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# **Secondary Controls in Domestic 1986 Model Year Cars**

Paul Green  
Don Ottens  
Sue Adams

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16. Abstract <p>This report describes a survey of 1986 model year domestic and imported cars. A total of 236 cars were examined, representing 90% of the cars domestically produced or imported to the United States for that model year. The data were collected by visiting car dealerships and surveying all models and body styles (i.e., 2-door, 4-door, station wagons, etc.). For each car surveyed, 31 secondary controls (e.g., front wiper, turn signal, dome light, etc.) were examined in order to answer the following questions:</p> <ul style="list-style-type: none"> <li>- Where were the switches for these controls located?</li> <li>- What kind of switches were used for each control?</li> <li>- What motions were used to operate these controls?</li> <li>- How were the switches labeled?</li> <li>- Were there any patterns in switch location or design by manufacturer?</li> </ul> <p>The report contains a large number of tables and figures that answer these questions.</p>			
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## EXECUTIVE SUMMARY

The purpose of this survey was to provide the Chrysler Corporation with data on the location, type of switch used, and method of operation for 31 secondary controls (wipers, etc.) found in 1986 model year cars sold in the U.S. In addition, information on how controls were labeled was also obtained. Those data were used to decide which switch designs to test in a subsequent experiment on driver preferences for controls.

In all, data on 236 make/model combinations was collected by visiting car dealerships in the Ann Arbor, Michigan, area. These combinations covered (in excess of) 90% of the cars sold in the U.S. for the 1986 model year.

The following table condenses the results of the survey. There are 31 entries, one for each of the secondary controls surveyed. The radio and climate controls were only surveyed for their locations (zone). All 29 other controls were surveyed for the following additional characteristics: type of switch, method of operation required to operate the control, labeling, directionality of the switch used, etc. The table that follows conveniently summarizes three of the most important control characteristics examined: location (zone), type of switch, and method of operation used for that particular control. The first column of the table lists the control; the second column labeled "(%) Zone" gives the percentage of all controls found in the given zone. The next two columns give the percentage of all controls which were a given switch type and the percentage of all controls which were activated by a given method of operation.

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Condensed Results of Secondary Controls Survey

CONTROL	CONTROL CHARACTERISTICS		
	(%)Zone	(%)Switch	(%)Operation
Auditory Horn	(62)center wheel hub (24)right & left spokes	(82)push surface <20*	(97)push forward <20*
Climate	(59)center console	-not surveyed-	-not surveyed-
Cruise Acceler.	(57)absent (23)1st left stalk	(51)slide (28)push button	(54)push right (30)push forward
Cruise Coast	(76)absent (9)right wheel spoke	(77)push button <20*	(55)push forward <20*
Cruise On/Off	(42)absent (29)1st left stalk	(56)4-position rocker <20*	(43)push right (40)push forward
Cruise Resume	(41)absent (35)1st left stalk	(57)slide (25)push button	(48)push right (25)push forward
Cruise Set	(41)absent (35)1st left stalk	(80)push button <20*	(62)push right (25)push forward
Dome Light	(34)lower left dash (25)center ceiling	(34)turn-pull-push knob (25)slide	(35)twist left(-Tx) (28)push up
Fog Lights	(81)absent (5)lower left dash	(44)2-position rocker (22)rotary knob	(67)push forward <20*
Front Defrost	(59)lower right dash (23)upper right dash	(61)slide (29)push button	(56)push right (30)push forward
Front Washer	(39)1st left stalk (34)1st right stalk <20*	(40)large lever (24)push-paddle (22)push button	(36)pull towards (36)push forward <20*
Front Wiper	(39)1st left stalk (35)1st right stalk	(39)large lever (33)rotary knob	(20)push up <20*
Hazard Light	(49)right side column (21)left side column <20*	(25)push-pull knob (20)push-push button <20*	(42)push left/up (25)push forward (24)push down
Headlights/ Parking lights	(38)lower left dash (21)1st left stalk <20*	(33)turn-pull-push knob (28)rotary knob (20)2-position rocker	(36)pull towards (27)push forward (22)twist left(-Ty)

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CONTROL	CONTROL CHARACTERISTICS		
	(%)Zone	(%)Switch	(%)Operation
High Beams	(97)1st left stalk	(99)large lever	(84)pull towards
Optical Horn	(72)absent (24)1st left stalk	(86)large lever <20*	(77)pull towards (21)push forward
Panel Lights	(65)lower left dash <20* <20*	(33)rotary knob (33)turn-pull-push knob (23)thumb wheel	(38)twist left (-Tx) (22)push up <20*
Radio	(50)lower right dash (21)center console	-not surveyed-	-not surveyed-
Rear Defrost	(31)lower right dash <20*	(43)2-position rocker (24)push button	(82)push forward <20*
Rear Washer	(85)absent (3)1st right stalk	(63)2-position rocker <20*	(74)push forward <20*
Rear Wiper	(85)absent (3)1st right stalk	(66)2-position rocker <20*	(77)push forward <20*
Steering Adjustment	(98)absent (2)2nd left stalk	(100)lever <20*	(83)pull towards <20*
Suspension Adjustment	(99)absent (1)center console	(100)lever <20*	(100)pull towards <20*
Turn Signal	(96)1st left stalk	(99)large lever	(98)push up/down
Power Door Locks	(63)absent (25)upper door <20*	(37)2-position rocker (33)push button (28)paddle	(38)push left (24)push down <20*
Power Seat Back Tilt	(96)absent (2)floor console	(30)push button (30)paddle	(40)push forward (30)push down
Power Seat Forward/Back.	(75)absent (10)left side seat	(85)joystick <20*	(86)push forward <20*
Power Seat Lumbar Adj	(75)absent (1)floor console <20*	(50)2-position rocker (50)joystick <20*	(50)push down (25)push forward (25)force not along axis
Power Seat Pan Adjust	(75)absent (10)left side seat	(45)paddle <20*	(50)push up/down (24)push down

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CONTROL	CONTROL CHARACTERISTICS		
	(%)Zone	(%)Switch	(%)Operation
Power Seat	(76)absent	(75)joystick	(49)push up/down
Up/Down	(10)left side seat	<20*	(37)push right/left
Power Window	(52)absent	(61)2-position rocker	(50)push down
	(33)upper door	(34)paddle	(20)push forward

\* Denotes that other zones (or switch types, or operations) accounted for less than 20% of all cases.

# PREFACE

This research was supported by the Chrysler Corporation under the Chrysler Challenge Fund Program. The purpose of that program is to:

1. establish more direct access to the advanced technologies being developed in universities,
2. promote increased interaction between Chrysler engineering activities and research personnel at university centers of engineering excellence, and
3. increase undergraduate and graduate student awareness of employment opportunities with the Chrysler Corporation.

We would like to thank Jim Pitt and Tom Hamilton of the Chrysler Corporation for their assistance and unlimited patience in guiding this project. They know that good research takes time to do and gave us the time to do it well.

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This report describes work carried out by the Human Factors Division of the University of Michigan Transportation Research Institute (UMTRI). As is the case with almost all research now, this project was a team effort. This project was managed by Paul Green, an Assistant Research Scientist in the Human Factors Division and an Adjunct Assistant Professor of Industrial and Operations Engineering. The data were collected by Don Ottens and Ray Krusic, with help from Chris Turner. All three were engineering students at the University of Michigan when the data were collected. In addition, Paul Green and Sue Adams, a human factors engineer in the Division, collaborated in analyzing the data, and Kris Zeltner, an engineering student, produced many of the tables in this report. Finally, this report was written by Paul Green, Don Ottens, and Sue Adams.

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# INTRODUCTION

This is the second in a series of reports describing research carried out at the University of Michigan Transportation Research Institute (UMTRI). The purpose of this series is to provide Chrysler with information they can use to design easy-to-use secondary controls for cars in the early 90's and beyond. The first report reviewed the literature on human factors and secondary controls such as the lights, wiper, etc. (Turner and Green, 1987). This second report describes which kinds of switches were used in 1986 model year cars for secondary controls. The final report (Green, Kerst, Ottens, Goldstein, and Adams, 1987) describes an extensive laboratory experiment concerning current driver preferences for switch types and control locations.

The initial report in this series (Turner and Green, 1987) reviewed the literature on human factors and automobile secondary controls. It is exhaustive in its coverage and is written primarily from a research perspective. The purpose of that report was to identify research methods used in previous studies that might be applicable to the preference study described later. It also identifies how the results using different methods compare, and provides design recommendations for control design. Those design recommendations appear near the end of that report.

In the third report (Green, Kerst, Ottens, Goldstein, and Adams, 1987), driver preferences for secondary controls and locations were obtained. Drivers were seated in a mockup of a future vehicle with a velcro-covered instrument panel. They selected the switches they preferred for about two dozen functions from a large selection of knobs, slide switches, rocker switches. Drivers then placed each switch in the desired location.

Obviously, to carry out such an experiment, information was needed on exactly what kinds of switches were being used so they could be tested. That information was collected for 1986 model year cars in this survey. While the UMTRI team was intimately familiar with the designs in question, their knowledge was not exhaustive prior to this survey. It was critical that such information be very complete, as preference studies such as this one are quite costly, and as indicated in the literature review that follows, done very infrequently. In this case the literature did not provide any help in deciding which switch designs to test.

The statistics from this survey should also be useful to the Chrysler Design Staff by providing insight into

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future driver expectancies for controls. (They have full knowledge of what is on the market, but have not yet seen the statistics presented here.)

As is noted in Anacapa Sciences (1976), driver expectancies for controls are influenced by the vehicles they have driven in the past; this is referred to as expectancy lag. In the early 90's there will be a large number of '86 model year vehicles still on the road, and hence, expectancies will be very much influenced by current designs. Further, because models can remain unchanged for several years, some current control designs will still be produced in the early 90's.

Expectancies are important because people respond most rapidly and accurately to control designs they expect (Anacapa Sciences, 1976). Minimizing the time and errors associated with using controls minimizes the total time the driver is distracted from the road, which reduces the chance of an accident. Aside from the obvious safety implications, drivers want (and prefer) to buy cars that are easy-to-use.

#### **Previous Surveys of Control Location**

Others have tallied the location of controls in production vehicles. There are nine reports in the literature addressing the issue of control location, mostly from the 70's. As will become clear, in many cases the data do not reflect current design practice. Several studies are described in detail here to emphasize that point. However, the methods used are still quite appropriate, and from that perspective, are worth reviewing.

#### **Woodson, Conover, Miller, and Selby (1969)**

This report (see also Conover, Woodson, Selby, and Miller, 1969) describes research carried out by Man Factors, Inc., under contract to the U.S. Department of Transportation (DOT). This report was the first major human factors review of automobile instrument panel controls and displays. It determined representative interior dimensions for cars (e.g., seat height), and reviewed how well controls and displays followed human factors principles. It also examined the consistency of design practices for control/display location, accessibility, and identification. To obtain that information, 45 American and 23 foreign 1969 model year cars were examined. The sample included most of the popular models of that period.

Woodson et al. (1969) provide only very limited statistical data on control location, method of operation, and labeling. That study emphasized critiquing existing control design over codifying the prevailing design

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practices. The pertinent results are presented in Table 1 to illustrate how much design practices have changed.

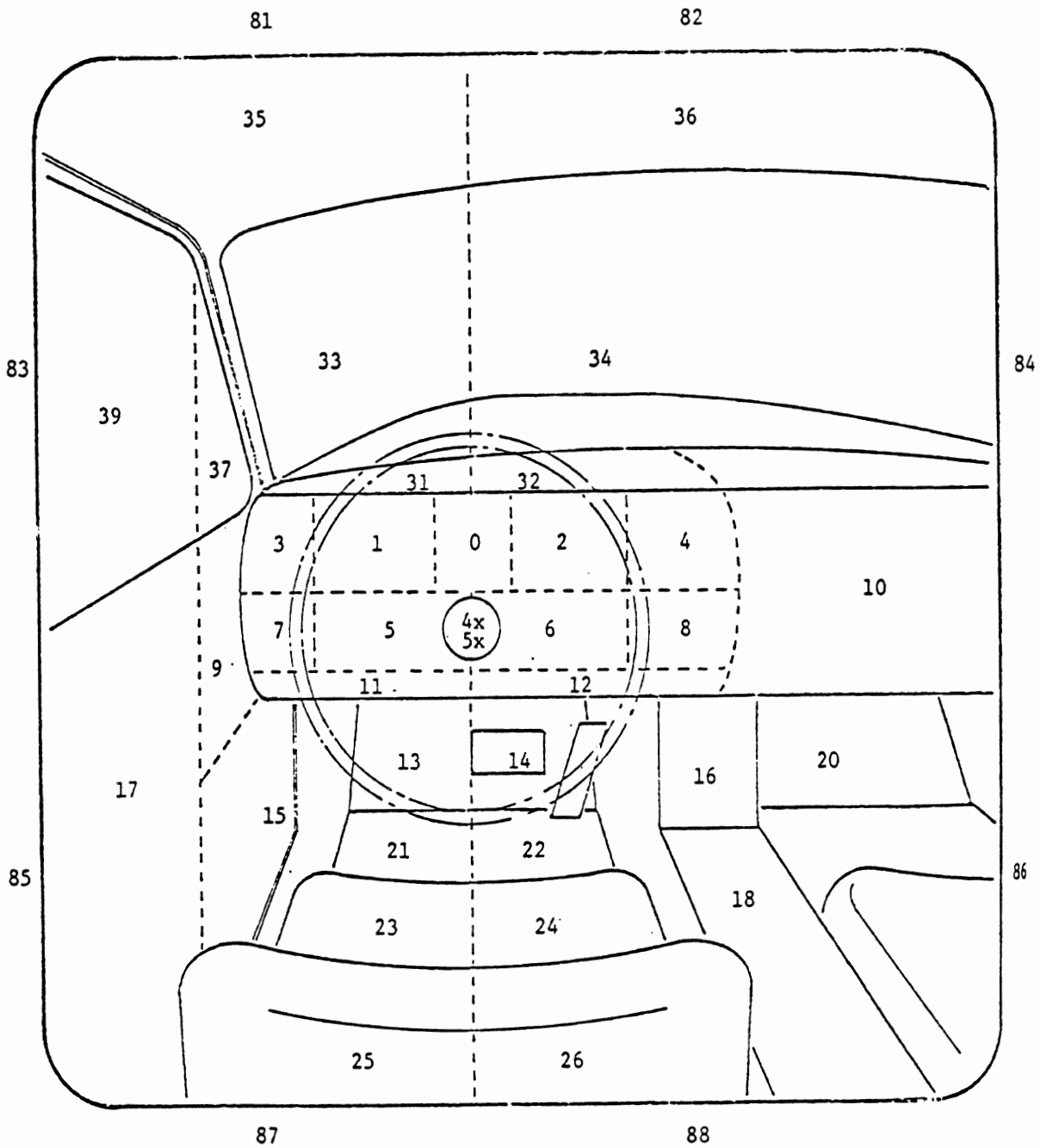
Table 1. Data on Controls, Woodson et al. (1969)

CONTROL	LOCATION	SWITCH TYPE
Lights on/off	left of steering wheel on panel (some on right panel or stalk)	circular pull-push knob (some rocker switches)
Wiper	left panel (some on right panel)	round knob (some rocker and slide switches, some stalk controls)
Washer		push button (some foot switches)
Climate Control	right of steering wheel (some left of strg. wheel; on dash or console in foreign cars)	34 different configurations
Radio	right of steering wheel	round knobs (design consistent across cars)
Ignition	right side of column (some on left side)	
Cruise Control (rarely found)	turn signal lever	
Hi Beam	floor mounted, left foot	push-push button

**Malone, Krumm, Shenk, and Kao (1972)**

Subsequent to the Man Factors project, Essex Corporation carried out a similar study for the Department of Transportation. Appendix A of the final report (Malone et al., 1972) describes a survey of 128 1970-model year cars in 37 model categories (unique instrument panel designs). Data was obtained from owner's manuals supplied by the manufacturers. Using the zones shown in Figure 1, the location of controls was identified. That zone structure is an important contribution of this study and has been used in virtually every subsequent study concerning control location. In the survey reported here, their scheme was used in a slightly modified form (more detail was provided).

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- 4x Steering Column
- 5x Steering Wheel
- 8x Behind Driver's Head
- 99 Cannot be seen or touched from within the vehicle
- 90 Automatic

Figure 1. Zones Used in Malone et al. (1972)

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From this data, Malone et al. computed commonality indices, which appear to be the percentage of all controls (not just secondary controls) for each pair of vehicles that were in the same zone. (The description of the computational procedure is unclear.) Values ranged from just over 25% to just under 85% with a median of 45%. (Readers should bear in mind that the computed similarity depends upon how many zones there were.)

Malone et al. carried out several analyses to determine the similarities of car instrument panels. The farther apart the curb weight of the cars being compared, the greater the differences in their instrument panels. There was greater consistency within manufacturers than between manufacturers. Datsun had the most consistent instrument panel designs followed by Toyota, Chrysler, GM, Ford, and Volkswagen. It is not clear if Malone's data takes into account the number of models produced.

Malone et al. also provide considerable data on various control characteristics. Some of this data is summarized in Table 2 (controls and/or characteristics not pertinent to the 1986 car survey are not presented here). The term "combined" has been used in Table 2 to describe those controls that share a common point of attachment. Malone et al. refer to this as "integrated". Again, the data show a diversity of designs.

#### **Anacapa Sciences (1974, 1976)**

Two Anacapa Sciences reports concern control locations. The 1976 (final) report describes what was done, while the 1974 (progress) report contains most of the figures. In brief, the locations of 12 controls were examined in 77 American and 38 foreign-made 1973 models. The data were obtained from owner's manuals and showroom inspections. Scatter plots for 10 of the controls (headlight, wiper, washer, climate, ignition, flasher, lighter, ashtray, radio, dimmer, defroster, horn) in the progress report are reproduced in Appendix A.

Anacapa noted that in collecting data, they did not use the same sampling procedure as Malone et al. Nonetheless, their results "generally agreed with those reported by the Essex investigators" (p. 10). To facilitate a direct comparison, the Anacapa data have been tabulated using the Essex zone scheme in Figure 1. (See Table 4.) Notice that except for a shift in the location of the ashtray (from under the dash to the center of the vehicle), a shift of the climate control system to higher locations on the dash (from zones 5, 6, and 8 to zones 1 and 2), and an increase in the percentage of floor mounted dimmer switches (to 85%), there are few changes in control arrangement over the two-year period. Anacapa recommended the Essex data be used in

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Table 2. Control Characteristics, Malone et al. (1972)

CONTROL	CHARACTERISTICS	
	Switch Type	Combined
-----		
Headlight	push-pull knob 94%	w/dome lights 87%
	vertical rocker 3%	w/courtesy lights 93%
	vertical toggle 3%	w/parking lights 94%
		w/panel lights 94%
.....		
Front Wiper (operation)	horiz. toggle (rt. to start) 21%	w/washer 72%
	vert. toggle (up to start) 16%	
	vert. toggle (down to start) 8%	
	rotary knob (rt. to start) 29%	
	rotary knob (lft. to start) 8%	
	rocker (down to start) 3%	
	thumb wheel 3%	
	knob (pull to start) 12%	
.....		
Wheel Tilt	vertical lever 100%	w/turn signal 21%
.....		
Horn (location)	pad (2 spoke) 44%	
	pad (3 spoke) 7%	
	push button (along spoke) 7%	
	push button (end of spoke) 14%	
	push button (center) 7%	
	wheel rim 16%	
	half ring 5%	
.....		
Cruise Control	push button 5%	w/turn signal 42%
.....		
High Beam	floor button 75%	w/turn signal 25%
.....		
Windshield Washer	push button 61%	w/wiper 72%
	rotary 11%	
	floor button 8%	
	push button 20%	
.....		
Rear Defog	vertical toggle 52%	
	rocker 24%	
	horizontal 20%	
	rotary 4%	
.....		
Hazard	pull knob 69%	
	push button 31%	

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preference to their own. In discussing this issue, Anacapa noted that one should be careful in using the Essex data because of problems with how the instrument panel is partitioned into zones as noted above. They suggest that instead of using the raw commonalty score, the data should be weighted based on the sales of the cars in question.

Related to this work is the McGrath (1974) report. That document describes the expectancies of European drivers and the location of controls in European cars. Since the current research concerns American drivers, McGrath (1974) will not be discussed.

**Krumm (1974)**

The work of Krumm (1974) was concerned with the effects of air bag design on use of the horn and stalk controls. Incidental to a survey of problems drivers had using stalk controls, data on the types of stalk controls being produced were collected. In a survey of almost 400 drivers, Krumm distinguished 25 vehicle types and 61 combinations of stalk controls. There were four basic families: one-left; one-left, one-right; two-left; and two-left, one-right. In addition to the turn signal, the dimmer, optical horn, headlights, and wiper/washer controls were also stalk-mounted at times.

**Mourant, Moussa-Hamouda, and Howard (1977)**

In a manner similar to Krumm (1974), Mourant et al. collected incidental data on stalk controls. Data was obtained from 405 drivers on problems in using controls. A total of 55% of those in the sample drove vehicles with stalk controls. Shown in Table 3 are the stalk configurations found. Note the variety, even within manufacturers.

**Green (1979)**

This report describes the design and method of operation of stalk controls in all U.S. and many foreign cars produced between 1977 and 1979. The purpose of the review was to identify the various schemes being used by manufacturers, but no statistical summaries were provided.

This report identifies five basic stalk configurations, the four found by Krumm (1974) plus a one-left, two-right configuration. The one-left, one-right configuration was most popular, especially with foreign manufacturers. The one-left (multifunction) stalk was most popular with domestic manufacturers. Ford exhibited the most diversity producing cars with stalk control designs in four of the five categories. All other manufacturers used only one design, though in general, there was no consistency as to

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Table 3. Number of Cars with Given Stalk Control Designs, Mourant et al. (1977)

MAKE	STALK CONFIGURATION			
	1-Left	1-Left & 1-Right	2-Left	2-Left & 1-Right
1. Datsun	28	6	-	-
2. Volkswagen	10	22	-	-
3. Toyota	24	8	-	-
4. Mercedes	28	1	2	-
5. Capri	31	-	-	-
6. Volvo	16	13	-	-
7. Opel	28	-	4	24
8. Fiat	-	-	4	24
9. Audi	4	22	-	-
10. MG	-	22	-	-
11. Colt	20	-	-	-
12. Mazda	-	-	11	-
13. Triumph	-	10	-	-
14. Mustang II	9	-	-	-
15. Granada	8	-	-	-
16. Subaru	5	3	-	-
17. Porsche	1	6	-	-
18. Alfa Romeo	2	-	5	-
19. Honda	3	3	-	-
20. Austin Marina	-	6	-	-
21. BMW	-	4	-	-
22. Renault	-	3	1	-
23. Peugeot	-	3	1	-
24. Mercury Monarch	2	-	-	-
25. Saab	-	1	-	-
26. Jaguar	1	-	-	1
27. Ferrari	-	-	-	1
28. Chevette	1	-	-	-
29. Cricket	-	-	-	1
30. Simca	-	-	1	-
31. English Ford Cortina	1	-	-	-
<b>Total</b>	<b>222</b>	<b>133</b>	<b>24</b>	<b>26</b>



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how many stalks were used, which functions were on which stalks, and which motions were associated with each function.

**Friedman and Schmitz (1981)**

This progress report describes work carried out by Minicars, Inc. for the U.S. Department of Transportation. (See Khadilkar, 1983 for a summary.) One of the tasks in the Minicars contract was a survey of the location of 23 controls and accessories in 1980 vehicles. They used the zone scheme described in Malone et al. (1972). Included in the survey were all make/model cars, light trucks, and vans that represented 1% or more of U.S. production. The distribution data for controls appear in Table 1.

Table 4 shows the frequency with which various controls were located in the zones used by Malone et al. (1972). The leftmost value of each triple are the data from Malone et al. (1972), the second triple are the data from Anacapa Sciences (1976), and the third from Friedman and Schmitz (1981). The only secondary control that occupied the same zone in all cars was the turn signal. Important secondary controls found in multiple zones include the climate controls (3, 5, 6, 8, 12), the flasher (46, 45, 3, 7, 8, 1, 11, 40), and the dimmer (13, 45). The reader should note that in many ways these data do not reflect current design practice. For example, in this data set 76% of the dimmer switches were floor-mounted.

**Summary**

While there have been several reviews of the location and method of operation of controls, most have focused entirely on stalk controls. There are only three studies in the literature that give an extensive statistical summary of the location of controls. The most comprehensive (Malone et al.) is now 15 years old and no longer reflects current design practice. Anacapa reports their data are similar to Malone's and suggest Malone should be used instead. The most recent study (Friedman and Schmitz, 1981), is also beginning to show its age. From this evidence one could infer that the data in studies on control location cease to reflect current design practice approximately five years after they are published.

However, the literature does indicate how the location of controls should be identified. All of the comprehensive studies of controls since 1972 have used the scheme developed by Malone et al. and, for the sake of consistency, a modified version of that scheme was used here as well.

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Table 4. Percent of Controls Located in Each Zone, Malone et al. (1972)/Anacapa Sciences (1976)/Friedman and Schmidt (1981).

ZONE	CONTROL						
	Ashtray	Climate	Dimmer	Hazard/ Flasher	Ignition	Lights On/Off	Lighter
0		--/--/02			00/02/--	--/02/--	
1		05/12/--		05/00/--		11/14/05	
2	03/02/--	03/23/--		00/02/02		03/00/--	--/08/--
3		03/00/--		03/06/--		32/39/08	
4	08/05/--	32/19/--				03/00/--	--/10/--
5		22/17/--		00/02/02		22/20/22	
6	03/05/--	16/12/--		00/02/02	--/11/--		--/13/--
7		--/--/14		03/00/--		22/20/51	
8	32/48/--	11/06/73		03/00/--		03/00/--	--/38/--
9							
10	08/17/--	00/02/--					--/15/--
11				03/00/--		05/02/03	
12	35/07/--	03/02/--	00/01/31				--/05/--
13			76/85/--				
14			--/--/05				
15				--/--/44			
16	03/07/--	00/08/--		00/02/--			--/05/--
17							
18	05/10/--	08/00/--	00/02/--			00/02/--	--/05/--
19							
20							
21		03/00/--					
31							
32	03/00/--						
40				05/00/11			
45			24/12/--	22/00/14			
46				57/87/75	--/87/--		
50							
51							
52							
451			--/--/64			--/--/10	
452							
461							
462							

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ZONE	Radio <sup>+</sup>	Rear Defrost <sup>+</sup>	Turn Signal	Washer	Window Control	Wiper	Vent
0		--/--/29					--/--/27
1		11/--/02		03/10/05		03/10/05	--/--/05
2	05/15/03	03/--/02		11/12/--		11/12/--	
3		08/--/04		27/22/12		27/21/12	12/--/--
.....							
4	30/23/24	16/--/13		11/05/--		11/05/--	04/--/56
5		05/--/05		32/07/17		32/14/17	02/--/--
6	27/31/08	14/--/16		05/12/02		05/12/02	02/--/06
7		03/--/04		03/22/21		03/21/21	02/--/--
.....							
8	24/25/37	08/--/20		00/05/02		00/02/--	06/--/--
9				03/00/--	66/--/--	03/00/--	
10	03/06/05	--/--/02					02/--/--
11		11/--/05		00/02/--			37/--/05
.....							
12	05/00/--	03/--/--		05/00/--			04/--/--
13				00/02/--			02/--/--
14							
15					07/--/--		20/--/--
.....							
16	--/--/22	--/--/02				00/02/--	
17							
18							
19							
.....							
20							02/--/--
21							
31							02/--/--
32							
.....							
40							
45			100/--/--				
46							
50							
.....							
51							
52				--/--/17			
451			--/--/100		--/--/18		
452				--/--/14		--/--/14	

-- The control was not surveyed for that study.

+ Five percent of the vehicles in the Essex study did not have a radio, 19% did not have a rear defrost control.

\* For the panel brightness in the Khadilkar study (1983), 54% of the controls were found in zone 7, while 27% were in zone 5.

## Scope of This Experiment

This report is concerned with secondary controls in 1986 cars. This report examines only cars with internal combustion engines. Vans and trucks are not included nor are electric vehicles. Further, this report examines domestic and foreign cars sold in the United States. Thus, cars manufactured by AMC-Renault, Audi, BMW, Chrysler, Ford, General Motors, Honda, Mazda, Mercedes-Benz, Nissan, Peugeot, Saab Scania, Subaru, Toyota, Volkswagen and Volvo, were considered as well as some Isuzu and Hyundai cars. Since limited production run cars (e.g., Ferarri, Jaguar, Lotus, Lamborghini, Maserati, Porsche, Rolls-Royce) represent a small fraction of the market and tend to be conservative in design, reviews of them were ignored. Reproductions (Avanti, Stutz-Bearcat, etc.) were also ignored because there are so few of them.

Chrysler identified about 30 functions to be included in the survey:

- . lighting (head lights on/off, high beam (beam switching and flashing), dome light, fog lights, panel brightness, hazard)
- . wiper/washer (both front and rear)
- . optical and audible horn
- . defrost (both front and rear)
- . turn signal
- . radio (location only)
- . climate controls (location only)
- . cruise controls (on/off, set, coast, accelerate, resume)
- . power windows, power seats (up/down, forward/back, back tilt, lumbar support, pan adjustment), and power door locks
- . steering and suspension adjustment

This survey addressed the following issues:

1. Where are the controls for these functions located?

The focus of this work is on identifying the zones in which controls are found. While the exact x, y, z coordinates could be obtained, these locations are more

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time-consuming to collect. Also, this would not be consistent with the procedure established by Malone et al.

2. What kinds of switches are used for each control?

There are many kinds of switches that might be used for secondary controls (push buttons, rocker switches, toggle switches, rotary knobs, etc.). Of interest was how frequently each switch type was used for each function.

3. What motions are used to operate these controls?

Clearly controls should operate in a way drivers expect them to, and to some degree expectancies are determined by what is common practice.

4. How are the switches labeled?

One way that drivers learn what controls are for is from their labels. The U.S. Department of Transportation is quite interested in this question.

5. Are there any patterns in switch location or design by manufacturer?

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# SURVEY PLAN

## How the Data Were Collected

The survey was carried out at various auto dealers in the Ann Arbor, Michigan, area. Prior to visiting a dealer, permission to carry out the survey was always obtained by phone.

It took approximately 15 to 40 minutes to survey one car. Most cars were examined in the dealer showrooms, although some were examined on the dealer lots. The experimenters examined cars one at a time, working straight through the survey from beginning to end. Each vehicle was examined by only one experimenter, though multiple experimenters were used to collect all of the data, as noted in the preface. To keep procedures consistent, experimenters worked together in several pilot tests of the survey procedure. Further, the experimenters met regularly to discuss coding decisions.

After the survey was complete, the experimenter picked up advertising brochures for the car examined. The original plan called for photographing the instrument panel of every car examined, using ruled dowels to provide a dimensioned frame of reference. This proved extremely difficult to do because auxiliary lighting was usually required (most car interiors were dark), and it was difficult to get in the proper position without removing the driver's seat. Slides made from the advertising brochures proved to be vastly superior, so they were used instead.

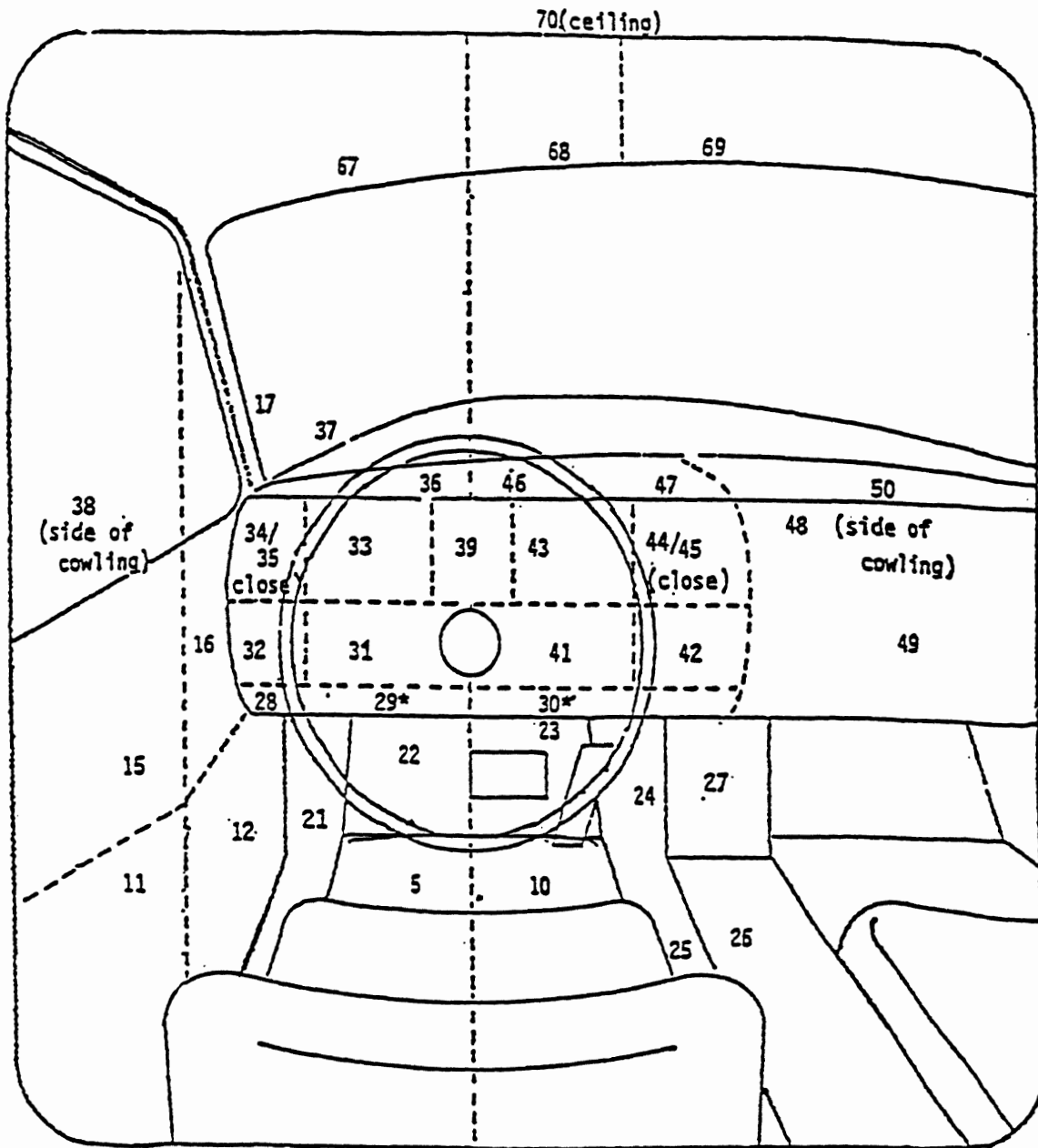
## Survey Materials

The survey data were collected using a four-page form shown in Appendix B and a coding guide. The coding guide consisted of six pieces of 8-1/2 x 11 inch cardboard that were taped together. On them were mounted a list of switch types and numbers, a diagram of the zone scheme, a method of operation table, and a list of ISO symbols.

### Coding Guide

The Zone Diagram identifies, using a two digit code, the regions where secondary controls might be found. (See Figure 2.) This coding scheme was modified from one used by Malone, Krumm, Shenk, and Kao (1972) to provide additional detail. As noted in Turner and Green (1987), as long as controls are within five inches of where drivers expect them to be, the exact location of a control has a minimal effect on performance. The modification of the Malone et al. (1972) scheme provided that level of specificity.

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\*28,29,30 are underneath

- 1-10 floor
- 11-20 door
- 21-30 lower body, firewall, console, under IP
- 31-40 panel left
- 41-50 panel right

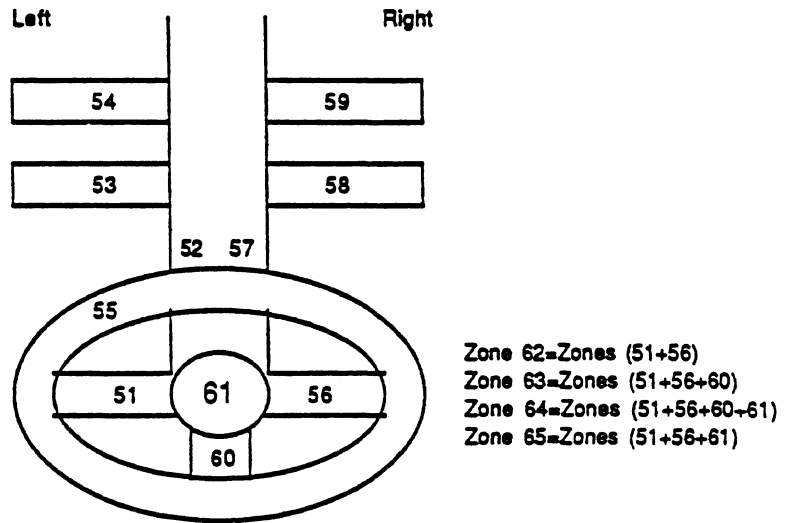
- 51-65 column or steering wheel
- 67-69 header, 70 ceiling
- 71- out of reach
- 72- automatic
- 73- not provided
- 74- other
- 80-82 seat

Figure 2. Zone Diagram



- SURVEY PLAN -

Zones on the steering wheel or steering column



Top view of drivers area

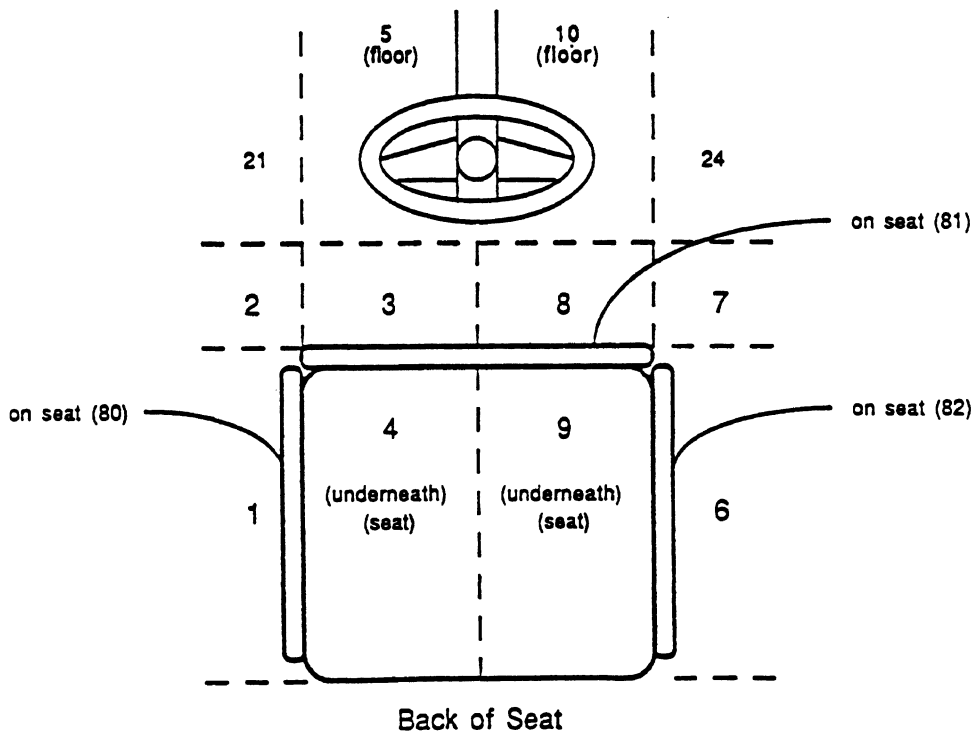
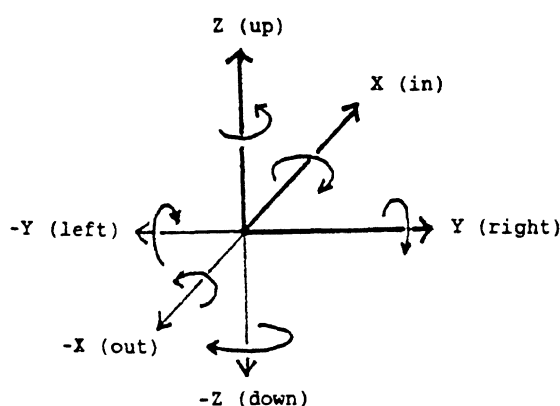


Figure 2. Zone Diagram (Continued)

- SURVEY PLAN -

The Method of Operation Table identifies the direction of the force or torque required to operate a control. (See Table 5.) The notation is based on the right-hand rule from physics. Therefore, to the right, forward, and up are all associated with positive values. The surveyor recorded the method of operation required to turn on or increase a control. This data was collected because it is important that drivers be able to operate controls as well as locate them (Mourant, Moussa-Hamouda, and Howard, 1977). Of course their ability to do so depends on how well the method of operation matches what drivers expect.

Table 5. Method of Operation Table



#	Vector	Motion	#	Vector	Motion
1	F <sub>x</sub>	push in	13	T <sub>x</sub>	twist in
2	F <sub>y</sub>	push right	14	T <sub>y</sub>	twist right
3	F <sub>z</sub>	push up	15	T <sub>z</sub>	twist up
4	-F <sub>x</sub>	pull out	16	-T <sub>x</sub>	twist out
5	-F <sub>y</sub>	push left	17	-T <sub>y</sub>	twist left
6	-F <sub>z</sub>	push down	18	-T <sub>z</sub>	twist down
7	+/-F <sub>x</sub>	push in/pull out	19	+/-T <sub>x</sub>	twist in/out
8	+/-F <sub>y</sub>	push right/left	20	+/-T <sub>y</sub>	twist right/left
9	+/-F <sub>z</sub>	push up/down	21	+/-T <sub>z</sub>	twist up/down
10	F <sub>x&amp;y</sub>	push/pull in/out, left/rt.	22	T <sub>x&amp;y</sub>	twist in/out, left/rt.
11	F <sub>x&amp;z</sub>	push/pull in/out, up/down	23	T <sub>x&amp;z</sub>	twist in/out, up/down
12	F <sub>y&amp;z</sub>	push/pull left/rt., up/down	24	T <sub>y&amp;z</sub>	twist left/rt., up/down
		25 force not along axis			
		26 torque not along axis			
		27 multiple (twist & push)			
		99 not fitted			

- SURVEY PLAN -

The Switch List is a comprehensive (but not exhaustive) list of 54 switch types (Table 6). A number of the switch types listed (e.g., mouse, puck) are not yet available in cars. This list was compiled in part from lists in human factors references (e.g., McCormick and Sanders, 1982; Pew and Green, 1986).

Table 6. Switch Type List

#	TYPE	EXAMPLE
-----		
<u>Uni-axial Hand Controls</u>		
(push in to operate)		
01	push button	radio station selection
02	push-push button	stereo loudness
03	push-paddle switch	Mazda 626 wiper
04	two-position rocker switch	rear defrost on/off
05	push-pull knob	
06	strip switch	rim blow horn
07	keyboard	qwerty keyboard
08	touchscreen	computer input
09	push surface	horn
10	lever	
11	four-position rocker switch	power seat adjuster
12	other	
(push aside to operate)		
21	slide switch	temperature control
22	toggle switch (bat handle)	wall light switch
23	paddle switch	power window
24	thumbwheel	panel brightness
25	small lever	similar to slide switch
26	large lever	turn signal stalk
(pull out to operate)		
31	pull-push knob	GM hazard switch
32	pull cord	bus (passengers)
33	pull chain	closet light
34	lever	
35	toggle	
36	paddle	
37	other	
(turn to operate)		
41	rotary handgrip	motorcycle
42	key switch	ignition
43	rotary knob	radio volume
44	other	

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(grasp and move)

51	large graspable lever	shift
52	knife switch	power switch
53	crank	car window
54	steering wheel	car steering, valve handwheel
55	other	

(other)

61	dial	telephone
62	other	

Uni-axial Foot Controls

65	foot pedal	brake
66	foot crank	bicycle
67	foot push button	
68	foot push-push button	old high-beam switch
69	other	

Multi-axial Controls

81	large lever	turn signal or high beam
82	joystick (finger-sized)	stereo balance
83	joypad	Keytronics device
84	turn-pull-push knob	GM light switch
85	turn-push knob	Mazda 626 radio
86	track ball	radar targeting
87	light pen	CRT
88	mouse	computer
89	puck	digitizer
90	paddle switch	seat adjuster
91	other	
99	not fitted	

- SURVEY PLAN -

The ISO Symbols Array shows the 46 symbols in ISO Standard 2575 (International Standards Organization, 1975) and their two digit code numbers. (See Figure 3.)

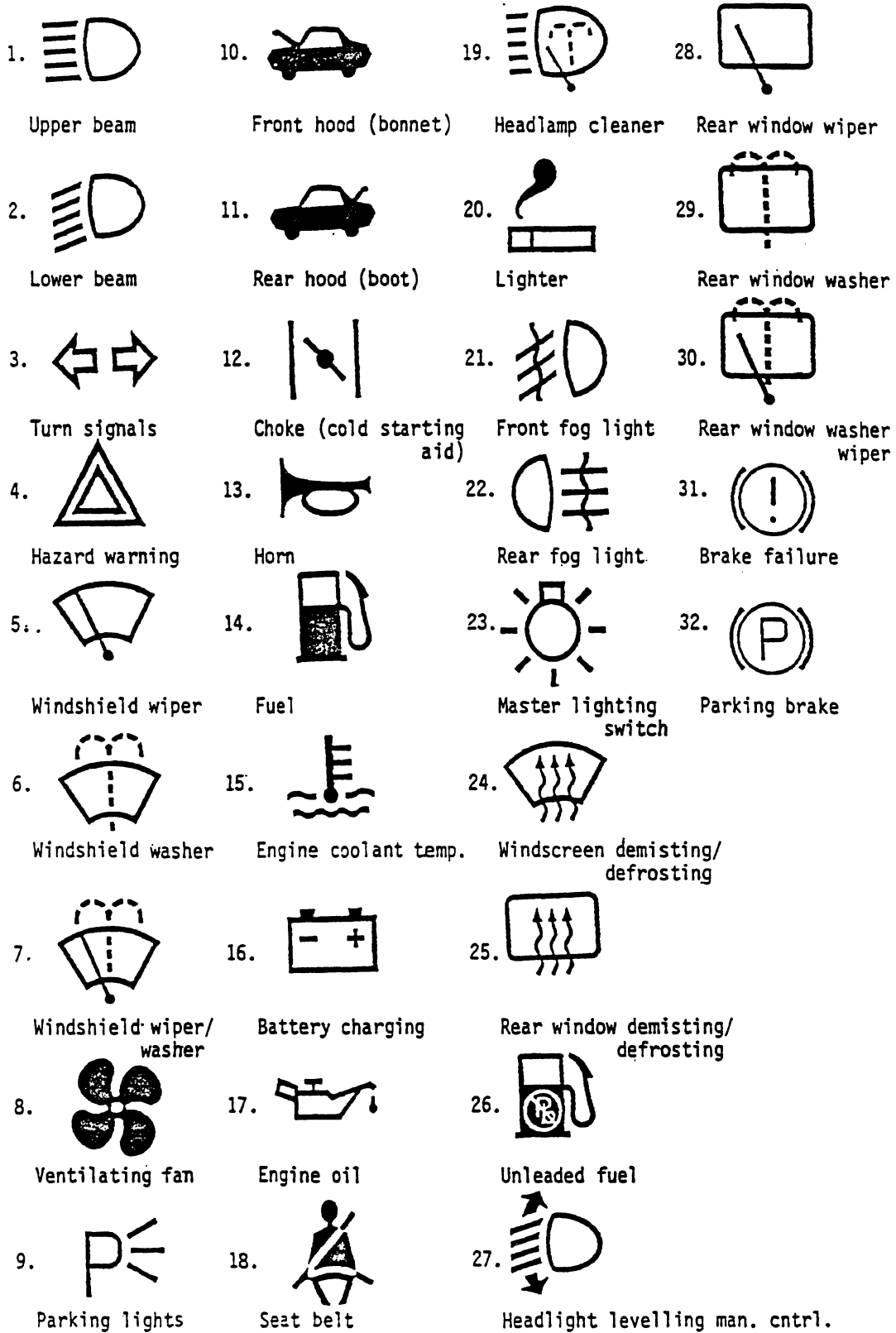


Figure 3. ISO Symbols Array

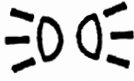













- |     |   |     |   |
|-----|---|-----|---|
| 33. |    | 41. |    |
|     | Position Lamp   |     | Air vent-right outlets  |
| 34. |    | 42. |    |
|     | Diesel pre-heat   |     | Air vent-left outlets   |
| 35. |    | 43. |    |
|     | Long range lamp   |     | Air ventilation-leg room  |
| 36. |   | 44. |   |
|     | Engine  |     | Air vent-right and left outlets   |
| 37. |  | 45. |  |
|     | Interior heating  |     | Windshield wiper intermittent   |
| 38. |  | 46. |  |
|     | Air Cond. Sys.  |     | Heated seat   |
| 39. |  |     |   |
|     | Off   |     |   |
| 40. |  |     |   |
|     | Air vent-all outlets  |     |   |

Figure 3. ISO Symbols Array (Continued)

### Survey Form

The first page of the survey form (shown in Appendix B) was used to record general information such as the make and model of the car being examined, the dealership name and address, and so forth. Pages two through four were used to record detailed data on each of the 31 secondary controls described previously. For each control the following information was collected:

1. Location - The two digit zone number corresponding to the approximate location of each control was determined from the Zone Diagram (Figure 2).
2. Method of Operation - The motion used to turn on or increase the setting of each control was recorded using the Method of Operation Table (Table 5).
3. Switch Type - A two-digit code corresponding to the switch type used for each control (e.g., push button, thumbwheel, toggle switch, etc.) was recorded. The list of candidates is shown in Table 6.
4. Positions - The number of modes a control could operate in was recorded. On and off were considered two modes. Controls that were continuous (infinitely variable) were recorded as such.
5. Dedication - A dedicated control is one whose action does not depend upon the mode or position of another control. For example, suppose a joystick served as the power mirror control. If a toggle switch was then used to determine whether the joystick adjusted the left or right mirror, then the joystick would be nondedicated because its action would depend upon the state of the toggle switch. However, the toggle switch would be dedicated because its action would not depend upon the position of another control.
6. Combination - Combined controls share a common point of attachment or are mounted on top of one another. For example, because the turn signal and cruise controls are sometimes located on the same stalk, these controls would be considered combined. While combining controls can reduce the space required, it may increase the opportunity for inadvertent errors.
7. Directionality - This characteristic refers to the number of axes along which a switch can be operated. A push button is uni-axial because it can only be operated along one axis. Some stalks, however, are multi-axial because they can be operated along more than one axis. Using multi-axial switches is another way of increasing the number of functions that can be controlled by a single switch.

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8. Integration - An integrated control is one whose activation causes another control(s) to be turned on. An example is the windshield washer. In most cars, when the windshield washer is turned on the wipers are also activated. If a control is not integrated, it is referred to as separated.

9. Labeling - If a control was labeled with a standard ISO symbol, the corresponding ISO code number was recorded. If some non-ISO symbol was present this was also recorded. In addition, if the positions of a control were labeled, this was indicated on the survey form.

10. Remarks - Finally, the form provided a space for recording any comments.

The terminology described above was developed and the associated information was collected to help identify unique control configurations and suggest to designers where there are opportunities for innovation. In a previous study where this was done (Green, 1979) the perspective was not deemed very useful at the time. In fact, several years later, many of the novel configurations identified (e.g., nondedicated touch screen controls) have begun to appear in production vehicles. For that reason, the expanded terminology has been included here.



## RESULTS AND DISCUSSION

This section provides the answers to the five questions raised in the introduction:

1. Where are the controls located?
2. What kinds of switches are used for each control?
3. What motions are used to operate each control?
4. How are the switches labeled?
5. Are there any patterns in switch location or design by manufacturer?

### Dedication, Combination, Directionality, and Integration

Common to all of these questions is a concern for how controls are structured, which pertains to the issues of dedication, combination, directionality, and integration as described in the survey plan section. In brief, all of the switches examined in this study were dedicated, that is each switch had a fixed purpose. In the future, as touch screens and other multipurpose interfaces are introduced into vehicles, that will no longer be true.

Table 7 addresses the issues of combination, directionality, and integration. The high beams, wiper, washer, and turn signal functions tended to be combined with other functions (usually each other) about 60% of the time. In contrast, some controls (defrost, suspension and steering adjust, power door lock, power windows) were never combined with other controls.

With regard to directionality, most controls were uni-axial in a majority of the vehicles surveyed. A few controls, such as the high beams, optical horn, and turn signal, were almost always multi-axial. As was discussed in the survey plan section, using multi-axial switches increases the number of functions that can be controlled by a single switch. For several controls (headlights/parking lights, dome light, panel lights, front wiper and washer) designs were less consistent.

Virtually all of the controls were separated; that is, activation of a switch did not cause another control to be activated. The exceptions were the front and rear washer, in which case operating the washer sometimes turned on the wiper as well.

- RESULTS AND DISCUSSION -

Table 7. Combination, Directionality, and Integration

Functions	Control Characteristics* (%)					
	Combination		Directionality		Integration	
	Com.	Noncom.	Uni-ax.	Multi-ax.	Integr.**	Separ.
Head/Parking Lights	22.9	77.1	60.6	39.4	0.0	100.0
High Beams	62.7	37.3	2.1	97.9	0.0	100.0
Dome Light	3.1	96.9	65.2	34.8	0.0	100.0
Fog Lights	13.3	86.7	100.0	0.0	8.9	91.1
Hazard Lights	5.7	94.3	65.9	34.1	0.4	99.6
Panel Lights	.0	100.0	99.2	0.8	0.0	100.0
Audible Horn	0.8	99.1	99.1	0.8	0.0	100.0
Optical Horn	19.7	80.3	15.2	84.8	0.0	100.0
Front Wiper	69.5	30.5	44.1	55.9	0.0	100.0
Rear Wiper	20.0	80.0	80.0	20.0	2.9	97.1
Front Washer	65.7	34.3	44.5	55.5	35.2	64.8
Rear Washer	17.1	82.9	82.9	17.1	51.4	48.6
Turn Signal	66.1	33.9	0.8	99.2	0.0	100.0
Cruise On/Off	57.6	42.4	95.7	4.3	0.0	100.0
▪ Set	68.6	31.4	97.1	2.9	2.2	97.8
▪ Resume	67.6	32.4	95.0	5.0	2.9	97.1
▪ Coast	35.7	64.3	100.0	0.0	0.0	100.0
▪ Accelerate	60.8	39.2	92.2	7.8	0.0	100.0
Climate Control	----- Only location examined -----					
Front Defrost	0.0	100.0	100.0	0.0	0.0	100.0
Rear Defrost	0.0	100.0	100.0	0.0	1.3	98.7
Radio	----- Only location examined -----					
Steering Adjust.	0.0	100.0	100.0	0.0	0.0	100.0
Suspension Adjust.	0.0	100.0	100.0	0.0	0.0	100.0
Power Door Lock	0.0	100.0	100.0	0.0	0.0	100.0
Power Windows	0.0	100.0	100.0	0.0	0.0	100.0
Power Seat Up/Down	1.8	98.2	21.1	78.9	0.0	100.0
▪ Forward/Back.	8.6	91.4	10.3	89.7	0.0	100.0
▪ Back Tilt	0.0	100.0	90.0	10.0	0.0	100.0
▪ Lumbar Adjust	25.0	75.0	50.0	50.0	0.0	100.0
▪ Pan Adjust.	1.7	98.3	84.5	15.5	89.7	10.3

\* All functions surveyed were dedicated controls.

\*\* Integrated controls also include the "special cases."

### Patterns in Switch Design and Location

A second issue is the consistency within manufacturers. Table 8 shows the number of different zones in which particular controls were found, divided by the number of models examined for a given manufacturer in which the control was provided. While the sample sizes for some manufacturer are small, the data show a lack of consistency in design. For example, while only three Isuzu models were examined, some controls (headlights/parking lights, panel light, hazard) were located differently in each model. On the other hand, of the 25 Chevrolet models examined, the headlights were found in 5 different zones, the hazard switch in 4, the horn in 3, and the front wiper in 5. Comparable levels of diversity are found in Pontiacs, Oldsmobiles, Fords, Chryslers, and Plymouths. (See Table 8.)

With regard to switch type, the degree of diversity is not as great as in the zone data. (See Table 9.) Note, for example the Chevrolet and Isuzu data where the number of switch types used is less than the number of zones used. In fact, for most manufacturers, only one or two types of switches were used for most controls.

### The Role of Production Sizes

The intent of this study was to determine the likelihood that a person driving a randomly selected 1986 car would encounter a particular switch in a particular location. A critical issue was whether it was necessary to adjust the data on control characteristics based on the number of cars produced in 1986. For this reason, the data (e.g., the likelihood a control was found in a particular zone) from each of the 236 cars were weighted according to the 1986 production totals for each car. (See Appendix C for how those production totals were obtained). The weighted data were then compared to the original (unweighted) data. For example, it is much more likely a driver would encounter a 1986 Ford Escort than a 1986 Mercedes Benz 560 SL, but in a simple analysis both would be counted equally in terms of where a driver would encounter a control and what type of switch would be used for a control. By weighting the data according to production totals the Ford Escort would be given more emphasis.

- RESULTS AND DISCUSSION -

**Table 8.** Number of Zones in which Controls Were Found for Each Manufacturer (# of different zones the control was found in/# of cars examined in which control was provided)

Control Manufacturer*	Headlt.	Dome Lt.		Panel Lt.		Aud. Horn		Fr. Wiper		
	Hi Beam		Fog Lt.	Hazard		Opt. Horn		Rr. Wiper		
AMC (2)	1/2	1/2	1/2	--	1/2	1/2	1/2	--	1/2	--
Chrysler (8)	2/8	1/8	2/8	--	2/8	2/8	3/8	--	1/8	1/1
Colt (16)	5/16	1/16	3/16	1/1	3/16	3/16	2/16	--	3/16	4/6
Plymouth (7)	2/7	1/7	2/7	--	2/7	1/7	2/7	--	1/7	1/2
Ford (16)	2/16	1/16	1/16	2/6	1/16	2/16	2/16	1/16	3/16	--
Lincoln (3)	1/3	1/3	2/3	1/1	1/3	1/3	1/3	--	1/3	--
Mercury (13)	2/13	2/13	1/12	1/1	2/13	1/13	2/13	1/9	4/13	1/1
Bulck (14)	3/14	1/14	4/14	--	3/14	2/14	4/14	--	2/14	--
Cadillac (6)	2/6	1/6	2/6	1/1	2/6	2/6	2/6	--	3/6	--
Chevrolet (25)	5/25	1/25	5/24	1/1	5/25	4/25	3/25	--	5/25	--
Oldsmobile (14)	5/14	1/14	6/14	--	5/14	1/14	3/14	--	2/14	--
Pontiac (20)	3/20	1/20	4/20	3/10	4/19	1/20	1/20	--	2/20	--
Volkswagon (8)	2/8	1/8	2/8	--	2/8	2/8	2/8	--	1/8	1/3
Audi (4)	2/4	2/4	2/4	--	2/4	2/4	1/4	--	2/4	1/1
BMW (5)	3/5	1/5	3/3	4/5	4/5	2/5	2/5	1/5	2/5	--
Nissan (12)	1/12	1/12	2/12	2/2	3/12	7/12	2/12	2/9	1/12	4/4
Fiat (1)	1/1	1/1	1/1	--	1/1	1/1	1/1	1/1	1/1	--
Honda (8)	1/8	1/8	1/8	--	3/8	2/8	2/8	--	1/8	1/1
Isuzu (3)	3/3	1/3	2/2	1/1	3/3	3/3	2/3	2/3	2/3	1/1
Mazda (5)	2/5	2/5	2/5	--	3/5	3/5	1/3	1/2	2/5	1/1
Mercedes (4)	3/4	2/4	2/3	1/3	2/4	3/4	2/4	2/4	3/4	--
Peugeot (2)	1/2	1/2	--	--	--	1/2	1/2	--	1/2	--
Renault (4)	2/4	1/4	2/4	--	2/4	3/4	2/4	1/3	2/4	1/1
Saab (7)	2/7	1/7	3/5	1/1	3/7	2/7	4/7	1/6	1/7	1/1
Subaru (4)	2/4	1/4	2/4	2/4	2/4	1/4	1/4	1/3	2/4	1/3
Toyota (15)	2/15	1/15	1/14	--	5/15	4/15	1/15	1/1	3/15	5/5
Volvo (7)	2/7	1/7	1/7	2/7	2/3	2/7	2/7	1/7	1/7	1/1
Other (3)	3/3	3/3	1/2	1/1	3/3	3/3	2/3	2/2	2/3	2/3

\* The number in parentheses represents the number of cars produced by a given manufacturer which were surveyed in this study.

- RESULTS AND DISCUSSION -

Table 8. Number of Zones in which Controls Were Found for Each Manufacturer (Continued)

Control	Fr. Washer	Turn	Cruise Set	Cruise Coast	Climate Ctrl.		
Manufacturer*	Rr. Washer	Cruise	On/Off	Cruise Res.	Cruise Acc.	Fr. Defrost	
AMC (2)	1/2	--	1/2	--	--	--	1/2 1/2
Chrysler (8)	1/8	1/1	1/8	1/6	1/6	1/6	-- -- 3/8 3/8
Colt (16)	3/16	4/6	1/16	2/8	2/8	2/8	1/2 1/2 4/16 4/16
Plymouth (7)	1/7	1/2	1/7	1/1	1/1	1/1	-- -- 4/7 4/7
Ford (16)	3/16	--	1/16	1/13	1/13	1/13	1/13 1/13 3/16 3/16
Lincoln (3)	1/3	--	1/3	2/3	2/3	2/3	2/3 2/3 2/3 2/3
Mercury (13)	4/13	1/1	1/13	2/9	2/9	2/9	2/9 2/9 3/13 3/13
Buick (14)	2/14	--	1/14	2/14	2/14	2/14	1/1 2/14 2/14 1/14
Cadillac (6)	3/6	--	1/6	4/6	2/6	2/6	2/5 2/6 3/6 3/6
Chevrolet (25)	6/25	--	1/25	1/7	1/7	1/7	1/1 1/7 4/25 3/25
Oldsmobile (14)	2/14	--	1/14	1/11	2/11	1/11	-- 1/11 3/14 4/14
Pontiac (20)	2/20	--	1/20	2/13	2/15	1/13	-- 1/13 3/20 3/20
Volkswagon (8)	1/8	1/3	1/8	1/5	1/5	1/5	-- -- 2/8 2/8
Audi (4)	2/4	1/1	2/4	2/4	2/4	2/4	-- -- 2/4 2/4
BMW (5)	2/5	--	1/5	2/3	1/1	2/3	-- 2/3 2/5 2/5
Nissan (12)	2/12	4/4	2/12	2/6	2/6	2/6	2/6 2/6 2/12 2/12
Fiat (1)	1/1	--	1/1	--	--	--	-- -- 1/1 1/1
Honda (8)	1/8	1/1	1/8	1/3	1/3	1/3	-- 1/3 1/8 1/8
Isuzu (3)	2/3	1/1	2/3	--	--	--	-- -- 1/3 1/3
Mazda (5)	2/5	1/1	1/5	2/3	2/3	2/3	2/3 -- 2/5 2/5
Mercedes (4)	3/4	--	2/4	2/3	2/3	2/3	-- 1/2 3/4 2/4
Peugeot (2)	1/2	--	1/2	--	--	--	-- -- 1/2 1/2
Renault (4)	2/4	1/1	1/4	2/2	2/2	2/2	1/1 2/2 1/4 1/4
Saab (7)	1/7	1/1	1/7	3/4	2/5	2/5	1/1 1/1 2/7 2/7
Subaru (4)	2/4	1/3	1/4	2/4	2/4	2/4	2/4 -- 2/4 2/4
Toyota (15)	3/15	5/5	1/15	4/6	2/6	2/6	2/6 2/6 1/15 1/15
Volvo (7)	1/7	1/1	1/7	1/3	1/3	1/3	-- -- 1/7 1/7
Other (3)	2/3	2/3	2/3	1/1	1/1	1/1	1/1 1/1 3/3 3/3

\* The number in parentheses represents the number of cars produced by a given manufacturer which were surveyed in this study.

- RESULTS AND DISCUSSION -

Table 8. Number of Zones in which Controls Were Found for Each Manufacturer (Continued)

Control Manufacturer*	Rr.	Defrost	Steering	Adj.	Door	Seat up/down		Seat tilt	Seat pan	
		Radio		Suspen.	Adj.	Window	Seat fwd/back	Seat lumbar		
AMC (2)	1/2	1/2	--	--	--	--	--	--	--	--
Chrysler (8)	5/7	3/8	--	--	2/6	3/6	1/5	1/5	--	1/5
Colt (16)	6/16	4/16	--	--	2/5	1/5	2/4	2/4	--	2/4
Plymouth (7)	2/7	3/7	--	--	2/2	--	1/1	1/1	--	1/1
Ford (16)	3/16	2/16	--	--	1/6	3/11	1/3	1/3	--	1/3
Lincoln (3)	2/3	2/3	--	--	2/3	2/3	2/2	3/3	2/2	1/1
Mercury (13)	3/10	3/12	--	--	2/7	2/8	2/4	2/4	--	2/4
Bulck (14)	3/14	3/14	1/3	--	2/11	3/8	2/8	2/8	1/1	2/8
Cadillac (6)	3/6	3/6	--	--	2/6	2/6	2/6	2/6	--	2/6
Chevrolet (25)	6/23	3/20	--	--	2/5	2/5	2/4	2/4	1/1	2/4
Oldsmobile (14)	6/14	2/14	1/1	--	3/10	2/10	3/8	3/8	--	3/8
Pontiac (20)	5/20	3/20	--	--	2/11	2/9	1/2	1/2	--	1/2
Volkswagon (8)	2/8	2/8	--	--	--	1/1	--	--	--	--
Audi (4)	2/4	2/4	--	--	--	2/4	1/2	1/2	--	1/2
BMW (5)	3/5	1/5	--	--	--	1/5	2/4	2/4	2/4	2/4
Nissan (12)	6/12	2/12	--	--	1/2	1/6	--	--	--	--
Fiat (1)	1/1	1/1	--	--	--	1/1	--	--	--	--
Honda (8)	3/8	3/8	--	--	1/1	1/3	--	--	--	--
Isuzu (3)	2/3	2/3	--	--	--	1/1	--	--	--	--
Mazda (5)	3/5	2/5	--	1/1	--	1/3	--	--	--	--
Mercedes (4)	4/4	2/4	--	--	1/1	1/3	--	--	--	--
Peugeot (2)	1/2	1/2	--	--	--	--	--	--	--	--
Renault (4)	3/4	2/4	1/1	--	1/1	1/1	1/1	1/1	--	1/1
Saab (7)	3/7	3/5	--	--	1/1	2/2	1/1	1/1	--	1/1
Subaru (4)	1/3	1/4	--	--	1/3	1/4	--	--	--	--
Toyota (15)	6/15	2/15	--	--	1/3	1/3	--	--	--	1/1
Volvo (7)	2/7	2/7	--	--	1/2	2/5	1/2	1/2	1/2	1/2
Other (3)	2/3	2/2	1/1	--	1/1	1/1	--	--	--	--

\* The number in parentheses represents the number of cars produced by a given manufacturer which were surveyed in this study.

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**Table 9.** Number of Switch Types Used by Each Manufacturer  
 (# of different switch types used/# of cars examined in  
 which control was found)

Control	Headlt.	Dome Lt.	Panel Lt.	Aud. Horn	Fr. Wiper					
Manufacturer*	HI Beam	Fog Lt.	Hazard	Opt. Horn	Rr. Wiper					
AMC (2)	1/2	1/2	1/2	--	1/2	--				
Chrysler (8)	1/8	1/8	1/8	--	1/8	1/1				
Colt (16)	5/16	1/16	4/16	1/1	3/16	4/16	2/16	--	3/16	1/6
Plymouth (7)	1/7	1/7	1/7	--	1/7	2/7	2/7	--	1/7	1/2
Ford (16)	4/16	1/16	3/16	1/6	3/16	2/16	1/16	1/16	3/16	--
Lincoln (3)	2/3	1/3	2/3	1/1	2/3	1/3	1/3	--	1/3	--
Mercury (13)	4/13	2/13	3/12	1/1	3/13	2/13	1/13	1/9	4/13	1/1
Buick (14)	2/14	1/14	3/14	--	2/14	2/14	1/14	--	2/14	--
Cadillac (6)	2/6	1/6	2/6	1/1	2/6	2/6	1/6	--	3/6	--
Chevrolet (25)	4/25	1/25	4/24	1/1	2/25	5/25	2/25	--	5/25	--
Oldsmobile (14)	4/14	1/14	4/14	--	3/14	2/14	2/14	--	2/14	--
Pontiac (20)	3/20	1/20	3/20	3/10	3/19	1/20	2/20	--	2/20	--
Volkswagon (8)	1/8	1/8	3/8	--	1/8	1/8	1/8	--	1/8	1/3
Audi (4)	2/4	1/4	1/4	--	2/4	2/4	1/4	--	1/4	1/1
BMW (5)	5/5	1/5	3/3	4/5	3/5	2/5	1/5	2/5	2/5	--
Nissan (12)	2/12	1/12	4/12	2/2	2/12	4/12	1/12	2/9	1/12	3/4
Fiat (1)	1/1	1/1	1/1	--	1/1	1/1	1/1	1/1	1/1	--
Honda (8)	1/8	1/8	1/8	--	2/8	2/8	2/8	--	1/8	1/1
Isuzu (3)	3/3	1/3	2/2	1/1	2/3	2/3	1/3	2/3	2/3	1/1
Mazda (5)	1/5	1/5	1/5	--	1/5	2/5	1/3	1/2	2/5	1/1
Mercedes (4)	2/4	1/4	2/3	1/3	2/4	2/4	2/4	1/4	2/4	--
Peugeot (2)	1/2	1/2	--	--	--	1/2	1/2	--	1/2	--
Renault (4)	2/4	1/4	3/4	--	1/4	2/4	2/4	1/3	2/4	1/1
Saab (7)	2/7	1/7	2/5	1/1	2/7	2/7	1/7	1/1	2/7	1/1
Subaru (4)	2/4	1/4	1/4	2/4	2/4	2/4	1/4	1/3	2/4	1/3
Toyota (15)	3/15	1/15	1/14	--	2/15	2/15	1/15	1/1	4/15	2/5
Volvo (7)	1/7	1/7	2/7	1/7	1/3	2/7	2/7	1/7	1/7	1/1
Other (3)	3/3	2/3	2/2	1/1	2/3	2/3	1/3	2/2	2/3	2/3

\* The number in parentheses represents the number of cars produced by a given manufacturer which were surveyed in this study.

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Table 9. Number of Switch Types Used by Each Manufacturer  
(Continued)

Control	Fr. Washer	Turn	Cruise Set	Cruise Coast	Fr. Defrost
Manufacturer*	Rr. Washer	Cruise	On/Off	Cruise Res.	Cruise Acc.
AMC (2)	1/2	--	1/2	--	1/2
Chrysler (8)	1/8	1/1	1/8	1/6	1/8
Colt (16)	3/16	1/6	1/16	2/8	3/16
Plymouth (7)	1/7	1/2	1/7	1/1	2/7
Ford (16)	3/16	--	1/16	1/13	2/16
Lincoln (3)	1/3	--	1/3	2/3	2/3
Mercury (13)	3/13	1/1	1/13	1/9	2/13
Buick (14)	2/14	--	1/14	2/14	1/14
Cadillac (6)	2/6	--	1/6	1/6	1/6
Chevrolet (25)	4/25	--	1/25	1/7	2/25
Oldsmobile (14)	1/14	--	1/14	1/11	4/14
Pontiac (20)	3/20	--	1/20	1/13	2/20
Volkswagon (8)	1/8	1/3	1/8	1/5	1/8
Audi (4)	1/4	1/1	1/4	1/4	2/4
BMW (5)	2/5	--	1/5	1/3	3/5
Nissan (12)	1/12	3/4	1/12	2/6	3/12
Fiat (1)	1/1	--	1/1	--	1/1
Honda (8)	1/8	1/1	1/8	1/3	2/8
Isuzu (3)	2/3	1/1	1/3	--	1/3
Mazda (5)	2/5	1/1	1/5	1/3	1/5
Mercedes (4)	2/4	--	1/4	1/3	2/4
Peugeot (2)	1/2	--	1/2	--	1/2
Renault (4)	2/4	1/1	1/4	1/2	2/4
Saab (7)	2/7	1/1	1/7	2/5	2/6
Subaru (4)	1/4	1/3	1/4	1/4	1/4
Toyota (15)	2/15	3/5	1/15	2/6	2/15
Volvo (7)	1/7	1/1	1/7	1/3	2/7
Other (3)	2/3	2/3	3/3	1/1	2/3

\* The number in parentheses represents the number of cars produced by a given manufacturer which were surveyed in this study.



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Table 9. Number of Switch Types Used by Each Manufacturer  
(Continued)

Control	Rr.	Defrost	Suspen.	Adj.	Window	Seat fwd/back	Seat lumbar			
Manufacturer*	Steering	Adj.	Door	Seat up/down	Seat tilt	Seat pan				
AMC (2)	1/2	--	--	--	--	--	--	--	--	--
Chrysler (8)	3/7	--	--	2/6	2/6	1/5	1/5	--	--	1/5
Colt (16)	3/16	--	--	2/5	2/5	1/4	1/4	--	--	1/4
Plymouth (7)	2/7	--	--	2/2	--	1/1	1/1	--	--	1/1
Ford (16)	4/16	--	--	2/6	2/11	1/3	1/3	--	--	1/3
Lincoln (3)	2/3	--	--	2/3	2/3	1/2	2/3	2/2	1/1	2/3
Mercury (13)	3/10	--	--	3/7	2/8	2/4	1/4	--	--	2/4
Buick (14)	2/14	1/3	--	1/11	1/8	2/8	2/8	1/1	--	3/8
Cadillac (6)	2/6	--	--	3/6	2/6	1/6	1/6	--	--	3/6
Chevrolet (25)	4/23	--	--	2/5	2/5	1/4	1/4	1/1	1/1	1/4
Oldsmobile (14)	5/14	1/1	--	2/10	2/10	1/8	1/8	--	--	2/8
Pontiac (20)	4/20	--	--	2/11	2/9	1/2	1/2	--	--	1/2
Volkswagon (8)	1/8	--	--	--	1/1	--	--	--	--	--
Audi (4)	2/4	--	--	--	1/4	1/2	1/2	--	--	1/2
BMW (5)	2/5	--	--	--	2/5	2/4	2/4	2/4	--	2/4
Nissan (12)	3/12	--	--	1/2	1/6	--	--	--	--	--
Fiat (1)	1/1	--	--	--	1/1	--	--	--	--	--
Honda (8)	2/8	--	--	1/1	2/3	--	--	--	--	--
Isuzu (3)	2/3	--	--	--	1/1	--	--	--	--	--
Mazda (5)	2/5	--	1/1	--	1/3	--	--	--	--	--
Mercedes (4)	2/4	--	--	1/1	1/3	--	--	--	--	--
Peugeot (2)	1/2	--	--	--	--	--	--	--	--	--
Renault (4)	3/4	1/1	--	1/1	1/1	1/1	1/1	--	--	1/1
Saab (7)	2/7	--	--	1/1	1/2	1/1	1/1	--	1/1	1/1
Subaru (4)	1/4	--	--	1/3	1/4	--	--	--	--	--
Toyota (15)	3/15	--	--	1/3	2/3	--	--	--	1/1	--
Volvo (7)	1/7	--	--	1/2	1/5	1/2	1/2	1/2	--	1/2
Other (3)	2/3	1/1	--	1/1	1/1	--	--	--	--	--

\* The number in parentheses represents the number of cars produced by a given manufacturer which were surveyed in this study.

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Correlations were computed for four control characteristics: location, switch type, method of operation, and number of positions. Those values were computed both by control, and across all controls. For the location data, (1333 data points) the correlation between the weighted and unweighted data was almost perfect ( $r=.992$ ). When looking at those correlations by control (43 data points per control, 31 controls), the values ranged from .936 for the optical horn to 1.000 (perfect) for the turn signal, cruise control on/off, and front defrost. Hence, clearly for the zone data the unweighted values are virtually indistinguishable from the weighted values. Similar patterns were obtained for the other characteristics: switch type - .985 (range .944-1.000), method of operation - .981 (range .757-1.000), number of positions - .995 (range .883-1.000).

Based on these findings, the analysis that follows is based on the unweighted data. Those data were easier to deal with and allowed fewer opportunities for error. This suggests that for future studies where a large sample size is used (in this case over 90% of 1986 production) the data need not be weighted by production totals.

#### Organization of the Results on Each Control

Specifically, the remainder of the results section considers the 31 controls examined one at a time in the following order:

Audible Horn	Panel Lights
Climate Control	Radio
Cruise Control Accelerate	Rear Window Defrost
Cruise Control Coast	Rear Window Washer
Cruise Control On/Off	Rear Window Wiper
Cruise Control Resume	Steering Adjustment
Cruise Control Set	Suspension Adjustment
Dome Light	Turn Signal
Fog Lights	Power Door Locks
Front Windshield Defrost	Power Seat (back tilt)
Front Windshield Washer	Power Seat (forward/back)
Front Windshield Wiper	Power Seat (lumbar)
Hazard Lights	Power Seat (pan adjust)
Headlights/Parking Lights	Power Seat (up/down)
High Beams	Power Window
Optical Horn	

A four-page segment is devoted to each control. In each of these segments will be a Zone Figure, Switch Type Table, Method of Operation Table, and an ISO Symbols Table containing data about the specific control. These data will be discussed along with the pertinent information from Table 7, which concerns combination, directionality, and integration; Table 8 which examines variability in switch

- RESULTS AND DISCUSSION -

location by manufacturer and Table 9, which examines variability in switch type by manufacturer. For the radio and climate control, only location was examined.

On the Zone Figure for each control, varying sizes of dots are used to indicate the frequencies at which controls were found in the different zones. The dots shown in Figure 4 illustrate the scale used to present the results. The size of the dot is proportional to the frequency at which the switch was found in a particular zone. The location where the control was found most frequently is indicated by a block "M."

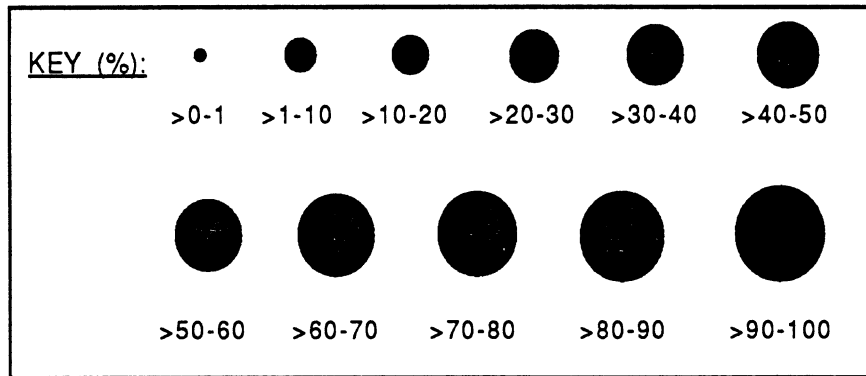


Figure 4. Scale Used to Present Location Results

### Audible Horn

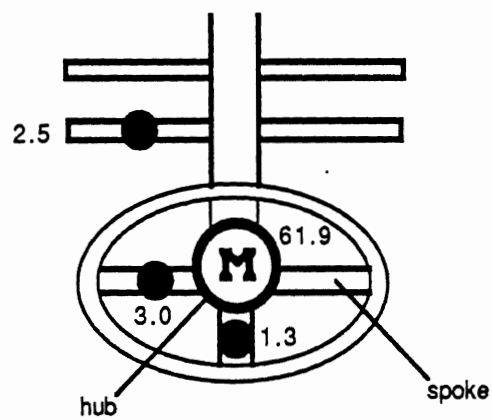
The audible horn, an essential safety component, is used in a variety of situations to provide warning information. The driver must be able to sound the horn without hesitation in order to alert pedestrians or other drivers of potentially dangerous situations. All of the 236 cars surveyed were equipped with an audible horn.

The Zone figure shows that in 61.9% of the cars surveyed the audible horn was located on the center hub of the steering wheel. Next most popular was to locate the horn on both the right and left spokes of the steering wheel (25.0%). All of the steering wheel-mounted audible horns were push surfaces. Some of the European manufacturers, like Renault, Mercedes Benz, and Volvo, placed the audible horn on the left stalk closest to the driver (2.5%). Two of these imports used a multi-axial large lever, while the remaining four incorporated a push button on the end of the large lever.

This shows a dramatic change from the data collected by Malone et al. (1972) who found that only 7% of the horn controls were located on the center hub, while 72% were located on various spokes or combinations of spokes. Also, 16% of the horn controls were located on the steering wheel rim, a configuration no longer employed. (See Table 2).

## AUDIBLE HORN

Location (% of switches in given location)



### Multiple Zone Positions

- 25.0 (right and left spokes)
- 2.5 (right, left, and bottom spokes)
- 2.1 (right and left spokes, and hub)
- 1.7 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table indicates 97.4% of the audible horn controls were push surfaces. As mentioned above, 2.6% of the controls were push buttons and .9% were multi-axial large levers. The Method of Operations Table shows that 97.4% of the horn controls were activated by a push in (forward). The ISO Symbol Table shows that 67.6% of the controls were identified by the "bugle" ISO symbol, .3% (2 cars) were identified by non-ISO symbols, and 32.1% (75 cars) were not labeled at all. Position labels were present on 19.2% of the controls. These position labels were arrows pointing toward the steering column, indicating that an inward push was required, and were located on the left stalk.

Furthermore, Table 7 shows that 99.1% of the audible horn controls were noncombined and uni-axial, while all of them were separated controls. The only combined and multi-axial controls were found in the two cars that used large levers. These levers were combined with the turn signals, optical horn, and other functions.

Table 8 shows that there was some variance in the location of the audible horn within most manufacturers. Buick and Saab showed the most variance between models, using 4 different horn locations.

Finally, Table 9 shows that nearly all of the car manufacturers used only one type of audible horn switch in all their models surveyed.

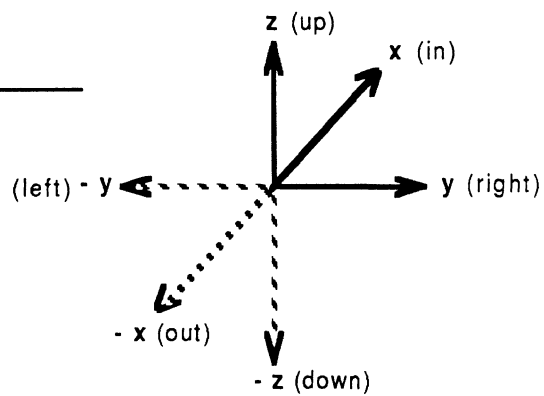
## AUDIBLE HORN

**Switch Type** (% of switches that are a given type)

%	Switch Type
97.5	push surface
2.6	push button
.9	large lever


**Method of Operation**(% of switches operated using given method)

%	Method of Operation
97.4	Fx
2.6	Fy



(axes relative to driver)

**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
67.6	

## Climate Control

The climate control unit adjusts the temperature and air flow inside the car. Some of the functions found in the climate control unit include air conditioning, heat, front defrost, vent, and so forth. All of the 236 cars surveyed were equipped with a climate control unit. In this study, only the location of the climate control was examined

The Zone Figure shows that in 58.9% of the cars surveyed the climate control was located on the lower right section of the dashboard. The next most popular location was on the upper right dashboard (22.5%).

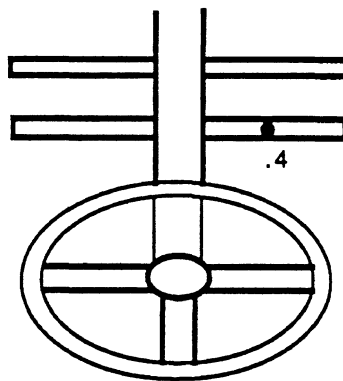
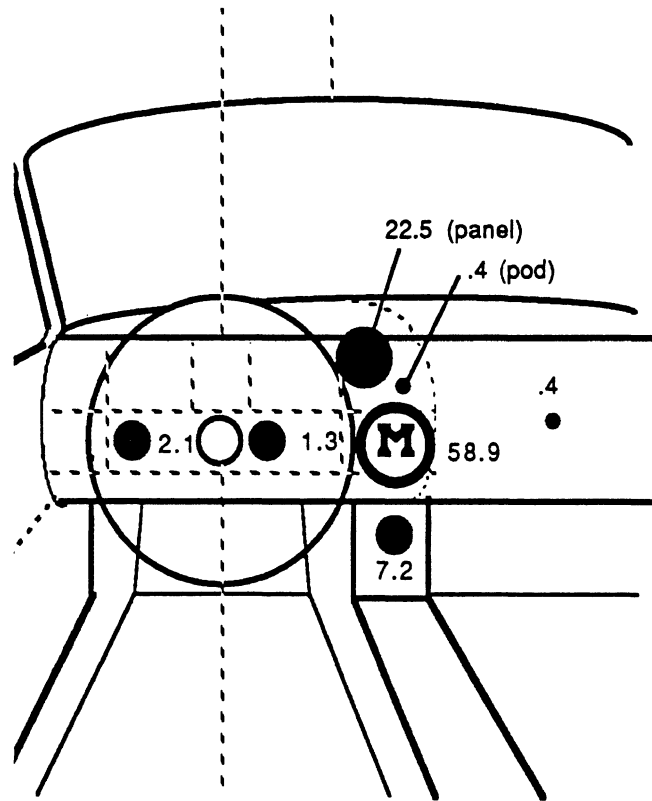
Since only the location of the climate control was of concern, there is no data on the switch type, method of operation, or ISO symbols used for the climate control.

Tables 7 and 9 do not apply to the climate control as explained above. Table 8 shows that some car manufacturers, such as Dodge Colt, Plymouth, and Chevrolet, used up to four different zones in their various models. The rest of the manufacturers, however, used only one or two distinct zones.



## CLIMATE CONTROL:

Location (% of switches in given location)



● 6.8 (multiple zones)

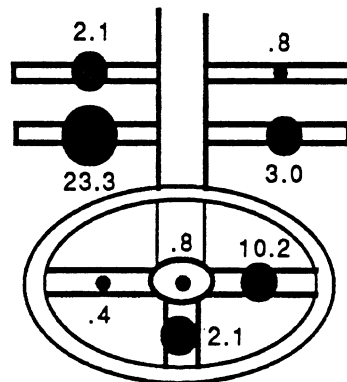
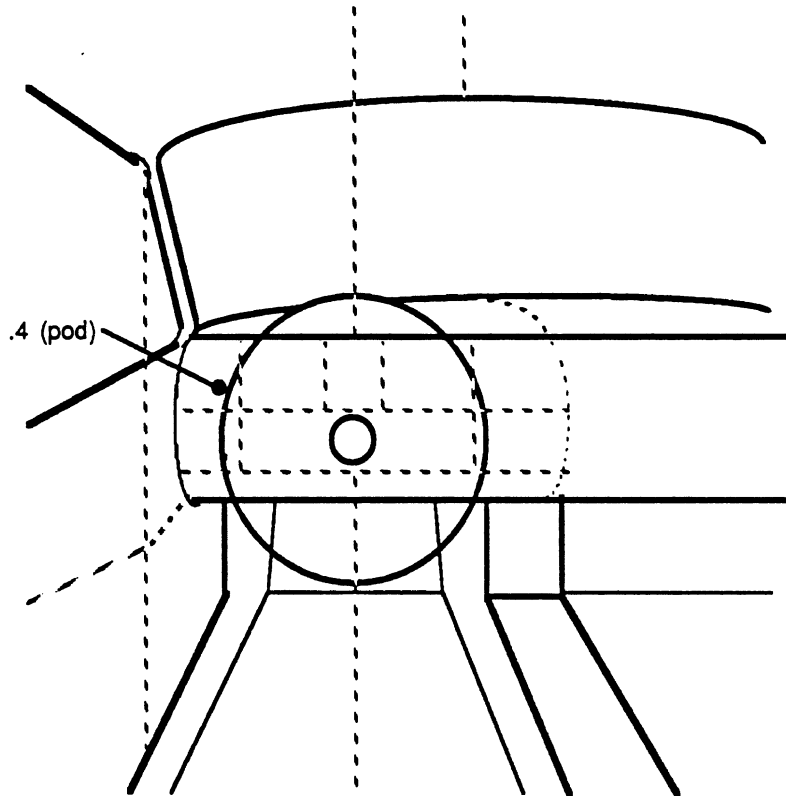
## Cruise Control Acceleration

The cruise control acceleration allows the driver to increase the speed of the car when the cruise control is engaged. Operating the acceleration control is equivalent to using the gas pedal of the car. Of the 236 cars surveyed, only 53.2% (102 cars) were equipped with cruise control acceleration.

The Zone Figure shows that the most popular location for this control was on the left stalk closest to the driver (23.3%). Of those left stalk-mounted controls 87.3% were slide switches. The next most popular zone was on the right spoke of the steering wheel (10.2%). All of these controls were push buttons.

## CRUISE CONTROL ACCELERATION

Location (% of switches in given location)



56.8 (not provided)

- RESULTS AND DISCUSSION -

The Switch Type Table indicates that 51.0% of the acceleration controls were slide switches, while 28.4% were push buttons. Moreover, 53.9% were activated by a push to the right (most were stalk-mounted controls). Another 30.4% required a push in (forward). None of the acceleration controls were identified by ISO symbols, but 56.9% were labeled with non-ISO symbols, such as "accel" or "accelerate", and 43.1% had no symbols. Finally, 54.9% had position labels such as "on/off".

Table 7 shows that 60.8% of the acceleration controls were combined with other controls. They were usually combined with the cruise resume and/or set controls. Also, 92.2% of the acceleration controls were uni-axial. Multi-axial acceleration controls were found in the BMW 528E 4-door and 635CSI 2-door sport coupe; the Mercedes Benz 300E 4-door sedan, 190E 4-door sedan, and 420SEL 4-door sedan; and the Nissan 300ZX 2-door and Stanza 4-door sedan and wagon. All of the controls were separated and dedicated.

Table 8 indicates that a majority of the manufacturers located the cruise acceleration control in one or two distinct zones.

Finally, Table 9 reveals that Nissan and Toyota showed more variance in acceleration control switch type than the other surveyed manufacturers, both used three different switch types.

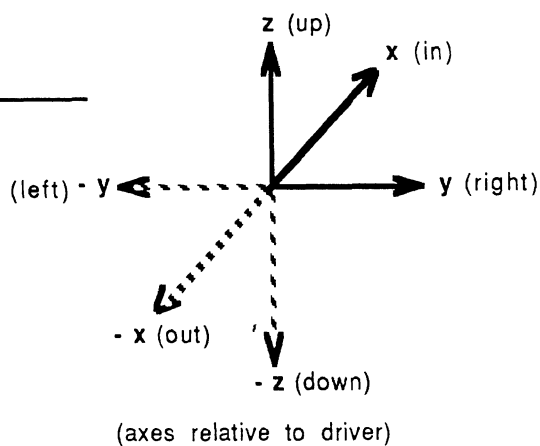
## CRUISE CONTROL ACCELERATION

Switch Type (% of switches that are a given type)

%	Switch Type
51.0	slide switch
28.4	push button
5.9	rotary knob
5.9	large lever (multi-axial)
4.9	two-position rocker switch
2.0	toggle (bat handle)
1.0	paddle switch (uni-axial)
1.0	large lever (uni-axial)

Method of Operation (% of switches operated using given method)

%	Method of Operation
53.9	F <sub>y</sub>
30.4	F <sub>x</sub>
5.9	-T <sub>y</sub>
3.9	-F <sub>y</sub>
2.9	+/-F <sub>z</sub>
2.0	-F <sub>x</sub>
1.0	F <sub>z</sub>



ISO Symbols (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

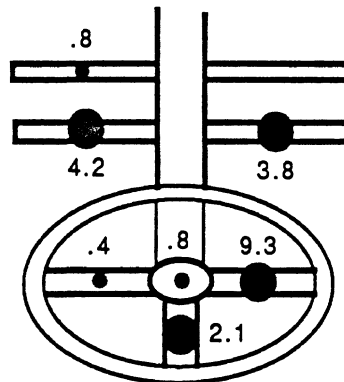
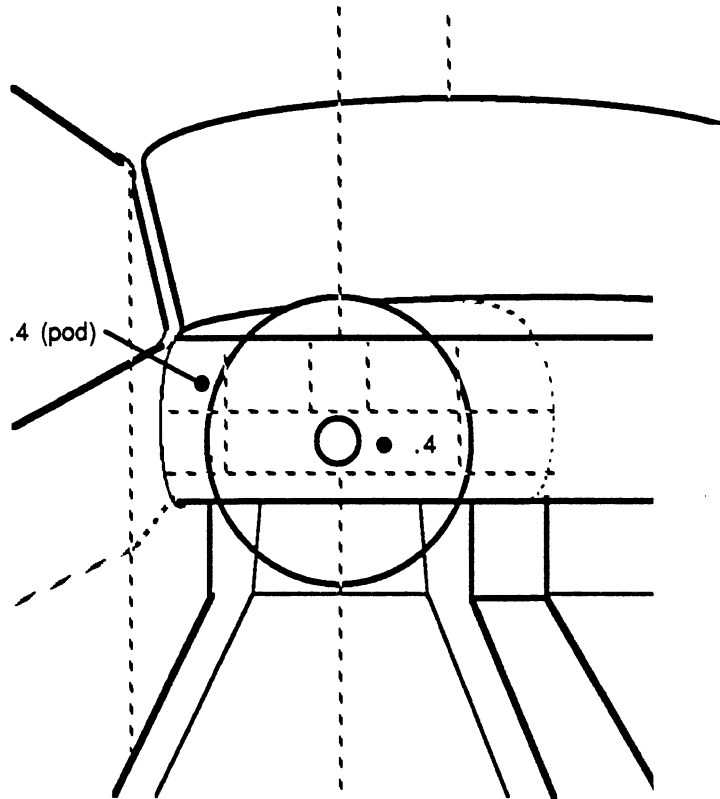
## Cruise Control Coast

The cruise control coast allows the driver to disengage the cruise control whenever it is in the "on" position. When the coast control is released, the cruise control returns to the previously set speed. The main advantage of the coast control is to give the driver the option to temporarily disengage the cruise control without actually turning it "off". Of the 236 cars surveyed only 23.7% (56 cars) were equipped with coast control.

The Zone Figure shows that in 9.3% of the cars surveyed the coast control was located on the right spoke of the steering wheel. Most of these cars were Ford models, and all of the controls were push buttons. Furthermore, in 4.2% and in 3.8% of the cars, the coast control was located on the left and right stalk closest to the driver, respectively. All of the left stalk-mounted coast controls were push buttons. Two-thirds of the right stalk-mounted coast controls were rotary knobs.

## CRUISE CONTROL COAST

Location (% of switches in given location)



76.3 (not provided)



1.3 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 76.8% of the coast switches were push buttons, while the next most popular switch type was the rotary knob (10.7%). The Method of Operations Table indicates that 55.4% of the coast switches were activated by a push in (forward), and 21.4% by a push to the right. None of the coast controls were identified by ISO symbols, but 82.1% were identified by non-ISO symbols such as "coast". No symbols were found on 17.9% of the controls. Finally, 28.6% of the switches had position labels present such as "coast on/off".

Table 7 shows that 64.3% of the coast controls were not combined with other controls. All of the coast controls surveyed were uni-axial, separated, and dedicated.

Furthermore, Table 8 indicates for those manufacturers that included the coast control, no more than two distinct locations were used.

Table 9 shows that nearly all of the manufacturers chose to use one type of switch to operate the cruise coast control (push button).



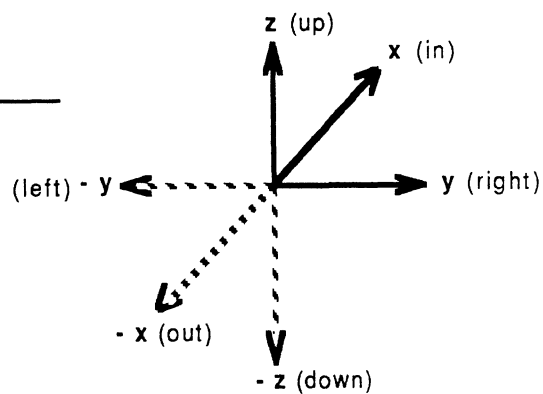
## CRUISE CONTROL COAST

**Switch Type** (% of switches that are a given type)

%	Switch Type
76.8	push button
10.7	rotary knob
5.4	slide switch
3.6	two-position rocker switch
1.8	paddle switch (uni-axial)
1.8	small lever (uni-axial)

**Method of Operation** (% of switches operated using given method)

%	Method of Operation
55.4	Fx
21.4	Fy
10.7	Ty
8.9	-Fy
1.8	-Fx
1.8	-Fz



(axes relative to driver)

**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

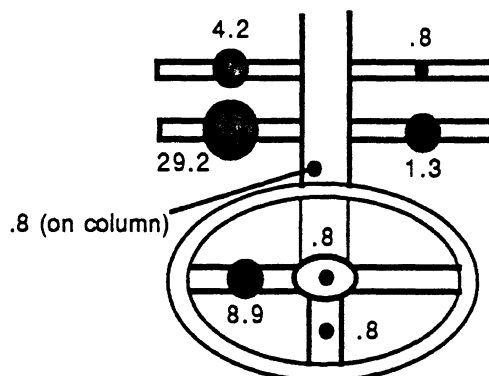
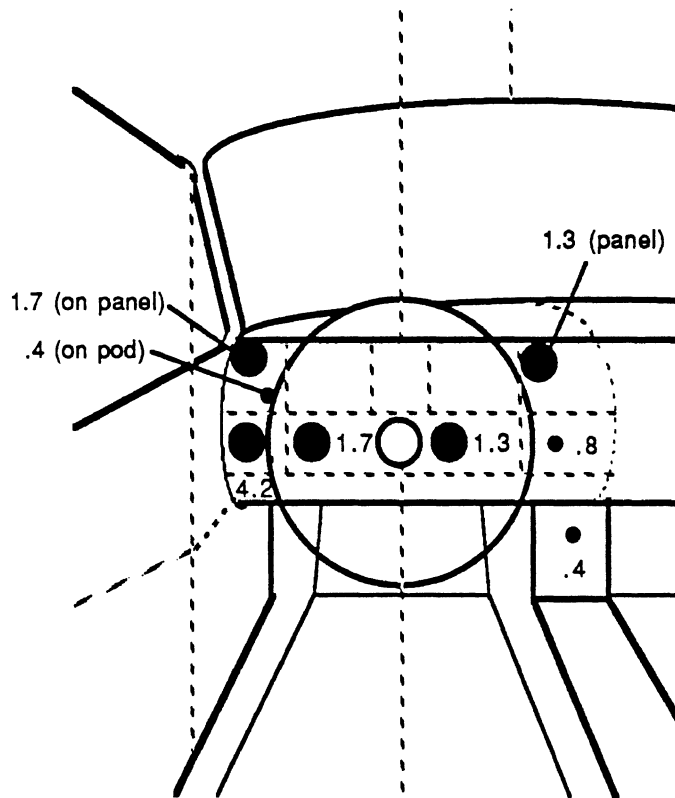
## Cruise Control On/Off


The cruise control on/off turns the cruise control system "on" and "off". When the cruise control is "on", the car can be set to travel at a specified speed by using the acceleration, coast, resume, and set controls. If the system is "off", then none of these cruise control functions will operate. Of the 236 cars surveyed, 58.9% (139 cars) were equipped with cruise on/off control.

As the Zone figure indicates, in 29.2% of the cars surveyed the cruise on/off control was located on the left stalk closest to the driver, while in 8.9% of the cars it was positioned on the left spoke of the steering wheel. Of those left stalk-mounted cruise on/off controls, 97.1% (67 controls) were slide switches. All of the left spoke-mounted cruise on/off controls were push buttons.

## CRUISE CONTROL ON/OFF

Location (% of switches in given location)



 41.1 (not provided)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 56.1% of the cruise on/off controls were slide switches. The next two most popular switch types were the push button and push-push button at 19.4% and 10.1%, respectively. The Method of Operations Table indicates that 43.2% of the cruise on/off controls were activated by a push to the right, and another 40.3% were activated by a push in (forward). None of the switches were identified by an ISO symbol, however 50.4% (70 controls) were marked with non-ISO symbols such as "cruise on/off". No symbols were found on 49.6% of the controls (69 controls). Finally, 87.1% had position labels such as "on/off" or an arrow pointing to the "on" position.

Table 7 reveals that 57.6% of the cruise on/off controls were combined with other switches. Most of them were combined with cruise set and/or cruise accelerate controls. Most of the controls were uni-axial controls (95.7%). Multi-axial cruise on/off controls were found in the Mercedes 560SL coupe, 300E 4-door sedan, 190E 4-door sedan, and 420SEL 4-door sedan; and the BMW 528E 4-door sedan and 635CSI 2-door sport coupe. Every cruise on/off control was separated and dedicated.

Also, Table 8 shows that most of the cruise on/off controls were located in one or two areas by most of the manufacturers. However, two manufacturers, Cadillac and Toyota, used as many as four different locations for the cruise on/off control.

Finally, Table 9 shows that all of the manufacturers used one or two distinct types of switches to operate the cruise on/off control.

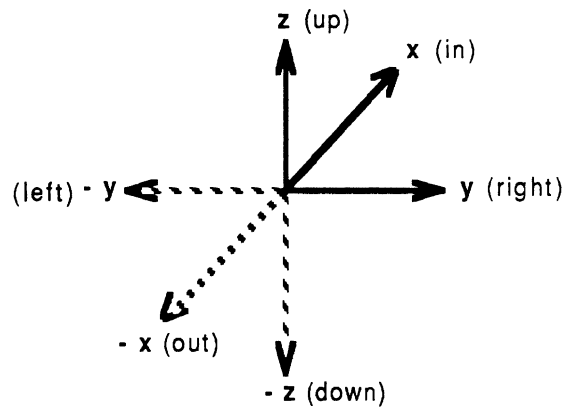
## CRUISE CONTROL ON/OFF

Switch Type (% of switches that are a given type)

%	Switch Type
56.1	slide switch
19.4	push button
10.1	push-push button
6.5	two-position rocker switch
4.3	large lever (multi-axial)
1.4	toggle switch (bat handle)
1.4	rotary knob
.7	paddle switch (uni-axial)

Method of Operation(% of switches operated using given method)

%	Method of Operation
43.2	Fy
40.3	Fx
10.8	-Fy
2.2	F not along axis
1.4	Fz
1.4	-Ty
.7	+/-Tx



(axes relative to driver)

ISO Symbols (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

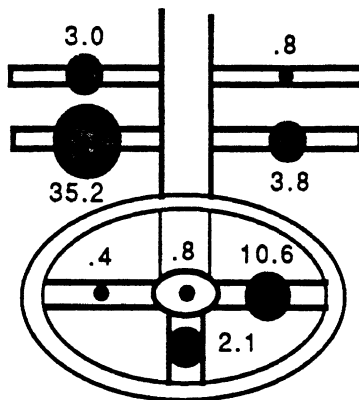
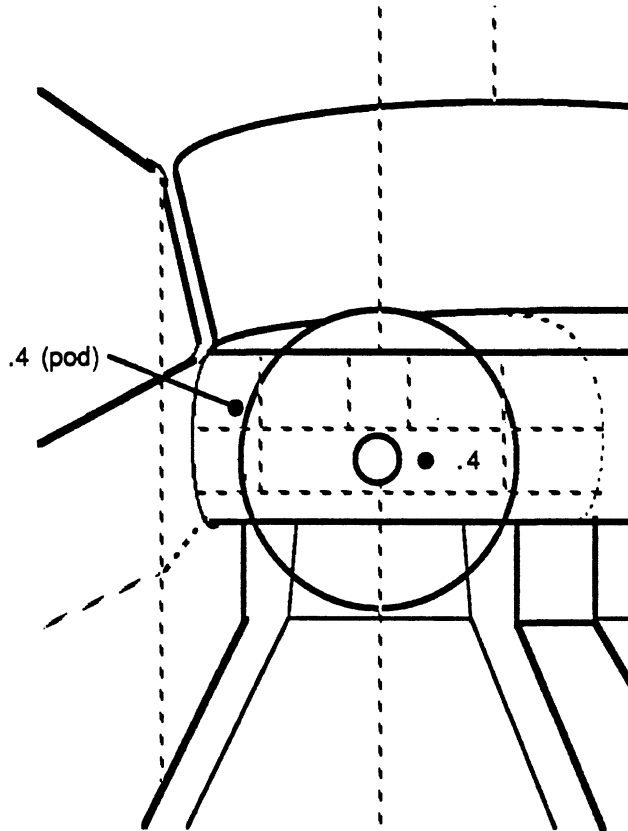
## Cruise Control Resume


The cruise control resume allows the driver to return to a previously set speed after the cruise control has been disengaged. Of the 236 cars surveyed, 58.9% (139 cars) were equipped with cruise control resume.


The Zone Figure shows that in 35.2% of the cars surveyed, the cruise control resume was located on the left stalk closest to the driver, and in 10.6% it was located on the right spoke of the steering wheel. Of those cars that had switches on the left stalk, 88.0% (73 controls) were slide switches. All of the switches located on the right spoke of the steering wheel were push buttons.

# CRUISE CONTROL RESUME

Location (% of switches in given location)



 41.1 (not provided)

 1.3 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table indicates that 56.8% of the resume controls were slide switches, while 24.5% were push buttons. Furthermore, the Method of Operation Table shows that 48.2% of the resume switches were activated by a push to the right while 24.5% required a push in (forward). The ISO Table shows that none of the cruise resume switches were identified by an ISO symbol. However, 48.2% of the controls (67 controls) were identified by a non-ISO symbol such as "cruise resume" or "resume", while 51.8% (72 controls) were not labeled at all. Position labels were used on 61.9% of the cruise resume controls. Most of these position labels were tick marks or arrows pointing to the right (the "on" direction).

Table 7 shows that 67.6% of the resume switches were combined. They were usually combined with other cruise control functions on the left stalk. In addition, 95.0% of the switches were uni-axial. Multi-axial cruise resume controls were found on the Mercedes Benz 560SL coupe, 300E 4-door sedan, 190E 4-door sedan, and 420 SEL 4-door sedan; the BMW 528E 4-door sedan and the 635CSI 2-door sport coupe; and the Nissan 300ZX. Integrated controls were found in the Volvo 740GT and in the Ford Escort 2 door and 4 door hatchbacks and Escort wagon. All of the cruise resume controls were dedicated.

Table 8 shows that across all of the manufacturers, only one or two distinct zones were used in placing the resume control. As mentioned above, these zones were the left stalk closest to the driver and the right spoke of the steering wheel.

Table 9 indicates that most manufacturers used one or two different switch types for the resume control, however Nissan and Toyota each used three switch types.



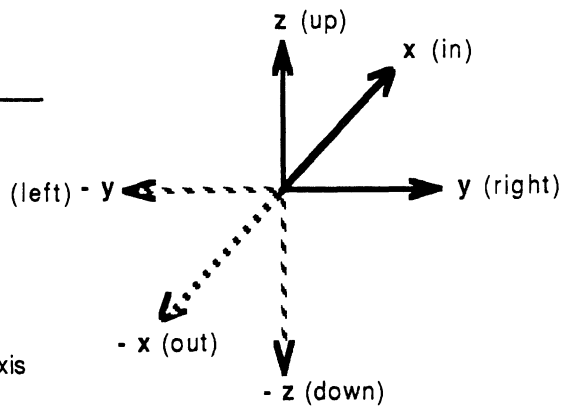
## CRUISE CONTROL RESUME

Switch Type (% of switches that are a given type)

%	Switch Type
56.8	slide switch
24.5	push button
5.8	rotary knob
5.0	large lever (multi-axial)
4.3	two-position rocker switch
1.4	toggle switch (bat handle)
.7	paddle switch uni-axial)
.7	small lever (uni-axial)
.7	large lever (uni-axial)

Method of Operation(% of switches operated using given method)

%	Method of Operation
48.2	Fy
24.5	Fx
12.2	-Fy
7.2	-Fx
5.8	-Ty
.7	Fz
.7	-Fz
.7	F not along axis



(axes relative to driver)

ISO Symbols (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

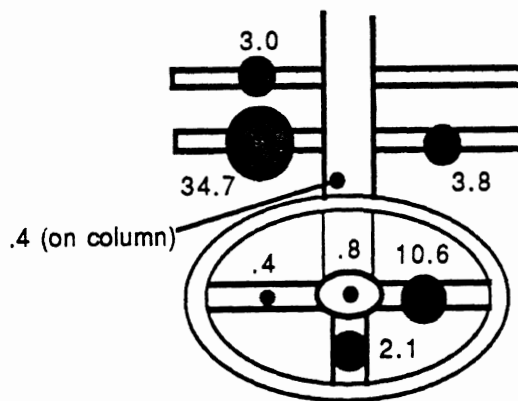
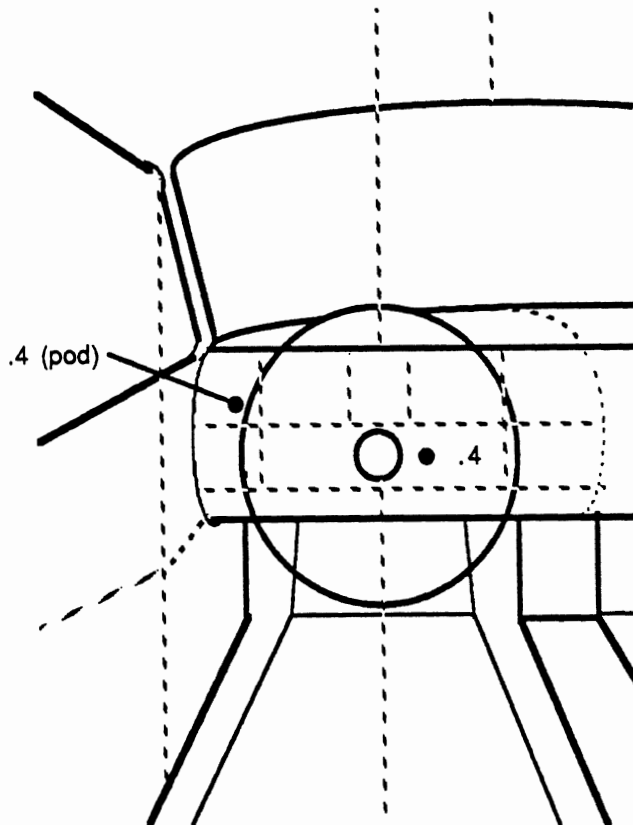
## Cruise Control Set




The cruise control set engages the cruise control to keep the car traveling at its current speed. When it is activated, the car will continue to move at the speed it is going, even with the foot off the gas pedal. Of the 236 cars surveyed, 58.4% (137 cars) were equipped with the set control.

Of those cars surveyed, 34.7% located the set control on the left stalk closest to the driver and 10.6% located it on the right spoke of the steering wheel. Of those switches located on the left stalk, 81.7% (67 controls) were push buttons.

# CRUISE CONTROL SET

Location (% of switches in given location)



-  41.1 (not provided)
-  1.3 (multiple zones)
-  .8 (automatic)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 79.6% of the set controls were push buttons and 12.4% were slide switches. In addition, the Method of Operation Table indicates that 62.0% of the switches were activated by a push to the right, while 24.8% required a push in (forward). The ISO Table shows that none of the set controls were identified by ISO symbols. However, 93.4% of the controls (128 controls) were identified by non-ISO symbols, such as "set" or "cruise set", while 6.6% (9 controls) had no labels. Finally, 30.7% of the switches had positions labels, like arrowheads (pointing to the right) or tick marks.

Table 7 indicates that 68.6% of the set controls were combined with other controls, usually the other cruise control functions. Only 2.9% of the switches were multi-axial, and these were found in the Mercedes Benz 560SL coupe, 300E 4-door sedan, 190E 4-door sedan, and 420SEL 4-door sedan. Only 2.2% of the set controls were integrated with other controls, these were found in the Ford Escort 2-door and 4-door hatchbacks and Escort wagon. All of the set controls were dedicated.

Table 8 and 9 show that all of the manufacturers were fairly consistent in placing the set control, as well as in using the same switch types.

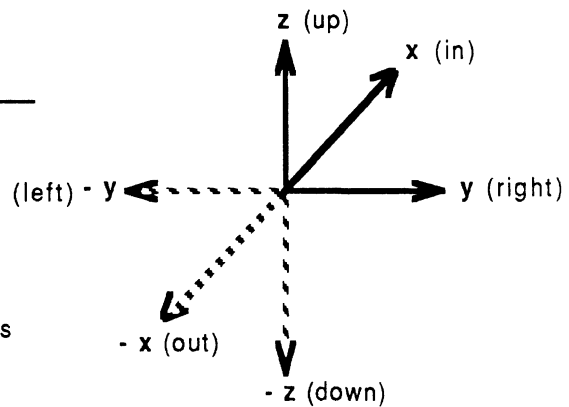
## CRUISE CONTROL SET

**Switch Type** (% of switches that are a given type)

%	Switch Type
79.6	push button
12.4	slide switch
2.9	rotary knob
2.9	large lever (multi-axial)
1.5	two-position rocker switch
.7	paddle switch (uni-axial)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
62.0	Fy
24.8	Fx
5.1	-Fy
2.9	Ty
2.2	+/-Fz
1.5	-Fx
.7	F not along axis
.7	Fz



(axes relative to driver)

**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

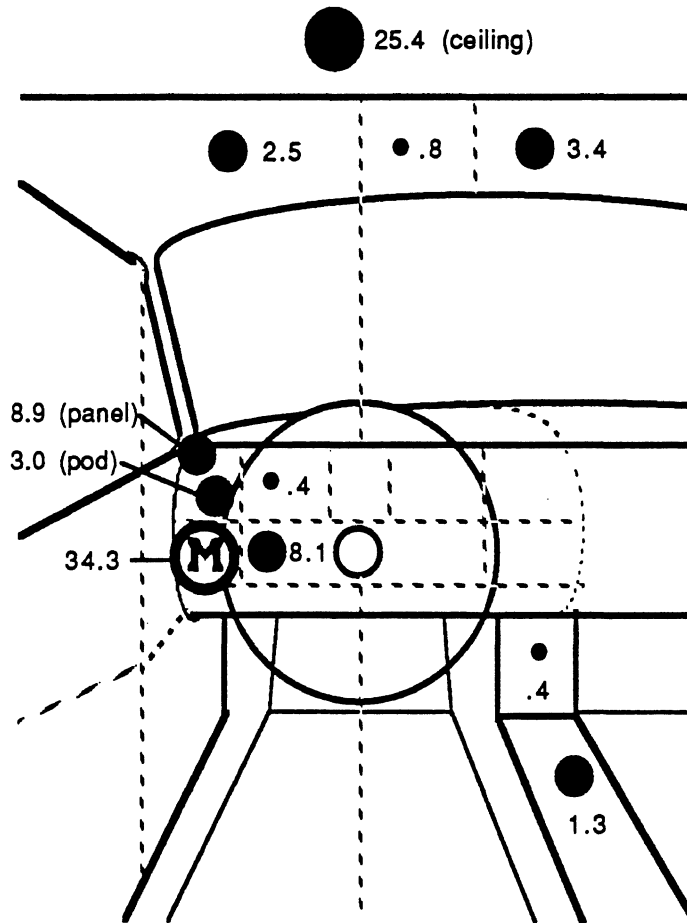
## Dome Light

The dome light control turns the dome light on and off. The dome light is usually centered on the headliner or middle region of the car's ceiling. It usually lights up when the driver's door is open, regardless of the control's position. Of the 236 cars surveyed, 94.9% (224 cars) were equipped with a dome light control.

The Zone Figure shows that in 34.3% of the surveyed cars the dome light control was located on the lower left dashboard. In another 25.4% of the cars the control was on the ceiling. Of those controls found on the lower left dash, 66.7% (54 controls) were turn-push-pull switches. Of those controls located on the ceiling, 76.7% (46 controls) were slide switches.

## DOME LIGHT

Location (% of switches in given location)



● 5.1 (not provided)

● 6.4 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 33.9% of the dome light switches were turn-push-pull knobs, while 25.4% were slide switches. Another 14.7% were thumbwheels. The Method of Operation Table indicates that 35.3% of the dome light switches were activated by a twist out (torque about the -x axis), while 22.8% were pushed up and 12.5% required a push in (forward). The ISO table shows that 2.2% of the dome light switches were identified by the ISO upper beam symbol. Non-ISO symbols were used to identify 11.2% of the controls (25 controls). Position labels were present for 18.8% of the switches. These position labels were typically spiral arrows curling toward the "on" position, and lines that varied in thickness as the intensity increased (thicker line means higher intensity).

Table 7 shows that only 3.1% of the dome light controls were combined; these were found in the Lincoln Towncar 4-door, the Cadillac Cimarron 4-door, and the Pontiac Sunbird convertible, 2-door coupe, 3-door hatchback, 4-door sedan, and wagon. Sometimes the dome light control was combined with the headlight switch. Most of the dome light switches (65.2%) were uni-axial. Multi-axial controls were found in the Mercedes 560SL coupe, 300E 4-door, 190E 4-door, and 420SEL 4-door. All of the switches were separated and dedicated.

Table 8 indicates that all of the manufacturers, except for GM, used one or two distinct zones for the dome light control. Oldsmobile used six different zones, Chevrolet used five zones, Buick used four zones, and Pontiac used three zones.

Table 9 shows that most of the manufacturers used between one and three different types of switches to control the dome light. Four manufacturers, however, used four switch types, they were Colt, Chevrolet, Oldsmobile, and Nissan.



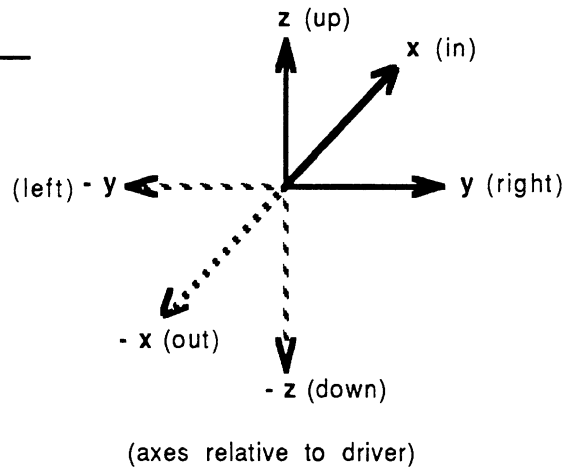
## DOME LIGHT

**Switch Type** (% of switches that are a given type)


%	Switch Type
33.9	turn-pull-push knob
25.4	slide switch
14.7	thumbwheel
10.7	rotary knob
5.8	push-push button
3.6	two-position rocker switch
2.2	small lever (uni-axial)
1.3	four-position rocker switch
.9	push button
.9	toggle switch (bat handle)
.5	turn-push knob

**Method of Operation** (% of switches operated using given method)

%	Method of Operation
35.3	-Tx
22.8	Fz
12.5	Fx
8.9	-Fx
5.8	-Fy
4.0	Fy
2.2	-Fz
1.8	+/-Fx
1.8	Tx
1.3	F not along axis
1.3	+/-Fy
.9	-Ty
.9	T not about axis
.4	-Tz



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
2.2	

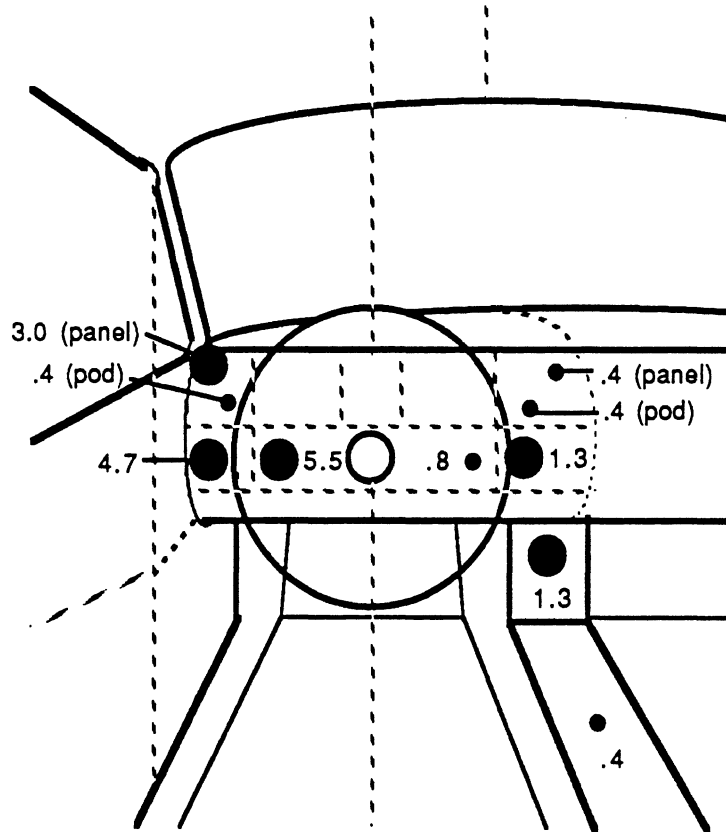
## Fog Lights

The fog lights improve visibility when driving in foggy weather. This control is standard on many European imports, but is available on only a few Japanese and American-built cars. Of the 236 cars surveyed, only 19.1% (45 cars) were equipped with fog lights.

According to the Zone Figure, in 5.5% of the surveyed cars the fog lights control was located on the lower center dashboard, while in 4.7% it was located on the lower left dashboard. Of those fog lights controls that were on the lower center dashboard, 46.2% (6 controls) were two-position rocker switches and 38.5% (5 controls) were push-push switches. Furthermore, of those fog lights controls that were on the lower left dashboard, 90.9% were rotary knobs (10 controls).

# FOG LIGHTS

Location (% of switches in given location)



80.9 (not provided)



.8 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 44.4% of the fog lights controls were two-position rocker switches and 22.2% were rotary knobs. Also, the Method of Operation Table indicates that 66.7% of the switches were activated by a push in (forward), while 13.3% required a twist in (torque about the +x axis). The ISO Table shows that 55.6% of the switches were identified by the front fog light ISO symbol, and a smaller percentage of the switches were labeled with the rear foglight (6.7%) and lower headlight (4.4%) ISO symbols. Non-ISO symbols such as "fog lights" or "fog" were found on 33.3% of the controls. Finally, 33.3% of the fog light controls had position labels such as "on/off" or tick marks.

Table 7 shows that only 13.3% of the fog light controls were combined with other controls; these were found in the Cadillac Cimarron 4-door, and the Pontiac Sunbird convertible, 2-door coupe, 3-door hatchback, 4-door sedan, and wagon. Some of the controls were combined with the headlight and parking light controls. All of the fog lights controls were uni-axial and dedicated, but 8.9% were integrated with other controls. In these cases, the fog lights were integrated with the parking lights.

Table 8 indicates that most of the manufacturers used one or two distinct zones for the fog lights control location. However, Pontiac and BMW used three zones each.

Table 9 reveals that Pontiac and BMW also showed the largest variance in types of switches used. Pontiac used three switch types for the fog lights and BMW used four.

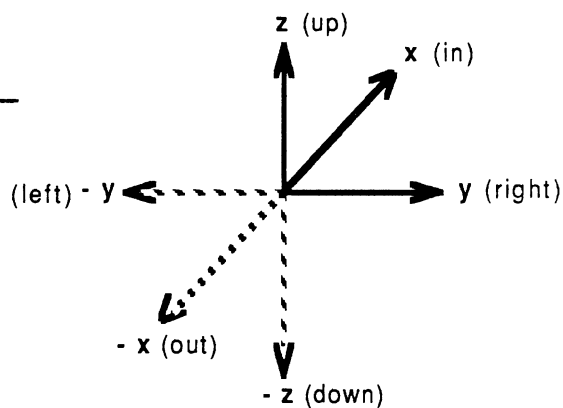
## FOG LIGHTS

**Switch Type** (% of switches that are a given type)

%	Switch Type
44.4	two-position rocker
22.2	rotary knob
17.8	push-push button
13.3	push button
2.2	slide switch

**Method of Operation** (% of switches operated using given method)

%	Method of Operation
66.7	Fx
13.3	Tx
8.9	Fz
6.7	Tx & y
2.2	-Fy
2.2	-Fz



(axes relative to driver)

**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
55.6	
6.7	
4.4	

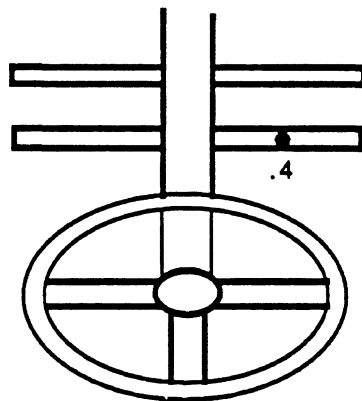
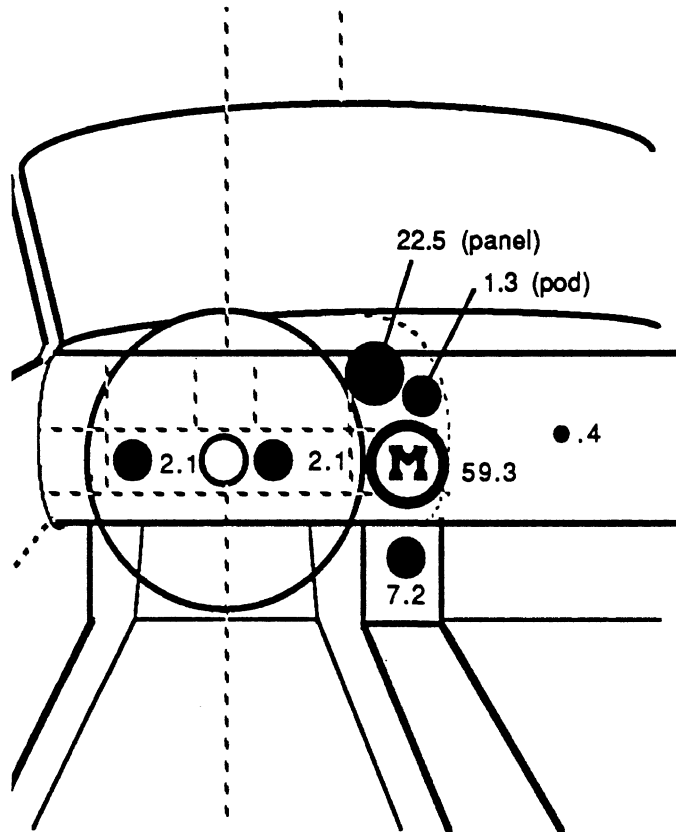
## Front Windshield Defrost

The front windshield defrost control is usually found in the climate control cluster. It removes the frost or fog buildup from the front windshield by blowing hot or cold air on its surface. All of the 236 cars surveyed were equipped with front windshield defrost.

The Zone Figure shows that in 59.3% of the cars surveyed the front defrost control was located on the lower right dashboard. In another 22.5% the front defrost was located on the upper right dashboard, while in 7.2% of the cars it was on the center console. Of those front defrost controls on the lower right dashboard, 67.1% (94 controls) were slide switches and 30.0% (42 controls) were push buttons. Similarly, on the upper right dashboard, 53.8% (28 controls) were slide switches and 21.2% (11 controls) were push buttons.

## FRONT WINDSHIELD DEFROST

Location (% of switches in given location)



● 4.7 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table indicates that 61.3% of the front defrost controls were slide switches and 29.4% were push buttons. The Method of Operations Table shows that 55.7% of the front defrost switches were activated by a push to the right and 29.8% required a push in (forward). In addition, the ISO Table shows that 98.3% of the controls were identified by the standard front defrost ISO symbol. Surprisingly, 1.3% of the controls were marked with the rear defrost ISO symbol; 49 controls (20.9%) were also labeled with a non-ISO symbol such as "firt defrt" or "front defr". Only 2.1% of the front defrost controls had position labels present, and they were typically arrows or tick marks.

Table 7 shows that all of the front defrost controls were noncombined, uni-axial, separated, and dedicated.

Table 8 shows that eighteen of the twenty-eight manufacturers located the front defrost control in one or two distinct zones, while ten (all American manufacturers) used three or four zones.

Table 9 shows that a majority of the manufacturers (24 of 28) use one or two switch types for the front defrost control. Colt, Oldsmobile, BMW, and Nissan used as many as three or four different types of switches.



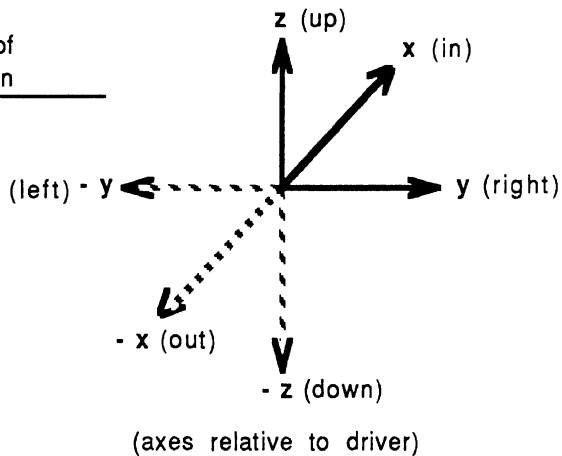
## FRONT WINDSHIELD DEFROST

**Switch Type** (% of switches that are a given type)

%	Switch Type
61.3	slide switch
29.4	push button
4.7	rotary knob
3.4	push-push button
.9	push-paddle switch
.4	lever (uni-axial)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
55.7	Fy
29.8	Fx
6.0	Fz
4.7	Tx
1.7	+/-Fy
1.3	-Fy
.9	-Fx



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
98.3	
1.3	

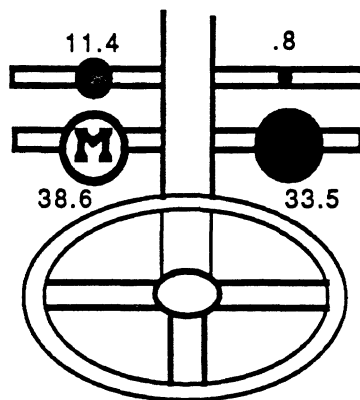
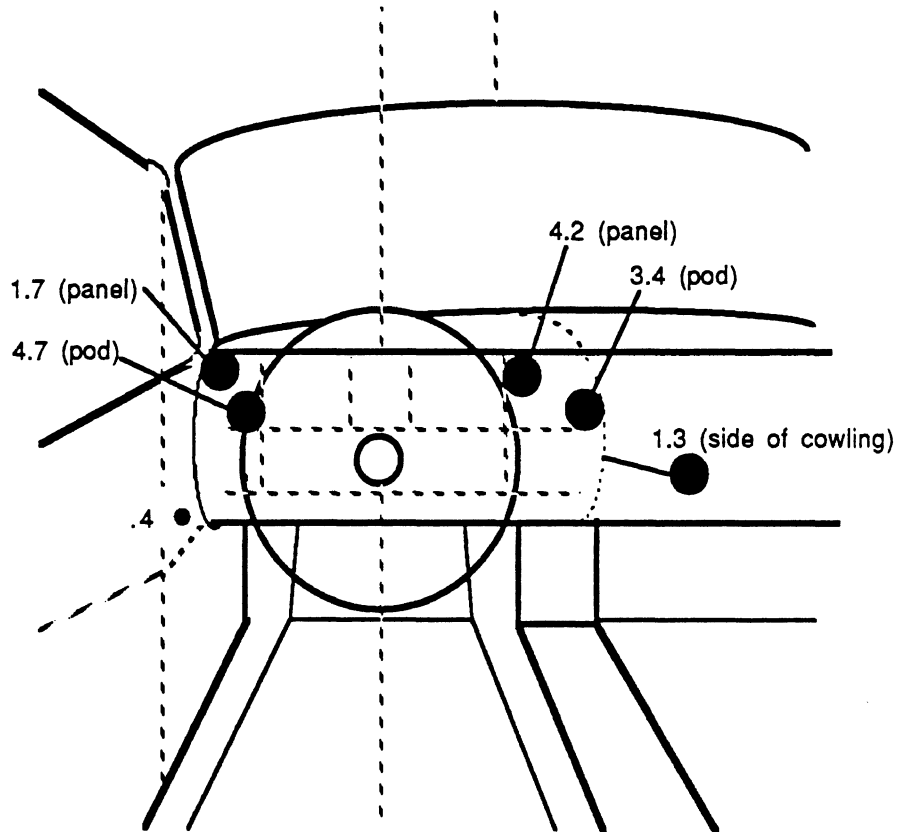
## Front Windshield Washer

The front windshield washer control operates the washer mechanism that sprays the front windshield. The front windshield wipers are usually activated when the front washer is turned on. All of the 236 cars surveyed were equipped with a front windshield washer.

The Zone Figure shows that in 38.6% of the cars surveyed the front washer control was located on the left stalk closest to the driver. In another 33.5% of the cars the control was on the right stalk closest to the driver. Of those front washer controls on the left stalk, 56.0% (51 controls) were push-paddle switches and 28.6% (26 controls) were turn-push knobs. Of those controls on the right stalk, 81.0% (64 controls) were multi-axial large levers and 19.0% (15 controls) were push buttons.

## FRONT WINDSHIELD WASHER

Location (% of switches in given location)



- RESULTS AND DISCUSSION -

In addition, the Switch Table indicates that 39.8% of the front windshield washer controls were multi-axial large levers, while 23.7% and 21.6% were push-paddle switches and push buttons, respectively. The Malone et al. (1972) study found 61% of the front washer controls to be push buttons (see Table 2).

The Method of Operation Table shows that 36.4% of the front washer controls were activated by pulling out (rearward) and 36.4% by pushing in (forward). The ISO Table shows that 51.3% of the controls were identified by the standard ISO front windshield wiper symbol and 47.0% by the windshield wiper/washer symbol. Non-ISO symbols such as "wash" or "w/w" identified 12.3% of the controls. Position labels were present on 56.8% of the controls, most of these labels were tick marks or arrows pointing to the "on" position.

Table 7 indicates that 65.7% of the front washer controls were combined, 55.5% were multi-axial, 35.2% were integrated, and all were dedicated. Most of the switches were integrated with the windshield wiper control, and they were combined with other left stalk-oriented controls.

Table 8 shows that most of the manufacturers used between one and three distinct zones, except for Mercury (4 zones) and Chevrolet (6 zones).

Finally, most of the manufacturers used one or two switch types for the front washer control. Chevrolet, however, used four different switch types.

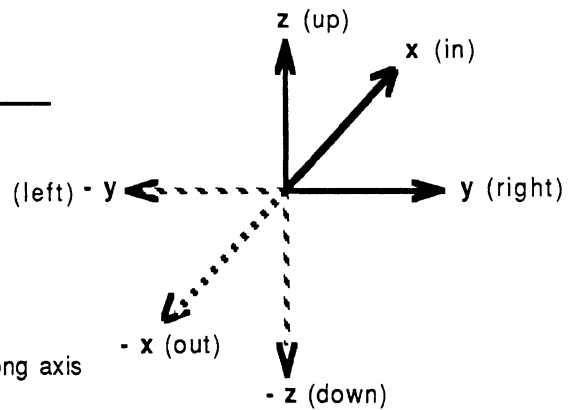
## FRONT WINDSHIELD WASHER

**Switch Type** (% of switches that are a given type)

%	Switch Type
39.8	large lever (multidirectional)
23.7	push-paddle switch
21.6	push button
12.7	turn-push knob
1.7	push-pull knob
.4	paddle switch (multi-axial)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
36.4	-Fx
36.4	Fx
8.9	Fy
8.5	-Fy
7.6	multiple
1.3	+/- Fx
.4	-Fz
.4	Force not along axis



(axes relative to driver)

**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
51.3	
47.0	

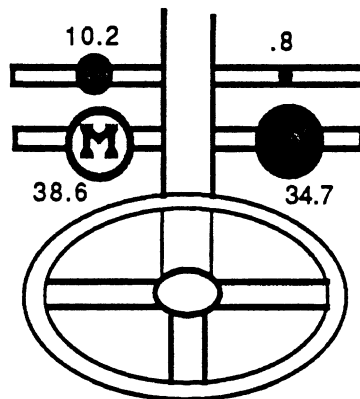
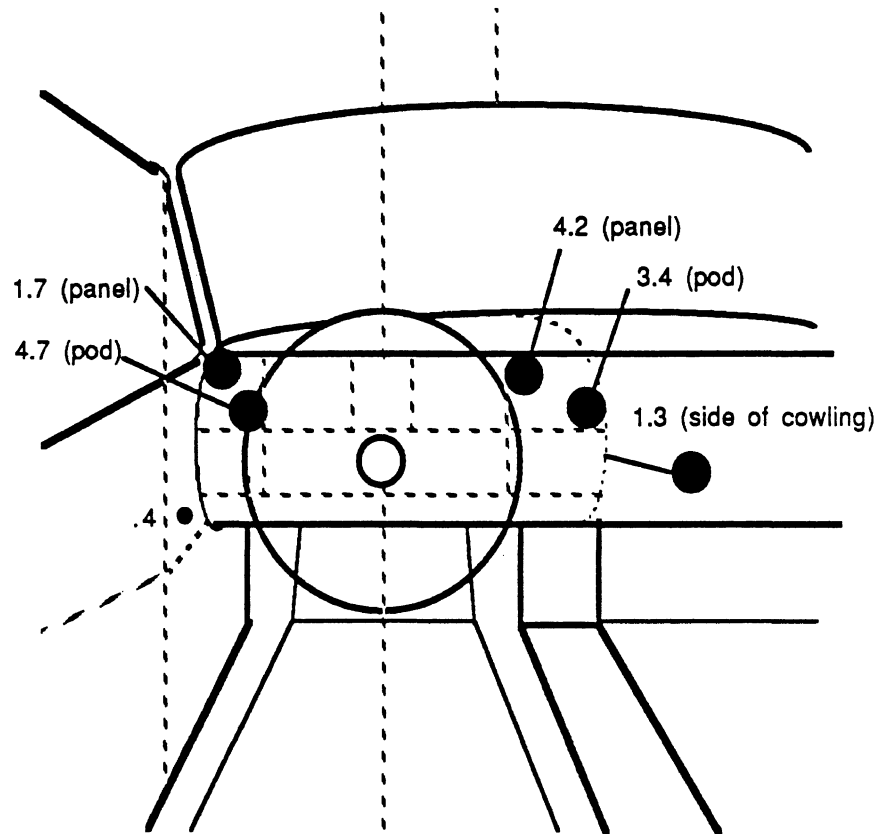
## Front Windshield Wiper

The front windshield wiper control operates the front windshield wipers. In some cars this control can make the windshield wipers run at different speeds. It is sometimes integrated with the front washer control, so that the wipers automatically come on when the washer is activated. All of the 236 cars surveyed were equipped with front wipers.

Based on the Zone Figure, 38.6% of the cars surveyed located the front wiper control on the left stalk closest to the driver, while 34.7% had it on the right stalk closest to the driver. Of those front wiper controls on the left stalk, 67.0% (61 controls) were rotary knobs and 28.6% (26 controls) were turn-push switches. Of those controls on the right stalk 75.6% (62 controls) were multi-axial large levers and 12.2% (10 controls) were uni-axial large levers.

## FRONT WINDSHIELD WIPERS

Location (% of switches in given location)



- RESULTS AND DISCUSSION -

The Switch Type Table shows that 38.6% of the front windshield wiper controls were multi-axial large levers and 32.6% were rotary knobs. The Malone et al. (1972) study found that 37% of the front wiper controls were rotary knobs and 45% were either horizontal or vertical toggle switches (see Table 2).

The Method of Operations Table shows that 20.3% of the controls were activated by a push up and 16.9% by twisting left (torque about the -y axis). The ISO Table indicates that 57.6% of the controls were identified by the ISO front windshield wiper symbol and 41.9% by the front windshield wiper/washer symbol. Also, 1 (.4%) control was labeled with multiple ISO symbols, and 30.5% of the controls were labeled with additional non-ISO symbols. A large fraction of the wiper controls (84.3%) had position labels. Most of these labels were tick marks, lines that would thicken as the wiper speed increased, and "lo", "med", and "hi" labels.

Table 7 shows that 69.5% of the controls were combined with other controls like the washer, turn signal, and cruise control (both of these were usually on the left stalk). This table also indicates that 55.9% of the controls were multi-axial. All of the wiper controls were separated and dedicated.

In Table 8, it is clear that most of the manufacturers used one to three distinct areas for placing the front wiper controls. However, as with the front washer control (see the previous section), Mercury and Chevrolet used the most zones. Mercury used four zones and Chevrolet used five.

Finally, Table 9 shows that most of the manufacturers used one to three different switch types for the front washer control. Mercury and Toyota used four switch types and Chevrolet used five.



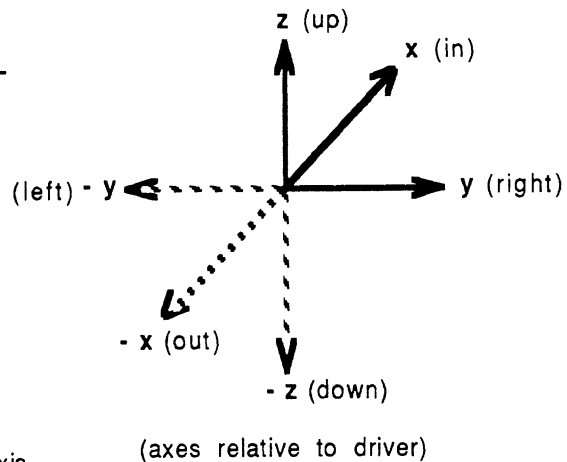
## FRONT WINDSHIELD WIPERS

Switch Type (% of switches that are a given type)


%	Switch Type
38.6	large lever (multi-axial)
32.6	rotary knob
11.9	turn-push knob
8.9	slide switch
4.2	large lever (uni-axial)
1.7	rotary handgrip
.8	push button
.4	push-push button
.4	thumbwheel
.4	paddle switch (multi-axial)

Method of Operation (% of switches operated using given method)

%	Method of Operation
20.3	Fz
16.9	-Ty
14.4	-Fz
13.6	+/- Ty
14.0	+/- Fz
13.1	Ty
3.0	Tx
2.1	Fy
.8	Fx
.8	+/- Fy
.4	-Fy
.4	Force not along axis



ISO Symbols (% of switches with given ISO symbol)

%	ISO Symbol
57.6	
41.9	
.4	multiple

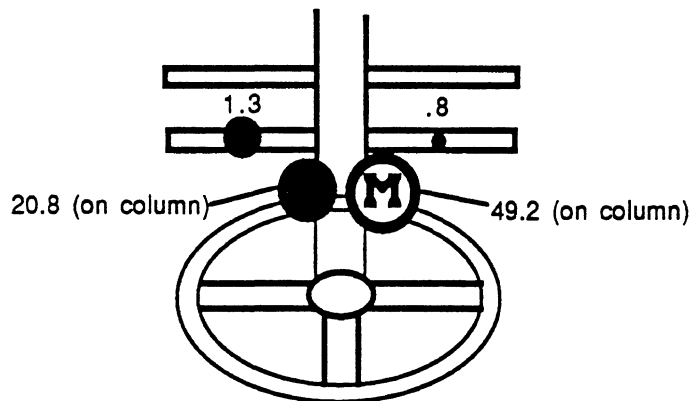
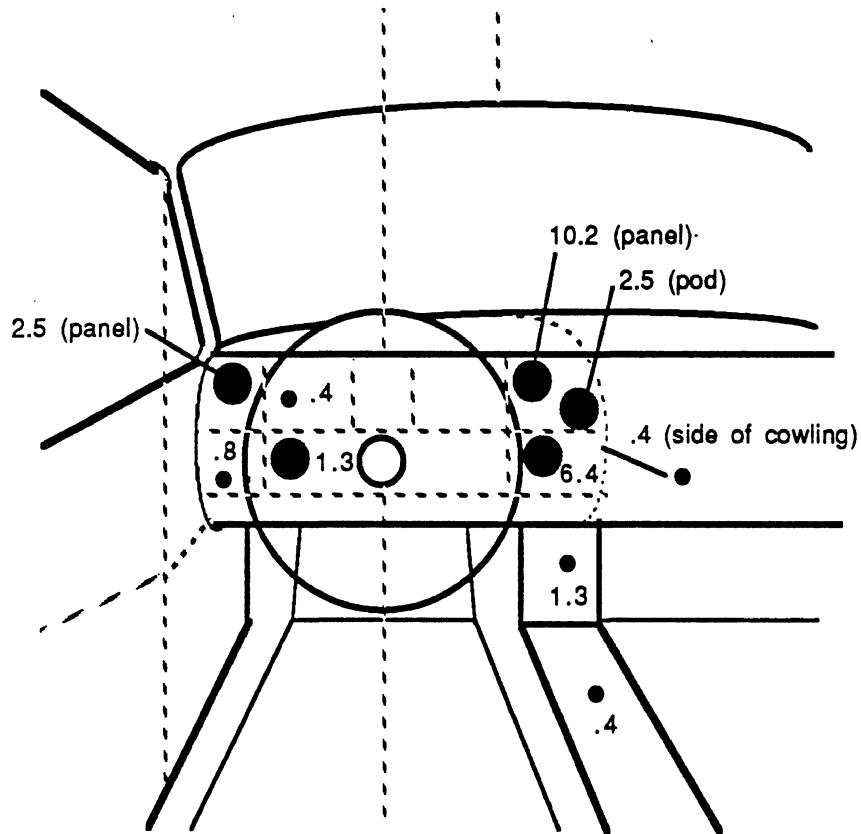
## Hazard Lights

The hazard lights control is also known as the four-way flasher, and it causes all of the parking lights (both front and rear) to blink on and off. It is commonly used to warn others that the driver may be in trouble or that his or her car is traveling at slower than normal speeds. All of the 236 cars surveyed were equipped with hazard lights.

The Zone Figure shows that in 49.2% of the surveyed cars the hazard lights control was located on the right side of the steering column and in 20.8% of the cars it was on the left side of the column. Of those hazard lights controls on the right side of the column, 50.9% (59 controls) were push-pull switches and 24.1% (28 controls) were push buttons. Of those controls on the left side of the column, 42.9% (21 controls) were pull out switches and 26.5% (13 controls) were two-position rocker switches.

## HAZARD LIGHTS

Location (% of switches in given location)



● 1.7 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 25.4% of the hazard lights controls were push-pull knobs; 19.9% and 18.2% were push-push and two-position rocker switches, respectively. This has not changed significantly since the Malone et al. (1972) study, where 69% of the hazard controls were pull knobs and 31% were push buttons (see Table 2).

The Method of Operations table indicates that 42.4% of the controls required a force not along any of the axes. This is primarily due to the awkward placement of the switches that were on the left side of the column. Most of these cases were found in GM cars. A smaller percentage of controls required a push in (forward) (25.0%) and push down (23.7%). The ISO Table shows that 98.3% of the controls were identified by the standard ISO hazard symbol. Non-ISO symbols such as "hazards" or "flashers" identified 44.5% of the controls. Position labels were found on only 2.5% of the hazard lights controls.

Table 7 shows that all of the hazard lights controls were noncombined, separated, and dedicated. Multi-axial controls were found in the AMC Eagle wagon and 4 door sedan.

Table 8 indicates that most of the manufacturers placed the hazard lights control in one to three zones. Nissan, however, used seven distinct zones for the hazard lights control.

By inspection of Table 9, it is clear that most of the manufacturers used no more than one or two switch types for the hazard lights control. Colt and Nissan used four switch types, and Chevrolet used five types of switches for the hazard lights control.

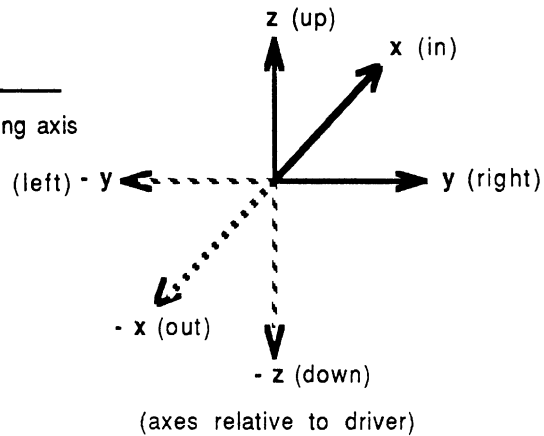
## HAZARD LIGHTS

**Switch Type** (% of switches that are a given type)


%	Switch Type
25.4	push-pull knob
19.9	push-push button
18.2	two-position rocker switch
13.6	push button
10.2	other (pull out to operate)
5.9	pull-push knob
3.4	slide switch
2.1	paddle switch (uni-axial)
1.3	small lever (uni-axial)

**Method of Operation** (% of switches operated using given method)

%	Method of Operation
42.4	Force not along axis
25.0	$F_x$
23.7	$-F_z$ (left) - $y$
4.7	$-F_y$
2.5	$F_y$
1.7	$F_z$



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
98.3	

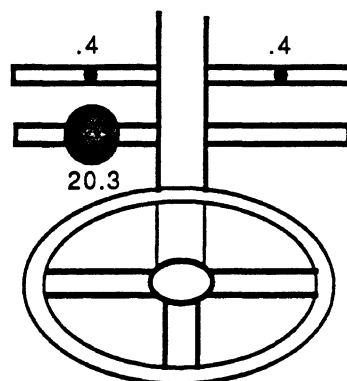
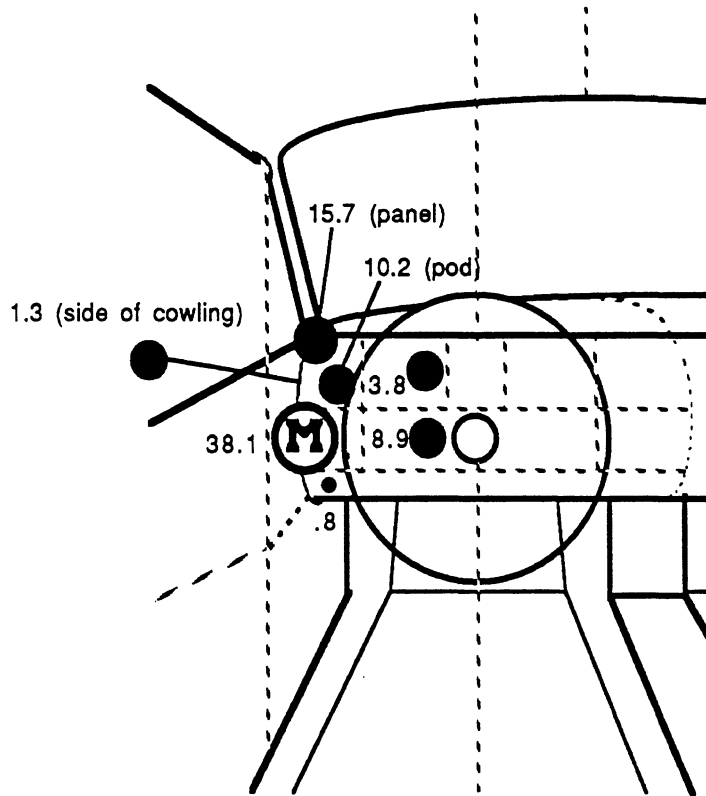
## Headlights/Parking Lights

The headlights/parking lights control operates the headlights and parking lights. When the headlights are turned on the parking lights automatically go on, but the parking lights can be activated independently of the headlights. All of the 236 cars surveyed were equipped with headlights/parking lights.

The Zone Figure shows that in 38.1% of the cars surveyed the headlight/parking light control was on the lower left dashboard, and in 20.3% the control was located on the left stalk closest to the driver. Of those controls on the lower left dashboard, 60.0% (54 controls) were turn-pull-push knobs and 25.6% (23 controls) were two-position rocker switches. Of those controls on the first left stalk, 81.3% (39 controls) were rotary knobs and 14.6% (7 controls) were multi-axial large levers.

## HEADLIGHTS/PARKING LIGHTS

Location (% of switches in given location)



- RESULTS AND DISCUSSION -

The Switch Type Table indicates that 33.1% of the headlight/parking light controls were turn-pull-push knobs. Another 27.5% were rotary knobs and 20.3% were two-position rocker switches. The most popular switch (turn-pull-push) was primarily found in American cars, while most of the left stalk-mounted controls (rotary knobs and multi-axial large levers) were found in Japanese and European cars. This is a drastic change from the findings of Malone et al. (1972) where 94% of the headlight controls were push-pull knobs (see Table 2).

The Method of Operation Table shows that 35.6% of the headlight/parking light controls were activated by a pull out (rearward). Another 27.1% and 21.6% required a push to the right and twist left (torque about the -y axis), respectively. In addition, the ISO Table indicates that 65.7% of the switches were identified by the standard ISO upper beam headlight symbol. The master lighting symbol (see opposite page) was also found on 25.4% of the controls. Non-ISO symbols such as "Headlights" or "lights" were found on 29.7% of the controls. Position labels were found on 42.4% of the controls, and most of them were tick marks defining off, parking lights, and headlights. Some of the controls were labeled "off", "park" (for parking lights), and "lo" (for low beams).

Table 7 shows that 77.1% of the headlight/parking light controls were not combined with other controls. Most of the headlight/parking light controls (60.6%) were uni-axial, all were integrated, and none were separated.

Most of the manufacturers used one to three distinct zones for the headlights/parking lights control as Table 8 shows. But Colt, Chevrolet, and Oldsmobile used up to five different zones.

Finally, Table 9 shows that one to three different types of switches were used by most of the manufacturers. There were, however, five carmakers that used four or five types of switches for the headlight/parking light control in their various models. These included, Ford, Mercury, and Oldsmobile, who all used four switch types. Colt and BMW used five switch types.



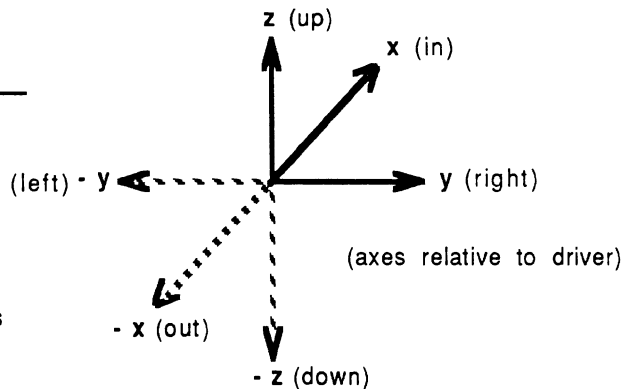
## HEADLIGHTS/PARKING LIGHTS

Switch Type (% of switches that are a given type)

%	Switch Type
33.1	turn-pull-push knob
27.5	rotary knob
20.3	two-position rocker switch
5.5	push button
3.8	pull-push knob
3.4	large lever (multi-axial)
1.7	small lever (uni-axial)
1.7	turn-push knob (multi-axial)
.8	push-paddle switch
.8	rotary handgrip
.4	push-push button
.4	slide switch
.4	paddle switch (uni-axial)

Method of Operation (% of switches operated using given method)

%	Method of Operation
35.6	-Fx
27.1	Fx
21.6	-Ty
10.2	Tx
2.1	Fz
1.7	Fy
.8	F not along axis
.4	+/- Tx
.4	+/- Ty



ISO Symbols (% of switches with given ISO symbol)

%	ISO Symbol
65.7	
25.4	
2.1	
.4	
.4	multiple ISO symbols used

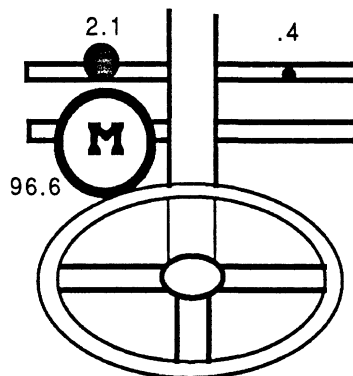
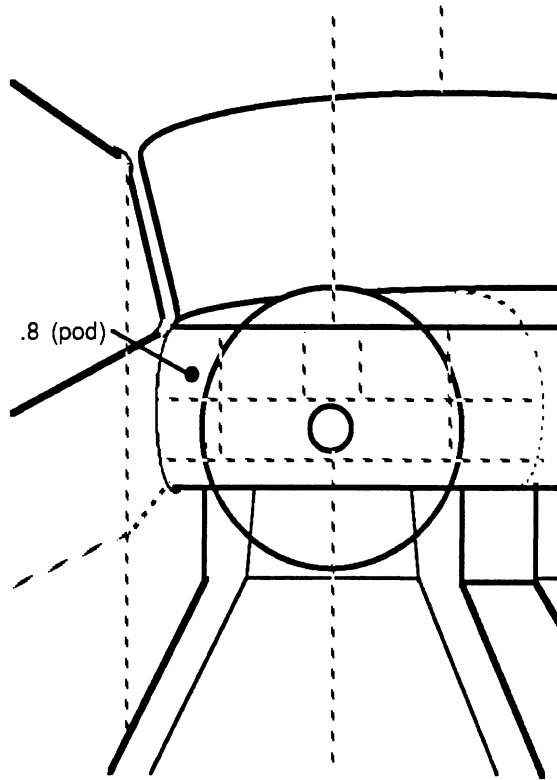
## High-Beams

The high-beam control is used to turn on the bright headlights when extra illumination is needed. It is most commonly used when the driver suspects that long range night vision is required. All of the 236 cars surveyed were equipped with high-beams.

The Zone Figure Shows that in 96.6% of the cars surveyed the high-beam control was located on the left stalk closest to the driver, all of those controls were multi-axial large levers.

## HIGH-BEAMS

Location (% of switches in given location)



- RESULTS AND DISCUSSION -

The Switch Type Table indicates that 99.2% of the high-beam controls were multi-axial large levers, however the control in the Isuzu Impulse was a push button and the control in the Merkur XR4Ti was a uni-axial large lever. This is a drastic change from the findings of Malone et al. (1972) where 75% of the high-beam controls were floor buttons (see Table 2).

The Method of Operation Table shows that 84.3% of the controls were activated by a pull out (rearward) and 12.7% required a push in (forward). In most of the imported cars the high-beam control was activated by a push in. The ISO Table shows that 18.6% of the controls were labeled with the upper beam headlight ISO symbol and 13.1% with the lower beam headlight. Non-ISO symbols such as "Hi Beam" or "Beams" were found on 2 controls (.8%). Position labels were found on 23.3% of the controls.

Table 7 shows that 62.7% of the controls were combined, 97.9% were multi-axial, and all were separated and dedicated. Uni-axial controls were found in the Mercury Capri GS, the Ford Mustang 2-door sedan and convertible, the Merkur XR4Ti 4-door sedan, and the Isuzu Impulse.

Tables 8 and 9 indicate that all of the manufacturers used no more than one or two different zones and switches. From the data above, it is apparent that the left stalk closest to the driver, and the multi-axial large lever were the favorites of the manufacturers.

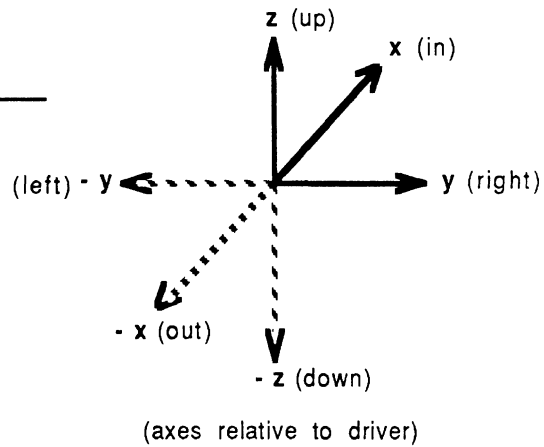
## HIGH BEAMS

**Switch Type** (% of switches that are a given type)

%	Switch Type
99.2	large lever (multi-axial)
.4	push button
.4	small lever (uni-axial)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
84.3	-Fx
12.7	Fx
1.7	-Ty
.8	-Fz
.4	Fz



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
18.6	
13.1	
.8	

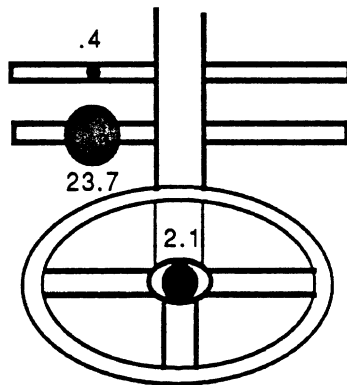
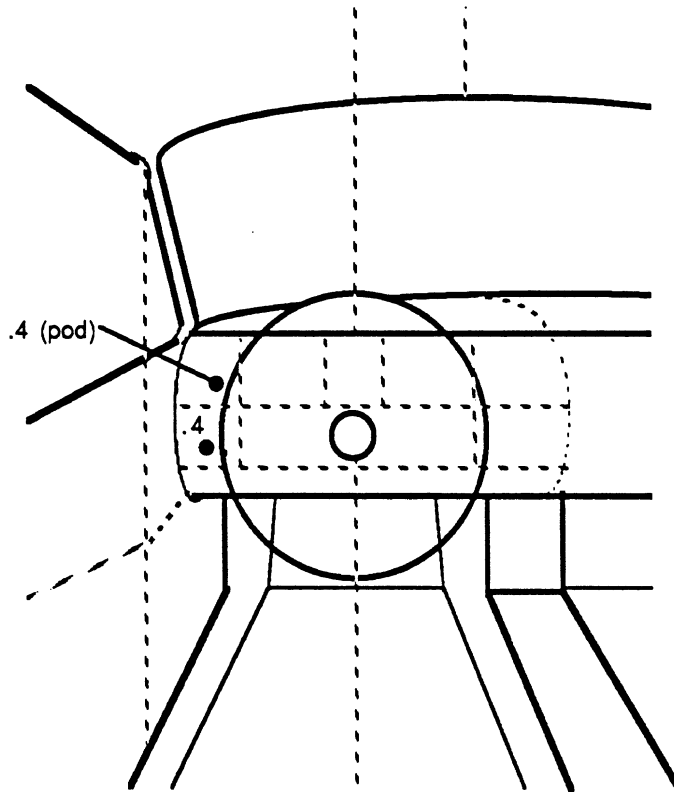
## Optical Horn

The optical horn is also known as the beam flasher, and is used to flash the headlights. It is commonly used to signal the driver in front when passing or that an oncoming car's high beams are on. Of the 236 cars surveyed, only 28.8% (68 cars) were equipped with an optical horn.

The Zone Figure shows that in 23.7% of the cars surveyed this control was located on the left stalk closest to the driver. Of those controls on the left stalk, all were multi-axial large levers.

# OPTICAL HORN

Location (% of switches in given location)



72.8 (not provided)

- RESULTS AND DISCUSSION -

The Switch Type Table indicates that 89.1% of the controls were large levers and 4.7% were push surfaces. Moreover, the Method of Operation Table shows that 79.7% of the controls were activated by a pull out (rearward), while 18.8% required a push in (forward). The ISO Table shows that 7.8% of the controls were labeled with the bugle symbol (more commonly used for the auditory horn), 10.9% with the upper beam symbol, and 9.4% with the lower beam symbol. No labels were found on 68.8% of the controls.

Table 7 indicates that 80.3% of the optical horn controls were not combined with other switches, and 84.8% were multi-axial. All of the optical horn controls were separated and dedicated.

Tables 8 and 9 indicate that all of the manufacturers used one or two different zones and switches for the optical horn control. From the data above, it is apparent that the left stalk closest to the driver, and the multidirectional large lever were the favorite zone and switch type.



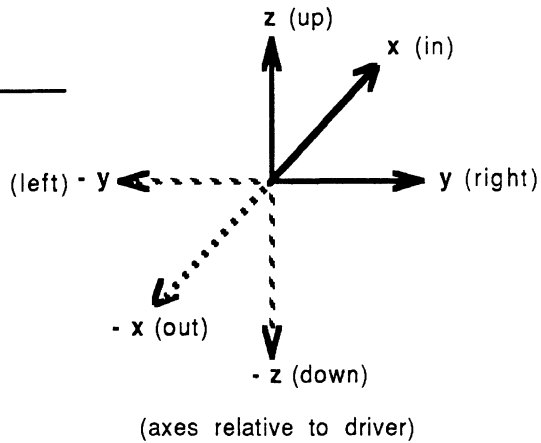
## OPTICAL HORN

**Switch Type** (% of switches that are a given type)

%	Switch Type
89.1	large lever
4.7	push surface
4.7	push button
1.6	joystick (finger-sized)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
79.7	-Fx
18.8	Fx
1.6	Fy



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
10.9	
9.4	
7.8	

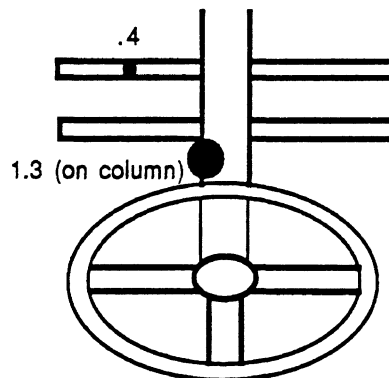
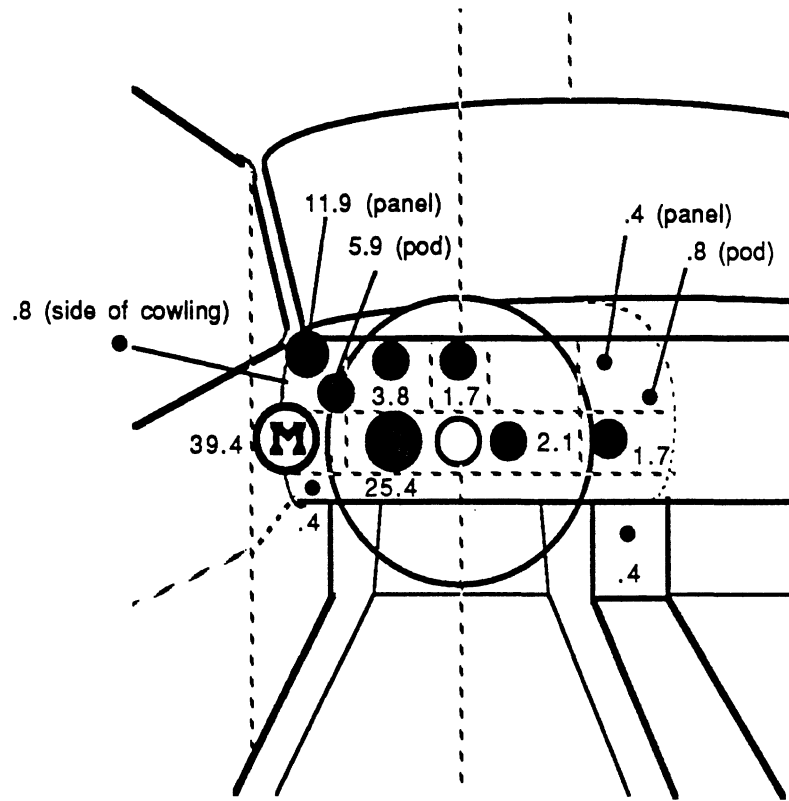
## Panel Lights

The panel lights control operates the lights that illuminate the controls and displays on the instrument panel. This is a standard feature on most automobiles. Of the 236 cars surveyed, 97.0% (229 cars) were equipped with a panel lights control.

The Zone Figure shows that 39.4% of the panel lights controls were located on the lower left dashboard and 25.4% were on the lower center dashboard. Of those controls on the lower left dashboard, 58.1% (54 controls) were turn-pull-push knobs and 23.7% (22 controls) were rotary knobs. Furthermore, of those controls on the lower center dashboard, 41.7% (25 controls) were rotary knobs and 30.0% (18 controls) were thumbwheels.

## PANEL LIGHTS

Location (% of switches in given location)



- 3.0 (not provided)
- .4 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 33.2% of the controls were rotary knobs, 33.2% were turn-pull-push knobs, and 23.1% were thumbwheels. The Method of Operation Table indicates that 38.4% of the controls were activated by a twist out (torque about the -x axis), while 21.8% required a push up, and 19.2% required a twist in (torque about the +x axis). The ISO Table indicates that 2.6% of the panel lights controls were identified by the master lighting ISO symbol and .4% (1 control) by the upper beam symbol. Non-ISO symbols such as "panel" were found on 96.9% of the controls. Position labels such as "brighter" were present on 18.3% of the controls.

Table 7 shows that 94.3% of the panel light controls were noncombined and 65.9% were uni-axial. Also, only .4% of the controls were integrated, and all of them were dedicated.

Table 8 reveals that Chevrolet, Oldsmobile, Pontiac, BMW and Toyota used as many as four or five different zones for the panel lights control location.

Table 9 shows that one to three different switch types were used by all manufacturers.

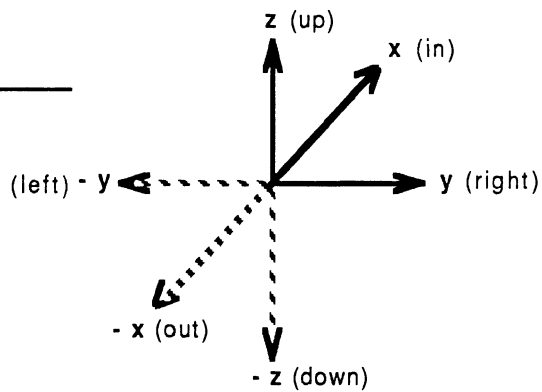
## PANEL LIGHTS

Switch Type (% of switches that are a given type)

%	Switch Type
33.2	rotary knob
33.2	turn-pull-push knob
23.1	thumb wheel
3.5	two-position rocker switch
3.5	slide switch
2.6	other (turn to operate)
.4	paddle switch (uni-axial)
.4	turn-push knob

Method of Operation(% of switches operated using given method)

%	Method of Operation
38.4	-Tx
21.8	Fz
19.2	Tx
6.6	Fy
3.9	Fx
2.2	+/- Fz
1.7	-Fz
1.7	Fy & z
1.3	-Fx
1.3	-Ty
.9	Torque not about axis
.4	-Fy
.4	Ty
.4	+/- Ty



(axes relative to driver)

ISO Symbols (% of switches with given ISO symbol)

%	ISO Symbol
2.6	
.4	

## Radio - Location Only

The radio cluster might include a cassette tape deck, graphic equalizer, and various other controls such as scan, seek, and tune. In this survey, only the location of the radio cluster was examined. Of the 236 cars surveyed, 95.3% (225 cars) were equipped with a radio.

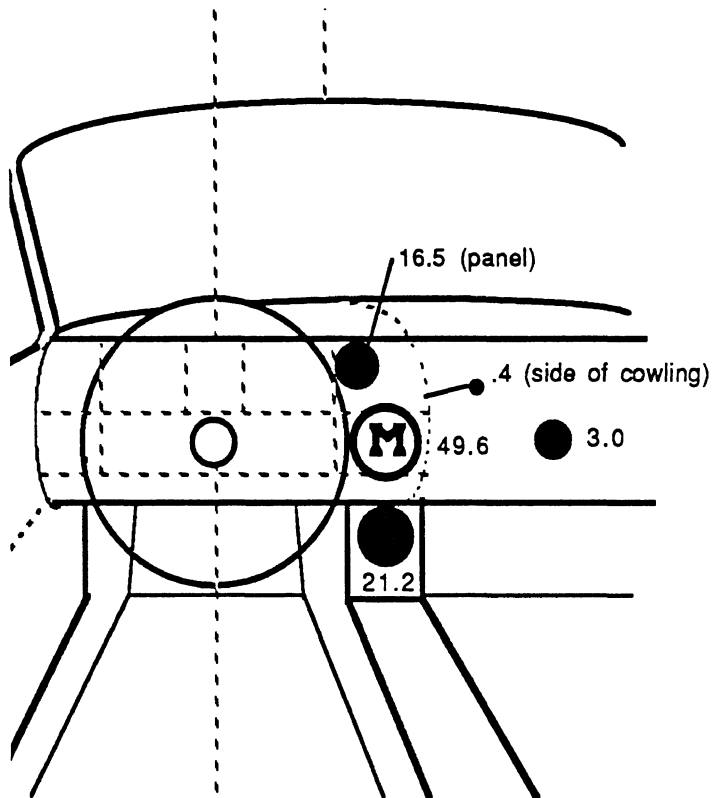
The Zone Figure shows that in 49.6% of the cars surveyed the radio cluster was located on the lower right dashboard, in 21.2% it was on the center console, and in 16.5% on the upper right dashboard.

Since only location was examined, the Switch Type Table and the ISO Table do not apply. In addition, Tables 7 and 9 do not apply.

Table 8 shows that all of the manufacturers placed the radio in one to three distinct zones.

## RADIO

Location (% of switches in given location)



● 4.7 (not provided)

● 4.7 (multiple zones)

## Rear Window Defrost

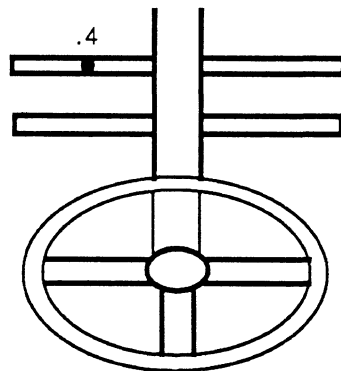
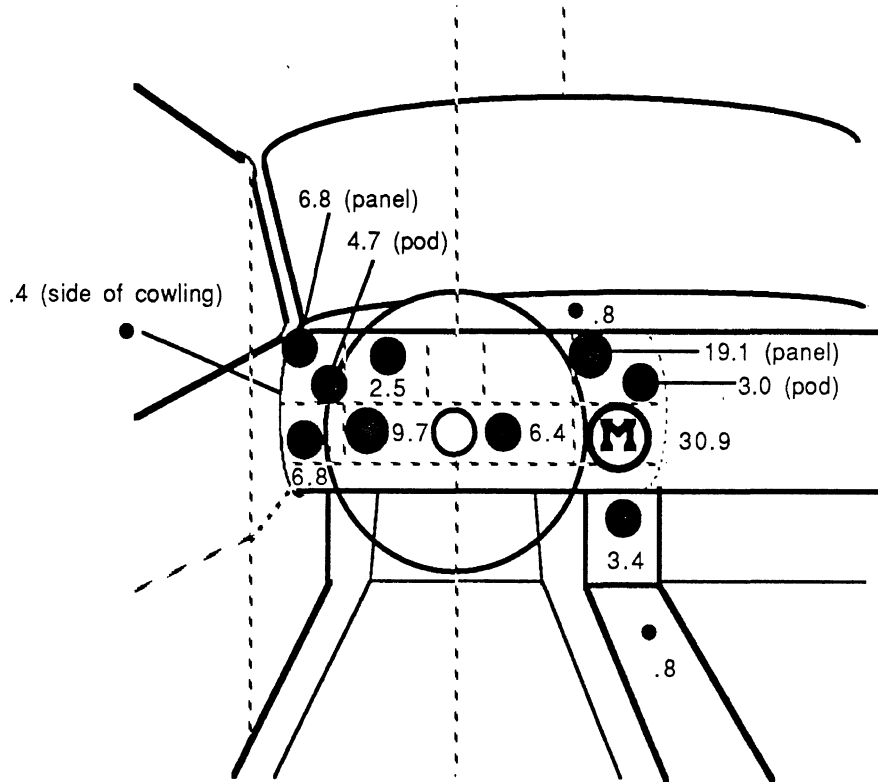
The rear window defrost control removes frost or fog from the rear window. Usually the rear defrost turns off automatically after 5 to 10 minutes. Of the 236 cars surveyed, 97.5% (230 cars) were equipped with a rear defrost.

The Zone Figure shows that in 30.9% of the cars surveyed the rear defrost control was located on the lower right dashboard. Most of the other locations were less popular, lower center dashboard (9.7%) and upper right dashboard (19.1%). Of those controls located on the lower right dashboard 38.4% (28 controls) were push buttons and 26.0% (19 controls) were 2-position rocker switches.



# REAR WINDOW DEFROST

Location (% of switches in given location)



- 2.5 (not provided)
- 1.7 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 43.0% of the rear defrost controls were two-position rocker switches, while 23.5% were push buttons. Malone et al. (1972) found that 52% of the rear defrost controls were vertical toggle switches, while 24% were rocker switches (see Table 2).

In addition, the Method of Operation Table indicates that 82.2% of the rear defrost controls were activated by a push in (forward). The ISO Table shows that 98.7% of the controls were identified by the rear window defrost symbol and .9% (2 controls) by the front window defrost symbol. Non-ISO symbols such as "rear def" or "rear defr" were found on 20.0% of the controls. Position labels such as "on/off", "lo/hi", or "cold/hot" were found on 40.9% of the controls.

Table 7 shows that all of the rear defrost controls were noncombined, uni-axial, and dedicated. Only 1.3% of the controls were integrated, these were found in the Ford Escort 2-door and 4-door hatchback and Escort wagon.

Also, Table 8 reveals that there were quite a few manufacturers that used as many as five or six different locations for the rear defrost control. Those were Colt, Chrysler, Chevrolet, Oldsmobile, Pontiac, Nissan, Mercedes, and Toyota.

Finally, Table 9 shows that most of the manufacturers used between one and three different switch types for the rear defrost control. Ford, Chevrolet, and Pontiac used four types of switches, while Oldsmobile used five.

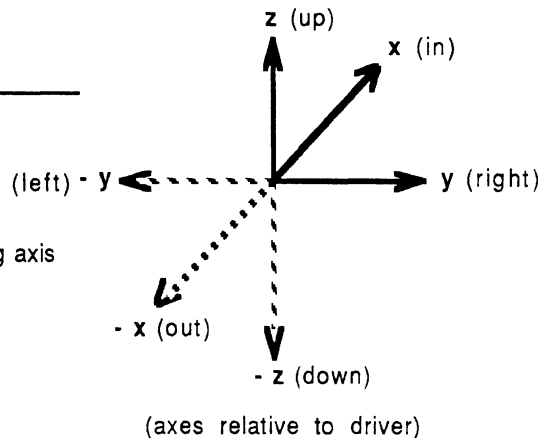
## REAR WINDOW DEFROST

**Switch Type** (% of switches that are a given type)

%	Switch Type
43.0	two-position rocker switch
23.5	push button
15.2	push-push button
8.7	toggle switch (bat handle)
4.8	rotary knob
2.2	slide switch
.9	push-paddle switch
.9	paddle switch (uni-axial)
.9	small lever (uni-axial)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
82.2	F <sub>x</sub>
10.0	F <sub>z</sub>
4.8	T <sub>x</sub>
2.2	F <sub>y</sub>
.9	F not along axis



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
98.7	
.9	

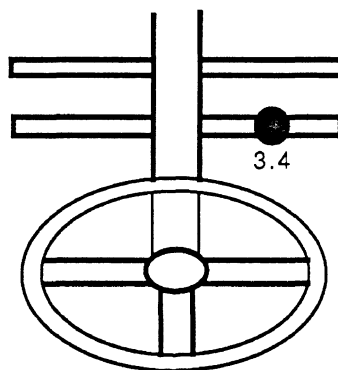
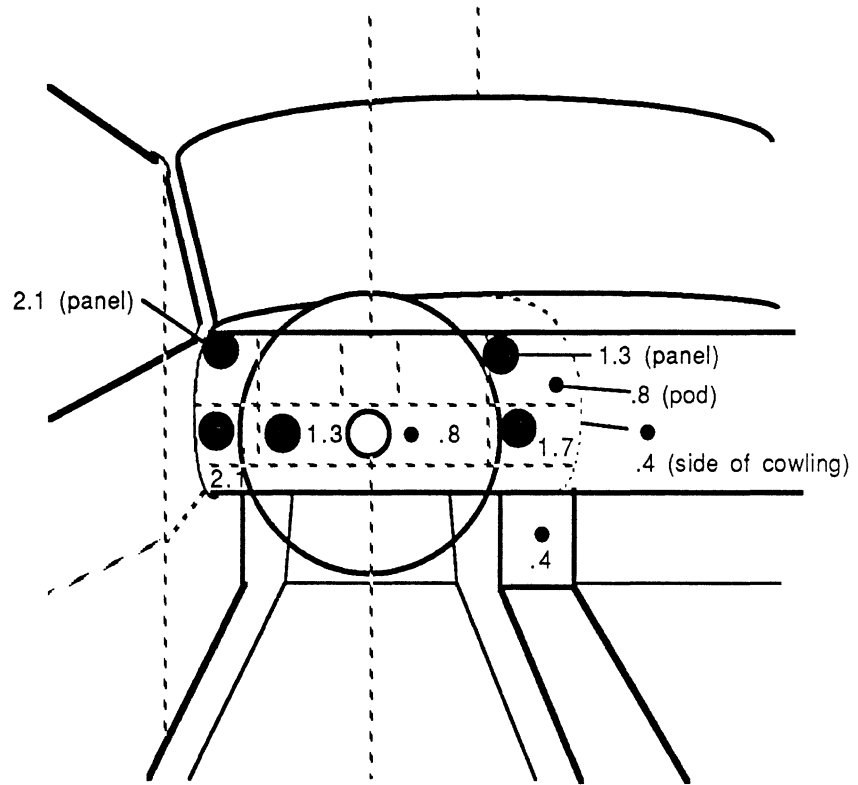
## Rear Window Washer

The rear window washer control operates the washer mechanism that sprays the rear window. Usually it operates in conjunction with the rear wiper. Only 14.8% (35 cars) of the 236 cars surveyed were equipped with a rear washer.

The Zone Figure shows that in 3.4% (8 cars) of the cars surveyed this control was located on the left stalk closest to the driver, in another 2.1% each (5 cars each) it was located on the upper and lower left dashboard. Of those controls located on the left stalk, 50.0% (4 controls) were multi-axial large levers and 25.0% each (2 controls each) were push buttons and rotary knobs. Of those controls found on the dashboard, most were two-position rocker switches, except for one that was a push button.

## REAR WINDOW WASHER

Location (% of switches in given location)



85.2 (not provided)



.4 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 62.9% of the controls were two-position rocker switches and 11.4% were multi-axial large levers. The Method of Operation Table shows that 74.3% of the controls were activated by a push in (forward). Also, the ISO Table shows that 74.3% of the controls were identified by the rear window wiper/washer ISO symbol and 25.7% by the rear window washer ISO symbol. Non-ISO symbols such as "rear wash" or "r. wash" were found on 8.6% of the controls. Position labels such as "on/off" were present on 28.6% of the controls.

Table 7 shows that 82.9% of the rear washer controls were noncombined and 82.9% of them were uni-axial. Over half of the controls were integrated, since activating the rear washer usually starts the rear wipers. All of the washer controls were dedicated.

Table 8 shows that most of the manufacturers used between one and two zones for the rear washer control location. Colt, Nissan, and Toyota used four, four, and five zones, respectively.

Table 9 indicates that most of the manufacturers used one or two different switch types for the rear washer control, except for BMW and Subaru who each used three switch types.

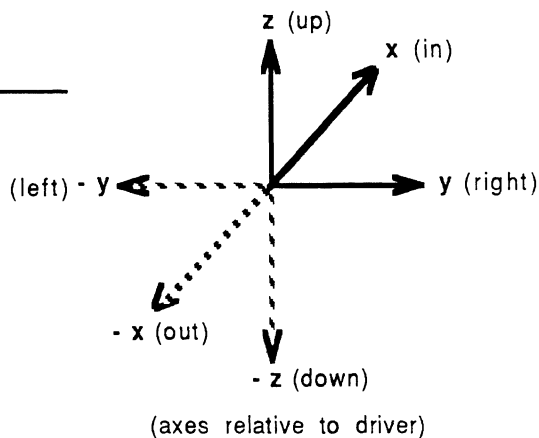
## REAR WINDOW WASHER

**Switch Type** (% of switches that are a given type)

%	Switch Type
62.9	two-position rocker switch
11.4	large lever (multi-axial)
8.6	push button
5.7	paddle switch (uni-axial)
5.7	rotary knob
2.9	pull-push knob
2.9	turn-push knob (multi-axial)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
74.3	F <sub>x</sub>
8.6	-F <sub>y</sub>
5.7	+/-T <sub>y</sub>
2.9	F <sub>y</sub>
2.9	-F <sub>x</sub>
2.9	T <sub>x</sub>
2.9	-T <sub>y</sub>



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
74.3	
25.7	

## Rear Window Wiper

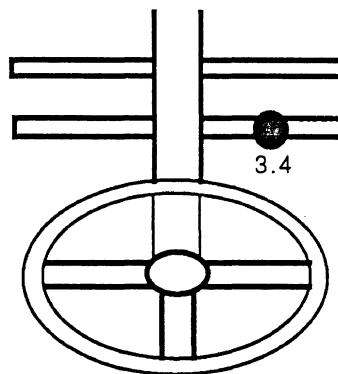
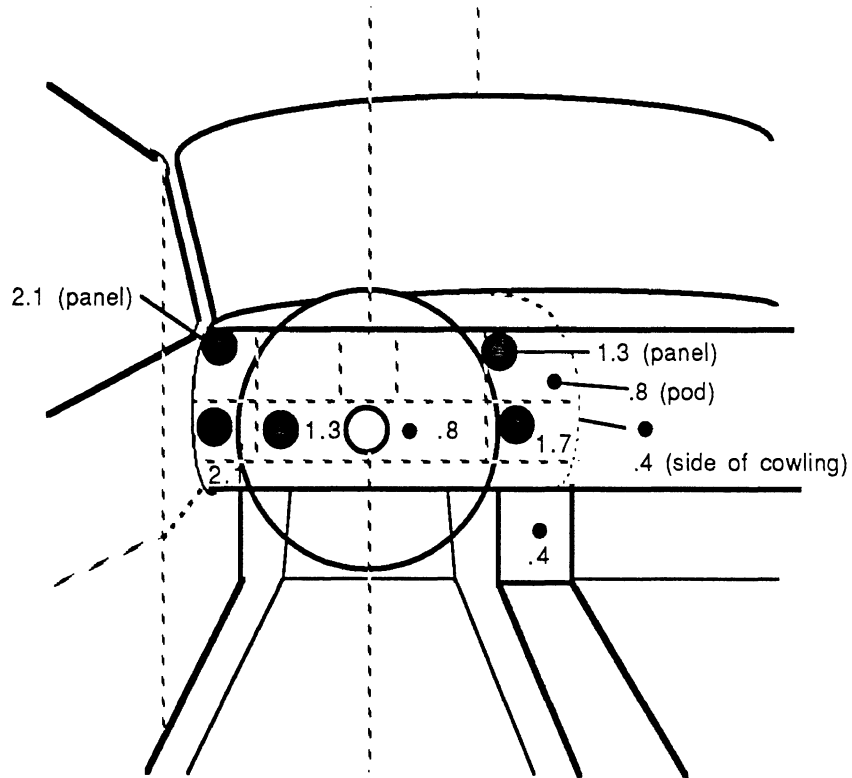
The rear window wiper control operates the rear window wipers. Usually, it is integrated with the rear washer control. However, the rear wiper can be operated independently of the rear washer. Only 14.8% (35 cars) of the 236 cars surveyed were equipped with a rear wiper.

The Zone Figure shows that in 3.4% of the cars surveyed this control was located on the right stalk closest to the driver. The next most popular locations were on the upper and lower left dashboard (2.1% each). Of those controls that were located on the right stalk, 50.0% (4 controls) were multi-axial large levers and 25.0% (2 controls) were rotary knobs. All of the controls placed on the dashboard were two-position rocker switches.



## REAR WINDOW WIPER

Location (% of switches in given location)



85.2 (not provided)



.4 (multiple zones)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 65.7% of the controls were two-position rocker switches, while 11.4% were multi-axial large levers. In addition, the Method of Operation Table indicates that 77.1% of the controls were activated by a push in (forward). The ISO Table shows that 77.1% of the controls were identified by the rear window washer/wiper ISO symbol and 17.1% by the rear window wiper ISO symbol. Non-ISO symbols such as "rear wipe" or "r. wipe" were found on 8.6% of the controls. Position labels such as "on/off" were present for 37.1% of the controls found.

Table 7 shows that 80.0% of the controls were noncombined and uni-axial. The only integrated control was found in the Audi 4000 coupe GT; when the wipers were turned on the rear washer would also be activated. All of the controls for the rear wiper were dedicated.

Table 8 shows that most of the manufacturers used one or two rear wiper control locations. However Colt, Nissan, and Toyota used four, four, and five different zones, respectively.

Finally, Table 9 indicates that most of the manufacturers used one or two switch types, but Nissan used up to three types of switches for the rear wiper.

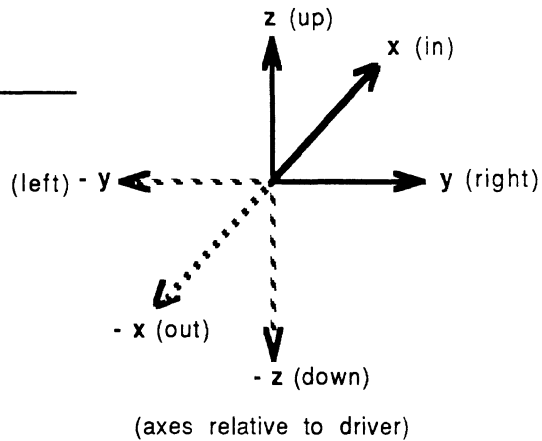
## REAR WINDOW WIPER

**Switch Type** (% of switches that are a given type)

%	Switch Type
65.7	two-position rocker switch
11.4	large lever (multi-axial)
8.6	rotary knob
5.7	paddle switch (uni-axial)
2.9	slide switch
2.9	large lever (uni-axial)
2.9	pull-push knob

**Method of Operation** (% of switches operated using given method)

%	Method of Operation
77.1	Fx
11.4	-Ty
5.7	-Fx
2.9	Fy
2.9	+/- Fy



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
77.1	
17.1	

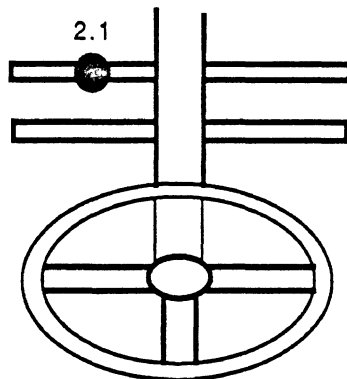
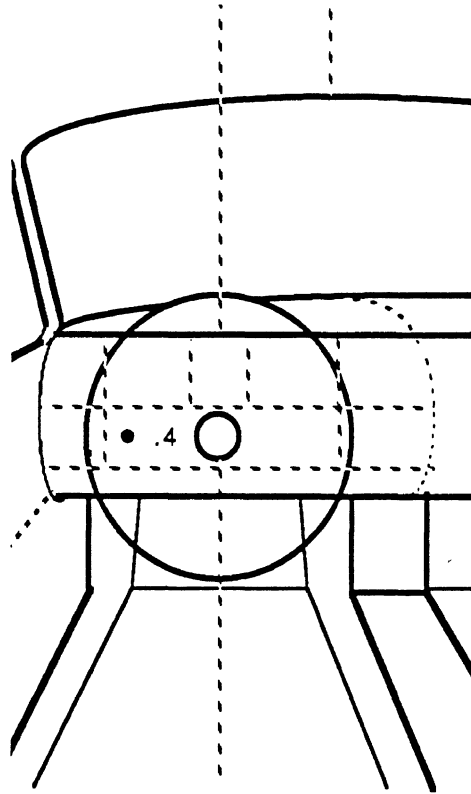
## Steering Adjustment

The steering adjustment control allows the driver to change the position of the steering wheel. It is commonly referred to as telescopic steering, and is distinct from the "tilt steering wheel" which is an entry/exit convenience. This feature is not available on most cars now in production. Only 2.5% (6 cars) of the 236 cars surveyed were equipped with steering adjustment. These cars were the Isuzu Impulse, Buick Regal Ltd. 2-door coupe, Buick Skyhawk 2-door coupe, 4-door sedan and wagon, and the Chevrolet Monte Carlo 2-door.

The Zone Figure shows that in 2.1% (5 cars) of the cars surveyed this control was located on the second left stalk away from the driver. In another .4% (1 car) the steering adjust control was located on the lower center dashboard.

## STEERING ADJUSTMENT

Location (% of switches in given location)



97.5 (not provided)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that all of the switches were pull out levers, and the Method of Operations Table indicates that 83.3% (5 controls) of the controls were activated by a pull out (rearward), 16.7% (1 control) required a push to the right. The ISO Table shows that no symbols were found on any of the controls. All of the controls had position labels.

Table 7 shows that all of the steering adjustment controls were noncombined, uni-axial, separated, and dedicated.

Malone et al. (1972) found that 100% of the steering adjust controls were vertical levers, and that 21% were combined with the turn signal. (see Table 2).

Furthermore, Table 8 and 9 show that all of the manufacturers that made cars with steering adjust used one zone and one switch type.

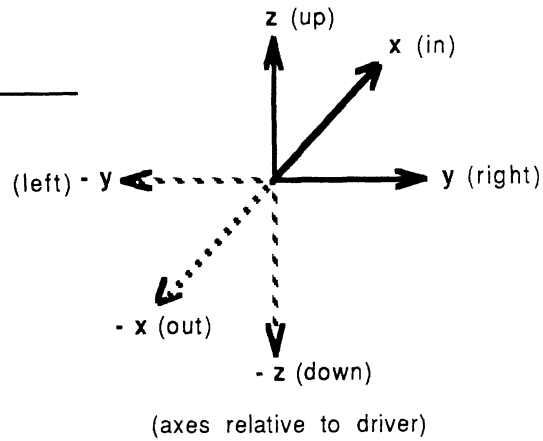
## STEERING ADJUSTMENT

Switch Type (% of switches that are a given type)

%	Switch Type
100.0	lever

Method of Operation (% of switches operated using given method)

%	Method of Operation
83.3	-Fx
16.7	Fy



ISO Symbols (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

## Suspension Adjustment

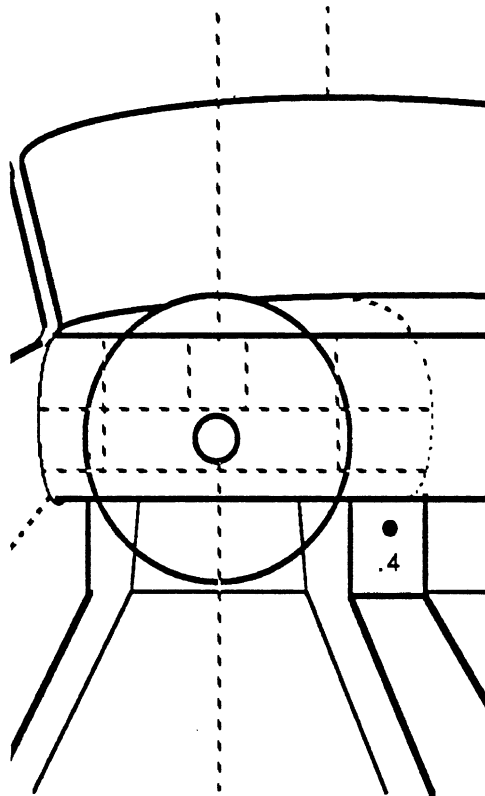
The suspension adjustment control changes how hard or soft the car rides. A soft ride is more comfortable, while a hard ride makes the car easier to maneuver. This control is not commonly available on most cars, but it can be found on some expensive or sport cars.

Only one of the 236 cars surveyed, the Mazda RX7 2-door sport coupe, was equipped with suspension adjust. The control was located on the center console.



## SUSPENSION ADJUSTMENT

Location (% of switches in given location)



99.6 (not provided)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that this control was a push button, and the Method of Operation Table indicates that a push down was required to operate this control. There were no ISO or non-ISO symbols found, and no position labels were present.

Table 7 shows that the suspension adjustment control was noncombined, uni-axial, separated, and dedicated.

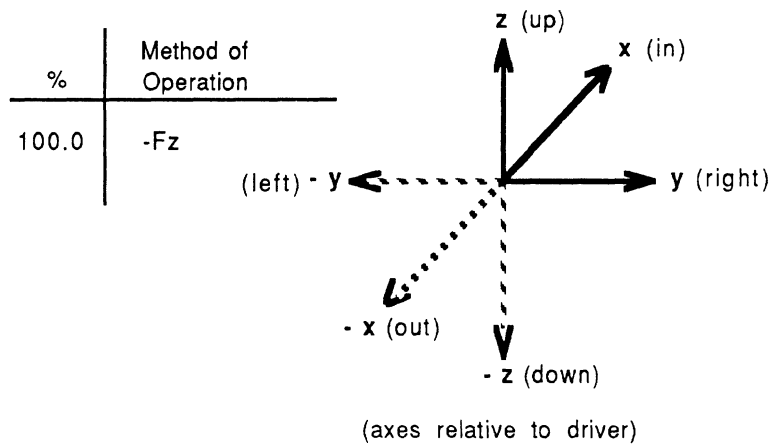
Finally, Tables 8 and 9 do not apply to this control, since there was only one found.

## SUSPENSION ADJUSTMENT

**Switch Type** (% of switches that are a given type)

%	Switch Type
100.0	push button

**Method of Operation**(% of switches operated using given method)



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

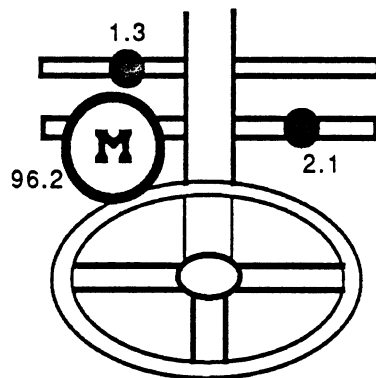
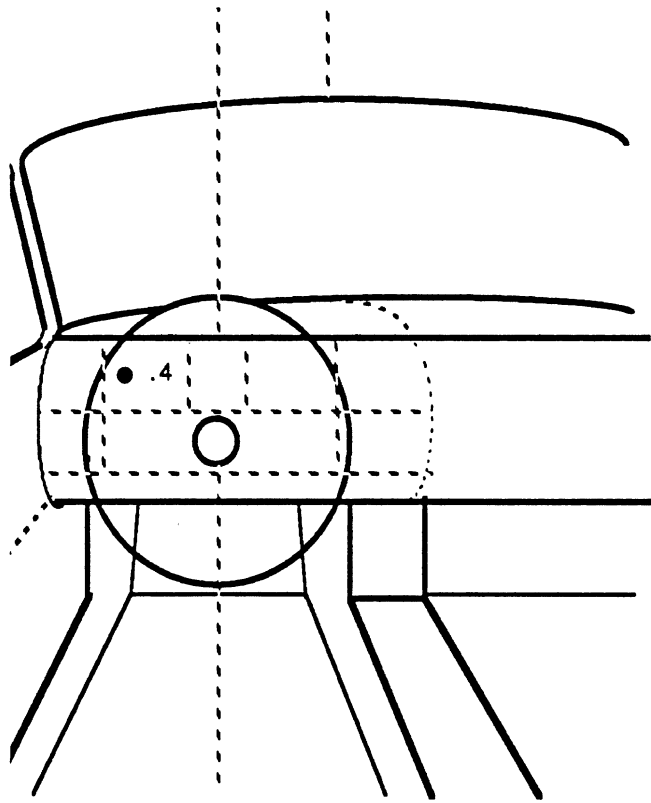
## Turn Signal

The turn signal control activates the left or right flashers on both the front and rear of the car. It is used to indicate a turn. All of the 236 cars surveyed were equipped with turn signals.

The Zone Figure shows that in 96.2% of the cars surveyed this control was located on the left stalk closest to the driver. In 2.1% of the cars the turn signal was on the right stalk closest to the driver. These cars were the Nissan Sentra 2-door coupe, 4-door sedan, 2-door and 5-door hatchbacks, and Sentra wagon. Of those turn signal controls on the left stalk closest to the driver, 99.1% (225 controls) were multi-axial large levers, .4% (1 control each) were uni-axial large levers and .4% were small levers. The controls located on the right stalk were multi-axial large levers.

## TURN SIGNAL

Location (% of switches in given location)



- RESULTS AND DISCUSSION -

The Switch Type Table shows that 98.7% of the controls were multi-axial large levers. The following switches were each found once: paddle switch (Isuzu Impulse), uni-axial large lever (Yugo 3-door hatchback), and uni-axial small lever (Fiat Bertone). The Method of Operation Table shows that 98.3% of the controls were activated by a push up (right turn) or pull down (left turn). In addition, 43.6% of the controls were identified by the standard ISO symbol for the turn signal, right and left arrows. No symbols were found on 56.4% of the controls. Finally, position labels such as "right" or "left" were found on 5.9% of the controls.

Table 7 shows that 66.1% of the turn signal controls were combined with other switches. Most of them were combined with the optical horn and high beams. Uni-axial controls were found in two cars, the Isuzu Impulse and the Fiat Bertone. All of the controls were separated and dedicated.

Table 8 indicates that all of the manufacturers used one or two different zones for the turn signal location.

Finally, Table 9 shows that most of the manufacturers used one type of switch (large levers) for the turn signal control. However, Volvo used three types of switches for the turn signal.

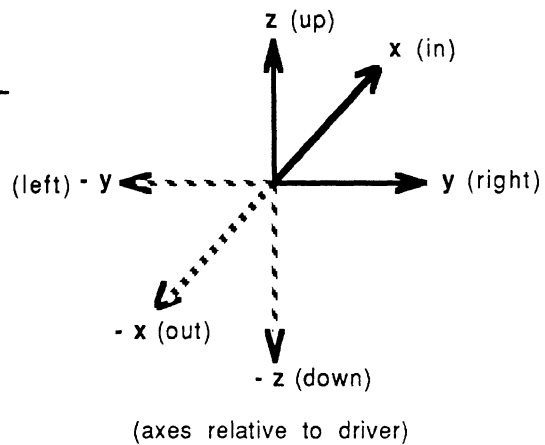
## TURN SIGNAL

**Switch Type** (% of switches that are a given type)

%	Switch Type
98.7	large lever (multi-axial)
.4	paddle switch (uni-axial)
.4	large lever (uni-axial)
.4	small lever (uni-axial)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
98.3	+/- Fz
1.7	F not along axis



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
43.6	

## Power Door Locks

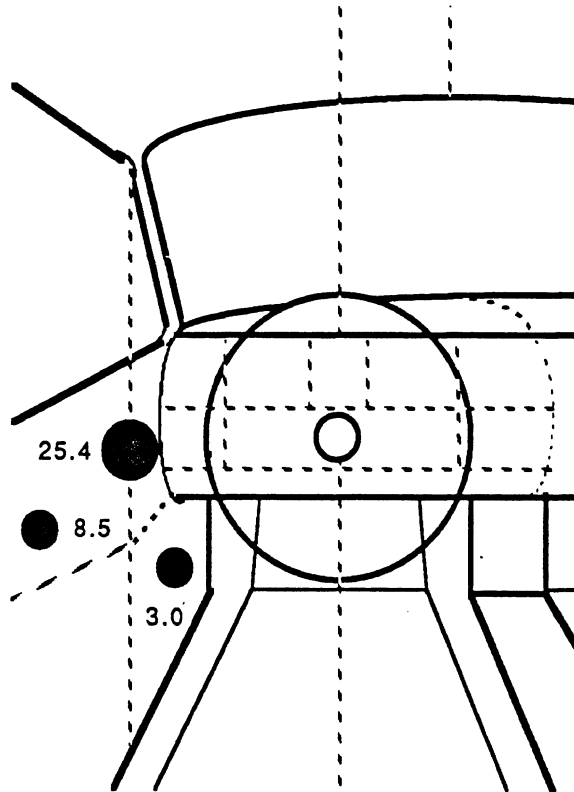
The power door locks control operates the electric door locks. This control is commonly used on more expensive cars, but it is sometimes available on less expensive cars as an option. Only 36.9% (87 cars) of the 236 cars surveyed were equipped with power door locks.

The Zone Figure shows that in 25.4% of the cars surveyed this control was located on the upper right door (furthest from the driver) and 8.5% were located on the upper left door (closest to the driver). Of those controls located furthest from the driver, 40.0% (24 controls) were push buttons and 36.7% (22 controls) were two-position rocker switches. Of those controls closest to the driver, 50.0% (10 controls) were two-position rocker switches and 25.0% each (five controls each) were push buttons and paddle switches.



## POWER DOOR LOCKS

Location (% of switches in given location)



63.1 (not provided)

- RESULTS AND DISCUSSION -

The Switch Type Table indicates that 36.8% of the controls were two-position rocker switches, 33.3% were push buttons, and 27.6% were paddle switches. In addition, 37.9% of the controls required a push left and 24.1% a push down. The ISO table shows that no ISO symbols were found on any of the controls. However, non-ISO symbols were found on 13.8% of the controls, and 86.2% of the controls had no symbols at all. Position labels such as "lock/unlock" were present on 85.1% of the controls.

Table 7 shows that all of the controls for the power door locks were noncombined, uni-axial, separated, and dedicated.

Also, Table 8 indicates that most of the manufacturers used one or two different locations for the power door lock control. Oldsmobile, however, used three zones.

Table 9 shows the same behavior across most of the manufacturers as in Table 8, however Mercedes and Cadillac used up to three switch types each for the power door lock control.

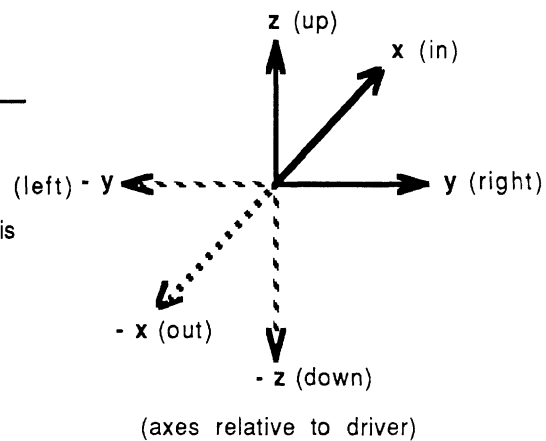
## POWER DOOR LOCKS

**Switch Type** (% of switches that are a given type)

%	Switch Type
36.8	two-position rocker switch
33.3	push button
27.6	paddle switch (uni-axial)
1.1	push-push button
1.1	small lever (uni-axial)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
37.9	-F <sub>y</sub>
24.1	-F <sub>z</sub>
18.4	+/-F <sub>x</sub>
11.5	F not along axis
5.7	F <sub>x</sub>
1.1	F <sub>y</sub>
1.1	+/-F <sub>z</sub>



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

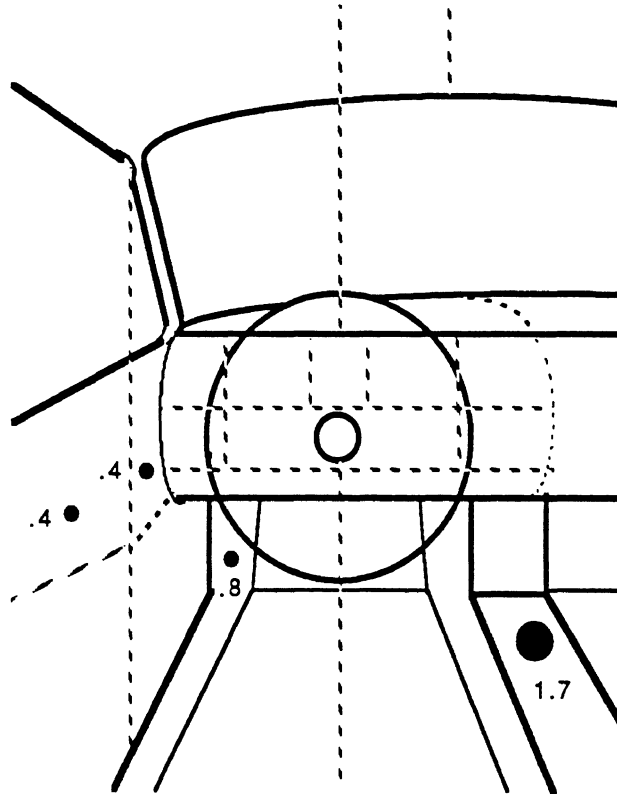
### Power Seat (Back Tilt)

The power seat tilt control adjusts the angle of the seat back, and is usually available for the driver and passenger seats. Only 4.2% (10 cars) of the 236 cars surveyed were equipped with power seat tilt control.

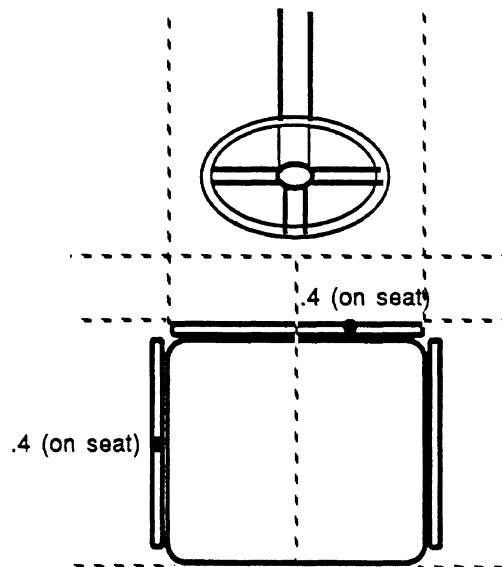
The Zone Figure shows that in 1.7% of the cars this control was located on the floor console. Of those, three controls were push buttons, and one was a paddle switch.

## POWER SEAT (BACK TILT)

Location (% of switches in given location)



95.8 (not provided)



- RESULTS AND DISCUSSION -

The Switch Type Table shows that 30.0% of the seat tilt controls were push buttons and 30.0% were paddle switches. Another 10.0% were push-paddle switches, 10% were two-position rocker switches and 10.0% were slide switches. The Method of Operation Table shows that 40.0% of the controls required a push in (forward) or pull out (rearward). Others required a push down (30.0%) or a push up or pull down (20.0%). The ISO Table shows that none of the controls for the power seat tilt were identified by ISO symbols, however 30.0% of the controls were labeled with non-ISO symbols such as "seat tilt". No symbols were found on 70.0% of the controls. Position labels such as "tilt forward/back" were found on 50.0% of the controls.

Table 7 shows that all of the power seat tilt controls were non-combined, 90.0% were uni-axial, 100.0% were dedicated, and none were separated.

Tables 8 and 9 indicate that only one or two zones and switch types were used by all the manufacturers.

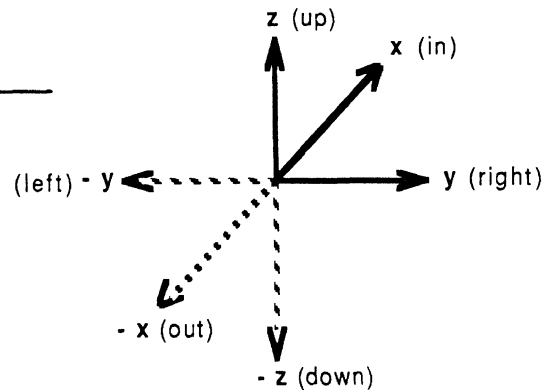
## POWER SEAT (BACK TILT)

**Switch Type** (% of switches that are a given type)

%	Switch Type
30.0	push button
30.0	paddle switch (uni-axial)
10.0	push-paddle switch
10.0	two-position rocker switch
10.0	slide switch
10.0	other (turn to operate)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
40.0	+/- Fx
30.0	-Fz
20.0	+/- Fz
10.0	+/- Ty



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

### Power Seat (Forward/Backward)

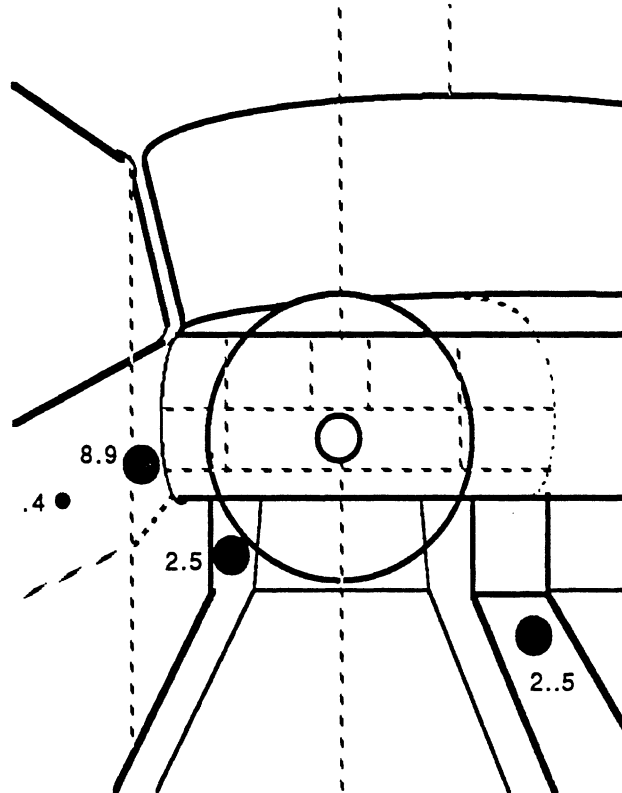
The power seat forward/backward control allows the driver to move the seat towards or away from the steering wheel. Only 24.6% (58 cars) of the 236 cars surveyed were equipped with power seat forward/backward control.

The Zone Figure shows that in 10.2% of the cars surveyed this control was located on the left side of the seat. In 8.9% of the cars it was located on the upper left door. Of those controls located on the left side of the seat, 95.8% (23 controls) were joysticks and 4.2% (1 control) were multi-axial paddle switches. Of those controls on the upper left door, 90.5% (19 controls) were joysticks and 4.6% (1 control each) were multi-axial paddle switches and uni-axial slide switches.

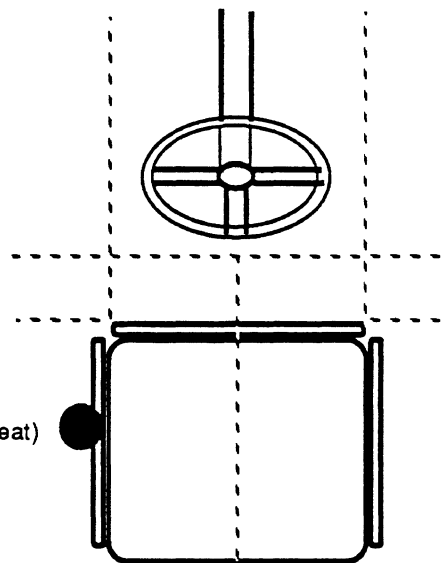


## POWER SEAT (FORWARD/BACKWARD)

Location (% of switches in given location)



75.4 (not provided)



- RESULTS AND DISCUSSION -

The Switch Table shows that 84.5% of the controls were finger-sized joysticks and 5.2% were push buttons. Furthermore, 86.2% of the controls were activated by a push to the right or left. The ISO Table indicates that none of the controls were identified by standard ISO symbols, but 25.9% were marked with non-ISO symbols. No symbols were found on 74.1% of the controls. Position labels were present on 43.1% of the controls.

Table 7 indicates that 91.4% of the controls were noncombined and 89.7% of the controls were multi-axial. All of the controls were dedicated and separated.

Table 8 shows that most of the manufacturers used one or two distinct zones for the power seat forward/backward control location. Lincoln and Oldsmobile however, used three zones each.

Table 9 shows that most of the manufacturers chose to use one or two switch types for the power seat forward/backward control.

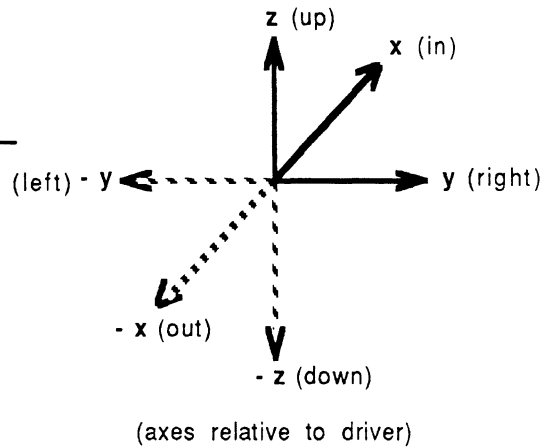
## POWER SEAT (FORWARD/BACKWARD)

**Switch Type** (% of switches that are a given type)

%	Switch Type
84.5	joystick (finger-sized)
5.2	push button
3.4	paddle switch (multi-axial)
3.4	slide switch
3.4	paddle switch (uni-axial)

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
86.2	+/-Fx
6.9	-Fz
6.9	+/-Fz



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

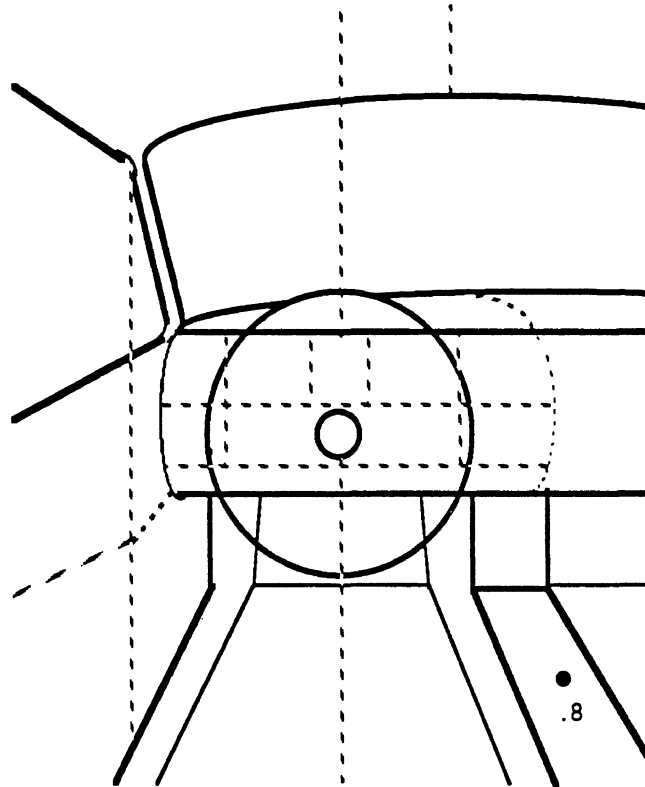
## Power Seat (Lumbar)

The purpose of the power seat lumbar control is to adjust the amount of lumbar support provided by the driver's seat. This control is not available in most cars presently manufactured. In fact, only 1.7% (4 cars) of the 236 cars surveyed were equipped with power seat lumbar control. These cars were the Toyota Celica GTS 3-door liftback, the Toyota Celica Supra 3-door hatchback, the Lincoln Mark VII 2-door, and the Chevrolet Corvette 2-door.

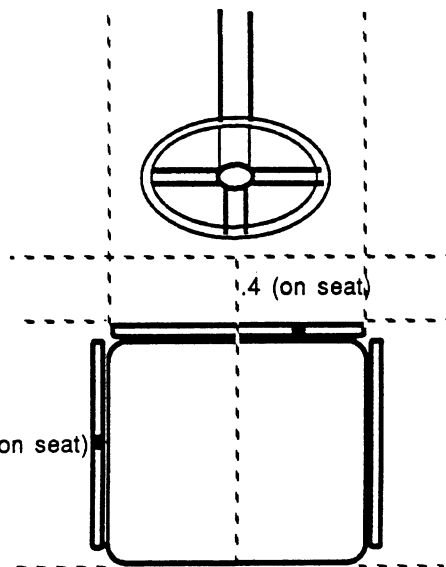
The Zone Figure shows that in two cars this control was located on the center console and both switches were finger-sized joysticks. In two other cars one control was placed on the left side of the seat, and the other was located on the front of the seat. Both of these controls were two-position rocker switches.

## POWER SEAT (LUMBAR)

Location (% of switches in given location)



98.3 (not provided)



- RESULTS AND DISCUSSION -

The Switch type Table shows the same results as noted above. In addition, the Method of Operations Table shows that two of the switches (50.0%) were activated by a push down, another by a push up or down, and the last one required a force not along any of the defined axes. Three of the four controls were identified by non-ISO symbols, while no symbols were found on the fourth control.

Table 7 indicates that three of the four controls were noncombined, two of them were uni-axial, and all of them were separated and dedicated. The lumbar control found in the Toyota Celica Supra was combined and multi-axial; the control found in the Toyota Celica GTS was also multi-axial.

Tables 8 and 9 do not really apply to any of these controls because there were so few.

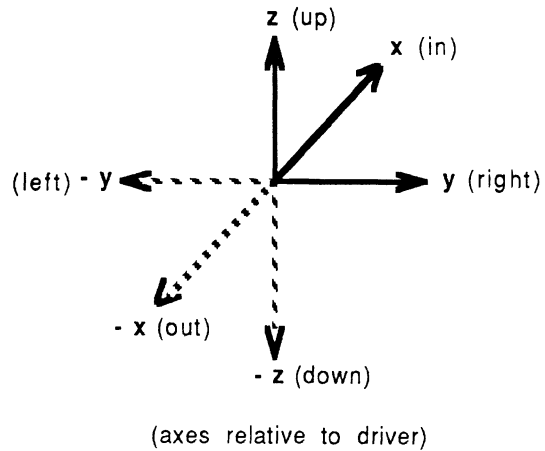
## POWER SEAT (LUMBAR)

**Switch Type** (% of switches that are a given type)

%	Switch Type
50.0	two-position rocker switch
50.0	joystick (finger-sized)

**Method of Operation** (% of switches operated using given method)

%	Method of Operation
50.0	-Fz
25.0	+/-Fx
25.0	F not along axis



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

### Power Seat (Pan Adjustment)

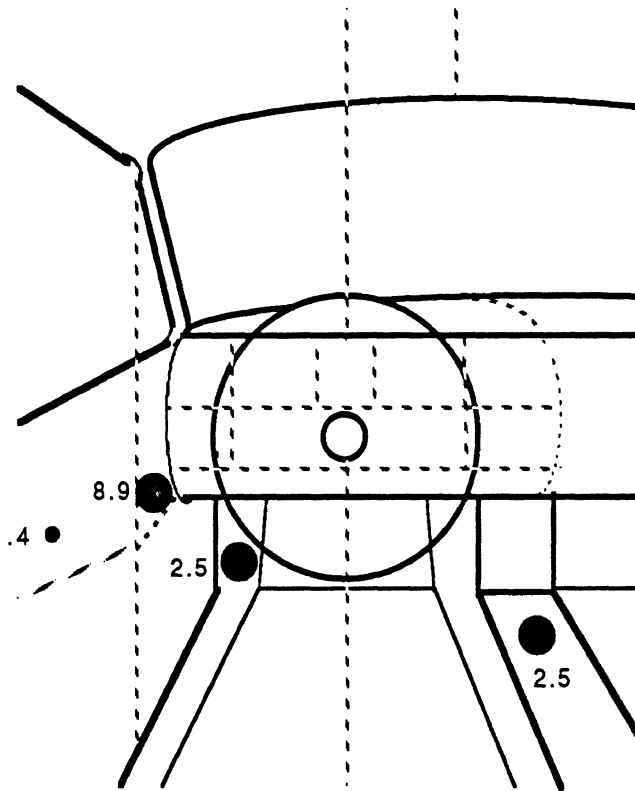
The power seat pan control adjusts the angle of the driver's seat pan. Only 24.6% (58 cars) of the 236 cars surveyed were equipped with power seat pan control.

The Zone Figure indicates that in 10.2% of the cars surveyed this control was located on the left side of the seat and in 8.9% on the upper left door. Of those controls located on the left side of the seat, 52.4% (11 controls) were two-position rocker switches, 19.0% (4 controls) were paddle switches, and 14.3% (3 controls) were push buttons. Of those controls found on the upper left door, 54.2% (13 controls) were paddle switches, 25.0% (6 controls) were joysticks, and 16.7% (4 controls) were push-paddle switches.

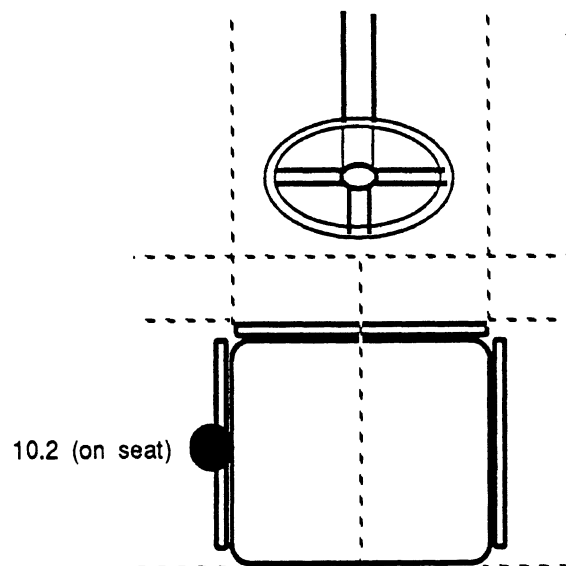


## POWER SEAT (PAN ADJUSTMENT)

Location (% of switches in given location)



75.4 (not provided)



- RESULTS AND DISCUSSION -

The Switch Type Table shows that 44.8% of the controls for the power seat pan were paddle switches. An additional 19.0% of the controls were two-position rocker switches. Furthermore, the Method of Operations Table shows that 50.0% of the controls were activated by a push up or down and 24.1% by a pull down. None of the controls were identified by standard ISO symbols, as noted in the ISO Table, but 25.9% of the controls were labeled with non-ISO symbols such as "seat pan". No symbols were found on 74.1% of the controls. Position labels such as "up/down" were present on 17.2% of the power seat pan controls.

Table 7 indicates that 1.7% (1 control) of the controls was combined. This control was found in the Toyota Celica Supra 3-door hatchback. In addition, 15.5% of the controls were multi-axial, 89.7% were integrated, and all were dedicated.

Table 8 shows that most of the manufacturers used one or two distinct zones for placing the power seat pan control, except Lincoln and Oldsmobile who used three zones each.

Table 9 shows that Buick and Cadillac used up to three different switch types for the power seat pan control.

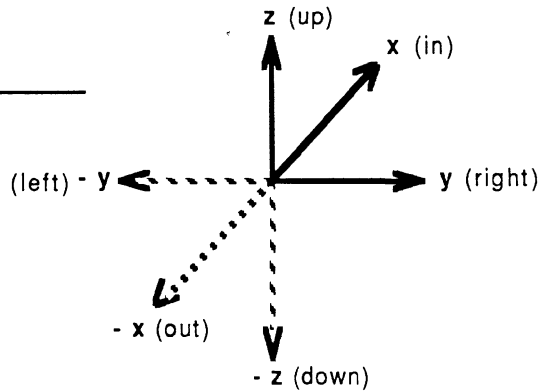
## POWER SEAT (PAN ADJUSTMENT)

Switch Type (% of switches that are a given type)

%	Switch Type
44.8	paddle switch
19.0	two-position rocker switch
10.3	push-paddle switch
10.3	push button
10.3	joystick (finger-sized)
3.4	paddle switch (multi-axial)
1.7	slide switch

Method of Operation (% of switches operated using given method)

%	Method of Operation
50.0	+/- Fz
24.1	-Fz
10.3	+/- Fx
8.6	+/- Fy
5.2	Fz
1.7	+/- Ty



(axes relative to driver)

ISO Symbols (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

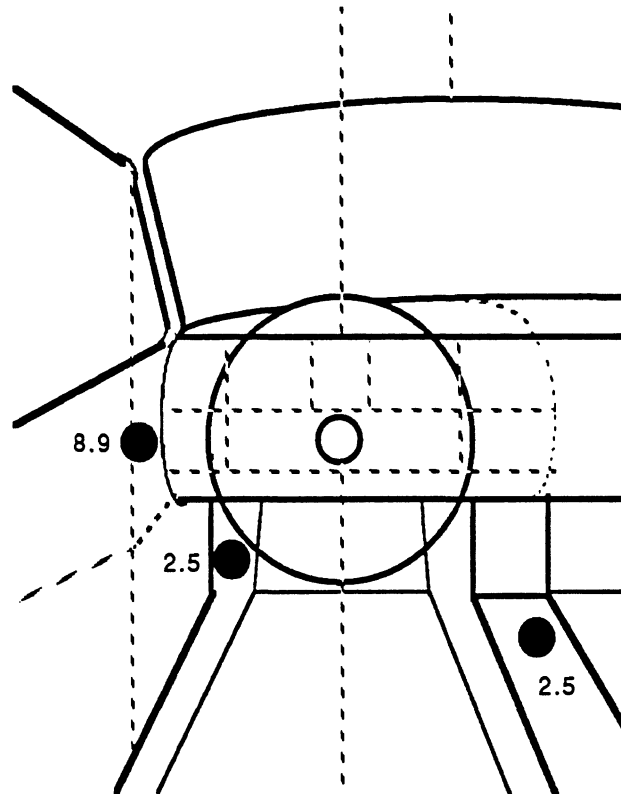
### Power Seat (Up/Down)

The power seat up/down control adjusts the height of the seat. Of the 236 cars surveyed, 24.2% (57 cars) were equipped with power seat up/down control.

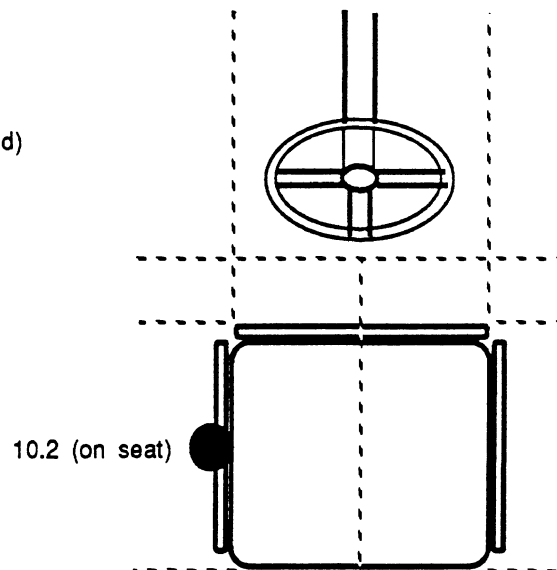
The Zone Figure shows that in 10.2% of the cars surveyed this control was located on the left side of the seat and in 8.9% it was on the upper right door. Of those controls located on the left side of the seat, 90.5% (19 controls) were joysticks and 4.6% each (1 control each) were slide and multi-axial paddle switches. Of those power seat up/down controls found on the upper right door, 70.8% (17 controls) were joysticks and 25.0% (6 controls) were paddle switches.

## POWER SEAT (UP/DOWN )

Location (% of switches in given location)



75.8 (not provided)



- RESULTS AND DISCUSSION -

The Switch Type Table shows that 75.4% of the controls were joysticks and 14.0% were paddle switches. The Method of Operations Table indicates that 49.1% of the controls were activated by a push up or down, while 36.8% required a push right or left. In addition, none of the power seat up/down controls were identified by standard ISO symbols, however 29.8% of the controls were labeled by non-ISO symbols such as "pwr. seat. up/dn.". No symbols were found on 70.2% of the controls. Position labels such as "up/dn" were found on 35.1% of the controls surveyed.

Table 7 shows that 1.8% of the power seat up/down controls were combined. These were usually the left side seat-mounted multi-axial paddle switches that combined the up/down function with forward/backward. Also, 21.1% of the controls were uni-axial. All of the controls were separated and dedicated.

Tables 8 and 9 show that most of the manufacturers used one or two distinct zones and switch types for the power seat up/down control. The only exception was Oldsmobile which used three separate zones in placing the power seat up/down control.

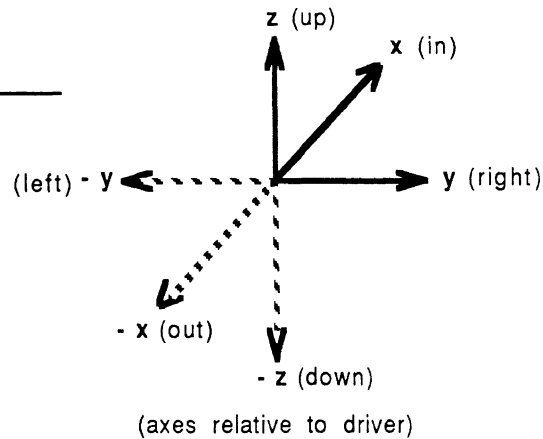
## POWER SEAT (UP/DOWN)

**Switch Type** (% of switches that are a given type)

%	Switch Type
75.4	joystick (finger-sized)
14.0	paddle switch (uni-axial)
5.3	push button
3.5	paddle switch (multi-axial)
1.8	slide switch

**Method of Operation** (% of switches operated using given method)

%	Method of Operation
49.1	+/-Fz
36.8	+/-Fy
7.0	+/-Fx
7.0	-Fz



**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

## Power Windows

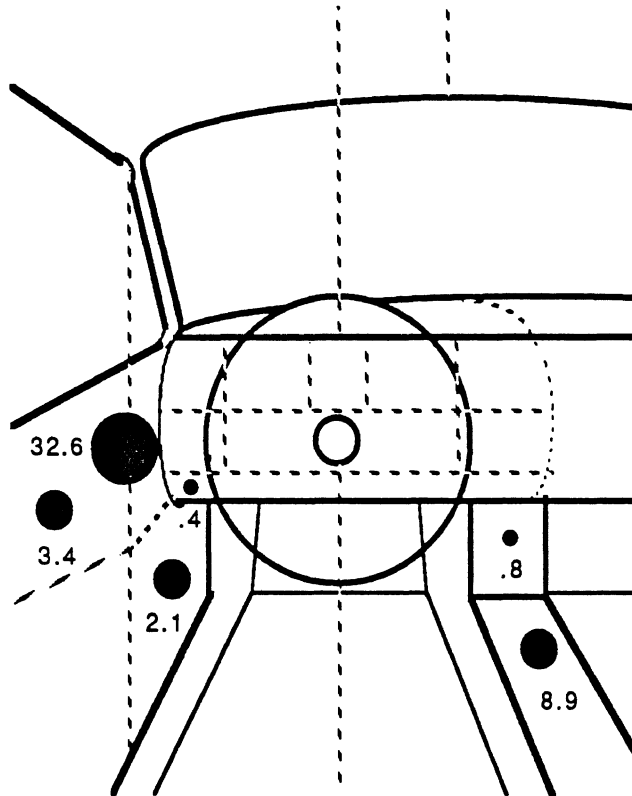
The power window control opens and closes the car windows. Usually the driver can control all the car windows. Of the 236 cars surveyed, 48.3% (114 cars) were equipped with power windows.

The Zone Figure shows that in 32.6% of the cars surveyed this control was located on the upper right door and in 8.9% it was located on the center console. Of those controls that were located on the upper right door 59.7% (46 controls) were two-position rocker switches and 40.3% (31 controls) were paddle switches. Of the controls on the center console 66.7% (14 controls) were two-position rocker switches and 23.8% (5 controls) were push buttons.



## POWER WINDOWS

Location (% of switches in given location)



51.7 (not provided)

- RESULTS AND DISCUSSION -

The Switch Type Table shows that 61.4% of the controls were two-position rocker switches and 34.2% were paddle switches. Furthermore, 50.0% of the switches were activated by a push down, while 20.2% required a push in (forward) or a pull out (rearward). None of the controls for the power window were identified by standard ISO symbols, but 38.6% used non-ISO symbols such as "pwr window". No symbols were found on 61.4% of the controls. Position labels such as "up/dn" were present on 71.1% of the controls.

The results in Table 7 show that all of the power window controls were noncombined, uni-axial, separated, and dedicated.

Table 8 shows that most manufacturers located the power window control in one or two zones. However, Chrysler, Ford, and Buick each used three different locations.

Table 9 shows that all of the manufacturers use only one or two switch types for the power window control.

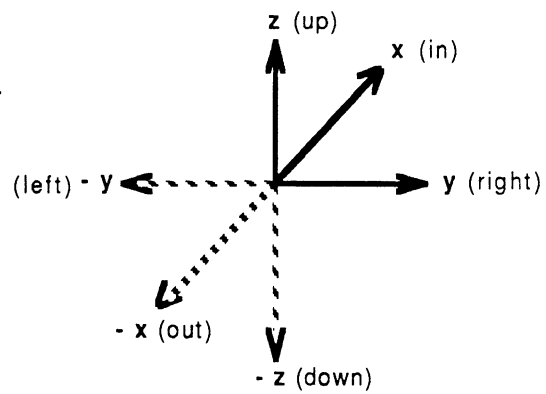
## POWER WINDOWS

**Switch Type** (% of switches that are a given type)

%	Switch Type
61.4	two-position rocker
34.2	paddle switch
4.4	push button

**Method of Operation**(% of switches operated using given method)

%	Method of Operation
50.0	-Fz
20.2	+/-Fx
13.2	F not along axis
9.6	+/-Fz
5.3	-Fy
.9	Fx
.9	Fy



(axes relative to driver)

**ISO Symbols** (% of switches with given ISO symbol)

%	ISO Symbol
100.0	none

- RESULTS AND DISCUSSION -

## CLOSING THOUGHTS

Any discussion or remarks concerning specific controls or control characteristics has been covered in the previous section and therefore will not be repeated here. A few words should be said, however, about what the authors learned while conducting this study.

It is the authors' opinion that the basic data collection procedure employed here was sound, and that careful management of this procedure and the data analysis process were critical to the success of this study.

Further, based upon the analysis of vehicle production totals, it would appear that it is not necessary to weight the data according to production totals so long as the sample is representative of what a driver is likely to encounter.

Also, a collection of brochures and the slides made from those brochures proved to be useful internally for recalling specific designs.

Finally, as indicated in the introduction, the literature seems to suggest that control designs and locations change considerably over a period of approximately five years. This should be taken into account when using the information presented in this report, since its applicability may be limited to the next five years.

The authors hope that readers find the information presented here to be useful. Any feedback concerning this material would be greatly appreciated.

- CLOSING THOUGHTS -

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# APPENDICES

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APPENDIX A. Anacapa Sciences (1974) Scatter Plots of Control Locations

Source: Anacapa Sciences, 1974

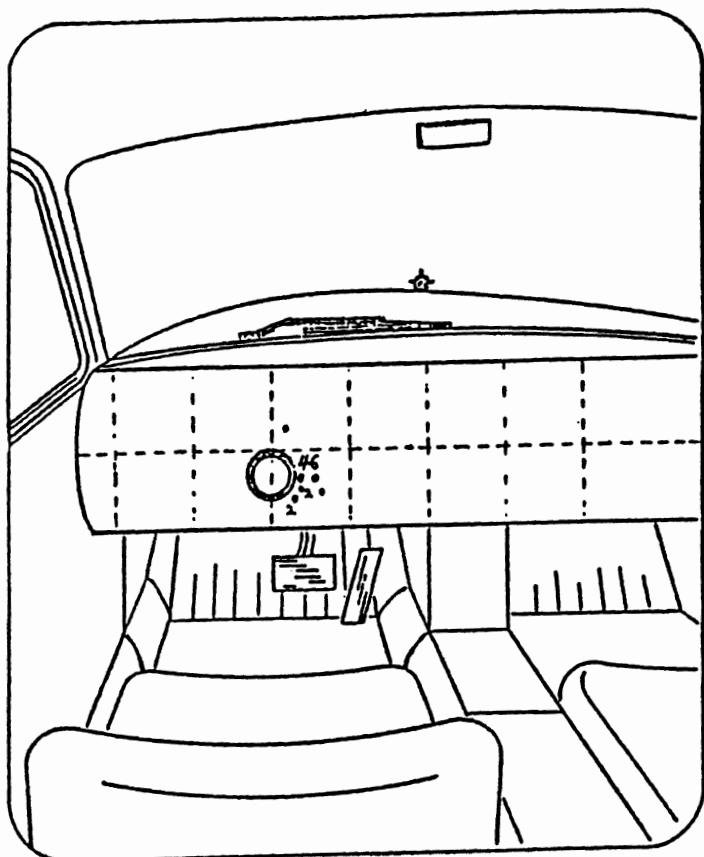


Figure 2, Locations of Ignition/Starter  
in 1973 Cars  
(N=53)

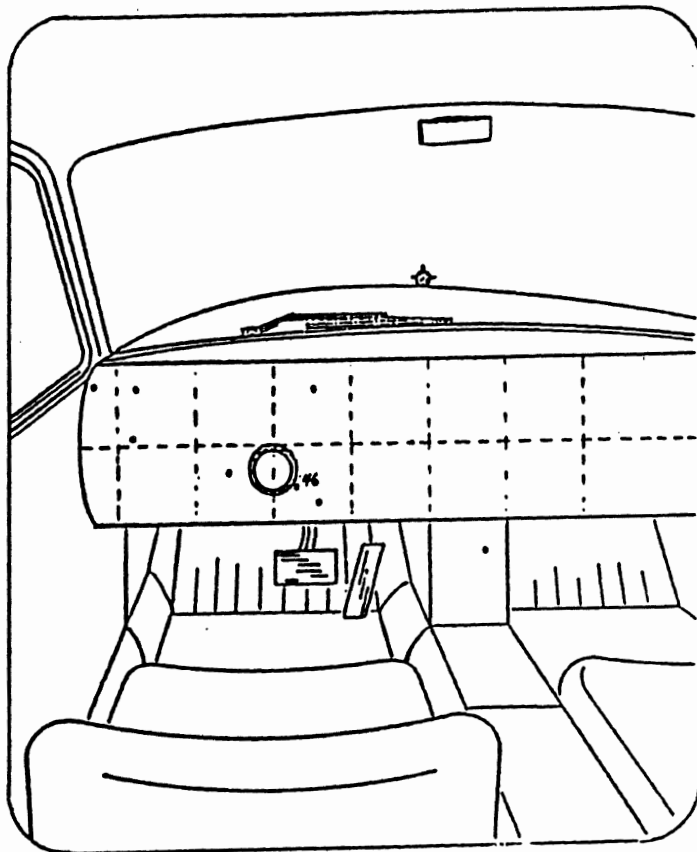


Figure 3, Locations of Flasher  
in 1973 Cars  
(N=53)

APPENDIX A. Anacapa Sciences (1974) Scatter Plots of Control Locations (Continued)

Source: Anacapa Sciences, 1974

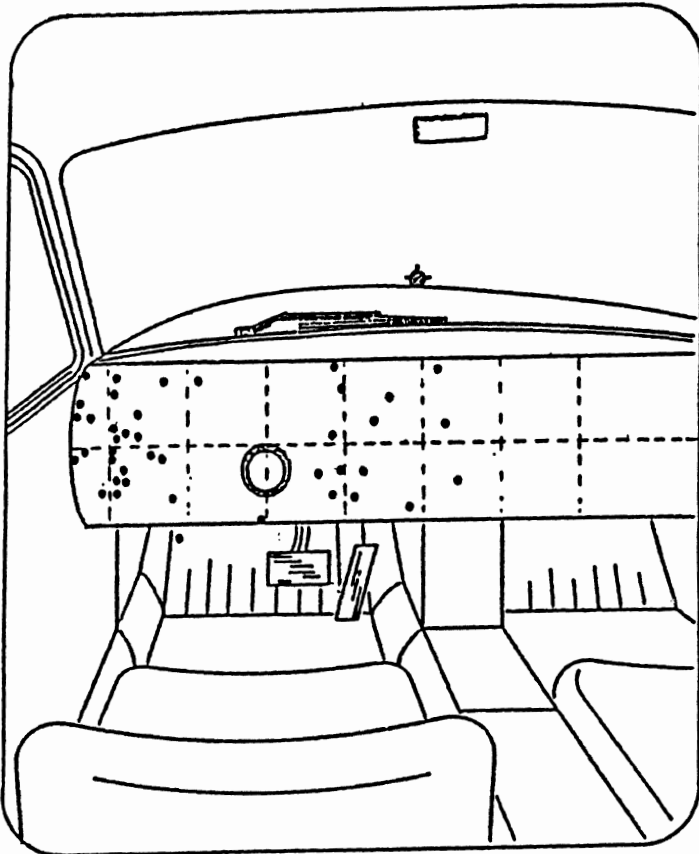


Figure 4, Locations of Washer in 1973 Cars  
(N=43 (39 Dual, 4 Single))

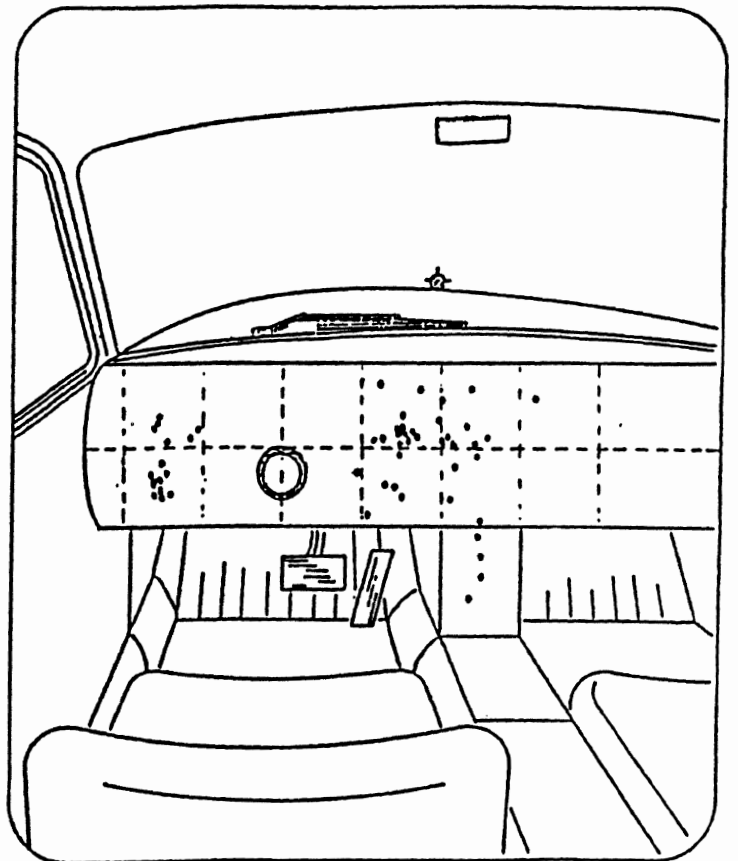


Figure 5, Locations of Climate Controls in 1973 Cars  
(Centroid)  
(N=52)

APPENDIX A. Anacapa Sciences (1974) Scatter Plots of Control Locations (Continued)

Source: Anacapa Sciences, 1974

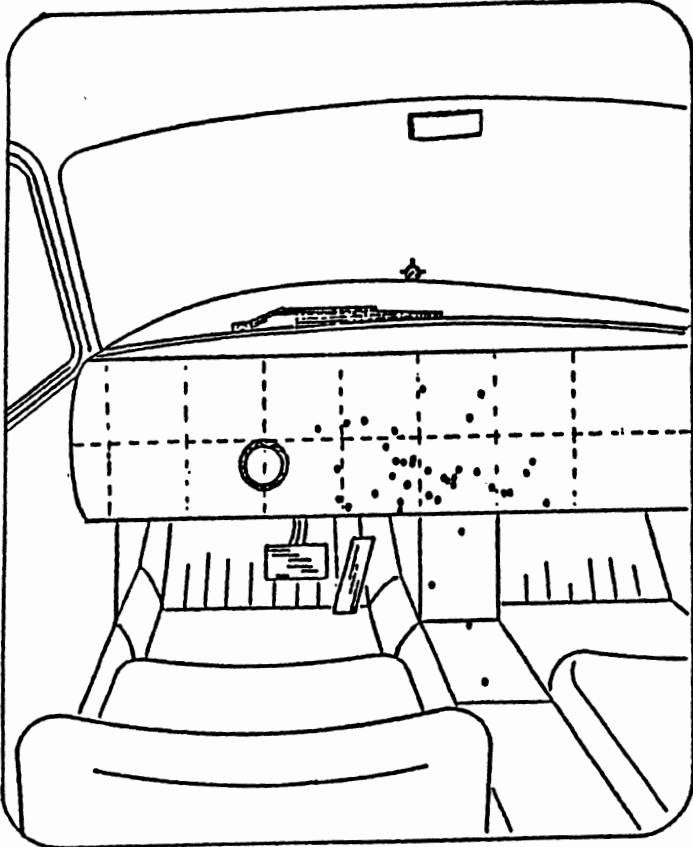


Figure 6, Locations of Lighter in 1973 Cars  
(N=39)

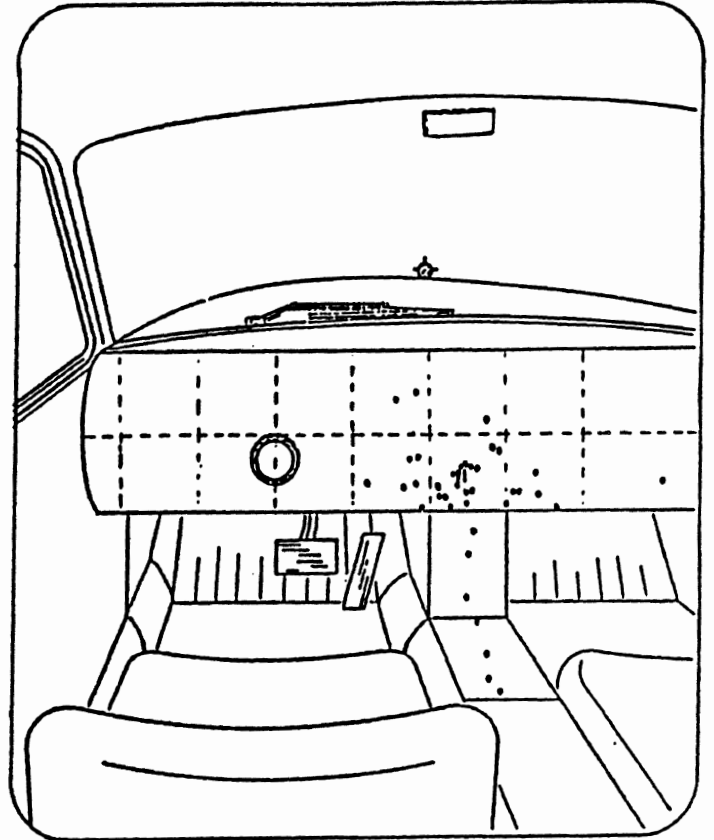


Figure 7, Locations of Ashtray in 1973 Cars  
(N=42)

APPENDIX A. Anacapa Sciences (1974) Scatter Plots of Control Locations (Continued)

Source: Anacapa Sciences, 1974

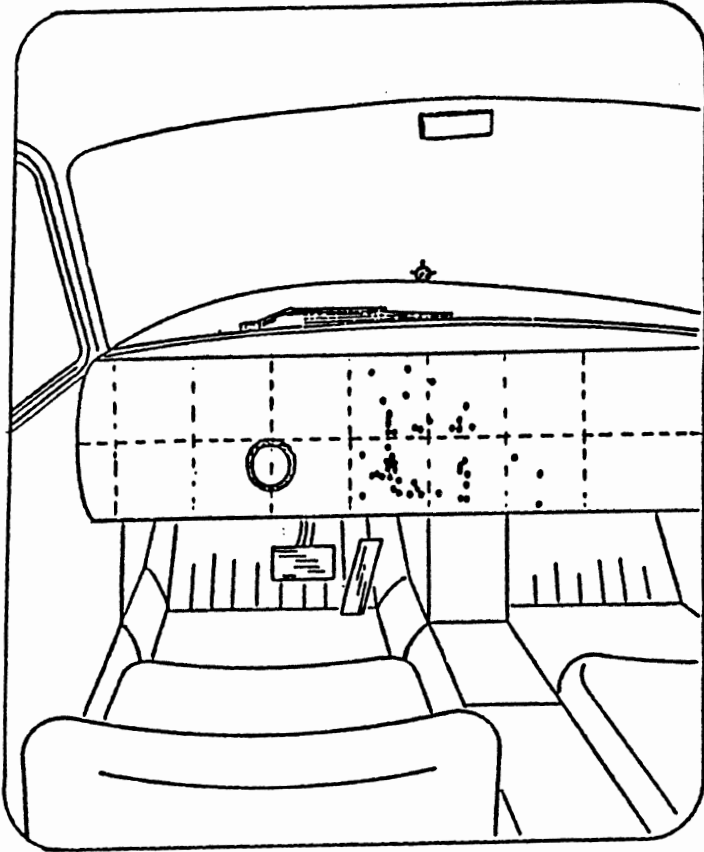


Figure 8, Locations of Radio in 1973 Cars (N=48)

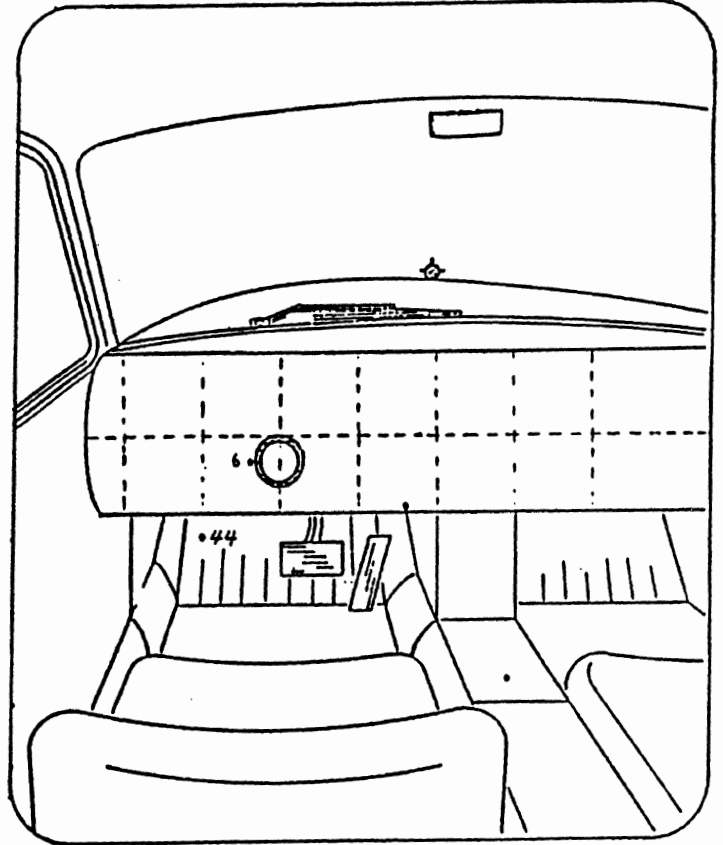


Figure 9, Locations of Dimmer in 1973 Cars (N=52)

APPENDIX A. Anacapa Sciences (1974) Scatter Plots of Control Locations (Continued)

Source: Anacapa Sciences, 1974

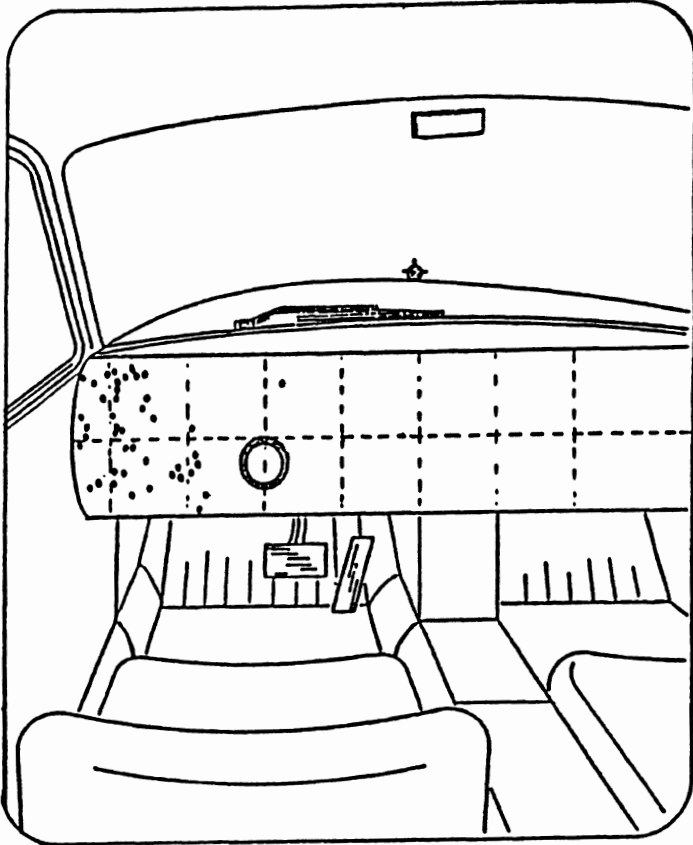


Figure 10, Locations of Headlight in 1973 Cars (N=44)

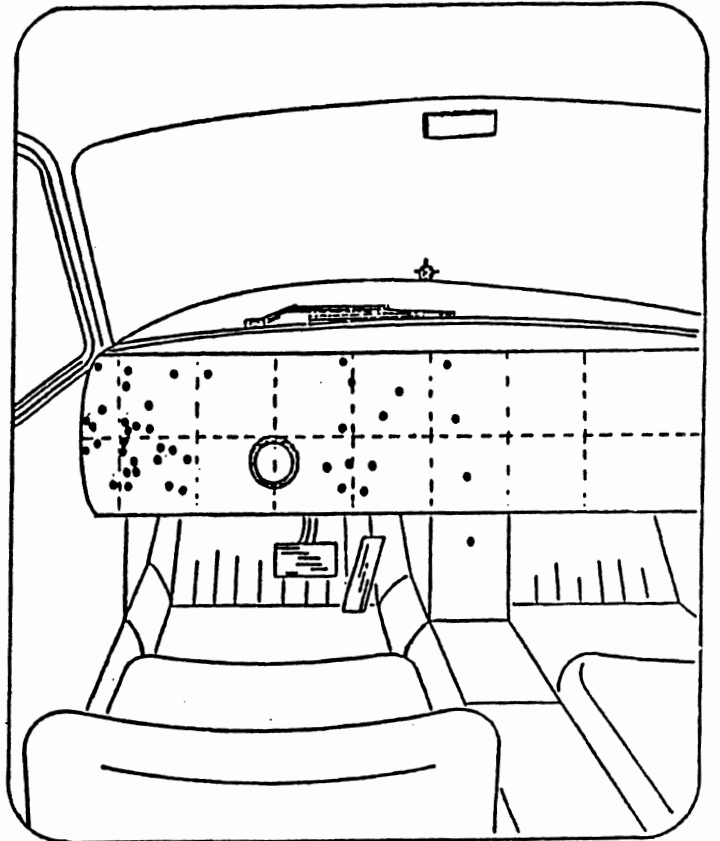


Figure 11, Locations of Wiper in 1973 Cars (N=42 (39 Dual, 3 Single))

- APPENDICES



APPENDIX B. Method for Obtaining Production Totals;  
Production Totals for each Car Surveyed

Introduction

One of the goals of this project was to determine the likelihood that a person driving a randomly selected 1986 model year car in the U.S. would encounter a specific instrument panel control design. To achieve that goal, the data collected by the survey of 1986 cars needs to be adjusted according to the number of each car produced. For example, there is one entry in the data base for the Dodge Omni four-door and one entry for the Dodge Daytona, but about four times as many four-door Omnis were produced, therefore the data for the Omni would have a greater weighting.

Methods Used

(1) *Production Totals in Ward's* - Consult Ward's 1987 Automotive Yearbook, Forty Ninth Edition (Ward's Communications Inc., 1987) to find the production totals for domestic cars or import totals for foreign cars with respect to each make, model, and body style examined in the field study. Just over two-thirds of the production totals were found this way. Since Ward's has a good reputation for tracking the industry, these values are believed to be quite accurate. However, there were a few instances where Ward's reported two different values for the same datum. For instance, that was the case for the Volkswagen Golf, which is built in the United States. In addition, the Nissan Sentra was not listed as being available in a two-door hatchback, when it actually was. Therefore, it is possible there were other errors in Ward's.

(2) *Sales Totals in Ward's* - In some cases for foreign cars, Ward's gave only the import totals for a particular make, but not totals for each body style. When that occurred the sales figures from Ward's, which were separated by body style, were used to estimate production totals. For example, given the production total for the Saab 900, sales data for each model were used to estimate the number of two-door, three-door (and so fourth) models produced for other Saab body styles. These computed values were reviewed by an UMTRI expert who tracks vehicle production for accuracy (Andrea, 1987). While these values are not as accurate as actual production data, they are probably within a few percent of the actual numbers. Also, because of the small percentage of the market they represent, errors in these values will have only a small effect on subsequent control location and type calculations.

(3) *Contact the Manufacturer* - If neither production or sales totals were available from Ward's, the manufacturer

was contacted by phone for the desired data. In most cases, it was best to contact the public relations department.

## Background

Four tables from Ward's were used to determine or estimate the number of automobiles produced or imported by a particular manufacturer.

- Table I Car Production by Body Style for '86 Model Year

This page lists those car models made by U.S. manufacturers, and divides them into every kind of two and four-door body style produced (e.g., two-door sedans, pillared, convertibles, etc; and four-door sedans, hatchbacks, and wagons).

- Table II Car Production by Make by States '86 Model Year

This page lists the number of cars produced in each state, with further data on the car model and factory responsible for assembling the car.

- Table III Ward's Import Car Market Segmentation

This includes data on those automobiles that were imported during the '86 and '85 model years. It lists the number of imports by car models, with a corresponding import market share for the year. In some cases, particular car models and body styles were cited individually.

- Table IV '86 Model Import Car Sales by Make and Body Style

This page lists the number of imported cars sold during the '86 model year by manufacturer and body style (two and four-doors), but not by model. It is very similar to Table I, except there are no details on the specific model of car imported.

**Example:** Using only the production totals from Ward's  
(Method (1))

**Question:** How many 1986 model year Chrysler Fifth Avenues were produced?

**Answer:** Go to Table I in Ward's and look for the heading "Chrysler/Plymouth." Find the row marked "Fifth Avenue" and scan across the line to see which styles of Fifth Avenues were produced. In this example, the number of Fifth Avenues

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produced during the 1986 model year were 104,744 units. Based on the column this total was found under, all Fifth Avenues were four-door sedans.

Example: Using only the sales totals from Ward's (Method (2))

Question: How many 1986 Mazda 323's (two-door hatchbacks, and four-door sedans and wagons), Mazda 626's (two-door sedans, and four-door sedans and hatchbacks), and Mazda RX7's were imported?.

Answer: Since production data for foreign cars was not available, sales figures were used to estimate the number imported. Tables III and IV in Ward's gave the following totals:

(From Table III)

Model	Units
Mazda 323	74,082
Mazda 626	92,431
Mazda RX7	56,203

(From Table IV)

	2-door models				4-door models			total
	S	P	H	C	S	H	W	
Mazda	24,203	-	68,744	-	106,038	7,171	702	206,858

S=sedan, P=pillared hardtop, H=hatchback, C=convertible, W=wagon

For the '86 Mazda 323 body styles available, the following percentages were computed, assuming that each body style was equally popular for each model:

(From Table IV)

Body Style	Units	(%)
2dr. hatch.	68,744	(60.43)
4dr. sedan	106,038	(39.17)
4dr. wagon	702	(0.40)
Total	175,484	(100.00)

----->These are the import sales percentages, by body style, for the '86 Mazda 323's.

Multiplying the body style import sales percentages by the

number of Mazda 323's imported, yields the following results:

(using the numbers above)

2-dr hatch Mazda 323	60.43%	x	74,802	=	44,768
4-dr sedan	"	39.17%	x	"	= 29,018
Wagon	"	0.40%	x	"	= 296

This same procedure was followed for the Mazda 626's. Fortunately, the number of Mazda RX7's imported were determined by looking at the import total (Method (1)) in Table III.

**Example:** Contacting the manufacturer (Method (3))

**Question:** How many Renault Sportswagon Deluxe's were imported to the United States for the model year '86?

**Answer:** Since it was not possible to estimate the number of Renault Sportswagons imported to the United States (surprisingly, Table III did not even list the Renault Sportswagon), it was necessary to call American Motors Corporation, which is the importing arm for Renault in the U.S. American Motors Corporation was contacted and their Public Relations department reported 2760 Sportswagons imported to the U.S. during the '86 model year.

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Production (or import) Totals of 1986 Model Year Automobiles

6943	AMC Eagle wagon
1274	AMC Eagle 4-dr. sedan
23947	Subaru XT 2-dr. coupe
15424	Subaru 4-dr sedan & turbo
66629	Honda Civic CRX 3-dr. hatchback
135834	Honda Civic 5-dr. hatchback
82983	Honda Civic 3-dr. hatchback
9370	Honda Civic wagon & 4wd wagon
47809	Honda Civic 4-dr. sedan
64028	Honda Accord 3-dr. hatchback
104819	Honda Accord 4-dr. sedan
12032	Subaru 3-dr.
70845	Subaru wagon
79841	Honda Prelude SI
11779	Volkswagon Quantum 4-dr.
9445	Audi 5000S 4-dr. turbo
1411	Audi 5000S wagon
18244	Lincoln Continental 4-dr.
10828	Volkswagon Scirocco 3 dr. hatchback
19328	Lincoln Mark VII 2-dr.
87227	Volkswagon Jetta 4-dr. sedan
5398	Volkswagon Jetta 2-dr.
17733	Volkswagon GTI 2-dr. hatchback
35200	Volkswagon Golf 2-dr. hatchback
45145	Volkswagon Golf 4-dr. hatchback
14173	Volkswagon Cabriolet
31487	Chevy Celebrity 2-dr.
320050	Chevy Celebrity 4-dr.
90405	Chevy Celebrity wagon
16320	Audi 4000S & 4000S Quattro
2826	Audi 4000 coupe GT
112900	Lincoln Town Car 4-dr. sedan
18175	Cadillac Coupe de Ville 2-dr.
129857	Cadillac Sedan de Ville 4-dr.
49115	Cadillac Fleetwood 4-dr. sedan
18175	Cadillac Fleetwood 2-dr. coupe
35109	Chevy Corvette
24534	Cadillac 4-dr. Cimarron
13996	Dodge Aries K 2-dr.
60337	Dodge Aries K 4-dr.
36672	Chrysler Laser 2-dr.
144534	Oldsmobile Cutlass Supreme 2-dr.
26953	Dodge Diplomat 4-dr. sedan
6131	Volvo 740 turbo 4-dr.
5555	Peugeot 505 turbo 4-dr. sedan
2529	Peugeot 505 wagon
23142	Cadillac Eldorado 2-dr. sedan
2862	Pontiac Sunbird convertible
55579	Pontiac Sunbird 2-dr. coupe
6273	Pontiac Sunbird 3-dr. hatchback
62934	Pontiac Sunbird 4-dr. sedan
7453	Pontiac Sunbird wagon

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61593	Pontiac Firebird
48870	Pontiac TransAm
44284	Pontiac Grand Prix 2-dr.
70629	Pontiac Parisienne 4-dr. sedan
14459	Pontiac Parisienne wagon
49165	Pontiac Bonneville 4-dr. sedan
12266	Pontiac T1000 3-dr. hatchback
9423	Pontiac T1000 5-dr. hatchback
83974	Pontiac Fiero 2-dr. coupe
133683	Pontiac Grand Am 2-dr. coupe
89913	Pontiac Grand Am 4-dr. sedan
26299	Pontiac 6000 STE 4-dr. sedan
80056	Pontiac 6000 LE 4-dr. sedan
22234	Pontiac 6000 LE wagon
11134	Pontiac 6000 LE 2-dr. sedan
57370	Chevy Cavalier 2-dr. coupe
86498	Chevy Cavalier 4-dr. sedan
30490	Chevy Cavalier wagon
47350	Nissan Pulsar NX 2-dr. coupe
40530	Chevy Sprint 2-dr.
20463	Chevy Sprint 4-dr.
133954	Chevy Nova 4-dr. sedan
45072	Chevy Nova 5-dr. hatchback
9869	Chevy Caprice 2-dr.
189959	Chevy Caprice Classic 4-dr.
45183	Chevy Caprice Classic wagon
60137	Chevy Spectrum 3-dr. hatchback
39233	Chevy Spectrum 4-dr.
36365	Chevy Cavalier Z24 2-dr. sport coupe
10226	Chevy Cavalier Z24 3-dr. sport hatchback
61445	Chevy Cavalier RS 2-dr.
17361	Chevy Cavalier RS 4-dr.
6252	Chevy Cavalier RS wagon
58390	Chevy Chevette 2-dr.
66497	Chevy Chevette 4-dr.
34072	Toyota Corolla 2-dr.
23324	Toyota Corolla 3-dr. hatchback
37693	Toyota Cressida 4-dr.
4487	Toyota Cressida wagon
27841	Toyota MR2 2-dr.
25156	Toyota Celica ST 2-dr. sport coupe
81575	Toyota Celica GTS 3-dr. liftback
644	Volvo 760 GLE 4-dr.
9332	Volvo 760 GLE wagon & turbo
86065	Toyota Corolla 4-dr. sedan
8716	Toyota Corolla 5-dr. liftback
42445	Toyota Tercel 3-dr. liftback
15853	Toyota Tercel 5-dr. liftback
18636	Toyota Tercel 4wd wagon
95219	Nissan Maxima 4-dr. sedan
17536	Nissan Maxima wagon
6131	Volvo 740 GT turbo 4-dr.
137811	Toyota Camry 4-dr. sedan
13957	Toyota Camry 5-dr. hatchback

- APPENDICES -

8689	Volvo 740 GLE wagon
16277	Mazda 626 2-dr. sedan
71329	Mazda 626 4-dr. sedan
29880	Volvo 240 DL 4-dr.
15626	Volvo 240 DL wagon
56203	Mazda RX7 2-dr. sport coupe
9050	Dodge Colt Vista wagon
9050	Dodge Colt Vista 4wd wagon
51099	Chrysler New Yorker 4-dr.
6493	Chrysler Lebaron Town & Country wagon
40254	Chrysler Lebaron 4-dr.
34622	Plymouth Caravelle 4-dr.
104744	Chrysler Fifth Ave. 4-dr.
14761	Plymouth Grand Fury
84508	Plymouth Horizon 5-dr. hatchback
46387	Plymouth Turismo Duster 3-dr. hatchback
24761	Chrysler Lebaron 2-dr.
19684	Chrysler Lebaron convertible
15762	Plymouth Reliant K 2-dr.
79988	Plymouth Reliant K 4-dr.
27255	Plymouth Reliant K wagon
73557	Chrysler Lebaron GTS 2-dr.
56267	Dodge 2-dr. Charger or Shelby turbo
108322	Dodge Omni 2-dr.
172550	Dodge Omni 4-dr.
23035	Aries SE wagon
11714	Dodge 600 SE 2-dr. sedan
31526	Dodge 600 SE 4-dr. sedan
44366	Dodge Daytona
34033	Dodge Colt turbo 3-dr. hatchback
21277	Dodge Colt turbo 4-dr. sedan
2336	Conquest 2-dr.
29018	Mazda 323 DX 3-dr. hatchback
44768	Mazda 323 DX 4-dr. sedan
51897	Dodge Lancer ES
14532	Mercury Capri GS
243016	Ford Escort 2-dr. hatchback
109891	Ford Escort 4-dr. hatchback
80552	Ford Escort wagon
62076	Ford Tempo GL 2-dr. sedan
173014	Ford Tempo GL 4-dr. sedan
156461	Ford Thunderbird & turbo
164637	Ford Taurus 4-dr. sedan
53916	Ford Taurus wagon
3382	Ford Mustang SVO 3-dr. hatchback
70611	Ford Mustang 2-dr. sedan
22946	Ford Mustang convertible
90068	Ford LTD Crown Victoria 4-dr. sedan
6291	Ford LTD Crown Victoria 2-dr. sedan
19306	Ford LTD Crown Victoria wagon
53830	Ford LTD 4-dr. sedan
12958	Ford LTD wagon
44518	Mercury Topaz GS & LS 4-dr. sedan
12048	Mercury Topaz GS & LS 2-dr. sedan

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5317	Mercury Grand Marquis 2-dr. sedan
87191	Mercury Grand Marquis 4-dr. sedan
9231	Mercury Grand Marquis wagon
129907	Mercury Cougar LS or XR7 2-dr. sedan
14315	Mercury Merkur XR4ti 4-dr. sedan
64132	Mercury Sable GS 4-dr. sedan
21601	Mercury Sable GS wagon
39452	Mercury Lynx 2-dr. hatchback
21628	Mercury Lynx 4-dr. hatchback
13498	Mercury Lynx wagon
12565	Mercedes Benz 560SL coupe
35959	Yugo 3-dr.
6942	BMW 735I 4-dr. sedan
9352	BMW 325 4-dr.
15880	BMW 528E 4-dr. sedan
2979	BMW 635 CSI 2-dr. sports coupe
23639	Mercedes Benz 300E
18992	Mercedes Benz 190E 4-dr. sedan
26301	Mercedes Benz 500 SEL, 420, 560 4-dr. sedan
42891	Renault Alliance DL 4-dr. sedan
23204	Renault Alliance DL 2-dr. sedan
2015	Renault Alliance convertible
2760	Renault Sportswagon deluxe
91229	Buick Regal LTD 2-dr. coupe
4996	Buick Electra Park Ave. 2-dr. coupe
114858	Buick Electra 4-dr. sedan
10371	Buick Electra wagon
14781	Buick Century Custom 2-dr. coupe
234352	Buick Century 4-dr. sedan
25374	Buick Century wagon
62230	Skylark LTD sedan
45884	Buick Skyhawk 2-dr. coupe
29959	Buick Skyhawk 4-dr. sedan
6079	Buick Skyhawk wagon
21522	Buick Lesabre LTD 2-dr. coupe
73450	Buick Lesabre LTD 4-dr. sedan
22138	Buick Riviera 2-dr. coupe
117641	Olds Regency Brougham 4-dr.
196910	Olds Delta 88 Royale 4-dr. sedan
37392	Olds Delta 88 Royale 2-dr.
14869	Olds Firenza 2-dr.
22853	Olds Firenza 4-dr.
5416	Olds Firenza wagon
267493	Olds Cutlass Ciera 4-dr.
49573	Olds Cutlass Ciera 2-dr.
35890	Olds Cutlass Ciera wagon
86514	Olds Calais Supreme 2-dr. coupe
64787	Olds Calais Supreme 4-dr. sedan
15924	Olds Toronado 2-dr.
21073	Olds Custom Cruiser 2 seat wagon
119210	Chevy Monte Carlo 2-dr.
192219	Chevy Camaro 2-dr.
552	Saab 900 2-dr.
7806	Saab 900 3-dr.



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5510	Saab 900 4-dr.
946	Saab 900S and turbo 2-dr.
13385	Saab 900S & turbo 3-dr.
9447	Saab 900S & turbo 4-dr.
9603	Saab 9000 turbo 5-dr.
33823	Toyota Celica Supra 3-dr. hatchback
10172	Isuzu Imark 2-dr.
15874	Isuzu Imark 4-dr.
27041	Nissan Sentra 2-dr. coupe
81410	Nissan Sentra 4-dr.
11703	Nissan Sentra 2-dr. hatchback
1328	Nissan Sentra 5-dr. hatchback
14993	Nissan Sentra wagon
52936	Nissan 300ZX and turbo
57259	Stanza 4-dr. sedan
10545	Stanza regular & 4wd wagon
45952	Nissan 200SX 3-dr. hatchback and notchback
30853	Hyundai Pony 1600 GLS
16882	Hyundai Excel GLS
12864	Isuzu Impulse

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10,779,474          Total

- APPENDICES

APPENDIX C. Survey Form

The University of Michigan Transportation Research Institute, Human Factors Division Secondary Control Study																																								
Analyst _____ Date/Time _____ Place _____ Salesperson/Contact _____	Vehicle Make _____ Vehicle Model _____ Vehicle Code _____ Control Config. _____ <div style="text-align: center; margin-left: 100px;">                     (L)   (R)   (L)   (R)   (HUB)                 </div>																																							
<u>Comments:</u>          	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> <table style="width: 100%; border: none;"> <tr> <td style="width: 10%; text-align: right;">#</td> <td>L/R Stalks</td> </tr> <tr><td>4</td><td>- 0</td></tr> <tr><td>1</td><td>- 1</td></tr> <tr><td>2</td><td>- 2</td></tr> <tr><td>3</td><td>- &gt;2</td></tr> </table> </td> <td style="width: 50%; border: none; vertical-align: top;"> <table style="width: 100%; border: none;"> <tr> <td style="width: 10%; text-align: right;">#</td> <td>L/R of the Steering Wheel</td> </tr> <tr><td>1</td><td>Panel</td></tr> <tr><td>2</td><td>Extended Hood (e.g. CX)</td></tr> <tr><td>3</td><td>Extended Panel/Panel Wings (e.g. Berlinetta)</td></tr> <tr><td>4</td><td>Column Wings (flat surface)</td></tr> <tr><td>5</td><td>Column Pods (edge mounted controls)</td></tr> <tr><td>6</td><td>Vertical Barrel - From Column</td></tr> <tr><td>7</td><td>Vertical Barrel - From Panel</td></tr> <tr><td>8</td><td>Horizontal Barrel - From Column</td></tr> <tr><td>9</td><td>Horizontal Barrel - From Panel</td></tr> <tr><td>10</td><td>In/Out Barrel - From Panel</td></tr> <tr><td>11</td><td>Surface Not Used</td></tr> <tr><td>12</td><td>Other</td></tr> </table> </td> </tr> </table> <p style="margin-top: 10px;"><u>Steering Hub Code</u></p> <p>1 - No controls on hub other than horn or cruise there.                  2 - Other controls on hub (other than cruise or horn).</p>		<table style="width: 100%; border: none;"> <tr> <td style="width: 10%; text-align: right;">#</td> <td>L/R Stalks</td> </tr> <tr><td>4</td><td>- 0</td></tr> <tr><td>1</td><td>- 1</td></tr> <tr><td>2</td><td>- 2</td></tr> <tr><td>3</td><td>- &gt;2</td></tr> </table>	#	L/R Stalks	4	- 0	1	- 1	2	- 2	3	- >2	<table style="width: 100%; border: none;"> <tr> <td style="width: 10%; text-align: right;">#</td> <td>L/R of the Steering Wheel</td> </tr> <tr><td>1</td><td>Panel</td></tr> <tr><td>2</td><td>Extended Hood (e.g. CX)</td></tr> <tr><td>3</td><td>Extended Panel/Panel Wings (e.g. Berlinetta)</td></tr> <tr><td>4</td><td>Column Wings (flat surface)</td></tr> <tr><td>5</td><td>Column Pods (edge mounted controls)</td></tr> <tr><td>6</td><td>Vertical Barrel - From Column</td></tr> <tr><td>7</td><td>Vertical Barrel - From Panel</td></tr> <tr><td>8</td><td>Horizontal Barrel - From Column</td></tr> <tr><td>9</td><td>Horizontal Barrel - From Panel</td></tr> <tr><td>10</td><td>In/Out Barrel - From Panel</td></tr> <tr><td>11</td><td>Surface Not Used</td></tr> <tr><td>12</td><td>Other</td></tr> </table>	#	L/R of the Steering Wheel	1	Panel	2	Extended Hood (e.g. CX)	3	Extended Panel/Panel Wings (e.g. Berlinetta)	4	Column Wings (flat surface)	5	Column Pods (edge mounted controls)	6	Vertical Barrel - From Column	7	Vertical Barrel - From Panel	8	Horizontal Barrel - From Column	9	Horizontal Barrel - From Panel	10	In/Out Barrel - From Panel	11	Surface Not Used	12	Other
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- APPENDICES -

APPENDIX C. Survey Form (Continued)

#	Control Name	Zone	Type	Ded.	Dirx.	Labels		Vehicle:
		Op Code	#Pos.	Comb.	Int.	Switch	Positions	Remarks
11	Headlights/ Parking lights							
12	High Beam							
13	Dome Lights							
14	Fog Lights							
15	Panel Lights							
16	Hazard							
21	Audible Horn							
22	Optical Horn							
31	Front Wiper							
32	Rear Wiper							
33	Front Washer							
34	Rear Washer							

APPENDIX C. Survey Form (Continued)

#	Control Name	Zone	Type	Ded.	Direx.	Labels		Vehicle:
		Op Code	#Pos.	Comb.	Int.	Switch	Positions	Remarks
41	Turn Signal							
51	Cruise On/Off							
52	Cruise Set							
53	Cruise Resume							
54	Cruise Coast							
55	Cruise Accel.							
61	Climate (location only)							
62	Front Defrost							
63	Rear Defrost							
71	Radio (location only)							
81	Steering Adj.							
82	Suspension Adj.							

APPENDIX C. Survey Form (Continued)

#	Control Name	Zone	Type	Ded.	Dirx.	Switch	Labels Positions	Vehicle:
		Op Code	#Pos.	Comb.	Int.			Remarks
83	Power Door Locks							
84	Power Windows							
91	Power Seat Up/Down							
92	Power Seat Forward/Back.							
93	Power Seat Back Tilt							
94	Power Seat Lumbar Support							
95	Power Seat Pan Adjustment							
Further Remarks:								