking had or may have had an influence.

The responses from this survey indicate that units travel an average of 200 000 km per year and it is estimated that each unit may be involved in a significant accident once every five years or 1 000 000 km. Thus collecting samples of 500 analysable accidents, estimated to be the sample size necessary to generate statistically meaningful differences, would require the monitoring of 2 500 unit-year or, approximately, 1 250 ABS units and 1 250 non-ABS units over a two-year period.

**APPENDIX A**

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**SURVEY QUESTIONNAIRE**



**Transport Canada  
Transportation Development Centre**

**FLEETS SURVEY OF HEAVY VEHICLE ABS SYSTEMS OPERATION**

**Questionnaire # 1 - November 1995**

**Covering six-month period from JUNE 1995 to NOVEMBER 1995**



## Survey Objectives

The objective of this survey is to obtain feedback from Canadian motor carriers operating heavy vehicles with installed ABS systems in order to determine their experience with ABS technology as it relates to vehicle braking performance and accident rates as well as ABS system performance, durability, maintainability and impact on vehicle operating cost.

The survey of participating fleets will be conducted at regular intervals of six to twelve months over a three-year period through questionnaires identical to the present document and may be complemented by telephone follow-ups and/or on-site visits as required to establish statistically valid results from a representative cross section of ABS system users.

## Instructions

- 1 - Respondents are asked to answer all sections of the questionnaire providing informations that best reflect their fleet's characteristics and experience with ABS technology during the six-month period between **June and November 1995**.
  
- 2 - Information obtained from various fleets will be aggregated and averaged to provide an industry wide indication of experience with ABS systems installed on heavy vehicles. Consequently, where respondants are asked to provide numbers and/or percentages, high accuracy is not essential. Approximate, but representative, answers are sufficient and obviously more useful than no answer at all.
  
- 3 - Requests for information or queries on the survey and/or this questionnaire should be directed to the Consultant mandated by the Transportation Development Centre:

Beauchemin - Beaton - Lapointe Inc.  
2045 Stanley Street  
11th Floor  
Montreal, Quebec  
H3A 2V4

Telephone: (514) 499-4500

Fax: (514) 499-4515

Attention: Ms Marie Mantha, Eng.  
Mr Jacques R. Tourville, Eng.

- 4 - Questionnaires should be returned **before 1 January 1996**, either by mail or fax, to the address or number and to the attention of the persons indicated above.

**1 Company and Contact Names**

1.1 Name and Address

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1.2 Contact for Purposes of this Survey

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Telephone: \_\_\_\_\_

Fax: \_\_\_\_\_

**2 Fleet Statistics**

2.1 Number of Heavy Vehicles in Fleet

	<b>Conventional Braking</b>	<b>ABS Equipped</b>
Heavy Trucks:	_____	_____
Tractors:	_____	_____
Semi-Trailers (excluding A and B trains):	_____	_____
A-Train trailers:	_____	_____
B-Train trailers:	_____	_____
Other: _____	_____	_____
<b>Totals</b>	_____	_____

2.2 Number of Heavy Vehicle Drivers with ABS experience

<b>No</b> experience with ABS:	_____
<b>Less than 1 year</b> of experience with ABS:	_____
<b>1 to 2 years</b> of experience with ABS:	_____
<b>More than 2 years</b> of experience with ABS:	_____
<b>Total</b>	_____

**3 Description and Number of ABS Systems**

<b>Manufacturer</b>	<b>Model Number</b>	<b>Year</b>	<b>Number of Systems</b>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

**4 Operations Characteristics**

4.1 Distances Travelled  
( Average distance travelled by a typical fleet vehicle in the 6-month period )

**Conventional Braking Units:** \_\_\_\_\_ km  
**ABS Equipped Units:** \_\_\_\_\_ km

4.2 Types of Products Hauled  
( As percentages of total distance travelled by all fleet vehicles )

	<b>Conventional Braking</b>	<b>ABS Equipped</b>
General:	_____ %	_____ %
Bulk Solids:	_____ %	_____ %
Bulk Liquids:	_____ %	_____ %
Other: _____	_____ %	_____ %
Other: _____	_____ %	_____ %
<b>Totals</b>	<b>100 %</b>	<b>100 %</b>

4.3 Types of Hauling Environment  
( As percentages of total distance travelled by all fleet vehicles )

	<b>Conventional Braking</b>	<b>ABS Equipped</b>
Urban:	_____ %	_____ %
Suburban:	_____ %	_____ %
Intercity:	_____ %	_____ %
Other: _____	_____ %	_____ %
<b>Totals</b>	<b>100 %</b>	<b>100 %</b>

**5 Vehicle Maintenance and Where Performed**

( As percentages of total fleet maintenance expenditures )

5.1 Vehicle Maintenance

Performed in own facilities: \_\_\_\_\_ %  
 Performed in specialised shops: \_\_\_\_\_ %  
 Performed by maintenance Contractors: \_\_\_\_\_ %  
**Total** **100 %**

5.2 Braking Systems Maintenance

Performed in own facilities: \_\_\_\_\_ %  
 Performed in specialised shops: \_\_\_\_\_ %  
 Performed by maintenance Contractors: \_\_\_\_\_ %  
**Total** **100 %**

5.3 ABS Systems Maintenance

Performed in own facilities: \_\_\_\_\_ %  
 Performed in specialised shops: \_\_\_\_\_ %  
 Performed by maintenance Contractors: \_\_\_\_\_ %  
**Total** **100 %**

5.4 Are ABS systems maintenance and general braking systems maintenance performed by the same persons?

Yes  No

**6 Accident Rate and Severity Reduction**

Please provide your best estimate of the potential of ABS systems to reduce accident rate and severity.

**Accident Rate Reduction**

High	<input type="checkbox"/>
Moderate	<input type="checkbox"/>
Low	<input type="checkbox"/>
Not-Significant	<input type="checkbox"/>
No Opinion	<input type="checkbox"/>

**Accident Severity Reduction**

High	<input type="checkbox"/>
Moderate	<input type="checkbox"/>
Low	<input type="checkbox"/>
Not-Significant	<input type="checkbox"/>
No Opinion	<input type="checkbox"/>

Give examples, if any, of situations where ABS caused an accident to be avoided or reduced its severity.

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**7 Potential Adverse Effect**

7.1 Please indicate if there were situations or conditions in which ABS may have had the reverse effect of reducing safety.

Yes  No

If "Yes", please provide details.

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7.2 Please indicate if your fleet's ABS systems are equipped with turn-off switches.

Yes  No

If "Yes", were there situations or conditions in which they were used by drivers?

Yes  No

If "Yes", please provide details.

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**8 ABS Systems Maintenance Policy**

If a unit's ABS system is defective, please indicate, on the basis of your fleet's policy and procedures, when the situation was to be corrected.

Prior to the unit's next dispatch

Within a period of: 1 day  1 week  1 month

At the unit's next scheduled maintenance

**9 ABS Systems Operational Performance**

Please rate the following aspects of ABS systems performance based on your fleet's experience and driver reports during the last six months.

	High	Satisfactor	Low	Inadequate	No Opinion
9.1 Reliability of ABS systems to consistently perform as expected during vehicle operation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.2 Reduction of vehicle stopping distance under severe brake application and slippery pavement conditions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.3 Increase in vehicle stability during brake application under slippery pavement conditions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.4 Adequacy of Warning Light in keeping driver aware of ABS system operational status.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.5 Reduction in premature tire wear by the prevention of tire "Flat Spotting".	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.6 Reduction in brake system wear and maintenance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please provide further comments if necessary.

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**10 Durability of ABS Systems**

Please rate the durability of this equipment based on its trouble free operation and/or its maintenance requirements.

High       Satisfactory       Low       Inadequate

No Opinion

**11 ABS Systems Maintenance Requirements**

Please indicate ABS maintenance requirements by writing in the appropriate boxes below the total numbers of maintenance activities performed on all ABS equipped fleet vehicles. You are asked to provide a breakdown of these activities by System Component, Cause of Failure and Nature of Repair.

Failed Component of ABS System	Number	Source / Cause of Component Failure	Number	Nature of Maintenance Activity	Number
ECU	<input type="checkbox"/>	Equipment failure External damage	<input type="checkbox"/> <input type="checkbox"/>	Adjustment Repair Replacement	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Speed Sensors	<input type="checkbox"/>	Equipment failure External damage	<input type="checkbox"/> <input type="checkbox"/>	Adjustment Repair Replacement	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Pressure Modulating Valves	<input type="checkbox"/>	Equipment failure External damage	<input type="checkbox"/> <input type="checkbox"/>	Adjustment Repair Replacement	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Cables & Connectors	<input type="checkbox"/>	Equipment failure External damage	<input type="checkbox"/> <input type="checkbox"/>	Adjustment Repair Replacement	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Warning Light	<input type="checkbox"/>	Equipment failure External damage	<input type="checkbox"/> <input type="checkbox"/>	Adjustment Repair Replacement	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Please provide further comments if necessary.

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\_\_\_\_\_

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**12 Availability of ABS Parts, Service and Technical Support**

Excellent	Good	Poor	Very Poor	No
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12.1 Please rate, on the basis of global fleet experience with ABS systems during the last six months, the availability from ABS systems manufacturers and distributors of the following:

Replacement parts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Specialized maintenance equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintenance service and assistance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Technical support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Training programs for mechanics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12.2 Please rate the availability in your area(s) of operation of the following:

Adequately trained maintenance personnel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Specialized maintenance shops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please provide further comments if necessary.

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**13 ABS Maintenance Complexity**

Please indicate the perceived level of complexity of ABS system maintenance.

by Fleet Management

by Vehicle Maintainers

Very complex	<input type="checkbox"/>	<input type="checkbox"/>
Relatively complex	<input type="checkbox"/>	<input type="checkbox"/>
Relatively simple	<input type="checkbox"/>	<input type="checkbox"/>
Simple	<input type="checkbox"/>	<input type="checkbox"/>
No opinion	<input type="checkbox"/>	<input type="checkbox"/>

Please provide further comments if necessary.

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**14 Impact of ABS Systems on Vehicle Purchase Prices**

Please indicate, on the basis of your more recent purchases of vehicles, the impact of ABS systems on vehicle purchase prices. Indicate this as a percentage of additional ABS system cost over the purchase price of an identical vehicle without ABS. Use an average figure based on the types of units in your fleet.

Less than 1%	<input type="checkbox"/>	1 % to 2%	<input type="checkbox"/>	2% to 5%	<input type="checkbox"/>
5% to 10%	<input type="checkbox"/>	More than 10%	<input type="checkbox"/>		

**15 Impact of ABS Systems on Vehicle Maintenance Costs**

Please indicate the impact of ABS systems on vehicle maintenance costs. Indicate this as a percentage of additional maintenance costs associated with ABS systems over the total maintenance costs (excluding vehicle down-time) of identical vehicles without ABS. Use an average figure based on the type of units in your fleet.

Less than 1%	<input type="checkbox"/>	1 % to 2%	<input type="checkbox"/>
2% to 5%	<input type="checkbox"/>	More than 5%	<input type="checkbox"/>

Please provide further comments if necessary.

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**16 Impact of ABS Systems on Total Vehicle Operating Costs**

Please indicate your best overall estimate of the impact of ABS systems on total vehicle operating costs. An average figure should be given that is representative of the types of units in your fleet. Indicate this as the percentage of additional operating costs of the vehicle generated by ABS systems over the total operating cost (including all fleet management and overhead as well as vehicle down-time) of identical vehicles without ABS.

Less than 0.5%	<input type="checkbox"/>	0.5 % to 1%	<input type="checkbox"/>	1% to 2%	<input type="checkbox"/>
2% to 5%	<input type="checkbox"/>	More than 5%	<input type="checkbox"/>		

Please provide further comments if necessary.

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**APPENDIX B**

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**LIST OF RESPONDENTS**



**Appendix B**  
**LIST OF RESPONDENTS**

The following is the list, in alphabetical order, of the fleets that graciously participated in this survey by providing answers, comments and information on the basis of their practical in-service experience with ABS systems installed on their heavy vehicles.

The Transportation Development Centre, Beauchemin-Beaton-Lapointe Inc. and the author of this report gratefully acknowledge their participation which made this survey possible and contributed to the general availability of data on ABS systems and particularly on their impact on road safety as well as on vehicle operation, maintenance and related costs.

CANADIAN AMERICAN TRANSPORTATION INC.  
Coteau-du-Lac, Que.

CANADIAN LIQUID AIR LTD  
Montreal, Que.

IRVING OIL LTD  
Saint John, N.B.

LEVY TRANSPORT LTEE  
Saint-Romuald, Que.

LIQUID CARBONIC INC.  
Markham, Ont.

MIDLAND TRANSPORT LTD  
Moncton, N.B.

SUNBURY TRANSPORT LIMITED  
Fredericton, N.B.

TRANSPORT ROBERT (1973) LTEE  
Rougemont, Que.

TRIMAC TRANSPORTATION SERVICES LTD  
(Both Central and West Regions)  
Calgary, Alb.



**APPENDIX C**

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**RESPONSES TO TELEPHONE INQUIRIES**





**Survey of Fleet Experience with Heavy Vehicle ABS**

**RESPONSES TO TELEPHONE INQUIRIES**

**Respondent A**

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- 1- Q Does your fleet ever operate units in mixed ABS / non-ABS configurations?  
A Yes.
- Q If YES, have your drivers ever reported problems and/or difficulties with such configurations?  
A No.
- 2- Q Does your fleet provide driver training on ABS?  
A No.
- 3- Q Have you any objection to your fleet being identified, in an alphabetical list, as a participant to this survey?  
A No.

## Survey of Fleet Experience with Heavy Vehicle ABS

### RESPONSES TO TELEPHONE INQUIRIES

#### Respondent B

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- 1- Q Does your fleet ever operate units in mixed ABS / non-ABS configurations?  
A Yes.
- Q If YES, have your drivers ever reported problems and/or difficulties with such configurations?  
A No.
- 2- Q Does your fleet provide driver training on ABS?  
A No.
- 3- Q Have you any objection to your fleet being identified, in an alphabetical list, as a participant to this survey?  
A No.
- 4- Q You have indicated that, in your opinion, ABS reduces accident rate and severity, do you have hard data (records and/or statistics) supporting this opinion?  
A No, but having assisted to ABS demonstrations (Blainville) it is obvious that it would be so.
- 5- Q You have indicated that, on bumpy gravel roads, ABS may have an adverse effect, what is this opinion based on?  
A Personal experience.
- 6- Q You have indicated that your ABS systems are equipped with a turn-off switch, can you justify the inclusion of this feature which you also indicate is never used by drivers  
A The turn-off switch, which is located in the ABS panel and not accessible to drivers, is a standard feature of the systems provided by the manufacturer.

## Survey of Fleet Experience with Heavy Vehicle ABS

### RESPONSES TO TELEPHONE INQUIRIES

#### Respondent C

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- 1- Q Does your fleet ever operate units in mixed ABS / non-ABS configurations?  
A Yes.
- Q If YES, have your drivers ever reported problems and/or difficulties with such configurations?  
A No.
- 2- Q Does your fleet provide driver training on ABS?  
A Yes.
- Q If YES, what kind?  
A Drivers are given the opportunity to view videos provided by the equipment manufacturers.
- 3- Q Have you any objection to your fleet being identified, in an alphabetical list, as a participant to this survey?  
A No
- 4- Q You have indicated that, in your opinion, ABS reduces tire and braking system wear, do you have hard data (records and/or statistics) supporting this opinion?  
A No, but it is obvious.
- 5- Q You have indicated that, in your opinion, ABS reduces accident rate and severity, do you have hard data (records and/or statistics) supporting this opinion?  
A No, but it obviously is one of the major factors contributing to our improving safety record.

## Survey of Fleet Experience with Heavy Vehicle ABS

### RESPONSES TO TELEPHONE INQUIRIES

#### Respondent D

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- 1- Q Does your fleet ever operate units in mixed ABS / non-ABS configurations?  
A Yes.
- Q If YES, have your drivers ever reported problems and/or difficulties with such configurations?  
A No.
- 2- Q Does your fleet provide driver training on ABS?  
A Yes.
- Q If YES, what kind?  
A Drivers are given the opportunity to view videos provided by the equipment manufacturers and they are told what to expect, in terms of braking reaction, from ABS equipped units.
- 3- Q Have you any objection to your fleet being identified, in an alphabetical list, as a participant to this survey?  
A No
- 4- Q You have indicated that, in your opinion, ABS reduces tire and braking system wear, do you have hard data (records and/or statistics) supporting this opinion?  
A No, but it is so obvious (24 ABS-equipped trailers have not generated a single flat-spotted tire in over two years of operation) that all future fleet purchases of vehicles will specify ABS.

## Survey of Fleet Experience with Heavy Vehicle ABS

### RESPONSES TO TELEPHONE INQUIRIES

#### Respondent E

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- 1- Q Does your fleet ever operate units in mixed ABS / non-ABS configurations?  
A Yes.
- Q If YES, have your drivers ever reported problems and/or difficulties with such configurations?  
A No.
- 2- Q Does your fleet provide driver training on ABS?  
A Yes.
- Q If YES, what kind?  
A Drivers are given the opportunity to view videos provided by the equipment manufacturers.
- 3- Q Have you any objection to your fleet being identified, in an alphabetical list, as a participant to this survey?  
A No
- 4- Q You have indicated that, in your opinion, ABS reduces tire and braking system wear, do you have hard data (records and/or statistics) supporting this opinion?  
A Yes, covering two years of operation.

## Survey of Fleet Experience with Heavy Vehicle ABS

### RESPONSES TO TELEPHONE INQUIRIES

#### Respondent F

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- 1- Q Does your fleet ever operate units in mixed ABS / non-ABS configurations?  
A Yes.
- Q If YES, have your drivers ever reported problems and/or difficulties with such configurations?  
A No.
- 2- Q Does your fleet provide driver training on ABS?  
A Yes.
- Q If YES, what kind?  
A Drivers are given the opportunity to view videos provided by the equipment manufacturers and to try the equipment in the yard. Furthermore, six more experienced drivers have been designated as instructors and are available to provide any training requested by specific drivers.
- 3- Q Have you any objection to your fleet being identified, in an alphabetical list, as a participant to this survey?  
A No
- 4- Q You have indicated that, in your opinion, ABS reduces tire and braking system wear, do you have hard data (records and/or statistics) supporting this opinion?  
A No.
- 5- Q You have indicated that ABS increases maintenance costs and total operating costs by more than 5%, on what bases are those answers funded?  
A These values are more representative of the costs generated by ABS during its introduction period, present values are of approximately 1% since purchase prices have been going down, the equipment is becoming more durable and maintenance personnel has gained experience.

## Survey of Fleet Experience with Heavy Vehicle ABS

### RESPONSES TO TELEPHONE INQUIRIES

#### Respondent G

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- 1- Q Does your fleet ever operate units in mixed ABS / non-ABS configurations?  
A Yes.
- Q If YES, have your drivers ever reported problems and/or difficulties with such configurations?  
A No.
- 2- Q Does your fleet provide driver training on ABS?  
A Yes.
- Q If YES, what kind?  
A Drivers are given the opportunity to view videos provided by the equipment manufacturers and to try the equipment in the yard.
- 3- Q Have you any objection to your fleet being identified, in an alphabetical list, as a participant to this survey?  
A No
- 4- Q You have indicated that, in your opinion, ABS reduces tire and braking system wear, do you have hard data (records and/or statistics) supporting this opinion?  
A No.



## Survey of Fleet Experience with Heavy Vehicle ABS

### RESPONSES TO TELEPHONE INQUIRIES

#### Respondent H

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- 1- Q Does your fleet ever operate units in mixed ABS / non-ABS configurations?  
A Yes.
- Q If YES, have your drivers ever reported problems and/or difficulties with such configurations?  
A No.
- 2- Q Does your fleet provide driver training on ABS?  
A Yes.
- Q If YES, what kind?  
A Discussions at regularly scheduled "Safety Meetings".
- 3- Q Have you any objection to your fleet being identified, in an alphabetical list, as a participant to this survey?  
A No
- 4- Q You have indicated that, in your opinion, ABS reduces tire and braking system wear, do you have hard data (records and/or statistics) supporting this opinion?  
A No.
- 5- Q You have indicated that, in your opinion, ABS reduces accident rate and severity, do you have hard data (records and/or statistics) supporting this opinion?  
A No.
- 6- Q You have indicated that "a vehicle stopping suddenly in front of truck" could constitute a situation where ABS can have an adverse effect, please explain.  
A This statement, made by someone on my staff, is obviously false and should be disregarded.

## Survey of Fleet Experience with Heavy Vehicle ABS

### RESPONSES TO TELEPHONE INQUIRIES

#### Respondent I

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- 1- Q Does your fleet ever operate units in mixed ABS / non-ABS configurations?  
A Yes.
- Q If YES, have your drivers ever reported problems and/or difficulties with such configurations?  
A No.
- 2- Q Does your fleet provide driver training on ABS?  
A Yes.
- Q If YES, what kind?  
A Drivers are given the opportunity to view videos provided by the equipment manufacturers.
- 3- Q Have you any objection to your fleet being identified, in an alphabetical list, as a participant to this survey?  
A No
- 4- Q You have indicated that, in your opinion, ABS reduces tire and braking system wear, do you have hard data (records and/or statistics) supporting this opinion?  
A No.
- 5- Q You have indicated that, in your opinion, ABS reduces accident rate and severity, do you have hard data (records and/or statistics) supporting this opinion?  
A No.
- 6- Q You have indicated that your fleet included 9 "Other" type vehicles, please provide details.  
A Light delivery trucks.