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**A Case Study:  
Proposed School Bus  
Safety Standards  
under the  
Canadian Motor Vehicle Safety Act**

**Fifth in a Series of Studies on  
Government Regulatory Activity**

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Safety Standards  
under the  
Canadian Motor Vehicle Safety Act**

**Fifth in a Series of Studies on  
Government Regulatory Activity**

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## FOREWORD

In recent years, increasing concern has been expressed both inside and outside government about the social and economic impact of government regulatory activity. On the one hand, the regulatory process itself has been faulted for being insensitive to public needs and opinions while, on the other hand, doubts have been expressed concerning the efficiency and effectiveness of particular regulations, standards or guidelines. More specifically, with the onslaught of serious inflationary problems, it has been argued that regulations may be unnecessarily adding to costs and prices. In fact, it was in the context of the establishment of the Anti-Inflation Board and the resulting debate on controls and post-controls policies that the Cabinet directed the Department of Consumer and Corporate Affairs and the Treasury Board Secretariat to assess the feasibility of applying cost-benefit and related methods of analysis to government social regulations, and to suggest modifications to the regulatory process which might encourage greater public participation.

In response to this mandate, a Working Group on Social Regulations, chaired by François Lacasse of the Treasury Board Secretariat, was established. In the Department of Consumer and Corporate Affairs, the project was originally directed by Lawson Hunter and subsequently by Dale Orr. Other members of the Working Group included Harry Baumann (Project Manager), Bruce Montador, Michel Proulx, André Morin and Joan Huntley (Treasury Board Secretariat) and Lee McCabe and Ron Hirshhorn (Consumer and Corporate Affairs). As well, the Working Group received advice on legal matters from Allan Rosenzweig (seconded to CCA from the Department of Justice). The Federal-Provincial Relations Office made available the services of Richard Schultz as a consultant on jurisdictional problems between levels of government in the regulatory area. In addition, the Working Group received considerable help on technical matters from the Departments of Transport, Environment, Health and Welfare, Energy Mines & Resources as well as the National Research Council and the Atomic Energy Control Board.

Because of the nature of the mandate and the limited resources, the Working Group pursued the following operational strategy. First, it concentrated on health, safety and fairness regulations leaving aside economic or rate-setting regulations. This decision proved to be fortuitous since little research on social regulations has been carried out in Canada, and more extensive provisions exist for public participation in the rate-setting process. Second, the Working Group decided to study both the allocative and non-allocative effects of regulations. In other words, the Working Group was concerned not only with the impact of regulations on economic (market) efficiency, but also their impact on (a) the distribution of income - who pays, who benefits (b) technical progress (c) international competitiveness (d) regional balance (e) market structure (f) inflation. Third, the Working Group decided to prepare two types of background papers. The first type were general studies on the reasons for social regulation, the US experience with regulatory reform, the regulatory process in Canada and techniques for the evaluation of regulations. The second group of papers consisted of case studies of representative regulations of recent vintage in the health, safety and fairness area.

Since a major purpose of this project was the examination of various mechanisms for encouraging greater public input into the regulation-making process, we have decided that selected background papers and case studies prepared by the Working Group should be published in order to increase public awareness of this very important aspect of government activity.

Sylvia Ostry  
Deputy Minister-CCA

Maurice LeClair  
Secretary-TBS

## SUMMARY

A socio-economic impact analysis of the proposed standards for the design and construction of new school buses was performed in order to examine the feasibility of using available methodologies to evaluate new social regulations. These include School Bus Passenger Seating and Crash Protection (CMVSS 222), School Bus Joints Strength (CMVSS 221), Rear-view Mirrors (CMVSS 111), Window Retention and Emergency Exits (CMVSS 217), Rollover Protection (CMVSS 220) and Fuel System Integrity (CMVSS 301).

A preliminary assessment of the proposed changes has shown that they would not lead to significant effects on the distribution of income or on dynamic efficiency and would not involve substantial additional costs (i.e., their estimated total cost in any given year would be about \$3 million) when compared to those of many other proposed social regulations. Thus, it is not clear that the proposed standards would be evaluated systematically if criteria were used for identifying proposals that may have a major socio-economic impact.

The major costs of the new regulations would be the increased design and construction costs and the additional gasoline costs associated with the increased weight of the vehicle. The major benefits would be the reduction in injuries that occur inside the school bus in the event of an accident. It was possible to quantify the potential benefits of standards 222 and 221 but not those of the other standards.

A cost-effectiveness comparison of the components of the new regulation was attempted, but the results were too sensitive to various hypotheses (made about the potential benefits of standard 221) to be useful. An alternative to the main component of the proposed regulation was also considered, but it was impractical; more specifically, seat belts were considered as an alternative to standard 222 but they were not a feasible substitute, since it would be difficult to ensure their appropriate use.



The set of new safety standards taken as a whole were also compared to two hypothetical alternatives. The first one combined the proposed changes with a forward-control type of structure and the second supposed a complete change in the structure of school buses. The new set of standards (with an estimated cost per injury prevented of \$19,000 under the least favourable construction-cost hypothesis) was found more cost-effective than the more dramatic changes of the latter two alternatives (with an estimated cost per injury prevented of \$115,000 and \$415,000, respectively).

However, when compared to a school bus of the conventional type, there would be potential additional benefits to be derived from either an intermediate or a complete change in the school bus structure through the reduction in fatalities that occur outside the vehicle (33 per cent of the fatalities occur when the students are struck by school buses). For achieving a broader objective, such as reducing injuries and fatalities whatever the place of occurrence, however, an intermediate change in the structure would be more cost-effective than a complete change. Indeed, the potential benefits they could generate are identical, whereas the additional costs associated with the former would be substantially lower than those of the latter.

Other alternatives (e.g., training program for school bus drivers, maintenance schedule, traffic patrol program, etc.) were also considered, but there was insufficient evidence about their potential effects to include them in the analysis.

The proposed standards would not have any significant non-allocative effects (e.g., on technological progress, competition, employment, income distribution, etc.). From the broader perspective of reducing injuries and fatalities whatever the place of occurrence, however, the intermediate measure mentioned above would lead to production and employment effects, since the average useful life of such buses is about 12 years instead of eight years as for the conventional type.

Finally, although some analytical and data problems were encountered, the paper illustrates that a socio-economic impact analysis of similar social regulations could be performed.

## INTRODUCTION

In Canada, 2 million of the 6 million students enrolled at the primary and high-school levels must have access to transportation in order to get to school.<sup>1</sup> Ninety-eight per cent of them use the services of conventional school buses, which constitute 90 per cent of the motor vehicles used for the purpose of pupil transportation.<sup>2</sup> In 1974, an estimated number of 1,039 injuries and 23 fatalities occurred in 2,279 accidents involving school buses.<sup>3</sup> Even if accident and associated injury and fatality figures usually fluctuate widely from one year to another, it is well known that the safety record of the vehicles used for pupil transportation is much better than that of vehicles used for other purposes. For example, in the United States, it is estimated that school bus transportation is eight times safer than passenger car transportation.<sup>4</sup>

Several federal safety standards for the design and construction of new school buses have been promulgated under the Motor Vehicle Safety Act since 1971. New safety standards for the design and construction of school buses are currently being elaborated by Transport Canada and most of them will have been implemented by the end of 1978 (i.e., School Bus Passenger Seating and Crash Protection (CMVSS 222), School Bus Joints Strength (CMVSS 221), Rear-view Mirrors (CMVSS 111), Window Retention and Emergency Exits (CMVSS 217), Rollover Protection (CMVSS 220) and Fuel System Integrity (CMVSS 301)). The development of new safety standards for school buses has probably been motivated by pressures from parents and from the public in general, as well as by the fact that the United States National Highway Traffic Safety Administration had previously developed similar standards.<sup>5</sup>

A preliminary assessment of the proposed changes has shown that they would not lead to significant effects on the distribution of income or on dynamic efficiency and would not involve substantial additional costs (i.e., their estimated total cost in any given year would be about \$3 million) when compared to those of many other proposed social regulations. Thus, it is not clear that the proposed

standards would be evaluated systematically if criteria were used for identifying proposals that may have a major socio-economic impact.<sup>6</sup> However, a socio-economic impact analysis of the proposed changes was performed to examine the feasibility of using available methodologies to evaluate new social regulations.

The first section of this paper describes the proposed school bus safety standards under the Canadian Motor Vehicle Safety Act. In the second section, the social costs and benefits of the proposed changes are examined, and the cost-effectiveness methodology is used to compare these costs and benefits to those of possible alternatives for achieving the same objective. The third section presents an analysis of the possible non-allocative effects of the new regulations (i.e., on the distribution of income, market structure and competition, technological progress, production, employment, and energy consumption). The final section offers some conclusions.

1. PROPOSED SCHOOL BUS SAFETY STANDARDS UNDER  
THE CANADIAN MOTOR VEHICLE SAFETY ACT

Federal safety standards for the design and construction of new school buses have been in effect since regulations pursuant to the Motor Vehicle Safety Act became effective on January 1, 1971.<sup>7</sup> These standards initially pertained mainly to the driver's visibility under night-time and adverse weather conditions, and to glazing.<sup>8</sup> The standards have since been expanded to include, among other things, seat strength and belt installation for the driver of the vehicle, identification of safety-related controls to facilitate driver recognition, requirements for fireproof upholstery materials, and an accelerator system that will close the throttle in the event of a linkage failure or a reduction in driver power demand. The standards also specify air brake system requirements and minimum window retention forces to contain occupants inside the bus in the event of an accident.<sup>9</sup>

The proposed federal safety standards specific to new school buses are:

Rear-view Mirrors (CMVSS 111; Proposed Effective Date: July 1978)

The purpose of this standard is to improve the visibility of the driver by specifying rear-view mirror requirements.

Window Retention and Emergency Exits (CMVSS 217; Proposed Effective Date: September 1978)

This standard establishes requirements for the retention of windows other than windshields and specifies the number, location, and the operation and warning system of emergency exits. The purposes of this standard are to reduce the likelihood of occupants being thrown from the bus and to provide readily accessible means of emergency exits.

Rollover Protection (CMVSS 220; Proposed Effective Date:  
January 1, 1978)

This standard specifies the minimum strength of the roof structure to protect occupants in rollover accidents.<sup>10</sup>

School Bus Joints Strength (CMVSS 221; Proposed Effective  
Date: September 1978)

This standard regulates the strength of interior panel joints in order to lessen the likelihood of injuries caused by sharp metal edges, which occur when the body panels become separated from the structural components to which they have been fastened.

School Bus Passenger Seating and Crash Protection (CMVSS 222;  
Proposed Effective Date: September 30, 1978)

The objective of this standard is to improve occupant protection by specifying for seats minimum requirements of strength and energy absorption, anchorage strength, and padding material in areas that can come into contact with the head and knees. Minimum requirements for restraining barriers are also included.

Fuel System Integrity (CMVSS 301; Proposed Effective Date:  
September 30, 1978)

The purpose of this standard is to reduce the possibility of the release of hazardous amounts of inflammable fluids resulting from an accident.

In addition to these six safety standards developed for new school buses, there are proposed new general safety standards that apply to all motor vehicles, including school buses. A list of these is presented in Appendix A. However, as will be seen in the next section, the most important proposed standards with respect to the costs of the new regulation as well as the possibility of reducing injuries are the specific standards 222 and 221.<sup>11</sup>

One may note that the Canadian safety standards for the design and construction of new school buses that are proposed or are being developed are generally quite similar to standards in the United States.<sup>12</sup> There are, however, some minor differences. In Canada, for example, the school bus seats will be required, under standard 222, to be two inches higher than in the United States.

Finally, the federal government has the responsibility to formulate standards for the design and construction of new school buses, while regulation of maintenance, repair, inspection and operation of the school bus fleet and the setting of minimum driver requirements are provincial responsibilities. The safety standards that the provincial governments may enact can therefore be aimed at lessening the probability of the occurrence of an accident, while the federal safety standards may reduce the probabilities of injury or death in a school bus accident, given the general pattern of accidents involving school buses.

## 2. AN ANALYSIS OF THE ALLOCATIVE EFFECTS OF THE PROPOSED STANDARDS

This section examines the social costs and benefits of the proposed standards for the construction of new school buses. In addition, a cost-effectiveness analysis is made to compare these costs and benefits to those of possible alternatives for achieving the same objective; it was not possible to use the benefit-cost methodology for this latter purpose because some of the potential benefits (e.g., severe injuries prevented and lives saved) cannot be reduced to monetary values that can be agreed upon by all concerned parties.

### The Costs

The major costs of the new regulations would be the increased construction costs and the additional gasoline costs associated with the increased weight of the vehicle.

No estimate of the increased construction costs associated with the proposed Canadian standards is available. However, two estimates of the costs of similar United States standards were obtained, and they are considered, by those responsible for the formulation of the Canadian standards, as plausible estimates of the costs of the Canadian standards.

An estimate was first made during the development of the United States standards.<sup>13</sup> The proposed changes were expected to lead to increased construction costs of approximately \$1,200 per vehicle (subsequently called "construction-cost hypothesis 1"). The United States counterparts of standard 222 (School Bus Passenger Seating and Crash Protection) and standard 221 (School Bus Joints Strength) account for two-thirds (\$800) and one-sixth (\$200) of this amount, respectively. The other proposed standards thus account for the remaining \$200.<sup>14</sup>

Lower estimates of the construction costs for standards 222 (\$632) and 221 (\$138) were obtained from one of the school bus body manufacturers.<sup>15</sup> If one adds \$200 for the other proposed changes, an



estimate of \$970 is obtained for the increased construction costs per vehicle (subsequently called "construction-cost hypothesis 2").

The two sets of estimates are used in the following analysis; the construction costs associated with the proposed standards are incurred at the beginning of the period covering the expected useful life of a school bus.<sup>16</sup>

Another cost of the proposed standards is the additional gasoline cost associated with the increased weight of the vehicle. From various sources of information (see Appendix B), it can be estimated that if the price of gas were not to increase in real terms during the useful life of a school bus, the cost of gasoline consumption would increase by about \$65 annually. This additional gasoline cost can be applied to standard 222 (School Bus Passenger Seating and Crash Protection), which would account for most of the increased weight of the vehicle resulting from the standards.

The present value of the additional gasoline cost defrayed during the expected useful life (eight years)<sup>17</sup> of a conventional school bus (PVG) can be calculated with the aid of the following formula, which also allows for the consideration of various hypotheses concerning the expected increase in the real price of gasoline:

$$PVG = \sum_{i=1}^8 \frac{G}{(1+r)^i} (1+e)^i = \sum_{i=1}^8 \frac{G}{(1+y)^i}$$

$$\text{where } y = \frac{r-e}{1+e}$$

and where

G = additional gasoline cost that would be defrayed each year of the expected useful life of a school bus

r = real social rate of discount

e = the annual rate of change in the real price of gasoline

Using a 10-per-cent real rate of discount (the usual norm for government investment projects) and various hypotheses concerning "e" (0 per cent, 2 per cent, 4 per cent and 6 per cent), one obtains the present values of the additional gasoline cost displayed in column 2 of Table 1. Although a sensitivity analysis for differing rates of changes in the real price of gasoline is undertaken, the basic assumption of the study will be an annual rate of change of 2 per cent (the most widely held point of view for analysing new conventional energy-source projects).

As can be seen from Table 1, standard 222 accounts for a proportion as high as 75 per cent of the total discounted (over the expected useful life of a school bus) costs resulting from the proposed standards. The total discounted costs per vehicle show some variability, which depends mainly upon the construction-cost hypothesis considered and, to a lesser extent, on the assumption made with respect to the annual rate of change in the real price of gasoline.

### The Benefits

The major benefits of the proposed standards for the construction of new school buses would be the reduction in injuries that occur inside the school bus in the event of an accident. For the purpose of the cost-effectiveness comparisons to be made below, the benefits are stated in terms of the expected number of injuries that the proposed standards are expected to prevent over the lifetime of a conventional school bus.<sup>18</sup>

Information from the Traffic Accident Information Data System of Transport Canada for the year 1974<sup>19</sup> allows for the estimation of the total number of injuries related to school bus accidents in 1974 in Canada: 1,039.<sup>20</sup> Dividing this figure by the number of school buses gives a total number of injuries per school bus per year<sup>21</sup> of 0.034. Over the expected useful life of a conventional school bus, the total number of injuries is thus about 0.271.

TABLE 1

## DISCOUNTED COSTS OF THE PROPOSED STANDARDS PER SCHOOL BUS

Hypothesis Concerning "e"	Additional Gasoline Cost	Construction Cost Hypothesis	Standard 222	Standard 221	Other Standards	All Proposed Standards
0%	\$347.25	1	\$800.00	\$200.00	\$200.00	\$1,547.00
		2	\$632.22	\$137.41	\$200.00	\$1,316.00
2%	\$376.28	1	\$800.00	\$200.00	\$200.00	\$1,576.00
		2	\$632.22	\$137.41	\$200.00	\$1,345.00
4%	\$407.91	1	\$800.00	\$200.00	\$200.00	\$1,608.00
		2	\$632.22	\$137.41	\$200.00	\$1,377.00
6%	\$442.36	1	\$800.00	\$200.00	\$200.00	\$1,642.00
		2	\$632.22	\$137.41	\$200.00	\$1,411.00

However, the proposed standards could not be expected to eliminate this number of injuries per school bus, even if they proved 100 per cent effective. The reasons are that the proposed standards can only affect the number of injuries that occur inside the school bus (as opposed to the total number of injuries related to school bus accidents), and that they can only prevent a proportion of the injuries occurring inside the school bus.

From United States data,<sup>22</sup> 58.4 per cent of the total injuries associated with school bus accidents occur to pupils inside the school bus. Since standard 222 is expected to save 40 per cent of these injuries,<sup>23</sup> it can thus be estimated that the structurally stronger and more energy-absorbing seat under this proposed standard would save approximately 0.063  $[(.584 \times .4) \times 0.271]$  injury over the expected life of a conventional school bus.

A rough estimate of the expected percentage reduction in injuries occurring inside the school bus resulting from standard 221 was also derived from United States data: 12.5 per cent.<sup>24</sup> Standard 221 could thus be expected to save approximately 0.02  $[(.584 \times .125) \times 0.271]$  injury over the expected life of a conventional school bus.

The benefits to be generated by the other proposed standards are not discernible,<sup>25</sup> so that the expected total number of injuries to be prevented because of the proposed standards over the lifetime of a conventional school bus is approximately 0.08. It should be noted that, unlike the monetary costs, the physical benefits were not discounted. The implicit assumption is thus that the value of the expected reduction in injuries over the lifetime of a school bus is independent of the year in which the injury would have occurred. (For a more detailed discussion of this point, see M. Proulx, Evaluation Methodologies for Social Regulations, Planning Branch, Treasury Board Secretariat, 1978).

## Cost-Effectiveness Comparisons

In this section, the cost-effectiveness ratios of the proposed school bus standards are presented and compared to those of possible technological alternatives for achieving the same objective (i.e., to reduce injuries that occur inside the school bus in the event of an accident). Alternatives to be considered under a broader objective (i.e., to reduce injuries and deaths whatever the place of occurrence) are also examined.

### (1) Cost-Effectiveness Ratios of the Proposed Changes and the Status Quo Alternative

From the above information on the social costs and benefits of the proposed changes, the cost-effectiveness ratios of the contemplated standards can be easily calculated. As can be seen in Table 2, the discounted cost per injury prevented resulting from the new regulations is much more sensitive to the construction-cost hypothesis than to the hypothesis made with respect to the expected rate of change in the real price of gasoline. Furthermore, although the cost per injury prevented for standard 221 appears as substantially smaller than for standard 222, a sensitivity analysis with respect to the benefits of standard 221 (for example, if it were expected to reduce 6 per cent rather than 12.5 per cent of the injuries occurring inside the school bus) could change the ranking under construction-cost hypothesis 1.<sup>26</sup> Finally, under an annual rate of change in the real price of gasoline of two per cent, the cost per injury prevented for the whole set of proposed standards is approximately \$19,000 under construction-cost hypothesis 1 and \$16,000 under construction-cost hypothesis 2.

In addition to the pressures of the public in general,<sup>27</sup> the status quo alternative is weakened by the fact that even doing nothing could mean additional costs. Indeed, Canadian manufacturers exporting to the United States would have to conform to similar standards for the exported part of their production. These potential additional costs, which would not lead to corresponding benefits, would depend on the economies of scale in the industry.<sup>28</sup>

TABLE 2

Discounted Cost Per Injury Prevented

Standards	Hypothesis concerning "e" (per cent)	Construction Cost Hypothesis	Cost- Effectiveness Ratio
221	not applicable	1 2	\$10,106 \$ 6,922
222	0	1 2	\$18,112 \$15,459
	2	1 2	\$18,569 \$15,917
	4	1 2	\$19,059 \$16,406
	6	1 2	\$19,612 \$16,959
Other Standards	no discernible benefits		
All Proposed Standards	0	1 2	\$18,612 \$15,832
	2	1 2	\$18,960 \$16,181
	4	1 2	\$19,321 \$16,545
	6	1 2	\$19,729 \$16,954

- (2) Alternatives for Achieving the Same Objective as the Proposed Standards (i.e., to reduce the number of injuries that occur inside the school bus in the event of an accident)

(a) Alternatives to each of the proposed standards

Technological alternatives to each of the proposed standards, given the specifications of conventional school buses, were explored. The only possible one would have been seat belts as an alternative to standard 222. However, the alternative was considered impractical,

since it is not possible to ensure their appropriate use without compromising safe driving. The seat-belt anchorage requirement of the proposed standard will provide the school district with the option of installing seat belts.

(b) Alternative to the whole set of proposed standards

A complete change in the structure of the bus, that is, an intra- or inter-city bus, is sometimes mentioned as a possible alternative to the proposed changes in school bus safety standards. Although an intra- or inter-city bus seems to be structurally stronger and to have better seats than the conventional type of school bus, a complete change in the structure is not unanimously perceived as a perfect or better substitute to the existing structure along with the proposed new standards.<sup>29</sup> For example, it could be argued that, even if the seats of an intra-city bus have more padding material and are more comfortable than the current seats of a conventional school bus, this does not mean that, in the event of an accident, they would protect the passengers as well as seats modified to meet standard 222.

It was not necessary to enquire about possible differences between the intra-city bus specifications and those of a conventional school bus combined with the proposed changes. Indeed, if one assumes that the potential benefits would be the same, and even if one allows for the supplementary benefits related to the prevention, under the intra-city bus alternative,<sup>30</sup> of injuries that occur in front of the school bus, the intra-city bus alternative would be less cost-effective than the proposed changes.

The cost of an intra-city bus is about \$75,000, \$58,100 more than a conventional school bus. By adding to this amount the additional gasoline cost associated with this vehicle<sup>31</sup> over its expected lifetime (12 years) and discounted at a 10 per cent rate, the total cost of the intra-city bus alternative would be approximately \$59,300..

The benefits would consist of 0.143<sup>32</sup> injury prevented over the expected lifetime of an intra-city bus (as opposed to 0.08 for the proposed standards).

The cost per injury prevented under this alternative is thus approximately \$415,000,<sup>33</sup> a cost-effectiveness ratio much greater than the one associated with the proposed changes (\$19,000 under the least favourable construction-cost hypothesis).

Another alternative to the proposed standards that could generate the same potential benefits as an intra-city bus is an intermediate change in the school bus structure (i.e., a forward-control type of school bus combined with the proposed changes). The discounted cost of the intermediate change in the structure (under the same set of assumptions as for an intra-city bus) is approximately \$16,370 per school bus.<sup>34</sup> The cost per injury prevented is thus about \$115,000,<sup>35</sup> which is less than for the intra-city bus alternative but considerably more than for the proposed changes.

In addition to the major benefits in terms of reduced injuries, the above alternatives (i.e., the forward-control type of school bus combined with the proposed changes and the intra-city bus) would also generate other benefits. Indeed, since their expected useful life is 12 years instead of eight years, as for the conventional school bus, the four-year differential in terms of durability is an additional benefit in that no additional resources would be required during this period. The above calculations do not take this benefit into account, although the major benefits are calculated over the respective expected useful life of each vehicle.

In many cases (e.g., the proposed safety standards for glazing products), benefits in terms of durability are very important and must be considered explicitly. In this case, they were not considered because of the relative importance of the major benefits (in terms of reduced injuries) and the arbitrariness that would have inevitably characterized



the choice of a time horizon within which an analysis comparing the benefits (including durability) could be made. In other words, the introduction of benefits in terms of durability were not expected, in this particular case, to change the ranking of the various means or to change substantially the ratios of cost per injury prevented among them. And, in fact, they did not change the ranking.

A calculation of the discounted costs of the various means of achieving the stated objective and of their potential benefits (including durability) over an arbitrary time horizon of 24 years (e.g., the smallest common multiple of 8 and 12) did not change the previous ranking. The proposed changes in school bus safety standards (with a discounted cost of \$11,000 per injury saved) are still much more cost-effective than an intermediate or a complete change in the school bus structure (with discounted costs per injury saved of \$52,000 and \$253,000, respectively). More specifically, the ratio of costs per injury prevented between the proposed school bus safety standards and the intra-city bus alternative ( $\$11,000 / \$253,000$ ) is the same as without the inclusion of durability considerations ( $\$19,000 / \$415,000$ ), while the same ratio for the proposed school bus safety standards and the forward-control alternative is only slightly changed [ $\$11,000 / \$52,000$  (or one-fifth) versus  $\$19,000 / \$115,000$  (or one-sixth)].

Finally, given that the end results were not changed, regardless of whether the benefits in terms of durability were considered or not along with the major benefits (in terms of reduced injuries), the expected useful life of each vehicle was used for cost-effectiveness analysis. The expected useful life of each of the various alternatives may be considered as a less arbitrary time horizon than the time period defined by the smallest common multiple of the expected life of the various alternatives. This would be the case because the major physical benefits (i.e., reduced injuries), unlike the monetary costs, were not discounted and because technological changes could potentially occur in the school bus industry.

(3) Alternatives under a Broader Objective (i.e., to reduce injuries and deaths whatever the place of occurrence)

The proposed standards for the construction of new school buses are primarily intended to reduce injuries that occur inside the conventional school bus in the event of an accident. Alternatives such as an intra-city bus or a forward-control type of school bus combined with the proposed changes also have the potential, however, for reducing the number of deaths associated with school bus accidents over and above the potential of the proposed changes. Indeed, 33 per cent of pupil fatalities or 17.5 per cent of the total fatalities associated with school bus accidents occur because the students are struck by school buses.<sup>36</sup> The expected number of fatalities to be prevented over the average useful life of one of the alternatives is 0.0017.<sup>37</sup>

For the achievement of a broader objective, such as the reduction of injuries and fatalities whatever the place of occurrence, an intra-city bus and a forward-control type of school bus combined with the proposed changes would thus have to be considered. The latter would, however, be more cost-effective than the former. Indeed, a forward-control type of school bus combined with the proposed standards would have the potential for generating the same additional benefits as an intra-city bus and would be less costly (with a discounted cost of \$16,370 versus \$59,300; the expected lifetime of a forward-control bus is the same as that of an intra-city bus).

Under the forward-control alternative, the cost per life saved would be approximately \$8.7 million. Indeed, the proposed safety standards, which were found to be the most cost-effective for achieving the objective of reducing injuries that occur inside the school bus in the event of an accident, would lead to increased costs per vehicle of \$1,576. By subtracting this amount from the costs (\$16,370) implied by the forward-control alternative (which would have to be considered under the objective of reducing injuries and deaths whatever the place of occurrence), a per-vehicle estimate of the cost that would be aimed at saving lives is obtained: \$14,794. This figure divided by the expected

number of lives saved over the average useful life of a forward-control type of school bus gives a cost per life saved of \$8.7 million.

Other alternatives for reducing injuries and deaths whatever the place of occurrence (e.g., training program for school bus drivers, changes in the maintenance schedule, safety or traffic patrol) were also considered (even if to regulate in these areas is a provincial rather than a federal responsibility), but there is insufficient evidence about their potential effects to explicitly include them in the analysis.

### 3. NON-ALLOCATIVE EFFECTS OF THE PROPOSED STANDARDS

In the previous section, the social costs and benefits of the proposed standards for new school buses were examined and compared to those of possible alternatives for achieving the same objective. The analysis led to the conclusion that the proposed changes are the most cost-effective for achieving the stated objective.

However, the analysis did not take into account the possible impact of the new regulation on the distribution of income, market structure and competition, technological progress, employment, and energy consumption. The purpose of this section is to examine the potential impact of the proposed changes on these variables.

#### Distribution of Income

A large proportion of the school bus purchase cost and a proportion of the maintenance and operating expenditures are defrayed by the provincial departments of education. The remaining costs are defrayed by the school boards (which receive their revenues from property taxes).<sup>38</sup> The users of the school bus transportation system are generally not charged for the service, except when they live off the regular route of a school bus.

The majority of the expenditures related to the school bus transportation system are thus financed by general provincial revenues, which are proportional. The precise distributive incidence of property taxes is not known (see H.J. Aaron, Who pays the property tax?, The Brookings Institution, 1975).

Quebec (34.4 per cent), Ontario (28.2 per cent), Alberta (10.3 per cent) and Saskatchewan (9.3 per cent) account for a large fraction of the total Canadian school bus fleet.<sup>39</sup> These provinces are thus likely to be more affected by the new regulations than the other provinces. Also, the additional expenditures associated with the proposed

standards would, as the current expenditures do, imply a redistribution of income from the population at large to the population of users.

### Market Structure and Competition

There are four body manufacturers (Blue Bird, Wayne, Superior and Thomas) of conventional school buses in Canada. They are branches of United States firms and they assemble the parts that are mainly made in Canada. As is the case in the United States,<sup>40</sup> no effect on the market structure and on competition in this highly concentrated industry can be anticipated, even if some manufacturers could potentially be slightly more efficient than others in complying with the standards.<sup>41</sup>

### Technological Progress

Since the regulations do not imply major technical changes, it is unlikely that the dynamic effects would be important. Also, the school bus manufacturers have the freedom to comply with the requirements of the standards in a manner that is most advantageous to them, technically and economically.

### Production and Employment

No production and employment impact of the proposed standards on the school bus body manufacturing industry can be anticipated. Also, no employment impact on school bus operations is expected. According to the available information,<sup>42</sup> no significant loss of the seating capacity resulting from the proposed standards can be anticipated. A loss of one or possibly two seats per school bus would not affect the school bus operations significantly because the average capacity utilization is under the designated capacity by two to three seats. Also, it should be noted that the demographic projections forecast a reduction in the number of school-age children. This could further reduce the average capacity utilization of a bus on a given route.<sup>43</sup>

However, some of the school bus chassis<sup>44</sup> manufacturers "believe that the effect of imposing this standard [standard 222] would be to make them [the small van-type school buses] so expensive that manufacturers would have to discontinue the production and marketing of these vehicles as school buses."<sup>45</sup>

The small van-type school buses are mainly used in urban areas, constituting about 6 per cent of all the vehicles used for pupil transportation and accommodating approximately 1 per cent of the current population of users.<sup>46</sup> They fulfil a real need in the transportation of small groups of school children (e.g., nurseries, special schools). When they are classified as multi-purpose passenger vehicles (nine passengers or less), seat belts are required. When they are classified as buses (10 passengers or more), the standards they have to comply with are not so rigorous. Standard 222 would be one way of dealing with this loophole.<sup>47</sup>

Outside the school bus chassis industry, it is not believed that standard 222 would affect the production of small van-type school buses. This belief is supported by the fact that some manufacturers (e.g. Wayne Corporation) now offer a school bus with a van-type chassis and a body similar to the conventional school bus. Those who could be affected are the operators who sell their services to the school boards and used to convert small vans (bought from the chassis manufacturers) into small van-type school buses. It is believed that the implementation of standard 222 for small van-type school buses would severely affect the profitability of this type of activity.

Under the general objective (broader than the objective of the proposed standards) of reducing injuries and deaths associated with school buses whatever the place of occurrence, a forward-control type of school bus combined with the proposed changes would appear as the most cost-effective. The introduction of this type of school bus on a large scale would probably lead to production and employment effects, since the average useful life of such buses is about 12 years instead of eight years as for the conventional type. Also, given that Canadian school bus

body manufacturers export to other countries where different standards could prevail, the adoption of forward-control school buses on a large scale would be likely to have export and cost implications.<sup>48</sup>

### Energy Consumption

As mentioned previously, the gasoline consumption of new school buses would increase, given the additional weight of the vehicle associated with the standards. The additional consumption would be approximately 65 gallons of gasoline per school bus per year.<sup>49</sup> On the basis of the current school bus fleet, this would mean an additional consumption of about 2 million gallons of gasoline per year once the fleet is composed entirely of new school buses or, in other words, an increase in gasoline consumption of seven per cent.

## CONCLUSIONS

The purpose of this paper is to determine the feasibility of performing a socio-economic impact analysis of proposed safety standards for new school buses.

Some variability was observed in the cost estimates obtained from different sources, but the end results were not sensitive to it. Obtaining reliable data to estimate the potential benefits of the new social regulation (e.g., the number of injuries that occur inside a school bus in the event of an accident and that could be prevented by new standards) proved to be more difficult. Indeed, the number of injuries and fatalities associated with school bus accidents are not compiled for the years before 1974. They are available, however, for 1974 and 1975 from the Traffic Accident Information Data System of Transport Canada (Road and Motor Vehicle Traffic Safety). From this information and from United States data, which allowed for the estimation of the percentage reduction in injuries that could be expected from the proposed standards, a rough estimate of the potential benefits was derived. However, even relatively large errors in the benefits estimates would not have changed the results of the study.

The cost-effectiveness rather than the benefit-cost methodology was used to analyse the allocative effects of the proposed changes because some of the potential benefits (e.g., severe injuries prevented and lives saved) cannot be reduced to monetary values that can be agreed upon by all concerned parties. The analysis was performed and led to the conclusion that when compared to possible alternatives, the proposed changes are the most cost-effective for achieving the stated objective.

The potential non-allocative effects of the proposed safety standards were also considered. However, no significant impact of the new social regulation on distribution of income, market structure and competition, technological progress, production, and employment can be anticipated. From the broader perspective of reducing injuries and



fatalities regardless of where they occur, however, a forward-control type of school bus, which appears as the most cost-effective alternative, would lead to production and employment effects, since its average useful life is about 12 years instead of eight years as for the conventional type of school bus. The information required for the examination of these potential effects was either available from published documents or made available by federal, provincial, and local government officials, and various concerned associations.

Finally, although some analytical and data problems were encountered, this paper illustrates that a socio-economic impact analysis of similar social regulations can be performed.

## NOTES

- 1 See Statistics Canada, Pupil Transportation in Canada, 1970-71, Supply and Services Canada, Catalogue no. 81-237, p.21, Table 3.
- 2 The percentage of transported pupils who use the services of conventional school buses was estimated from data on the number of each category of vehicles used for pupil transportation (see Statistics Canada, op. cit., p. 31, Table A) and under the assumption that station wagons, cars, and other vehicles can carry four pupils, whereas small van-type school buses can carry 15 pupils. It can be estimated that 98.3 per cent (1,943,016) of the 1,977,217 transported pupils use the services of conventional school buses. Dividing the number of conventional school bus users by the total fleet of these buses, one obtains an average of 63.4 pupils per bus. This last figure is in agreement with information from the United States [see U.S. Department of Transportation, NHTSA, School Bus Passenger Seating and Crash Protection, Inflationary Impact Statement (in compliance with DOT Order 2050, dated July 25, 1975), p.6] showing that the average capacity utilization of a normal 66-seat school bus on a given route is under its designated seating capacity by about two to three seats.
- 3 These figures were estimated from data available from the Traffic Accident Information Data System of Transport Canada (Road and Motor Vehicle Traffic Safety). The compiled number of school bus injuries (863), fatalities (19), and accidents (1,899) are for Nova Scotia, Quebec, Ontario, Manitoba, Saskatchewan, and British Columbia. These six provinces account for about 83 per cent of the total school bus fleet, so that an adjustment coefficient was applied to the data from the Traffic Accident Information Data System, Transport Canada, in order to obtain an estimate for Canada.
- 4 The school bus injury rate in the United States is one injury for eight million passenger miles compared to one injury for one million passenger miles for passenger cars (see U.S. Department of Transportation, NHTSA, Pupil Transportation Safety Program Plan, prepared by the School Bus Task Force, May 1973).
- 5 For a more detailed discussion of these points, see the section below on the status quo alternative.
- 6 This rough estimate of \$3 million is obtained from multiplying the number of school buses expected to be replaced annually by the additional costs associated with the proposed standards. A more sophisticated preliminary assessment of the total cost of the proposed standards in any given year was also made. For example, it took into account the demographic projections for the population of users over the next 25 years. In this particular case, however, a more sophisticated preliminary assessment did not change the results.

- 7 "School bus" means a bus designed or equiped primarily to carry children to and from school, whose compliance label must state that the vehicle is a school bus. Two kinds of standards that have implications for the design and construction of new school buses can be found under the Motor Vehicle Safety Act: general safety standards that apply to all motor vehicles, including school buses, and specific standards formulated especially for school buses.
- 8 A list of standards already in effect and standards that are being proposed or in the process of being developed are presented in Appendix A.
- 9 See Transport Canada (Road and Motor Vehicle Traffic Safety), "Status of School Bus Safety Standards", Memorandum, April 28, 1976.
- 10 This standard is not likely to impose new constraints to manufacturers, since they already comply with a similar industrial standard for the strength of the roof structure.
- 11 Among the general safety standards, standard 105 (Brake Systems) would represent a relatively major change in school bus equipment. However, even this proposed standard is minor compared with standards 222 and 221.
- 12 In the United States, the National Highway Traffic Safety Administration is responsible for issuing safety standards to comply with Title II of Public Law 93-492, Motor Vehicle and School Bus Safety Amendments of 1974. This legislation requires that the Secretary of Transportation issue school bus safety standards regarding the performance aspects of emergency exits, interior protection for occupants, floor strength, seating systems, crashworthiness of body and frame (including protection against rollover hazards), vehicle operating systems, windows and windshields, and fuel systems. The new Federal Motor Vehicle Safety Standards were supposed to become effective April 1, 1977.
- 13 See U.S. Department of Transportation, NHTSA, School Bus Passenger Seating and Crash Protection, Inflationary Impact Statement (in compliance with DOT order 2050, dated July 25, 1975). An estimate of the potential change in the cost of a new 66-seat school bus is obtained by multiplying the price per pound of curb weight by the estimated increase in weight resulting from the standards.
- 14 This last amount also includes the cost of the proposed new general standard 105 (Brake Systems). It may be noted that the cost of the vehicle is \$16,900, and that the average annual operating costs were estimated (with data from Statistics Canada, Pupil Transportation in Canada, 1970-71, Supply and Services Canada, Catalogue no. 81-237) at about \$6,500 per vehicle in 1977 dollars.
- 15 See Wayne Corporation, Federal Standards Pricing Guidelines - Lifeguard, Bulletin no. 1091, January 12, 1977. This estimate is for a conventional type of school bus with 65 passenger seats.

- 16 Although most of the school bus parts and accessories required to comply with the new regulation are manufactured in Canada, a proportion are imported from the United States. It was not necessary, however, to correct the above cost estimates in view of this fact, since, under the Automotive Products Agreement between the United States and Canada, the Government of Canada accords duty-free treatment to imports of such products from the United States.
- 17 In Canada, the expected useful life of a normal school bus (eight years) is shorter than in the United States (10 years; see U.S. Department of Transportation, op.cit., p. 2). Differences in climate may account for this discrepancy.
- 18 In addition, the proposed standards might reduce the severity of injuries, which will still occur. However, the magnitude of the impact on injury severity cannot be quantified because of inadequate data. Also, no reliable data are available with respect to the potential impact of the proposed standards on passenger fatalities.
19. Data for 1975 were also available from the Traffic Accident Information Data System, Transport Canada. However, to use averages of 1974 and 1975 data in order to have greater confidence would not have changed the results. Indeed, the number of injuries per school bus per year is 0.0340 when 1974 data are used, whereas it would have been 0.0347 if averages of 1974 and 1975 data had been used.
- 20 See Note 3.
- 21 The assumption made is not that 1974 data are representative of what could be expected in the future. The assumption is that the ratio obtained (i.e., the number of injuries per school bus) will remain constant through time. The constancy of this ratio has been observed in the United States over the period 1962 to 1971 (see U.S. Department of Transportation, NHTSA, Pupil Transportation Safety Program Plan, prepared by the School Bus Task Force, May 1973).
- 22 See U.S. Department of Transportation, NHTSA, Pupil Transportation Safety Program Plan, prepared by the School Bus Task Force, May 1973.
- 23 See U.S. Department of Transportation, School Bus Passenger Seating and Crash Protection, op. cit., p. 8).
- 24 "By far the most frequent type of injuries inside the bus are facial injuries, which account for over one-quarter of the injuries and are severe enough to require the services of an oral surgeon." Also, "sharp edges of the interior sheet metal are reported to cause some of the injuries occurring inside the school bus". (See U.S. Department of Transportation, NHTSA, Pupil Transportation Safety Program Plan, prepared by the School Bus Task Force, May 1973). Under the arbitrary assumption that half the facial injuries are caused by the interior body panels and half by the seats and

other structures, one-eighth, or 12.5 per cent, of the injuries that occur inside the school buses would result from joints weakness. Because of the arbitrariness of this assumption, the true value may lie on one side or the other of this estimate.

- 25 See U.S. Department of Transportation, NHTSA, School Bus Passenger Seating and Crash Protection, op. cit., p. 1.
- 26 See Note 24.
- 27 These pressures are probably related to the observed and expected percentage increase in the number of accidents and pupils injured over time. For example, in the United States (see U.S. Department of Transportation, NHTSA, Pupil Transportation Safety Program Plan, prepared by the School Bus Task Force, May 1973), the number of passengers, buses, and miles increased by 49 per cent, 52 per cent, and 39 per cent, respectively, from 1960 to 1971, whereas the number of accidents and passenger-pupils injured increased by 408 per cent and 106 per cent, respectively, over the same period.
- 28 Although reliable data on the international trade flows of school buses are not available, the Canadian body manufacturers of school buses export part of their production to the United States and other countries. The product that Canadian manufacturers export must comply with the regulations of the receiving country, which sometimes differ from Canadian ones and generate higher costs of production. This is also true for foreign manufacturers who export to Canada. This would be the reason why Mr. Norman A. Clark, Vice-President of the Motor Vehicle Manufacturers' Association, wrote in his letter dated March 15, 1977: "We believe the need for continued compatibility between the standards called out by each country [the United States and Canada] is beyond question in terms of benefits to all involved, including the consuming public."
- 29 See Ontario Ministry of Transportation and Telecommunications, "Allegations made by the Ottawa Saturday Citizen, March 9, 1974, concerning the condition of school buses and the practices of school boards and manufacturers", mimeo, undated, p.3, where it is argued that, in all probability, the more expensive buses are built to operate many more miles, providing increased comfort for the passenger.
- 30 The injuries that occur to students as pedestrians constitute 4.4 per cent of all injuries associated with school bus accidents (see U.S. Department of Transportation, NHTSA, Pupil Transportation Safety Program Plan, prepared by the School Bus Task Force, May 1973). It is assumed that all the injuries to students as pedestrians occur in front of the school bus and that they could all be prevented by the alternative (benefits that would be over and above the potential benefits of the proposed changes). The assumption thus favours the alternative, which would appear as even less cost-effective under a less favourable assumption. The intra-city bus alternative could thus save 35.1 per cent (30.7 per cent + 4.4

per cent) of the number of injuries per school bus per year, as opposed to 30.7 per cent  $[(.584 \times .4) + (.584 \times .125)]$  for the proposed standards.

- 31 An intra-city bus gets five miles per gallon as compared with nine miles per gallon for the normal type. The additional gasoline cost estimate (\$1,248) has been derived under the assumption of a 2-per-cent annual rate of increase in the real price of gasoline.
- 32 This estimate was obtained from the following calculation: (a) the total number of injuries per school bus per year  $(0.034) \times$  the expected useful life of an intra-city bus (12 years) = 0.407 injury over the expected useful life of an intra-city bus; (b)  $0.407 \times$  the proportion of all injuries that could be prevented by an intra-city bus (.351) = 0.143 injury prevented over the expected lifetime of an intra-city bus.
- 33 The cost per injury prevented under the intra-city bus alternative is underestimated, since it is a 53-passenger seat vehicle, while the conventional school bus has 66 passenger seats, and the average capacity utilization of a bus on a given route is about 62 seats.
- 34 The forward-control type of school bus differs from the conventional type in that it does not have a front hood and thus looks much more like a commercial bus. A 66-seat forward-control type of school bus would cost approximately \$31,200, \$14,300 more than a conventional school bus. By adding to this amount the same construction costs as those of the proposed standards and the additional gasoline cost associated with the increased weight in the vehicle resulting from the standards, one obtains the total discounted ( $r=.10$ ) costs displayed in the last column of the table below.

DISCOUNTED COSTS PER  
FORWARD-CONTROL SCHOOL BUS  
COMBINED WITH THE PROPOSED CHANGES

Hypothesis concerning "e" (per cent)	Construction Cost Hypothesis	Total Discounted Cost
0	1	\$16,290
	2	\$16,059
2	1	\$16,370
	2	\$16,139
4	1	\$16,461
	2	\$16,229
6	1	\$16,561
	2	\$16,330

- 35 Given the discounted costs presented in the table of Note 34 and the expected benefits of 0.143 injury prevented over the 12-year expected useful life of a forward-control type of school bus, the cost-effectiveness ratios of this alternative under various assumptions can be easily calculated:

Hypothesis concerning "e" (per cent)	Construction Cost Hypothesis	Cost-Effectiveness Ratios (dollars)
0	1	114,257
	2	112,637
2	1	114,819
	2	113,198
4	1	115,457
	2	113,829
6	1	116,158
	2	114,538

- 36 These percentages were calculated from data in U.S. Department of Transportation, NHTSA, Pupil Transportation Safety Program Plan, prepared by the School Bus Task Force, May 1973.
- 37 In 1974, 23 fatalities associated with school bus accidents occurred (estimated from Transport Accident Information Data System, Transport Canada; see Note 3). The estimated number of fatalities per school bus per year is 0.00075. By multiplying this last figure by 12 (the average useful life of the alternatives considered), one obtains 0.009. As mentioned in the main text, the alternatives could eliminate only 17.5 per cent of this figure or prevent 0.0017 fatality over their expected lifetime.
- 38 The fraction of the school bus purchase cost and that of the operation expenditures defrayed by the departments of education and the school boards vary from one province to another. In Quebec, the school bus purchase cost is entirely defrayed by the Department of Education, which also subsidizes the operating expenditures by allowing a per-user subsidy to the school boards. The Department of Education defrays about 75 per cent of the total costs and the school boards, 25 per cent (Quebec, Ministère de l'Éducation, Financement). In Ontario, the Department of Education defrays 30 per cent of the school bus purchase cost and the school boards defray two-thirds of the operating expenditures at the primary-school level and 40 per cent at the secondary level (Ottawa Board of Education).
- For Canada, the cost of pupil transportation is about 5 per cent of total school board expenditures. This percentage varies from 2 per cent in British Columbia to 10 per cent in Saskatchewan.
- 39 See Statistics Canada, Pupil Transportation in Canada, 1970-71, Supply and Services Canada, Catalogue no. 81-237.
- 40 See U.S. Department of Transportation, NHTSA, School Bus Passenger Seating and Crash Protection, op. cit., p. 5.
- 41 Other possible impacts of the proposed changes on the market structure are discussed under Section 3, The Non-Allocative Effects of the Proposed Standards, Production and Employment.

- 42 See U.S. Department of Transportation, NHTSA, School Bus Passenger Seating and Crash Protection, op. cit., p. 6. Also, the absence of any employment impact would presuppose that the supply of school bus services is cost inelastic ("inflexible with regard to cost").
- 43 It is thus conceivable that an impact on employment could stem from the projected decline in school-age population.
- 44 The chassis is the part of a motor vehicle that includes the frame, suspension system, wheels, and steering mechanism, but not the body and engine. There are eight manufacturers in the school bus chassis industry (Ford, General Motors, and Chrysler, among others).
- 45 Chrysler Corporation, letter sent to National Highway Traffic and Safety Administration, concerning school bus passenger seating and crash protection, November 17, 1975, p. 2.
- 46 Calculated from data available in Statistics Canada, Pupil Transportation in Canada, 1970-71, Supply and Services Canada, Catalogue no. 81-237.
- 47 Standard 222 for small van-type school buses will be similar to standard 222 for large school buses; a difference is that seat belts will be required for the former. Standards 221 and 301 will not apply to small van-type school buses. Standards 217 and 220, which will apply, are not expected to affect the industry.
- 48 See the discussion under the status quo alternative.
- 49 Calculated from data presented in Appendix B.



## APPENDIX A

### EFFECTIVE AND PROPOSED FEDERAL SCHOOL BUS SAFETY STANDARDS

This appendix presents a summary of the federal safety standards for the design and construction of new school buses. The first section includes existing standards, the second proposed standards. In the second section, the standards that apply to all motor vehicles (including school buses) and those which apply only to school buses are distinguished by the prefixes (G) and (S), respectively. In the first section, all the standards except standard 111A (Rear-view Mirrors) are "general", and so such a distinction is not made.

#### SECTION I: EFFECTIVE STANDARDS

<u>Effective January 1, 1971</u>	<u>Title</u>	<u>Requirements</u>
102	Shift Sequence	Gear positions identified for automatic and manual gearshift.
103	Defrost and Defrosting	Windshield defrosting and defogging system be provided.
104	Wiping and Washing	Two-speed windshield wiping and washing system be provided.
107	Reflecting Surfaces	No bright reflecting surfaces in the driver's field of view.
108	Lighting	Specifies quantity, location, and power of lighting equipment on vehicles.
111A	Rear-view Mirrors	A school bus shall be fitted with a mirror for the driver to see directly in front of the bus.
112	Headlamp Concealment	Specifies control and fail-safe operation for concealed headlamp.
113	Hood Latch System	A secondary latching system if the hood opens from the front of the vehicle and can obstruct the driver's view when opened.

Effective  
January 1, 1971  
(Cont'd)

	<u>Title</u>	<u>Requirements</u>
116	Hydraulic Fluids	Specifies fluid for braking systems.
205	Glazing Materials	Specifies the glazing for use on motor vehicles.
209	Seat Belt Assembly	Specifies strength and hardware for seat belts.
1,101	Emission Device	Requires devices for control of engine pollutants.
1,102	Crankcase Emission	Requires no crankcase emissions from gasoline engines.
1,103	Exhaust Emission	Limits amount of hydrocarbons and carbon monoxide emitted from an exhaust system.
1,104	Diesel Opacity	Limits for density of diesel engine smoke.
1,105	Evaporative Emission	Limits the evaporative emissions from gasoline tanks, carburetors, etc.

Effective July 1973

101	Control Location	Vehicle controls within reach of the driver; certain controls to be identified and illuminated.
207	Seat Anchorage	Specifies anchorage strength for driver's seat.
208	Seat Belt	Specifies seat belt requirement for driver.
210	Seat Belt Anchorage	Specifies anchorage strength for driver's seat belts.
302	Inflammability	Requires non-combustibility of interior fitting and upholstery.
1,106	Noise	Limits noise emitted from a vehicle.

Effective  
November 1, 1973

213	Child Seat and Restraints	Child car seats used in buses to meet Hazardous Products Regulations. <u>Note:</u> This is particularly directed to the small bus, where young children are being transported.
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Effective  
January 1, 1974

	<u>Title</u>	<u>Requirements</u>
124	Accelerator Control Systems	Requires accelerator to return to close position on release or breakage of control.

Effective  
September 1, 1974

217	Bus Window Retention, Release and Emergency Exits	Windows to remain in place to avoid ejection of passengers.
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Effective  
January 1, 1976

121	Air Brakes Systems	Specifies requirements for reservoir capacity, emergency brakes, parking brakes and failure warning.
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## SECTION II: CANADIAN MOTOR VEHICLE SAFETY STANDARDS BEING DEVELOPED

	<u>Title</u>	<u>Requirements</u>
(G) 101	Control Location	Adoption of international symbols for controls and displays. Planned January, 1978.
(G) 103	Windshield Defrosting	Amend the standard to specify minimum acceptable performance levels for defrosting and defogging systems. (Pending results of study in progress.)
(G) 105	Brake Systems	To specify equipment, performance, and testing of hydraulic brakes. Planned January, 1978.

	<u>Title</u>	<u>Requirements</u>
(G) 106	Brake Hoses	To specify the minimum standard for brake hoses used on air, hydraulic, and vacuum brake systems. Planned September, 1978.
(G) 108	Lighting Equipment	Amending the standard to allow the use of more efficient lighting equipment. Planned March, 1977.  Amending the standard to allow the use of more efficient headlamps. Planned December, 1977.  Amending the standard to allow the use of halogen-type headlamps. Planned December, 1977.
(S) 222	School Bus Passenger Seating and Crash Protection	See Section 1 of this paper.
(S) 301	Fuel System Integrity	See Section 1 of this paper.
(G) 302	Inflammability	Amend the standard to modify test procedures and redefine components that it applies to. Planned July, 1978.
(S) 111	Rear-view Mirrors	See Section 1 of this paper.
(S) 217	Window Retention and Emergency Exits	See Section 1 of this paper.
(S) 220	Rollover Protection	See Section 1 of this paper.
(S) 221	School Bus Joints Strength	See Section 1 of this paper.
(G) 1,106	Noise	Amend the standard to reduce the maximum allowable exterior and interior noise levels. Planned January, 1978.

Source: Transport Canada (Road and Motor Vehicle Traffic Safety), "Status of School Bus Safety Standards", Memorandum, April 28, 1976.

## APPENDIX B

### ESTIMATION OF THE ADDITIONAL GASOLINE COST RESULTING FROM THE PROPOSED STANDARDS FOR NEW SCHOOL BUSES

An estimate of the non-discounted additional gasoline cost that would be incurred each year of the expected life of a new school bus, if the price of gas were not to increase in real terms during this period, can be derived from various sources of information. For the purpose of this estimation, the market prices of gasoline used (and obtained from Energy, Mines and Resources Canada) are gross of taxes. Indeed, since it is not likely that the additional gasoline needed will come from new supplies, the correct measure is the value of the inputs in alternative use or the producer's price plus taxes (see A.C. Harberger, Project Evaluation: Collected Papers, Chicago: Markham Publishing Co., 1973, pp. 54-58).

First, from data on annual gas and oil expenditures from the operation of school-board-owned buses (\$279,767) and the total number of miles, including those for extra curricular activities (2,594,760) in Prince Edward Island, a gasoline cost estimate of 10.78 cents per mile can be derived (P.E.I. Department of Education Annual Report, 1974, p. 22).

Second, since this estimate is based upon the price of gasoline in Prince Edward Island, it must be adjusted to reflect the true opportunity cost of gasoline for Canadian society (i.e., the international price). The adjustment coefficient is the ratio obtained from dividing the opportunity cost of a gallon of gasoline for Canadian society (\$1.01) by the price per gallon in Prince Edward Island (94.9 cents). By applying this coefficient (1.06335) to the above gasoline cost per mile, one obtains an actual gasoline cost per mile of 11.44 cents. The opportunity-cost estimate of a gallon of gasoline for Canadian society has been derived in the following way. The difference of \$4.50 between the Canadian price (\$9.75) and the international price (\$14.25) per barrel leads to a difference of 13 cents per gallon. To this amount can be added an amount of two cents per gallon to reflect

the cost of the larger inventories required. The addition of the 15-cent difference to the average Canadian price per gallon of gasoline (85.7 cents in Toronto) gives an opportunity-cost estimate of approximately \$1.01 per gallon.

Third, the additional gasoline cost per mile resulting from the proposed standards (eight-tenths of one cent) can be obtained by multiplying the actual cost per mile (11.44 cents) by the expected increase in gasoline consumption (7 per cent; see Inflationary Impact Statement: School Bus Passenger Seating and Crash Protection, op. cit., p.5) associated with the increased weight of the vehicle resulting from standard 222. The multiplication of the additional gasoline cost per mile by the average number of miles per day and school bus (42.3; estimated from information in Statistics Canada, Pupil Transportation in Canada, 1970-71, Ottawa, Supply and Services Canada, Catalogue no. 81-237) gives the additional gasoline cost per day (33.9 cents). The additional gasoline cost per year is thus \$65.09 (33.9 cents per day multiplied by 192 days. The number of days per year that school buses are in operation is estimated from information in Department of Education, P.E.I., op. cit., p.22).

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