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**National Highway
Traffic Safety
Administration**

Development and Test of Rural Pedestrian Safety Countermeasures

Hale, A.
Shapiro, R. G.
Blomberg, R. D.
Kearney, E. F.

Dunlap and Associates East, Inc.
17 Washington Street
Norwalk, Connecticut 06854

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*Mr. Kearney is a lawyer, traffic law expert and former Executive Director of the National Committee on Uniform Traffic Laws and Ordinances.

16. Abstract

Prior to any promulgation by NHTSA of four model traffic regulations for rural pedestrian safety it was the objective of this study to assess, where feasible, the potential effectiveness of these regulations to prevent pedestrian accidents. The model regulations/ legislative packages developed under a previous contract (DOT-HS-7-01753) were entitled:

- Model Regulation for School Bus Pedestrians
- Model Regulation for Pedestrians on Highways
- Model Freeway Walking Restrictions Regulation
- Model Vehicle Hazard Warning Lights Regulation

After extensive analysis only the Model Regulation for School Bus Pedestrians was deemed feasible for testing and further development. The results of studies conducted on school bus driver experiences and school bus passing violations to assess the potential effectiveness of various aspects of this regulation are described. A revised model school bus regulation, incorporating the results of the tests conducted, along with concepts for public information and education to support statutory enactment and compliance with the model are presented. While the revised Model Regulation for School Bus Pedestrians is the principal product of this study many of its provisions may be implemented without the need for a regulatory format.

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METRIC CONVERSION FACTORS

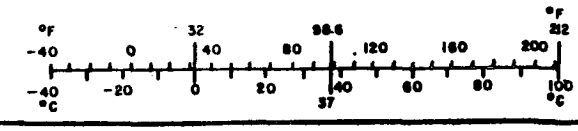
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
~~mi^2~~	~~square miles~~	~~2.6~~	~~square kilometers~~	~~km^2~~
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.96	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

TECHNICAL SUMMARY

CONTRACTOR	Dunlap and Associates East, Inc. 17 Washington Street Norwalk, CT 06854	CONTRACT NUMBER DTNH22-80-C-07568
REPORT TITLE	Development and Test of Rural Pedestrian Safety Countermeasures	REPORT DATE December 1983
REPORT AUTHOR(S)	Hale, A.; Shapiro, R.G.; Blomberg, R.D. and Kearney, E.F.	

In a previous research contract (DOT-HS-7-01753) for the National Highway Traffic Safety Administration (NHTSA), four model traffic regulations and supporting rationale were developed to counteract specific types of rural-suburban pedestrian accidents. These regulations were:

- Model Regulation for School Bus Pedestrians--Requires special school bus signalling equipment (amber and red signal lights, swing-arm stop sign, pedestrian crossing mirrors, etc.) and driver procedures to prevent children from being struck while crossing to or from a school bus by motor vehicles or the school bus itself.

- Model Regulation for Pedestrians on Highways--Requires certain behaviors of pedestrians travelling on highways without sidewalks (e.g., walking as far from roadways as possible, facing traffic) and the use of yet to be specified visibility enhancements during twilight and darkness; designed to prevent pedestrians from being struck while walking along the roadway where no sidewalks exist.

- Model Freeway Walking Restrictions--Bans "unnecessary" walking on freeways to minimize the risk of casual pedestrians being struck on freeways and thruways.

- Model Vehicle Hazard Warning Lights Regulation--Requires all passenger cars which stop on a roadway or shoulder to actuate four-way flashers and all vehicles to actuate four-way flashers when proceeding at a "hazardously" slow speed; designed to minimize chances for a dismounted motorist being struck by passing vehicles and slow moving vehicles being struck by overtaking vehicles.

(Continue on additional pages)

"PREPARED FOR THE DEPARTMENT OF TRANSPORTATION, NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION UNDER CONTRACT NO.: DTNH22-80-C-07568. THE OPINIONS, FINDINGS, AND CONCLUSIONS EXPRESSED IN THIS PUBLICATION ARE THOSE OF THE AUTHORS AND NOT NECESSARILY THOSE OF THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION."

The principal objectives of the present contract were to determine which regulations were feasible for effectiveness testing, conduct such tests, modify the content of the regulation(s) as necessary to reflect new information and results gained during the testing process and develop concepts for informational materials to promote enactment and enforcement of the regulation(s).

In considering feasibility for effectiveness testing, documented accident reduction and hazardous behavior reduction were considered the most desirable measures of effectiveness. After considerable investigation and analysis, it was determined that only the Model Regulation for School Bus Pedestrians (hereafter referred to as the Model Regulation) was feasible for testing.

The principal aim of the model regulation is to minimize the risk of a pupil pedestrian being struck by the school bus itself (usually because the seated driver can't see the pedestrian near the bus) or being struck while crossing to or from the bus by a passing motorist. Two studies were conducted to assess the effectiveness of provisions of the model regulation for providing means for observing pedestrians near the bus and the signalling system used to inform motorists of the requirement to stop for loading or unloading school buses. Both studies were conducted in the State of Ohio. Here, several different signalling systems, including the "model" system (i.e., eight light plus stop swing arm--see below for a definition), were operating as well as several different pedestrian crossing mirror systems.

The first study concerned an analysis of Columbus, Ohio police investigated school bus driver reports of motorist passing violations in Columbus between September 1979 and June 1982. In all, 429 violation reports constituted the data base which was examined during the Fall of 1982 to determine the violation report frequencies for each of the three types of school bus signalling systems in operation during the study period. The three systems studied were:

- Four light (two flashing red roofline lights front and back)
- Eight light (above plus two flashing amber pre-stop warning roofline lights front and back)
- Eight light plus stop swing arm (octagonal stop sign having two flashing red lights)

Analysis of the data revealed that the eight light plus stop swing arm system experienced statistically significantly fewer passing violations per bus in operation (approximately 2/3 to 1/2 as many) as the four light or eight light systems. There was no statistically significant difference in violation rates between the four light and eight light systems. Conclusive data on the exposure of the signalling systems to motorists (i.e., the opportunity for passing violations to occur) were unavailable. However, these findings are interpreted as supportive evidence for the safety benefit of using octagonal stop swing arms on school buses to indicate the requirements for motorists to stop.

The second study principally involved an assessment of the attitudes and experiences of a state-wide sample of 3,131 Ohio school bus drivers concerning school bus signalling systems and convex mirror systems. Considering the signalling system, 68 percent of the respondents preferred the eight light plus stop arm signalling system as opposed to a four light plus stop swing arm (ten percent), four lights (six percent) or eight light system (nine percent). Nearly 72 percent of those bus drivers reporting a "close call" with a child crossing the street preferred the eight light plus stop arm signalling system while 67 percent who did not have a close call preferred the eight light plus stop arm signalling system versus the other three systems. For those drivers who currently used an eight light plus stop arm system, nearly 80 percent expressed a preference for the system versus the other three systems. In addition, 61 percent of current four light and eight light system users also preferred the eight light plus stop arm system versus the other three systems.

With regard to the several configurations of pedestrian convex mirror systems in use, nearly 60 percent all respondents indicated problems seeing pedestrians near their buses. Nearly 75 percent of the visibility problems encountered by respondents were reported as actual blind spots. These points suggested some fundamental problems with convex crossing mirror systems relating to a combination of design, installation, adjustment, maintenance or driver use defects. Overall, drivers seemed to prefer two mirrors on the left side and two mirrors on the right side (47.4 percent) over other mirror combinations (two left/one right--22.2 percent; one left/two right--4.3 percent; one left/one right--9.6 percent; one right--0.9 percent and one left--4.3 percent). Similarly, they seemed to object most to only one mirror on the left. This was indicated by: 1) the highest number of blind spots being reported by drivers with only one mirror on the left; 2) the drivers with only one left mirror reporting the most difficulty seeing pedestrians due to blind spots; and 3) drivers, regardless of their own mirror system, indicating that as an ideal system they would like to have two left and two right mirrors. Most importantly, however, those drivers who had two left and one or two right mirrors reported the fewest incidents of the bus hitting or nearly missing pupil pedestrians in the locations monitored by the mirror system. While these findings provided useful insights on pedestrian convex mirror system effectiveness, no one system could be clearly required by the model regulation in the absence of objective visual performance data.

Incorporating the results of the two studies summarized above and the operating experiences of pupil transportation systems (notably North Carolina), the Model Regulation for School Bus Pedestrians was modified and expanded. The final version of the model regulation is presented herein along with the empirical and logical rationale supporting its provisions. The proposed model embodies the following key elements:

- A uniform appearance for school buses (paint scheme and legend)
- Use of an eight light plus an octagonal stop swing arm signalling system at every school bus stop where school children are received or discharged
- Motorists to stop for a stopped school bus with its signal system actuated
- Functional requirements specified for detecting and monitoring pedestrians near the bus.

- o School bus drivers to report motorists who illegally pass school buses to the police (NEW)*
- o Police to investigate school bus passing violation reports filed by school bus drivers and take follow-up enforcement action where warranted (NEW)
- o Qualification instruction for school bus drivers and annual school bus safety instruction for all K-6 pupils
- o Inspection of school buses and related safety equipment
- o Advance school bus stop warning signs posted where sight distances to school bus stops are limited (NEW)
- o Issuance of summary to drivers of the latest requirements regarding school bus appearance, signalling systems and required driver behavior (NEW)

Finally, concepts for public information and education to promulgate the regulation and encourage compliance are presented. The intended audience for a promulgation pamphlet described includes legislators, pupil transportation administrators and specialists, departments of transportation, boards of education, local and national safety organizations and community action groups. While it is necessary to implement the provisions of this regulation in a regulatory format (i.e., state statutes or administrative code) to realize the full derived safety benefit, selected features (e.g., the functional requirements for a system to observe pedestrians near the school bus) may be implemented without need for a regulation.

*"NEW" indicates provisions developed during the course of this study.

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ACKNOWLEDGEMENTS

In the planning and conduct of this study, essential support and assistance has been provided by various agencies and individuals. Dr. Alfred J. Farina, Jr. and Dr. Marvin M. Levy, National Highway Traffic Safety Administration (NHTSA) Contract Technical Managers, were primary sources of technical consultation in developing and meeting useful contract goals. Messrs. David H. Soule, (NHTSA Pupil Transportation Specialist) and Lawrence Pavlinski of Traffic Safety Programs (NHTSA) also contributed valuable information regarding the development and testing of the Model Regulation for School Bus Pedestrians.

In regard to the study of school bus passing violations conducted in Columbus, Ohio, outstanding cooperation and assistance were forthcoming from the Police Department and Public Schools, in particular the following individuals:

- Sergeant Lawrence A. Bigler, Commanding Officer, Columbus Police Accident Investigation Squad, whose cooperation and hospitality, as well as that of the rest of the squad, facilitated our access to their school bus passing violation data files.

- Mr. Ronald A. Smucker, Director of Transportation, Columbus Public Schools, who provided extensive data on school bus equipment and operations in the Columbus City School District.

Instrumental to a statewide study of Ohio school bus drivers' experiences and attitudes concerning various subjects embodied by the Model Regulation for School Bus Pedestrians was the exceptional interest and assistance forthcoming from the following individuals within the Ohio Department of Education:

- Mr. Herman L. Massie, Chief of Ohio Pupil Transportation and Mr. David Campbell, whose personal efforts in coordinating the distribution of survey questionnaires made the survey possible at all.

- The Ohio Association of Administrators of Pupil Transportation (OAAPT).

- The various regional and local supervisors of pupil transportation throughout Ohio who distributed the questionnaires to school bus drivers.

- The over 3,000 Ohio school bus drivers who took the time to conscientiously complete the questionnaires.

Mr. Edward F. Kearney, former Executive Director of the National Committee on Uniform Traffic Laws and Ordinances (NCUTLO) is a co-author of this report. Mr. Kearney oversaw and interrelated the drafting of the regulatory language for the Model Regulation for School Bus Pedestrians with respect to existing provisions of the Uniform Vehicle Code and Model Traffic Ordinance (UVC/MTO) (1979). Mr. Kearney also supervised the analysis of state traffic laws conducted by the NCUTLO staff during the summer of 1981.

We sincerely thank Mr. Frank Barabas (Manager) and the school bus drivers of the Candlewood Valley Transportation Company (Danbury, Connecticut) for their kind assistance in pilot testing the data gathering instrument for the Ohio school bus driver study reported in Appendix B.

We also wish to acknowledge the assistance of Saxe Mitchell, Inc. and, in particular, the contributions of Messrs. Mitchell Laub and Stanley Miller in the illustration and development of concepts for the model regulation pamphlet.

Finally, we thank Karen Kolenda-Schoelch for her patience and skill in preparing this document.

I. INTRODUCTION

A. Contractual Background

For well over a decade, the National Highway Traffic Safety Administration (NHTSA) has been conducting research into the causal factors associated with urban, rural/suburban and freeway pedestrian accidents. Given an understanding of the predisposing conditions and precipitating behaviors for various accident types, then public educational, training and regulatory countermeasures can be developed to correct the circumstances and behaviors which tend to induce pedestrian accidents. In a previous contract, Contract No. DOT-HS-7-01753 (Hale, Blomberg and Kearney, 1980) an effort was undertaken to develop regulatory countermeasures for rural and suburban pedestrian accident types identified by Knoblauch (1977) and freeway pedestrian accident types identified by Knoblauch, Moore and Schmitz (1976). Resulting from the analysis and development on this previous contract were four model pedestrian safety regulations which are listed below and briefly summarized in Table 1:

- Model Regulation for School Bus Pedestrians
- Model Regulation for Pedestrians on Highways
- Model Freeway Walking Restrictions
- Model Vehicle Hazards Warning Lights Regulation

Development of the above regulations was the result of the judgement that the desired behaviors, safety equipment, competencies and other circumstances were most likely achieved through statutory regulation control, rather than public education or training. Principally such factors as high driver involvement or likelihood of driver control in the accident type, a highly recognizable traffic situation, limited occurrence of the accident type in the traffic environment tended to suggest amenability of an accident type to regulatory control.

Before promulgating and recommending that any or all of these regulations be adopted by concerned jurisdictions, it was necessary to attempt an assessment of the potential effectiveness of each regulation in reducing target accident type occurrence. Empirical assessment data would provide the basis for determining the basic utility of a regulation and making any necessary changes in the provisions thereof.

B. Objectives of the Study

There were three overall objectives of this contract and they were:

- Assessment of the effectiveness of the model regulation(s), where feasible.
- Development and refinement of the tested model regulation(s), based on the results of the test(s) conducted.
- Development of public information and education concepts supporting enactment of and sustained compliance with a model regulation. Foremost in this category would be the development of concepts for a

Table 1. Model Regulation Summary

Regulation Title	Model Regulation for School Bus Pedestrians	Model Regulation for Pedestrians on Highways	Model Freeway Walking Restrictions	Model Vehicle Hazards Warning Lights Regulation
Target Problem	Children being struck crossing to or from school buses or by school buses themselves.	Pedestrians who are struck walking along rural and suburban highways principally during nighttime and mostly walking on the right with traffic.	Pedestrians being struck on freeways who are not compelled or authorized to be there.	Pedestrians being struck near disabled vehicles, mostly at night.
Principal Features of Regulation	To minimize the failures of motorists to stop for school buses, the model regulation mandates a uniform appearance for school buses (paint scheme and legend) and the use of compelling signalling devices (flashing amber pre-stop warning lights, flashing red lights and a "stop" signal arm) to remind motorists of their obligation to stop and remain stopped for a school bus which has stopped to receive or discharge passengers. The requirements for use of the signalling equipment by bus drivers are clearly specified. Aids such as convex mirrors, are required to enhance the bus driver's ability to detect any child immediately in front of the bus who cannot be directly seen. The bus driver is held responsible for clearing the front of the bus before moving forward. A minimum training requirement for school bus drivers is postulated as well as a minimum safety education requirement for pupils riding school buses. Inspection requirements are stipulated to ensure that the special signalling equipment is operational on buses used to transport school children.	Provisions require preferential use of various highway elements (i.e., sidewalk, shoulder, roadway edge) under certain conditions to minimize the risk of traffic collisions. Walking on the left, facing traffic is also required in the absence of sidewalks. To improve the nighttime conspicuity of pedestrian on highways yet to be specified (by pending research) materials or devices are mandated to be worn by pedestrians between the hours of sunset and sunrise, with certain exceptions.	Basically, unnecessary "foot traffic" is banned from freeway with notable exceptions (e.g., dismounted motorists, police officers, road workers, tow truck operators, etc.) A requirement to post the ban on foot traffic is also stated.	Vehicle hazard warning lights are defined and their use mandated whenever a vehicle stops upon a highway, with certain exceptions. To complete the treatment of useful applications for vehicles hazard warning lights, their use is required by slow moving vehicles.
Supporting Empirical Evidence	Studies conducted by Bequette (76) and the National Safety Council (75) have shown a drop in school bus passing violations when the the stop signal arm has been employed.			Research by Lanman, Lum and Lyles (79) suggests that the risk of collision between a slow moving vehicle and an overtaking vehicle is reduced when the slow moving vehicle employs its vehicle hazard warning lights.
Recommended Level of Application	State law.	State law.	State law.	State law.

pamphlet to promulgate the model regulation. Such a package would be principally aimed at such specialized groups as legislators, traffic safety and pupil transportation specialists and legislative advisory groups. Potential users of the promulgation package to promote the model legislation embodied by the Model Regulation for School Bus Pedestrians could include:

- National Association of State Directors of Pupil Transportation Services
- National Association for Pupil Transportation
- National School Transportation Association
- Southeastern State Association for Pupil Transportation
- California Association of School Transportation Officials
- State and Local Legislators
- Legislative Advisory Groups (e.g., Institute for Traffic Safety Management and Research [NY]; Motor Vehicle Conference [CA])
- National Committee on Uniform Traffic Laws and Ordinances
- NHTSA Regional Administrators
- Governor's Highway Safety Representatives
- National Safety Council (School Bus Section)
- American Automobile Association (national organization and local clubs)
- State Parent-Teacher Associations

C. Organization of the Report

This report is organized into four additional sections. Section II deals with the methods and procedures employed in ultimately selecting the Model Regulation for School Bus Pedestrians for testing and development and in acquiring assessment data. Section III presents the tested and refined version of the Model Regulation for School Bus Pedestrians including a background of the accident problem, approach and overview, provisions of the model regulation and an annotation of each provision with supporting rationale. The supporting rationale presented is either rational analysis or empirical evidence derived from this and other research studies. Section IV presents preliminary concepts for public information and education (PI&E) support of the model regulation. Included are preliminary illustrations, and suggestions for format, layout and text. In Section V the conclusions and recommendations forthcoming from this study are discussed. Appendix A contains a complete report of the study of police investigated school bus passing violations in Columbus, Ohio as a function of stop signalling system used. Appendix B

contains a comprehensive report of the statewide investigation of Ohio drivers' experiences and attitudes vis a vis school bus operations addressed by the Model Regulation for School Bus Pedestrians. Appendix C presents a glossary of standardized words and phrases employed in the Uniform Vehicle Code and Model Traffic Ordinance (NCUTLO, 1979) as background for the model regulation presented in Section III.

II. METHODS AND PROCEDURES

In this section the considerations and methods employed in determining which model regulation(s) could feasibly be tested and developed are discussed. Assessment studies for concepts embodied by the Model Regulation for School Bus pedestrians are also described.

A. Model Regulation Testing Approaches

In structuring a test of a model traffic regulation there are three basic approaches that can be reasonably considered, namely, "actual implementation," "existing situation" and "essential features."

In the actual implementation approach the model law or ordinance is enacted in a test jurisdiction. Accident reduction and/or hazardous behavior reduction data are collected before and after the model regulation becomes effective and in a similar comparison jurisdiction without the model regulation. The actual implementation approach is probably the most realistic test of a regulation in that its ability to be enacted is also tested as well as its effectiveness in reducing associated accidents or precipitating behaviors (see Hale, Blomberg and Preusser, 1978). On the negative side, this method can be costly and time consuming to gain enactment of the model regulation.

In the existing situation approach, the attempt is made to locate a jurisdiction where the model regulation or its components have been enacted recently. In this case, assuming available and adequate accident data, pre-post accident frequency comparisons can be made as well as post assessments of prevailing levels of compliance behavior. Recency of enactment is the key with this method. If enactment were more than five years prior, adequate pre-regulation accident records may be difficult to acquire. Also the criteria for accident reporting and the structure of the data collected can change if the time frame for an existing situation test is too long. Pre-regulation behavioral data are generally unavailable, as well.

With the essential features paradigm, the attempt is made to implement the significant operational provisions of the model regulation in a jurisdiction without recourse to legislative enactment. A given agency within a jurisdiction (e.g., department of motor vehicles, pupil transportation agency, traffic commission) may have the administrative authority to implement provisions and requirements of a model regulation (e.g., required equipment on a motor vehicle; traffic signs, signals and pavement markings). Under certain circumstances, then, the essential features of a model regulation can be introduced into the traffic environment without legislative enactments.

It was clear that from a standpoint of cost benefit to the Government, that the possibilities for testing the model regulations via either the existing situation or essential features approach would be investigated before possibilities for the more time consuming and costly actual implementation approach were investigated. Essential to evaluating the feasibility of existing situation possibilities was the need for a "state of existing traffic law" analysis.

In essence, the project staff needed to know if and where the key operational provisions of the four model regulations existed throughout the states. In addition, it was necessary to know when key provisions of the model regulations were enacted to estimate the recency and availability of associated accident data. The services of the consulting staff of the National Committee on Uniform Traffic Laws (NCUTLO) were therefore enlisted to conduct a review of current state traffic laws.

B. NCUTLO Analysis of State Traffic Laws

The objective of this analysis of state laws by NCUTLO was to determine where suitable jurisdictions existed for existing situation tests of the Model Regulation for School Bus Pedestrians, Model Regulation for Pedestrians on Highways, and the Model Vehicle Hazard Warning Lights Regulation. The decision was made that any testing which could be done with the Model Freeway Walking Restrictions Regulation would be done via the administrative authority controlling a freeway or turnpike system of interest.

In August 1981 the NCUTLO staff conducted a review and analysis of the traffic codes of all 50 states, the District of Columbia and Puerto Rico. The analysis was current as of 1 January 1981. In addition to a general analysis of the concordance of state jurisdictions in whole or in part with the three model regulations, NCUTLO was asked to answer several key focus questions regarding the model regulations. The inquiries related to conditions which would be particularly important to the selection of both experimental and comparison sites for either existing situation or actual implementation modes of assessment and they were:

Model Regulation for Pedestrians on Highways

- Identify any states (and dates of effectiveness) which have enacted the left side walking provisions within the last ten years.
- Identify which states do not specify on which side of the roadway a pedestrian must walk.

Model Vehicle Hazard Warning Lights Regulation

- Determine which states currently permit the use of four way flashers by a stopped passenger vehicle.
- Which states currently require the use of four way flashers by a stopped passenger vehicle.
- Of the states which currently permit the use of four way flashes by a stopped vehicle, which turnpike (toll road) authorities have the administrative powers to require the use of four way flashers by passenger vehicles stopped on the turnpike.

Model School Bus Regulation

Determine which states currently:

- o Require or permit only red flashing lights on school buses (four light system)
- o Require or permit a four light system plus a STOP swing arm
- o Require or permit amber flashing warning lights in addition to the red lights (eight light system)
- o Require or permit an eight light system plus a STOP swing arm
- o Allow discretionary use of the school bus "signal system" when picking up or discharging school children
- o Require mandatory use of the signal system when picking up or discharging school children
- o Determine dates of effectiveness for above provisions

The results of the above inquiries are discussed in the next section.

C. Analysis and Selection of Model Regulations for Testing and Development

With a variety of considerations, including the NCUTLO state law analysis, size and distribution of the target accident type(s) for each model regulation, project resources, and NHTSA pedestrian program priorities, each model regulation was scrutinized as an individual case for testing possibilities.

1. Model Regulation for Pedestrians on Highways

There are provisions in this model regulation related to the position and direction of pedestrians on highways which could be tested. Most notably the provision requiring pedestrians to walk on the left side of the highway facing traffic, when no sidewalk is available, is one which may benefit from a field assessment. Smeed (1953) in a count of pedestrian accidents in Britain between August 1949 and February 1950 determined that is was "more than twice as dangerous to walk with one's back to the traffic as it is to walk facing it." Logic dictates that left-side walking should be safer because the orientation of the pedestrian's senses and attention is in the direction of approaching traffic for the most part. Such an orientation can give the pedestrian the accident-preventing margin of advance warning should a vehicle be moving too close to the edge of the roadway or moving off onto the shoulder.

While a test of the left-side walking provision is possible, it was not recommended for the following reasons:

- o The determination of left versus right-side walking in accidents involving persons walking along the roadway would not be difficult from an examination of state traffic accident records

before and after the statutory requirement for such behavior. It would be necessary to have an estimate of "exposure" or on average how many people walk on the left versus right side to properly weight the accident data. However, any reasonable estimate of the left-side/right-side exposure for pedestrians involved in these accident statistics would be time consuming and expensive.

- Forty-eight jurisdictions (including District of Columbia and Puerto Rico) presently require by statute that pedestrians walk on the left-side of a two way roadway, facing traffic. Only four states, i.e., Arkansas, Maine, Massachusetts and Mississippi do not specify on which side of the roadway a pedestrian must walk. Thus, apparently, the vast preponderance of jurisdictions are already convinced of the merit of left-side walking.

In view of the foregoing, field testing of this regulation was not considered practicable and, therefore, not recommended.

2. Model Vehicle Hazard Warning Lights Regulation

The portion of this regulation addressing pedestrian safety, per se, requires that four-way flashers be actuated on stopped or disabled passenger vehicles. The pedestrian safety impact of a stopped vehicle's actuated four-way flashers system on passing traffic has recently been the subject of investigations for NHTSA (Ulmer, Leaf and Blomberg, 1981) and FHWA (Knoblauch and Tobey, 1980). Further evaluations of the impact of four-way flashers on passing traffic, i.e., speed and lateral placement, would not seem cost justifiable.

Another approach to field testing considered was a compliance study. In a controlled environment such as a turnpike authority or within a system of fleet vehicles (such as the telephone company) the requirement to use four-way flashers for all stopped passenger vehicles could be implemented. In the case of a cooperating turnpike authority with autonomous rule making authority, the requirement could be established and promulgated through educational advisories (handouts, signs) at toll booths. In the case of a large corporate fleet of passenger vehicles, the requirement could be disseminated through normal corporate regulatory channels. In either case, vehicle breakdowns would have to be detected during a "before" and "after" regulation period and the determination also made of whether the four-way flashers were operating at the time of detection. Similar data should be acquired in the cases of actual disabled vehicle-related pedestrian accidents occurring in a "before" and "after" period.

To obtain sufficient behavioral or compliance data via either scenario would have required a complex, coordinated detection system for behavioral compliance. Since disabled vehicle-related pedestrian accidents are not abundant, it could take some considerable post-regulation time to acquire a valid sample in any test situation or jurisdiction.

A compliance test did not seem particularly worthwhile in and of itself when considering the complexity and expense of developing a reliable detection system for disabled vehicles (coordinating with law enforcement personnel, towing services, possible need for project staff patrol of roadway segments). The likelihood of acquiring sufficient after period pedestrian accident data for a meaningful "before" and "after" comparison was not great. For these reasons, actual field testing of the Model Vehicle Hazard Warning Lights Regulation was not recommended.

3. Model Freeway Walking Restrictions

The basic concept of this regulation has inherent merit. The results of prohibiting unnecessary foot traffic on freeways will depend upon the effectiveness of supporting educational, engineering and enforcement efforts.

Due to the low frequency of freeway pedestrian accident occurrence, the low density and unpredictability in location of the accident-precipitating pedestrian behaviors, a field test of this regulation was not recommended.

4. Model Regulation for School Bus Pedestrians

This model regulation encompasses many requirements including mandated equipment and markings for school buses, duties of school bus drivers, duties of drivers approaching school buses, required instruction for school bus drivers and pupil riders and required inspections of school buses. While all provisions of this model regulation were seen to constitute an essential whole for implementation, there were nevertheless, perceived to be core features, which were essential considerations for testing. These features are:

- The requirement for a signal system on the school bus which includes two alternately flashing red roofline lights front and back, two alternately flashing amber roofline lights front and back, and an octagonal stop swing arm with alternately flashing red lights top and bottom on each side.

- The requirement for convex, crossing mirrors or other devices to enable the driver of a stopped school bus to see a person near the bus who is in danger of being struck by the bus when it resumes motion.

- The requirement for the bus driver to use the aforementioned signal system each and every time the school bus stops alongside the roadway to pick-up or discharge school children (in contrast to UVC 11-706(b) which provides for discretionary use of a signal system as do 13 states plus the District of Columbia and Puerto Rico).

The first and third features itemized above address one of the two varieties of the school bus accident type, i.e., children crossing to or from a stopped school bus being struck by a passing motorist. The second of the itemized features of the model regulation above deals with the variety of the school bus pedestrian accident type where the school bus itself strikes a pedestrian after making a stop to receive or discharge passengers.

Seventy-eight percent of the accident cases studied by Knoblauch (1977) involved pedestrians crossing to or from a school bus and 34 percent of the motorists involved in these accidents passed a stopped bus with the "signal lights" flashing. Despite the long standing requirement for motorists to stop for stopped school buses with activated signalling systems, demonstrated motorist compliance leaves much to be desired (see Appendix A). A compelling stop signalling system could minimize motorist stopping violations. The ideal, practicable school bus signalling system was seen to be the eight light plus stop swing arm system specified by the model regulation described and for the reasons elaborated upon at some length in the final technical report, "Model Regulations and Public Education for Rural-Suburban Pedestrian Safety" (Hale, Blomberg and Kearney, 1980) and in Section III.C.§2.

According to an analysis of state laws performed by the staff of the NCUTLO (1981) 20 states explicitly required or authorized red flashing lights only and they included:

Alabama	Nevada	Oregon	West Virginia
California	New Hampshire	Rhode Island	Wisconsin
Hawaii	New York	Tennessee	District of Columbia
Michigan	North Dakota	Texas	Puerto Rico
Mississippi	Oklahoma	Virginia	Florida

Nine state explicitly required or authorized red lights plus amber lights only (an eight light system) and they were:

Alaska	Montana	Pennsylvania
Delaware	Oregon	South Carolina
Wyoming	South Dakota	Utah

Among the above 29 jurisdictions requiring or authorizing only red lights or red plus amber lights, it is important to note that use of stop signal arms on school buses occurs on an optional basis within school districts in all but nine of these jurisdictions. Designated agencies have yet to authorize the use of stop swing arms on school buses in the following states where a de-facto prohibition existed (Specialty Manufacturing, 1982).

California	Delaware	Hawaii	Michigan	Oregon
Montana	Pennsylvania	South Dakota	Texas	

Seven states explicitly required or authorized red lights plus a stop swing arm and they were:

	Date Stop Arm Approved
Kentucky	02/09/56
Maine	06/28/74
Massachusetts	07/02/73
Missouri	08/03/49
Nebraska	05/21/73
North Carolina	04/30/65
Washington	04/29/65

Eleven states explicitly authorized or required red lights plus amber lights plus a stop swing arm and they were:

	Date Stop Arm Approved
Colorado	02/19/74
Georgia	03/21/70
Idaho	03/06/78
Illinois	09/05/74
Indiana	02/26/73
Iowa	09/01/41
Kansas	03/22/74
Louisiana	06/23/66
Minnesota	04/22/47
Ohio	03/15/79
Vermont	04/08/69

In the remaining five states, the requirements were not clearly interpretable. Included within this group was Connecticut wherein buses typically employ a four light system and a stop swing arm is used on an optional basis by school districts. Connecticut law permits the use of red, green and amber flashing lights on school buses, and says nothing, per se, about the use of stop swing arms. Under these statutory conditions, a wide variation in practice and non-standardization of signalling equipment for school buses can result. The impact of this heterogeneity on resident and transient motorists may unnecessarily degrade traffic safety near school buses stopping or stopped to load or unload school children.

When one considers that only eleven states required the model regulation's eight light plus stop swing arm signalling system, a considerable number of states remained without this requirement and potentially in need of experimentally determined cost justification to enact the model regulation. A field test of this regulation could provide that justification.

In conceiving the variables to be included in any existing situation test of this regulation, the following basic scenario was initially recommended:

> Select an experimental state which has an eight-light system plus stop swing arm plus the requirement to use the system whenever the bus stops to load or unload school children. Examine accident data three years before the eight-light plus swing arm provision became effective and at least two years afterwards. Observe/analyze motorist stopping behavior around these ideally configured buses. Compare accident and behavioral data in the before and after periods with a red lights only comparison state.

The stop swing arm, is rationally appealing and used by jurisdictions to a noticeable degree already. According to NCUTLO (1981) 18 states required or explicitly authorized stop swing arms as of January 1981. Approximately 41 states are using it on an optional basis (Specialty Manufacturing, 1982). However, because it represents some significant cost (about $200 installed) a performance test of the signalling device was seen as desirable. While a stop swing arm was demonstrated to be of considerable success in the ice cream vendor accident situation (see Hale, Blomberg and Preusser, 1978) its effectiveness in the school bus situation has not been demonstrated for

NHTSA. Therefore, a before and after accident data analysis was initially considered in a jurisdiction which had recently enacted the the stop swing arm requirement for buses. Such a jurisdiction was determined to be the State of Ohio.

On 1 April 1978, through administrative action, an eight light signalling system and a three convex mirror system for observing pedestrians near a school bus became mandatory for all buses subsequently acquired. Concurrently, a stop swing arm was also made optional equipment. Prior to this, Ohio school buses carried only a four light signalling system (no amber lights and no stop swing arm) and a single convex mirror for the bus driver to observe pedestrians crossing in front of the bus. On 15 March 1979, by statutory requirement, the eight light system and stop swing arm became mandatory on all buses subsequently acquired. As a result of a phased implementation of the eight light stop/swing arm requirement, a before and after accident study was not particularly suitable as there was no discrete treatment effect. In fact, as was reflected for the 1981/82 school year, the following types and numbers of school bus signalling systems were in effect throughout the State of Ohio:

- About 6,000 four light buses
- About 1,000 eight light buses
- About 4,000 eight light and swing arm buses

Moreover, an examination of the numbers of school bus related pedestrian accidents (both hit by bus and hit by passing vehicle) occurring statewide in Ohio in recent years revealed the following frequencies:

1980/81	22	(2 fatalities)
1979/80	23	(0 fatalities)
1978/79	34	(4 fatalities)
1977/78	19	(3 fatalities)
1976/77	26	(2 fatalities)
1975/76	31	(2 fatalities)
1974/75	16	(1 fatality)

These numbers clearly would not permit a valid "post" study of the relative effectiveness of the three signalling systems in place based on accident data. Thus any kind of formal quantitative study of the effect of school bus signalling systems on school bus pedestrian accidents was not considered feasible in Ohio.

An investigation of the potential for other state jurisdictions serving as experimental sites for a before and after or post study of school bus related accidents was conducted. No potentially suitable site was found that had recently enacted a model regulation eight light and stop swing arm provision or had sufficient accident data to conduct a valid assessment. Jurisdictions investigated included Illinois, Indiana, Kansas and Idaho.

However, substantial school bus passing violations data did exist within the Columbus Police Department for the 1979-82 school years. During the 1981/82 school year 405 reports of illegal passing of stopped school buses were filed with the Columbus Police Department by Columbus City School

District school bus drivers. Assurances pending formal written approval were forthcoming from the Columbus Police Department that we could have access to these violation data for the purposes of coding situation/location descriptors (for follow-up site visits where required), officer evaluations, school bus numbers and school bus driver name. All these data could then be correlated with the types of buses involved and signalling system in use at the time of the violations (knowing the bus numbers involved and school bus driver's name). This would be done by accessing the Columbus City school bus equipment logs for those buses experiencing passing violations.

Ohio transportation officials have in the past been extremely cooperative and interested in studies of highway safety. Ohio itself is considered a representative state for the nature and magnitude of school bus operations. Therefore, it was proposed that assessment data, other than accident data per se, be gathered in this state relevant to the two major provisions of the Model Regulation for School Bus Pedestrians, i.e.:

- o The signalling system (eight light and stop swing arm) which is involved in the school bus related accident type where a motorist is passing a stopped school bus strikes a pedestrian/passenger crossing to or from the school bus.

- o The convex mirror/pedestrian monitoring system which is involved in the school bus accident type where a pedestrian/passenger is struck by the bus itself.

Specifically, the following assessments regarding the Model Regulation for School Bus Pedestrians were proposed for accomplishment:

- o Study of Violations Data and School Bus Signalling Systems

  The principal assessment data used in this study were the Columbus Police Department school bus passing violations data previously described for the 79/80, 80/81 and 81/82 school years. The violations data were then associated with the appropriate Columbus City school bus equipment record by each bus number recorded in the violations file. Once the school bus equipment record was identified, it was determined what type of signalling system (i.e., four light, eight light, eight light plus stop swing arm) was present on the school bus involved. Appendix A contains a full discussion of the methods and results of the study of school bus passing violations data in Columbus.

- o Study of School Bus Driver Experience and Attitudes Concerning Pupil Pedestrian Safety

  There were no accident or violations data available that would yield any opportunities for evaluating the effectiveness of crossing mirror systems or other topics of school bus operations addressed by the model regulation. Access to the experiences of operating school bus drivers on a statewide basis in Ohio could yield important information which could enhance the overall scope and depth of the model regulation. With the

promise of interest and cooperation in such an undertaking expressed by the Ohio Office of Pupil Transportation, such a study of school bus driver experience and attitudes was recommended. The reader should turn to Appendix B for a complete account of the methods and results for this study.

In the next section the "Model Regulation for School Bus Pedestrians" is presented which incorporates the results of information gained from the two assessment studies conducted and the operating experience of several jurisdictions.

III. MODEL REGULATION FOR SCHOOL BUS PEDESTRIANS

A. Introduction

1. Background of the Problem

In the study of rural and suburban pedestrian accidents (Knoblauch, 1977) the "School Bus Related" accident type (three percent of the accident sample) involved pedestrians being struck while going to or from a school bus or school bus stop. Forty-five percent of the pedestrians were 0 to 9 years of age. Ninety-one percent of these accidents occurred on two-lane highways in residential or country locations. Nearly 74 percent of the accidents occurred in daylight conditions while the balance occurred during twilight or darkness. Seventy-eight percent of the pedestrians were struck trying to cross the highway. Ironically, 22 percent of the striking vehicles were the school buses themselves. A disturbing proportion of motorists (34 percent) proceeded past a stopped bus with signal lights flashing.

While school bus related pedestrian accidents only accounted for three percent of all cases studied by Knoblauch (1977) there are nevertheless two recurring varieties of this accident type which seem preventable, i.e.:

- Child is struck going to or from a stopped school by a passing motorist, usually overtaking the bus from the rear.
- Child near the front or sides of a stopped school bus (having just left or about to enter the bus) is struck by the school bus itself because the driver does not see the child.

Educational measures should and are being taken to prepare children for coping with the dangers of crossing the street to and from school buses and bus stops. They should continue. However, children are forgetful and impulsive and may be distracted so as to abandon their training in the real world. Thus, it behooves officials to create as benign a traffic environment as possible in which children may cross the street. It remains to be seen if motorist compliance with the long standing requirements to stop for school buses which are stopped to load or unload children can be brought to a satisfactory level.

At this time diverse school bus signalling systems and procedures are in place throughout the country. For instance some jurisdictions require only a four red light stop signalling system and others require a stop signal arm in addition to the four lights; some jurisdictions require an eight light (four amber pre-stop warning light plus the four red stop lights) system and others require an eight light plus stop signal arm system. Some states leave the matter of installing a stop signal arm as a local community option thus creating within a state a mixed fleet of buses--some with and others without a stop signal arm.

The method of pre-stop warning varies considerably from jurisdiction to jurisdiction. Some of the variations which may be encountered, include:

- o Amber flashing lights activated in advance of the school bus stop; motorists must stop when the bus stops and red flashing lights are turned on (and a stop signal arm extended in some cases, as well).

- o The red flashing lights are turned on in advance of the stop; motorists must stop even while the bus is moving with the lights flashing (and a stop signal arm extended also in some cases).

- o The red flashing lights are turned on in advance of the stop; motorists must stop when the bus comes to a stop.

- o The red lights are turned on in advance of the stop; motorists must stop when the bus stops and a stop signal arm is extended.

- o The red lights are turned on and a stop signal arm extended in advance of the bus stop; motorists must stop when the school bus stops.

In addition to the above inconsistencies in national and local practice, there is also variation among states as to whether a school bus driver may or must activate the stop signalling system every time the bus has stopped to load or unload passengers. As of 1980, 15 jurisdictions allowed discretionary use of the signalling system and 37 jurisdictions required use of the system at every school bus stop (NCUTLO, 1981). Thus, the discretion allowed some bus drivers in the use or non use of the signalling system at a school bus stop may impose an unnecessary judgmental burden upon the bus driver which could put passengers at unnecessary risk.

Clearly the above situations can present a chaotic and dangerously confusing picture of requirements for motorists within a given state and travelling between certain states. Uniform and compelling school bus markings and signalling devices that effectively remind motorists of their duties can improve this present situation. Public education on the requirements of the law coupled with credible levels of enforcement should carry the necessary improvements the rest of the way.

It is also extremely important for a driver of a stopped school bus to be able to detect the presence of anyone immediately in front of the bus, before forward motion is resumed. This can be a problem in the case of the "conventional" or long hood bus which currently predominates in school bus operations nationwide. The seated driver has problems seeing small children near the front bumper without the aid of convex crossing mirrors or other detection systems. Visibility of the area immediately in front of the school bus is not particularly a problem for the seated driver of a forward control or transit type school bus. For both types of bus, visibility close to the ground along the sides of the bus is also essential. Despite warnings to the contrary, small children occasionally position themselves between the front and rear wheels of the bus.

2. Approach and Overview

Being called a "Model Regulation for School Bus Pedestrians" this set of provisions seeks to regulate principally those aspects of the pupil transportation system which are seen to directly affect pedestrian safety. The provisions of the regulation are intended for enactment into statutes of a state traffic code and/or the administrative rules of the overseeing state agencies (e.g., Department of Education, Department of Transportation). Thus, the bus as its appearance or operation may affect motorist behavior becomes a principal focus of regulatory attention. Human actions (prescribed, proscribed) and equipment features for school buses and bus stops as they might improve the pedestrian safety of school bus passengers all have been considered. The concern for the children in this regulation is while they are on the highway or street, enroute to or from the school bus.

Some of the provisions in the model regulation already exist in state traffic codes. Others do not. Some of the provisions of this regulation reproduce or are patterned after those in the Uniform Vehicle Code and Model Traffic Ordinance (NCUTLO, 1979), hereafter referred to as the "UVC." The objective has been to identify and incorporate provisions that have favorable records of performance in actual operations or test situations and to include new provisions, as necessary, to counteract school bus related pedestrian accident problems uncovered by Knoblauch (1977) and other investigators. Ideally, effective existing practices and new approaches have been combined into a conceptually complete model school bus regulation for pedestrian safety predicated upon uniform school bus appearance and operational procedures.

B. Provisions of the Model Regulation

Figure 1 contains the provisions of the "Model Regulation for School Bus Pedestrians." The traffic terminology employed in the wording of the Model Regulation basically follows UVC Chapter 1 "Words and Phrases Defined." That chapter is reproduced in Appendix C for the convenience of the reader. Within the body of some of the model regulations, certain words or phrases may appear in parentheses. The parenthetical material will indicate one of two things:

- o A description of an agency whose "official designation" should then be supplied by the enacting jurisdiction.
- o Optional language (more than one set of parentheses) with the decision as to which version is selected left up to the local jurisdiction.

Finally, the reader will notice that no penalty provisions appear in the model regulation. The matter of penalization is better left to the judgment of local jurisdictions guided by established practices.

MODEL REGULATION FOR SCHOOL BUS PEDESTRIANS

§ 1 — Definitions

(a) School bus--Every motor vehicle that is used to transport children to or from school or school activities and in doing so receives or discharges children along a highway, excluding a bus operated by a common carrier in urban transportation of school children.

(b) School bus driver--a person who drives or is in actual physical control of a school bus. (1)

§ 2 — Appearance and equipment requirements for school buses

(a) The body of the school bus, including hood, cowl and fenders shall be National School Bus Glossy Yellow in color. (2)

(b) Every school bus shall clearly display the words "SCHOOL BUS" on both the front and rear of the bus placed as high as possible without compromising their visibility. The letters shall be black in color, at least eight inches high and conform to "Series D" of the Standard Alphabets for Highway Signs. (3) *Whenever the school bus is operated for purposes other than transporting children, the words "SCHOOL BUS" shall be covered or concealed.*

(c) Every school bus shall, in addition to other equipment required by law, be equipped with:

(1) Signal lamps displaying two alternately flashing amber lights to the front and to the rear of the bus. The lamps shall be visible for at least 500 feet in

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(1) *In conjunction with this definition, it should be noted that § 7 requires minimum training for a driver of a school bus carrying school children.*

(2) *A specification range for this color may be found in Federal Standard No. 595a, color 13432.*

(3) *See the Standard Alphabets for Highway Signals and Pavement Markings, Federal Highway Administration, 1977 Edition.*

Figure 1. Model Regulation for School Bus Pedestrians

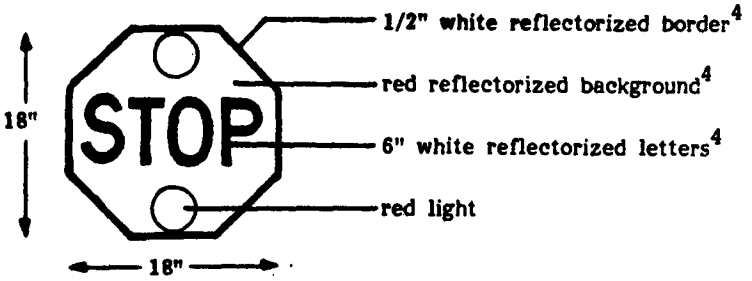
(continued)

normal sunlight. If separate signal heads are used, the lamps shall be located next to the lamps in subsection (2) but closer to the vertical centerline of the bus. If dual purpose signal heads are used, they shall be positioned as in subsection (2).

(2) Signal lamps displaying two alternately flashing red lights to the front and to the rear of the bus. The lamps shall be visible for at least 500 feet in normal sunlight and be located as high and widely spaced laterally as practicable.

(3) A stop signal arm that can be extended horizontally from the left side of the school bus coincident with the actuation of the alternately flashing red lights in subsection (2). The arm shall be octagonal in shape, red and white in color and contain two alternately flashing red lights which are visible for at least 300 feet to the front and rear in normal sunlight. The lights shall only flash when the stop arm is extended. The bottom of the stop arm shall be as close as practicable to 44 inches above the ground. The stop arm shall duplicate the design, size and specifications in subsection (4).

(4) Specifications for the school bus stop signal arm.



(5) Exterior mirrors or other appropriate devices shall be installed on the school bus and adjusted so that a seated bus driver can detect a person, who would

(4) colors to meet specifications in the latest Federal Highway Administration Standard Color Charts.

Figure 1. Model Regulation for School Bus Pedestrians (cont'd)

(continued)

otherwise be obscured from view, in any position adjacent to the side or front of the bus forward of the rear wheels.

(d) The lights and stop signal arm required by this section shall conform to the most recent standards and recommended practices of the Society of Automotive Engineers and the United States Department of Transportation. (5)

(e) This section shall become effective for all school buses put into service after _____ (date) and for all school buses on _____ (date).

§ 3 — Owner's responsibilities

Every owner of a school bus shall comply with the appearance and equipment requirements in § 2.

§ 4 — Duties of school bus drivers

(a) Except as provided in subsection (c) a school bus driver shall display the alternately flashing amber lights described in § 2 at least 100 feet but not more than 500 feet before every stop at which the alternately flashing red lights and stop signal arm will be used pursuant to subsection (b).

(b) Except as provided in subsections (c) and (f), a school bus driver shall simultaneously actuate the alternately flashing red lamps and the stop signal arm described in § 2 whenever the bus has stopped on a highway for the purpose of receiving or discharging passengers and the alternately flashing amber lights shall not be displayed. The school bus driver shall prevent any children from leaving the bus until any vehicles approaching the bus from either direction have stopped.

(5) *As of 1983 Federal Motor Vehicle Safety Standard No. 108, defines vehicular signal lighting requirements with particular reference to school buses in § 4.1.4 SAE Standard J887, "School Bus Signal Lamps," May 1972 specifies quantitative design and performance parameters for school bus signal lamps. SAE Recommended Practice J113a defines design and performance requirements for school bus stop signal arms.*

Figure 1. Model Regulation for School Bus Pedestrians (cont'd)

(continued)

The alternately flashing red lights and stop arm shall be displayed until passengers going to or from the bus have completed crossing the roadway and have reached a place of safety. Before resuming forward motion, the school bus driver shall determine that no one is in or near the path of the bus and then cease displaying the alternately flashing red lights and stop signal arm.

(c) Except as provided in subsection (f), a school bus driver shall not display the alternately flashing amber or red lights and the stop signal arm described in this section:

(1) In business districts and on urban arterial streets designated by (State Highway Commission) or local authorities;

(2) At intersections or other places where traffic is controlled by traffic control signals or police officers;

(3) In designated school bus loading areas where the school bus is entirely off the roadway.

(4) When the school bus has stopped for any purpose other than to receive or discharge school children;

(5) When the school bus is operated on a highway for any purpose other than transporting school children.

(d) A school bus driver shall not display the alternately flashing red lights and stop signal arm described in § 2 on any bus that is in motion.

(e) When stopping for the purpose of receiving or discharging passengers, a school bus driver shall stop as far to the right side of the highway as possible, safe and reasonable.

(f) When a school bus driver is following another school bus and the first bus properly displays its alternately flashing red lights and stop signal arm, the driver of the second bus shall actuate the red alternately

Figure 1. Model Regulation for School Bus Pedestrians (cont'd)

(continued)

flashing red lights and stop signal arm as per the first bus. This subsection shall not apply when the first bus remains more than (500 feet) away.

(g) Whenever a school bus driver believes another driver has not complied with the requirements in § 5(b), the school bus driver shall promptly report the registration number, vehicle and driver description and the time, date and place of the alleged violation to the local law enforcement agency.

(h) Whenever necessary, a school bus driver shall move the bus as far to the right on the highway as practicable to allow any significant accumulation of following traffic to pass the bus.

(i) When stopping on a highway with separate roadways or with four or more traffic lanes, exclusive of shoulders, passengers shall only be received or discharged on their residence side of the highway.

(j) Prior to, during or following the receipt or discharge of children, the school bus driver shall not back the school bus.

§ 5 — Duties of drivers approaching school buses

(a) The driver of a vehicle meeting or overtaking a school bus from either direction shall proceed at a reasonable and prudent speed and be prepared to stop when the school bus is displaying alternately flashing amber lights.

b) The driver of a vehicle meeting or overtaking from either direction any school bus stopped on the highway shall stop before reaching such school bus when the bus displays the alternately flashing red lights and stop signal arm described in § 2. The driver shall not proceed until the school bus resumes motion or the alternately flashing red lights and stop signal arm are no longer displayed.

Figure 1. Model Regulation for School Bus Pedestrians (cont'd)

(continued)

(c) The driver of a vehicle on a highway with separate roadways need not stop upon meeting a stopped school bus with its red lights and stop signal arm activated which is upon a different roadway or when upon a controlled access highway and the school bus is stopped in a loading zone which is part of or adjacent to the highway and when pedestrians are not permitted to cross the roadway.

§ 6 — Police to investigate school bus passing violation reports

Upon receipt of a school bus driver's report of an alleged violation of 5(b), the law enforcement agency shall attempt to determine the identity of the driver at the time and place of the alleged violation. If the driver's identity is established, the report of the registration plate number shall establish probable cause for issuance of a citation for violation of 5(b). If the identity of the driver at the time of the alleged violation cannot be established, the (law enforcement agency) shall issue a warning letter to the owner of the vehicle at the time of the alleged violation. In the case of a leased or rented vehicle, the warning letter shall be issued to the individual who was the lessee at the time of the alleged violation.

§ 7 — Course required for school bus drivers

A person shall not drive a school bus carrying any school child unless that person has successfully completed the school bus driver training course(s) required by the (State Department of Education).

§ 8 — Instruction required for pupils riding school buses

At the beginning of each school year, all kindergarten through sixth grade pupils transported by school buses shall, as a minimum, receive instruction approved by the (State Department of Education) in proper school bus riding, boarding and alighting, evacuation, associated street crossing and bus stop waiting practices.

Figure 1. Model Regulation for School Bus Pedestrians (cont'd)

(continued)

§ 9 — Inspection of school buses required

(a) Every school bus shall be inspected at least twice a year by (appropriate state or local agency). The inspection shall include tests of such equipment as shall be specified in regulations adopted by (appropriate state agency) and shall determine whether the school bus complies with the construction, design and appearance requirements by this Act and the regulations adopted by the (State Department of Education).

(b) Prior to each trip by a school bus on a highway, a school bus driver shall determine, in addition to other required safety inspections, whether the special flashing lamps, stop arm and system to observe pedestrians near a school bus described in § 2 are functioning properly. If any such lamp, arm or system does not function properly, it shall be repaired or adjusted or the school bus shall not be used to transport any school child on a highway unless the bus traverses a route where such special equipment is never required to be used.

§ 10 — School bus stop advance warning required

In any location where highway characteristics do not permit a driver to have an unobstructed view of a school bus for 500 feet when it is stopped to receive or discharge passengers, a "School Bus Stop Ahead" sign shall be posted at least 500 feet in advance of the stop. The sign shall conform to all requirements set forth by (Section 7B-11 of the Manual on Uniform Traffic Control Devices)(State Highway Commission).

§ 11 — Required notice to motorists and motor vehicle owners

The (Registrar/Commissioner of Motor Vehicles) shall at the time of issuing registration plates and driver's licenses, provide a summary of the latest requirements in § 2 and § 5.

Figure 1. Model Regulation for School Bus Pedestrians (concluded)

C. Annotation of the Provisions of the Model Regulation

The rationale for each section and subsection of the model regulation is presented below. Where supportive empirical evidence is available it is described. Otherwise logical analysis and/or legal precedents (largely the UVC) justifying the provisions are presented.

§ 1--Definitions

(a) Irrespective of the passenger carrying capacity of a motor vehicle used to carry school children, said vehicle must be considered a "school bus" if that vehicle picks-up or discharges children along the highway. The underlined phrase is the key to the definition as "along the highway" is where the hazards are greatest for children going to or from a stopped school bus. If a motor vehicle were used to transport children to and from school and did not pick-up or discharge children along the highway, then such a vehicle would not be a "school bus" in a strict sense and would not have to conform to the appearance and equipment provisions in § 2 necessary to protect children who will have to cross the highway in going to or from a stopped school bus. Clearly, this definition would require that a passenger vehicle which is used to pick up and discharge children do so in off-roadway locations to avoid being classified as a school bus.

Common carrier buses transporting school children simultaneously with other passengers are excluded from the definition of a school bus as these vehicles operate principally in an urban environment which typically offers a host of traffic control devices (marked crosswalks, traffic signals, bus stop signs, etc.) to protect the crossing of passengers to and from these buses. In addition, the presence of adults in the passenger population of common carrier buses would likely serve as a moderating influence on the crossing behavior of any school children using these vehicles.

(b) It may seem obvious who a school bus driver is. It was, however, considered important to define this term and alert the readers to the minimum training requirements specified in § 7. It is not sufficient to be able to skillfully control a school bus carrying school children without benefitting from essential training in the cognitive and affective domains of school bus driving, particularly those related to supervision of roadway crossings by school children. As it is worded, the definition of a school bus driver is linked to the minimum training requirement in § 7 by a footnote. Taken together, 1(b) and § 7 support a minimum training requirement for school bus drivers but do not absolve anyone from complying with the other requirements of this regulation who might not have had the minimum required training and is nevertheless driving a school bus carrying children.

§ 2--Appearance and equipment requirements for school buses

(a)(b) It is essential from the standpoint of rapid, correct and reliable responses to school buses by motorists that the appearance and operation of school buses and associated equipment in the traffic environment is uniform from jurisdiction to jurisdiction. The specification of "National School Bus Glossy Yellow" as the color for the school bus body is one which is of a long standing uniqueness. The black color also is typical and an effective color contrast for lettering on the yellow body. Both these color requirements are specified by the National Conference on School Transportation in Minimum

Standards for School Buses (NEA, 1970), as well as the Highway Safety Program Standard No. 17, Pupil Transportation Safety (NHTSA, 1974).

When considering the paint scheme and signal equipment, no other legend or wording other than "SCHOOL BUS" should have to appear on the front and back of school buses to identify them to the motoring public. Any additional words or phrases would be superfluous and a potential source of distraction to an approaching motorist. The "Series D" alphabet is an effective series of letters yielding approximately 50 feet of daytime legibility for each inch of character height (Baerwald, 1965). The "Series D" alphabet is also the one specified in the Highway Safety Program Standard No. 17, Pupil Transportation Safety (NHTSA, 1974). The wording of this provision follows closely that found in the Minimum Standards for School Buses (NEA, 1970) as well as the Uniform Vehicle Code (UVC) § 11-706 (c) (NCUTLO, 1979). Because the paint scheme is such a strong symbol connoting school bus, it therefore is reasonable to require obscuration of this school bus legend when the vehicle is not being used as a school bus. This should prevent any undue caution or deference being given to a school bus vehicle not being used as a "school bus."

(c) The objective of this entire section is to provide for a minimum, standardized and effective array of displays for school buses--no more or less than are needed to engender the desired responses from the motoring public to school bus operations.

(1) The increasing number of jurisdictions adopting pre-stop amber warning lights, before the flashing red lights are activated, speaks to the perceived utility of this signal phase on school buses. In 1972, four states specifically provided for the use of amber warning lights (Yaw, 1972). In 1980, 20 states specifically provided for the use of amber warning lights, either with only red lights or red lights plus a stop swing arm (NCUTLO, 1981).

The use of pre-stop flashing amber lights is a consistent and useful application of the traffic light stereotype. A steady amber phase on a traffic light indicates that "the related green movement is being terminated or that a red indication will be exhibited immediately thereafter (UVC § 11-202 (b) 1.)" A flashing amber traffic light is generally understood to mean "drivers of vehicles may proceed through the intersection or past such a signal only with caution (UVC § 11-204 (a) 2.)" Both of these definitions positively transfer to the school bus application. Amber should inform drivers of the imminent onset of the red lights, and swing arm and, thus, the requirement to stop. Amber also should indicate the desirable option of passing a school bus displaying flashing amber lights if a motorist from the opposite direction is too close to make a reasonably controlled stop before reaching the bus. Dangerous stops and vehicle-to-vehicle conflicts should, therefore, be minimized. Thus, amber flashing lights are seen as warranted for three major reasons: a) To provide reasonable warning to motorists that a school bus is about to stop, therefore, requiring motorists in both directions to stop when the red flashing lights and swing arm are activated; b) to allow motorists too close to the bus a "safety valve" and the option to pass or overtake a school bus with amber flashing lights, if a controlled stop cannot reasonably be made before reaching the bus; and c) to prevent misuse of the red flashing lights and/or stop signal arm while the bus is in motion as a pre-stop warning signal.

As recently as 1972, 15 jurisdictions required bus drivers to activate alternately red flashing lights and in some cases the stop swing arm itself, while moving, from 50 feet to 300 feet in advance of the intended stop as well as at the stop itself (Yaw, 1972). This is a potentially dangerous and confusing situation for motorists. Allowing vehicles to pass a school bus in motion with red lights flashing during a warning phase, but requiring motorists to stop when the bus finally stops, is disturbing. In essence, motorists are being asked to determine when a school bus's wheels have ceased to rotate to know when a stop is required. If jurisdictions agree that a pre-stop warning signal should be transmitted by a school bus, as do the authors, said signal should conform as much as practicable to existing stereotypes in the traffic environment. Thus, the requirement for alternately flashing amber lights prior to making a stop has been included which is consistent with established traffic engineering practices.

The wording of this section acknowledges advancing technology and allows for the incorporation of dual-purpose signal heads (a single lens which shows either a red or amber flashing light) in lieu of separate red and amber lenses. The overall content of this provision parallels that of UVC § 12-228 (b), except that in the present case the amber lights are required for standardization, not just permitted as in the UVC § 12-228 (b).

(2) The requirement for alternately flashing red lights is a long-standing and consistent application of the traffic signal stereotype in the school bus environment, namely, a flashing red traffic signal denoting the requirement to stop. Thus, the use of alternately flashing roof-mounted red lights in conjunction with an activated stop swing arm which also has flashing red lights (§ 2 (c) 3.) is viewed as an appropriate and consistent application. The minimum visibility distance of 500 feet covers stopping sight distance speeds up to about 55 mph.

(3)(4) The efficacy of a stop swing arm, as a traffic control device, has been demonstrated both in the school bus context and in ice cream truck operations. During a field test of a stop swing arm in California, Bequette (1976) found a statistically significant reduction in passing violations for buses equipped with octagonal stop arms versus those without across a sample of city and rural jurisdictions throughout the state. The National Safety Council (1975) reported reductions in bus driver reported passing violations after installation of octagonal stop arms ranging from 40 to 70 percent from tests conducted in Maryland, Massachusetts, Virginia and West Virginia. Moreover, Hale, Blomberg and Preusser (1978) found that stop swing arms in conjunction with flashing signal lights mounted on ice cream trucks reduced child pedestrian accidents near ice cream trucks by 77 percent. Skrypnek (1980) studied school bus passing violations over a six-month period in Alberta, Canada. She found in comparisons conducted between the incidence of passing violations when a stop arm was and was not in use that the stop signal arms reduced the incidence of driver-reported passing violations by approximately 50 percent.

While the above evidence involving school bus driver reports of passing violations is supportive of the effectiveness of a stop signal arm, it suffers from the potential biases of the school drivers knowing of the experimental evaluation during the before and after phases of the study as well as a lack of corroboration that the reported violations actually occurred. The study of

police investigated/authenticated school bus passing violations reported by bus drivers between September 1979 and June 1982 in Columbus, Ohio, (see Dunlap and Associates East, Inc., 1982, in Appendix A) corrected the above criticisms of potential bias. Namely, the data acquired were violation reports made by school bus drivers operating four light, eight light and eight light plus stop signal arms system in the blind--they didn't know their reports were part of any evaluative study as none had been conducted at the time data were collected. Moreover, the violations data used in the study were actual police files of investigated/validated school bus violations. The results of the study showed that, of the three stop signalling systems in operation during the September 1979 to June 1982 period, the eight light plus stop arm system had significantly fewer (approximately 2/3 to 1/2 as many) reported passing violations as the four or eight light systems (which did not differ from one another statistically).

A final point on the perceived effectiveness of a stop signal arm. There are times when the motorist's view of the school bus roof-mounted signal lights can be compromised due to prevailing background sunglare or a large vehicle stopped behind the school bus acting as a screen. In either case a motorist might be tempted to pass the school bus. A stop signal arm extended approximately at driver eye level from the left side of the bus could be the only fail-safe measure for preventing a vehicle in these circumstances from passing the stopped school bus.

It, therefore, seems quite clear that a stop swing arm on a vehicle authorized to carry it can convey a compelling "stop" message to the motoring public. Short of a physical barricade across the road, it seems as effective a signalling device as can be employed presently. As support for this fact, 18 jurisdictions specifically authorize or require school bus stop swing arms in their vehicle codes (seven states with four light systems and eleven states with eight light systems) as of January 1981 (NCUTLO, 1981). Moreover, the principal manufacturer of stop signal arms asserts that these devices are either optional or required equipment in 41 states (Specialty Manufacturing, 1982).

The octagonal shape for the stop arm has been specified for two reasons: a) it predominates as the shape of stop arms used by school buses today, and b) it is the shape recommended by the Society of Automotive Engineers in SAE J1133a (1980). It is understood that the octagonal school bus stop arm is not a strict application of the roadside octagonal stop sign. The behavior required by the school bus stop arm is for the motorist to stop and stay stopped as long as the swing arm is extended and the red lights are flashing. In the roadside context, a stop sign requires that a motorist stop and yield the right of way to any cross traffic before proceeding. While the messages are somewhat different, the chances for confusion between the two seem minimal because the stop arm is used in a unique application, namely, as a stop signal arm on a school bus.

The legend "STOP" is required on the swing arm and not the school bus body, for one basic reason. Such important information should be conspicuously displayed only at the time motorist reaction is required. If such information were to be carried only on the bus body, motorist adaptation could result from the constant display of these legends. Moreover, the legend on the bus body would not be as prominent as it is on a signal arm which temporarily extends beyond the normal silhouette of the bus. Thus, the swing arm presents the "STOP" message to motorists only when that message is to be obeyed.

The white reflectorized legends and border for the stop swing arm as well as the red reflectorized background are typical for a stop sign and the colors recommended for a stop swing arm in SAE J1133a. Reflectorization is seen as an essential conspicuity enhancing device as school bus operations must necessarily extend, in some cases, into the hours of dusk and darkness at certain times of the year. The double-faced lamps at the top and bottom of the stop arm are desirable swing arm conspicuity enhancers and are recommended in SAE J1133a.

The 18 by 18 inch dimensions for the stop arm blade is an industry standard and has proven to be a serviceable item. The stop arm would actually extend about 20 inches from the side of the school bus to account for a two-inch hinge mechanism.

The lettering proposed for the swing arm uses the "Series D" characters. The daytime visibility of six-inches-high letters for the "STOP" legend should be approximately 300 feet in either direction.

The 44 inch mounting height for the swing arm places it roughly at the driver's eye level as per Allen's (1966) suggestion for maximum conspicuity and visual barrier effect for the close-in motorist.

It is possible that the established format for a jurisdiction's traffic regulation or administrative code may preclude the use of graphic descriptions within any of its provisions. If this is the case, the following text is recommended as an alternative to the present graphic specification for the signal arm. This optional material shown below should be inserted at the second sentence of § 2 (c) (3), superseding the remainder of § 2 (c) (3) and all of § 2 (c) (4):

> *The stop signal arm shall have the shape of a regular octagon measuring 18 inches in height and width, and approximately seven and one-half inches on a side. The two alternately flashing lights shall be located at the top and bottom of the vertical centerline of the signal arm. The red lights shall only flash when the signal arm is extended and they shall be visible for at least 300 feet to the front and rear in normal sunlight. The signal arm shall have a red reflectorized background upon which shall be a half- inch white reflectorized border. The word "STOP" shall appear in the middle of the signal arm in six-inch-high white reflectorized letters. All colors shall meet specifications in the most recently published Federal Highway Administration Standard Color Charts. The bottom of the extended signal arm shall be as close as practicable to 44 inches above the highway.*

When considering the entire signalling system required by Sections § 2 (c) (1) through (4), namely eight lights plus stop signal arm, it should be mentioned that, in the statewide study of 3,131 Ohio school bus drivers' driving experiences (in Appendix B), 68 percent of all respondents favored the eight light plus stop signal arm system. Nearly 80 percent of those drivers currently using the eight light plus stop signal arm system expressed a preference for it. Sixty-one percent of the four light and eight light system

users expressed a preference for the eight light plus stop swing arm system, as well.

(5) During loading and unloading operations, children near the perimeter of a school bus cannot frequently be seen by a seated school bus driver. The area along the front bumper is particularly dangerous because it is difficult for the driver of a long hood or conventional school bus to see a small child (five to ten years) going to or from the bus in this location. Children continue to be struck in this area and run over either by the bus's front or rear wheels. They also are struck near the sides of the bus between the rear and front wheels due either to slipping accidentally, being pushed under the bus or bending over or down in these areas to retrieve an object. Children should and are being instructed on the dangers of being near the bus where they can't be seen by the driver during loading and unloading operations. They are advised against being near the bus during loading and unloading to include walking well in front of the bus (six to ten feet) while crossing. However, it is a well known fact that young children's behavior in this regard can be unreliable. Thus, the bus driver must "count" passengers off and on the bus to and from a place of safety. The driver must also be able to monitor the areas along the sides and front of the bus for children before resuming forward motion after a stop.

There has been a long-standing requirement for a single, exterior convex "crossing mirror" located on the left or right front of a bus to monitor the area along the right-front bumper where direct observation is not possible (NEA, 1970). However, a single convex mirror is not adequate for the task of monitoring the territory near the bus where a child can be (see Negri, 1969). When considering the standard, eight inch diameter convex mirror with a 12 to 14 inch radius of curvature, recent data suggest that four or more such mirrors may be required to do the job--two convex mirrors mounted off the left-front fender and two off the right-front fender seem to offer the potential for the necessary views being provided to the bus driver, given the proper mountings and adjustments. On the left, one mirror would be adjusted to show a view low and along the length of the left side of the bus; the other would show a view near and along the front bumper. On the right, one mirror would show the view low and along the length of the right side of the bus and the other would show a view near and along the front bumper. Redundant views of the particularly dangerous front-bumper area seem justified as blind spots often occur immediately underneath a mounted mirror and a mirror can be jarred out of proper adjustment. Also the image at the far end of the range of a convex mirror is somewhat distorted and sometimes difficult to detect or interpret.

From the survey of Ohio school bus drivers contained in Appendix B, drivers generally preferred two mirrors on the left and two mirrors on the right over other mirror combinations. Ohio currently requires two convex mirrors on the left-front fender and one on the right. Similarly, respondents did not favor only one mirror on the left as indicated by:

- The highest number of blind spots being reported by drivers with only one mirror on the left.

- Drivers, as a whole, regardless of the mirror system currently being used (which ranged from one left mirror to two mirrors on the left and two on the right with all combinations in between) indicated that the ideal pedestrian mirror system was two left and two right mirrors.

- Drivers with the two left and one or two right-mirror systems reported the fewest incidents of buses hitting or nearly hitting pupil pedestrians who were in locations monitored by convex mirrors.

From all the information reviewed to date, it would appear that the minimum effective conventional convex mirror system would consist of two convex mirrors on one front fender and one mirror on the other front fender. The single convex mirror would be aimed down one side of the bus. One of the pair of mirrors would be aimed across the front bumper of the bus and the other mirror down the other side of the bus.

As of the 1979/80 school year, North Carolina, in addition to four conventional convex mirrors (two on each fender), required a fifth convex mirror to be mounted atop the driver's side, rectangular side-view mirror. This convex mirror is aimed to give the driver a view of a zone some six to 15 feet forward of the bus where a very small child or one who is bent over or kneeling down would not be necessarily in the direct view of the driver and therefore out of the range of the crossover mirrors. Thus, there are grounds for saying that from three to five conventional convex mirrors may be required on a conventional bus to provide the driver with sufficient ability to detect pedestrians near the bus who cannot be seen directly.

The exact minimum type and number of convex mirrors cannot now be specified in § 2 (c) (5) because the definitive controlled research on this subject has not as yet been performed and was not within the scope of this contract. Factors affecting a determination of a sufficient number of convex pedestrian mirrors required include, as a minimum:

- Type of School Bus

  The requirements for the greatest number of convex mirrors are likely to be with the conventional or long-hood school bus. The protruding engine compartment significantly obscures the driver's direct view of the ground near the front of the bus. In a transit or forward control school bus, an available direct view forward of the bus generally precludes the need for the crossover mirror(s). Side-view convex mirrors would still be needed.

- Type of Mirror

  The conventional eight inch diameter, 12 to 14 inch radius of curvature convex mirror predominates in school bus operations today. Another variant of this convex mirror currently emerging is one with an eight inch diameter and an approximate four inch radius of curvature. This "ultra" convex or eliptical mirror affords the viewer an extremely wide field of view. Distortion of images at the extremity of the mirror is a complaint, however. It is not presently known how much, if any, the distorted imagery with this mirror delays or prevents the detection of pedestrian targets in the extremity of the mirror's field of view. Some jurisdictions using or testing this ultra-convex mirror find it very effective and better able to reveal the front area of a conventional bus as a single mirror than the conventional convex mirror. If the ultra-convex mirror has

effective expanded coverage, then the total number of ideal pedestrian convex mirrors may be reduced. As an example, North Carolina dropped the requirement for five pedestrian convex mirrors to three. The high-mounted (atop the side-view mirror) convex mirror was retained. However, one ultra-convex mirror was mounted on the left-front fender (replacing two conventional convex mirrors) and one ultra-convex mirror on the right-front fender. Each mirror purportedly gives a satisfactory view of the front bumper and the respective side of the bus.

- Manner of Mirror Mounting

How a convex mirror is mounted, as well as adjusted, greatly affects the area of coverage afforded the viewer. The location forward, sideward and upward from the corner of a school bus front bumper is particularly important in establishing the field of view for a convex mirror. Generally, the more a mirror is mounted forward and sideward from the fender, the wider the view of the bus's perimeter afforded and the less likely a blind spot will occur at or near the mirror-mounting position. However, the more a convex mirror mounting protrudes from the perimeter of the bus, the more prone to damage and misalignment it is.

- Crossing Control Arm

In several states (e.g., Georgia, North Carolina, Ohio and Tennessee) "crossing control arms" are either being tested, about to be approved or are in use statewide. These six inch by six foot devices are mounted on the right-front bumper of the bus and swing out parallel with the right side of the bus whenever the stop signals go on. The crossing control arm thus mechanically works like the stop signal arm and is intended as a stand-off to encourage children to cross at least six feet in front of the bus and thus remain in the direct view of the school bus driver. Assuming this system works as intended, it could theoretically obviate the requirement for crossover convex mirrors. In the five years prior to the 1978/79 school year in North Carolina, nine "pupil hit by school bus" fatalities occurred. However, during the 1978/79 school year alone, North Carolina experienced eight pupils killed by school buses. With this problem as a backdrop, North Carolina installed in the 1979/80 school year crossing control arms on all K-8 school buses coincident with the addition of four pedestrian convex mirrors to the one left-hand convex mirror previously required. Thus, all buses now had a five-mirror system and all K-8 buses had a five mirror system plus crossing control arm. In addition, special instruction was given to elementary pupils concerning the risks of being struck by the school bus. School bus drivers were also given instruction on the use of the crossing control arm and the system of five convex pedestrian mirrors. Since the 1978/79 school season only two hit-by-bus fatalities have occurred (North Carolina, 1983). While this may be suggestive of crossing control arm effectiveness, it is not conclusive. What is not known is how much the five pedestrian mirror system and the pupil and bus driver educational programs contributed to the accident reduction. However, the crossing

control arm must be viewed as a potentially strong means, coupled with pupil and bus driver education programs and effective mirror systems, of minimizing "pupil struck by school bus" accidents.

In summary, § 2 (c) (5) of the model regulation specifies a performance requirement for the school bus driver and the need for equipment aids to be able to see the sides and front of the bus and/or detect anybody near the bus in these areas. The precise means for pedestrian monitoring cannot be specified at this time, however. Alternative means have been discussed, which singly or in combination should meet the requirements of this section, and they include:

- Three to five conventional convex (12 to 14 inch radius of curvature), eight inch diameter mirrors.
- One to two ultra-convex (four inch radius of curvature), eight inch diameter mirrors.
- Crossing control arm.

The above means for detecting people near the bus all relate to the enhancement of human vision. The wording of this section does not preclude other means for detecting objects alongside or even underneath the bus, such as electronic presence-detecting systems which can be applied to school bus pedestrian-monitoring requirements (Guardimark, 1983).

(d) The anchoring of all equipment features required in previous sections to the relevant performance specifications in Society of Automotive Engineers recommended practices and standards, as well as Federal Motor Vehicle Safety Standard No. 108, assures proven satisfactory performance for the components selected.

(e) Some reasonable time limit should be set for effectiveness of the equipment provisions which will be new requirements for some jurisdictions. Dates of effectiveness ultimately specified should consider both what is reasonable for the operating companies and each manufacturer involved and what will soonest serve the public interest. This section acknowledges that a date of effectiveness for the model regulation's equipment provisions will be initially easier to set and implement for new buses purchased after enactment of the regulation. More difficult to establish will be a date when all buses in service will have to be retrofitted with the new signalling equipment specified in § 2(c). This date will be predicated upon a reasonable lead time (one probably including a summer recess) to acquire and install the equipment on the buses in service in each jurisdiction.

§ 3--Owner responsibilities

This section clearly assigns the responsibility for compliance with the provisions of § 2 to the owners of school buses. The necessity of such a provision is self-evident.

§ 4--Duties of school bus drivers

(a) The "pre-stop" alternately flashing amber lights are required, not permitted, to be actuated in advance of every bus stop where the stop signals

are to be used (i.e., where passengers are to be picked-up or discharged), and within the distances specified. The requirement for the amber lights ensures the necessary standardization for a stop warning signal and uniformity in motorist response. The actuation distances for the amber flashing lights are basically conservative (covering the hard braking distances for a range of speeds from approximately 35 to 65 miles per hour) and are those specified in UVC § 12-228(b).

As noted in the provision, exceptions to the mandatory use of amber lights exist in Section (c).

(b) To only permit the use of flashing red lights when discharging or receiving passengers, as does UVC § 11-706(b) and the laws of several jurisdictions,* leaves an uncomfortable burden of discretion upon the bus driver as to when the lights may or may not be required. The driver may not always have sufficient knowledge in advance to make the decision. Moreover, young children are unpredictable. For example, a group of children, before leaving the bus, may indicate to the bus driver that no one is planning to cross the street. When the door opens and children hit the street, one chases another across the street. If the driver was convinced that no one was going to cross, he might not have turned on the warning lights, thinking it desirable not to "inconvenience" vehicular traffic unnecessarily. Another situation frequently encountered is where a group of children are waiting to be picked up on the same side of the street as the school bus. Thinking the group was complete, under permissive wording for use of the signals, the bus driver might be tempted not to turn the warning lights on. During the boarding process, a late-comer could run across the street unbeknown to the school bus driver. In the cases cited, the unpredictable child would be unprotected. Conservatism is best in this matter of child pedestrian safety. The school bus signals should be used coincident with every stop to receive or discharge passengers along the highway. The presumption should always be made that children may cross the street notwithstanding reasonable expectations to the contrary.

This section clearly limits the use of the flashing red lights and stop arm (the "stop system") to the case where the school bus has stopped to receive or discharge passengers, avoiding any uncertainties associated with motorists attempting to stop for a moving school bus with the signals on. It keys the deactivation of the amber warning lights to activation of the stop system. The bus driver is obligated not to allow children to leave the bus until any approaching traffic has stopped and to leave the stop system activated until all those who must have crossed safely. When picking up children, the driver should provide a signal to children who must cross to the bus when traffic conditions appear to permit a safe crossing. Finally, two essential steps are required before the bus may resume forward motion. First the driver must determine no one is near the bus and in harm's way when the bus will move forward. This is not an unreasonable requirement being imposed upon the school bus driver. For many years UVC § 11-603 has stated that "No person shall start a vehicle which is stopped, standing or parked unless and until such movement can be made with reasonable safety." Having determined that

*As of January 1981, the laws of 15 jurisdictions (including the District of Columbia and Puerto Rico) allowed for discretionary use of the stop signalling system and 37 jurisdictions required use of the system at every school bus stop (NCUTLO, 1981).

"all is clear" the driver then must turn off the stop signalling system before resuming forward motion. The last provision is important if motorists are to respect and consistently comply with the stop signalling system.

(c) This section stipulates certain traffic situations where the alternately flashing amber and red lights and stop arm should not be used. Most of these exceptions are already set forth in UVC § 11-706(b). Precluding the use of the flashing lights and stop arm in business districts and arterial streets is desirable from two standpoints. First, these locations are associated with dense and higher speed traffic flows which present hazards to child pedestrians. Second, school bus operations in these locations could unnecessarily impede the normal flow of traffic. Prohibited use of the flashing lights and stop signal arm at intersections avoids the obvious potential conflicts with any traffic control devices already present. When the school bus is entirely off the roadway in a designated loading area, use of the lights and stop arm would be unnecessary and potentially confusing to any motorist nearby. Finally, when the school bus is used for purposes other than the transportation of school-aged children (presumably involving individuals beyond school age), then it should be unnecessary to use the flashing lights and stop arm as the passengers should possess adequate street-crossing skills. In this case, the burden of safety can reasonably be shifted back to the adult bus riders.

(d) A prohibition of the use of flashing red lights and stop arm while the bus is in motion is included to insure that the flashing red lights and swing arm will consistently signify a requirement for motorists to stop. This avoids abuse of the equipment which could become a source or irritation to the motoring public. If bus drivers use the red flashing lights and swing arm (and amber lights) in the manner prescribed in subsections (a), (b) and (c), there should be no problems for motorist compliance. However, this provision is intended as insurance for attaining that outcome.

(e) Contrary to some thinking on school bus positioning on the roadway during the loading or unloading of passengers, this subsection requires school buses to be as far right as possible. This view was supported by 44 percent of the respondents in the Appendix B study who thought the best place to stop the bus is the far right side of the road (40 percent thought the traveled lane was best and ten percent thought that blocking two lanes was best). There are two principal reasons for positioning the bus in this location:

- A far right bus position maximizes the number of traffic lanes to the left of the bus available as an escape route for a large vehicle (e.g., fuel truck, tractor trailer truck) which may be unable to stop when it comes upon a stopped school bus. In this situation the relative risk to any crossing pedestrians posed by this vehicle which cannot stop is probably less than that to the complement of passengers in the stopped bus which could be struck if it were blocking the available traveled lanes.

- In the study of Ohio school bus drivers reported in Appendix B, there were 373 narratives describing "close calls" or actual events experienced, involving a child being struck by a passing motorist and in which the direction of the violation was volunteered by the respondents. Of this set of 373 respondents, 26.8 percent reported motorist passing from the rear <u>on the right side</u> of the bus, 49.9

percent reported a motorist passing from the rear on the left side of the bus and 23.3 percent involved a motorist passing from the front of the bus. It seems even more alarming that the 100 cases spontaneously reported of motorists illegally passing school buses on the right translates into three percent of the entire survey sample. This suggests that the problem of motorists illegally passing stopped school buses from the rear on the right is not a remote event. This situation is particularly hazardous to entering or exiting pupils as a vehicular threat is not expected from that side of the bus. There were even some reported instances of vehicles driving onto lawns and other private property to pass the bus on the right. For these fanatical acts, no reasonable countermeasure such as a stop signal arm on the right side of the bus would likely help the situation. However, positioning the bus as far to the right for a stop on the highway will clearly minimize the convenient opportunities for passing the school bus on the right, such as a paved or driveable shoulder or parking lane, or even an unused traffic lane. Clearly, if a motorist is going to pass a school bus illegally, it should be in a manner that is expected (either from the front or from the rear on the left) and for which pupils have had countermeasure safety training.

(f) Accident data reveal the occurrence of a highly preventable but not very predictable form of school bus related pedestrian accident. Occasionally one or more school buses inadvertently end up traveling in a tandem formation. If the leading bus makes a stop to receive or discharge passengers, its red flashing lights and stop arm are actuated. By current practice any following buses are not obligated to do likewise unless they are receiving or discharging passengers. Any vehicles behind a following bus likely see no signals at the time and may be tempted to pass the stopped following bus because the stopped following bus is screening the lead bus's flashing lights and signal arm. If a motorist behind the following bus decides to move out and pass, then it may not be possible for the passing vehicle to stop in time before coming upon the leading bus. A vehicle and/or a pedestrian accident can be precipitated. To prevent this hazardous situation, a closely following bus must employ its flashing lights and swing arm according to any leading bus. If the distance between the buses is sufficiently great, there is no screening effect and hence no hazard. Thus, the more than 500 feet separation exclusion is specified.

(g) In effect this provision designates the school bus driver as an enforcement agent for promoting compliance with the requirements to stop for school buses. Without this active participation by bus drivers in reporting alleged school bus passing violations it is not likely that the police alone can create a credible level of enforcement in the mind of the public. Police do not typically have significant resources to commit to selective enforcement of school stop laws for any extended period of time. Thus, involving school bus drivers in the violation detection and reporting process is potentially significant means for developing sustained compliance through deterrence against the commission of violations.

The content of this section is based, in part, upon § 4511.75.1 of the Ohio Vehicle Code. This legislation has enabled the Columbus City Public Schools and Columbus Police Department to cooperate effectively in detecting, apprehending and sanctioning school bus passing violators. This continuing cooperation since the Fall of 1979 produced the data base of police investigated

school bus passing violations which supported the study of stop signalling system effectiveness reported in Appendix A.

The information which the school bus driver is asked to report (i.e., vehicle registration number, vehicle and operator description, time, date and place of the alleged violation) have all proved useful to the police in following up and identifying violators. In fact, a violation report form, such as used by the Columbus City Public Schools (see Figure 1 of the report in Appendix A) organizes these and other useful reporting data in an effective manner. Of all the data to be obtained, a description of the violating driver is often the most difficult to establish due to a poor or blocked line of sight for the bus driver. Second most difficult to obtain is a registration number. These facts make it desirable for school bus drivers to have a radio on which to report passing violations. This timely reporting of violations by radio would increase the chances of police apprehension of a violator by vehicle description alone. The school bus violation report filled out by the bus driver could serve as a confirmatory follow-up to the radio report or the sole stimulus for a police investigation in the case where radios are not aboard school buses.

The violation report (radio or written) should be made to the designated enforcement agency as soon as possible with a minimum of administrative screening, once school bus drivers are properly trained on how to execute the report. Minimizing the time between observing a school bus passing violation and actionable report of same in the police hands will increase the chances of apprehending and prosecuting alleged violators. Informing the public of the existence and activities of this cooperative program between school bus drivers and law enforcement personnel can do a great deal to promote compliance with the law.

(h) When a line of vehicles following a school bus along its route develops the potential for a frustrated motorist attempting an imprudent or illegal passing of the bus develops. The longer a motorist feels trapped behind a school bus the greater the potential for a hazardous passing of the school bus. Factors which can intensify the feeling of frustration are:

- Rush hour travel situations, particularly morning rush hour where commuters are in a hurry to go to work.

- School bus stops occurring on a major artery of state road with higher traffic capacities and speed limits (35 mph or greater). Multiple travelled lanes in each direction will provide a ready escape route for a following motorist to either attempt a legal or illegal passing of the bus.

What is being advocated in this provision is that the school bus driver relieve the potential for motorist frustration and imprudent passing behavior when the situation warrants it. When the bus driver believes that a motorist or group of motorists may have been following the bus for some extended period of time, the following vehicle(s) should be allowed to pass the school bus. Adequate highway conditions should exist to permit a safe passing of the bus. As a minimum, available roadway and/or shoulder width should exist for the school bus to move far enough to the right to provide passing motorists enough roadway and sight distance to any opposing traffic to allow a safe passing. It is recommended that when the school bus driver wishes to allow

passing traffic to pass the bus that this be done between school bus stops and not coincident with a school bus stop. The school bus driver should initiate the right turn signal and pull over to the right as far as possible and stop, leaving the right turn signal on. No other signals should be turned on. The school bus driver should not motion traffic by, but merely wait and passively provide the opportunity for following traffic to legally pass the school bus. If following traffic choses not to pass the bus, so be it. At least the opportunity for safely passing the school bus has been provided and the school bus driver should proceed to the next stop on the route.

Discretion is called for on the part of the bus driver in deciding when and where to allow following traffic to pass the bus. Clearly there will be times where the school bus driver may wish to allow traffic to pass and cannot due to the roadway conditions. However, where the appropriate opportunities are available to relieve an accumulation of vehicles behind the bus, the small amount of time to do this is well worth it to minimize the risks of an imprudent or illegal passing of the school bus.

(i) Multiple lane roadways in each direction and divided highways generally are associated with higher volumes and speeds of traffic. Any necessary school bus operations on these roadways are, as a result, generally fraught with more hazards than on two lane roadways. On divided highways, motorists from an opposite direction to the bus understandability are not required to stop for the school bus stop signals. Any motorists following the school bus on a four or more lane highway will have more open lanes in which to pass a stopped bus. Thus, when picking up or discharging people on divided roadways or ones with four or more lanes in each direction, pupil crossing of such roadways is clearly to be avoided. Thus, the provision mandates that where it is necessary for a school bus to stop on a divided highway or one with four or more traffic lanes, school bus stops should be so situated that pupils should be received or discharged only from the residence side of such highways. This will obviate the need for passengers to cross these highways to leave or reach the bus.

It should be pointed out that the stop signalling system should still be turned on when stops are made on these highways unless the stops are made "in designated school bus loading areas where the bus is entirely off the roadway." (§ 4(c)(3)). Despite the fact that stops are located on the passenger residence side of these highways, children, especially the younger ones, are unpredictable. They still could decide to cross while the "protective influence" of the bus remains and thus should have the protection and alerting value of the stop signalling system.

(j) Children continue to be struck by the rear ends of school buses. The seated bus driver does not have an effective view of small children moving near the rear bumper. In this position, they are essentially invisible to the school bus driver. Even though children are instructed not to cross from or be near the back of the bus, they will nevertheless be there from time to time. Thus, for the sake of pupil pedestrian safety, it is imperative that the school bus not be backed when situated at a school bus stop on a route. In theory, it would be acceptable if a crossing monitor were on board who could safely observe a backing movement by a school bus. However, these resource personnel are in short supply or nonexistent in most jurisdictions. Thus, the prohibition against school bus backing while making stops on a route is an

essential safeguard for pupil pedestrian safety. School bus stops must be planned and located so that backing movements by school buses are not required to negotiate these stops. Similarly, drivers must be trained to avoid getting into on-route situations which might require backing the bus.

§ 5--Duties of drivers approaching school buses

(a) This subsection is patterned after UVC § 11-706(a) modified to account for the required motorist response for the flashing amber warning lights. It keys the motorist's readiness to stop to the display of flashing amber lights.

(b) This provision also closely follows UVC §11-706(a). It requires motorists to stop before reaching the school bus only when both the red flashing lights and stop signal arm are actuated. The lights and signal arm serve as the reliable stimulus for the motorist's stop response, as a motorist coming from the rear of the bus cannot see if children are crossing in front of the stopped bus. The motorist may only proceed when the red flashing lights and stop arm are no longer displayed or when the bus resumes motion. The latter condition must be stated as a driver must be relieved of the requirement to remain stopped should a bus driver inadvertently (and illegally) proceed ahead with the red flashing lights and stop arm actuated. No need was seen to specify a stopping distance from the front of the bus for motorists approaching from the front. Such a distance would be hard to enforce and motorists seem to be allowing sufficient clearance for pedestrians to cross.

It should be noted that when a jurisdiction enacts this model regulation, there will likely be a time during which existing four light stop signalling systems may be coexisting with the newly required eight light plus stop signal arm systems. Until such time as the four light system buses can be replaced or retrofitted with the new eight light plus stop signal systems, motorists must comply with either system. As §5(b) is presently written, it may be literally interpreted as to require motorists only to stop for the simultaneously displayed red lights and stop signal arm. For the transitional period, a jurisdiction may wish to insert a "sunset clause" in this provision. Such a clause would require for the expected transitional period that drivers "... *stop before reaching such school bus when the bus displays the alternately flashing red lights (or the alternately flashing red lights) and stop signal arm described in § 2.*" The parenthetical phrase is the suggested sunset clause* which could be implemented if a jurisdiction were concerned about the legal basis for ensuring motorist compliance with multiple signalling systems in operation.

(c) This section is a close paraphrasing of UVC §11-706(d) and relieves a motorist of the obligation to stop for a stopped school bus if on a different roadway of a divided highway. The presumption is clearly that any school bus passengers in this situation are not permitted to cross the divided highway. The divided versus the undivided highway does not seem to be an unreasonable or inconsistent discrimination for a motorist to make. The highway division is a compelling perception to the motorist. It seems preferable from a system reliability perspective for the school bus signal

*The date on which the sunset clause becomes inoperative would be the date by which all buses would have the eight light plus stop signal arm systems installed.

system to work the same way in all cases and not be capable of being partially activated only to the rear and not to the front to accommodate the divided highway case (see Post, 1978 for an opposing argument). The relief from the requirement for motorists to stop for a school bus off the roadway in a loading zone is reinforcement for and consistent with §4(c)(3).

§ 6--Police to investigate school bus passing violation reports

This section specifies some of the more important mechanics of law enforcement investigatory follow-up to school bus passing violation reports filed by a bus driver required in § 4(g). Effective police investigation of violation reports and taking of appropriate enforcement action where warranted is essential to maintaining the enthusiastic interest of bus driver's in reporting violations in the first place. As with § 4(g) this section is modelled after Ohio Vehicle Code § 4511.75.1 which has been working well in Columbus, Ohio as documented in Appendix A.

A principal objective of this provision is to enable police to verify the identity of the alleged violator driver at the time and place of the alleged violation. Often, violating drivers are found to be the registered owners of the vehicles in question, or by contacting the owner the driver at the time of the violation can frequently be identified. By whatever means the police may reasonably identify the alleged violator, this provision clearly establishes the initial report of a registration plate number by the bus driver as sufficient or probable cause for issuing a summons or citation for a violation of § 5(b).

Often a good vehicle description and plate number are available, but the identity of the driver at the time of the violation is not confirmed through police investigation. So that the opportunity for an educational experience is not lost, the provision requires the law enforcement or other appropriate agency to send a "warning letter" to the owner or lessee of the vehicle at the time of violation. A good example of such a warning letter is that used by the Columbus Police Department, which is shown in Appendix A, Figure 3. The basic thrust of such a letter is to summarize the elements of the law which may have been violated as well as the associated penalties for conviction. The warning letter thus serves the purpose of public education of the requirements for stopping for school buses. It is directed to an individual who either may have actually committed the violation or knows and can communicate with the actual violator.

§ 7--Course required for school bus drivers

The setting of a minimum standard of educational and skill qualification for bus drivers is essential to providing the highest quality operators of school buses. What is described in this provision is in fact a requirement for a program of certification (and maintenance thereof) for school bus drivers, which is overseen by the State Department of Education or other appropriate state agency. The U.S. Department of Transportation's basic three-day course, School Bus Drivers Instructional Program (NHTSA, 1974)* is a widely recognized standard of excellence for pre-service qualification and is

*The June 1974 publication in three volumes is available from the U.S. Government Printing Office: 1) Instructor's Guide, Stock No. 5003-00160; 2) Course Guide, Stock No. 5003-00158; and 3) Trainee Study Guide, Stock No. 5003-00162.

recommended as the basis for a minimum training requirement. It is understood that a jurisdiction may already have or will develop a local equivalent to the U.S. Department of Transportation's basic training course. Periodic in-service training is highly desirable and is within the purview of this provision. The details of the competencies required by school bus drivers are best left to specification in the body of administrative regulations governing the jurisdictional pupil transportation system. These competencies are, however, clearly articulated in the School Bus Drivers Instructional Program (NHTSA, 1974).

§ 8--Instruction required for pupils riding on school buses

As a complementary requirement to the one expressed in § 7, minimum annual instruction in school bus safety is required for kindergarten through sixth grade pupils, at the beginning of each school year. A basis for conducting instruction on most of the school bus pedestrian safety topics mentioned in this provision may be found in the U.S. Department of Transportation's On-Bus Program--A Pedestrian Safety Curriculum for Rural and Suburban Schools (NHTSA, 1979). Manuals for this curriculum exist for both the bus driver and transportation director. These materials provide a sound basis for developing a locally produced training program.

Although children over 12 years of age are involved in school bus related pedestrian accidents, the majority involved are under 12 years of age. Moreover, any program of pupil-oriented school bus safety instruction conducted annually since kindergarten should have served whatever useful purpose it can by the end of a pupil's sixth year of schooling.

§ 9--Inspection of school buses required

The inspection provisions are included to assure that the special equipment and school bus appearance requirements of this model regulation, as well as any other state and local requirements, are implemented. Subsection (a) sets the options for inspection intervals and compliance standards. Subsection (b) prohibits operation of any school bus to transport children on the highway when the special flashing lights and stop arm in § 2 are not functioning properly. The exceptions to this requirement are where a school bus may travel a route where no stops are made upon the highway to receive or discharge school children or when the bus transports passengers other than school children.

§ 10--School bus stop advance warning required

In some areas there are roadway situations where sight distances are rather limited but where, unavoidably, school bus stops must be located. Typically undulating or curving roads contribute to limited sight distance problems for school bus operations in suburban and rural areas. A driver approaching a stopped bus with signals flashing or a school bus stop with children in attendance could be put in a precarious situation should the sight distance to either of these situations be less than the achievable stopping sight distance. Hence wherever insufficient stopping sight distance to a school bus stop is afforded drivers at prevailing speeds on a given roadway, warning of the school bus stop location must be provided. The minimum lead distance for posting a "School Bus Stop Ahead" warning sign is given as 500 feet (which is

recommended by the Manual on Uniform Traffic Control Devices (FHWA, 1979), which is the appropriate sight stopping distance for a vehicle traveling at speeds up to 55 mph. Signs would be required to be posted in advance of either or both approaches to a school bus stop where the available sight distance is less than 500 feet. The shape, color and legend for the sign should meet the latest requirements of the Manual on Uniform Traffic Control Devices (FHWA, 1979).

In summary, this provision will provide a measure of necessary warning to drivers approaching school bus stops with less than 500 feet sight distance. The warning tacitly implied by the phrase "school bus stop ahead" is twofold. First, approaching drivers are warned that there may be children walking to or waiting for a school bus up ahead--calling for all the caution that a driver approaching such a situation should exercise. Second, the warning is provided that a school bus may be stopped up ahead with its signals flashing--thus, requiring that the approaching driver be prepared to stop. For either case, the "school bus stop ahead" sign gives the driver a warning which otherwise could be dangerously absent.

§ 11--Required notice to drivers and motor vehicle owners

As a recurring mechanism to educate the public on the latest requirements for school bus stop signals and requirements for drivers to stop, this section requires that educational materials be promulgated by the jurisdictional motor vehicle agency at the time registration plates and driver's licenses are issued. A brief summary of the requirements in § 2 and § 5 is called for and probably could be presented in the form of a small pamphlet. Such a pamphlet should be issued to all drivers at least once and as often as the requirements may change. This means for promulgating the latest requirements for school bus stopping laws will be especially important for new or transferred out-of-state motor vehicle operators and owners. This educational delivery system should remove the basis for anyone claiming ignorance of the law as an excuse for a violation.

IV. PUBLIC INFORMATION AND EDUCATION CONCEPTS

A. Introduction

To increase the chances of the Model Regulation for School Bus Pedestrians presented in Section III becoming the basis for uniform regulation of school bus operations nationwide, there are several measures within the realm of public information and education (PI&E) which should be considered. These concepts are basically three and are listed below:

- o A pamphlet to promote enactment of any or all of the model regulation's provisions.
- o Radio and television public service announcements to promote motorist compliance with requirements to stop for school buses.
- o A brief training brochure/pamphlet for school bus drivers on the requirements for their performance set forth in the model regulation.

These concepts are elaborated upon in succeeding sections.

B. Model Regulation Promotional Pamphlet

While dissemination of this technical report will bring the model regulation to the attention of many potential users, the technical report format is not the most effective means for doing so. A more convenient, concise and sharpened instrument is needed to promulgate the provisions of the model regulation and their supporting rationale and evidence. The recommended format for such an instrument is a pamphlet. Specifically, what is recommended for formal development is a pamphlet along the lines of the one prepared for the Model Ice Cream Truck Ordinance (NHTSA, 1979). The essential descriptors for the format of this pamphlet are:

- o $8\frac{1}{2}$" x 11" panel size
- o 12-14 panels in total length
- o two-color

The $8\frac{1}{2}$" x 11" panel size is necessary to accommodate the somewhat lengthy content to be included (which accounts for the estimated 12-14 panels). Two colors are recommended to heighten the visual appeal of the package and to still keep production costs at a reasonable level.

The content foreseen for the pamphlet can be organized into four major areas which are discussed below:

- o Background

  In this opening section the need for the model regulation should be presented. The accident data supporting the accident type of child struck going to or from a school bus (by the bus or passing

motorist) should be reviewed along with the latest national/regional frequencies of occurrence. The other major category of need for the regulation is the heterogeneity of school bus stopping signals and associated procedures. Clearly uniformity in school bus appearance, signalling systems and operational procedures throughout the state and the country will best serve the public interest.

The approach (guidelines and scope) followed for development of the model regulation should be reviewed here also. An important assumption to be stated is that the model regulation is principally addressed to those aspects of school bus operations which affect pupil pedestrian safety. In addition, the empirical research conducted to assess various provisions of the model regulation, particularly that conducted in the present study, should be briefly reviewed.

o The Model Regulation

This section should have two parts. The first part should be an overview of the organization of the model regulation and a brief summary of its contents. The second section should present all of the provisions of the model regulation as they appear in Chapter III of this report.

o Annotation of the Model Regulation

The rationale and evidence supporting each provision of the model regulation should appear in this section. The annotation in Chapter III of this report would serve as the basis for the development of this section. However, for the purposes of promulgation, the annotation in Chapter III should be abridged somewhat.

o Implementation Considerations

Advice to the jurisdictions, where it can reasonably be provided, should be offered to expedite the process of enactment and implementation of the model regulation. Advice on the relative merits of codifying certain provisions of the model regulation in a state's traffic code or body of administrative regulations should be discussed. Costs for retrofitting or adding the required equipment to school buses should be reviewed as well. Finally, it should be emphasized that the model regulation has built-in programs for public education and police enforcement--both of which will be essential to the success of the model regulation and the reduction of school bus-related pedestrian accidents. The public education program for motorists and vehicle owners is described in § 11 of the Model Regulation which requires summary information on the latest requirements to stop for school buses to be distributed by the Commissioner/Registrar of Motor Vehicles. The built-in enforcement aspects of the model regulation are defined by § 4 (g) and § 6 which require school bus drivers to report stop law violations and the police to investigate these reports and take enforcement action where warranted.

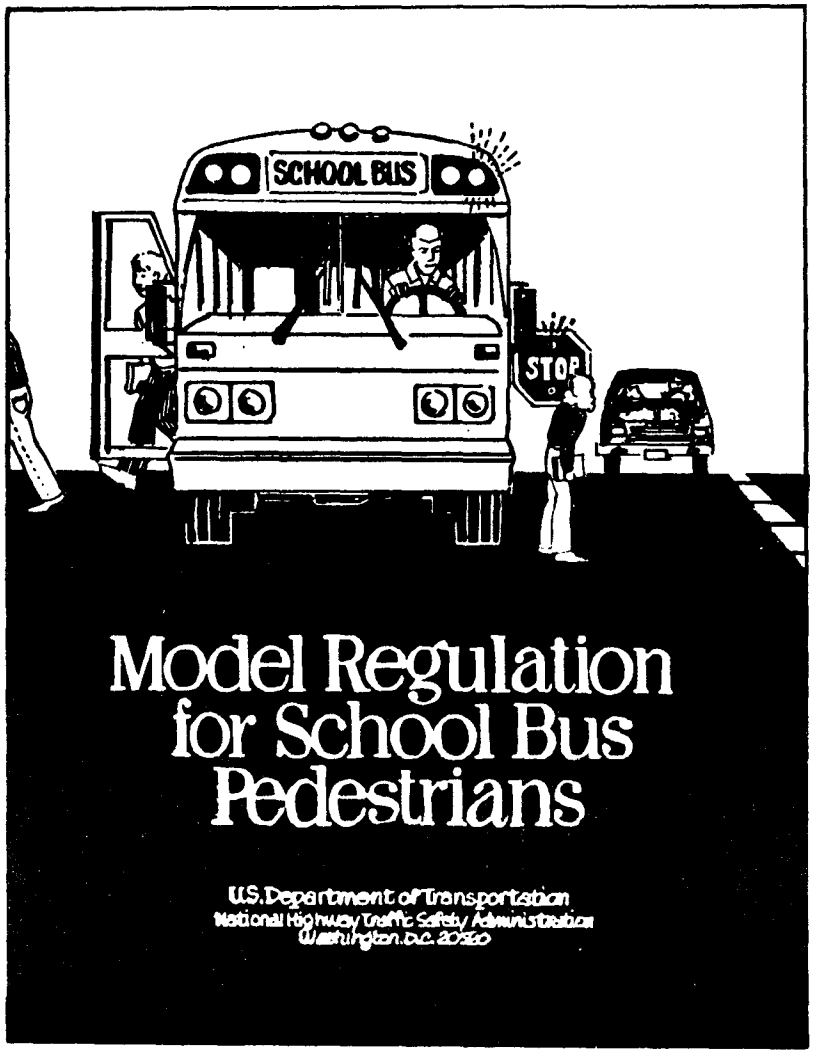
Figure 2 presents preliminary sketches of illustrations for the pamphlet. The first panel is a rendition of the front cover which shows a "model regulation" school bus, head-on discharging pupil pedestrians. The alternately flashing light pattern is shown on both the roof lights and the swing arm lights. No pedestrian crossing mirrors are explicitly shown covering the front of the bus as a transit type school bus is portrayed. This is a recommended portrayal to obviate the necessity of showing a particular mirror configuration when an ideal is not really known. Also, transit buses are an increasing proportion of school bus fleets and may represent the wave of the future when both pupil pedestrian safety and economy of operation are considered over the long run.

The audience for the promulgation pamphlet is considerable. Interested agencies include, as a minimum, the following which could either promote or carry out enactment of the model regulation:

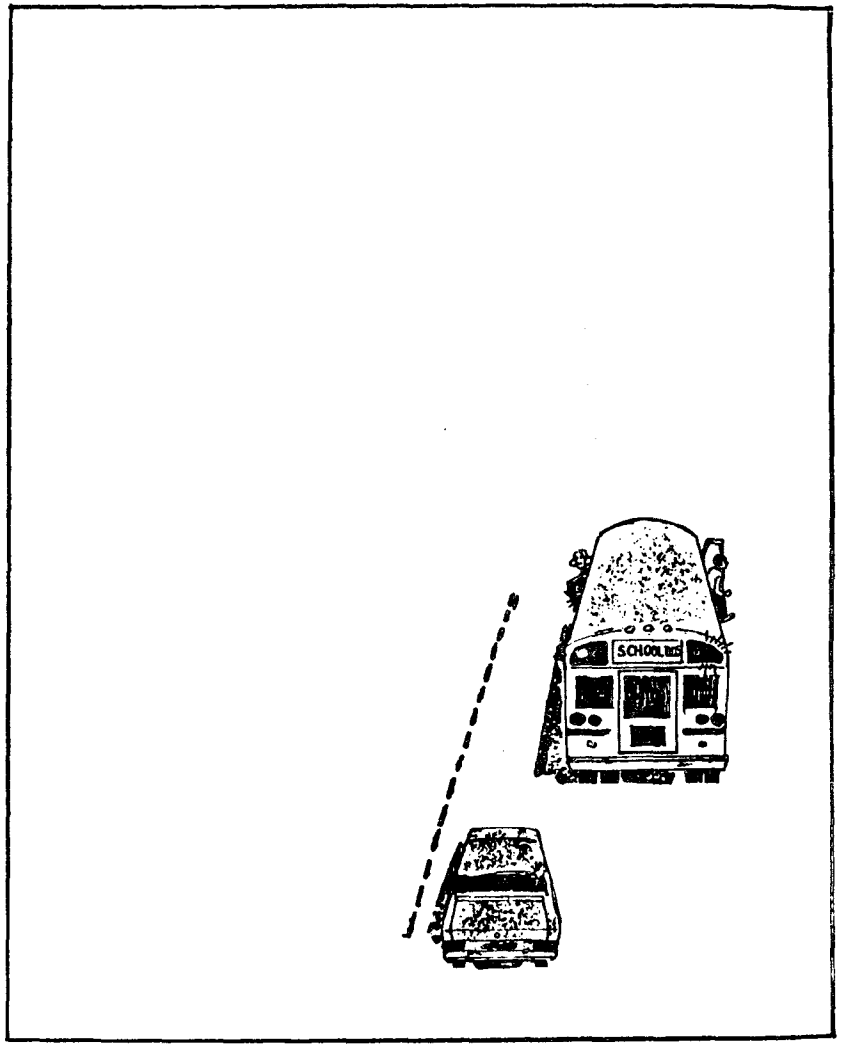
- State and Local Legislators and Associated Legislative Service Bureaus.
- Legislative Advisory Groups (e.g., Institute for Traffic Safety Management and Research [NY]; Motor Vehicle Conference [CA]).
- National Committee on Uniform Traffic Laws and Ordinances.
- NHTSA Regional Administrators.
- Governor's Highway Safety Representatives.
- National Association of State Directors of Pupil Transportation Services.
- National Safety Council (School Bus Section).
- National Association for Pupil Transportation.
- National School Transportation Association.
- Southeastern State Association for Pupil Transportation.
- California Association of School Transportation Officials.
- State Parent-Teacher Associations

C. Public Service Announcements

While the model regulation does call for written advisories on motorist requirements to stop for school buses to be disseminated, radio and television public service announcements (PSA's) on these requirements can truly make for an effective public information and education program. In consideration of this fact, 30-second and 60-second television PSA's and 15-second and 30-second radio PSA's should be produced. Script development for these spots should emphasize showing or telling about the following major points:



Front Cover



Quarter Panel in Text

Figure 2. Suggested Illustrations for Model Regulation Pamphlet

- Reasons why motorists must stop for loading/unloading school buses displaying the flashing lights and stop signal arm (e.g., children crossing at front of bus blocked from view of motorists to the rear; unpredictability of small children).

- The eight lights and stop swing arm as the signalling equipment in force.

- When motorists must stop and stay stopped.

- When motorists may pass school buses.

- School bus drivers are required to report school bus passing violations to the police who investigate these violations and issue citations to violators where warranted.

While all of the above points are important in the development of script for these PSA's, the last point is particularly important in terms of gaining sustained compliance with the stopping for school bus requirements of the model regulation. Motorists should treat the flashing lights and extended stop swing arm of a school bus with more respect knowing that the school bus driver will report an illegal passing of these signals.

D. School Bus Driver Training Pamphlet

While several jurisdictions have excellent school bus driver training programs presently in place supporting many of the provisions of the model regulation, others do not. Hence, development of a succinct pamphlet for school bus drivers telling them how to meet the school bus driver duty requirements of the model regulation (§ 4) would be beneficial. Such a pamphlet could follow the concept for the pamphlet described in Hale, Blomberg and Kearney (1980). The pamphlet could then be a readily available instructional handout for school bus drivers at the depots where they train and work.

V. CONCLUSIONS AND RECOMMENDATIONS

The Model Regulation for School Bus Pedestrians presented in this report is, to the knowledge of the authors, the most complete body of regulatory provisions on school bus-related pedestrian safety in existence. Adoption or incorporation of the model regulation's provisions by the states can do much to promote motorist compliance with the necessary requirements to stop for loading/unloading school buses by:

- Presenting uniform school bus appearance, stop signalling indications (via the eight light plus stop signal arm system) and procedures for signal use to the motoring public and minimum functional requirements for a system to observe pedestrians near the school bus.

- Establishing a potentially effective cooperative system for school bus passing violation detection, reporting, investigation and enforcement between school bus drivers and the police.

Overall, the combined results of the school bus violations study (Appendix A) and the school bus driver study (Appendix B) underscore the value of a stop swing arm system for school buses. The results of Appendix B show that Ohio school bus drivers prefer and report superior performance for the eight light plus stop swing arm system.

A heightened awareness of the safety issues and requirements addressed by the model regulation should be enhanced by compliance with the requirements of the regulation for appropriate instruction of pupils and school bus drivers. Moreover, the model regulation requirement to inform the public on the latest stop-for-school-bus provisions partially satisfies a need for education of the motoring public.

In view of the foregoing, and the previously cited assessment and experiential data supporting many of the model regulation provisions, it is recommended that NHTSA disseminate this model traffic regulation to the states. Prior to accomplishing this event and for the reasons outlined in Chapter IV, it is also recommended that the following PI&E items be produced as instrumental to or part of the promulgation of the model regulation:

- Model Regulation Pamphlet

  Efficiently presents the model regulation to pupil transportation administrators and legislators who could support and lobby for it.

- PSA's for the Driving Public

  30-second and 60-second television, 15-second and 30-second radio PSA's on the model regulation's requirements for motorists and the enforcement program in effect.

- Motorist Pamphlet

  Promulgated to motorists by a jurisdictional Commissioner/Registrar of Motor Vehicles on the model regulation's requirements and the enforcement program in effect.

- School Bus Driver Pamphlet

  Disseminated to school bus drivers informing them of their duties specified by the model regulation.

There is one final recommendation. As noted in the Annotation for the model regulation in Chapter III, available evidence does not support the specification of an equipment configuration to monitor pupil pedestrians who may be near the bus. Three measures to provide bus driver visual access to areas along the bus where direct vision is not possible were discussed, namely:

- Conventional convex pedestrian mirrors.
- Ultra-convex pedestrian mirrors.
- Crossing control arm.

Electronic detection systems also exist for sensing the presence of pedestrians near the bus who are not discernible by direct view. While school bus driver opinion tends to favor the use of two convex crossing mirrors on the left front fender and two on the right (Appendix B), carefully conceived and controlled research should be sponsored by NHTSA to objectively identify a cost-effective pedestrian monitoring system. Such a system should provide sufficient capability for seated school bus drivers to monitor locations along conventional and transit-type buses where pupil pedestrians cannot otherwise be detected.

While it is necessary to implement the provisions of this regulation in a regulatory format (i.e., state statutes or administrative code) to realize the full derived safety benefit, selected features (e.g., the functional requirements for a system to observe pedestrians near the school bus) may be implemented without need for a regulation.

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APPENDIX A.

MOTORIST PASSING VIOLATIONS ASSOCIATED WITH THREE TYPES OF SCHOOL BUS SIGNALLING SYSTEMS

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LIST OF FIGURES AND TABLES

ABSTRACT AND ACKNOWLEDGEMENTS

From a file of police investigated school bus driver reports of motorist passing violations in Columbus, Ohio during September 1979 to June 1982, violation frequencies for three types of school bus signalling systems were examined, i.e.:

- four light (two flashing red roofline lights front and back)
- eight light (above plus two flashing amber pre-stop warning roofline lights front and back)
- eight light plus stop swing arm (octagonal stop sign)

Significantly, the eight light plus stop swing arm system had approximately 2/3 to 1/2 as many passing violations as the four light or eight light system. There was no significant difference in violation frequencies between the four light and eight light systems. These findings are interpreted as supportive evidence for the safety benefit of using octagonal stop swing arms on school buses to indicate the requirement for motorists to stop.

We are indebted to the following officials in Columbus, Ohio without whose support this study would not have been possible:

- Columbus Police Department

  All members of the Accident Investigation Squad, particularly Sergeant Lawrence A. Bigler, CO, whose cooperation and hospitality facilitated our access to their school bus passing violation data files.

- Columbus City Public Schools

  Mr. Ronald A. Smucker, Director of Transportation, who provided extensive data on school bus equipment and operations in the Columbus City School District.

I. INTRODUCTION

Contract No. DTNH22-80-C-07568, "Development and Test of Rural Pedestrian Safety Countermeasures," is concerned with the assessment of the Model Regulation for School Bus Pedestrians (Hale, Blomberg and Kearney, 1980). Among the various provisions included are those addressed to required behavior for school bus drivers and motorists and safety equipment for school buses. Of great importance to school bus child pedestrian safety is the signalling system employed to indicate that motorists must stop for a school bus which has stopped to receive or discharge passengers. The Model Regulation for School Bus Pedestrians requires an eight light plus stop swing arm signalling system, i.e.:

- Two amber lights mounted at the roofline to be actuated in advance of the school bus stop as a warning to motorists of the impending requirement to stop.

- Two red lights mounted at the roofline to be activated when the school bus is stopped to receive or discharge passengers and motorists approaching from either direction must stop.

- An octagonal stop swing arm (with two flashing red lights) which swings out perpendicular to the traffic side of the bus when the red lights are activated--reminding motorists of the requirement to stop.

The Uniform Vehicle Code (NCUTLO, 1979), as do many states (approximately 20), requires only red flashing roof lights as the necessary signalling equipment on school buses to indicate when motorists must stop for a school bus. Since the model regulation requires amber pre-stop lights and the stop swing arm in addition to the flashing red lights, empirical justification for the cost of this equipment could promote justifiably greater acceptance of the eight light plus stop swing arm system beyond the approximately eleven states which presently require this system.

With the objective of assessing the safety benefit of this equipment, the present study was planned and conducted. Before this planning was accomplished, however, previous studies conducted to assess the effectiveness of the stop swing arm were reviewed (Bequette, 1976; National Safety Council, 1975). The basic approach of these swing arm studies was to ask designated school bus drivers to keep a record of motorist passing violations for school buses equipped only with a four-light system for a given period of time. After a swing arm was installed, the same bus drivers recorded violations accrued with a four-light plus stop swing arm system during an "after" period of time equal to the "before" period. In all cases, the swing arm produced statistically significant reductions in the number of associated motorist passing violations. However, these before and after "swing arm" studies cannot really be considered scientifically rigorous and suffer from such flaws as:

- The potential for uncontrolled variables to operate differentially in the before and after periods which could confound the results.

- The lack of control to prevent bus drivers from consciously or unconsciously biasing their detections of school bus passing violations before and after the swing arm installation.

While the results of the aforementioned studies collectively do represent some measure of justification for a stop swing arm on school buses, the desirability for obtaining more objective assessment data led to the present study.

In any empirical study of school bus signalling system effectiveness, administrative or statuatory approval should exist for the installation and operation of any signalling system used on school buses in any jurisdiction. Thus, a suitable regulatory environment was sought to permit a useful study of the system required by the model regulation--namely, an eight light plus stop swing arm. Such a jurisdiction was found in the State of Ohio.

On 15 March 1979 the Ohio state legislature enacted legislation (Section 4511.75 (B)) which required an eight light plus stop swing arm system to be installed on all new buses contracted for on or after 1 June 1979. What this requirement created as of the 1979/80 school year was a heterogeneous fleet of school buses statewide, as funds were not available to retrofit all buses in operation to the new eight light plus stop swing arm requirement. Specifically, school buses of the model year 1977 and older had four light signalling systems, model years 1978 and 1979 had eight light systems and model years 1980 and newer had eight lights plus a stop swing arm. While not ideal in terms of a desirable uniformity for traffic signalling devices, the three concurrently operating school bus signalling systems presented the opportunity for an empirical study of school bus signalling system effectiveness.

The most important form of assessment which was sought was a comparison of the accident experience for the three types of signalling systems in periods before and after their introduction. Unfortunately, the records of the Ohio Department of Education, Office of Pupil Transportation showed that too few accidents occurred statewide annually for a valid assessment. Between Fall 1971 and Spring 1982 (eleven school years total), the number of school bus related pedestrian accidents occurring ranged from eight to 30 per year, with the mean number being 20 per year. This figure includes both pupils who were struck by the school bus itself and pupils who were struck going to or from the bus by passing motorists. In the 1980-81 school year, 14 incidents involved a collision between the bus and the pupil and only two incidents involved a collision between a motorist passing the bus and a pupil going to or from the bus.

With an "accident study" being unfeasible, another source of relatively substantive assessment data was examined, namely recorded instances of motorists passing a stopped school bus with the signals activated. Ohio Code Section 4511.751 requires that the operator of a school bus report to the jurisdictional law enforcement agency the license plate number and general description of the vehicle which unlawfully passes a stopped school bus. This state statute further provides that:

> Upon receipt of the report of the alleged violation of division (A) of Section 4511.75 of the Revised Code, the law enforcement agency shall conduct an investigation to

> attempt to determine the identity of the operator of the vehicle at the time of the alleged violation. If the identity of the operator at the time of the alleged violation is established, the reporting of the license plate number of the vehicle shall establish probable cause for the law enforcement agency to issue a citation for the violation of division (A) of Section 4511.75 of the Revised Code. However, if the identity of the operator of the vehicle at the time of the alleged violation cannot be established, the law enforcement agency shall issue a warning to the owner of the vehicle at the time of the alleged violation, except in the case of a leased or rented vehicle when the warning shall be issued to the lessee at the time of the alleged violation.

Thus, the potential for a data base of school bus passing violations which could be correlated with the signalling system in use on the buses involved existed. Following discussions with Ohio state pupil transportation officials, the existence of an active program of school bus violation reporting and police investigation in Columbus, Ohio was identified. After discussions with Columbus police and pupil transportation officials, the potential for a controlled study of school bus violation experience for the three school bus signalling systems (i.e., four lights, eight lights, and eight lights plus swing arm) in the City of Columbus was confirmed.

There are several important advantages of the school bus passing violation data base in Columbus, Ohio over the school bus passing violation data bases used in previous studies (Bequette, 1976; National Safety Council, 1975):

- The alleged passing violations reported by school bus drivers were investigated by trained police accident investigators to validate the necessary elements of the offense.

- All the violations detected were done so in the "blind" as the school bus drivers filing violation reports were unaware of participating in any form of signalling system assessment study. Their behavior was externally motivated only, presumably, by "system" requirements to report school bus passing violations.

- Presumably, police violation investigations were conducted in the "blind." The existence any signalling system assessment was not known to police personnel at the time the violation investigations were conducted.

II. METHOD

A. Police Violations Data File

Ideally, when a school bus driver in Columbus, Ohio observes a passing violation, the bus driver completes a violation report (Figure 1) and turns this report into his/her supervisor. The supervisor then forwards this report to the Columbus police for investigation. The police first contact the bus driver and/or the driver of the violating vehicle to determine what happened and then complete a police report (Figure 2).

As a result of the police investigation, a summons is issued if the driver admits to the violation, or if the bus driver can identify the other driver. A warning letter (Figure 3) or a verbal warning is issued to the vehicle owner when the bus driver correctly records the license number of the violator's vehicle, but cannot identify the driver, if the police cannot locate the driver, or if the driver is not from the Franklin County area (Columbus police jurisdiction).

The case remains unsolved if the bus driver reports a non-existent license plate number or if the license plate number recorded does not meet the description of the car offered by the bus driver (implying that the bus driver reported an incorrect number). The alleged violator is absolved if the bus driver filled out a report for a non-violation such as a motorist passing the school bus orthogonally at an intersection.

The file of recorded and investigated violations reported from September 1979 through June 1982 was examined at the Columbus police department by the project staff. The following information was extracted from the bus driver's violation report and/or the police officer's investigation report and recorded on a coding form:

- bus driver's sex
- bus route number
- bus number
- date and time of violation
- location of violation
- violator vehicle type
- type direction of travel for the bus and the other vehicle
- number of lanes on the highway
- violator's race, sex and age
- frequency of other violations in the same general area as the reported violation
- whether a child had been crossing the street at the time of the violation
- police disposition of the case

B. Columbus Public Schools Data Base

For each violation record, the bus driver's date of employment, sex, date of birth and full time/part time status were obtained from the Columbus public schools. Further information on each bus operated by Columbus public schools

COLUMBUS PUBLIC SCHOOLS
Transportation Department '82 MAY 21 AM11 40

REPORT OF SCHOOL BUS FLASHER VIOLATORS

The bus driver is to fill out this form completely and be able to make a positive identification of the driver violator if charges are made against the violator. PLEASE DO NOT CALL THESE VIOLATORS IN BY THE RADIO. Submit this form to your supervisor on the same day the violation occurs.

* * * * * * * * * * * * * * * * * * * *

DRIVER OF BUS _____

HOME ADDRESS _____ TELEPHONE NO. _____

COMPOUND Morse Rd. TELEPHONE NO. 475-7664

BUS ROUTE NO. 146 BUS NO. 287

DATE OF VIOLATION 5-20-82 TIME OF VIOLATION 3:53 AM (PM)

LOCATION OF VIOLATION (Be Specific) S.E. Corner on Maize Rd. at Acton Rd

LICENSE NO. OF VIOLATOR Temp. Tag. MAKE OF AUTO Chevy

MODEL Camaro COLOR Bronze-Copper

DIRECTION OF TRAVEL OF BUS: (Please Circle) (N) S E W

DIRECTION OF TRAVEL OF VIOLATOR: (Please Circle) (N) S E W

HOW MANY TRAFFIC LANES? 2 STATE TRAFFIC CONDITIONS Raining-Roads-Wet

CAN YOU MAKE A POSITIVE IDENTIFICATION OF THE DRIVER OF THE VIOLATING VEHICLE? (✓) YES ( ) NO

IF ABOVE ANSWER IS YES, DESCRIBE DRIVER OF VIOLATING VEHICLE. _____

Name: Laurie White female - Late teens
Shoulder length dark hair

HAVE YOU HAD OTHER VIOLATORS IN THIS AREA? (✓) YES ( ) NO

HOW OFTEN? 2-3 times weekly

PLEASE LIST ANY OTHER ADDITIONAL INFORMATION WHICH MAY BE HELPFUL IN IDENTIFYING THE VIOLATOR OR VEHICLE OF THE VIOLATOR.

I followed the car, never losing sight of it, to Midvale Rd. I talked with the passenger who was left at that address and she gave me the driver's name.
The passenger was white female, approx. 16 to 18 yrs. medium dark curly hair.

_____ (Driver's Signature)

5/20/82 (Date)

RECEIVED BY: _____ (COMPOUND SUPERVISOR) DATE May 21/1982 PHONE # _____

Figure 1. Columbus School Bus Passing Violation Report

school bus — COLUMBUS, OHIO POLICE DEPT. SUPPLEMENT COLLISION REPORT

Date May 20 Time 253p.m Day thurs Location ... Rd ... Rd
Year Make Color Type Lic# State
Owner ... Public Schools Add. ...Rd Compound Phone 47...
Driver Add. Phone
Damages-Injuries
Narrative:
School bus stopped headed n/b on Maize Rd and unit #2 traveling n.b passed stopped school bus
I ...

Officer Cr.# Report Taken At Date Time
Evidence

AUTO WANTED

30 ... ohio

Year 7... Make Chev Color ... Gold Type camaro Lic # State
Damages
Additional Description
Owner Add. Phone
Emp. Ins.

DRIVER WANTED

Description ..., Blk, ... DOB 6-17-65 Employment Student
Name Add. Phone
Race W Sex F Oper. Lic. # SS#
Charge(s) FTS School Bus Sec. # 2131.3 Ticket # 256255
Date Closed 5-27-82 By PSH Reason Arrest
Court Date Summons

U-21.100 (REV. JUNE, 19

CASE SUMMARY

WITNESSES
... The report indicates that the bus driver ... the #2 unit
were losing sight of it to ... Midvale The bus driver talked to the passenger
who ... left at that address and the passenger gave the busdriver the name of
the driver of the #2 unit as ... Shoulder ... hair
... ... times ... line ... busy ...
... the ... several times and the line is either busy or
... will not ...
... with the ...
5-25-82 Ran the #2 and ... was not at home. Left a message requesting she
call at 3PM or 7PM...psh
5-26-82 Mr. ... called, wanting to know how we got ... name...
She was not at home but he will have her call at 3pm or 7pm as per ...'s
OI card. meb
-26-82 Received a call from the #2 driver, ..., saying that she does re-
call driving in the area of this violation but does not think that she passed
a school bus displaying red flashers. Told her about the driver getting her
name from her girlfriend and she did acknowledge the fact of dropping her off
but her girlfriend had not said anything to her about this. Advised her that
a cite would be forthcoming. Called the #1 and left a message requesting she
call me at 7PM...psh
5-26-82 Called the busdriver and she related that she had stopped n/o Maize
at Acton to drop off eight students, four of which have to cross the street.
Traffic had stopped in both directions and she noticed that the #2 was stopped
n/s two cars back and then suddenly pulled out and passed the stopped bus. This
was her last stop and so she followed and spoke to the passenger when the #2
dropped her off and that is who told her the #2 name. continued

page 2 CASE SUMMARY Maize & Acton

6-26-82 continued she said that the #2 went left of center to pass her at Acton
and she was able to get the first part of the license at that time and when she
pulled up behind the #2 at the red light at Cooke as the second vehicle back, she
was able to get the remainder of the tag. Thinks that she may be able to ID the
driver even though she only got a look from the side....psh

Figure 2. Columbus Police Investigation Report

TOM MOODY
MAYOR

BERNARD T. CHUPKA
SAFETY DIRECTOR

CITY OF COLUMBUS
OHIO

DIVISION OF POLICE
P.O. BOX 15009
COLUMBUS, OHIO 43215

EARL BURDEN
CHIEF OF POLICE

It has been brought to the attention of the Columbus Division of Police that on a vehicle bearing license number registering to on a was reported to have been in violation of the Ohio Revised Code Section 4511.75. This pertains to the passing of school busses stopped for the purpose of loading or unloading school children.

Senate Bill 389 which became effective on March 15, 1979 placed the burden upon the local law enforcement agency, once having been advised of such a violation by the school bus operator, to conduct an investigation to identify the owner of such vehicle and its operator. Once this has been established the operator of said vehicle may be issued a citation or warning.

The above vehicle which registers to you was reported in such a violation on at in the City of Columbus, Ohio.

If in fact your vehicle was in Columbus on the date and time in question, and may have violated this law, then you should be informed of the seriousness of such an offense and of the possible penalty.

The law is specific in its directions to operators of motor vehicles when meeting and overtaking a school bus stopped for the purpose of boarding and or discharging children. It states a driver shall stop at least ten feet from the front or rear of the bus, and shall not proceed until the bus resumes motion or the driver signals for the vehicle to proceed.

Also where a highway has been divided into four or more traffic lanes, or is divided, a vehicle need not stop for a school bus approaching from the opposite direction which has stopped, and is discharging passengers.

The maximum penalty for violation of this law is a fine of five hundred dollars plus court costs and drivers rights suspension of one year. This is coupled with a mandatory court appearance in this city.

Investigation of this reported violation has concluded that there may have been some extenuating circumstances in the reporting of your license tag. For this reason it has been decided that you should be given a warning, in regard to this violation, and be advised of the previously mentioned facts. If there are any questions pertaining to this letter, please call the Columbus Division of Police, Accident Investigation Squad at Area Code 614-462-4767 Monday thru Friday 8:00 AM to 4:00 PM

SERGEANT LAWRENCE A. BIGLER #2106
Accident Investigation Squad
For
CAPTAIN RICHARD E. POOR #2012
Traffic Bureau Commander

LAB:REF:mb

Figure 3. Police Warning Letter

during the study period was also obtained from the school department, which included:

- o bus number
- o bus body type
- o bus chassis type
- o year of bus manufacture and associated signalling system.

The numbers of each type of school bus signalling system in operation each school year were unchanged throughout the study period (September 1979-June 1982).

C. Procedure

Data from the violation files and the Columbus Public Schools data base were merged using a Pascal program on an Apple II Plus computer. Chi square tests were performed to determine the significance of the difference in numbers of passing violations reported for the signalling system types. Additional chi square analyses were performed to determine whether the number of drivers reporting passing violations differed based upon the bus signalling system in use, and whether the mean age or tenure of the drivers using the various signalling systems differed.

III. RESULTS

From a review and analysis of the Columbus police department school bus passing violation report records accumulated between September 1979 and June 1982, a total of 434 bona fide records were coded for data analysis. This excluded 59 records which were filed for buses not operated by Columbus City Schools and 21 records which were determined by police investigators not to be violations of the school bus stop law. Five of the 434 bona fide passing violation records were not classifiable as to school bus signalling system type and thus were dropped from the signal system analysis. Thus, a total of 429 school bus passing violation records was established as the principal working data base for this study.

Table 1 summarizes the results for the study. During the 1979-82 period, 55 violations occurred with eight light plus stop swing arm buses, 217 violations occurred with eight light buses and 157 violations occurred with four light buses. Considering the number of each system in operation within the Columbus city school district (see Table 1) as a means for determining the expected values for the Chi Square analysis,* the differences in the observed frequency of violations among the three signalling systems were statistically significant ($X^2 = 11.01$, 2 d.f., $p < .01$). In comparing the violation frequencies for just the four light versus the eight light plus swing arm systems a statistically significant difference was obtained ($X^2 = 9.04$, 1 d.f., $p < .01$). Similarly, a statistically significant difference ($X^2 = 10.24$, 1 d.f., $p < .01$) was found in a comparison of the violation frequencies for the eight light and the eight light plus stop swing arm systems. The difference between the four light and eight light system violation frequencies was not significant.

A descriptive term which was derived from these data is violation rate. This rate was computed by dividing the total number of violations accrued for buses of a given signalling system type by the total number of buses of that signalling system type in operation. The violation rate for both the four light and eight light systems was approximately one violation per bus and the rate for the eight light plus swing arm was only 0.63 violation per bus.

The school year experiencing the most recorded violations was the 1981-82 school year with 335 violations reported in total. Only 94 violations were reported in the 1979-80 and 1980-81 school years. This situation was due principally to the fact that the coordination between school bus drivers, police investigators and the courts took some time to establish after the program was inaugurated in 1979. Since the bulk of the data base was accumulated in the 1981-82 school year, an analysis of just these data was carried out. The major results for this time period are shown in Table 2.

*The null hypothesis in this case assumes an equal opportunity for each signalling system to accrue violations. Thus, the frequency of each bus signalling type in operation was transformed into a percentage which when multiplied times the base of violations yielded the respective expected frequencies for each observed frequency.

Table 1. Major Study Results for the September 1979 - June 1982 Sample*

Bus Signalling System	No. Violations	Total** No. Buses	Average No. Violations/Bus	No. Reporting Buses	Mean Birth Year Bus Drivers	Mean Hiring Year Bus Drivers
FOUR LIGHT	157 (37%)	157 (34%)	1.00	55 (37%)	1943	1979
EIGHT LIGHT	217 (51%)	213 (47%)	1.02	68 (46%)	1943	1978
EIGHT LIGHT PLUS SWING ARM	55 (12%)	88 (19%)	0.63	25 (17%)	1944	1978
TOTAL	429 (100%)	458 (100%)	----	148 (100%)	----	----

*The following school years were involved: 79/80, 80/81, 81/82.

**Assigned to fleet operations for each school year.

Table 2. Study Results for the 1981-82 School Year

Bus Signalling System	No. Violations	Total* No. Buses	Average No. Violations/Bus	No. Reporting Buses	Mean Birth Year Bus Drivers	Mean Hiring Year Bus Drivers
FOUR LIGHT	128 (38%)	157 (34%)	0.82	40 (31%)	1943	1979
EIGHT LIGHT	168 (50%)	213 (47%)	0.79	68 (54%)	1943	1978
EIGHT LIGHT PLUS SWING ARM	39 (12%)	88 (19%)	0.44	19 (15%)	1944	1978
TOTAL	335 (100%)	458 (100%)	----	127 (100%)	----	----

*Assigned to fleet operations during school year.

In the 1981-82 school year there were 39 passing violations reported for the eight light plus stop swing arm buses, 168 violations for the eight light buses, and 128 violations for the four light buses. On average, these violation frequencies transformed into violation rates of 0.44 violations per bus for the eight light plus stop swing arm system. 0.79 violations per bus for the eight light system and 0.82 violations per bus for the four light system. The differences in observed violation frequencies among the types of signalling systems were statistically significant (X^2 = 12.16, 2 d.f., $p < .01$). Comparisons between the eight light plus swing arm and the eight light system (X^2 = 10.35, 1 d.f., $p < .01$) and the eight light plus swing arm and the four light system (X^2 = 11.47, 1 d.f., $p < .01$) were also statistically significant. The difference in violation frequency between the four and eight light systems was again not significant.

In considering the characteristics of the school bus driver population as a potential source of bias for the study results, no such biases were uncovered. The average year of birth for each of the three groups of bus drivers and average year of employment for each of the three groups were not significantly different (see Tables 1 and 2), with the averages being 1943 and 1978 respectively. The overall population of violation reporting school bus drivers was 70 percent female (N=93) and 30 percent male (N=40). The potential for school bus driver reporting bias was also considered. Approximately 35 percent of all bus drivers with four light systems, 32 percent those with eight light systems and 28 percent of those with eight light plus swing arm systems reported at least one violation. These differences in reporting rate are not statistically significant.

Data defining the characteristics of the motorist violator population were sparce. Those data of sufficient reliability were concerned with sex and racial origin. The breakdowns for these categories were as follows:

Violator Sex: Male - 53% (N=232), Female - 38% (N=165), Unk. - 9% (N=37)

Violator Racial Origin: White - 53% (N=232), Black - 25% (N=107), Oriental - 3% (N=11), Spanish - 1 (0%), Other - 1 (0%), Unk. - 19% (N=82)

Violation data descriptors beyond those already discussed appear in Table 3. More than five times as many written warnings as verbal warnings were issued (87 versus 17). Forty-seven percent of all the violations resulted in the issuance of a traffic summons. Thus, of all the bona fide violation records studied, 71 percent resulted in some form of follow-up enforcement action. Some 129 or 26 percent of the cases were "unsolved" as far as identifying a driver or vehicle owner and any enforcement action being taken. However, as no police information uncovered in these cases ever indicated that the violation detections were invalid, these violation records were justifiably retained within the data base for this study.

The distribution of violations over months of the school year was basically unremarkable. The distribution of violations over the hours of day, showed no unexpected results. The peak periods seemed to track density of school

Table 3. Violation Data Descriptions

Violation Disposition:

Summons	204 (47%)
Written Warning	87 (20%)
Verbal Warning	17 (4%)
Unsolved	126 (29%)

Monthly Violation Frequency:

September	42 (10%)	January	45 (10%)
October	62 (14%)	February	53 (12%)
November	50 (12%)	March	56 (13%)
December	47 (11%)	April	30 (7%)
		May	47 (11%)

Time of Day Violation Frequency:

0600-0659	12 (3%)	1200-1259	10 (2%)
0700-0759	65 (15%)	1300-1359	-- (0%)
0800-0859	85 (20%)	1400-1459	28 (7%)
0900-0959	2 (.5%)	1500-1559	170 (39%)
1000-1059	2 (.5%)	1600-1659	26 (6%)
1100-1159	5 (1%)	1700-1759	2 (6%)
		Unk.	25 (6%)

Violator Vehicle Type:

Car	388 (90%)	Bus	6 (1%)
Van	29 (7%)	Lg. Truck	5 (1%)
		Unk.	6 (1%)

No. Traffic Lanes at Violation Location:

1	16 (4%)
2	331 (76%)
3	26 (6%)
4	40 (9%)
Unk.	21 (5%)

Relative Direction of Travel for School Bus and Violating Vehicle:

Same Direction	196 (45%)
Opposite Direction	238 (55%)
Unk.	0 (0%)

Note: Such traffic environmental descriptions as visibility and lighting estimates, normally available on accident reports, were not readily available on the traffic violation records employed in this study.

bus operations, i.e., 35 percent of the violations occurred between 7:00 a.m. and 9:00 a.m. and 52 percent of the violations occurred between 2:00 p.m. and 5:00 p.m. with 39 percent occurring in the period 3:00 p.m. to 4:00 p.m.

In regard to violator vehicle type, clearly the car predominated accounting for 90 percent of all the cases. Van/pick-up trucks, large trucks and buses comparably account for the remaining fractions.

Insofar as roadway type is concerned, two lane highways predominated as roadway environments for violation occurrences, accounting for 76 percent of the cases.

In considering the effectiveness of stop swing arms in influencing approaching traffic, the direction of motorist travel vis a vis the swing arm equipped vehicle has been cited as a determining factor (see Hale, Blomberg and Kearney, 1978). Specifically, it has been postulated that the influence of the swing arm is in fact greater for motorists traveling in the same direction as the swing arm equipped vehicle than it is for motorists traveling in an opposite direction. The difference is explained in terms of the proximity induced greater visual impact of the swing arm for motorists in adjacent lanes versus opposing lanes. This hypothesis appears confirmed by the results of this study. Fifty-five percent (N=238) of all passing violations occurred with vehicles approaching from an opposite direction to the school bus. Forty-five percent (N=196) of the violations occurred with motorists moving in the same direction as the school bus. The difference in frequencies is statistically significant ($X^2 = 4.06$, 1 d.f., $p < .05$). This result compares favorably with the results of the field test of Model Ice Cream Truck Ordinance in Detroit (Hale, Blomberg and Kearney, 1978) where ice cream trucks were equipped with stop (then go) swing arms to protect principally child pedestrian customers. In this case the average speed of motorists passing the stopped ice cream truck with the swing arm extended (not all motorists complied with the stop requirement) was 18.68 mph for vehicles approaching the ice cream truck versus 13.52 mph for motorists proceeding in the same direction as the ice cream truck. This difference was statistically significant ($T = 8.99$, 783 d.f., $p < .005$). Stop swing arms seem more effective in controlling same direction rather than opposite direction traffic. Thus, the risk of a stopping violation with school buses appears greater for motorists approaching from the opposite direction. Attendant hazards in this situation may be offset by the greater visual access afforded motorists from this direction to child pedestrian crossings which occur under protection of the signalling system at the front of the school bus. This greater visual access to the crossing pathway for children at the front of the bus may, in fact, tempt motorists to violate the signals when no one is immediately seen to be crossing.

IV. DISCUSSION

Whether considering the entire set of violation data from September 1979 to June 1982 or just the 1981-82 school year, significantly fewer violations were reported for eight light plus swing arm buses versus four or eight light buses. For the 1979-82 period the four light and eight light buses within the Columbus school district experienced approximately one violation per bus, whereas the eight light plus swing arm buses experienced only 0.63 violations per bus. In the 1981-82 school year, the four light and eight light buses experienced 0.82 and 0.79 violations per bus respectively and the eight light plus swing arm buses had only 0.44 violations per bus. Overall, eight light plus swing arm buses experienced approximately 2/3 to 1/2 the violation rate of four and eight light buses.

There are several possible interpretations of these results. The first is that the presence of the swing arm reduced the number of motorists passing a school bus. This could have been due to any or all of the following:

- The stop arm served as a "visual barrier" which discouraged vehicles from passing the bus.
- Drivers are "conditioned" to stop for stop signs.
- The stop sign with flashing lights is more compelling than just flashing roof lights, due to its location near the roadway and the fact that it is displayed (swung out) only when motorists are required to stop.
- The swing arm is a more "reliable" warning signal (at eye level on the left side of the bus) than the flashing roof lights which may not always be visible to motorists due to obscuration by a tree or vehicle blocking the driver's view.

Another interpretation of the data is that for some reason or another, the drivers in four and eight light buses were simply more zealous in reporting violations that the drivers in swing arm buses. This interpretation can be dismissed because there was no significant difference in the proportion of drivers of each bus/signalling system type. Furthermore, from discussions with the Columbus Pupil Transportation Director, it was determined that there were no particular patterns of assigning drivers to buses/signalling systems throughout Columbus.

A qualification regarding the results of this investigation should be raised at this point. In establishing the rationale for deriving expected violation frequencies and calculating violation rate data (i.e., average number of violations per bus/signalling system type) it has been assumed that all bus/signalling systems have had equal exposure and opportunity to accrue passing violations. Ideally, exposure would be measured not only by the number of buses employing a particular signalling system each day, but the number of stops each bus makes each day (which can vary somewhat daily, monthly and from year to year) as well. Moreover, for each bus and route traveled, the opportunity to accrue violations would be significantly affected by the vehicle traffic density expected for the roadway location and time of

day when each school bus stop is made. Unfortunately, it was not possible to acquire and analyze the aforementioned data within the scope and resources for this study.

The general effect of a reduced number of passing violations with the eight light plus stop swing arm is consistent with other swing arm assessments with school buses (Bequette, 1976; National Safety Council, 1975) and vendor trucks (Hale, Blomberg and Kearney, 1978). In the school bus swing arm studies, reductions in passing violations after the installation of the swing arm ranged from 40 to 73 percent. In these studies bus drivers were simply asked to record the number of passing violations observed on their buses for a period of a month or more before and after installation of a swing arm. These studies posed several basic problems, however. First, bus drivers were very much aware of the purpose of this study, thus they may have been biased to report fewer violations after their bus was equipped with the swing arm (to please "the boss"). Second, the citizens in several of the localities, were also aware of a study, and may have artificially altered their behavior. Third, appearance of the STOP arms was novel and the general public may have been more willing initially to stop to see the novel device at work. Finally, the violations reported were not verified via police investigation.

The present study, as far as is known, did not suffer from the above problems. No one involved in the creation of the passing violation data file (motorists, school bus drivers or police) knew that the violation reports and subsequent investigations would be analyzed for the purposes of any assessment until the project staff contacted the Columbus Police Department. The time of contact was the summer of 1982, well after the last violation report had been filed and investigated.

The present study has shown that an eight light plus swing arm signalling system in the Columbus City School District experienced approximately 2/3 to 1/2 as many motorist passing violations as either the eight light or four light signalling systems. There was no significant difference in performance between eight light and four light systems. The results of the present study and those reported in previously discussed "before" and "after" school bus swing arm assessment studies (Bequette, 1976; National Safety Council, 1975) collectively form a body of assessment data that leads to a reasonably justifiable conclusion. That conclusion is that a stop swing arm on school buses significantly reduces passing violations that would otherwise be experienced in its absence with four or eight systems alone.

Although the present study examined the violation performance of an eight light plus swing arm versus eight light and four light systems, it was not possible to examine the performance of a four light plus stop swing arm system as well. Such an investigation could have tested the effectiveness for the amber pre-stop warning lights. However, in the absence of supporting empirical data, the inherent logical appeal of amber lights as a warning to motorists of an unexpected requirement to stop on the roadway is undeniable. Without substantial doubt, the stop swing arm provision of the Model Regulation for School Bus Pedestrian seems well justified rationally and empirically.

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APPENDIX B.

SCHOOL BUS DRIVER EXPERIENCES AND OPINIONS REGARDING VARIOUS ASPECTS OF PUPIL PEDESTRIAN SAFETY

ACKNOWLEDGEMENTS

We gratefully acknowledge the very kind cooperation and assistance provide by Mr. Herman Massie, Chief, Ohio Pupil Transportation. The keen interest expressed by Mr. Massie and his staff, Messrs. David Campbell and Richard Green, in the research topics of this survey and the direct support provided in developing and distributing the survey questionnaire were instrumental in making this study possible. We also wish to thank the Ohio Association of Administrators of Pupil Transportation who greatly assisted in the process of distributing the questionnaire to the school bus drivers. And finally, we express our sincere gratitude to the over 3,000 Ohio school bus drivers who had the interest to take the time to conscientiously complete the survey questionnaire.

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I. INTRODUCTION

The "Model Regulation for School Bus Pedestrians" developed and tested under Contract No. DTNH22-80-C-07568 principally seeks to minimize the risk of pedestrian accidents occurring during the loading and unloading of passengers. The threats to school bus pedestrians are two:

- o Being struck by the school bus itself because a small child near the bus can't be seen by the school bus driver when moving the bus forward; and
- o Being struck by a motorist passing the stopped bus, while the pedestrian is crossing to or from the bus.

In the case of long hood or conventional buses, a convex crossing mirror system or other sensing system can help the driver to detect any children lurking near the front of the bus. An attention-getting signalling system (flashing roof lights and a stop swing arm) can reduce the chances of a law abiding motorist inadvertently or ignorantly passing a stopped school bus which is loading or unloading children. The model regulation addresses the two critical areas of visibility at the front of the bus and the composition of the stop signalling system. While numerous signalling system options are in existence throughout the jurisdictions (four red roof lights; four red lights plus stop swing arm; four amber lights, four red lights plus stop swing arm, etc.) the model regulation specifies the eight light plus stop signal arm system. Ideally justification for the costs of additional signalling equipment beyond the four red lights required by the Uniform Vehicle Code (UVC Section 12-228(a)) should accompany the requirement for the eight light plus swing arm stop system required by the model regulation.

In the absence of sufficient pedestrian accident data (in terms of adequate numbers of interpretable events) data in any jurisdiction where a valid evaluation of pedestrian monitoring/mirror systems or signalling systems could be achieved, the State of Ohio was approached for a statewide survey of school bus drivers. The over ten thousand school bus drivers operating in urban, suburban and rural jurisdictions represented a valuable resource of operating experience with a variety of crossing mirror systems and stop signalling systems. In regard to the latter category, it was ascertained that three stop signalling systems were in operation: 1) four red lights only (four light); 2) four amber lights plus four red lights (eight light); and 3) four amber lights plus four red lights plus stop signal arm (eight light plus stop swing arm). With these facts in mind, the decision was made to conduct a statewide survey of Ohio school bus drivers to obtain specific experimental and attitudinal information regarding crossing mirror system and stop signalling systems. Additional information was sought on other aspects of school bus operations which could affect "system improvement" of pedestrian related activities.

This report is organized into four major sections: Section I has presented an overall introduction to the subject matter. Section II describes the methods employed in obtaining the results. Section III presents the results of the study and Section IV contains the summary and conclusions reached.

II. METHOD

A. Development of the Information Gathering Instrument

An instrument was developed during the Fall of 1982 to meet the aforementioned informational objectives. The information gathering instrument was subsequently approved by the National Highway Traffic Safety Administration (NHTSA) during January 1983. The form was pilot-tested with a sample of 15 Connecticut school bus drivers in January 1983. Subsequently a final version of the form was prepared which is shown in Figure 1.

The attempt was made to obtain as much information as possible within an administration time of 10-15 minutes and a format not to exceed both sides of a single 8½ x 11 inch page (to facilitate distribution and collection of the instruments). All items were constructed with the intent of gaining as much information from the respondent as possible with minimum inconvenience. Further, questions were constructed so that computerized data processing costs would be minimized. Anonymity for respondents was considered essential to maximize the rate of return and candor of responses.

The first part of the instrument sought basic descriptive information about the bus being driven and an evaluation of the bus mirror system:

- the type of STOP signalling system being used (four light; eight light; or eight light plus stop swing arm)
- the type of bus (conventional style school bus with front hood, transit/pusher bus [no front hood] or van)
- the bus body type (Bluebird, Carpenter, Coach & Equipment, Collins, Superior, Thomas, Ward, Wayne)
- the bus chassis type (Chevrolet, Dodge, Ford, GMC, International Harvester)
- the pedestrian crossing mirror system in use (one or two mirrors on the right and/or left front fenders)
- the effectiveness of the mirror system
- the presence of blind spots
- the length of time the mirrors tend to stay adjusted
- the presence of "close calls" involving the bus striking a pupil-pedestrian

The second part of the instrument sought basic descriptive information about the bus route. Drivers were asked to classify the part of their route where stops were made by:

OHIO SCHOOL BUS DRIVER SURVEY
Ohio Association of Administrators of Pupil Transportation (OAAPT)
Pupil Transportation Section
Ohio Department of Education

Dear School Bus Driver:

Your experiences and opinions can help to assure the safest possible transportation for Ohio pupils. *Therefore*, please complete all of the items below and return your completed questionnaire to your supervisor as soon as possible. The completion of this form has been streamlined as much as possible requiring that you only circle your answer for each item in *most cases*.

Example: (1) Type of transmission preferred: (1)=manual; 2=automatic

ABOUT YOUR BUS:

(Circle one number for your answer to each item, except where otherwise indicated)

(1) Type of "stop" signalling system used: 1=four red lights; 2=four red plus four amber lights; 3=four red plus four amber lights plus stop swing arm

(2) Type of bus: 1=conventional; 2=transit/pusher; 3=van

(3) Bus body type: 1=Bluebird; 2=Carpenter; 3=Coach & Equipment; 4=Collins; 5=Superior; 6=Thomas; 7=Ward; 8=Wayne; 9=unknown

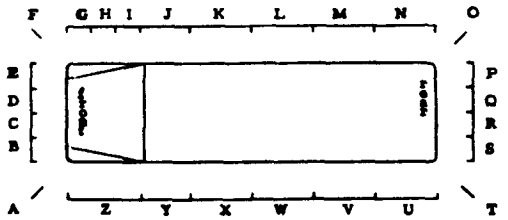
(4) Bus chassis type: 1=Chevrolet; 2=Dodge; 3=Ford; 4=GMC; 5=Int. Harvester; 6=unknown

(5) Pedestrian crossing mirror system used:
1=One mirror left front fender;
2=One mirror right front fender;
3=One mirror left front, one mirror right front fender;
4=One mirror left front, two mirrors right front fender;
5=Two mirrors left front; one mirror right front fender;
6=Two mirrors left front, two mirrors right front fender;
7=unknown
8=other (describe)_____

(6) When properly adjusted, how effective is the pedestrian crossing mirror system?: 1=totally effective; 2=very effective; 3=fairly effective; 4=of little use; 5=of no use whatsoever

(7) Is it ever difficult to see pupil pedestrians at certain locations near your bus when seated with your mirror system in its best adjustment?: 1=yes; 2=no

(8-21) If yes, circle the letter marking any location or locations along the bus where a crossing mirror visibility problem can exist which could be dangerous for the pupil pedestrian?:



(22) If yes, what causes the visibility problem?: 1=a total blind spot; 2=a small, hard to see image; 3=both; 4=other (describe)

_____
_____

(23) How often do the pedestrian convex mirrors stay adjusted?: 1=always; 2=almost always; 3=most of the time; 4=occasionally; 5=never

(24) Have you ever had a "close call" or actual event involving your bus striking a pupil pedestrian?: 1=yes; 2=no
(If yes, briefly describe most recent occurrence)

_____
_____
_____
_____

AVERAGE OR TYPICAL FEATURES OF YOUR SCHOOL BUS ROUTE WHERE STOPS ARE MADE:

(Circle one number for your answer to each item, except where otherwise indicated)

(25) Neighborhood: 1=mixed commercial/residential; 2=residential/multifamily dwellings; 3=residential/single family dwellings; 4=open/rural

(26) Type of streets: 1=one way; 2=two way

(27) Traveled lanes in each direction: 1=one; 2=two; 3=three; 4=more than three

(28) Speed limit in effect: 1=15 mph or less; 2=20 mph; 3=25 mph; 4=30 mph; 5=35 mph; 6=40 mph; 7=45 mph; 8=50 mph or more

(29-33) Times of day your bus is driven throughout the year: (circle all letters which apply) a=dawn; b=daylight AM; c=daylight PM; d=dusk; e=darkness

YOUR EXPERIENCES WITH MOTORISTS STOPPING FOR THE SCHOOL BUS STOP SIGNALS

(Circle one number for your answer to each item, except where otherwise indicated)

(34) During what time of day, if any, do motorists most often fail to stop for your signals?: 1=daylight AM; 2=daylight PM; 3=dusk; 4=darkness; 5=anytime; 6=never

(35) On what day of the week, if any, do motorists most often fail to stop for your signals?: 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=anyday; 7=never

(36-37) During what month, if any, do motorists most often fail to stop for your signals?: 1=September; 2=October; 3=November; 4=December; 5=January; 6=February; 7=March; 8=April; 9=May; 10=June; 11=any month; 12=never

OTHER SIDE PLEASE

Figure 1. School Bus Driver Survey Form

During what kinds of roadway or traffic conditions, if any, do motorists most often fail to stop for your signals?: (circle all letters which apply)

(38) a=when you're stopped at an intersection;
(39) b=when you're stopped between intersections;
(40) c=single traveled lane in each direction;
(41) d=two or more traveled lanes in any direction;
(42) e=speed limits under 35 mph;
(43) f=speed limits of 35 mph and over;
(44) g=rush hour traffic AM;
(45) h=rush hour traffic PM;
(46) i=a big back-up of traffic following bus;
(47) j=when motorists approach front of bus;
(48) k=when motorists approach rear of bus;
(49) l=no particular conditions;
(50) m=other (describe)_____

What do you think accounts for motorists failing to stop for your signals?: (circle all letters which apply)

(51) a=they don't know they're supposed to stop;
(52) b=they don't see the signals in time due to poor visibility (ex. rain, fog, snow, sunglare);
(53) c=they don't see the signals in time due to a hill or curve between them and the bus;
(54) d=they don't see the signals in time due to a large vehicle between them and the bus;
(55) e=they're going too fast for the conditions to stop in time;
(56) f=they're not concentrating on their driving;
(57) g=they deliberately decide to violate the signals;
(58) h=other (describe)_____

(59) How many motorist stopping violation reports did you turn in between September and December, 1982?: 0=none; 1=1; 2=2; 3=3; 4=4; 5=5; 6=6; 7=7; 8=8; 9=9 or more

(60) How would you rate the thoroughness of any follow-up police investigation for stopping violations you have reported between September and December 1982?: 1=didn't report any; 2=excellent; 3=very good; 4=good; 5=fair; 6=poor; 7=no known follow-up

(61) How important do you think it is for school bus drivers to report stopping violations and for the police to investigate these reports and take enforcement action where indicated?: 1=absolutely essential; 2=very important; 3=important; 4=of little importance; 5=no importance whatsoever

(62) Where on the highway is the best place to stop a school bus to receive or discharge passengers?: 1=as far to the right as possible; 2=in the traveled lane; 3=partially blocking two traveled lanes; 4=other (describe)_____

(63) Have you ever had a "close call" or actual event involving a passing motorist striking a pupil pedestrian crossing to or from your bus with the signals on?: 1=yes; 2=no
(If yes, briefly describe most recent occurrence)
_____
_____
_____
_____

FOR AN IDEAL OR NEW BUS:

(Circle one number for your answer to each item)

(64) To help you to avoid striking any pupil pedestrian near your bus who is not directly visible; there should be at least:
1=one convex mirror on left front fender;
2=one convex mirror on right front fender;
3=one convex mirror on left front fender, one convex mirror on right front fender;
4=one convex mirror on left front fender, two convex mirrors on right front fender;
5=two convex mirrors on left front fender, one convex mirror on right front fender;
6=two convex mirrors on left front fender, two convex mirrors on right front fender;
7=other (describe)_____

(65) To be sure that motorists will stop for your school bus when it has stopped to discharge or receive pupil pedestrians, the stop signalling system should have: 1=four red lights; 2=four red plus four amber lights; 3=four red lights plus stop swing arm; 4=four red and four amber lights plus stop swing arm; 5=other (describe)_____

(66) A "crossing arm" has been designed to keep pupil pedestrians who cross at the front of a school bus in the direct view of the bus driver. The crossing arm is like a railroad crossing arm, six feet long, and swings out from the far right hand front bumper straight forward whenever the stop signals go on. How important would it be for a crossing arm to be on your school bus?: 1=absolutely essential; 2=very important; 3=important; 4=of little importance; 5=no importance whatsoever

ABOUT YOURSELF AND YOUR PUPIL PASSENGERS:

(67-68) Your age: (write in age) _____

(69) Sex: (circle one) 1=male; 2=female

(70-71) Number of years driving a roadway motor vehicle (ex. car, truck, motorcycle, moped) (write in years) _____

(72-73) Number of years driving a school bus (write in years) _____

(74-75) Average number of hours spent driving your school bus each day with pupils on board (write in hours)
_____

(76-80) Grade levels of most pupils transported (circle all letters which apply) a=K-4th grade; b=5th-6th grades; c=7th-8th grades; d=9th grade; e=10th-12th grades

Thank you again for your help!!

Any additional comments?

Figure 1. School Bus Driver Survey Form (cont.)

- neighborhood (mixed commercial/residential, residential/multifamily dwellings, residential/single family dwellings, open/rural)
- type of streets (one-way vs. two-way)
- number of travelled lanes in each direction (one, two, three or more than three)
- speed limit in effect (15 or less, 20, 25, 30, 35, 40, 45, 50 or more mph)
- the times of day the bus route is driven (dawn, daylight a.m., daylight p.m., dusk, darkness)

The third part of the instrument sought information about motorists conforming to the school bus stop requirements and what is done to follow-up on those motorists who violate the law. Drivers were asked:

- the time of day in which violations tend to occur
- the day of week in which violations tend to occur
- the month in which violations tend to occur
- the kinds of roadway conditions conducive to motorists not stopping (stopped at intersection, stopped between intersections, single/multi-lane roads, speed limits over/under 35 mph, rush hour traffic a.m./p.m., big traffic backups following the bus, motorists approaching the front/rear of the bus)
- the perceived reasons for the violations (not familiar with law; signals not seen due to either visibility, natural obstructions, large vehicular obstructions; speeding, not concentrating, deliberately violating signals)
- how many violations the driver reported to the police
- the driver's rating of the thoroughness of the police follow-up
- the driver's evaluation of the importance of reporting violations
- the best place on the highway to stop and receive/discharge passengers
- a description of the most recent occurrence of a motorist hitting or nearly missing a child boarding or disembarking from the school bus

The fourth part of the instrument asked the driver what signal system and mirror systems ought to be present on a new or an ideal bus. Furthermore, a description of a "crossing arm" was presented and drivers were asked to determine whether or not it would be useful. A crossing arm is like a railroad crossing arm, six feet long which swings out like a stop swing arm from the far right hand bumper of the bus--straight forward--whenever

the stop signals go on. Its purpose is to encourage pupils moving in front of bus to do so at least six feet away so the bus driver can see them better.

The fifth section sought biographical and employment information about the driver:

- o age
- o sex
- o number of years driving any vehicle
- o number of years driving a school bus
- o number of hours driving a school bus each day
- o grade level of pupils transported

B. Distribution of the Data-Gathering Instrument

Approximately 6,000 forms were distributed to pupil transportation supervisors in a cross-section of rural, suburban and urban districts throughout the state. These forms were distributed by the Director of Ohio Pupil Transportation and his staff in a series of regional meetings with supervisors held during 19-21, and 24 January 1983. Packages of forms were distributed to each supervisor which contained, in addition to the blank forms a cover letter (see Figure 2) and pre-addressed, stamped return envelopes. Supervisors were asked to distribute the appropriate number of forms and return envelopes to individual bus depots and bus drivers in their jurisdictions. Of the 6,000 forms distributed, 3,131 were received within the allotted three week collection time interval. Between the 15 February cutoff date and 31 March 1983, approximately 800 additional forms were received.

C. Processing and Analysis of the Data

All responses to each item of individual forms, which were preformatted/coded to facilitate data entry, were keyed to magnetic tape by a commercial keying service. Furthermore, the close call verbal reports involving the bus hitting or nearly missing a pedestrian were post-coded into seven categories for computer analysis. These categories included:

- o Child fell or bent down in front of the bus making him invisible to the driver
- o Child was so small he could not be seen by the driver from where he was crossing
- o Child crossed the street unexpectedly after reaching the sidewalk on the same side of the street as the bus
- o Child was pushed in front of the bus by another child while "playing"
- o Child was late on the way to school, causing him to dart in front of the moving bus

STATE OF OHIO
DEPARTMENT OF EDUCATION
COLUMBUS
43215

January, 1983

FRANKLIN B. WALTER
SUPERINTENDENT OF
PUBLIC SCHOOLS

HERBERT D. BRUM
DIRECTOR
DIVISION OF
SCHOOL FINANCE
615 Ohio Departments Building
614-466-4230
614-466-6266

TO: Transportation Supervisors

FROM: Herman L. Massie, Chief, Pupil Transportation

SUBJECT: School Bus Driver Survey

These School Bus Driver Survey Forms were prepared for the purpose of collecting and analyzing data related to Ohio pupil transportation safety. The form is self-explanatory and should take approximately 15 minutes to complete.

Participation in this survey is voluntary, however, we believe that this survey and an analysis of the results are important to pupil transportation safety and would be valuable to our State in future school bus specifications and school bus driver training. You are encouraged to take the time to distribute and collect the forms from your school bus drivers and forward to Dunlap and Associates East, Inc., in the postage-paid, self-addressed envelope as soon as possible. Please do not put more than 100 survey forms per envelope.

If you have any questions regarding this form, please do not hesitate to contact me at 614/466-4230.

Thank you for your cooperation in this matter.

HLM/lh

Figure 2. Survey Cover Letter

- a child on the way home from school returned to the bus to get something or to pick up something he/she dropped in front of the bus after safely reaching the opposite side of the street

- the child slid under the bus (perhaps due to ice and snow).

The close call verbal reports involving a passing motorist either hitting or nearly missing a child were post-coded into three categories for computer analysis:

- passing the bus from behind on the left

- passing the bus from behind on the right

- passing the bus from the front

There were a number of close-call reports which could not be classified into any of the categories listed above and which could not be meaningfully classified into any categories. These were placed into an "other" category. Tabulations and crosstabulations of the data were developed which are presented and discussed in the next section.

III. RESULTS

The basic results of the study are organized into two sections below: Section A--Characteristics of the Study Sample and Section B--Major Operational Results of the Study.

A. Characteristics of the Survey Sample

The salient characteristics of the population of 3,131 individuals, their buses and bus routes sampled during this study are discussed below.

1. Gender and Age

The breakdown of the sample by gender was as follows:

	Male	Female	N/A	Total
Number	924	2,142	65	3,131
Percent	29.5	68.4	2.1	100.0

The age of survey respondents was distributed across ten categories as shown below, with fully 80 percent of the drivers falling into the range of 30-59 years:

	16-19	20-24	25-29	30-34	35-39	40-44	45-49	50-59	60-69	70 +	N/A	Total
Number	4	89	250	375	534	570	462	553	180	6	108	3,131
Percent	.1	2.8	8.0	12.0	17.1	18.2	14.8	17.7	5.7	0.2	3.4	100.0

2. Driving Experience

The number of years of experience driving any type of a motor vehicle (including a car, truck, motorcycle or moped) of survey respondents was as shown below:

	0	1	2	3	4	5	6-10	11-15	16-20	21-25	25 +	N/A	Total
Number	1	14	13	15	27	30	227	352	518	525	1258	151	3,131
Percent	0	.4	.4	.5	.9	1.0	7.3	11.2	16.5	16.8	40.2	4.8	100.0

The number of years of experience driving a school bus was distributed as follows:

	0	1	2	3	4	5	6-10	11-15	16-20	21-25	25 +	N/A	Total
No.	36	173	221	276	334	294	817	552	211	89	69	59	3,131
%	1.1	5.5	7.1	8.8	10.7	9.4	26.1	17.6	16.7	2.8	2.2	1.1	100.0

The average number of hours spent daily driving the school bus with pupils on board was arrayed in the following manner:

	0	1	2	3	4	5	6	7	8	9	10 +	N/A	Total
Number	68	71	294	400	1077	591	328	134	77	3	9	79	3,131
Percent	2.2	2.3	9.4	12.8	34.4	18.9	10.5	4.3	2.5	0.1	0.3	2.5	100.0

Most bus drivers transport all types of school children (e.g., children in K-4, 5-8 and 9-12). Indeed, 86.0 percent (2,692) of the drivers transport children in grades K-4, 87.3 percent (2,734) of the drivers transport children in grades 5-8, and 82.4 percent (2,580) of the drivers transport high school students.

3. The Buses

There are three types of school buses currently driven throughout Ohio: Conventional buses are the traditional school bus with a protruding hood; Transit/Pusher buses are like public transportation buses in that they do not have a front hood; Vans are small enclosed vehicles which may or may not have a small front hood. The number and percentage of drivers reporting that they drive each type of vehicle are shown below:

	Number	Percentage
Conventional School bus	2,842	90.8
Transit/Pusher Bus	146	4.7
Van	45	1.4
Multi-answer	4	.1
No answer	94	3.0

Since relatively few drivers reported driving other than a conventional school bus and since the Chief of Pupil Transportation indicated that there were few, if any, transit/pusher school buses operating in Ohio no further analysis was done with this item.

The bus bodies for the buses were manufactured by:

	Number	Percentage
Bluebird	306	9.8
Carpenter	914	29.2
Coach & Equipment	17	.5
Collins	2	.0
Superior	874	27.9
Thomas	70	2.2
Ward	94	3.0
Wayne	641	19.6
Unknown	57	1.8
Multi-answer	12	0.4
No answer	144	4.6

The bus chassis breakdown was as follows:

	Number	Percentage
Chevrolet	395	12.6
Dodge	18	.6
Ford	338	10.8
GMC	215	6.9
International Harvester	1966	62.8
Unknown	65	2.1
Multi-answer	13	.4
No answer	121	3.9

4. The Bus Route

The major characteristics of the bus routes driven by the respondents are discussed below. The bus stops occurred for the respondents' buses in the following types of neighborhoods:

	Number	Percentage
Commercial/residential	642	20.5
Residential/multifamily	441	14.1
Residential/single family	828	26.4
Open/rural	686	21.9
Multi-answer	402	12.8
No answer	132	4.2

The distribution of bus stops by types of streets was as follows:

	Number	Percentage
One way	1680	53.7
Two way	976	31.2
Multi-answer	104	3.3
No answer	77	2.4

The relative frequency of travelled lanes on streets where stops occur on the bus route were:

	Number	Percentage
One	1680	53.7
Two	976	31.2
Three	26	.8
More than three	59	1.9
Multi-answer	280	8.9
No answer	110	3.5

The average speed limit on that portion of the bus route where stops occurred was:

	Number	Percentage
15 mph or less	20	.6
20 mph	45	1.4
25 mph	666	21.3
30 mph	100	3.2
35 mph	777	24.8
40 mph	105	3.3
45 mph	212	6.8
50 mph or more	352	11.2
Multi-answer	666	21.3
No answer	188	6.0

Buses wer driven at the following times of day (respondents were asked to check all times that applied):

	Number
Dawn	2660
Daylight a.m.	2829
Daylight p.m.	2814
Dusk	1226
Darkness	1406

B. Major Operational Results of the Study

The basic inquiries of the survey were focused in two areas:

- o The usability and effectiveness of pedestrian mirror systems and ways to enhance effectiveness (e.g., the addition of a crossing arm)

- o The effectiveness of the Stop signalling system on the school bus and ways to achieve uniform and effective laws governing stopping for school bus signals

The overall responses to these two items are discussed in the following sections.

1. The Pedestrian Mirror System

Prior to 1 April 1978 Ohio school buses were required to have at least one convex crossing mirror located on the left front of the bus. As of 1 April 1978 a minimum of two convex mirrors on the left and one on the right front of the bus was required. Within these requirements which were proactive a number of alternatives currently exist. Bus drivers indicated that their buses had the following mirror systems:

	Number	Percentage
One Left Mirror; No Right Mirror	1019	32.5
No Left Mirror; One Right Mirror	32	1.0
One Left Mirror; One Right Mirror	205	6.5
One Left Mirror; Two Right Mirrors	92	2.9
Two Left Mirrors; One Right Mirror	1099	35.1
Two Left Mirrors; Two Right Mirrors	547	17.5
Unknown	2	0.0
Other	51	1.6
Multi-answer	31	1.0
No Answer	53	1.7

When asked to rate the effectiveness of the mirror systems, 22.0 percent (689) of the drivers indicated that their mirror systems were totally effective, 43.4 percent (1,358) indicated that their mirror systems were fairly effective, 1.5 percent (46) indicated that their mirror systems were of little use, three felt that their mirror systems were of no use, four answered the question with more than one answer and 1.3 percent (40) did not answer the question.

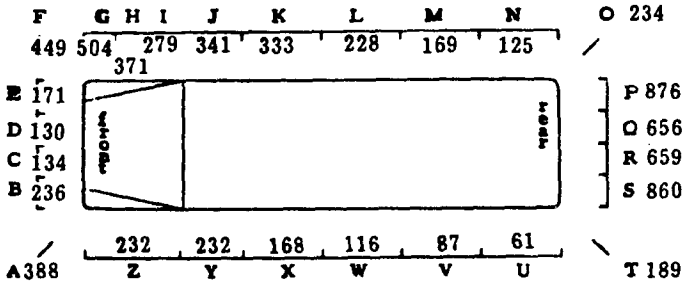
The data tables to be discussed hereafter may be found in an Appendix of Tables at the conclusion of this report. Chi Square analyses were performed for each contingency table presented.

The crosstabulation between mirror system type and mirror effectiveness, (see Table 1) shows that drivers with two left and two right mirrors gave their mirror systems the highest effectiveness ratings. Drivers with one left mirror and two right mirrors and drivers with two left mirrors and one right mirror gave their mirror systems relatively high ratings. Drivers with one left and one right mirror gave their mirrors a lower effectiveness rating; and the lowest effectiveness rating was given to one left mirror only systems. It is interesting to note that one right mirror only systems received a very high rating. However, this rating may have been artifactually inflated because there were indeed very few drivers (one percent of the sample) with that mirror system.

When asked whether it is ever difficult to see pupil pedestrians at certain locations near the bus while seated with the mirror system optimally adjusted 59.0 percent (1,847) of the drivers responded affirmatively, while 38.0 percent (1,191) of the drivers responded negatively. Three percent either responded both yes and no, or they did not respond to the question.

The crosstabulation of whether or not pedestrians are difficult to see by whether or not the mirrors are described as being effective shows that of the drivers who rated their mirrors being totally effective, 31.1 percent of the drivers still have reported difficulties seeing pupil pedestrians (see Table 2). Of those drivers who rated their mirror systems as being very effective, 54.5 percent still reported having pedestrian visibility problems. Of those drivers who rated their mirror system as being of little use, 78.3 percent reported having difficulties seeing pupil pedestrians. Since many drivers who rated their mirror systems as being very effective still reported pedestrian visibility problems, it seems that the drivers were rating the mirror system on some basis other than its ability to eliminate all pedestrian visibility problems.

Those drivers who responded that it is sometimes difficult to see pupil pedestrians were asked to label those points along the bus in which a crossing mirror visibility problem can exist which could be dangerous for pupil pedestrians. A copy of the diagram labeled with the number of drivers who indicated that a particular part of the bus was particularly dangerous to pupil pedestrians is shown below:



Seventy-five percent (885) of the drivers indicated that the visibility problem(s) were due to a blind spot, 11 percent (281) drivers indicated that the visibility problems were due to a small image and 14 percent (362) drivers indicated that the problems were due to both small image(s) and blind spot(s).

The crosstabulation of mirror system by whether or not it is difficult to see pedestrians shows that drivers with only one mirror on the left side had more difficulty seeing pedestrians than drivers with any other type of mirror system (see Table 3). Although drivers with only one mirror on the right report fewer pedestrian visibility problems than any other drivers, there are relatively few drivers with one right mirror (less than one percent of the sample size), thus this finding may be unduly influenced by small sample size.

The crosstabulation of mirror system by blind spots (see Table 4) shows that drivers with only one mirror on the left side of the bus report far more blind spots than drivers with multiple mirrors. However, drivers with multiple mirrors report more blind spots at the left front fender (point A), and the rear of the bus than drivers with only a single mirror. The increase in "blind spots" reported may be due to drivers with multiple mirrors having a more extensive lines of sight and thus the opportunity for experiencing more blind spots. Clearly the extreme difficulty evidenced in being able to see pedestrians at the rear of the bus should preclude backing the bus while pedestrians may be near the bus.

When asked how well mirrors stay adjusted, 30 percent (947) of the drivers reported that their mirrors stay adjusted all of the time, 42 percent (1,385) reported that their mirrors almost always stay adjusted, 21 percent (645) of the drivers reported that their mirrors stay adjusted most of the time, four percent (118) reported that their mirrors only stay adjusted occasionally and one percent (27) reported that their mirrors never stay adjusted. Two percent (77) of the drivers did not answer the question.

Reviewing Table 5 one finds that over 70 percent of the drivers who have pupils on board their buses for less than six hours report that their mirrors remain adjusted always or almost always. Less than 70 percent of the drivers who have pupils on board their buses for over six hours report that their mirrors stay adjusted. Thus, it seems that those drivers who drive throughout the day should check their mirror adjustment around mid day.

Clearly, mirror adjustment is important because it was positively correlated with mirror effectiveness (see Table 6) as well as with ease of seeing pedestrians (see Table 7).

Looking at an important question about crossing mirror systems, 12.8 percent (n=402) of the drivers reported that they had a close call or an actual incident in which their bus hit a pupil pedestrian. Although slightly fewer drivers with two left and one or two right mirrors (12.3 percent) reported incidents than drivers with only one left mirror (14.3 percent), the difference is non-significant (see Table 8). Thus, one might hastily conclude that the mirror systems are ultimately equivalent. However, this conclusion is not justified. Drivers were asked if they had ever had a close call and not whether they had recently had a close call or how many close calls they had. Thus, it is possible that those drivers with more recent mirror configurations (e.g., two left and two right mirrors) were relating to an incident which occurred many years before when they had an old mirror system--say, one left mirror only. Alternatively, it is possible that drivers might have fewer or no incidents involving areas of the bus which are protected by the mirror system. Thus, they might have been more likely to report incidents which could not be prevented by a mirror system no matter how good it was.

To test this hypothesis each of the narratives describing a bus-child incident were categorized into the following types:

- The child fell or bent down in front of the bus (perhaps to pick up dropped papers or lunchbox), thus disappearing from the driver's view
- The child was very close to the front or side of the bus making him invisible to the driver even though the child was standing
- The child unexpectedly darted in front of the bus after being discharged from school
- The child was pushed in front of the bus in play activities
- The child was late for school and darted in front of the bus from the opposite side of the street
- The child returned to the bus after having safely reached the opposite side of the street at discharge
- The child slid under the bus
- Uninterpretable or missing explanations

With two left mirrors and one or two right mirrors, there were fewer incidents involving children being unseen when they bent down or were too close to the front grille and there were more incidents involving students being late for school (see Table 30). This would indicate that certain mirror configurations may indeed prevent those incidents which they are designed to prevent. The increased incidence of late children could not be prevented by

prevented by any mirror system. Quite likely the increased frequency of reporting this type of incident was caused by the fact that there were less mirror avoidable incidents to report. Not surprisingly, drivers with incidents which could have been avoided by better mirror systems rated their mirrors less effective than those drivers who reported incidents which could not have been avoided regardless of the mirror system in use.

Drivers with close calls rated their mirror systems less effective than drivers without close calls (see Table 9). Drivers with close calls were more likely to say that pedestrians were difficult to see than drivers without close calls (see Table 10).

In designing an ideal or a new bus (Table 11), 4.3 percent (135) of the drivers felt that one left mirror would be ideal, 0.9 percent (28) of the drivers felt that one right mirror would be ideal, 9.6 percent (301) drivers felt that one left and one right mirror would be ideal, 4.3 percent (134) of the drivers felt that one left and two right mirrors would be ideal, 22.2 percent (694) of the drivers felt that two left and one right mirrors would be ideal, 47.4 percent (1,483) of the drivers felt that two left and two right mirrors would be ideal, 1.0 percent (32) of the drivers thought that some other mirror system would be ideal, 4.7 percent (147) of the drivers marked more than one answer and 5.7 percent (177) of the drivers did not respond to the question. More drivers with close calls preferred having two left mirrors and one or two right mirrors than drivers without close calls (see Table 11). Overall drivers preferred having two left and two right mirrors. However, those drivers with other mirror systems often tended to respond that their mirror system was the ideal one. In other words, the familiar is sometimes rated as being the ideal (see Table 12).

The crossing control arm met with mixed reception--12.4 percent (388) of the drivers thought that it would be absolutely essential, 19.5 percent (612) thought that it would be very important, 17.5 percent (547) thought that it would be important, 24.9 percent (781) thought that it was of little importance, and 16.9 percent (529) thought that it was of no importance. Less than one percent (7) of the drivers responded with more than one answer and 8.5 percent (267) neglected to answer the question. Table 13 shows that amongst those drivers who have experienced close calls, a larger percentage of the drivers favor the idea of a crossing arm. Although the type of close call interacted with usefulness of the crossing arm, the interaction is not readily interpretable. Those drivers who like the crossing arm also favor the idea of a stop signal and for passing motorists (see Table 14).

Under the miscellaneous category, it is also interesting to note that bus drivers who tend to prefer two left and two right mirrors are more enthusiastic than any other group of drivers about the use of a crossing control arm possibly indicating a "preference for safety equipment" attitudinal factor (see Table 29).

2. Stop Signalling System

Of the 3,131 respondents 42.8 percent (1,341) reported that their stop signalling system had four lights only, 15.9 percent (498) reported that

their bus had eight lights and 37.1 percent (1,162) drivers reported that their bus had eight lights plus a stop swing arm. Four percent of the participants either did not answer the question or supplied more than one answer to the question.

When asked "have you ever had a close call" or actual event involving a passing motorist striking a pupil pedestrian crossing to or from your bus with the signals on, 26.2 percent (820) of the drivers responded yes. The drivers were then asked to write a brief description of the incident. Based upon the driver's descriptions the incidents were classified as: 1) motorist passing from the rear of the bus on the right side of the bus; 2) passing from the rear on the left side of the bus; or 3) passing from the front of the bus. Of the 820 responses, 373 of the narratives could be classified in this manner. The remaining narratives were either unclear, incomplete or missing. Of the 373 classifiable narratives 26.8 percent (100) involved a motorist passing on the right side of the bus, 49.9 percent (186) involved a motorist passing on the left of the bus and 23.3 percent (87) involved a motorist passing from the front of the bus. The writers assume that in most cases, drivers would have been very clear to specify passes on the right of the bus, whereas they might have been less clear in specifying passes on the left side of the bus or passes from the front of the bus. Thus, the number of front and left passing violations were probably higher than stated. It is interesting to note that many of the passing on right violations involved a motorist driving on somebody's lawn or otherwise driving off the highway in order to pass the school bus. The authors admit to a high degree of shock and surprise at the reported incidence of violators passing a school bus on the right hand side of the bus. The hazard inflicted upon embarking or disembarking passengers is extreme due to this unexpected occurrence.

The crosstabulation between close call in which the bus driver reported dangerous passing violations and type of signalling system used was not significant (see Table 15). However, only 24.8 percent of the drivers with eight lights and stop arm reported passing violations, whereas 26.9 percent of the drivers with four lights reported violations and 27.9 percent of the drivers with eight lights reported passing violations. In Table 16 (nonsignificant) it is interesting to note that with only a four red light stop system most violations involved passing the school bus from the rear on the left (50 percent of the violations), followed by passing from the front (44.8 percent of the violations), and passing from the rear on the right (39.0 percent of the violations). With eight light plus stop swing arm signals only 30 percent of the violations involved passing on the left (the side with the stop sign), with some reduction in passing from the front (35.6 percent of the violations), but the number of right passing violations increased (42.0 percent of the violations). Thus, it appears as if the stop sign reduces the opportunity for unintentional violations by reminding motorists to stop, but it does not reduce pre-planned intentional violations such as passing the bus on the right side.

Drivers were asked how many violations they had reported to the police. The data (shown in Table 17) show that 32.5 percent of the bus drivers turned in violation reports. Reasons for not turning in such reports volunteered by the drivers included fear of lawsuit, police ineffectiveness and inconvenience in filing a report. Thus, the number of reports filed is not

especially meaningful for measuring the success of the signal system. The overall interaction of number of reports filed by signal system (shown in Table 17) was marginally significant and followed the trend of most violations reported. Fewer drivers with eight lights plus stop arm filed reports (29.7 percent) as opposed to drivers with eight lights (30.9 percent) and drivers with four lights (35.5 percent). Perhaps there were fewest violations reported when busses had amber lights because the amber provided the motorists with a chance to get by before the bus actually stopped.

A tendency to speed up on amber is suggested by the fact that drivers identified motorists approaching the rear of the bus as a problem causing violations more frequently for red plus amber buses (20.7 percent) than for red only (14.5 percent) or for eight light plus stop arm buses (14.6 percent) (see Table 19). The yellow warning light without a stop swing arm present may cause more drivers to try and pass the bus before it stops. This suggests that the red, amber system could be less effective than red alone or the red, amber stop system. Fewer bus drivers perceive that motorists drive through the stop signals due to poor visibility (see Table 18). However, the most drivers (16.3 percent) reporting this reason have four light stop systems. Driver with eight light systems tend to perceive this reason less frequently (14.1 percent) and drivers with eight light plus stop arm tend to perceive this problem least frequently (12.4 percent). This suggests that four light signals are least compelled followed by eight. Ohio school bus drivers apparently regard the eight light plus stop arm system as most effective.

In terms of designating the ideal stopping system for a new or an ideal bus, 68 percent of the drivers felt that an eight light plus stop arm system would be best, 10 percent felt that a four light plus stop arm would be best, 8.6 percent felt that an eight light would be best and 6.2 percent felt that four light system would be best (see Table 20). Considering signalling system preference in regard to current system used (see Table 20) while the highest percentage of preference for the eight light plus stop arm system was expressed by same system users (79.8 percent), four light and eight light system users expressed 61.6 percent and 61.4 percent preference for the eight light plus stop arm system.

There was also a significant interaction between motorist striking or having a close call with a pupil pedestrian and perceived ideal signals. Fully 72 percent of those drivers reporting a close call were more likely to chose an eight light plus stop arm system versus 67 percent who did not have a close call (see Table 21).

3. Conditions Affecting Motorist Violation of Stop Signals

Bus drivers were asked to indicate during what months, days and times of day violations seemed to occur most frequently. The results are shown below.

Month	Number	Percentage
September	241	8.3
October	9	.1
November	14	.2
December	85	2.8
January	23	1.0
February	2	.0
March	1	.0
April	21	1.0
May	22	1.0
June	14	.2
No particular month	2323	78.6
Never	201	6.8

Day	Number	Percentage
Monday	143	4.6
Tuesday	4	0.1
Wednesday	14	0.4
Thursday	10	0.3
Friday	370	11.8
Any Day	2089	66.7
Multi-answer	147	4.7
No answer	155	5.0

Time of Day	Number	Percentage
Daylight a.m.	610	19.5
Daylight p.m.	1049	33.4
Dusk	18	0.6
Darkness	16	0.5
Anytime	873	27.9
Never	197	6.3
Multi-answer	303	9.7
No answer	65	2.1

Of individual months cited, September is rated the worst. This is consistent with the generally held view that motorists require some getting used to stopping for school buses in September. In the violations study in Appendix A, however, September was only the sixth highest month for recorded school bus passing violations. However, the most frequently cited time of year for school bus violations is "no particular month."

Mondays and Fridays show some tendency to be viewed as problems for violations, although clearly "any day" is the overwhelming choice. Afternoons are indicated as being the worst time for violations, exceeding either the "anytime" or "daylight a.m." category. This finding is consistent with the Appendix A violation study which found 60 percent of the recorded violations occurring in the afternoon. The above temporal factors should be considered in developing any programs of selective enforcement for school bus stop laws.

Looking at roadway or traffic conditions which may be associated with school bus passing violations, the following results were obtained:

Condition	Number
Stopped at intersection	654
Stopped between intersections	481
Single traveled lane	265
Two or more lanes in each direction	590
Speed limit under 35 mph	519
Speed limit over 35 mph	822
Rush hour traffic a.m.	794
Rush hour traffic p.m.	886
Back-up of traffic following bus	279
Motorists approaching front of bus	1,681
Motorists approaching rear of bus	488
No particular conditions	766
Other	84

In order of highest frequency which was greater than that for "no particular conditions" the following traffic conditions are noteworthy for enforcement and extra caution:

- Motorists approaching the front of bus (consistent with Appendix A violation study report) 1,681
- Rush hour traffic p.m. 886
- Speed limit over 35 mph 822
- Rush hour traffic a.m. 794

(No particular conditions 766)

Bus drivers selected the reasons below for motorists failing to stop for their signals in the frequencies shown:

Reason	Number
They don't know they're supposed to stop	743
They don't see the signals in time due to poor visibility	453
They don't see the signals in time due to hill or curve between car and bus	278
They don't see signals due to large vehicle between car and bus	129
They are going too fast for conditions to stop in time	1,393
They are not concentrating on their driving	2,520
They deliberately decide to violate signals	1,142
Other* (write in)	136

Most notably bus drivers felt that violators were not concentrating on their driving. This reason was closely followed by a judgment that motorists are often going too fast for the conditions to stop in time. The

*many of which were paraphrases of "they are not concentrating on driving"

coupling of these two reasons could be a deadly combination. Next in frequency of selection is the category of willful or deliberate violation which is rather disquieting. Bus drivers who believe that motorists don't know they're supposed to stop outnumber by two to one those who cite visibility obstructions as a reason for violations.

Drivers reported turning in the following number of violation reports in the first half of the 1982-83 school year:

No. Violation Reports	Number	Percentage
Zero	2,112	67.4
One	342	10.9
Two	253	8.0
Three	147	4.7
Four	66	2.1
Five	41	1.3
Six	24	1.0
Seven	7	0.2
Eight	2	0.1
Nine or more	35	1.1
Multi-answer	4	0.1
No answer	98	3.1

Bus drivers rated the importance of following up on violation reports as:

Categories of Importance	Number	Percentage
Absolutely essential	1,647	52.6
Very important	945	30.2
Important	299	9.5
Of little importance	92	2.9
Of no importance	34	1.1
Multi-answer	23	0.7
No answer	91	2.9

In spite of giving reporting violations a high importance rating, most drivers did not report many violations. Many claimed in the narrative that the police follow up is not good and it's just not worth doing--indicating that police follow up, investigatory feedback to drivers and streamlining of reporting procedures, as well as coming up with an alternatives to "getting the license number and driver description" all need to be given consideration in encouraging bus driver reporting of school bus passing violations. Indeed bus drivers specifically gave police follow up the following ratings: Excellent (111); Very Good (117); Good (154); Poor (205), No Known Follow up (447), Multi-answer (35); No violations reported (1625) and no rating given (379).

When asked where the best place to stop the bus is, most of the drivers 44 percent (1,374) responded that the far right side of the road was the best; 40 percent (1,242) responded that the best place was the traveled lane. Ten percent (316) responded that it was blocking two lanes, 199 (6.3 percent) responded with other, no answer or multianswers. Of the drivers

that responded blocking two lanes, several wrote in that it was illegal to block two lanes, but it was safest for the pedestrians if they did so. Several of the drivers related stories where they had hits or near misses involving pupil pedestrians being struck prior to deciding to ignore the law and block both lanes anyway. Other drivers indicated that they believe the best place to stop is at the far right side, but they also commented that the only reason they marked such an answer is that the law stipulated that they must stop at the far right side.

Some drivers indicated that they wanted to eliminate the danger of having their passengers cross a major street so they actually turned the bus around (e.g., by going around the block) to pick up the students on their residence side of the street. Other drivers indicated that if they had less pressure to meet time schedules they would like to take similar measures to improve pedestrian safety.

It appears that wider multiple lane roads are less safe places for school bus crossings than narrow roads. Those drivers who drive primarily on three or more lane roads were more likely to respond that motorists were not stopping because they do not know that they are supposed to stop (33 percent) as opposed to only 25.6 percent of those who drive on two lane roads and 21.5 percent of those who drive on one lane roads (see Table 22). This could mean that any public education program must concentrate on informing motorists that they have to stop on wide multiple lane as well as two lane narrow roads. It is also interesting to note that violations from the rear of the bus were more likely on wider roads (see Table 23), whereas violations from the front were less likely to be reported by drivers who drive on wide roads (see Table 24). Perhaps this variation is due to the fact that approaching motorists do not have to stop on divided roads (which tend to be wide ones). Alternatively this may be due to buses being more likely to pick up children from one one side of the street at the time on wide and/or divided roads (which also may be why motorists ignore the stop law).

Table 25 shows that bus drivers in rural neighborhoods tend to stop in the travelled lane, whereas drivers with urban and suburban routes tend to pull over to the right of the road as much as possible. Also, drivers who stop on wider roads tend to find with traffic build ups more people tend to pass the school buses (see Table 26), there are more violations at rush hour (see Table 27) and there are more passing at an intersection violations (see Table 28).

4. Subjective Comments

Among the subjective comments from responding bus drivers, there were several interesting remarks. A great many of these focused on how useful the survey was to improve driver-administrator communications, obtain feed-back from drivers, etc. Many drivers complained about the lack of police follow ups on violation reports. Some stated it was not worth reporting violations because the police don't care. Others reported police cars passing their bus. Most, however, complained that it is next to impossible to get a license number, driver description and auto description while watching out for the children's safety and they stated that they would like another way to report violations. Several drivers related the fact that police told them they could be sued for turning in false reports if the motorist was acquitted. Many

drivers complained that the ride downtown to turn in reports was asking too much of the drivers. They would rather either turn in the reports to their supervisor at the garage or have the police come to or telephone the garage to get them.

A large number of drivers asked for better "bus backing" warning systems, i.e., strobe lights, return of backing signs and a beeping sound to warn others that they are about to back up. Others requested strobe lights to make the bus stop signalling system more visible. Many requested more public education programs on school bus stop laws and on proper conduct and behavior for school bus passengers. Some drivers also criticized having amber lights on their buses. They said motorists just regard them as "speed up and pass the bus before it stops" lights.

Drivers also asked for "defroster systems" for their outside mirrors, front and rear windows. Special education drivers suggested that the questions were not relevant to them but that they thought a separate survey of special education drivers would be a good idea.

Many bus drivers thought that all school bus drivers ought to take in-service training on a regular basis. An usually high number of drivers reported that the recently implemented high back seats were more of a safety hazard than a safety feature due to the more restricted views of the childrens' activities afforded the bus driver. Also, many drivers would prefer improved inspections for both safety and vehicle-related equipment.

IV. SUMMARY AND CONCLUSIONS

With regard to all mirror systems in use, nearly 60 percent of all respondents indicate problems seeing pedestrians near their buses. Nearly 75 percent of the visibility problems encountered are actual blind spots. These points suggest some fundamental problems with convex crossing mirror systems relating to some combination of design, installation, adjustment, maintenance or driver use defects. Overall drivers seemed to prefer two mirrors on the left side and two mirrors on the right side over other mirror combinations. Similarly, they seemed to object most to only one mirror on the left. This is indicated by: 1) the highest number of blind spots being reported by drivers with only one mirror on the left; 2) the drivers with only one left mirror reporting the most difficulty seeing pedestrians due to blind spots; 3) drivers, regardless of their own mirror system, indicating that as an ideal system they would like to have two left and two right mirrors. Most importantly, however, those drivers who have two left and one or two right mirrors report the fewest incidents of mirror avoidable bus hitting or nearly missing pupil pedestrians.

Considering the signalling system 68 percent of the respondents prefer the eight light plus stop arm signalling system. Nearly 72 percent of the those drivers reporting a "close call" with a child crossing the street prefer the eight light plus stop arm signalling system versus 67 percent who did not have a close call. Finally for those drivers who currently use an eight light plus stop arm system nearly 80 percent express a preference for the system. In addition, 61 percent of four light and eight light system users also prefer the eight light plus stop arm system.

Overall, drivers seemed to show a slight preference for having crossing arms. Those drivers who have nearly missed hitting pedestrians and drivers in urban areas tend to show the highest enthusiasm for the system. Similarly, those drivers who like eight light plus stop arm systems also tend to like the crossing arm.

Several other findings were noted which could be used in the selective enforcement of school bus stopping laws and to particularly caution the school bus driver to high risk situations. While September is viewed somewhat as a high risk month for passing violations, basically all months are about equal. Similarly, while Mondays and Fridays show some elevated perception of greater passing violations, basically all days are seen as equally risky. Morning rush hour, afternoon rush hour and indeed the entire afternoon are seen as peak periods for school bus passing violations. Multiple lane roadways in each direction present increased risks for passing violations, strongly supporting the desirable practice of loading passengers only on the residence side of such roadways (precluding the need for a pedestrian crossing).

The most surprising finding in the entire study was the large number of pass from the rear on the right side of the school bus violations. As it turns out, the stop warning system probably does not influence these drivers because a "right" pass is likely an act of willful disregard of pupil pedestrian safety. Probably, the only way to reduce these violations is by driver education and enforcement. The presence of the stop sign on the buses does tend to reduce pass from the rear on the left side and frontal passing violations. This suggests that the stop sign is useful in preventing unintentional or ignorant passings of a stopped school bus.

APPENDIX OF TABLES

Table 1

PEDESTRIAN MIRROR EFFECTIVENESS BY PEDESTRIAN MIRROR SYSTEM *
Ohio School Bus Driver Survey
26 Feb 1983

	TOTALLY EFFECT.	VERY EFFECT.	FAIRLY EFFECT.	OF LITTLE USE	OF NO USE	MULTIANSWER	
1 LEFT	141	350	494	27	1	1	#RESP
	13.8	34.3	48.5	2.6	0.1	0.1	ROW %
	20.5	25.8	49.8	58.7	33.3	25.0	COL %
1 RIGHT	10	8	12	1			#RESP
	31.2	25.0	37.5	3.1			ROW %
	1.5	0.6	1.2	2.2			COL %
1 LEFT/1 RIGHT	43	84	71	4		1	#RESP
	21.0	41.0	34.6	2.0		0.5	ROW %
	6.2	6.2	7.2	8.7		25.0	COL %
1 LEFT/2 RIGHT	23	44	22	1			#RESP
	25.0	47.8	23.9	1.1			ROW %
	3.3	3.2	2.2	2.2			COL %
2 LEFT/1 RIGHT	267	574	241	8	1	1	#RESP
	24.3	52.2	21.9	0.7	0.1	0.1	ROW %
	38.8	42.3	24.3	17.4	33.3	25.0	COL %
2 LEFT/2 RIGHT	177	253	105	3			#RESP
	32.4	46.3	19.2	0.5			ROW %
	25.7	18.6	10.6	6.5			COL %
UNKNOWN			2				#RESP
			100.0				ROW %
			0.2				COL %
WRITE-IN	9	16	22	1		1	#RESP
	17.6	31.4	43.1	2.0		2.0	ROW %
	1.3	1.2	2.2	2.2		25.0	COL %
MULTIANSWER	7	11	10	1	1		#RESP
	22.6	35.5	32.3	3.2	3.2		ROW %
	1.0	0.8	1.0	2.2	33.3		COL %
OTHER	12	18	12				#RESP
	22.6	34.0	22.6				ROW %
	1.7	1.3	1.2				COL %
SUM	689	1358	991	46	3	4	#RESP
	22.0	43.4	31.7	1.5	0.1	0.1	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

*Row heading is always mentioned first in the title, and column heading mentioned second.

Table 1 (cont.)

PEDESTRIAN MIRROR EFFECTIVENESS BY PEDESTRIAN MIRROR SYSTEM
Ohio School Bus Driver Survey
26 Feb 1983

	OTHER	SUM	
1 LEFT	5	1019	#RESP
	0.5	100.0	ROW %
	12.5	32.5	COL %
1 RIGHT	1	32	#RESP
	3.1	100.0	ROW %
	2.5	1.0	COL %
1 LEFT/1 RIGHT	2	205	#RESP
	1.0	100.0	ROW %
	5.0	6.5	COL %
1 LEFT/2 RIGHT	2	92	#RESP
	2.2	100.0	ROW %
	5.0	2.9	COL %
2 LEFT/1 RIGHT	7	1099	#RESP
	0.6	100.0	ROW %
	17.5	35.1	COL %
2 LEFT/2 RIGHT	9	547	#RESP
	1.6	100.0	ROW %
	22.5	17.5	COL %
UNKNOWN		2	#RESP
		100.0	ROW %
		0.1	COL %
WRITE-IN	2	51	#RESP
	3.9	100.0	ROW %
	5.0	1.6	COL %
MULTIANSWER	1	31	#RESP
	3.2	100.0	ROW %
	2.5	1.0	COL %
OTHER	11	53	#RESP
	20.8	100.0	ROW %
	27.5	1.7	COL %
SUM	40	3131	#RESP
	1.3	100.0	ROW %
	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .284489 E 03 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 28

CONT COEF = .293636

Table 2

PEDESTRIANS DIFFICULT TO SEE BY PEDESTRIAN MIRROR EFFECTIVENESS
Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	MULTIANSWER	OTHER	SUM	
TOTALLY EFFECT.	214	454	4	17	689	#RESP
	31.1	65.9	0.6	2.5	100.0	ROW %
	11.6	38.1	50.0	20.0	22.0	COL %
VERY EFFECT.	740	581	3	34	1358	#RESP
	54.5	42.8	0.2	2.5	100.0	ROW %
	40.1	48.8	37.5	40.0	43.4	COL %
FAIRLY EFFECT.	839	134	1	17	991	#RESP
	84.7	13.5	0.1	1.7	100.0	ROW %
	45.4	11.3	12.5	20.0	31.7	COL %
OF LITTLE USE	36	8		2	46	#RESP
	78.3	17.4		4.3	100.0	ROW %
	1.9	0.7		2.4	1.5	COL %
OF NO USE	2	1			3	#RESP
	66.7	33.3			100.0	ROW %
	0.1	0.1			0.1	COL %
MULTIANSWER	3	1			4	#RESP
	75.0	25.0			100.0	ROW %
	0.2	0.1			0.1	COL %
OTHER	13	12		15	40	#RESP
	32.5	30.0		37.5	100.0	ROW %
	0.7	1.0		17.6	1.3	COL %
SUM	1847	1191	8	85	3131	#RESP
	59.0	38.0	0.3	2.7	100.0	ROW %
	100.0	100.0	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .516969 E 03 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 4

CONT COEF = .382907

Table 3

PEDESTRIANS DIFFICULT TO SEE BY PEDESTRIAN MIRROR SYSTEM
Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	MULTIANSWER	OTHER	SUM	
1 LEFT	770	231	1	17	1019	#RESP
	75.6	22.7	0.1	1.7	100.0	ROW %
	41.7	19.4	12.5	20.0	32.5	COL %
1 RIGHT	14	14		4	32	#RESP
	43.7	43.7		12.5	100.0	ROW %
	0.8	1.2		4.7	1.0	COL %
1 LEFT/1 RIGHT	109	83		13	205	#RESP
	53.2	40.5		6.3	100.0	ROW %
	5.9	7.0		15.3	6.5	COL %
1 LEFT/2 RIGHT	46	44		2	92	#RESP
	50.0	47.8		2.2	100.0	ROW %
	2.5	3.7		2.4	2.9	COL %
2 LEFT/1 RIGHT	572	501	2	24	1099	#RESP
	52.0	45.6	0.2	2.2	100.0	ROW %
	31.0	42.1	25.0	28.2	35.1	COL %
2 LEFT/2 RIGHT	257	277	2	11	547	#RESP
	47.0	50.6	0.4	2.0	100.0	ROW %
	13.9	23.3	25.0	12.9	17.5	COL %
UNKNOWN	2				2	#RESP
	100.0				100.0	ROW %
	0.1				0.1	COL %
WRITE-IN	35	12	1	3	51	#RESP
	68.6	23.5	2.0	5.9	100.0	ROW %
	1.9	1.0	12.5	3.5	1.6	COL %
MULTIANSWER	17	11	1	2	31	#RESP
	54.8	35.5	3.2	6.5	100.0	ROW %
	0.9	0.9	12.5	2.4	1.0	COL %
OTHER	25	18	1	9	53	#RESP
	47.2	34.0	1.9	17.0	100.0	ROW %
	1.4	1.5	12.5	10.6	1.7	COL %
SUM	1847	1191	8	85	3131	#RESP
	59.0	38.0	0.3	2.7	100.0	ROW %
	100.0	100.0	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .181682 E 03 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 7

CONT COEF = .240210

Table 4

BLIND SPOTS BY PEDESTRIAN MIRROR SYSTEM
Ohio School Bus Driver Survey
26 Feb 1983

	A	B	C	D	E	F	
1 LEFT	154	101	50	49	63	177	#RESP
	5.8	3.8	1.9	1.9	2.4	6.7	ROW %
	39.7	42.8	37.3	37.7	36.8	39.6	COL %
1 RIGHT	2	1	1	2	4	8	#RESP
	4.7	2.3	2.3	4.7	9.3	18.6	ROW %
	0.5	0.4	0.7	1.5	2.3	1.8	COL %
1 LEFT/1 RIGHT	33	17	14	15	13	33	#RESP
	10.0	5.2	4.2	4.5	3.9	10.0	ROW %
	8.5	7.2	10.4	11.5	7.6	7.4	COL %
1 LEFT/2 RIGHT	12	4	4	3	4	11	#RESP
	11.5	3.8	3.8	2.9	3.8	10.6	ROW %
	3.1	1.7	3.0	2.3	2.3	2.5	COL %
2 LEFT/1 RIGHT	119	89	39	37	62	124	#RESP
	9.0	6.7	3.0	2.8	4.7	9.4	ROW %
	30.7	37.7	29.1	28.5	36.3	27.7	COL %
2 LEFT/2 RIGHT	51	18	20	19	17	73	#RESP
	7.6	2.7	3.0	2.8	2.5	10.8	ROW %
	13.1	7.6	14.9	14.6	9.9	16.3	COL %
UNKNOWN							#RESP
							ROW %
							COL %
WRITE-IN	7	2	1	1	4	13	#RESP
	7.8	2.2	1.1	1.1	4.4	14.4	ROW %
	1.8	0.8	0.7	0.8	2.3	2.9	COL %
MULTIANSWER	1	2	2	1	1	1	#RESP
	2.6	5.3	5.3	2.6	2.6	2.6	ROW %
	0.3	0.8	1.5	0.8	0.6	0.2	COL %
OTHER	9	2	3	3	3	7	#RESP
	12.9	2.9	4.3	4.3	4.3	10.0	ROW %
	2.3	0.8	2.2	2.3	1.8	1.6	COL %
SUM	388	236	134	130	171	447	#RESP
	7.3	4.4	2.5	2.4	3.2	8.4	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 4 (cont.)

BLIND SPOTS BY PEDESTRIAN MIRROR SYSTEM
Ohio School Bus Driver Survey
26 Feb 1983

	G	H	I	J	RIGHT BACK	BACK	
1 LEFT	315	261	190	227	309	330	#RESP
	11.9	9.9	7.2	8.6	11.7	12.5	ROW %
	62.5	70.4	68.1	66.6	50.7	35.3	COL %
1 RIGHT	41	31	21	21	41	71	#RESP
	9.3	7.0	4.7	4.7	9.3	16.3	ROW %
	0.8	0.8	0.7	0.6	0.7	0.7	COL %
1 LEFT/1 RIGHT	221	91	101	171	381	551	#RESP
	6.7	2.7	3.0	5.2	11.5	16.7	ROW %
	4.4	2.4	3.6	5.0	6.2	5.9	COL %
1 LEFT/2 RIGHT	41	11	21	51	101	271	#RESP
	3.8	1.0	1.9	4.8	9.6	26.0	ROW %
	0.8	0.3	0.7	1.5	1.6	2.9	COL %
2 LEFT/1 RIGHT	971	561	441	471	1371	3301	#RESP
	7.3	4.2	3.3	3.6	10.4	25.0	ROW %
	19.2	15.1	15.8	13.8	22.5	35.3	COL %
2 LEFT/2 RIGHT	481	341	231	301	871	1421	#RESP
	7.1	5.0	3.4	4.4	12.9	21.0	ROW %
	9.5	9.2	8.2	8.8	14.3	15.2	COL %
UNKNOWN			11		11	21	#RESP
			25.0		25.0	50.0	ROW %
			0.4		0.2	0.2	COL %
WRITE-IN	71	41	31	61	101	221	#RESP
	7.8	4.4	3.3	6.7	11.1	24.4	ROW %
	1.4	1.1	1.1	1.8	1.6	2.4	COL %
MULTIANSWER	21	11	21	21	71	91	#RESP
	5.3	2.6	5.3	5.3	18.4	23.7	ROW %
	0.4	0.3	0.7	0.6	1.1	1.0	COL %
OTHER	51	21	21	51	71	111	#RESP
	7.1	2.9	2.9	7.1	10.0	15.7	ROW %
	1.0	0.5	0.7	1.5	1.1	1.2	COL %
SUM	5041	3711	2791	3411	6101	9351	#RESP
	9.5	7.0	5.2	6.4	11.5	17.6	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 4 (cont.)

BLIND SPOTS BY PEDESTRIAN MIRROR SYSTEM
Ohio School Bus Driver Survey
26 Feb 1983

	LEFT BACK	LEFT FRONT	SUM	
1 LEFT	197	223	2646	#RESP
	7.4	8.4	100.0	ROW %
	49.4	59.3	49.7	COL %
1 RIGHT	3		43	#RESP
	7.0		100.0	ROW %
	0.8		0.8	COL %
1 LEFT/1 RIGHT	26	28	330	#RESP
	7.9	8.5	100.0	ROW %
	6.5	7.4	6.2	COL %
1 LEFT/2 RIGHT	8	9	104	#RESP
	7.7	8.7	100.0	ROW %
	2.0	2.4	2.0	COL %
2 LEFT/1 RIGHT	85	55	1321	#RESP
	6.4	4.2	100.0	ROW %
	21.3	14.6	24.8	COL %
2 LEFT/2 RIGHT	65	48	675	#RESP
	9.6	7.1	100.0	ROW %
	16.3	12.8	12.7	COL %
UNKNOWN			4	#RESP
			100.0	ROW %
			0.1	COL %
WRITE-IN	5	5	90	#RESP
	5.6	5.6	100.0	ROW %
	1.3	1.3	1.7	COL %
MULTIANSWER	5	2	38	#RESP
	13.2	5.3	100.0	ROW %
	1.3	0.5	0.7	COL %
OTHER	5	6	70	#RESP
	7.1	8.6	100.0	ROW %
	1.3	1.6	1.3	COL %
SUM	399	376	5321	#RESP
	7.5	7.1	100.0	ROW %
	100.0	100.0	100.0	COL %

Table 5

NUMBER OF HOURS DRIVING BUS BY MIRROR STAYS ADJUSTED
Ohio School Bus Driver Survey
26 Feb 1983

	<1	1	2	3	4	5	6	
ALWAYS	24	22	109	132	324	182	77	#RESP
	2.5	2.3	11.5	13.9	34.2	19.2	8.1	ROW %
	35.3	31.0	37.1	33.0	30.1	30.8	23.5	COL %
ALMOST ALWAYS	28	34	126	171	438	262	143	#RESP
	2.1	2.6	9.6	13.0	33.3	19.9	10.9	ROW %
	41.2	47.9	42.9	42.7	40.7	44.3	43.6	COL %
MOST OF TIME	16	8	46	72	242	101	79	#RESP
	2.5	1.2	7.1	11.2	37.5	15.7	12.2	ROW %
	23.5	11.3	15.6	18.0	22.5	17.1	24.1	COL %
OCCASIONALLY		4	5	15	42	24	15	#RESP
		3.4	4.2	12.7	35.6	20.3	12.7	ROW %
		5.6	1.7	3.7	3.9	4.1	4.6	COL %
NEVER		1	4	1	13	3	2	#RESP
		3.7	14.8	3.7	48.1	11.1	7.4	ROW %
		1.4	1.4	0.2	1.2	0.5	0.6	COL %
MULTIANSWER					1		1	#RESP
					50.0		50.0	ROW %
					0.1		0.3	COL %
OTHER		2	4	9	17	19	11	#RESP
		2.6	5.2	11.7	22.1	24.7	14.3	ROW %
		2.8	1.4	2.2	1.6	3.2	3.4	COL %
SUM	68	71	294	400	1077	591	328	#RESP
	2.2	2.3	9.4	12.8	34.4	18.9	10.5	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 5 (cont.)

NUMBER OF HOURS DRIVING BUS BY MIRROR STAYS ADJUSTED
Ohio School Bus Driver Survey
26 Feb 1983

	7	8	9	>9	OTHER	SUM	
ALWAYS	29	29	4	15	947		#RESP
	3.1	3.1	0.4	1.6	100.0		ROW %
	21.6	37.7	44.4	19.0	30.2		COL %
ALMOST ALWAYS	57	25	1	3	27	1315	#RESP
	4.3	1.9	0.1	0.2	2.1	100.0	ROW %
	42.5	32.5	33.3	33.3	34.2	42.0	COL %
MOST OF TIME	37	16	2	2	26	645	#RESP
	5.7	2.5	0.3	0.3	4.0	100.0	ROW %
	27.6	20.8	22.2	22.2	32.9	20.6	COL %
OCCASIONALLY	6	5			2	118	#RESP
	5.1	4.2			1.7	100.0	ROW %
	4.5	6.5			2.5	3.8	COL %
NEVER	1		2			27	#RESP
	3.7		7.4			100.0	ROW %
	0.7		66.7			0.9	COL %
MULTIANSWER						2	#RESP
						100.0	ROW %
						0.1	COL %
OTHER	4	2			9	77	#RESP
	5.2	2.6			11.7	100.0	ROW %
	3.0	2.6			11.4	2.5	COL %
SUM	134	77	3	9	79	3131	#RESP
	4.3	2.5	0.1	0.3	2.5	100.0	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 6

MIRROR STAYS ADJUSTED BY PEDESTRIAN MIRROR EFFECTIVENESS
Ohio School Bus Driver Survey
26 Feb 1983

	ALWAYS	ALMOST ALWAYS	MOST OF TIME	OCCASIONALLY	NEVER	MULTIANSWER	
TOTALLY EFFECT.	309	249	88	23	7		#RESP
	44.8	36.1	12.8	3.3	1.0		ROW %
	32.6	18.9	13.6	19.5	25.9		COL %
VERY EFFECT.	405	635	247	34	8	2	#RESP
	29.8	46.8	18.2	2.5	0.6	0.1	ROW %
	42.8	48.3	38.3	28.8	29.6	100.0	COL %
FAIRLY EFFECT.	211	409	291	51	9		#RESP
	21.3	41.3	29.4	5.1	0.9		ROW %
	22.3	31.1	45.1	43.2	33.3		COL %
OF LITTLE USE	13	11	14	5	2		#RESP
	28.3	23.9	30.4	10.9	4.3		ROW %
	1.4	0.8	2.2	4.2	7.4		COL %
OF NO USE	1			1	1		#RESP
	33.3			33.3	33.3		ROW %
	0.1			0.8	3.7		COL %
MULTIANSWER		2	2				#RESP
		50.0	50.0				ROW %
		0.2	0.3				COL %
OTHER	8	9	3	4			#RESP
	20.0	22.5	7.5	10.0			ROW %
	0.8	0.7	0.5	3.4			COL %
SUM	947	1315	645	118	27	2	#RESP
	30.2	42.0	20.6	3.8	0.9	0.1	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 6 (cont.)

MIRROR STAYS ADJUSTED BY PEDESTRIAN MIRROR EFFECTIVENESS
Ohio School Bus Driver Survey
26 Feb 1983

	OTHER	SUM	
TOTALLY EFFECT.	13	689	#RESP
	1.9	100.0	ROW %
	16.9	22.0	COL %
VERY EFFECT.	27	1358	#RESP
	2.0	100.0	ROW %
	35.1	43.4	COL %
FAIRLY EFFECT.	20	991	#RESP
	2.0	100.0	ROW %
	26.0	31.7	COL %
OF LITTLE USE	1	46	#RESP
	2.2	100.0	ROW %
	1.3	1.5	COL %
OF NO USE		3	#RESP
		100.0	ROW %
		0.1	COL %
MULTIANSWER		4	#RESP
		100.0	ROW %
		0.1	COL %
OTHER	16	40	#RESP
	40.0	100.0	ROW %
	20.8	1.3	COL %
SUM	77	3131	#RESP
	2.5	100.0	ROW %
	100.0	100.0	COL %

Table 7

MIRROR STAYS ADJUSTED BY PEDESTRIANS DIFFICULT TO SEE
Ohio School Bus Driver Survey
26 Feb 1983

	ALWAYS	ALMOST ALWAYS	MOST OF TIME	OCCASIONALLY	NEVER	MULTIANSWER	OTHER	
YES	496	823	415	62	14	1	36	#RESP
	26.9	44.6	22.5	3.4	0.8	0.1	1.9	ROW %
	52.4	62.6	64.3	52.5	51.9	50.0	46.8	COL %
NO	436	457	213	46	13	1	25	#RESP
	36.6	38.4	17.9	3.9	1.1	0.1	2.1	ROW %
	46.0	34.8	33.0	39.0	48.1	50.0	32.5	COL %
MULTIANSWER	2	3	2	1				#RESP
	25.0	37.5	25.0	12.5				ROW %
	0.2	0.2	0.3	0.8				COL %
OTHER	13	32	15	9			16	#RESP
	15.3	37.6	17.6	10.6			18.8	ROW %
	1.4	2.4	2.3	7.6			20.8	COL %
SUM	947	1315	645	118	27	2	77	#RESP
	30.2	42.0	20.6	3.8	0.9	0.1	2.5	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 7 (cont.)

MIRROR STAYS ADJUSTED BY PEDESTRIANS DIFFICULT TO SEE
Ohio School Bus Driver Survey
26 Feb 1983

		SUM	
YES	I	1847	#RESP
	I	100.0	ROW %
	I	59.0	COL %
NO	I	1191	#RESP
	I	100.0	ROW %
	I	38.0	COL %
MULTIANSWER	I	81	#RESP
	I	100.0	ROW %
	I	0.3	COL %
OTHER	I	85	#RESP
	I	100.0	ROW %
	I	2.7	COL %
SUM	I	3131	#RESP
	I	100.0	ROW %
	I	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .378358 E 02 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 4

CONT COEF = .112063

Table 8

CLOSE CALL BY PEDESTRIAN MIRROR SYSTEM
Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	MULTIANSWER	OTHER	SUM	
1 LEFT	146	833		40	1019	#RESP
	14.3	81.7		3.9	100.0	ROW %
	36.3	32.2		29.0	32.5	COL %
1 RIGHT	4	28			32	#RESP
	12.5	87.5			100.0	ROW %
	1.0	1.1			1.0	COL %
1 LEFT/1 RIGHT	25	172		8	205	#RESP
	12.2	83.9		3.9	100.0	ROW %
	6.2	6.6		5.8	6.5	COL %
1 LEFT/2 RIGHT	10	79		3	92	#RESP
	10.9	85.9		3.3	100.0	ROW %
	2.5	3.1		2.2	2.9	COL %
2 LEFT/1 RIGHT	130	923	1	45	1099	#RESP
	11.8	84.0	0.1	4.1	100.0	ROW %
	32.3	35.6	100.0	32.6	35.1	COL %
2 LEFT/2 RIGHT	70	448		29	547	#RESP
	12.8	81.9		5.3	100.0	ROW %
	17.4	17.3		21.0	17.5	COL %
UNKNOWN		2			2	#RESP
		100.0			100.0	ROW %
		0.1			0.1	COL %
WRITE-IN	6	41		4	51	#RESP
	11.8	80.4		7.8	100.0	ROW %
	1.5	1.6		2.9	1.6	COL %
MULTIANSWER	4	27			31	#RESP
	12.9	87.1			100.0	ROW %
	1.0	1.0			1.0	COL %
OTHER	7	37		9	53	#RESP
	13.2	69.8		17.0	100.0	ROW %
	1.7	1.4		6.5	1.7	COL %
SUM	402	2590	1	138	3131	#RESP
	12.8	82.7	0.0	4.4	100.0	ROW %
	100.0	100.0	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .373784 E 01
DEGREES OF FREEDOM = 7

CONT COEF = .257727 E -01

Table 9

CLOSE CALL BY PEDESTRIAN MIRROR EFFECTIVENESS
Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	MULTIANSWER	OTHER	SUM	
TOTALLY EFFECT.	63	598		28	689	#RESP
	9.1	86.8		4.1	100.0	ROW %
	15.7	23.1		20.3	22.0	COL %
VERY EFFECT.	149	1151	1	57	1358	#RESP
	11.0	84.8	0.1	4.2	100.0	ROW %
	37.1	44.4	100.0	41.3	43.4	COL %
FAIRLY EFFECT.	181	767		43	991	#RESP
	18.3	77.4		4.3	100.0	ROW %
	45.0	29.6		31.2	31.7	COL %
OF LITTLE USE	6	38		2	46	#RESP
	13.0	82.6		4.3	100.0	ROW %
	1.5	1.5		1.4	1.5	COL %
OF NO USE	1	3		1	3	#RESP
	1	100.0		1	100.0	ROW %
	1	0.1		1	0.1	COL %
MULTIANSWER	1	3		1	4	#RESP
	25.0	75.0		1	100.0	ROW %
	0.2	0.1		1	0.1	COL %
OTHER	2	30		8	40	#RESP
	5.0	75.0		20.0	100.0	ROW %
	0.5	1.2		5.8	1.3	COL %
SUM	402	2590	1	138	3131	#RESP
	12.8	82.7	0.0	4.4	100.0	ROW %
	100.0	100.0	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .394101 E 02 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 4

CONT COEF = .114703

Table 10

CLOSE CALL BY PEDESTRIANS DIFFICULT TO SEE
Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	MULTIANSWER	OTHER	SUM	
YES	325	1443	1	78	1847	#RESP
	17.6	78.1	0.1	4.2	100.0	ROW %
	80.8	55.7	100.0	56.5	59.0	COL %
NO	72	1076		43	1191	#RESP
	6.0	90.3		3.6	100.0	ROW %
	17.9	41.5		31.2	38.0	COL %
MULTIANSWER	1	7			8	#RESP
	12.5	87.5			100.0	ROW %
	0.2	0.3			0.3	COL %
OTHER	4	64		17	85	#RESP
	4.7	75.3		20.0	100.0	ROW %
	1.0	2.5		12.3	2.7	COL %
SUM	402	2590	1	138	3131	#RESP
	12.8	82.7	0.0	4.4	100.0	ROW %
	100.0	100.0	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .868005 E 02 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 1
YATES CORRECTED CHI SQUARE = .857739 E 02 (SIGNIFICANT AT .001 LEVEL)

CONT COEF = .170019

Table 11

IDEAL MIRRORS BY CLOSE CALL
Ohio School Bus Driver Survey
26 Feb 1983

	ONE LEFT	ONE RIGHT	1 LEFT/1 RIGHT	1 LEFT/2 RIGHT	2 LEFT/1 RIGHT	2 LEFT/2 RIGHT	WRITE-IN	
YES	81	21	341	181	741	2131	61	#RESP
	2.01	0.51	8.51	4.51	18.41	53.01	1.51	ROW %
	5.91	7.11	11.31	13.41	10.71	14.41	18.71	COL %
NO	1241	231	2601	1101	5851	12151	251	#RESP
	4.81	0.91	10.01	4.21	22.61	46.91	1.01	ROW %
	91.91	82.11	86.41	82.11	84.31	81.91	78.11	COL %
MULTIANSWER					11		1	#RESP
					100.01		1	ROW %
					0.11		1	COL %
OTHER	31	31	71	61	341	551	11	#RESP
	2.21	2.21	5.11	4.31	24.61	39.91	0.71	ROW %
	2.21	10.71	2.31	4.51	4.91	3.71	3.11	COL %
SUM	135I	281	3011	1341	6941	14831	321	#RESP
	4.31	0.91	9.61	4.31	22.21	47.41	1.01	ROW %
	100.01	100.01	100.01	100.01	100.01	100.01	100.01	COL %

Table 11 (cont.)

IDEAL MIRRORS BY CLOSE CALL
Ohio School Bus Driver Survey
26 Feb 1983

	MULTIANSWER	OTHER	SUM	
YES	26	21	402	#RESP
	6.5	5.2	100.0	ROW %
	17.7	11.9	12.8	COL %
NO	110	138	2590	#RESP
	4.2	5.3	100.0	ROW %
	74.8	78.0	82.7	COL %
MULTIANSWER	1	1	1	#RESP
	1	1	100.0	ROW %
	1	1	0.0	COL %
OTHER	11	18	138	#RESP
	8.0	13.0	100.0	ROW %
	7.5	10.2	4.4	COL %
SUM	147	177	3131	#RESP
	4.7	5.7	100.0	ROW %
	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .141912 E 02 (SIGNIFICANT AT .05 LEVEL)
DEGREES OF FREEDOM = 6

CONT COEF = .723485 E -01

Table 12

IDEAL MIRRORS BY PEDESTRIAN MIRROR SYSTEM
Ohio School Bus Driver Survey
26 Feb 1983

	ONE LEFT	ONE RIGHT	1 LEFT/1 RIGHT	1 LEFT/2 RIGHT	2 LEFT/1 RIGHT	2 LEFT/2 RIGHT	
1 LEFT	101	15	139	61	134	446	#RESP
	9.9	1.5	13.6	6.0	13.2	43.8	ROW %
	74.8	53.6	46.2	45.5	19.3	30.1	COL %
1 RIGHT	1	3	7	5	1	12	#RESP
	3.1	9.4	21.9	15.6	3.1	37.5	ROW %
	0.7	10.7	2.3	3.7	0.1	0.8	COL %
1 LEFT/1 RIGHT	4		66	13	28	78	#RESP
	2.0		32.2	6.3	13.7	38.0	ROW %
	3.0		21.9	9.7	4.0	5.3	COL %
1 LEFT/2 RIGHT	2	2	10	17	8	36	#RESP
	2.2	2.2	10.9	18.5	8.7	39.1	ROW %
	1.5	7.1	3.3	12.7	1.2	2.4	COL %
2 LEFT/1 RIGHT	14	3	37	19	484	451	#RESP
	1.3	0.3	3.4	1.7	44.0	41.0	ROW %
	10.4	10.7	12.3	14.2	69.7	30.4	COL %
2 LEFT/2 RIGHT	6	3	29	10	21	417	#RESP
	1.1	0.5	5.3	1.8	3.8	76.2	ROW %
	4.4	10.7	9.6	7.5	3.0	28.1	COL %
UNKNOWN						1	#RESP
						50.0	ROW %
						0.1	COL %
WRITE-IN	1	1	7	4	7	19	#RESP
	2.0	2.0	13.7	7.8	13.7	37.3	ROW %
	0.7	3.6	2.3	3.0	1.0	1.3	COL %
MULTIANSWER	4		2	1	3	8	#RESP
	12.9		6.5	3.2	9.7	25.8	ROW %
	3.0		0.7	0.7	0.4	0.5	COL %
OTHER	2	1	4	4	8	15	#RESP
	3.8	1.9	7.5	7.5	15.1	28.3	ROW %
	1.5	3.6	1.3	3.0	1.2	1.0	COL %
SUM	135	28	301	134	694	1483	#RESP
	4.3	0.9	9.6	4.3	22.2	47.4	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 12 (cont.)

IDEAL MIRRORS BY PEDESTRIAN MIRROR SYSTEM
Ohio School Bus Driver Survey
26 Feb 1983

	WRITE-IN	MULTIANSWER	OTHER	SUM	
1 LEFT	5	67	51	1019	#RESP
	0.5	6.6	5.0	100.0	ROW %
	15.6	45.6	28.8	32.5	COL %
1 RIGHT		1	2	32	#RESP
		3.1	6.2	100.0	ROW %
		0.7	1.1	1.0	COL %
1 LEFT/1 RIGHT	2	4	10	205	#RESP
	1.0	2.0	4.9	100.0	ROW %
	6.2	2.7	5.6	6.5	COL %
1 LEFT/2 RIGHT	2	6	9	92	#RESP
	2.2	6.5	9.8	100.0	ROW %
	6.2	4.1	5.1	2.9	COL %
2 LEFT/1 RIGHT	7	30	54	1099	#RESP
	0.6	2.7	4.9	100.0	ROW %
	21.9	20.4	30.5	35.1	COL %
2 LEFT/2 RIGHT	6	27	28	547	#RESP
	1.1	4.9	5.1	100.0	ROW %
	18.7	18.4	15.8	17.5	COL %
UNKNOWN	1			2	#RESP
	50.0			100.0	ROW %
	3.1			0.1	COL %
WRITE-IN	7	1	4	51	#RESP
	13.7	2.0	7.8	100.0	ROW %
	21.9	0.7	2.3	1.6	COL %
MULTIANSWER	2	7	4	31	#RESP
	6.5	22.6	12.9	100.0	ROW %
	6.2	4.8	2.3	1.0	COL %
OTHER		4	15	53	#RESP
		7.5	28.3	100.0	ROW %
		2.7	8.5	1.7	COL %
SUM	32	147	177	3131	#RESP
	1.0	4.7	5.7	100.0	ROW %
	100.0	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .105003 E 04
DEGREES OF FREEDOM = 42
STANDARDIZED CHI SQUARE = .109985 E 03 (SIGNIFICANT AT .001 LEVEL)

CONT COEF = .525456

Table 13

CROSSING ARM BY CLOSE CALL
Ohio School Bus Driver Survey
26 Feb 1983

	ABS. ESSENTIAL	VERY IMPORTANT	IMPORTANT	OF LITTLE IMPOR	NO IMPORTANCE	MULTIANSWER	OTHER	
YES	72	94	71	81	49	2	33	#RESP
	17.9	23.4	17.7	20.1	12.2	0.5	8.2	ROW %
	18.6	15.4	13.0	10.4	9.3	28.6	12.4	COL %
NO	289	504	454	681	452	4	206	#RESP
	11.2	19.5	17.5	26.3	17.5	0.2	8.0	ROW %
	74.5	82.4	83.0	87.2	85.4	57.1	77.2	COL %
MULTIANSWER			1					#RESP
			100.0					ROW %
			0.2					COL %
OTHER	27	14	21	19	28	1	28	#RESP
	19.6	10.1	15.2	13.8	20.3	0.7	20.3	ROW %
	7.0	2.3	3.8	2.4	5.3	14.3	10.5	COL %
SUM	388	612	547	781	529	7	267	#RESP
	12.4	19.5	17.5	24.9	16.9	0.2	8.5	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 13 (cont.)

CROSSING ARM BY CLOSE CALL
Ohio School Bus Driver Survey
26 Feb 1983

		SUM	
YES	I	402I	#RESP
	I	100.0I	ROW %
	I	12.8I	COL %
NO	I	2590I	#RESP
	I	100.0I	ROW %
	I	82.7I	COL %
MULTIANSWER	I	1I	#RESP
	I	100.0I	ROW %
	I	0.0I	COL %
OTHER	I	138I	#RESP
	I	100.0I	ROW %
	I	4.4I	COL %
SUM	I	3131I	#RESP
	I	100.0I	ROW %
	I	100.0I	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .268617 E 02 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 4

CONT COEF = .984066 E -01

Table 14

CROSSING ARM BY IDEAL SIGNALS
Ohio School Bus Driver Survey
26 Feb 1983

	ABS. ESSENTIAL	VERY IMPORTANT	IMPORTANT	OF LITTLE IMPOR	NO IMPORTANCE	MULTIANSWER	
RED ONLY	11	37	28	61	43		#RESP
	5.7	19.1	14.4	31.4	22.2		ROW %
	2.8	6.0	5.1	7.8	8.1		COL %
RED PLUS AMBER	16	36	52	84	67		#RESP
	5.9	13.3	19.3	31.1	24.8		ROW %
	4.1	5.9	9.5	10.8	12.7		COL %
RED PLUS STOP	46	65	50	88	42	2	#RESP
	14.7	20.8	16.0	28.2	13.5	0.6	ROW %
	11.9	10.6	9.1	11.3	7.9	28.6	COL %
RED-AMBER-STOP	295	454	390	509	350	5	#RESP
	13.8	21.3	18.3	23.9	16.4	0.2	ROW %
	76.0	74.2	71.3	65.2	66.2	71.4	COL %
WRITE-IN	5	5	4	11	7		#RESP
	13.2	13.2	10.5	28.9	18.4		ROW %
	1.3	0.8	0.7	1.4	1.3		COL %
MULTIANSWER	13	8	16	12	6		#RESP
	22.4	13.8	27.6	20.7	10.3		ROW %
	3.4	1.3	2.9	1.5	1.1		COL %
OTHER	2	7	7	16	14		#RESP
	1.6	5.4	5.4	12.4	10.9		ROW %
	0.5	1.1	1.3	2.0	2.6		COL %
SUM	388	612	547	781	529	7	#RESP
	12.4	19.5	17.5	24.9	16.9	0.2	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 14 (cont.)

CROSSING ARM BY IDEAL SIGNALS
Ohio School Bus Driver Survey
26 Feb 1983

	OTHER	SUM	
RED ONLY	14	194	#RESP
	7.2	100.0	ROW %
	5.2	6.2	COL %
RED PLUS AMBER	15	270	#RESP
	5.6	100.0	ROW %
	5.6	8.6	COL %
RED PLUS STOP	19	312	#RESP
	6.1	100.0	ROW %
	7.1	10.0	COL %
RED-AMBER-STOP	127	2130	#RESP
	6.0	100.0	ROW %
	47.6	68.0	COL %
WRITE-IN	6	38	#RESP
	15.8	100.0	ROW %
	2.2	1.2	COL %
MULTIANSWER	3	58	#RESP
	5.2	100.0	ROW %
	1.1	1.9	COL %
OTHER	83	129	#RESP
	64.3	100.0	ROW %
	31.1	4.1	COL %
SUM	267	3131	#RESP
	8.5	100.0	ROW %
	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .568244 E 02 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 16

CONT COEF = .142133

Table 15

CLOSE CALL BY TYPE OF STOP SIGNAL SYSTEM USED
Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	MULTIANSWER	OTHER	SUM	
RED ONLY	361	941		39	1341	#RESP
	26.9	70.2		2.9	100.0	ROW %
	44.0	43.0		32.5	42.8	COL %
RED PLUS AMBER	139	339	1	19	498	#RESP
	27.9	68.1	0.2	3.8	100.0	ROW %
	17.0	15.5	50.0	15.8	15.9	COL %
RED, AMBER & STOP	288	823	1	50	1162	#RESP
	24.8	70.8	0.1	4.3	100.0	ROW %
	35.1	37.6	50.0	41.7	37.1	COL %
MULTIANSWER	2	5			7	#RESP
	28.6	71.4			100.0	ROW %
	0.2	0.2			0.2	COL %
OTHER	30	81		12	123	#RESP
	24.4	65.9		9.8	100.0	ROW %
	3.7	3.7		10.0	3.9	COL %
SUM	820	2189	2	120	3131	#RESP
	26.2	69.9	0.1	3.8	100.0	ROW %
	100.0	100.0	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .194328 E 01
DEGREES OF FREEDOM = 2

CONT COEF = .259178 E -01

Table 16

TYPE OF STOP SIGNAL SYSTEM USED BY DIRECTION OF SIGNAL VIOLATIONS
Ohio School Bus Driver Survey
26 Feb 1983

	RED ONLY	RED PLUS AMBER	RED/AMBER/STOP	MULTIANSWER	OTHER	SUM	
RIGHT	39	16	42		3	100	#RESP
	39.0	16.0	42.0		3.0	100.0	ROW %
	2.9	3.2	3.6		2.4	3.2	COL %
LEFT	93	34	56		3	186	#RESP
	50.0	18.3	30.1		1.6	100.0	ROW %
	6.9	6.8	4.8		2.4	5.9	COL %
FRONT	39	16	31		1	87	#RESP
	44.8	18.4	35.6		1.1	100.0	ROW %
	2.9	3.2	2.7		0.8	2.8	COL %
OTHER	1170	432	1033	7	116	2758	#RESP
	42.4	15.7	37.5	0.3	4.2	100.0	ROW %
	87.2	86.7	88.9	100.0	94.3	88.1	COL %
SUM	1341	498	1162	7	123	3131	#RESP
	42.8	15.9	37.1	0.2	3.9	100.0	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .466753 E 01
DEGREES OF FREEDOM = 4

CONT COEF = .112215

Table 17

NUMBER OF VIOLATION REPORTS FILED BY TYPE OF STOP SIGNAL SYSTEM USED
Ohio School Bus Driver Survey
26 Feb 1983

	0	1	2	3	4	5	
RED ONLY	865	165	130	75	35	17	#RESP
	64.5	12.3	9.7	5.6	2.6	1.3	ROW %
	41.0	48.2	51.4	51.0	53.0	41.5	COL %
RED PLUS AMBER	344	46	36	27	10	8	#RESP
	69.1	9.2	7.2	5.4	2.0	1.6	ROW %
	16.3	13.5	14.2	18.4	15.2	19.5	COL %
RED, AMBER & STOP	817	115	84	42	20	15	#RESP
	70.3	9.9	7.2	3.6	1.7	1.3	ROW %
	38.7	33.6	33.2	28.6	30.3	36.6	COL %
MULTIANSWER	3	3	1	1	1	1	#RESP
	42.9	42.9	1	14.3	1	1	ROW %
	0.1	0.9	1	0.7	1	1	COL %
OTHER	83	13	3	2	1	1	#RESP
	67.5	10.6	2.4	1.6	0.8	0.8	ROW %
	3.9	3.8	1.2	1.4	1.5	2.4	COL %
SUM	2112	342	253	147	66	41	#RESP
	67.5	10.9	8.1	4.7	2.1	1.3	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 17 (cont.)

NUMBER OF VIOLATION REPORTS FILED BY TYPE OF STOP SIGNAL SYSTEM USED
Ohio School Bus Driver Survey
26 Feb 1983

	6	7	8	9 OR MORE	MULTIANSWER	OTHER	
RED ONLY	9	5	1	11	2	26	#RESP
	0.7	0.4	0.1	0.8	0.1	1.9	ROW %
	37.5	71.4	50.0	31.4	50.0	26.5	COL %
RED PLUS AMBER	6	2	1	3	1	14	#RESP
	1.2	0.4	0.2	0.6	0.2	2.8	ROW %
	25.0	28.6	50.0	8.6	25.0	14.3	COL %
RED, AMBER & STOP	9			19	1	40	#RESP
	0.8			1.6	0.1	3.4	ROW %
	37.5			54.3	25.0	40.8	COL %
MULTIANSWER							#RESP
							ROW %
							COL %
OTHER				2		18	#RESP
				1.6		14.6	ROW %
				5.7		18.4	COL %
SUM	24	7	2	35	4	98	#RESP
	0.8	0.2	0.1	1.1	0.1	3.1	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 17 (cont.)

NUMBER OF VIOLATION REPORTS FILED BY TYPE OF STOP SIGNAL SYSTEM USED
Ohio School Bus Driver Survey
26 Feb 1983

		SUM	
RED ONLY	I	1341	#RESP
	I	100.0	ROW %
	I	42.8	COL %
RED PLUS AMBER	I	498	#RESP
	I	100.0	ROW %
	I	15.9	COL %
RED, AMBER & STOP	I	1162	#RESP
	I	100.0	ROW %
	I	37.1	COL %
MULTIANSWER	I	7	#RESP
	I	100.0	ROW %
	I	0.2	COL %
OTHER	I	123	#RESP
	I	100.0	ROW %
	I	3.9	COL %
SUM	I	3131	#RESP
	I	100.0	ROW %
	I	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .346288 E 02 (SIGNIFICANT AT .05 LEVEL)
DEGREES OF FREEDOM = 18

CONT COEF = .108315

Table 18

REASONS FOR VIOLATIONS:

MOTORISTS DO NOT SEE SIGNALS IN TIME DUE TO POOR VISIBILITY
BY TYPE OF STOP SIGNAL SYSTEM USED
Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	SUM	
RED ONLY	218	1123	1341	#RESP
	16.3	83.7	100.0	ROW %
	48.1	41.9	42.8	COL %
RED PLUS AMBER	70	428	498	#RESP
	14.1	85.9	100.0	ROW %
	15.5	16.0	15.9	COL %
RED, AMBER & STOP	144	1018	1162	#RESP
	12.4	87.6	100.0	ROW %
	31.8	38.0	37.1	COL %
MULTIANSWER	1	6	7	#RESP
	14.3	85.7	100.0	ROW %
	0.2	0.2	0.2	COL %
OTHER	20	103	123	#RESP
	16.3	83.7	100.0	ROW %
	4.4	3.8	3.9	COL %
SUM	453	2678	3131	#RESP
	14.5	85.5	100.0	ROW %
	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .759885 E 01 (SIGNIFICANT AT .05 LEVEL)
DEGREES OF FREEDOM = 2

CONT COEF = .502564 E -01

Table 19

ROADWAY & TRAFFIC CONDITIONS CONDUCIVE TO VIOLATIONS: MOTORISTS APPROACHING REAR OF BUS BY TYPE OF STOP SIGNAL SYSTEM USED

Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	SUM	
RED ONLY	194	1147	1341	#RESP
	14.5	85.5	100.0	ROW %
	39.8	43.4	42.8	COL %
RED PLUS AMBER	103	395	498	#RESP
	20.7	79.3	100.0	ROW %
	21.1	14.9	15.9	COL %
RED, AMBER & STOP	170	992	1162	#RESP
	14.6	85.4	100.0	ROW %
	34.8	37.5	37.1	COL %
MULTIANSWER	1	6	7	#RESP
	14.3	85.7	100.0	ROW %
	0.2	0.2	0.2	COL %
OTHER	20	103	123	#RESP
	16.3	83.7	100.0	ROW %
	4.1	3.9	3.9	COL %
SUM	488	2643	3131	#RESP
	15.6	84.4	100.0	ROW %
	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .119304 E 02 (SIGNIFICANT AT .01 LEVEL)
DEGREES OF FREEDOM = 2

CONT COEF = .629263 E -01

Table 20

IDEAL SIGNALS BY TYPE OF STOP SIGNAL SYSTEM USED
Ohio School Bus Driver Survey
26 Feb 1983

	RED ONLY	RED PLUS AMBER	RED PLUS STOP	RED-AMBER-STOP	WRITE-IN	MULTIANSWER	
RED ONLY	153	121	159	826	16	22	#RESP
	11.4	9.0	11.9	61.6	1.2	1.6	ROW %
	78.9	44.8	51.0	38.8	42.1	37.9	COL %
RED PLUS AMBER	16	95	35	306	7	12	#RESP
	3.2	19.1	7.0	61.4	1.4	2.4	ROW %
	8.2	35.2	11.2	14.4	18.4	20.7	COL %
RED, AMBER & STOP	18	39	104	927	15	21	#RESP
	1.5	3.4	9.0	79.8	1.3	1.8	ROW %
	9.3	14.4	33.3	43.5	39.5	36.2	COL %
MULTIANSWER		1	2	3			#RESP
		14.3	28.6	42.9			ROW %
		0.4	0.6	0.1			COL %
OTHER	7	14	12	68		3	#RESP
	5.7	11.4	9.8	55.3		2.4	ROW %
	3.6	5.2	3.8	3.2		5.2	COL %
SUM	194	270	312	2130	38	58	#RESP
	6.2	8.6	10.0	68.0	1.2	1.9	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 20 (cont.)

IDEAL SIGNALS BY TYPE OF STOP SIGNAL SYSTEM USED
Ohio School Bus Driver Survey
26 Feb 1983

	OTHER	SUM	
RED ONLY	44	1341	#RESP
	3.3	100.0	ROW %
	34.1	42.8	COL %
RED PLUS AMBER	27	498	#RESP
	5.4	100.0	ROW %
	20.9	15.9	COL %
RED, AMBER & STOP	38	1162	#RESP
	3.3	100.0	ROW %
	29.5	37.1	COL %
MULTIANSWER	1	7	#RESP
	14.3	100.0	ROW %
	0.8	0.2	COL %
OTHER	19	123	#RESP
	15.4	100.0	ROW %
	14.7	3.9	COL %
SUM	129	3131	#RESP
	4.1	100.0	ROW %
	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .253888 E 03 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 8

CONT COEF = .286602

Table 21

IDEAL SIGNALS BY CLOSE CALL
Ohio School Bus Driver Survey
26 Feb 1983

	RED ONLY	RED PLUS AMBER	RED PLUS STOP	RED-AMBER-STOP	WRITE-IN	MULTIANSWER	OTHER	
YES	33	58	77	590	15	21	26	#RESP
	4.0	7.1	9.4	72.0	1.8	2.6	3.2	ROW %
	17.0	21.5	24.7	27.7	39.5	36.2	20.2	COL %
NO	156	205	226	1474	21	35	72	#RESP
	7.1	9.4	10.3	67.3	1.0	1.6	3.3	ROW %
	80.4	75.9	72.4	69.2	55.3	60.3	55.8	COL %
MULTIANSWER				1			1	#RESP
				50.0			50.0	ROW %
				0.0			0.8	COL %
OTHER	5	7	9	65	2	2	30	#RESP
	4.2	5.8	7.5	54.2	1.7	1.7	25.0	ROW %
	2.6	2.6	2.9	3.1	5.3	3.4	23.3	COL %
SUM	194	270	312	2130	38	58	129	#RESP
	6.2	8.6	10.0	68.0	1.2	1.9	4.1	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 21 (cont.)

IDEAL SIGNALS BY CLOSE CALL
Ohio School Bus Driver Survey
26 Feb 1983

		SUM	
YES	I	820I	#RESP
	I	100.0I	ROW %
	I	26.2I	COL %
NO	I	2189I	#RESP
	I	100.0I	ROW %
	I	69.9I	COL %
MULTIANSWER	I	2I	#RESP
	I	100.0I	ROW %
	I	0.1I	COL %
OTHER	I	120I	#RESP
	I	100.0I	ROW %
	I	3.8I	COL %
SUM	I	3131I	#RESP
	I	100.0I	ROW %
	I	100.0I	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .188984 E 02 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 4

CONT COEF = .810917 E -01

Table 22

REASONS FOR VIOLATIONS:

MOTORISTS DO NOT KNOW THEY ARE SUPPOSED TO STOP BY NUMBER OF TRAVELLED LANES
Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	SUM	
ONE	361	1319	1680	#RESP
	21.5	78.5	100.0	ROW %
	48.6	55.2	53.7	COL %
TWO	250	726	976	#RESP
	25.6	74.4	100.0	ROW %
	33.6	30.4	31.2	COL %
THREE	91	171	261	#RESP
	34.6	65.4	100.0	ROW %
	1.2	0.7	0.8	COL %
MORE THAN THREE	201	391	591	#RESP
	33.9	66.1	100.0	ROW %
	2.7	1.6	1.9	COL %
MULTIANSWER	781	2021	2801	#RESP
	27.9	72.1	100.0	ROW %
	10.5	8.5	8.9	COL %
OTHER	251	851	1101	#RESP
	22.7	77.3	100.0	ROW %
	3.4	3.6	3.5	COL %
SUM	7431	23881	31311	#RESP
	23.7	76.3	100.0	ROW %
	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .115629 E 02 (SIGNIFICANT AT .01 LEVEL)
DEGREES OF FREEDOM = 3

CONT COEF = .648132 E -01

Table 23

ROADWAY & TRAFFIC CONDITIONS CONDUCIVE TO VIOLATIONS

MOTORISTS APPROACHING REAR OF BUS BY NUMBER OF TRAVELLED LANES

Ohio School Bus Driver Survey

26 Feb 1983

	YES	NO	SUM	
ONE	189	1491	1680	#RESP
	11.2	88.7	100.0	ROW %
	38.7	56.4	53.7	COL %
TWO	181	795	976	#RESP
	18.5	81.5	100.0	ROW %
	37.1	30.1	31.2	COL %
THREE	5	21	26	#RESP
	19.2	80.8	100.0	ROW %
	1.0	0.8	0.8	COL %
MORE THAN THREE	14	45	59	#RESP
	23.7	76.3	100.0	ROW %
	2.9	1.7	1.9	COL %
MULTIANSWER	75	205	280	#RESP
	26.8	73.2	100.0	ROW %
	15.4	7.8	8.9	COL %
OTHER	24	86	110	#RESP
	21.8	78.2	100.0	ROW %
	4.9	3.3	3.5	COL %
SUM	488	2643	3131	#RESP
	15.6	84.4	100.0	ROW %
	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .320762 E 02 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 3

CONT COEF = .107550

Table 24

ROADWAY & TRAFFIC CONDITIONS CONDUCIVE TO VIOLATIONS

MOTORISTS APPROACHING FRONT OF BUS BY NUMBER OF TRAVELLED LANES

Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	SUM	
ONE	964	716	1680	#RESP
	57.4	42.6	100.0	ROW %
	57.3	49.4	53.7	COL %
TWO	474	502	976	#RESP
	48.6	51.4	100.0	ROW %
	28.2	34.6	31.2	COL %
THREE	15	11	26	#RESP
	57.7	42.3	100.0	ROW %
	0.9	0.8	0.8	COL %
MORE THAN THREE	22	37	59	#RESP
	37.3	62.7	100.0	ROW %
	1.3	2.6	1.9	COL %
MULTIANSWER	158	122	280	#RESP
	56.4	43.6	100.0	ROW %
	9.4	8.4	8.9	COL %
OTHER	48	62	110	#RESP
	43.6	56.4	100.0	ROW %
	2.9	4.3	3.5	COL %
SUM	1681	1450	3131	#RESP
	53.7	46.3	100.0	ROW %
	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .260571 E 02 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 3

CONT COEF = .970406 E -01

Table 25

A STOPPING PLACE BY NEIGHBORHOOD
Ohio School Bus Driver Survey
23 Mar 1983

	FAR RIGHT	TRAVELED LANE	BLOCK TWO LANES	WRITE-IN	MULTIANSWER	OTHER	
COMM./RES.	318	201	76	10	14	23	#RESP
	49.5	31.3	11.8	1.6	2.2	3.6	ROW %
	23.1	16.2	24.1	32.3	25.9	20.2	COL %
RES./MULTIFAM.	231	128	52	6	5	19	#RESP
	52.4	29.0	11.8	1.4	1.1	4.3	ROW %
	16.8	10.3	16.5	19.4	9.3	16.7	COL %
RES./SINGLE FA.	387	295	99	6	13	28	#RESP
	46.7	35.6	12.0	0.7	1.6	3.4	ROW %
	28.2	23.8	31.3	19.4	24.1	24.6	COL %
OPEN/RURAL	217	408	35	4	8	14	#RESP
	31.6	59.5	5.1	0.6	1.2	2.0	ROW %
	15.8	32.9	11.1	12.9	14.8	12.3	COL %
MULTIANSWER	168	175	34	4	11	10	#RESP
	41.8	43.5	8.5	1.0	2.7	2.5	ROW %
	12.2	14.1	10.8	12.9	20.4	8.8	COL %
OTHER	53	35	20	1	3	20	#RESP
	40.2	26.5	15.2	0.8	2.3	15.2	ROW %
	3.9	2.8	6.3	3.2	5.6	17.5	COL %
SUM	1374	1242	316	31	54	114	#RESP
	43.9	39.7	10.1	1.0	1.7	3.6	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 25 (cont.)

A STOPPING PLACE BY NEIGHBORHOOD
Ohio School Bus Driver Survey
23 Mar 1983

	SUM	
COMM./RES.	642	#RESP
	100.0	ROW %
	20.5	COL %
RES./MULTIFAM.	441	#RESP
	100.0	ROW %
	14.1	COL %
RES./SINGLE FA.	828	#RESP
	100.0	ROW %
	26.4	COL %
OPEN/RURAL	686	#RESP
	100.0	ROW %
	21.9	COL %
MULTIANSWER	402	#RESP
	100.0	ROW %
	12.8	COL %
OTHER	132	#RESP
	100.0	ROW %
	4.2	COL %
SUM	3131	#RESP
	100.0	ROW %
	100.0	COL %

OSTATISTICS BASED ON RAW FREQUENCY
OCHI SQUARE = .157010 E 03 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 9
OCONT COEF = .244335

Table 26

ROADWAY & TRAFFIC CONDITIONS CONDUCIVE TO VIOLATIONS:

BIG TRAFFIC BACKUP BEHIND BUS BY NUMBER OF TRAVELLED LANES

Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	SUM	
ONE	130	1550	1680	#RESP
	7.7	92.3	100.0	ROW %
	46.6	54.3	53.7	COL %
TWO	92	884	976	#RESP
	9.4	90.6	100.0	ROW %
	33.0	31.0	31.2	COL %
THREE	6	20	26	#RESP
	23.1	76.9	100.0	ROW %
	2.2	0.7	0.8	COL %
MORE THAN THREE	10	49	59	#RESP
	16.9	83.1	100.0	ROW %
	3.6	1.7	1.9	COL %
MULTIANSWER	30	250	280	#RESP
	10.7	89.3	100.0	ROW %
	10.8	8.8	8.9	COL %
OTHER	11	99	110	#RESP
	10.0	90.0	100.0	ROW %
	3.9	3.5	3.5	COL %
SUM	279	2852	3131	#RESP
	8.9	91.1	100.0	ROW %
	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .144499 E 02 (SIGNIFICANT AT .01 LEVEL)
DEGREES OF FREEDOM = 3

CONT COEF = .724161 E -01

Table 27

ROADWAY & TRAFFIC CONDITIONS CONDUCIVE TO VIOLATIONS:

RUSH HOUR TRAFFIC-A.M. BY NUMBER OF TRAVELLED LANES

Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	SUM	
ONE	396	1284	1680	#RESP
	23.6	76.4	100.0	ROW %
	49.9	54.9	53.7	COL %
TWO	248	728	976	#RESP
	25.4	74.6	100.0	ROW %
	31.2	31.2	31.2	COL %
THREE	12	14	26	#RESP
	46.2	53.8	100.0	ROW %
	1.5	0.6	0.8	COL %
MORE THAN THREE	18	41	59	#RESP
	30.5	69.5	100.0	ROW %
	2.3	1.8	1.9	COL %
MULTIANSWER	90	190	280	#RESP
	32.1	67.9	100.0	ROW %
	11.3	8.1	8.9	COL %
OTHER	30	80	110	#RESP
	27.3	72.7	100.0	ROW %
	3.8	3.4	3.5	COL %
SUM	794	2337	3131	#RESP
	25.4	74.6	100.0	ROW %
	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .892819 E 01 (SIGNIFICANT AT .05 LEVEL)
DEGREES OF FREEDOM = 3

CONT COEF = .569798 E -01

Table 28

ROADWAY & TRAFFIC CONDITIONS CONDUCIVE TO VIOLATIONS:

STOPPED AT AN INTERSECTION BY NUMBER OF TRAVELLED LANES

Ohio School Bus Driver Survey
26 Feb 1983

	YES	NO	SUM	
ONE	312	1368	1680	#RESP
	18.6	81.4	100.0	ROW %
	47.7	55.2	53.7	COL %
TWO	223	753	976	#RESP
	22.8	77.2	100.0	ROW %
	34.1	30.4	31.2	COL %
THREE	10	16	26	#RESP
	38.5	61.5	100.0	ROW %
	1.5	0.6	0.8	COL %
MORE THAN THREE	15	44	59	#RESP
	25.4	74.6	100.0	ROW %
	2.3	1.8	1.9	COL %
MULTIANSWER	69	211	280	#RESP
	24.6	75.4	100.0	ROW %
	10.6	8.5	8.9	COL %
OTHER	25	85	110	#RESP
	22.7	77.3	100.0	ROW %
	3.8	3.4	3.5	COL %
SUM	654	2477	3131	#RESP
	20.9	79.1	100.0	ROW %
	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .131862 E 02 (SIGNIFICANT AT .01 LEVEL)
DEGREES OF FREEDOM = 3

CONT COEF = .691932 E -01

Table 29

CROSSING ARM BY IDEAL MIRRORS
Ohio School Bus Driver Survey
26 Feb 1983

	ABS. ESSENTIAL	VERY IMPORTANT	IMPORTANT	OF LITTLE IMPOR	NO IMPORTANCE	MULTIANSWER	
ONE LEFT	61	311	251	351	241	11	#RESP
	4.41	23.01	18.51	25.91	17.81	0.71	ROW %
	1.51	5.11	4.61	4.51	4.51	14.31	COL %
ONE RIGHT	21	61	41	71	71	1	#RESP
	7.11	21.41	14.31	25.01	25.01	1	ROW %
	0.51	1.01	0.71	0.91	1.31	1	COL %
1 LEFT/1 RIGHT	361	611	621	781	421	1	#RESP
	12.01	20.31	20.61	25.91	14.01	1	ROW %
	9.31	10.01	11.31	10.01	7.91	1	COL %
1 LEFT/2 RIGHT	131	221	341	391	201	1	#RESP
	9.71	16.41	25.41	29.11	14.91	1	ROW %
	3.41	3.61	6.21	5.01	3.81	1	COL %
2 LEFT/1 RIGHT	631	1231	1321	2041	1381	11	#RESP
	9.11	17.71	19.01	29.41	19.91	0.11	ROW %
	16.21	20.11	24.11	26.11	26.11	14.31	COL %
2 LEFT/2 RIGHT	2401	3161	2411	3561	2381	31	#RESP
	16.21	21.31	16.31	24.01	16.01	0.21	ROW %
	61.91	51.61	44.11	45.61	45.01	42.91	COL %
WRITE-IN	41	81	11	91	31	1	#RESP
	12.51	25.01	3.11	28.11	9.41	1	ROW %
	1.01	1.31	0.21	1.21	0.61	1	COL %
MULTIANSWER	141	251	291	281	341	21	#RESP
	9.51	17.01	19.71	19.01	23.11	1.41	ROW %
	3.61	4.11	5.31	3.61	6.41	28.61	COL %
OTHER	101	201	191	251	231	1	#RESP
	5.61	11.31	10.71	14.11	13.01	1	ROW %
	2.61	3.31	3.51	3.21	4.31	1	COL %
SUM	3881	6121	5471	7811	5291	71	#RESP
	12.41	19.51	17.51	24.91	16.91	0.21	ROW %
	100.01	100.01	100.01	100.01	100.01	100.01	COL %

Table 29 (cont.)

CROSSING ARM BY IDEAL MIRRORS
Ohio School Bus Driver Survey
26 Feb 1983

	OTHER	SUM	
ONE LEFT	13	135	#RESP
	9.6	100.0	ROW %
	4.9	4.3	COL %
ONE RIGHT	2	28	#RESP
	7.1	100.0	ROW %
	0.7	0.9	COL %
1 LEFT/1 RIGHT	22	301	#RESP
	7.3	100.0	ROW %
	8.2	9.6	COL %
1 LEFT/2 RIGHT	6	134	#RESP
	4.5	100.0	ROW %
	2.2	4.3	COL %
2 LEFT/1 RIGHT	33	694	#RESP
	4.8	100.0	ROW %
	12.4	22.2	COL %
2 LEFT/2 RIGHT	89	1483	#RESP
	6.0	100.0	ROW %
	33.3	47.4	COL %
WRITE-IN	7	32	#RESP
	21.9	100.0	ROW %
	2.6	1.0	COL %
MULTIANSWER	15	147	#RESP
	10.2	100.0	ROW %
	5.6	4.7	COL %
OTHER	80	177	#RESP
	45.2	100.0	ROW %
	30.0	5.7	COL %
SUM	267	3131	#RESP
	8.5	100.0	ROW %
	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .606776 E 02 (SIGNIFICANT AT .001 LEVEL)
DEGREES OF FREEDOM = 24

CONT COEF = .150170

Table 30

PEDESTRIAN MIRROR SYSTEM BY REASON
FOR BUS-CHILD INCIDENT OR CLOSE CALL
Ohio School Bus Driver Survey
26 Feb 1983

	1 LEFT	1 RIGHT	1 LEFT/1 RIGHT	1 LEFT/2 RIGHT	2 LEFT/1 RIGHT	2 LEFT/2 RIGHT	
CHILD FELL/BENT	42	2	9		31	16	#RESP
	40.0	1.9	8.6		29.5	15.2	ROW %
	4.1	6.2	4.4		2.8	2.9	COL %
SMALL CHILD	31	1	4		19	6	#RESP
	50.0	1.6	6.5		30.6	9.7	ROW %
	3.0	3.1	2.0		1.7	1.1	COL %
UNEXPECTED CROSS	13	1	4	1	16	6	#RESP
	28.3	2.2	8.7	2.2	34.8	13.0	ROW %
	1.3	3.1	2.0	1.1	1.5	1.1	COL %
PUSH/FIGHT/PLAY	13		1	3	9	4	#RESP
	41.9		3.2	9.7	29.0	12.9	ROW %
	1.3		0.5	3.3	0.8	0.7	COL %
LATE	5		1	2	8	10	#RESP
	17.2		3.4	6.9	27.6	34.5	ROW %
	0.5		0.5	2.2	0.7	1.8	COL %
RETURN TO BUS	3		1	3	5	1	#RESP
	20.0		6.7	20.0	33.3	6.7	ROW %
	0.3		0.5	3.3	0.5	0.2	COL %
SLIDE UNDER BUS	1				3	2	#RESP
	14.3				42.9	28.6	ROW %
	0.1				0.3	0.4	COL %
OTHER	911	28	185	83	1008	502	#RESP
	32.1	1.0	6.5	2.9	35.5	17.7	ROW %
	89.4	87.5	90.2	90.2	91.7	91.8	COL %
SUM	1019	32	205	92	1099	547	#RESP
	32.5	1.0	6.5	2.9	35.1	17.5	ROW %
	100.0	100.0	100.0	100.0	100.0	100.0	COL %

Table 30 (cont.)

PEDESTRIAN MIRROR SYSTEM BY REASON
FOR BUS-CHILD INCIDENT OR CLOSE CALL
Ohio School Bus Driver Survey
26 Feb 1983

	UNKNOWN	WRITE-IN	MULTIANSWER	OTHER	SUM	
CHILD FELL/BENT		1	1	3	105	#RESP
		1.0	1.0	2.9	100.0	ROW %
		2.0	3.2	5.7	3.4	COL %
SMALL CHILD				1	62	#RESP
				1.6	100.0	ROW %
				1.9	2.0	COL %
UNEXPECTED CROSS		3		2	46	#RESP
		6.5		4.3	100.0	ROW %
		5.9		3.8	1.5	COL %
PUSH/FIGHT/PLAY		1			31	#RESP
		3.2			100.0	ROW %
		2.0			1.0	COL %
LATE		1	1	1	29	#RESP
		3.4	3.4	3.4	100.0	ROW %
		2.0	3.2	1.9	0.9	COL %
RETURN TO BUS		1		1	15	#RESP
		6.7		6.7	100.0	ROW %
		2.0		1.9	0.5	COL %
SLIDE UNDER BUS			1		7	#RESP
			14.3		100.0	ROW %
			3.2		0.2	COL %
OTHER	2	44	28	45	2836	#RESP
	0.1	1.6	1.0	1.6	100.0	ROW %
	100.0	86.3	90.3	84.9	90.6	COL %
SUM	2	51	31	53	3131	#RESP
	0.1	1.6	1.0	1.7	100.0	ROW %
	100.0	100.0	100.0	100.0	100.0	COL %

STATISTICS BASED ON RAW FREQUENCY

CHI SQUARE = .577704 E 02
DEGREES OF FREEDOM = 36
STANDARDIZED CHI SQUARE = .256567 E 01 (SIGNIFICANT AT .01 LEVEL)

CONT COEF = .411136

APPENDIX C.

UVC Chapter 1

Words and Phrases Defined

UNIFORM VEHICLE CODE

NOTE: This act or any portion thereof should be prefaced by a descriptive title conforming to the requirements of the constitution or statutes of the state enacting it.

Be it enacted, * * *

CHAPTER 1

Words and Phrases Defined

§ 1-101—Definition of words and phrases

The following words and phrases when used in this act shall, for the purpose of this act, have the meanings respectively ascribed to them in this chapter, except when the context otherwise requires.

§ 1-102—Alley.—A street or highway intended to provide access to the rear or side of lots or buildings in urban districts and not intended for the purpose of through vehicular traffic. (NEW, 1968.)

§ 1-103—Arterial street.—Any U.S. or State numbered route, controlled-access highway, or other major radial or circumferential street or highway designated by local authorities within their respective jurisdictions as part of a major arterial system of streets or highways. (NEW, 1954; RENUMBERED, 1968.)

§ 1-104—Authorized emergency vehicle.—Such fire department vehicles, police vehicles and ambulances as are publicly owned, and such other publicly or privately owned vehicles as are designated by the commissioner (or other appropriate state official) under § 15-111 of this act. (REVISED AND RENUMBERED, 1968.)

§ 1-105—Bicycle.—Every vehicle propelled solely by human power upon which any person may ride, having two tandem wheels, except such vehicles with a seat height of no more than 25 inches from the ground when the seat is adjusted to its highest position, and except scooters and similar devices. (REVISED, 1975 & 1979.)

§ 1-106—Bus.—Every motor vehicle designed for carrying more than 10 passengers and used for the transportation of persons; and every motor vehicle, other than a taxicab, designed and used for the transportation of persons for compensation. (RENUMBERED, 1968.)

§ 1-107—Business district.—The territory contiguous to and including a highway when within any 600 feet along such highway there are buildings in use for business or industrial purposes, including but not limited to hotels, banks, or office buildings, railroad stations and public buildings which occupy at least 300 feet of frontage on one side or 300 feet collectively on both sides of the highway. (RENUMBERED, 1968.)

§ 1-108—Cancellation of driver's license.—The annulment or termination by formal action of the department of a person's driver's license because of some error or defect in the license or because the licensee is no longer entitled to such license, but the cancellation of a license is without prejudice and application for a new license may be made at any time after such cancellation. (RENUMBERED, 1968.)

§ 1-109—Commissioner.[1]—The commissioner of motor vehicles of this State.

§ 1-110—Controlled-access highway.—Every highway, street or roadway in respect to which owners or occupants of abutting lands and other persons have no legal right of access to or from the same except at such points only and in such manner as may be determined by the public authority having jurisdiction over such highway, street or roadway.

§ 1-111—Crosswalk.—(a) That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or, in the absence of curbs, from the edges of the traversable roadway; and in the absence of a sidewalk on one side of the roadway included within the extension of the lateral lines of the existing sidewalk at right angles to the centerline. (REVISED, 1975.)

(b) Any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface.

§ 1-112—Dealer.—Every person in the business of buying, selling or exchanging vehicles. (REVISED, 1971.)

§ 1-113—Department.[2]—The department of motor vehicles of this State.

§ 1-113.1—Divided highway.—A highway divided into two or more roadways by leaving an intervening space or by a physical barrier or by a clearly indicated dividing section so constructed as to impede vehicular traffic. (NEW, 1971.)

§ 1-113.2—Driveaway-towaway operation.—Any operation in which any motor vehicle, trailer or semitrailer, singly or in combination, new or used, constitutes the commodity being transported, when one set or more of wheels of any such vehicle are on the roadway during the course of transportation, whether or not any such vehicle furnishes the motive power. (NEW, 1962; RENUMBERED, 1971.)

§ 1-114—Driver.—Every person who drives or is in actual physical control of a vehicle.

§ 1-114.1—Driver's license.—Any license to operate a motor vehicle issued under the laws of this State. (NEW, 1968.)

§ 1-115—Essential parts.—All integral and body parts of a vehicle of a type required to be registered hereunder, the removal, alteration or substitution of which would tend to conceal the identity of the vehicle or substantially alter its appearance, model, type or mode of operation.

§ 1-116—Established place of business.—The place actually occupied either continuously or at regular periods by a dealer or manufacturer where his books and records are kept and a large share of his business is transacted.

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[1]If the term "commissioner" is not appropriate in a particular state, then the appropriate term and definition should be substituted.

[2]If the administration of this act is not vested in the department of motor vehicles within a particular state, the above definition should be revised to designate the appropriate department or bureau of the state government to administer this act.

§ 1-117—Explosives.—Any chemical compound or mechanical mixture that is commonly used or intended for the purpose of producing an explosion and which contains any oxidizing and combustive units or other ingredients in such proportions, quantities or packing that an ignition by fire, by friction, by concussion, by percussion or by detonator of any part of the compound or mixture may cause such a sudden generation of highly heated gases that the resultant gaseous pressures are capable of producing destructive effects on contiguous objects or of destroying life or limb.

§ 1-118—Farm tractor.—Every motor vehicle designed and used primarily as a farm implement, for drawing plows, mowing machines and other implements of husbandry.

§ 1-119—Flammable liquid.—Any liquid which has a flash point of 70°F., or less, as determined by a tagliabue or equivalent closed-cup test device.

§ 1-120—Foreign vehicle.—Every vehicle of a type required to be registered hereunder brought into this State from another state, territory or country other than in the ordinary course of business by or through a manufacturer or dealer and not registered in this State.

§ 1-121—Gross weight.—The weight of a vehicle without load plus the weight of any load thereon.

§ 1-122—Highway.—The entire width between the boundary lines of every way publicly maintained when any part thereof is open to the use of the public for purposes of vehicular travel.[3]

§ 1-123—House trailer.—(a) A trailer or semitrailer which is designed, constructed and equipped as a dwelling place, living abode or sleeping place (either permanently or temporarily) and is equipped for use as a conveyance on streets and highways, or

(b) A trailer or a semitrailer whose chassis and exterior shell is designed and constructed for use as a house trailer, as defined in paragraph (a), but which is used instead permanently or temporarily for the advertising, sales, display or promotion of merchandise or services, or for any other commercial purpose except the transportation of property for hire or the transportation of property for distribution by a private carrier. (NEW SECTION, 1956.)

§ 1-123.1—Human powered vehicle.—Every vehicle designed to be moved solely by human power. (NEW, 1979.)

§ 1-124—Identifying number.—The vehicle number assigned by the manufacturer or by the department for the purpose of identifying the vehicle. The term shall include any numbers or letters assigned by the manufacturer for the purpose of identifying a part of a vehicle and any such number placed on a part in accordance with this act or regulations of the department for the purpose of identifying it. (REVISED, 1979.)

§ 1-125—Implement of husbandry.—Every vehicle designed or adapted and used exclusively for agricultural operations and only incidentally operated or moved upon the highways. (REVISED, 1971.)

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[3]By the above definition the terms "street" and "highway" are synonymous and interchangeable.

§ 1-126—Intersection.—(a) The area embraced within the prolongation or connection of the lateral curb lines, or, if none, then the lateral boundary lines of the roadways of two highways which joint one another at, or approximately at, right angles, or the area within which vehicles traveling upon different highways joining at any other angle may come in conflict.

(b) Where a highway includes two roadways (3) feet or more apart, then every crossing of each roadway of such divided highway by an intersecting highway shall be regarded as a separate intersection. In the event such intersecting highway also includes two roadways (30) feet or more apart, then every crossing of two roadways of such highways shall be regarded as a separate intersection.

(c) The junction of an alley with a street or highway shall not constitute an intersection. (NEW, 1968.)

§ 1-127—Laned roadway.—A roadway which is divided into two or more clearly marked lanes for vehicular traffic.

§ 1-128—License or license to operate a motor vehicle.—Any driver's license or any other license to permit to operate a motor vehicle issued under, or granted by, the laws of this State including: (REVISED, 1968.)

1. Any temporary license or instruction permit;
2. The privilege of any person to drive a motor vehicle whether or not such person holds a valid license;
3. Any nonresident's operating privilege as defined herein.

§ 1-129—Lienholder.—A person holding a security interest in a vehicle. (NEW, 1956.)

§ 1-130—Local authorities.—Every country, municipal and other local board or body having authority to enact laws relating to traffic under the constitution and laws of this State.

§ 1-131—Mail.—To deposit in the United States mail properly addressed and with postage prepaid. (NEW, 1956.)

§ 1-132—Manufacturer.—Every person engaged in the business of constructing or assembling vehicles of a type required to be registered hereunder at an established place of business in this State.

§ 1-133—Metal tire.—Every tire the surface of which in contact with the highway is wholly or partly of metal or other hard, nonresilient material.

§ 1-133.1—Moped.—A motor-driven cycle both with pedals to permit propulsion by human power and with a motor which produces not to exceed two brake horsepower and which is not capable of propelling the vehicle at a speed in excess of 30 mph on level ground. If an internal combustion engine is used, the displacement shall not exceed 50 cubic centimeters and the moped shall have a power drive system that functions directly or automatically without clutching or shifting by the operator after the drive system is engaged. (NEW, 1979.)

§ 1-133.2—Motor home.—Every motor vehicle designed, used or maintained primarily as a mobile dwelling, office or commercial space. (NEW, 1971; RENUMBERED, 1979.)

§ 1-134—Motor vehicle.—Every vehicle which is self-propelled, and every vehicle which is propelled by electric power obtained from overhead trolley wires but not operated upon rails, except vehicles moved solely by human power. (REVISED, 1975.)

§ 1-135—Motorcycle.—Every motor vehicle having a seat or saddle for the use of the rider and designed to travel on not more than three wheels in contact with the ground, but excluding a tractor.

§ 1-136—Motor-driven cycle.—Every motorcycle, motor scooter or motorized bicycle having an engine with less than 150 cubic centimeters displacement or with five brake horsepower or less. (REVISED, 1975.)

§ 1-137—Nonresident.—Every person who is not a resident of this State.

§ 1-138—Nonresident's operating privilege.—The privilege conferred upon a nonresident by the laws of this State pertaining to the operation by such person of a motor vehicle, or the use of a vehicle owned by such person, in this State.

§ 1-138.1—Odometer.—An instrument for measuring and recording the actual distance a motor vehicle travels while in operation, other than any auxiliary odometer designed to be reset by the operator of the motor vehicle for the purpose of recording mileage on trips. (NEW, 1979.)

§ 1-139—Official traffic-control devices.—All signs, signals, markings and devices not inconsistent with this act placed or erected by authority of a public body or official having jurisdiction, for the purpose of regulating, warning or guiding traffic.

§ 1-140—Owner.—A person, other than a lienholder, having the property in or title to a vehicle. The term includes a person entitled to the use and possession of a vehicle subject to security interest in another person, but excludes a lessee under a least not intended as security. (REVISED, 1956; RENUMBERED, 1968.)

§ 1-141—Park or parking.—Means the standing of a vehicle, whether occupied or not, otherwise than temporarily for the purpose of and while actually engaged in loading or unloading property or passengers. (REVISED, 1971.)

§ 1-142—Passenger car.—Every motor vehicle, except motorcycles and motor-driven cycles, designed for carrying 10 passengers or less and used for the transportation of persons. (NEW, 1962; RENUMBERED, 1968).

§ 1-143—Pedestrian.—Any person afoot.

§ 1-144—Person.—Every natural person, firm, copartnership, association or corporation.

§ 1-144.1—Personal identification card.—A document issued by the department for the sole purpose of identifying the bearer and not authorized for use as a driver's license. (NEW, 1979.)

§ 1-145—Pneumatic tire.—Every tire in which compressed air is designed to support the load.

§ 1-146—Pole trailer.—Every vehicle without motive power designed to be drawn by another vehicle and attached to the towing vehicle by means of a reach or pole, or by being boomed or otherwise secured to the towing vehicle, and ordinarily used for transporting long or irregularly shaped loads such as poles, pipes or structural members capable, generally, of sustaining themselves as beams between the supporting connections.

§ 1-147—Police officer.—Every officer authorized to direct or regulate traffic or to make arrests for violations of traffic regulations.

§ 1-148—Private road or driveway.—Every way or place in private ownership and used for vehicular travel by the owner and those having express or implied permission from the owner, but not by other persons.

§ 1-149—Railroad.—A Carrier of persons or property upon cars (, other than streetcars,) operated upon stationary rails. (REVISED, 1968.)

§ 1-150—Railroad sign or signal.—Any sign, signal or device erected by authority of a public body or official or by a railroad and intended to give notice of the presence of railroad tracks or the approach of a railroad train.

§ 1-151—Railroad train.—A steam engine, electric or other motor, with or without cars coupled thereto, operated upon rails (except streetcars). (REVISED, 1971.)

§ 1-152—Reconstructed vehicle.—Every vehicle of a type required to be registered hereunder materially altered from its original construction by the removal, addition or substitution of essential parts, new or used.

§ 1-153—Registration.—The registration certificate or certificates and registration plates issued under the laws of this State pertaining to the registration of vehicles.

§ 1-154—Residence district.—The territory contiguous to and including a highway not comprising a business district when the property on such highway for a distance of 300 feet or more is in the main improved with residences or residences and buildings in use for business.

§ 1-155—Revocation of driver's license.—The termination by formal action of the department of a person's license or privilege to operate a motor vehicle on the highways, which terminated license or privilege shall not be subject to renewal or restoration except that an applciation for a new license may be presented and acted by the department after the expiration of the applicable period of time prescribed in this act. (REVISED, 1975.)

§ 1-156—Right of way.—The right of one vehicle or pedestrian to proceed in a lawful manner in preference to another vehicle or pedestrian approaching under such circumstances of direction, speed and proximity as to give rise to danger of collision unless one grants precedence to the other. (REVISED, 1962.)

§ 1-157—Road tractor.—Section deleted in 1971.

§ 1-158—Roadway.—That portion of a highway improved, designed or ordinarily used for vehicular travel, exclusive of the sidewalk, berm or shoulder even though such sidewalk, berm or shoulder is used by persons riding bicycles or other human powered vehicles. In the event a highway includes two or more separate roadways the term "roadway" as used herein shall refer to any such roadway separately but not to all such roadways collectively. (REVISED, 1975.)

§ 1-159—Safety zone.—The area of space officially set apart within a roadway for the exclusive use of pedestrians and which is protected or is so marked or indicated by adequate signs as to be plainly visible at all times while set apart as a safety zone.

§ 1-159.1—Salvage vehicle.—A vehicle which is sold for the purpose of being scrapped, destroyed or salvaged for parts and any vehicle for which a total loss settlement of $1,000 or more has been made by an insurance company, other than an unrecovered, stolen vehicle. (NEW, 1979.)

§ 1-160—School bus.—Every motor vehicle that complies with the color and identification requirements set forth in the most recent edition of *Minimum Standards for School Buses*[4] and is used to transport children to or from school or in connection with school activities, but not including buses operated by common carriers in urban transportation of school children. (REVISED, 1962.)

§ 1-161—Security agreement.—A written agreement which reserves or creates a security interest. (NEW, 1956.)

§ 1-162—Security interest.—An interest in a vehicle reserved or created by agreement and which secures payment or performance of an obligation. The term includes the interest of a lessor under a lease intended as security. A security interest is "perfected" when it is valid against third parties generally, subject only to specific statutory exceptions. (NEW, 1956.)

§ 1-163—Semitrailer.—Every vehicle with or without motive power, other than a pole trailer, designed for carrying persons or property and for being drawn by a motor vehicle and so constructed that some part of its weight and that of its load rests upon or is carried by another vehicle.

§ 1-164—Sidewalk.—That portion of a street between the curb lines, or the lateral lines of a roadway, and the adjacent property lines, intended for use by pedestrians.

§ 1-165—Solid rubber tire.—Every tire of rubber or other resilient material which does not depend upon compressed air for the support of the load. (REVISED, 1971.)

§ 1-166—Special mobile equipment.—Every vehicle not designed or used primarily for the transportation of persons or property and only incidentally operated or moved over a highway, including but not limited to: ditch digging apparatus, well boring apparatus and road construction and maintenance machinery such as

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[4]Produced and sponsored by the National Commission on Safety Education of the National Education Association, Washington, D.C. 20036.

asphalt spreaders, bituminous mixers, bucket loaders, tractors other than truck tractors, ditchers, levelling graders, finishing machines, motor graders, road rollers, scarifiers, earth moving carry-alls and scrapers, power shovels and drag lines, and self-propelled cranes and earth moving equipment. The term does not include house trailers, dump trucks, truck mounted transit mixers, cranes or shovels, or other vehicles designed for the transportation of persons or property to which machinery has been attached. (REVISED, 1956.)

§ 1-167—Specially constructed vehicle.—Every vehicle of a type required to be registered hereunder not originally constructed under a distinctive name, make, model or type by a generally recognized manufacturer of vehicles and not materially altered from its original construction.

§ 1-168—Stand or standing.—Means the halting of a vehicle, whether occupied or not, otherwise than temporarily for the purpose of and while actually engaged in receiving or discharging passengers. (NEW, 1956.)

§ 1-169—State.—A state, territory or possession of the United States, the District of Columbia, the Commonwealth of Puerto Rico or a province of Canada. (REVISED, 1968.)

§ 1-170—Stop.—When required means complete cessation from movement.

§ 1-171—Stop or stopping.—When prohibited means any halting even momentarily of a vehicle, whether occupied or not, except when necessary to avoid conflict with other traffic or in compliance with the directions of a police officer or traffic-control sign or signal. (REVISED, 1956.)

§ 1-172—Street.—The entire width between boundary lines of every way publicly maintained when any part thereof is open to the use of the public for purposes of vehicular travel.[5]

§ 1-173—Streetcar.—A car other than a railroad train for transporting persons or property and operated upon rails principally within a municipality.[6]

§ 1-174—Suspension of driver's license.—The temporary withdrawal by formal action of the department of a person's required or privilege to operate a motor vehicle on the public highways, which temporary withdrawal shall be for a period of specifically designated by the department. (REVISED, 1968.)

§ 1-175—Through highway.—Every highway or portion thereof on which vehicular traffic is given preferential right of way, and at the entrances to which vehicular traffic from intersecting highways is required by law to yield the right of way to vehicles on such through highway in obedience to a stop sign, yield sign, or other official traffic-control device, when such signs or devices are erected as provided in this act. (REVISED, 1968.)

§ 1-176—Trackless trolley coach.—Every motor vehicle which is propelled by electric power obtained from overhead trolley wires but not operated upon rails.

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[5]By the above definition the terms "street" and "highway" are synonymous and interchangeable.

[6]This definition should be omitted by states in which streetcars are not in operation.

§ 1-177—Traffic.—Pedestrians, ridden or herded animals, vehicles, streetcars and other conveyances either singly or together while using any highway for purposes of travel.

§ 1-178—Traffic-control signal.—Any device, whether manually, electrically or mechanically operated, by which traffic is alternately directed to stop and permitted to proceed. (REVISED, 1962.)

§ 1-179—Trailer.—Every vehicle with or without motive power, other than a pole trailer, designed for carrying persons or property and for being drawn by a motor vehicle and so constructed that no part of its weight rests upon the towing vehicle.

§ 1-180—Transporter.—Every person engaged in the business of delivering vehicles of a type required to be registered hereunder from a manufacturing, assembling or distributing plant to dealers or sales agents of a manufacturer.

§ 1-181—Truck.—Every motor vehicle designed, used or maintained primarily for the transportation of property.

§ 1-181.1—Truck camper.—Any structure designed, used or maintained primarily to be loaded on or affixed to a motor vehicle to provide a mobile dwelling, sleeping place, office or commercial space. (NEW, 1971.)

§ 1-182—Truck tractor.—Every motor vehicle designed and used primarily for drawing other vehicles and not so constructed as to carry a load other than a part of the weight of the vehicle and load so drawn.

§ 1-183—Urban district.—The territory contiguous to and including any street which is built up with structures devoted to business, industry or dwelling houses situated at intervals of less than 100 feet for a distance of a quarter of a mile or more. (NEW, 1954.)

§ 1-184—Vehicle.—Every device in, upon or by which any person or property is or may be transported or drawn upon a highway, excepting devices used exclusively upon stationary rails or tracks. (REVISED, 1975.)

§ 1-185—Vehicle identification number.—The numbers and letters, if any, designated by the department for the purpose of identifying the vehicle or the unique identifier assigned to each vehicle by the manufacturer pursuant to regulations. (NEW, 1979.)