UM-HSRI-79-98

NATIONAL ACCIDENT SAMPLING SYSTEM

SPECIAL STUDIES DEVELOPMENT:

STEERING COLUMN
SIDE INTRUSION
ROOF INTRUSION

Final Report

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16. Abstract

This final report documents the development of three separate accident investigation methodologies incorporated into the National Accident Sampling System (NASS) as special studies. There are (3) Steering Column, (4) Side Intrusion, and (5) Roof Intrusion. The protocols for each of these special studies involve the determination, measurement, and recording of data relating to steering columns, side and roof intrusion in vehicles involved in crashes and selected for investigation by the NASS.

Basic workproducts developed are: modular field accident data forms used for recording damage to interior steering components and side and roof direct damage: User's Guide and Coding Manual, Steering Column (UM-HSRI-79-43); User's Guide and Coding Manual, Side Intrusion (UM-HSRI-79-44); and User's Guide and Coding Manual, Roof Intrusion (UM-HSRI-79-250; and a compilation of tables containing reference dimensions and descriptions of various vehicle steering wheel and column assemblies; Steering Column, Compiled Reference Tables (UM-HSRI-79-45).

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CONTENTS

1.0 SUMMARY

This is the final report of a study by the Highway Safety Research Institute to develop three accident investigation methodologies for use by accident investigators in the National Crash Severity Study (NCSS) and the National Accident Sampling System (NASS) sponsored by the National Highway Traffic Safety Administration (NHTSA). These methodologies were developed in preparation for initiating special studies to be conducted in NCSS and NASS as companion efforts to the on-going investigation of selected motor vehicle accidents in each project.

The methodologies include Steering Column (NASS Special Study #3), Side Intrusion (NASS Special Study #4), and Roof Intrusion (NASS Special Study #5), and involve visual observations of damage and vehicle crash performance as well as measurement of steering component changes and side and roof intrusion resulting from a crash. The methodologies use data forms that address various aspects of each special study where information is essential to assess the problems associated with each. Each data form is structured so that investigator responses can be efficiently coded and machine handled.

Two one-week training sessions were conducted for NASS and NCSS accident investigators. The training sessions included presentations of special studies involving motorcycle crashes and truck underride crashes in addition to the steering column, side, and roof intrusion studies. Results of the training sessions and experience gained from field trials of the methodologies indicate that their design was practical and can be applied uniformly and consistently by NCSS and NASS investigators.

2.0 INTRODUCTION AND BACKGROUND

2.1 Introduction

At the request of the National Highway Traffic Safety Administration (NHTSA), the Highway Safety Research Institute (HSRI) conducted three Special Studies to develop as supplements to the National Accident Sampling System (NASS) accident data collection methods. The three special studies were: Number 3 -- Steering Column; Number 4 -- Side Intrusion; and Number 5 -- Roof Intrusion.

Earlier work by HSRI had focused on development of methods to measure and document the intrusion of occupant contact surfaces into occupant surfaces. This was documented in HSRI report UM-HSRI-78-17-1; Methodology for the Measurement of Intrusion in Motor Vehicle Accidents.

The purpose of this current project was to develop separate but parallel and compatible methodologies for the measurement of intrusion by three separate occupant compartment surfaces: the steering column/wheel, the side, and the roof.

2.2 Background

The NHTSA operates a motor vehicle accident data collection system known as NASS on an expanding nationwide scale. The purpose of this system is to collect, according to a pre-defined sampling system, a random selection of motor vehicle crashes and to document the crash scene, vehicular damage profile, and occupant injury patterns. The system is designed to be flexible by allowing for special studies, yet rigid in terms of basic data collection efforts and data recording. Teams of investigators--stationed nationwide--continue to receive training in motor vehicle accident investigation skills.

The NASS project consists of two basic accident data acquisition systems. One is the Continuous Sampling System (CSS) which, as the name implies, consists of a continuous data acquisition effort, using a basic accident investigation protocol. The second system consists of special study protocols addressed to special topical areas of concern to highway safety. These special studies are usually of limited duration and planned to achieve specific objectives. The special study protocols developed in this study were for use in such special study efforts in NASS.

To take advantage of the ability of NASS to accommodate special projects, five "special studies" projects were initiated simultaneously by NHTSA. They were:

SS1 (Special Study Number 1) -- Motorcycle

SS2 (Special Study Number 2) -- Truck Underride

SS3 (Special Study Number 3) -- Steering Column

SS4 (Special Study Number 4) -- Side Intrusion

SS5 (Special Study Number 5) -- Roof Intrusion

The University of Southern California was designated to develop the motorcycle special study protocol. Indiana University was designated to develop the truck underride protocol. HSRI was designated to develop the three special study protocols concerned with passenger compartment intrusion.

Development of a methodology for the measurement of intrusion* preceded this project. This previous study provided the methodology for the uniform measurement of intrusion into the passenger compartment of crash-damaged vehicles. It was developed under NHTSA sponsorship for use in the National Crash Severity Study (NCSS). Field use of this protocol in NCSS (National Collision Severity Study accident investigation project conducted by NHTSA) demonstrated that its design was practical and that it could be applied uniformly on a large scale.

*Methodology for the Measurement of Intrusion in Motor Vehicle Accidents, P. Cooley, T.L. McDole, et al., April 15, 1978, report UM-HSRI-78-17-1, contract number DOT-HS-7-01805.

This study of intrusion was initiated by the NCSS (National Crash Severity Study). The NCSS is gradually being phased out, replaced by NASS, and in order to provide a basis for a more precise evaluation of certain motor vehicle safety standards, the intrusion methodology developed for NCSS was re-directed into this present effort and split into three special study protocol developments addressing (1) the performance of the steering column in crashes; (2) the classification and measurement of occupant injuries in selected side-impact crashes; and (3) the classification and measurement of occupant injuries in selected crashes with roof crush. This report described the development of these NASS special study protocols.

2.3 Project Overview

This project adapted existing intrusion measurement methodology and related data collection efforts into three specific data collection systems within the NASS data collection framework. Each special study consisted of a data collection protocol, a user's guide, and a training seminar. HSRI also served as the host for a series of training sessions for each of the NASS team members, to coordinate the training related to all five special studies.

This report documents the development of each HSRI's special studies and reports on the training sessions held.

3.0 DEVELOPMENT OF SPECIAL STUDIES

The three special study protocols (SS3, Steering Column; SS4, Lower Side Surface; SS5, Roof) were developed simultaneously. In each instance data elements were outlined, data form items were developed with code value ranges, the items were formatted into a basic data form outline, and user's guides and reference material (where appropriate) were developed. Prototype data forms were submitted to the sponsor for review, were subsequently revised, and then turned over to Indiana University for standardization into the NASS data form format, reproduction, and distribution.

The following sections highlight the development of each special study and reproduce the data form outline as furnished to Indiana University (IU). The appendices contain the data forms as formatted and distributed by IU to the NASS teams.

Reference documents and user's guides developed to accompany the data forms are referenced in the appropriate section but not reproduced in this report.

3.1 Steering Column

The purpose of this effort was to develop methods, a data recording instrument, and supporting documentation for methods of examining, measuring, and assessing the condition and performance of steering components in crashed vehicles.

3.1.1 Methodology. A basic question in developing the protocol was this: What portions of a vehicle's steering system should be included? Steering system designs vary. Individuals from major motor vehicle manufacturing companies were consulted during the process of

developing a comprehensive set of methods for evaluating all existing vehicle steering systems.

While an ideal set of methods might involve acquiring damage-related data on all portions and components of a steering system, this ideal was tempered by two practical considerations: Field investigator's limited knowledge of the intricacies of steering systems, and limitations on their access to steering system components in crashed vehicles. Crash-damaged vehicles in the NCSS and NASS samples are examined on the basis of informal arrangements between investigators and tow operators, storage facility personnel, and disposal operators. Vehicles are not owned by such organizations but only stored by them. They permit NASS and NCSS investigators limited access to such vehicles only out of a desire to cooperate with research that will improve highway safety. Because disassembling various vehicle components could impose a liability on tow yard operators, it was decided to address only portions of vehicle steering systems that can be viewed directly by an investigator without lifting, moving, or dismantling portions of the vehicle. This also excludes attempting access to portions of the steering system located in the engine compartment. Thus the methodology was limited to portions of the steering system located within the passenger compartment and in view of the investigator:

- The steering column, extending from the interior toe pan to, and including, the steering wheel and its hub.
- Associated mounting brackets, hardware.
- Energy-absorbing features.
- Steering wheel (rim, spokes, and hub).

To facilitate the documenting of data, those portions of the steering system within the passenger compartment were organized into four major subsystems: (1) steering wheel; (2) steering column; (3) column mounting; and (4) foundation.

The steering wheel subsystem consists of the steering wheel rim, spokes, and hub. The steering subsystem column includes the housing

jackets, energy-absorbing device, and the toe plate (if any). This subsystem extends from the toe pan at the vehicle's firewall, or front cowl, to the shaft end where the wheel hub is attached. The column mounting subsystem consists of the brackets, shear module, clamps, and associated hardware used to attach the column to the foundation or vehicle. The foundation subsystem consists of the surfaces or devices to which the column mounting devices are fastened so as to secure the column in the vehicle. These mounting surfaces are typically the instrument panel, toe pan, or other vehicle substructure.

Based on the above organization, data elements were outlined to provide for identification and description of these subsystems (wheel, column, mounting, foundation) and for recording observed damage to each subsystem.

3.1.2 Data Form. Typically the format used for recording information for each subsystem was (1) system identification; (2) original (undamaged) dimension; (3) damaged dimension or distortion. Thus, for example, the steering wheel would first be identified as to number of spokes and arrangement, a notation of original dimensions (if any), and a notation of the nature and extent of the deformation of the wheel rim and spokes, including dimensions, if any.

Categories dealing with each subsystem were expanded into data elements with assigned code values. All items were organized into a logical sequence and drafted into the prototype data form shown in Figure 1.

The form was designed so that explanatory information accompanies each of the descriptive variables included. This enables the investigator to readily identify and properly encode the type of steering system encountered. To further facilitate the investigator's correct description of the item, a reference manual was provided for investigator use (under separate cover). This reference document is described in the following section.

S T C

NATIONAL ACCIDENT SAMPLING SYSTEM
SPECIAL STUDY

PSU No. ___ ___ Special Studies No. 0 3

Case No. ___ ___ ___ ___ Vehicle No. ___ ___ .

STEERING COLUMN

Steering Column Performance Assessment

A description and documentation of the passenger compartment steering system components and damage.

WHEN TO USE THIS FORM: Complete this form whenever the CASE vehicle was a towaway and involved in a frontal or side collision (not rear impacts (ie:exclude clock directions 4-8, or a rollover) OR when there was driver contact with the steering system.

Steering System Defined:

That portion of the steering assembly which is located within the passenger compartment consisting of the following components/ subsystems.

1. The column, extending from the toe pan to its termination in the steering wheel hub.
2. Associated mounting brackets, hardware, and foundation.
3. Associated energy absorbing devices.
4. The steering wheel.

FIGURE 1. PROTOTYPE STEERING COLUMN DATA FORM

1.0 STEERING SYSTEM OPTIONAL EQUIPMENT:

1.1 Speed Control *(Factory Installed-- Not a dealer installed unit.)* __

1.2 Tilt Column Feature __

1.3 Telescoping Column Feature __

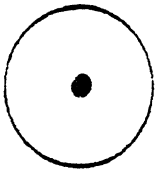
CODES:
1 = Equipped
2 = Not Equipped
9 = Unknown

2.0 STEERING WHEEL:

DEVICE

2.1 Wheel Code *(No. of spokes and arrangement)* __ __--(Ref. Table 2)

If other than shown in Table 2, code 97 and sketch here.



2.2 Wheel Profile __--(Ref. Table 3)

2.3 Wheel EA Type Code __ __--(Ref. Table 4)

If Type Codes (10-95)

DAMAGE

2.4 Wheel EA Compression Calculation

(1) Insert Original Dimension __ __.__--(Ref. Table 1)

(2) Insert Compressed Dimension--*See Ref. Table 4 for how-to-measure.* __ __.__

(3) Value for Compression __ __* -- Code Table A

2.5 Rim Distortion __-- Code Table B

2.6 Spoke Distortion __-- Code Table B

3.0 STEERING COLUMN:

DEVICE

3.1 EA Device Type __ __--(Ref. Table 5)

3.2 Mounting Method __--(Ref. Table 6)

COMPRESSION

3.3 EA Device Compression

(1) Insert Original Dimension __ __.__--(Ref. Table 1)

(2) Insert Compressed Dimension __ __.__

(3) Value for Compression __ __* -- Code Table A

3.4 Shear Module Movement

(1) Type of Movement __-- Code Table F

(2) Value of Measurement __ __* -- Code Table A

*Rounded to the nearest inch

COLUMN DISPLACEMENT

3.5 AC Dimension

(1) Insert Original Dimension ____.-- (Ref. Table 1 & 7)

(2) Insert Measured Dimension ____.

(3) Value for Axial Movement _ ___*-- Code Tables C & A
DIRECTION VALUE

3.6 Lateral (↔) Column Displacement-- -- Code Table C
As noted at the steering wheel end. DIRECTION MAGNITUDE

3.7 Vertical (↕) Column Displacement-- -- Code Table C
As noted at the steering wheel end. DIRECTION MAGNITUDE

3.8 Column Mounting Damage __-- Code Table D

4.0 FOUNDATION AND SURROUNDING STRUCTURE DAMAGE

4.1 Toe Pan Area Damage near Column __ __-- Code Table E

4.2 Instrument Panel Vertical Rotation near Column __ __-- Code Table E

4.3 Instrument Panel Buckle near Column __ __-- Code Table E

4.4 Bracket Mount Surface or Device Damaged *(if bracket mount used).* __ __-- Code Table E

5.0 PHOTOGRAPHIC DOCUMENTATION

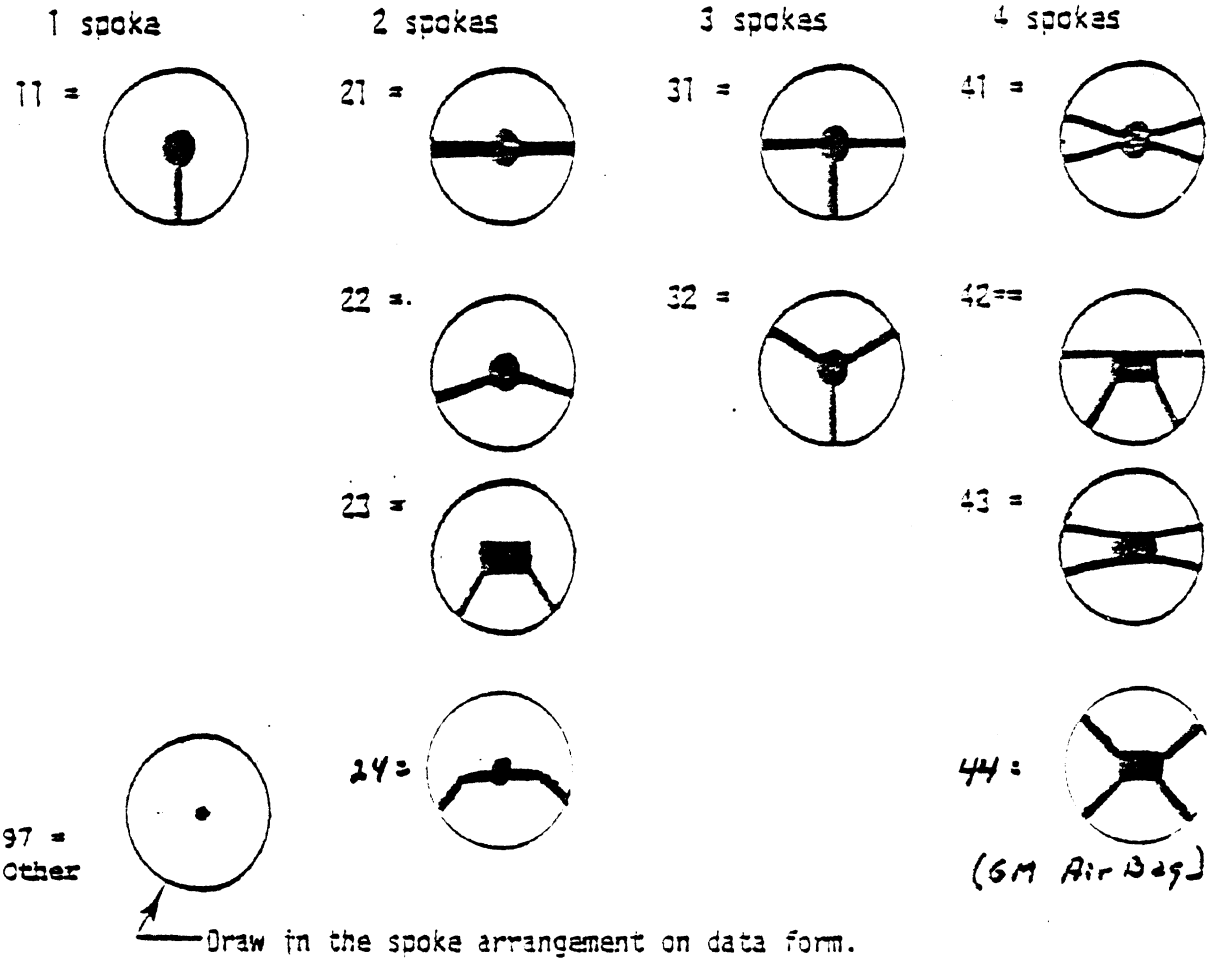
5.1 Take at least 2 photographs of the steering column wheel, EA Device, etc., so as to best depict the location and magnitude of the damage. Photograph the mounting and foundation also, if damaged.

*Rounded to the nearest inch.

-- STEERING COLUMN FORM COMPLETED --

Ref. Table 5--Dimensions. Not Included Here. See Separate Document.

Ref. Table 2--Wheel Code



99 - Unknown spokes and arrangement

Ref. Table 3--Wheel Profile

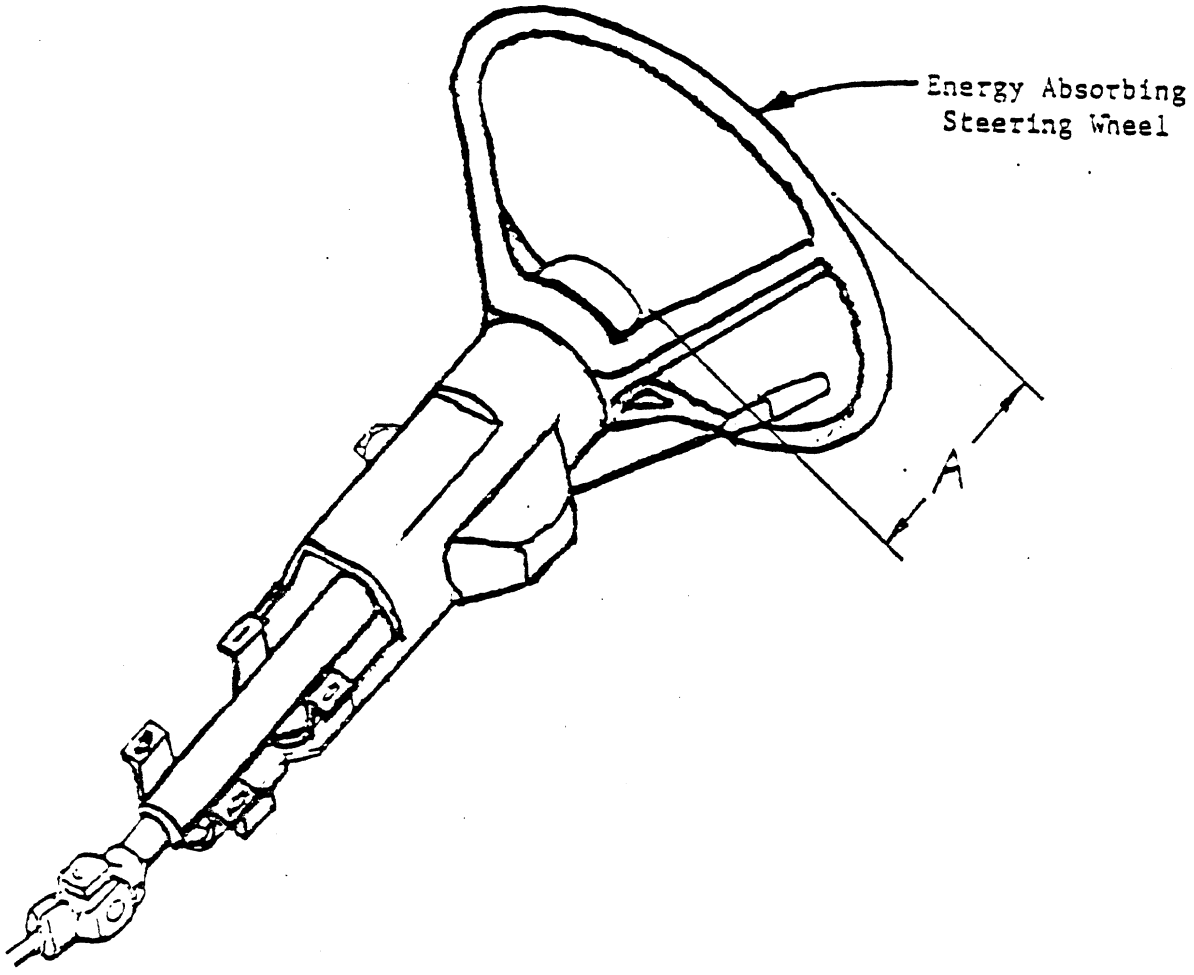
1. Deep dish (≥ 3")
2. Shallow dish (< 3")
3. Flat
4. Other profile*
5. Undetermined - no reference data
9. Unknown profile

*Note on data form.

Ref. Table 4--Wheel EA Type Code

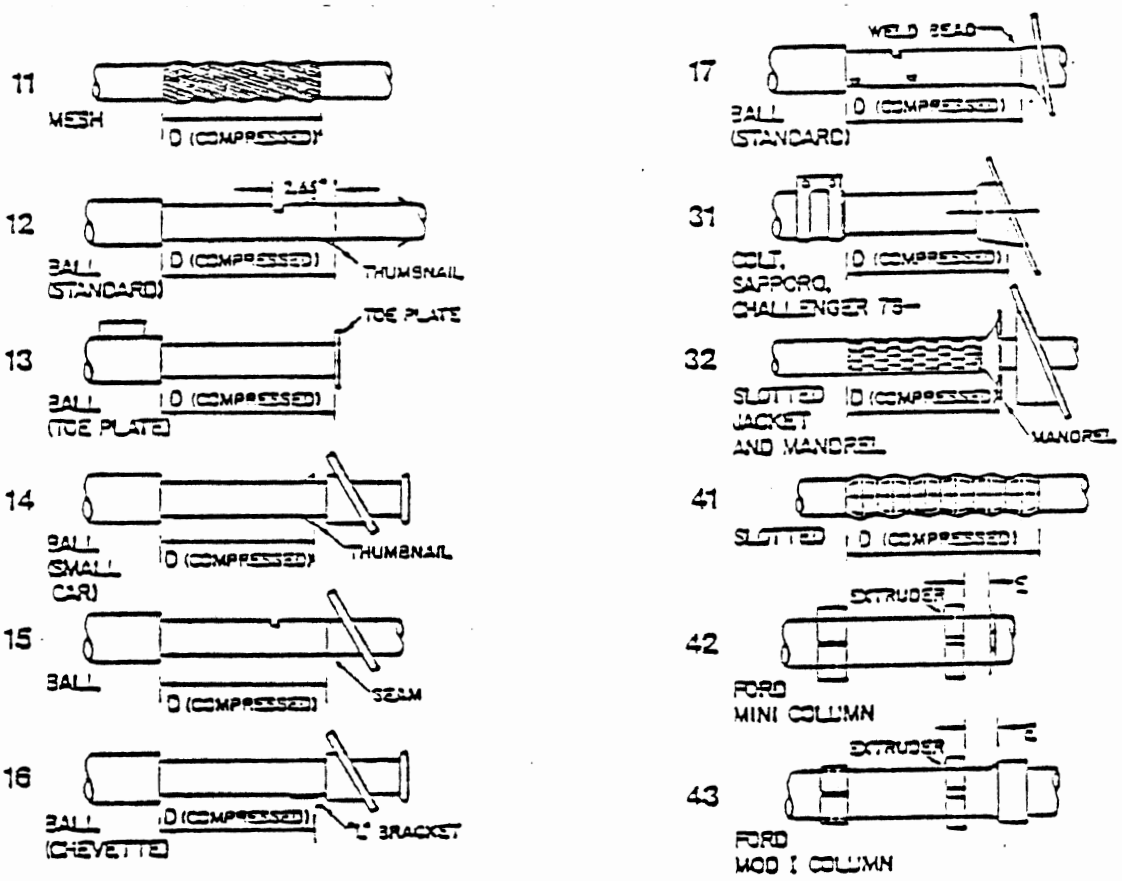
01	Non EA Type*
10	EA Type--Unspecified
21	Dodge Omni
22	Plymouth Horizon
98	Unknown if EA Type
95	Undetermined, no reference data

*While most wheels are designed to absorb some energy, certain wheels are specifically EA and replace the column EA capability.



Ref. Table 5--Column EA Device Type

STEERING COLUMN ENERGY ABSORBING DEVICES



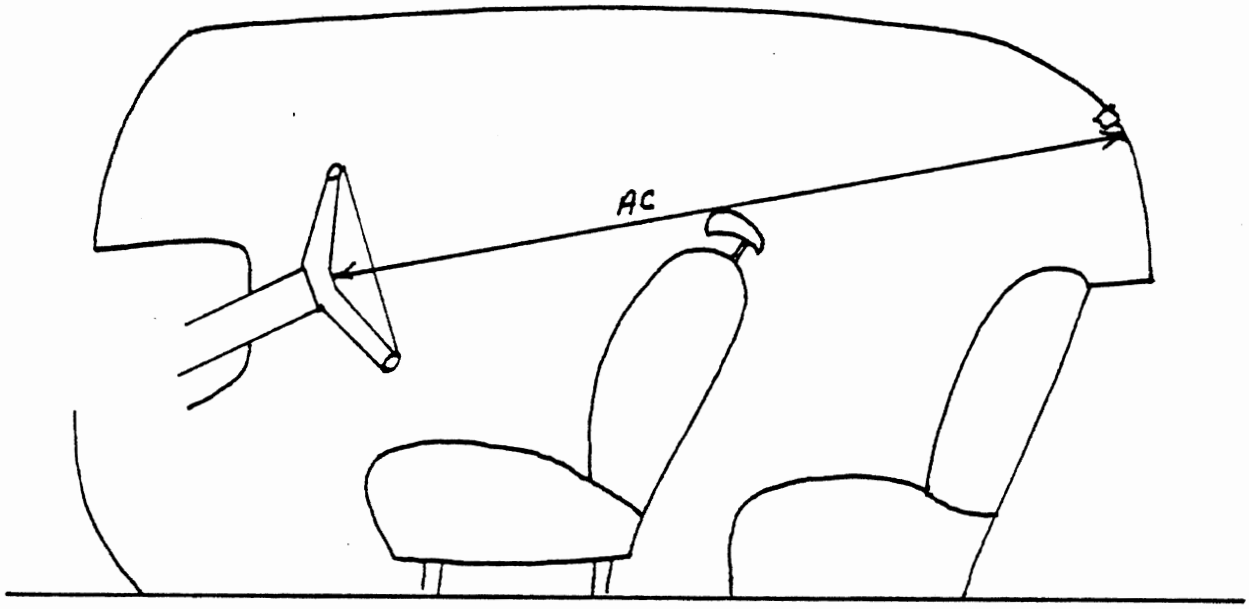
94 Other EA Column Type--Note on data form
95 Undetermined, no reference data
96 Unknown EA Column Type
98 Non EA Column
99 Unknown Type

Ref. Table 6--Column Mounting Method

1 Rigid to Instrument Panel and Toe Pan/Lower Firewall
2 Rigid to Instrument Panel, Lower Bracket
3 Rigid to Instrument Panel, No Lower Attachment
4 Shear Module at Instrument Panel, Rigid at Toe Pan/Lower Firewall
5 Shear Module at Instrument Panel, Lower Bracket
6 Shear Module at Instrument Panel, No Lower Attachment
7 Bracket
8 Other (specify on data form)
9 Unknown Method
0 Undetermined, No reference data

Ref. Table 7--AC Dimension Reference Points

Measurement to bottom edge of upper back lite trim at glass.



Code: 1 - back light glass header
5 - undetermined, no reference data

NOTE: (1) If adjustable Headrest, measurement is with headrest down.
(2) If high back seat, measurement is over top of seat back.
(3) Vehicles with no back seat, measurement is still taken to window trim.

CODE TABLES

CODE TABLE A
VALUE NOTATION OF MEASUREMENT

		3 digit values
00	No Movement, compression, collapse	000

Measured Value Code

___	Value of Measurement in inches	— — —

NOTE: Values are to be rounded to the nearest inch.

Observed Value Code (Cannot be measured)

80	Apparent Movement, Value Undetermined	980
81	Estimated Movement, less than 1"	981
82	Estimated Movement, between 1" and 2"	982
84	Estimated Movement, between 2" and 4"	984
86	Estimated Movement, between 4" and 6"	986
88	Estimated Movement, between 6" and 8"	988
90	Estimated Movement, greater than 8"	990

Other Codes:

95	Reference Data not available	995
98	Not designed for measurement, non-EA wheel, column	998
99	Unknown Value	999

CODE TABLE B
WHEEL SPOKE/RIM DISTORTION

1 No Distortion
2 Minor Bending-less than 1 inch
3 Severe Bending-greater than 1 inch
4 Broken, i.e.: separated
9 Unknown Distortion

CODE TABLE C
COLUMN LATERAL AND VERTICAL DISPLACEMENT AT STEERING WHEEL END

Direction:
1 No Displacement
2 Up, right, or compression (Measured dimension greater than original)
3 Down, left, or intrusion (measured dimension less than original)
4 Displacement, unknown direction
9 Unknown (includes loose column through mounting separation)

Magnitude:
1 No apparent displacement
2 Minor, 2" } "Eyeball Questimate"
3 Major, 2" }
9 Unknown

CODE TABLE D
COLUMN MOUNTING DAMAGE*

1 No Damage
2 Upper Mounting Assembly damaged or distorted** (including bracket)
3 Lower Mounting Assembly damaged or distorted
4 Upper and lower mounting assembly damaged or distorted
5 Bracket Mounting Assembly damaged or distorted
7 Other Mounting Damage
9 Unknown Damage

**NOTE: Does not include shear capsule separation, unless by other than normal shear capsule movement.*

***Damage results from twisting, tearing, bending, distorting, etc. to the mounting assembly.*

CODE TABLE E
FOUNDATION DAMAGE

01 None
02 Displaced or buckled rearward or into occupant space
03 Displaced or buckled forward or away from occupant space
04 Displaced Left
05 Displaced Right
06 Rotated or Displaced Upwards
07 Rotated or Displaced Downwards
08 Combination of Above (Note on data form which of above)
98 Not Applicable
99 Unknown if damaged

CODE TABLE F
SHEAR MODULE TYPE OF MOVEMENT

1 No Movement
2 Displacement Only
3 Displacement and Separation
4 Not Designed to Indicate Movement
8 Not Applicable, No shear module
9 Unknown Movement

Following a field test of the data elements, and minor alteration to them, the revised set of data elements was forwarded to Indiana University to be formatted into a data form compatible with the balance of the NASS data forms. This final data form (NASS version) is shown in Appendix A.

3.1.3 Reference Guide and User's Manuals. The development of a Reference Guide, containing detailed features of various steering systems was a significant and important portion of the overall effort to develop a steering column methodology. The need for reference data to both identify and dimension the vast variety of steering column designs present in motor vehicles was evident from the start of the project. In the past such information was provided by the Motor Vehicle Manufacturer's Association (MVMA) as a courtesy to accident research investigators. This information consisted of a compilation of the undamaged dimensions of the various steering column designs incorporated in U.S. manufactured vehicles. The information, however, was often unavailable until well into a conventional U.S. vehicle model year, and was compiled in a manner that often required some explanation and interpretation. In addition, the MVMA-provided data did not cover all vehicle types and models of concern to current accident study projects such as NCSS and NASS. Thus there was the need to provide a coherent, well-structured manual containing all the steering system information an investigator needs.

To gather such data, HSRI staff met with representatives of the major U.S. motor vehicle manufacturing firms and discussed this need. The manufacturers responded with data regarding the specific column designs incorporated in their vehicles. This data, in conjunction with data provided by the MVMA, formed the basis for the reference guide.

Thus the Reference Guide was developed to assist the accident investigator in accurately describing and measuring passenger compartment steering systems in vehicles selected for examination for crash

FIGURE 2. Reference Table 1: Compiled Steering Components

Year 1983 Make NHTSA

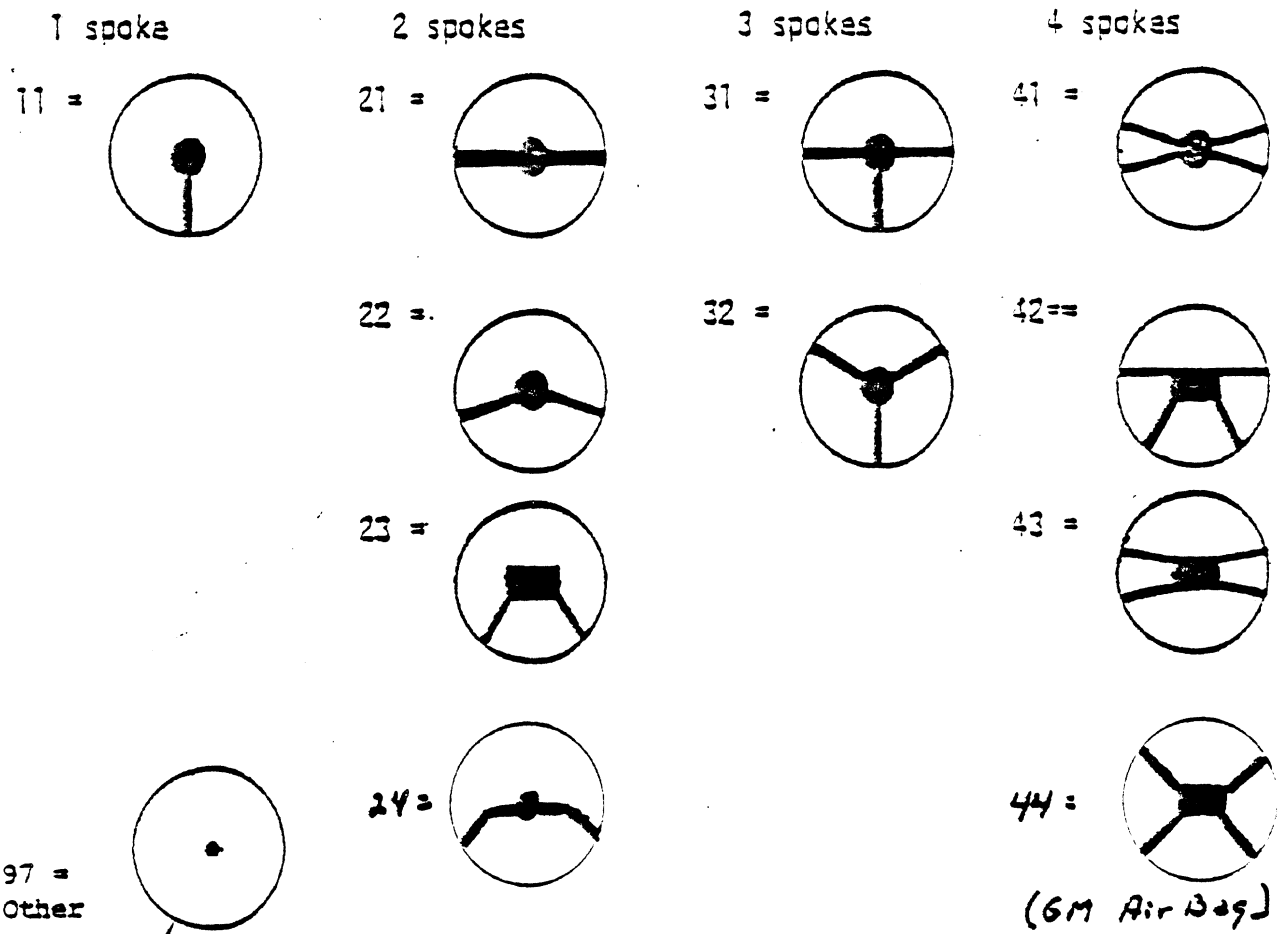
				STEERING WHEEL				COLUMN			AC DIMENSION	
Series Name (Ref. Table)	Body Style ///	VIN Body Code* ///	Opt. Strg. Equpt. ///	Wheel Code (2)	Profile (3)	Wheel EA Code (4)	EA Orig. Dimen. ///	EA Device Type (5)	Mount-ing Method (6)	EA Orig. Dimen. ///	Ref. Point (7)	Value ///
Standard 203	2 dr.	31	Std.	22	2	01	998	11	6	8.5	1	66
	4 dr.	32	Std.	22	2	01	998	11	6	8.5	1	69
	S Wagon	33	Std.	22	2	01	998	11	6	8.5	1	112
Delux 203	2 dr.	41	Std.	31	2	01	998	11	6	8.5	1	66
			Tilt	41	2	01	998	41	4	7.0	1	66*
	4 dr.	42	Std.	31	2	01	998	11	6	8.5	1	67
			Tilt	41	2	01	998	41	4	7.0	1	69*
	S Wagon	43	Std.	31	2	01	998	11	6	8.5	1	112
			Tilt	41	2	01	998	41	4	7.0	1	112*
Luxury	4 dr. HT	53	Tilt/ Tel.	11	3	01	998	16	5	5.5	1	998
			Tilt/ Tel. Speed	11	3	01	998	17	5	6.5	1	998
Sports	2 dr.	76	Tilt/ Tel/ Speed	43	1	37	4.5"	01	3	998	1	998
A	B	C	D	E	F	G	H	I	J	K	L	M

*VIN Body Code:
4th & 5th characters of VIN
.... x x .... etc.
1 2 3 4 5 6

*with tilt wheel at center position

FIGURE 3. REFERENCE TABLES 2-7

Ref. Table 2--Wheel Code



99 - Unknown spokes and arrangement

Ref. Table 3--Wheel Profile

1. Deep dish (≥ 3")
2. Shallow dish (< 3")
3. Flat
4. Other profile*
5. Undetermined - no reference data
9. Unknown profile

*Note on data form.

FIGURE 3 (continued)

Ref. Table 4--Wheel EA Type Code

01	Non EA Type*
02	EA Type--Unspecified
21	Dodge Omni
31	Plymouth Horizon
95	Undetermined--no reference data
99	Unknown if EA Wheel

*While most wheels are designed to absorb some energy (but are not called EA wheels), certain wheels are specifically EA and replace the column EA capability.

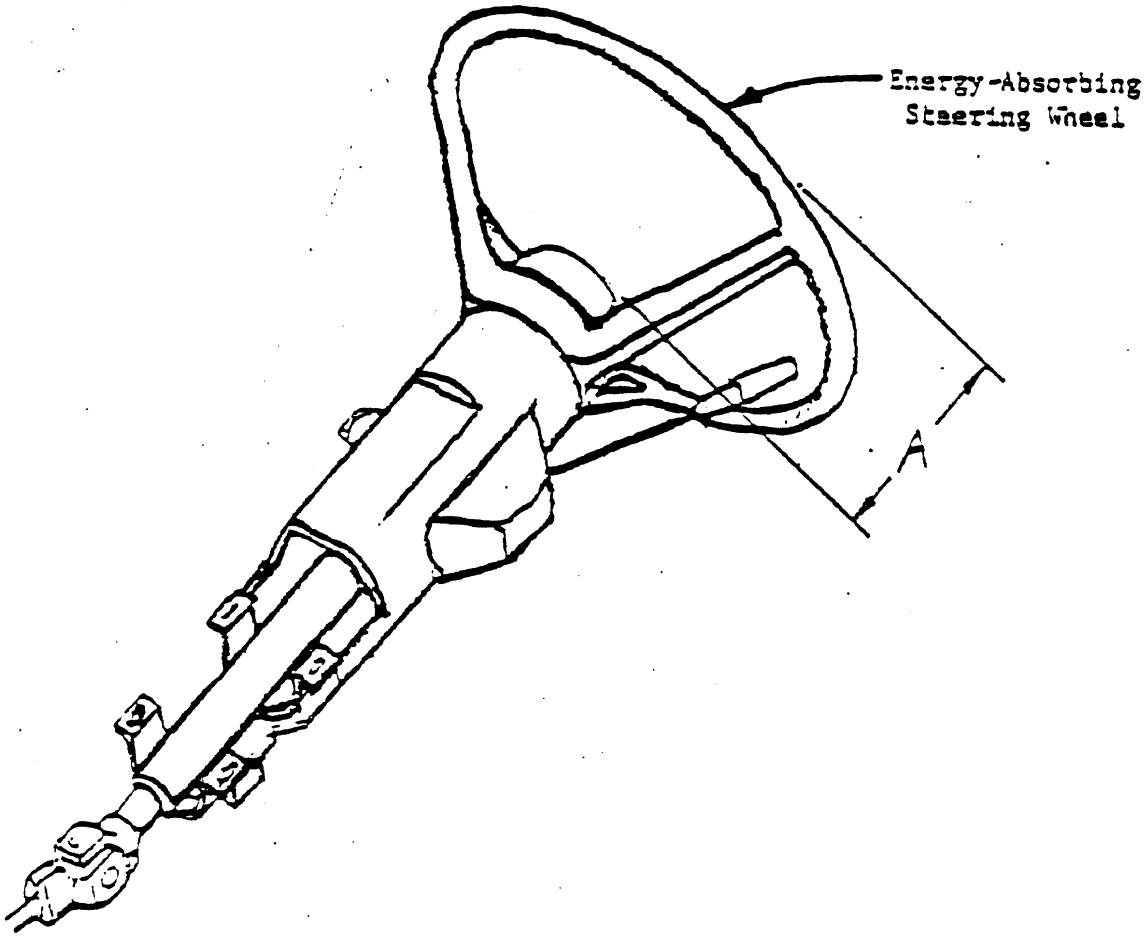
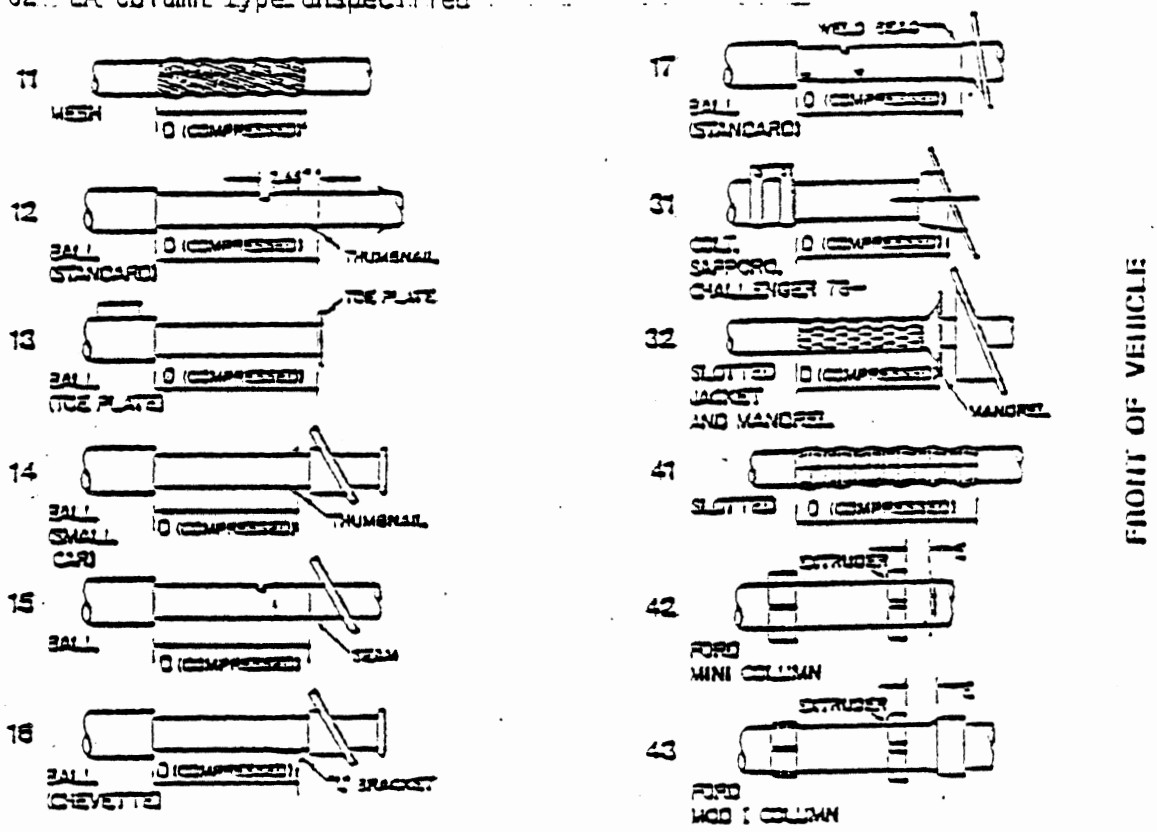


FIGURE 3 (Continued)

Ref. Table 5--Column EA Device Type

STEERING COLUMN
ENERGY ABSORBING DEVICES *

01 Non EA Column
02 EA Column Type Unspecified



90 Other EA Column Type--Note on data forms

95 Undetermined--no reference data

99 Unknown if EA Column

*See Variable 17 for larger drawings

FIGURE 3 (Continued)

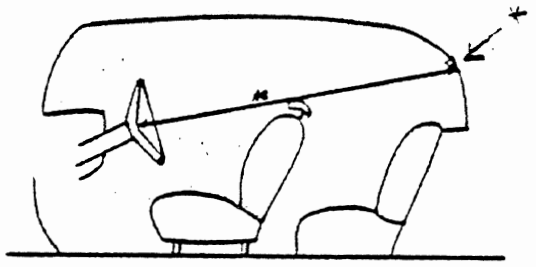
Ref. Table 6--Column Mounting Method

1 Rigid to Instrument Panel and Toe Pan/Lower Firewall
2 Rigid to Instrument Panel, Lower Bracket
3 Rigid to Instrument Panel, No Lower Attachment
4 Shear Module at Instrument Panel, Rigid at Toe Pan/Lower Firewall
5 Shear Module at Instrument Panel, Lower Bracket
6 Shear Module at Instrument Panel, No Lower Attachment
7 Bracket
8 Other (specify on data form)
9 Unknown Method
0 Undetermined--no reference data

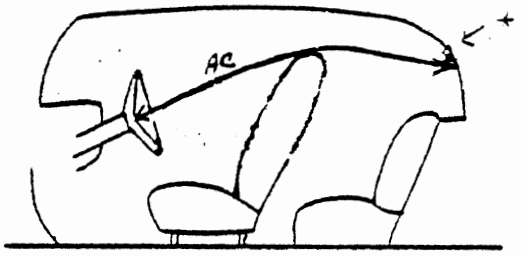
FIGURE 3 (Continued)

Ref. Table 7 -- AC Dimension Reference Points

1. Back light glass header - Straight line from wheel hub to reference point (If adjustable headrest, measurement is with headrest down.)



2. Back light glass header - Curved line over seat back from wheel hub to reference point (High back seats, tape measure should rest on top of seat back.)



3. Intermediate reference point - See note in Reference Table I

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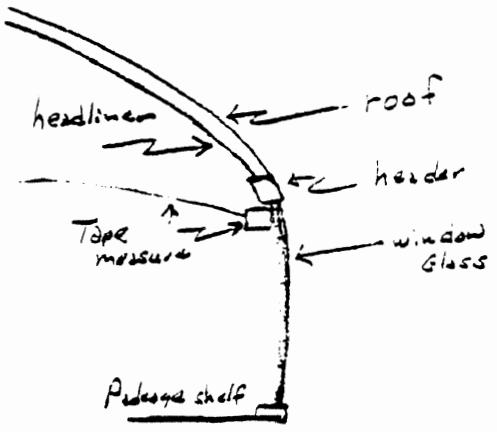
*Back light header detail



damage. The Reference Guide has two parts. Part I, containing Reference Table 1, summarizes the components of the passenger compartment steering system for most vehicles of interest. It is organized by vehicle made, model, and model year. Part II, containing Reference Tables 2-7, provides detailed descriptive data about each component of this steering system. Reference Table 1 is a summary of Tables 2-7 for specific vehicles. An example of Reference Table 1 is shown in Figure 2. Reference Tables 2, 3, 4, 5, 6, and 7 are shown in Figure 3. As shown, Reference Table 1 is a summary of Tables 2-7 for specific vehicles.

As shown in these examples, reference tables are organized for use in two ways. The first tables give pertinent data in summary form for common makes and models of vehicles encountered. Proper use requires that the investigator identify the make, model, and optional equipment for a certain vehicle, locate the vehicle in Reference Table 1, and then transfer the appropriate data values to the data form while verifying that the vehicle is so equipped.

The second set of tables gives code values for each specific element of the data form so that uncommon steering systems (not contained in the summary tables) may be described. These tables include information which describes how to make and record certain measurements relating to column performance in a crash. These tables aid the investigator in identifying the type of column and its safety features, as many features of the steering column and its associated hardware may not be readily identifiable by merely examining the vehicle. Thus these reference tables are essential to a proper examination of the steering system.

A User's Guide and Coding Manual was prepared to aid the investigator in completing the data form. The User's Guide contains a description of the data collection methodology as well as a detailed explanation of each data element. It is a "how-to-do" type document providing instructional material as well as measurement methodology.

By referring to this document, the investigator should be able to complete the data form without difficulty. An illustrative page is shown in Figure 4.

To help alleviate problems in assessing steering column performance, and to assist the investigator in understanding the various steering column devices, photographs and sketches of example units were obtained. Various vehicle types and models were acquired to develop such information. Most vehicles were new models making their entry into the vehicle population and were obtained on loan from local new car dealerships. They were carefully examined, measured, and photographed within the Institute garage facilities. Photographs obtained from such examinations were then notated with dimensions, identifying captions, and other pertinent features helpful to the investigator.

One overriding feature of most new vehicle designs is their tendency to locate steering column hardware of interest to investigators (column, shear capsule, attachments, etc.) so as to be increasingly inaccessible to visual inspection. This is particularly true for those vehicle which were the product of "downsizing" to decrease weight and increase fuel efficiency. Shear capsules in particular were found to be covered by trim panels and trim hardware, obscuring them from the view of an investigator.

Where such vehicles were encountered, documentation was prepared to illustrate features of the steering components within the passenger compartment with these covering components removed. This presented a view of the steering hardware which was normally covered from view. This information was not meant to imply that accident investigators conducting vehicle examinations were to similarly remove steering hardware covering components.

The User's guide is bound separately and identified as National Accident Sampling System Special Studies Number Three: Steering Column; User's Guide and Coding Manual, T.L. McDole, report UM-HSRI-79-44, revised edition, July 1979.

FIGURE 4. ILLUSTRATIVE PAGE FROM THE STEERING COLUMN USER'S GUIDE

Steering Column
Variable 15

VARIABLE GROUP: Steering Wheel: Damage

VARIABLE NAME: 15. Rim Distortion

FORMAT: 1 column, numeric, beginning column 28

ELEMENT VALUES:
1 No distortion
2 Minor bending--less than 1 inch
3 Severe bending--greater than 1 inch
4 Broken (i.e., separated)
9 Unknown distortion

SOURCE: Inspection only

REMARKS: Place a flat object such as a clipboard across the rim and look to see if any distortion is present. If distortion is present, quantify the magnitude. A precise measurement is not needed (and probably cannot be obtained anyway). Breakage of the wheel rim means a complete severance of the rim at one or more points. Separation of the spoke from the rim is coded under variable 16. (Spoke Distortion). A fracture, cracking, or breaking of the plastic or wood material does not qualify unless there is complete separation.

3.2 Side Intrusion

The purpose of developing a side-intrusion measurement methodology was to equip NCSS and NASS program accident investigators with the means to document the location and extent of side intrusion, i.e., intrusion into the passenger compartment lower side surfaces resulting from a crash. Data obtained from application of this methodology would tend to be used to assess the performance of the passenger compartment lower side surfaces in a collision through documenting the location and extent of intrusion and by noting resulting occupant contact and injury.

Side impacts and resulting intrusion have been known to inflict injuries to vehicle occupants. However, the pattern of such injuries differs from injury patterns resulting from frontal or rear impacts. The physical dangers of intrusion during such crashes are apparent, and are being addressed by Federal safety regulators in terms of revising Federal Motor Vehicle Safety Standard #214, "Side Door Strength." The development of this methodology will permit NCSS and NASS program accident investigators to acquire the data needed to better understand the relationship between crash severity and side intrusion, and the relationship between side intrusion occupant injury.

3.2.1 Methodology. The side-intrusion methodology developed in this project is addressed only to that portion of the side of vehicles as defined by the passenger compartment boundaries. It does not include sides of the engine compartment or trunk (luggage) compartment. The passenger-compartment side surfaces are defined as the area extending rearward from the vehicle "A" pillar to the last passenger compartment pillar, and from the bottom edge of the door sill-rocker panel (extended) to the belt line of the vehicle. The belt line defines the division between the roof and glazing portion of the passenger compartment and the sheet metal areas of the doors. Glazing and upper pillars are not included in this side surface area of interest. These

relevant side surfaces consist of up to three zones (depending upon the vehicle) and are defined as follows:

(1) Front -- area between A and B pillars

(2) Back -- area between B and C pillars

(3) Rear -- area between C and D pillars

The only side surfaces of interest in this methodology development are the right and left sheet-metal-enclosed sides of the vehicles.

The vehicle passenger compartment encloses the occupant space normally available for occupant seating, based on the vehicle design and seat configuration before the vehicle was involved in a crash. Vehicles with fixed seating which can be folded or compressed into a "down" position (i.e., station wagons) have an applicable side zone at that seat location regardless of whether the seat is extended upward or folded down. Vehicles with removable seating were considered to have an applicable side zone of interest at removable seat locations, but only if the seat were present at the time of the crash in which a side impact occurred. Cargo space behind seats was not considered as having an applicable side zone even though people might occupy such space with the vehicle moving.

Certain exceptions to these clearly defined areas of side surfaces were necessary. These were primarily because of vehicle types such as vans and multi-purpose vehicles where it is difficult to make a clear distinction between side surfaces of interest and side surfaces not of interest. Table 5 summarizes the common vehicle types and their applicable side zones addressed in this methodology development.

3.2.2 Data Form. A data form was designed to record the relevant features of the side impact damage. The form was organized into three major sections:

(1) Crushing force

(2) Component damage

(3) Intrusion

FIGURE 5. APPLICABLE SIDE SURFACES BY VEHICLE TYPE

Vehicle Type	Zone Front Between Pillars: A & B	Back B & C	Rear C & D
2 seat sports car	x		
Sedan 2 & 4 door, incl. hatchback	x	x	
Station wagon- 2 seat	x	x	
3 seat	x	x	x
dual facing rear seat	x	x	x
Pick-up truck- std.	x		
w/crew cab	x	x	
Van- cargo (1)*	x		
passenger (2)	x	x	x
custom-customized (3)	x		
Jeep-type (4)	x	x	
Multi-purpose passenger (5)	x	x	x

* Notes

1. Cargo van has only front seating; rest is for cargo.
2. Passenger van has all seating in factory-installed, removable seats.
3. Custom van has only front seating. Rest of area has been customized and has non-standard seating. Includes camper conversions.
4. Jeep-type includes back seating if installed. Otherwise, just front.
5. Multi-purpose passenger van or truck-based station wagon has all three zones or less, depending on available passenger seating.

The first two sections describe location and extent of side impact damage to the exterior sheet metal of the side surface, while the third describes intrusion of the inner side surface into the passenger compartment. The prototype data form is shown as Figure 6. Similar to the Steering Column form, it was reformatted by the University of Indiana for use in NASS so as to be compatible with other NASS data field forms. This NASS verson is contained in Appendix B.

The use of the side intrusion data form, when examining crashed vehicles, was made contingent on direct-contact damage. That is, data were to be acquired on only those crashed vehicles where an external crushing force was encountered by the side surface of the vehicle as a result of a side-impact crash. The force could emanate from any direction, but must impinge on the side surfaces defined above so as to result in inward crush to those surfaces. In addition to completing the Side Intrusion Data Form, the investigator was encouraged to augment data called for on the structured form with external and interior photographs of the vehicle, as well as supplemental notes, sketches, drawings, etc., where this could better be describe items or areas of interest.

A major portion of the data form was designed to accommodate information which could permit correlating occupant identification (occupant number in the crashed vehicle), occupant seated location, and occupant injury with the impact in terms of the occupant space intruded, intruding components, and the amount of intrusion and occupant space reduction as measured by the investigator.

Field tests of this methodology confirmed its practicality for providing data consistent with the definitions of the various data elements used to describe side intrusion.

3.2.3 Reference Guide. As with the steering column special study, a User's Guide and Coding Manual was prepared to accompany the side surface data form. The user's guide contains a description of

FIGURE 6. PROTOTYPE SIDE SURFACE DATA FORM

L S

NATIONAL ACCIDENT SAMPLING SYSTEM

SPECIAL STUDY

PSU No. ___ ___ Special Studies No. 0 4

Case No. ___ ___ ___ ___ Vehicle No. ___ ___

LOWER SIDE SURFACE

A documentation of the damage caused by the application of a crushing force to the side surface between the 'A' and the last pillar of the vehicle.

WHEN TO USE THIS FORM: Complete this form whenever an external crushing force has been applied to the side surface of the vehicle as a result of a side contact. The force can be from any direction but must crush the exterior side skin inward.

Side Surface Defined:

The side surface of the vehicle is defined as the area extending from the A-pillar to the last passenger compartment pillar and from the bottom edge of the door sill/rocker panel (extended) to the belt line. Window glass and upper pillars are not included in this area. The side surface consists of up to three zones (depending upon the vehicle) defined as: (1) front--the areas between the A and B pillars, (2) back--the area between the B and C pillars, and (3) rear--the area between the C and D pillars.

1.0 SIDE SURFACES

1.1 Indicate which component is located in each zone to make up the side surface.

FRONT OF VEHICLE

Left Side	Zone:	Right Side
____	Front	____
____	Back	____
____	Rear	____

CODES FOR COMPONENT:
1 Door
2 Panel
8 Not an applicable side surface
9 Unknown

2.0 CRUSHING FORCE

2.1 For ~~two~~ vehicle collisions, record the heading of the other vehicle relative to the heading of the case vehicle at the moment of the initial collision between the two. *NOTE: The heading of the other vehicle is to be measured clockwise from the forward longitudinal axis of the case vehicle. This value is equal to the algebraic difference between the heading angles of the two vehicles.*

(_ ___) - (_ ___) = ____

(* ↓ Other Veh) - (* ↓ Case Veh) = ____

*USE: + for angle measured clockwise
- for angle measured counter-clockwise

CODES:
--- Value in Degrees
500 Single Vehicle Crash
999 Unknown

2.2 Which zones were contacted by a crushing force?

FRONT OF VEHICLE

Left Side	Zone:	Right Side
____	Front	____
____	Back	____
____	Rear	____

CODES:
1 Contacted
2 Not Contacted
8 Not Applicable, not a side surface
9 Unknown if contacted

2.3 Record the specific location of the center of the crushing force in each side zone contacted.

FRONT OF VEHICLE

Left Side	Zone:	Right Side
__	Front	__
__	Back	__
__	Rear	__

CODES FOR SPECIFIC LOCATION WITHIN A ZONE:
Apply coding to Front, Back, Rear Zone as appropriate

Front of Car	Zone _1	_2	_3	_5*
1_	11	12	13	
2_	21	22	23	
3_	31	32	33	
4_	41	42	43	**
5_				***

*Full width of zone; **Rocker Panel; ***Full height to belt line.

55 Distributed crush over all of zone (no crush center possible)
99 Unknown crush center
98 Not Applicable--no side surface zone or not damaged

2.4 Depth of crush to each zone.

FRONT OF VEHICLE

LEFT SIDE	Zone:	RIGHT SIDE
____	Front	____
____	Back	____
____	Rear	____

CODES

1 0"-2"
2 2"-4"
3 4"-6"
4 6"-8"
5 greater than 8"
8 Not Applicable, no contact or side surface
9 Unknown

3.0 COMPONENT DAMAGE

3.1 In addition to the damage described above, were any structural/ hardware components contacted or damaged?

NOTE: Contact and damage (direct and induced) must result from a direct application of a crushing force to the side surface between the A Pillar and the Last Pillar of the vehicle.

Component:	LEFT Side [ ]	RIGHT Side [ ]
Check here if side not contacted.		
A Pillar	____	____
B Pillar	____	____
C Pillar	____	____
D Pillar	____	____

CODES

1 Not Damaged
2 Direct Damage, no separat
3 Direct Damage, separation
4 Indirect Damage, no separatio
5 Indirect Damage, separation
8 Not Applicable (not equip)
9 Unknown

	F Door	R Door	F Door	R Door
Door Latch/Striker	____	____	____	____
Door Hinges	____	____	____	____
Door Sill	____	____	____	____
	LEFT		RIGHT	

4.0 INTRUSION

Intrusion Defined:

Intrusion results whenever the internal boundary (surface) of the passenger compartment is moved inward due to direct damage resulting from the application of a crushing force as applied to the exterior surfaces of the vehicle.

Internal Side Surface: For the purposes of intrusion, the inner side surface extends from the inner door sill to the top of the upper window frame or top edge of the side glass. The roof rail is NOT included.

* * * * *

4.1 Did intrusion of the internal side surface result from the side crushing force?

( ) 2 No
( ) 9 Unknown } → *Go to Item 5.2*
( ) 1 Yes

4.2 Was there catastrophic intrusion into the passenger compartment by the side surface?

( ) 1 Yes
( ) 9 Unknown } → *Go to Item 5.0*
( ) 2 No

4.3 Indicate in which of the zone(s) the intrusion(s) occurred.
NOTE: Code all side zones as listed in 1.1.

FRONT OF VEHICLE

	Zone:	
____	Front	____
____	Back	____
____	Rear	____

LEFT RIGHT

CODES:
1 Intrusion
2 No Intrusion
8 Not Applicable, no side zones
9 Unknown

4.4 Total number of occupant spaces in the vehicle: ____ ____
99 = Unknown

4.5 Intrusion

Areas of intrusion, associated impacts, resulting maximum intrusion and occupant contact and injury.

Code intrusions from left to right, front to rear starting with Occupant Space #11.

Intrusion Number	Intruded Area Code	Occupant Space No.	Associated Impact No.	Number of Occupant Spaces in Seat Row	INTRUSION*		OCCUPANT CONTACT AND INJURY		
					Amount of Intrusion (Inches)	Reduction in Occupant Space	Contacted by Occupant Number ___	Assoc. Injury #1	Assoc. Injury #2
	A	B	C	D	E	F	G	H	I
1	__ __	__ __	__	__	__ __	__	__ __	__	__
2	__ __	__ __	__	__	__ __	__	__ __	__	__
3	__ __	__ __	__	__	__ __	__	__ __	__	__
4	__ __	__ __	__	__	__ __	__	__ __	__	__
5	__ __	__ __	__	__	__ __	__	__ __	__	__
6	__ __	__ __	__	__	__ __	__	__ __	__	__
7	__ __	__ __	__	__	__ __	__	__ __	__	__
8	__ __	__ __	__	__	__ __	__	__ __	__	__
9	__ __	__ __	__	__	__ __	__	__ __	__	__
10	__ __	__ __	__	__	__ __	__	__ __	__	__
11	__ __	__ __	__	__	__ __	__	__ __	__	__
12	__ __	__ __	__	__	__ __	__	__ __	__	__

**Occupant space dimension and reduction are measured laterally.*

4.6 Total number of intrusions: ___ ___ 99=Unknown
(Not necessarily number documented on previous page).

5.0 PHOTOGRAPHIC DOCUMENTATION

5.1 Photograph each side surface intrusion. Take at least 2 views, so as to best depict the location and magnitude of the intrusion.

5.2 Photograph each side surface zone where the side surface was contacted by a crushing force. Take at least 2 views, so as to best depict the location and magnitude of the crush.

-- END OF LOWER SIDE SURFACE DATA FORM --

CODES

Column A: Codes for Intruded Area or Component.

01 Window Frame
02 A Pillar--Upper
03 A Pillar--Lower
04 B Pillar--Upper
05 B Pillar--Lower
06 C Pillar--Upper
07 C Pillar--Lower
08 D Pillar--Upper
09 D Pillar--Lower
10 Door Panel or Side Panel--
includes all hardware
96 Other Side Component--*Specify on Data Form*
98 Not Applicable
99 Unknown

Column B: Codes for Occupant Space Number. Occupant space number is a 2-digit code. The use of the code is determined by the vehicle seat configuration at the time of the crash.

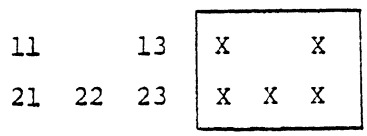
The first digit (left digit) denotes the seat row, with code values from 1-5. The second digit (right digit) denotes the position on the seat and (in some instances) the width of the seat.

Second Digit Codes:

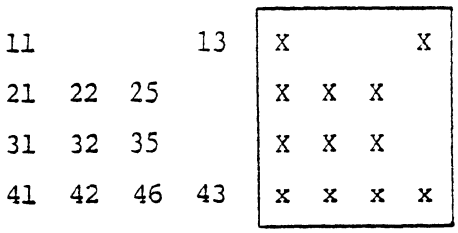
Seat Type	Code Value
Individual Seat (Bucket)	1=Left, 3=Right
Bench: Full width 3 passenger	1=Left, 2=Center, 3=Right
Full width 4 passenger	1=Left, 2=Left Center, 6=Right Center, 3=Right
Partial width--Left	1=Left, 2=Center, 5=Right + Aisle Space
Partial width--Centered	0=Left + Space, 2=Center, 5=Right + Space
Cargo Area	4=Entire vehicle wdith

EXAMPLES

Passenger Car: 5 Passengers



Van: 12 Passenger Capacity



Column C: Associated Impact Number. Code relevant impact from the CSS Vehicle Form, bottom of page 3 as follows.

1 Most Severe Impact (V15)
2 Secondary Impact (V22)
3 Other Recorded Impact (i.e. remaining CDC's from top of page 3)
4 Other Impact
9 Unknown Impact

Column D: Number of Defined Occupant Spaces in Seat Row

2 Two Occupant Spaces
3 Three Occupant Spaces
4 Four Occupant Spaces
9 Unknown

Column E: Give amount of intrusion (measured laterally) in inches.
99 = unknown

Column F: Space Reduction Code

1 No Reduction
2 Up to 25%
3 25% to 50%
4 Greater than 50%
9 Unknown Reduction

Column G: Contacted by Occupant Number____.

00 No Contact
__ Number of the occupant contacting the intrusion-- Use occupant number from CCS Occupant Form, page 1, variable 7
97 Contacted, Occupant Unknown
98 Not Applicable (vehicle not occupied)
99 Unknown if Contacted

Column H, I: Associated Injury

Code the injury (if injured) associated with the specific intrusion described on this line.

0 No injury
1-6 Injury number as listed at the bottom of page 7 of the CSS Occupant Form.
7 Other (unlisted) injury
8 Not applicable (vehicle not occupied)
9 Unknown if injured or unknown injury number.

the data collection philosophy and overall methodology as well as a detailed explanation of each data element. This manual is also a "how-to-do" document that provides instructional material as well as measurement methodology. Upon referring to this document, the investigator should be able to complete the data form without difficulty. An illustrative page is shown in Figure 7.

The user's guide is bound separately and identified as National Accident Sampling System Special Studies Number Four: Side Intrusion; User's Guide and Coding Manual, T.L. McDole, report UM-HSRI-79-44, revised edition, July 1979.

3.3 Roof Intrusion

The purpose of developing a roof intrusion measurement methodology was to similarly equip NCSS and NASS accident investigators with the means to document the performance of the roof on vehicles involved in crashes. Such measurements of roof crash performance included the location and extent of roof intrusion, with resulting occupant contact and injury.

The development of this methodology was an outgrowth of the need to better understand the mechanism, damage extent, and injury production in rollover accidents. By documenting roof performance and injuries incurred in rollover accidents, analysts can better understand this dangerous and often lethal type of crash. Regulators concerned with improving vehicle safety can develop better countermeasures to reduce and eliminate injuries. Federal Motor Vehicle Safety Standard #216, "Roof Crush Resistance," is addressed to improving vehicle performance in rollover crashes. This standard sets minimum crush resistance requirements through establishing test specifications for passenger cars. Data acquired through the use of this methodology can serve to evaluate the effectiveness of this standard as well as suggest improvements in the standard.

FIGURE 7. AN ILLUSTRATIVE PAGE FROM THE USERS MANUAL

VARIABLE GROUP: Intrusion

Side Intrusion Variable 67*

VARIABLE NAME: 67. Occupant Space Reduction

FORMAT: 1 column, numeric, beginning column 19

ELEMENT VALUES: Column F: Occupant Space Reduction

1 No reduction
2 Up to 25 percent
3 25 percent to 50 percent
4 Greater than 50 percent
9 Unknown reduction

SOURCE: Inspection

REMARKS: Estimate the amount of reduction in each occupant space resulting from the intrusion. While this is a guesstimate, the measured intrusion divided by the original width of the space should yield an accurate value. It is not required that the original dimension be ascertained, but this may be helpful.

3.3.1 Methodology. Since rollover crashes can be difficult to reconstruct and difficult to document, in terms of damage, occupant interior contacts, and where various injuries were incurred, this methodology was deliberately limited to data relating only to the performance of the roof in a crash. Roof performance is recognized to be but one of many considerations involving occupant safety in rollover crashes. It is the single most relevant causation factor to injuries incurred in rollover crashes with the exception of occupant ejection.

A definition of what actually constitutes the roof on a vehicle was first established. The roof was defined as that portion of the vehicle body which forms a canopy, or overhead surface, for interior passenger and cargo space. It includes the actual roof structure as well as the upper pillars (A, B, C, and D) which support this roof structure. In addition to the roof, it was felt necessary to include provisions for noting the effects of roof attachments in crashes (luggage racks, special lights, etc.).

One important area of information relative to roof performance is identification of areas of the roof that were impacted. This is contained in a group of variables under roof description. The sheet metal canopy comprising the roof was sectioned into 2, 4, or 6 areas for locating impact damage. These were originally organized to coincide with seated occupant positions directly under the roof. To assist the investigator to make a correct response to roof area impacted, various vehicle types were diagrammed to illustrate roof panel areas to be identified as damaged in a crash. These sections were aided in their identification by noting the upper pillars associated with a vehicle type. In addition to roof pillars, the investigator was instructed to take into consideration the manufacturer's designated seat positions in the vehicle in conjunction with the pillars. Criteria for selecting roof panel areas were established as follows:

(1) Manufacturer's designated seated positions in terms of seating rows within the vehicle.

(2) Belt restraint locations.

(3) Roof pillar (upper and lower) locations.

3.3.2 Field Data Form. The field data form, developed for use by NCSS and NASS ivestigators, was designed to address three general areas relating to roof crush. These were:

(1) Identification of roof type, roof material, and attachments to the roof.

(2) Estimation of the area of the exterior roof which was crushed or deformed from impact; the severity of the resultant damage; and the direction of crash forces which resulted in roof damage.

(3) Noting the actual interior occupant space which was intruded, the degree of interior intrusion penetration and related occupant space reduction with injuries, if any, to occupants.

The prototype data form is attached as Figure 8.

This data form was designed so that data could be acquired to permit correlation of occupant injuries and occupant seated position with roof intrusion. This includes intruding components, occupant space intrusion, identification of the impact in the crash which resulted in roof intrusion, and depth of interior roof intrusion.

These data forms were field tested. Similar to the Steering Column and Side Intrusion forms, this data form was also reformatted to be compatible with existing NASS data forms by the University of Indiana. This NASS form is contained in Appendix C.

3.3.3 User's Manual. A User's Guide and Coding Manual was prepared to aid the investigator in completing the data form. This User's Guide contains a description of the data collection philosophy and overall methodology as well as a detailed explanation of each data element. It is a "how-to-do" document providing instructional material as well as measurement methodology.

FIGURE 8. PROTOTYPE ROOF DATA FORM

R F

NATIONAL ACCIDENT SAMPLING SYSTEM

SPECIAL STUDY

PSU ___ ___ Special Studies No. 0 5

Case No. ___ ___ ___ ___ Vehicle No. ___ ___

ROOF CRASH PERFORMANCE ASSESSMENT

WHEN TO USE THIS FORM: This form is to be completed only if roof has been impacted and has sustained direct damage.

1.0 VEHICLE ROOF

ROOF DESCRIPTION

1.1 Upper Roof Pillars

FRONT OF CAR

LEFT SIDE	Pillar	RIGHT SIDE
___	A	___
___	B	___
___	C	___
___	D	___

CODES:

1 Upper Pillar Present
2 No Upper Pillar
8 Not Applicable
9 Unknown

1.2 Total number of roof areas:* ___ 9 = Unknown

**See Reference Sheet--"Roof Area Designation"*

ROOF ATTACHMENTS

1.3 ROOF ATTACHMENTS

( ) 1 Lights* (Clearance, spot, warning)
( ) 2 Horn or Siren*
( ) 3 Car Top Carrier (Portable, ski rack, light bar, etc.)
( ) 4 Roof Rack* (Permanent--OEM)
( ) 5 Wind Deflector
( ) 6 Other: _____
( ) 7 Combination of Above--
Note Combination: _____
( ) 8 Not Applicable (No attachments)
( ) 9 Unknown

**Attached directly to roof*

1.4 ROOF MATERIAL

( ) 1 Steel
( ) 2 Fiberglass
( ) 3 Fabric
( ) 6 Combination
( ) 8 Not Applicable (No Roof)
( ) 9 Unknown
( ) 7 Other: _____

1.5 OPTIONS

( ) 1 None
( ) 2 Sun Roof, Skylight
( ) 3 Convertible (top up)
( ) 4 T-Roof
( ) 6 Other: _____
( ) 8 Not Applicable (No Roof)
( ) 9 Unknown
( ) 5 Raised Roof or Pop-up Roof (camper etc)

1.6 ROLL BAR EQUIPPED

( ) 1 None
( ) 2 External
( ) 3 Internal
( ) 4 Roll Cage
( ) 9 Unknown

2.0 ROOF DEFORMATION AND CRUSH DIRECTION -- EXTERIOR

CRUSH

Roof Area Damaged	Inward Crush ≥4 Inches*	Dominant Crush Direction**
____	____	____
____	____	____
____	____	____
____	____	____
____	____	____
____	____	____

*CODES:
1 Yes
2 No
8 Not Applicable
9 Unknown

**See diagrams of vehicle type roof area projections and crush direction codes on attached reference sh

3.0 INTRUSION--INTERIOR

INTRUSION

3.1 Did intrusion of the interior roof surface result from the roof deformation?
( ) 2 No
( ) 9 Unknown
} ⟶ Go to item 4.0
( ) 1 Yes

3.2 ROOF AREA INTRUSION

-A- Intruding Components	-B- Roof Area Int'd	-C- Occupant Space	-D- Assoc'd Impact	-E- Intrusion Depth	-F- Occupant Space Reduc.	-G- Contacted by Occ. Number	-H- Assoc Injur
____	____	____	____	____	____	____	____
____	____	____	____	____	____	____	____
____	____	____	____	____	____	____	____
____	____	____	____	____	____	____	____
____	____	____	____	____	____	____	____
____	____	____	____	____	____	____	____

3.3 Total number of intrusions: ____ 99=Unknown
(Not necessarily number documented above)

4.0 PHOTOGRAPHIC INSTRUCTIONS

Photograph each roof impacted area from two different perspectives to best portray location and magnitude of roof damage.

Column D: Associated Impact. Code relevant impact from the bottom of page 3 of the CSS Vehicle Form as follows:

1 Most severe impact (V15)
2 Secondary Impact (V22)
3 Other recorded impact (i.e. remaining CDC's from top of page 3)
4 Other impact (not recorded on page 3)
9 Unknown impact

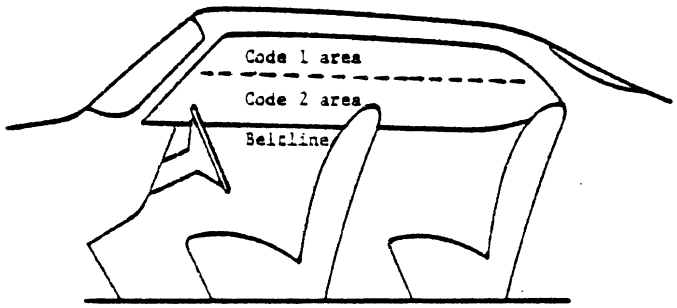
Column E: Intrusion Depth.

1 Inward crush less than 4 inches
4 Inward crush greater than 4 inches
9 Unknown

Column F: Occupant Space Reduction. Judge the inward intrusion of the interior roof surface with respect to the vehicle's beltline and seatbacks (see diagram).

1 Less than one-half the distance to the beltline
2 Greater than one-half the distance to the beltline
3 Contact to a level at the beltline or deeper
8 Not applicable
9 Unknown

NOTE: If in contact with seatback and greater than one-half the distance to the beltline, code 2.



Column G: Contacted by Occupant No___.

00 No Contact
-- Number of the occupant contacting the intrusion--use occupant number from CSS Occupant Form, page 1, variable 7.
97 Contacted, occupant unknown
98 Not Applicable (vehicle not occupied)
99 Unknown if contacted

Column H: Associated Injury. Code the injury (if injured) associated with the specific intrusion described on this line.

0 No injury
1-6 Injury number as listed at the bottom of page 7 of the CSS Occupant Form.
7 Other (unlisted) injury
8 Not applicable (vehicle not occupied)
9 Unknown if injured or unknown injury number.

CODES FOR SECTION 3.0

Column A: Intruded Components. Codes for intruded area(s) or component(s).

01	Roof and/or headliner
02	Windshield header
03	Door window frame
04	Roof side rails
05	Backlight header
06	Upper A-Pillar
07	Upper B-Pillar
08	Upper C-Pillar
09	Upper D-Pillar
10	Upper side panel (cargo vans, etc.)
11	Upper back panel (back door surface)
12	Other component--specify on data form
98	Not applicable
99	Unknown

Column B: Roof Area. Refer to roof area designations from attached reference sheet.

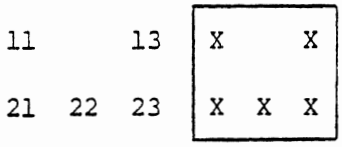
Column C: Occupant Space Number. A two digit code denotes occupant seat space. The first digit (left digit) denotes the seat row, with code values from 1-5. The second digit (right digit) denotes the position on the seat and (in some instances) the width of the seat.

Second Digit Codes:

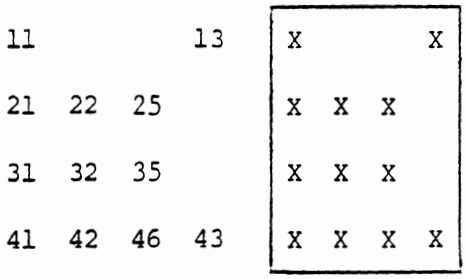
Seat Type	Code Value
Individual Seat (Bucket)	1=Left, 3=Right
Bench: Full width 3 passenger	1=Left, 2=Center, 3=Right
Full width 4 passenger	1=left, 2=Left Center, 6=Right Center, 3=Right
Partial width--Left	1=Left, 2=Center, 5=Right + Aisle Space
Partial width--Centered	0=Left + Space, 2=Center, 5=Right + Space
Cargo Area	4=Entire vehicle width

EXAMPLES

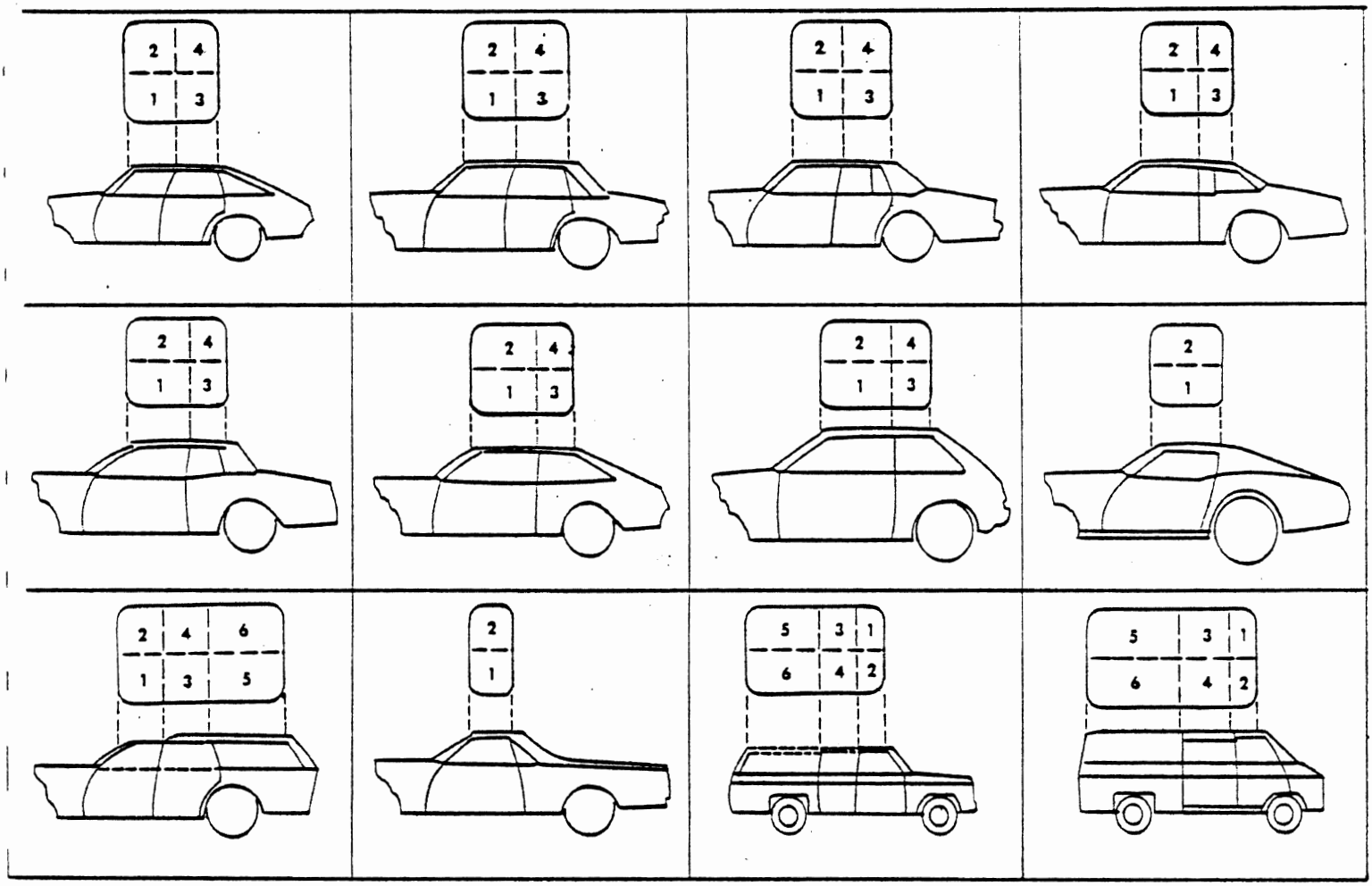
Passenger Car: 5 Passengers



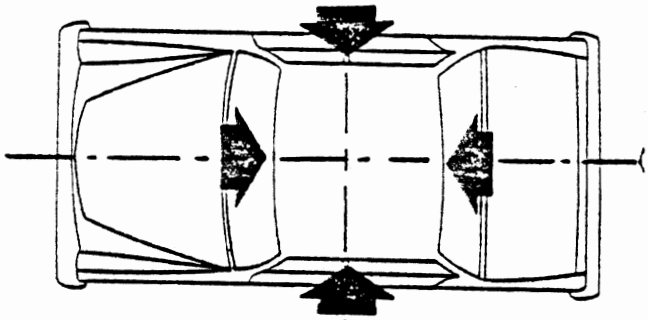
Van: 12 Passenger Capacity



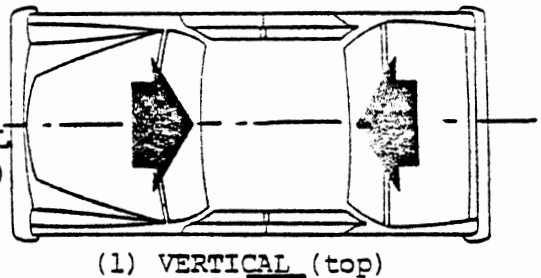
ROOF



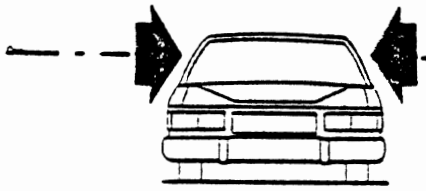
(3) LATERAL (Side)



(2) LONGITUDINAL (front, rear)



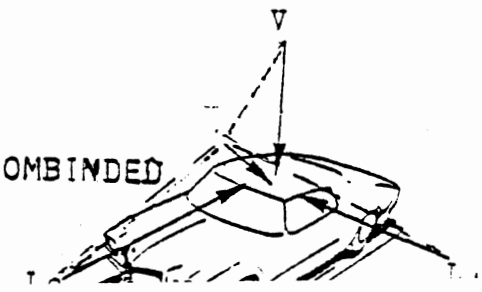
(1) VERTICAL (top)



(3) LATERAL (side)

(9) UNKNOWN

(4) COMBINDED



Upon reading this document, the investigator should be able to complete the data form without difficulty. An illustrative page is shown in Figure 9.

The User's Guide is bound separately and identified as National Accident Sampling System Special Studies Number Five: Roof Intrusion; User's Guide and Coding Manual, P. Cooley, report UM-HSRI-79-25, revised edition, July 1979.

FIGURE 9. EXAMPLE PAGE FROM THE ROOF USER'S MANUAL

Roof Intrusion
Variable 7-10

VARIABLE GROUP: Roof Description

VARIABLE NAME: 7-10. Upper Roof Pillars

FORMAT: 4 columns, numeric, beginning column 13

ELEMENT VALUES:
1 Upper Pillar Present
2 No Upper Pillar
8 Not Applicable
9 Unknown

SOURCE: Inspection

REMARKS: Roof pillars beginning with the A-pillar in the vehicle, are noted to more accurately identify vehicle roof types. Note that the variable is addressed to only UPPER roof pillars and not to lower pillars. Upper roof pillars may serve as an aid in determining the number of roof areas (VARIABLE 11) for the vehicle but are not a reliable guide. An absence of an upper pillar, such as the absent upper B-pillar in a 4-door hardtop sedan, does not indicate that the vehicle has fewer roof panel areas.

Two-door coupes (top row, last column of vehicle side views on reverse side of the data form, page 1) with small "opera" windows also have upper C-pillars, as do pick-up cars (last, row, second column).

Four-door sedans which have rearmost side opera windows only have a C-pillar. They do not have a D-pillar.

4.0 TRAINING SESSIONS

Two separate training sessions of one-week duration were conducted by HSRI for NASS accident investigators. The purpose of this effort was to instruct investigators in the proper application and use of the methodologies developed in this project. HSRI established training session dates in conjunction with NHTSA, devised a session calendar and training agendas, made all physical arrangements for classrooms, laboratory use and lodging for attendees, provided transportation for attendees between their lodging and the classrooms, coordinated the instructional needs of other participants, made arrangements for noon time meals while the training sessions were in progress, and provided a mechanism for the attendees to critique the training sessions.

A training conference schedule for the training sessions is shown in Figure 10. Each training session covered five major topics which were planned as NASS special studies. These were the steering column protocol, side intrusion and roof intrusion protocols, and protocols for investigating motorcycle crashes and truck underride crashes. The latter two were conducted by personnel from the University of Southern California and Indiana University, respectively.

Each training session attendee was requested to complete an evaluation questionnaire with his or her comments on the value and effectiveness of each segment of the training session. The overwhelming response rated the training sessions overall between "Good" and "Very Good." There were some problems with not having various field forms and materials available in time for complete review in the first training session, but this was but a minor difficulty with little effect on the total training effort.

The method of using specialized training sessions for presenting new materials and introducing new special studies into NASS was found to be effective and efficient. All individuals involved as staff and instructors in the training sessions were agreed that once returned to

FIGURE 10

NASS SPECIAL STUDIES TRAINING CONFERENCE SCHEDULE

Monday -- Chrysler Center for Continuing Engineering Education

8:30-9:00	Welcome: HSRI and NHTSA
9:00-10:15	Steering Column Special Study - T. McDole and P. Cooley
10:15-10:30	Break
10:30-11:45	Steering Column - continued
11:45-1:00	Lunch
1:00-1:30	Occupant Space
1:30-3:00	Rollover & Roof Special Study - P. Cooley
3:00-3:15	Break
3:15-5:00	Rollover & Roof - continued

Tuesday -- Chrysler Center

8:30-10:00	Lower Side Surface/Intrusion Special Study - T. McDole
10:00-10:15	Break
10:15-11:45	Lower Side Surface/Intrusion - continued
11:45-1:00	Lunch
1:00-4:30	Laboratory Session at Highway Safety Research Institute
4:30-	Discussion Hour

Wednesday -- Chrysler Center

8:30-10:15	Motorcycle Special Studies - H. Hurt
10:15-10:30	Break
10:30-11:45	Motorcycle - continued
11:45-1:00	Lunch
1:00-3:00	Motorcycle - continued
3:00-3:15	Break
3:15-5:00	Motorcycle - continued

Thursday -- Chrysler Center

8:30-10:15	Motorcycle - continued
10:15-10:30	Break
10:30-11:45	Motorcycle - continued
11:45-1:00	Lunch
1:00-3:00	Truck Underride Special Study - N. Tumbas
3:00-3:15	Break
3:15-5:00	Truck Underride - continued

Staff

Highway Safety Research Institute, The University of Michigan - Thomas McDole, Peter Cooley, Robert Scott; University of Southern California - H. Harrison Hurt; Indiana University - Nick Tumbas

their individual NASS PSU accident investigation teams, attendees would have no difficulty or delay in applying these new special study protocols.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The objective of developing a practical and field usable methodology for the uniform and consistent acquisition of various data relating to steering column, side, and roof performance in crashes was accomplished. In developing these data acquisition methodologies, previous methods used to obtain data on these critical areas of importance to highway safety were carefully reviewed. Of particular relevance and significance was the previous development of a more deliberate and extensive methodology to measure intrusion in motor vehicle crashes. This effort, conducted under contract DOT-HS-7-01805,* culminated in a detailed and extensive methodology for the measurement of intrusion in crashes which provided quantitative values of interior intrusion through careful measurements. The development of the side and roof intrusion protocols in this project was influenced by this previous work.

5.1 Conclusions

The development of the three special study projects began with a basic description of the problem and a thorough understanding of the data collection and analytical problems to be faced. To be effective, each special study must be able to document the damage and intrusion accurately and with sufficient depth of detail to permit more than just superficial analyses -- as, unfortunately has been the case in certain similar projects in the past.

Throughout these special studies, HSRI has resisted attempts to simplify the forms solely for the ease and convenience of the data collection. Likewise, we have taken steps to ensure that only data necessary to solve the problem be acquired.

*Methodology for the Measurement of Intrusion in Motor Vehicle Accidents, P. Cooley, et al., report UM-HSRI-78-17-1, dated April 15, 1978.

The systems which were addressed in these studies are complex--primarily due to the proliferation of designs and vehicle models to be studied. Thus, to be effective, the methodology and data acquisition must be capable of addressing these variations. To this end, we believe that the special studies as developed by HSRI are effective methods for the acquisition of the data needed to address the performance of vehicle steering systems, sides, and roofs in crashes. Anything less would result in collection that would fail to yield meaningful findings.

In preparing this report on this activity one cogent observation is that the Side Intrusion methodology may be inappropriately named. The field form developed for use in the NCSS and NASS programs is titled "Side Intrusion Form." The form is employed in crashes where the side sheet metal surfaces of a vehicle have been impacted, but the damage may not have resulted in intrusion into the passenger compartment. The form is completed when the side of a vehicle (selected for examination) is impacted with resultant direct contact damage. There are many such crashes without intrusion. A more appropriate name, in retrospect, might have been "Side Impact Form."

A similar reflection in completing this project is that the methodology may not be sufficiently extensive in terms of measurement of passenger compartment intrusion. Compromises were required to keep the field application of this methodology relatively simple to apply, and without requiring excessive additional effort on the part of the investigator when examining a vehicle involved in a crash. These compromises were mostly in areas where internal measurements were required. As a result, it may be difficult to assess the degree of interior penetration of intrusion in side impacts resulting in intrusion. HSRI had developed a method of accurately measuring interior intrusion, but this was abandoned in the effort to simplify and reduce time in the field required for each special study.

5.2 Recommendations

The following recommendations may help improve the design of future special studies and possibly those currently in progress. It is recommended that:

(1) More planning and coordination be considered for future special study efforts which require the development of new field accident investigation methodology. The work concluded here could have been completed with less effort had greater planning by NHTSA taken place on just what each special study was to entail, and what specifically each was to address.

(2) Future projects, in which development of accident investigation methodologies are contracted, be accompanied with thorough and completed project development statements and definitions.

(3) The development of a reference guide, or manual, containing data regarding steering components be continued and expanded to cover the complete range of vehicle types, models, and model years of interest in NASS. (Note: The reference guide developed in this project was limited to late-model vehicles because of time and funding limitations. Data exist to expand this reference guide to as far back as the mid-1960s. This should be expanded and continued as an ongoing effort so as to accommodate newer vehicles types and models as they emerge.)

(4) In addition to steering column reference data, other pertinent data essential to the examination of vehicles in crashes be similarly compiled. Many aspects of NASS accident vehicle examinations require reference data. One example is the application of the Collision Damage Classification (CDC) system. Damage extent zones in the CDC system are based on a division of vehicle lengths from certain reference points on the vehicle (i.e., frontal extent codes require establishing five frontal zones based on the distance from the base of the vehicle windshield to the extreme front end). Having such reference data available would greatly facilitate the work of the

accident investigator as well as ensure the accuracy of code values selected.

(5) Caution be exercised by analysts in arriving at inferences and conclusions through use of the steering column data obtained by application of the steering column protocol developed in this project. The methodology developed in this project was limited to only those steering systems components within the passenger compartment of vehicles. It does not include features of the steering system in the engine compartment that may be designed to restrict the rearward movement of the column in frontal crashes.

(6) That specialized training sessions, which are well planned and executed, be used for future introductions of new special studies in NASS. This method was found to be effective in eliminating potential confusion concerning the purposes and methods of new special studies.

6.0 REFERENCES

1. Cooley, P., et al. Methodology for the Development of Intrusion in Motor Vehicle Accidents. Highway Safety Research Institute, The University of Michigan, Report number UM-HSRI-78-17-1, April 15, 1978.

2. McDole, T.L. National Accident Sampling System Special Studies Number Three: Steering Column; User's Guide and Coding Manual. Highway Safety Research Institute, The University of Michigan, Report number UM-HSRI-79-43, Revised Edition, July 1979.

3. McDole, T.L. National Accident Sampling System Special Studies Number Four: Side Intrusion; Users Guide and Coding Manual. Highway Safety Research Institute, The University of Michigan, Report number UM-HSRI-79-44, Revised Edition, July 1979.

4. Cooley, P. National Accident Sampling System Special Studies Number Five: Roof Intrusion; Users Guide and Coding Manual. Highway Safety Research Institute, The University of Michigan, Report number UM-HSRI-79-25, Revised Edition, July 1979.

APPENDIX A

NASS
STEERING COLUMN
FIELD FORM

[illegible] (Result is rounded to the nearest inch.)

___ Inches — Subtract the Question 13 value from the Question 12 value and record the difference.

___ (00) [illegible]

Observed Value Code (cannot be measured):

___ (80) Apparent movement, value undetermined

Estimated movement:

___ (81) less than 1 inch

___ (82) between 1 and 2 inches

___ (84) between 2 and 4 inches

___ (86) between 4 and 6 inches

___ (88) between 6 and 8 inches

___ (90) greater than 8 inches

Other Codes:

___ (98) Not applicable, not measurable

___ (99) Unknown

26-27

15. Rim Distortion

___ (1) No distortion

___ (2) Minor bending — less than 1 inch

___ (3) Severe bending — greater than 1 inch

___ (4) Broken (I.E., separated)

___ (9) Unknown distortion

28

16. Spoke Distortion

___ (1) No distortion

___ (2) Minor bending — less than 1 inch

___ (3) Severe bending — greater than 1 inch

___ (4) Broken (I.E., separated)

___ (9) Unknown distortion

29

STEERING COLUMN — DEVICE [illegible]

17. Energy Absorbing Device Type

___ (01) Non-EA column — Code not applicable for Questions 19-21

___ (02) EA column type unspecified

___ — Code actual value (See Table of Compiled Steering Components for code applicable to your specific make, model, and model year. Also, see those listed on reverse side.)

___ (90) Other (describe on reverse side)

___ (95) Undetermined, no reference data — Code "unknown" for Questions 19 and 20 — complete Question 21

___ (99) Unknown if EA column — Code unknown for Questions 19-21

18. Mount [illegible] Method

___ (0) Undetermined, no reference data

Rigid to Instrument Panel:

___ (1) Mounted at toe pan/lower firewall

___ (2) Lower bracket

___ (3) No lower attachment

Shear Module(s) to Instrument Panel:

___ (4) Mounted at toe pan/lower firewall

___ (5) Lower bracket

___ (6) No lower attachment

___ (7) Brackets

___ (8) Other

___ (9) Unknown method

32

STEERING COLUMN — COMPRESSION

Column EA Device Compression Calculation

19. Device Original Dimension

___ Tenths of inches — Code actual value from Table of Compiled Steering Components

___ (998) Not applicable

___ (999) Unknown

33-35

20. Device Compressed Dimension

___ Tenths of inches — Code actual measured value

___ (998) Not applicable

___ (999) Unknown

36-38

21. Device Compression Value

(NOTE: Result is rounded to the nearest inch.)

___ Inches — Subtract the Question 20 value from the Question 19 value and record the difference.

___ (00) No movement, compression, or collapse

Observed Value Code (cannot be measured):

___ (80) Apparent movement, value undetermined

Estimated movement:

___ (81) less than 1 inch

___ (82) between 1 and 2 inches

___ (84) between 2 and 4 inches

___ (86) between 4 and 6 inches

___ (88) between 6 and 8 inches

___ (90) greater than 8 inches

Other Codes:

___ (98) Not applicable, not measurable

___ (99) Unknown

39-40

22. Shear Module Type of Movement

___ (1) No movement

___ (2) Displacement only

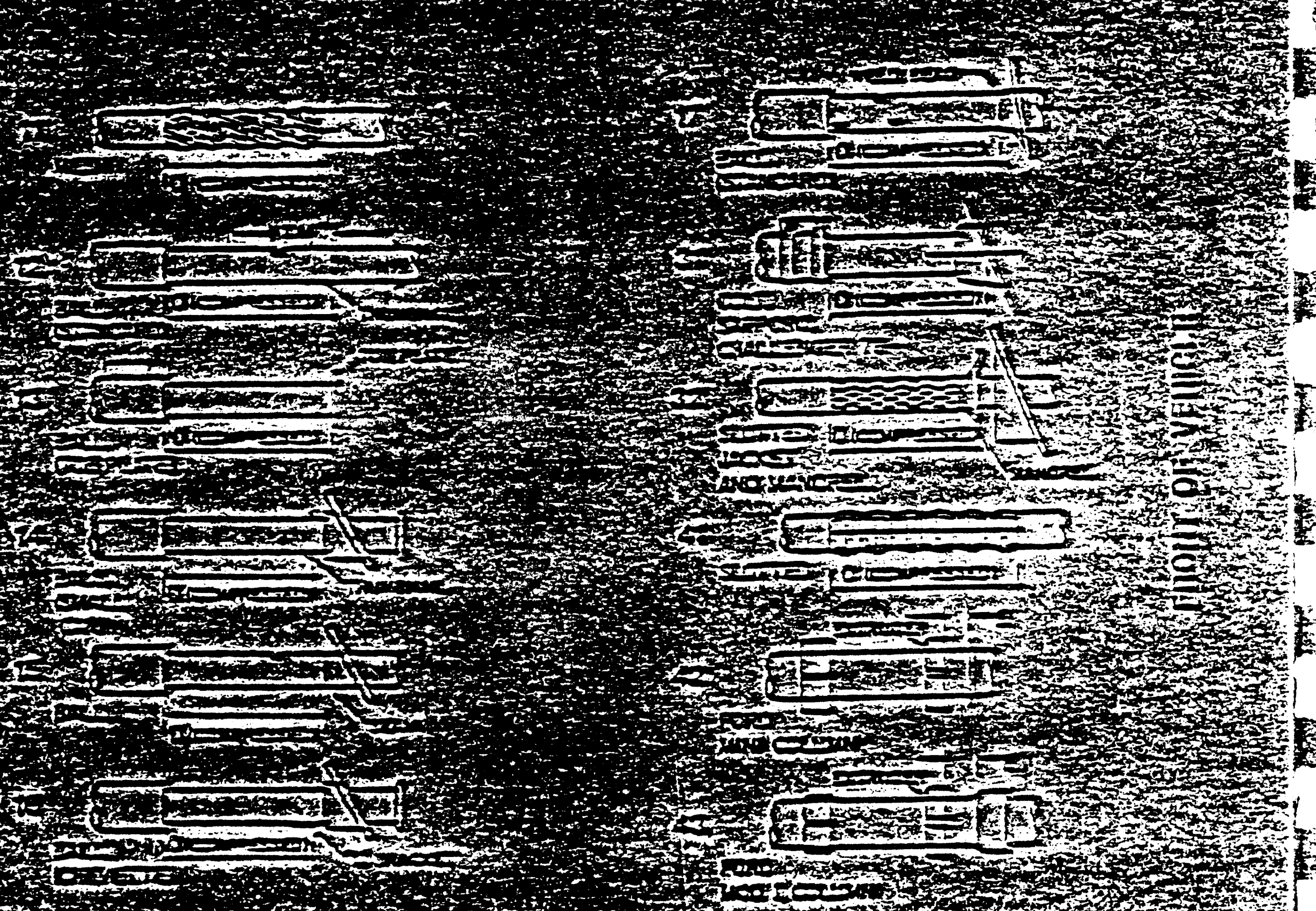
___ (3) Displacement and separation

___ (4) Not designed to indicate movement

___ (8) Not applicable or no shear module

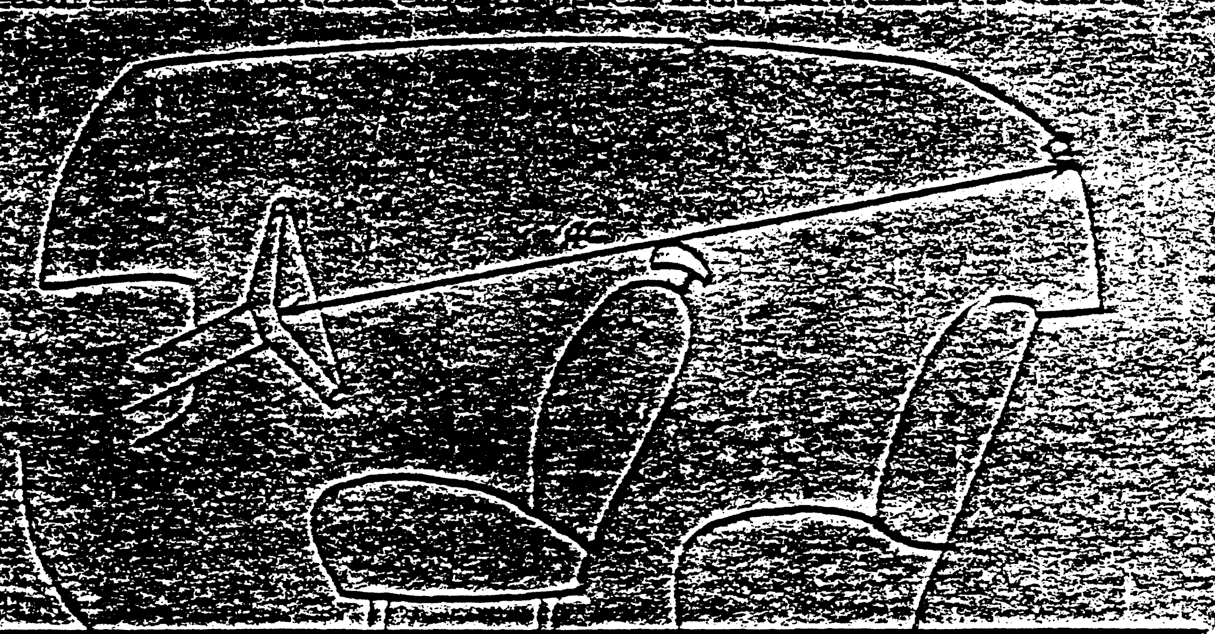
___ (9) Unknown movement

STEERING COLUMN ENERGY ABSORBING DEVICES



AC DIMENSION REFERENCE POINTS AND MEASUREMENT TECHNIQUE

Measurement to bottom edge of upper backlight trim at glass.



AC Reference Point Codes

(1) Backlight glass header

AC Measurement Notes: straight line measurement if possible

(1) If adjustable headrest, measurement is with headrest down

(2) If high back seat, measurement is over top of seat back

(3) Vehicles with no back seat, measurement is still taken to window trim

STEERING COLUMN FORM

1. Primary Sampling Unit Number [illegible]

2. Case Number [illegible]

3. [illegible]

4. Record Number [illegible]

5. Vehicle Number [illegible]

STEERING SYSTEM OPTIONAL EQUIPMENT

6. Speed Control [illegible]
(NOTE: Factory installed not [illegible] dealer installed unit [illegible])
__ (1) Equipped
__ (2) Not equipped
__ (9) Unknown

7. Tilt Column Feature [illegible]
__ (1) Equipped
__ (2) Not equipped
__ (9) Unknown

8. Telescoping Column Feature
__ (1) Equipped
__ (2) Not equipped
__ (9) Unknown

STEERING WHEEL EA DEVICE(S)

9. Wheel Configuration: Number of Spokes and Arrangement
____ — Code actual value from those listed in the Table of Compiled Steering Components or from the reverse side.
__ (95) Undetermined—no reference data
__ (97) Other. Sketch configuration in the space provided on the reverse side.
__ (99) Unknown spokes and arrangement

10. Wheel Profile
__ (1) Deep dish
__ (2) Shallow dish
__ (3) Flat
__ (4) Other profile [illegible]
__ (5) Undetermined—no reference data
__ (9) Unknown profile

STEERING COLUMN PERFORMANCE ASSESSMENT

When to Use This Form: Complete this form whenever this vehicle was a towaway and the initial crash event involved a frontal [illegible] collision [illegible] (clock directions 10–02) and [illegible]

Photographic Instructions: Take at least two photographs of the steering column wheel, Energy Absorbing (EA) Device, etc., so as to best depict the location and magnitude of the damage. Photograph the mounting and foundation also, if damaged.

Steering System Defined: That portion of the steering assembly which is located within the passenger compartment consisting of the following components/subsystems.
1. The column, extending from the toe pan to its termination in the steering wheel hub
2. Associated mounting brackets, hardware, and foundation
3. Associated energy absorbing devices
4. The steering wheel

11. Wheel Energy Absorbing (EA) Type Code [illegible] most wheels are designed to absorb some energy, certain wheels are specifically EA and replace the column EA capability. [illegible] Not an EA wheel — Code not applicable for Questions 12–14.
__ (02) EA wheel type unspecified
__ Code actual value. (See Table of Compiled Steering Components for code applicable to your specific make, model and model year.)
__ (97) Other [illegible]
__ (98) Undetermined—no reference data — Code "unknown" for Questions 12 and 13. Complete Question 14.
__ (99) Unknown if EA wheel — Code "unknown" for Questions 12–14.

STEERING WHEEL DAMAGE

Wheel EA Compression Calculation

12. Wheel Original Dimension
____ tenths of inches — Code actual value from Table of Compiled Steering Components.
__ (998) Not applicable
__ (999) Unknown

13. Wheel Compressed Dimension
(NOTE: See reference manual for how to measure. Example on reverse side.)
____ tenths of inches — Code actual measured value.
__ (998) Not applicable
__ (999) Unknown

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Wheel Configurations

1 Spoke

1T =

2 Spoke

2 =

3 Spoke

3 =

4 Spoke

4T =

2T =

3T =

4Z =

2Z =

4S =

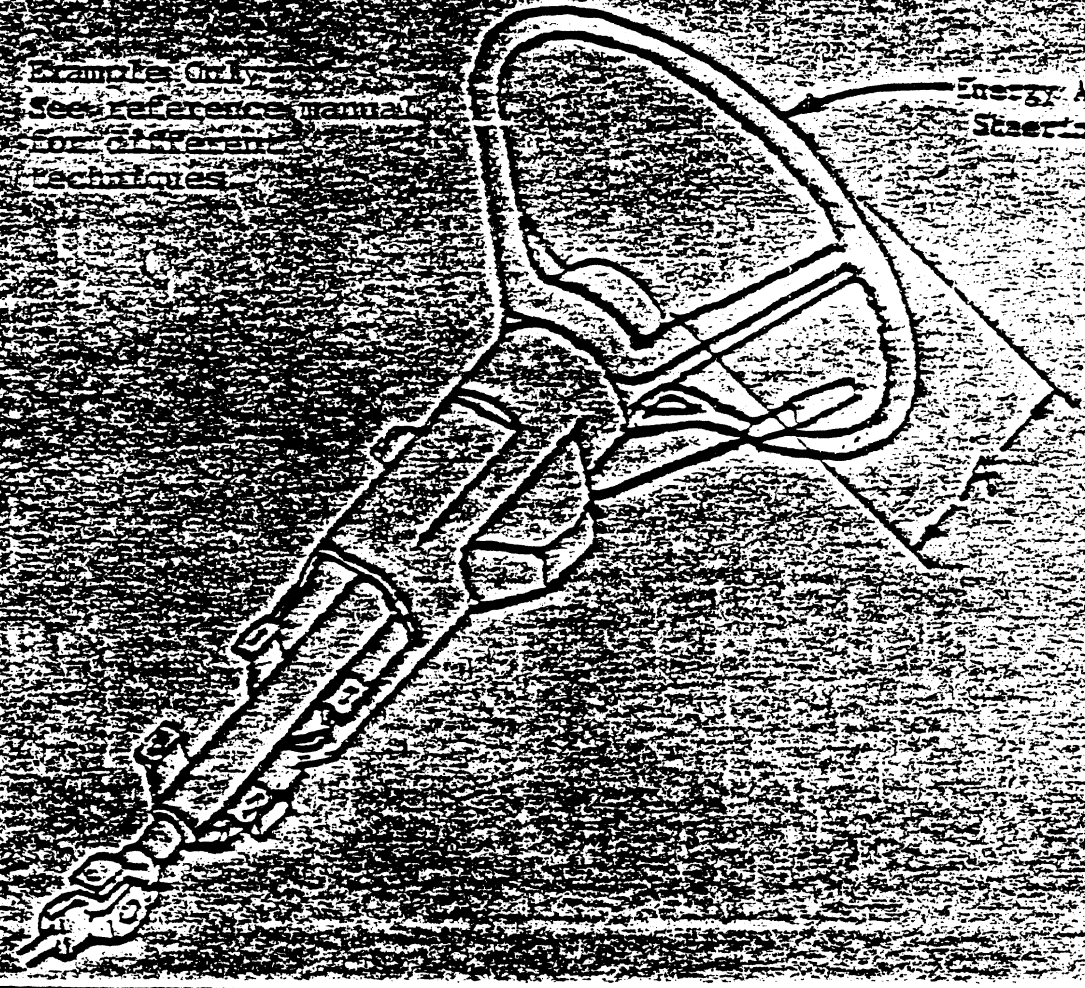
9T =

Other

Energy Absorbing Steering Wheel Measurement

Ex: Example Only

See reference manual for different techniques



23. Movement about [illegible] Measured Movement
(NOTE: Result is rounded to the nearest inch.)

____ inches — Code actual measured movement. See coding manual for measurement technique (s) [illegible]
___ (00) No movement [illegible] collapse [illegible]
Observed Value Code (cannot be measured):
___ (80) Apparent movement, value undetermined
Estimated movement:
___ (81) less than 1 inch
___ (82) between 1 and 2 inches
___ (84) between 2 and 4 inches
___ (86) between 4 and 6 inches
___ (88) between 6 and 8 inches
___ (90) greater than 8 inches
Other Codes:
___ (98) Not applicable, not measurable
___ (99) Unknown

47 48

COLUMN DISPLACEMENT

AC Dimension Axial Movement Calculation

24. AC Original Dimension

____ inches — Code actual value form Table of Compiled Steering Components
___ (995) Undetermined, no reference data — Code not applicable for Question 25; Complete Question 27.
___ (998) Not applicable — reference data available — Code not applicable for Questions 25 and 27.
___ (999) Unknown, not measurable — Code unknown for Questions 25 and 27.

25. AC Measured Dimension
(NOTE: See diagram and related notes on reverse side of preceding page.)

____ inches — Code actual measured value
___ (998) Not applicable
___ (999) Unknown

26. Direction of Axial Movement
___ (1) No displacement
___ (2) Compression (measured dimension greater than original)
___ (3) Intrusion (measured dimension less than original)
___ (4) Displacement, unknown direction
___ (9) Unknown (NOTE: Includes loose column through mounting separation.)

27. AC Axial Movement
(NOTE: Result is rounded to the nearest inch.)

____ inches — Subtract the Question 25 value from the Question 24 value and record the difference
___ (000) No movement, compression, or collapse
Observed Value Code (cannot be measured):
___ (980) Apparent movement, value undetermined
Estimated movement:
___ (981) less than 1 inch
___ (982) between 1 and 2 inches
___ (984) between 2 and 4 inches
___ (986) between 4 and 6 inches
___ (988) between 6 and 8 inches
___ (990) greater than 8 inches
Other Codes:
___ (998) Not applicable, not measurable
___ (999) Unknown

51 52 53

28. Lateral (←→) Column Displacement: Direction
(NOTE: Determined at the steering wheel end.)
___ (1) No displacement
___ (2) Right
___ (3) Left
___ (4) Displacement, unknown direction
___ (9) Unknown (NOTE: Includes loose column through mounting separation.)

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29. Lateral (←→) Column Displacement: Magnitude
(NOTE: See previous note.)
___ (1) No apparent displacement
___ (2) Minor, < 2 inches — Eyeball Guestimate
___ (3) Major, ≥ 2 inches — Eyeball Guestimate
___ (9) Unknown

55

30. Vertical (↕) Column Displacement: Direction
(NOTE: See note on Question 28.)
___ (1) No displacement
___ (2) Up
___ (3) Down
___ (4) Displacement, unknown direction
___ (9) Unknown (NOTE: Includes loose column through mounting separation.)

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31. Vertical (↕) Column Displacement: Magnitude
(NOTE: See note on Question 28.)
___ (1) No apparent displacement
___ (2) Minor, ≤ 2 inches — Eyeball Guestimate
___ (3) Major, > 2 inches — Eyeball Guestimate
___ (9) Unknown

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33. Column Mounting Damage
(NOTE: Does not include shear capsule separation unless by other than normal shear capsule movement.)
(1) No damage
(2) Upper mounting assembly *damaged or distorted* (including bracket)
(3) Lower mounting assembly *damaged or distorted*
(4) Upper and lower mounting assembly *damaged or distorted*
(5) Bracket mounting assembly *damaged or distorted*
(6) Other mounting damage
(9) Unknown damage
*Damage results from twisting, tearing, bending, distorting, etc. to the mounting assembly.

FOUNDATION AND SURROUNDING STRUCTURE DAMAGE

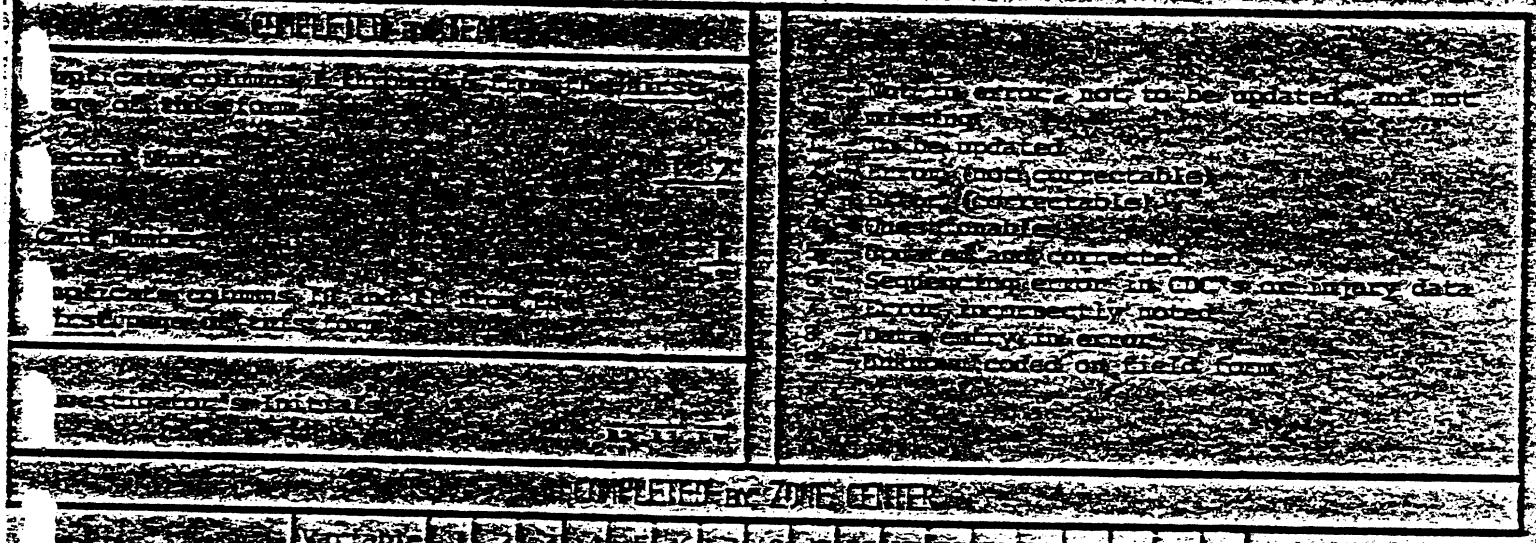
34. Toe Pan Area Damage Near Column
(01) None
(02) Displaced or buckled rearward, or into occupant space
(03) Displaced or buckled forward, or away from occupant space
(08) Combination of above [specify]
(98) Not applicable
(99) Unknown if damaged

34. Instrument Panel Vertical Rotation Near Column
(01) None
(06) Rotated or displaced upwards
(07) Rotated or displaced downwards
(08) Combination of above [specify]
(98) Not applicable
(99) Unknown if damaged

35. Instrument Panel Buckle Near Column
(01) None
(02) Displaced or buckled rearward, or into occupant space
(03) Displaced or buckled forward, or away from occupant space
(04) Displaced left
(05) Displaced right
(08) Combination of above [specify]
(98) Not applicable
(99) Unknown if damaged

36. Bracket Mount Surface of Device Damaged
(NOTE: If bracket mount used.)
(01) None
(02) Displaced or buckled rearward, or into occupant space
(03) Displaced or buckled forward, or away from occupant space
(04) Displaced left
(05) Displaced right
(06) Rotated or displaced upwards
(07) Rotated or displaced downwards
(08) Combination of above [specify]
(98) Not applicable
(99) Unknown if damaged

4/79



Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Response																		
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Variable																		
Response																		

APPENDIX B

NASS
SIDE INTRUSION
FIELD FORM

SIDE INTRUSION FORM

1. Primary Sampling Unit Number — 1 2
2. Case Number — 3 4 5 6
3. Special Study Number — 0 7 4 8
4. Record Number — 3 9
5. Card Number — 1 10
6. Vehicle Number — 11 12

Side Surface Zones
(NOTE: Indicate which component is located in each zone to make up the side surface.)

7. 8. 9. 10. 11. 12.

Front L	Front R	Back L	Back R	Rear L	Rear R	Zone: L=Left, R=Right
						(1) Door
						(2) Panel
						(8) Not an applicable side surface
						(9) Unknown

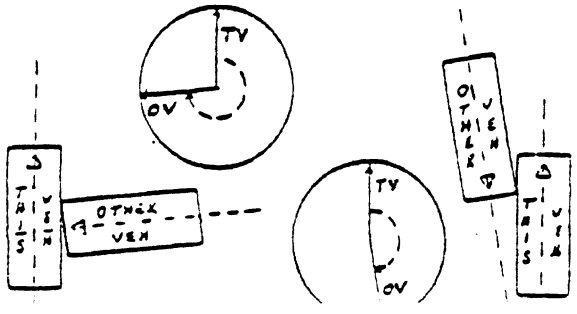
FL	FR	BL	BR	RL	RR
13	14	15	16	17	18

CRUSHING FORCE

13. Angle of Intersecting Longitudinal Axes
(NOTE: Record the forward longitudinal axis of the other vehicle relative to the forward longitudinal axis of this vehicle at the moment of the initial collision between the two. The forward longitudinal axis of the other vehicle is to be measured clockwise from the forward longitudinal axis of this vehicle. This value is equal to the algebraic difference between the heading angles of the two vehicles.)

_____ degrees -- Code to nearest ten degrees.
___(500) Vehicle-object contact
___(999) Unknown

19 20 21



LOWER SIDE SURFACE ASSESSMENT

When To Use This Form: Complete this form whenever an external crushing force has been applied to the side surface of the vehicle as a result of a side contact. The force can be from any direction but must crush the exterior side skin inward.

Photographic Instructions:
[Internal]--Photograph each side surface intrusion. Take at least 2 views, so as to best depict the location and magnitude of the intrusion.
[External]--Photograph each side surface zon where the side surface was contacted by a crushing force. Take at least 2 views, so as to best depict the location and magnitude of the crush.

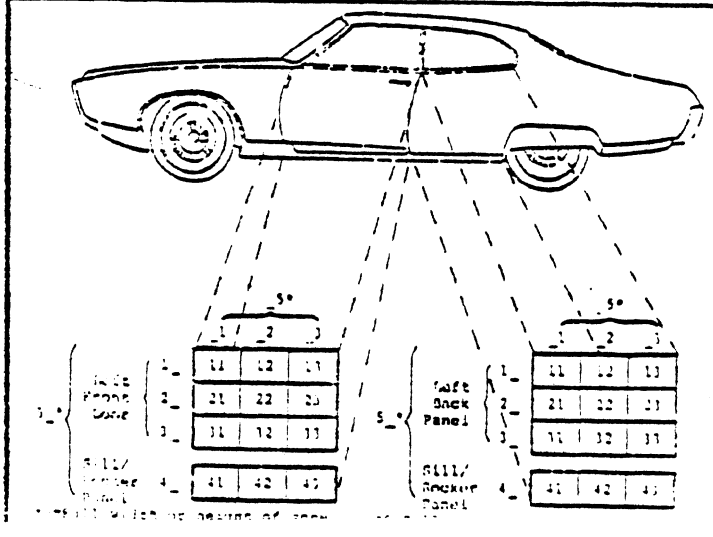
Side Surface Defined: The side surface of the vehicle is defined as the area extending from the A-pillar to the last passenger compartment pillar and from the bottom edge of the door sill/rocker panel (extended) to the belt line. Window glass and upper pillars are not included in this area. The side surface consists of up to three zones (depending upon the vehicle) defined as: (1) front--the areas between the A and B pillars, (2) back--the area between the B and C pillars, and (3) rear--the area between the C and D pillars.

Which Zones Were Contacted by a Crushing Force

14. 15. 16. 17. 18. 19.

Front L	Front R	Back L	Back R	Rear L	Rear R	Zone: Side: L=Left, R=Right
						(1) Contacted
						(2) Not contacted
						(8) Not applicable, not a side surface
						(9) Unknown if contacted

FL	FR	BL	BR	RL	RR
22	23	24	25	26	27



Location of the Center of the Crushing Force in Each Side Zone Contacted

20. 21. 22. 23. 24. 25.

Front L	Front R	Back L	Back R	Rear L	Rear R	Zone: Side: L=Left, R=Right
						(11-43) Center of crush [preceding page]*
						(55) Crush distributed over all of zone [no crush center possible]
						(98) Not applicable, no side surface zone, or not damaged
						(99) Unknown center

* Select from the table on the preceding page the value most representative of the center of crush.

F L	F R	B L	B R	R L	R R
28	29	30	31	32	33	34	35	36	37	38	39

Depth of Crush to Each Zone

26. 27. 28. 29. 30. 31.

Front L	Front R	Back L	Back R	Rear L	Rear R	Zone: Side: L=Left, R=Right
						(1) 0-2 inches
						(2) >2-4 inches
						(3) >4-6 inches
						(4) >6-8 inches
						(5) >8 inches
						(8) Not applicable, no contact or no side surface
						(9) Unknown

FL	FR	BL	BR	RL	RR
40	41	42	43	44	45

COMPONENT DAMAGE

In addition to the damage described above, were any structural/hardware components contacted or damaged? [NOTE: Contact and damage (direct and induced) must result from a direct application of a crushing force to the side surface between the A-pillar and the last pillar of the vehicle.]

Component Damage CODES

(1) Not damaged
(2) Direct damage, no separation*
(3) Direct damage, separation*
(4) Indirect damage, no separation*
(5) Indirect damage, separation*
(8) Not applicable [not equipped]
(9) Unknown
* Separation must be complete.

Structural Contact

32. 33. 34. 35. 36. 37. 38. 39.

Left Side A	Left Side B	Left Side C	Left Side D	Right Side A	Right Side B	Right Side C	Right Side D	Pillar:
								(1)
								(2)
								(3)
								(4)
								(5)
								(8)
								(9)

See Codes Below

LA	LB	LC	LD	RA	RB	RC
46	47	48	49	50	51	52

Component Damage CODES

(1) Not damaged
(2) Direct damage, no separation*
(3) Direct damage, separation*
(4) Indirect damage, no separation*
(5) Indirect damage, separation*
(8) Not applicable [not equipped]
(9) Unknown
* Separation

Left Door Hardware Contact

40. 41. 42. 43. 44. 45.

Latch/Striker F	Latch/Striker B	Hinges F	Hinges B	Sill F	Sill B	Zone:
						(1)
						(2)
						(3)
						(4)
						(5)
						(8)
						(9)

See Codes Above

LF	LB	HF	HB	SF	SB
54	55	56	57	58	59

Right Door Hardware Contact

46. 47. 48. 49. 50. 51.

Latch/Striker F	Latch/Striker B	Hinges F	Hinges B	Sill F	Sill B	Zone:
						(1)
						(2)
						(3)
						(4)
						(5)
						(8)
						(9)

See Codes Above or Adjacent

LF	LB	HF	HB	SF	SB

Column A: Intruding Component Codes for intruded area(s) or component(s).

(01) Window frame
(02) A pillar--upper
(03) A pillar--lower
(04) B pillar--upper
(05) B pillar--lower
(06) C pillar--upper
(07) C pillar--lower
(08) D pillar--upper
(09) D pillar--lower
(10) Door panel or side panel--includes all hardware
97) Other side component--[specify]

98) Not applicable
99) Unknown

Column B: Occupant Space Intruded A two digit code denotes occupant seat space. The first digit (left digit) denotes the seat row, with code values from 1-5. The second digit (right digit) denotes the position on the seat and (in some instances) the width of the seat.

Second Digit Codes:

Seat Type	Code Value
ndividual seat (bucket)	(1) Left, (3) Right
Bench: full width 3 passenger	(1) Left, (2) Center, (3) Right
nch: full width 4 passenger	(1) Left, (2) L. center, (6) R. center, (3) Right
Bench: partial width --left justified	(1) Left, (2) Center, (5) Right + aisle space
nch: partial width --centered	(0) L.+space, (2) Center, (5) R.+space
Cargo area	(4) Entire vehicle width

ample: Passenger Car--5 passengers

11		13	X X
21	22	23	X X X

Example: Van--12 passenger capacity

11			13	X X
21	22	25		X X X
31	32	35		X X X
41	42	46	43	X X X X

Column C: Associated Impact Code relevant impact from the bottom of page 3 of the CS VEHICLE FORM as follows:

(1) Most severe impact [V15]
(2) Secondary impact [V22]
(3) Other recorded impact [i.e., remaining CDC's from top of page 3]
(4) Other impact [not recorded on page 3]
(9) Unknown impact

Column D: Number of Occupant Spaces in Seat Row

(2) Two occupant spaces
(3) Three occupant spaces
(4) Four occupant spaces
(9) Unknown

Column E: Amount of Intrusion
(NOTE: Measured laterally in inches.)

-- Code actual value
(99) Unknown

Column F: Occupant Space Reduction

(1) No reduction
(2) Up to 25 percent
(3) 25 percent to 50 percent
(4) Greater than 50 percent
(9) Unknown reduction

Column G: Contacted by Occupant Number:

(00) No contact
-- Number of the occupant contacting the intrusion--use occupant number from CSS OCCUPANT FORM, page 1, variable 007
(97) Contacted, occupant unknown
(98) Not applicable [vehicle not occupied]
(99) Unknown if contacted

Column H: Associated Injury #1.-CSS Row No
Column I: Associated Injury #2.-CSS Row No
Code the injury (if injured) associated wit the specific intrusion described on this line.

(0) No injury
(1-6) Injury row number as listed at the botto of page 7 of the CSS OCCUPANT FORM
(7) Other [unlisted] injury
(8) Not applicable [vehicle not occupied]
(9) Unknown if injured or unknown injury numbe

INTRUSION

Intrusion Defined: Intrusion results whenever the internal boundary (surface) of the passenger compartment is moved inward due to direct damage resulting from the application of a crushing force as applied to the exterior surfaces of the vehicle.

Internal Side Surface: For the purposes of intrusion, the inner side surface extends from the inner door sill to the top of the upper window frame or top edge of the side glass. The roof rail is NOT included.

52. Did Intrusion of the Internal Side Surface Result from the Side Crushing Force

___(1) Yes
___(2) No] STOP! Complete external
___(9) Unknown] photographs only.

66

53. Was There Catastrophic Intrusion Into the Passenger Compartment by the Side Surface.

___(1) Yes*
___(2) No -- continue!
___(9) Unknown*

* STOP! Complete both internal and external photographs.

67

Zone(s) in which Intrusion(s) Occurred
(NOTE: Zones were specified in Q 7-12.)

54. 55. 56. 57. 58. 59.

Front L	Front R	Back L	Back R	Rear L	Rear R	Zone Side: L=Left, R=Right
___	___	___	___	___	___	(1) Intrusion
___	___	___	___	___	___	(2) No intrusion
___	___	___	___	___	___	(8) Not applicable, no side zone
___	___	___	___	___	___	(9) Unknown

FL	FR	BL	BR	RL	RR
--	--	--	--	--	--

68 69 70 71 72

60. Number of Occupant Spaces in Vehicle

_____ -- Code actual value.
___(99) Unknown

74 75

61. Total Number of Intrusions
(NOTE: This number can be greater than or equal to the number documented below.)

_____ -- Code actual value.
___(99) Unknown

76 77

Code intrusions from left to right, front to rear starting with Occupant Space #11.

Col:	-A- Intruding Component	-B- Occupant Space Intruded	-C- Associated Impact	-D- Number of Occupant Spaces in Seat Row	-E- Intrusion* Amount of Intrusion (inches)	-F- Intrusion* Occupant Space Reduction	-G- Occupant Contact and Injury Contacted by Occupant Number:	-H- Associated Injury #1. CSS Row No	-I- Associated Injury #2 CSS Row N
1	2* 62. 10 11 12	63. 13 14	64. 15	65. 16	66. 17 18	67. 19	68. 20 21	69. 22	70. 23
2	71. 24 25	72. 26 27	73. 28	74. 29	75. 30 31	76. 32	77. 33 34	78. 35	79. 36
3	80. 37 38	81. 39 40	82. 41	83. 42	84. 43 44	85. 45	86. 46 47	87. 48	88. 49
4	89. 50 51	90. 52 53	91. 54	92. 55	93. 56 57	94. 58	95. 59 60	96. 61	97. 62
5	98. 63 64	99. 65 66	100. 67	101. 68	102. 69 70	103. 71	104. 72 73	105. 74	106. 75
6	3* 107. 10 11 12	108. 13 14	109. 15	110. 16	111. 17 18	112. 19	113. 20 21	114. 22	115. 23
7	116. 24 25	117. 26 27	118. 28	119. 29	120. 30 31	121. 32	122. 33 34	123. 35	124. 36
8	125. 37 38	126. 39 40	127. 41	128. 42	129. 43 44	130. 45	131. 46 47	132. 48	133. 49
9	134. 50 51	135. 52 53	136. 54	137. 55	138. 56 57	139. 58	140. 59 60	141. 61	142. 62
10	143. 63 64	144. 65 66	145. 67	146. 68	147. 69 70	148. 71	149. 72 73	150. 74	151. 75
11	4* 152. 10 11 12	153. 13 14	154. 15	155. 16	156. 17 18	157. 19	158. 20 21	159. 22	160. 23
12	161. 24 25	162. 26 27	163. 28	164. 29	165. 30 31	166. 32	167. 33 34	168. 35	169. 36

*Duplicate columns

SIDE INTRUSION STUDY: VEHICLE LOG

COMPLETED BY TEAM

Duplicate columns 1 through 6 from the first age of this form.

Record Number 1 3 (7 8)

Card Number 1 (9)

Duplicate columns 11 and 12 from the first page of this form in col(s) 10 and 11.

Investigator's Initials (12 13 14)

_ - Not in error, not to be updated, and not missing
1 - To be updated
2 - Error (not correctable)
3 - Error (correctable)
4 - Questionable
5 - Updated and corrected
6 - Sequencing error in CDC's or injury data
7 - Error incorrectly noted
8 - Data entry in error
9 - Unknown coded on field form

COMPLETED BY ZONE CENTER

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Response	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)
Variable	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
Response	(44)	(45)	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	(60)	(61)	(62)	(63)	(64)	(65)	(66)	(67)	(68)	(69)	(70)	(71)	(72)
Variable	59	60	61	62	63	64	65	66	**	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Response	(73)	(74)	(75)	(76)	(77)	(78)	(79)	(80)	2 (1)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)
Variable	87	88	89	90	91	92	93	94	95	96	97	98	99	*0	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Response	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)
Variable	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	**	38	39	40	41	42	43
Response	(59)	(60)	(61)	(62)	(63)	(64)	(65)	(66)	(67)	(68)	(69)	(70)	(71)	(72)	(73)	(74)	(75)	(76)	(77)	(78)	(79)	(80)	3 (1)	(10)	(11)	(12)	(13)	(14)	(15)
Variable	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69			
Response	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	—	—	—

** Duplicate columns 1 through 8 and go to card number:

* From this point on the number "1" should precede each of the subsequent variables (e.g., *0=100, 01=101, 02=102, ... 69=169).

APPENDIX C

NASS
ROOF INTRUSION
FIELD FORM

ROOF INTRUSION FORM

1. Primary Sampling Unit Number ___ [1-2]

2. Case Number ___ [3-6]

3. Special Study Number 05 [7-8]

4. Record Number 3 [9]

5. Card Number 1 [10]

6. Vehicle Number ___ [11-12]

ROOF DESCRIPTION

Upper Roof Pillars

7. 8. 9. 10.

Pillars

A B C D

___ ___ ___ ___ (1) Upper pillar present

___ ___ ___ ___ (2) No upper pillar

___ ___ ___ ___ (8) Not applicable

___ ___ ___ ___ (9) Unknown [13-16]

11. Total Number of Roof Areas
(NOTE: See reverse side for roof area designations.)

___(2) Two
___(4) Four
___(6) Six
___(9) Unknown [17]

ROOF ATTACHMENTS

12. Roof Attachments
(NOTE: An asterisk [*] below indicates attachment directly to roof.)

___(1) Lights* (clearance, spot, warning)
___(2) Horn or siren*
___(3) Car top carrier (portable, ski rack, light bar, etc.)
___(4) Roof rack* (permanent--OEM)
___(5) Wind deflector
___(6) Other: _____

___(7) Combination of above--[specify] _____

___(8) Not applicable (no attachments)
___(9) Unknown [18]

ROOF CRASH PERFORMANCE ASSESSMENT

When To Use This Form: This form is to be completed only if the roof has been impacted and has sustained direct damage.

Photographic Instructions: Photograph each roof impacted area from two different perspectives to best portray location and magnitude of roof damage.

13. Roof Material

___(1) Steel
___(2) Fiberglass
___(3) Fabric
___(4) Other: _____

___(5) Combination of above--[specify] _____

___(8) Not applicable (no roof)
___(9) Unknown [19]

14. Roof Options

___(1) None
___(2) Sun roof, skylight
___(3) Convertible (top up)
___(4) T-roof
___(5) Raised roof, pop-up roof (camper)
___(6) Other: _____

___(8) Not applicable (no roof)
___(9) Unknown [20]

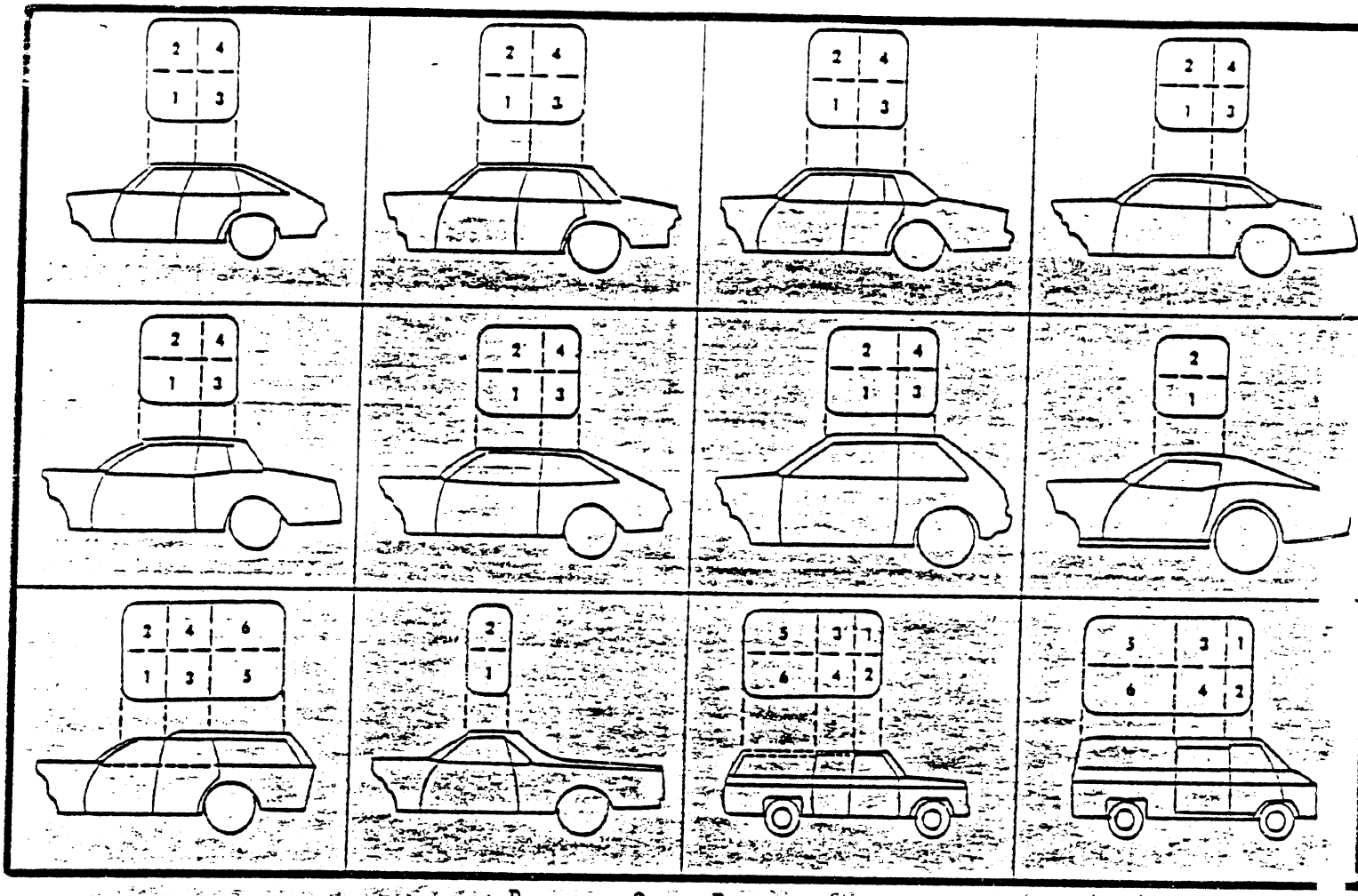
15. Roll Bar Equipped

___(1) None
___(2) External
___(3) Internal
___(4) Roll cage
___(9) Unknown [21]

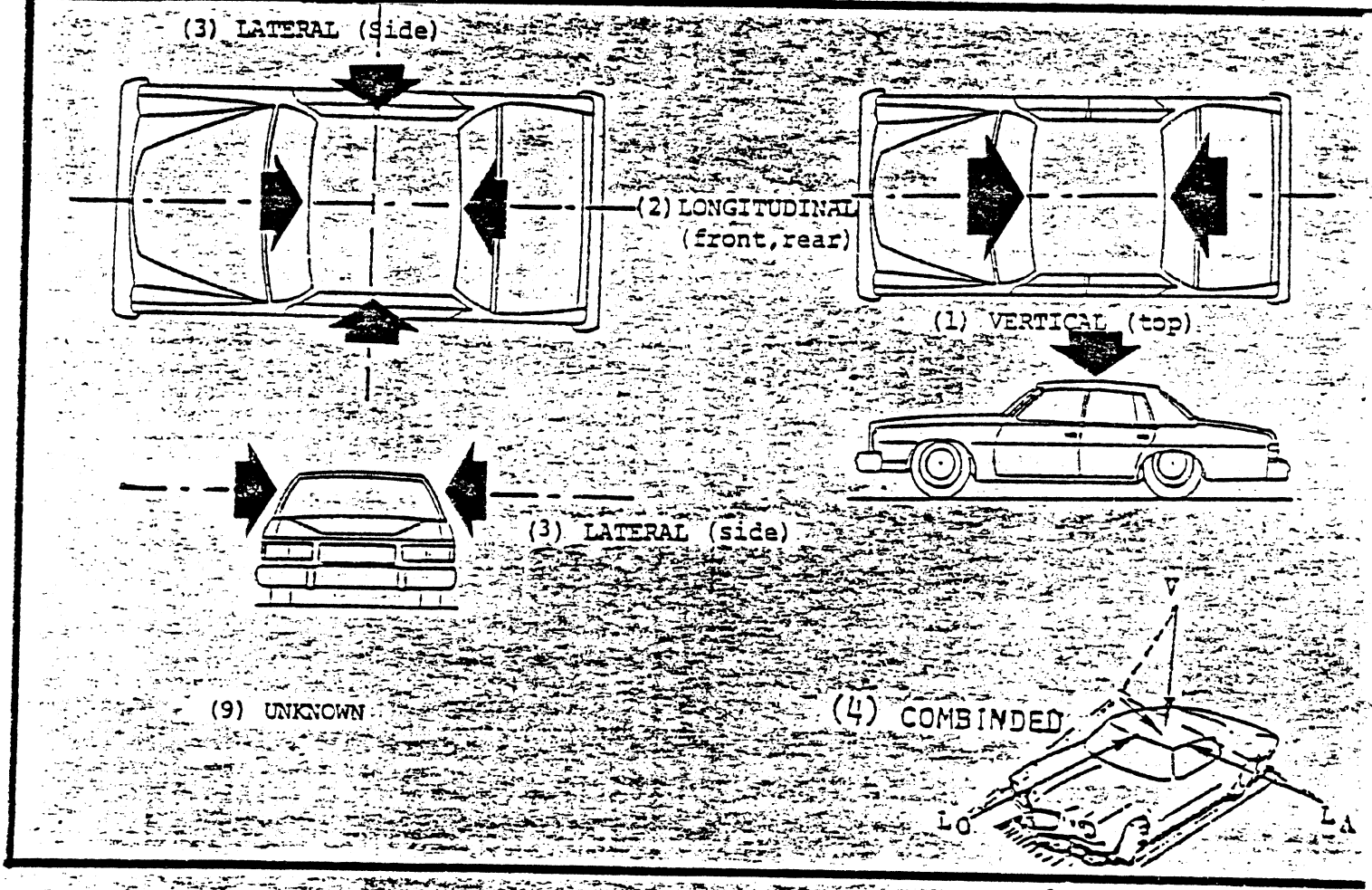
ROOF DEFORMATION AND CRUSH DIRECTION--EXTERIOR

Left Column	Roof Area Damaged	Inward Crush ≥4 Inches	Dominant* Crush Direction
1-One			
2-Two			
3-Three			
4-Four	16. [22]	17. [23]	18. [24]
5-Five			
6-Six			
Center Column	19. [25]	20. [26]	21. [27]
1-Yes			
2-No	22. [28]	23. [29]	24. [30]
8-Not applicable			
9-Unknown			
Right Column	25. [31]	26. [32]	27. [33]
1-Vertical			
2-Longitudinal	28. [34]	29. [35]	30. [36]
3-Lateral			
4-Combination			
9-Unknown	31. [37]	32. [38]	33. [39]

* See figures & diagrams on reverse side.



DOMINANT CRUSH DIRECTION



ROOF AREA INTRUSION--INTERIOR

34. Did Intrusion of the Interior Roof Surface Result from the Roof Deformation

___(1) Yes - continue!
___(2) No } ___ STOP!
___(9) Unknown } ___ STOP!

40

35. Total Number of Intrusions
(NOTE: This number can be greater than or equal to the number documented below.)

___ -- Code actual number.
___(99) Unknown

41 42

COLUMN	-A- Intruding Components	-B- Roof Area Intruded	-C- Occupant Space Intruded	-D- Associated Impact	-E- Intrusion Depth	-F- Occupant Space Reduction	-G- Contacted by Occupant Number:	-H- Associated Injury-CSS Row Number
	36. 43 44	37. 45	38. 46 47	39. 48	40. 49	41. 50	42. 51 52	43. 53
	44. 54 55	45. 56	46. 57 58	47. 59	48. 60	49. 61	50. 62 63	51. 64
Duplicate columns 1 through 9, Go to:	52. 65 66	53. 67	54. 68 69	55. 70	56. 71	57. 72	58. 73 74	59. 75
Card Number 2 10	60. 11 12	61. 13	62. 14 15	63. 16	64. 17	65. 18	66. 19 20	67. 21
	68. 22 23	69. 24	70. 25 26	71. 27	72. 28	73. 29	74. 30 31	75. 32
	76. 33 34	77. 35	78. 36 37	79. 38	80. 39	81. 40	82. 41 42	83. 43

Column A: Intruded Components Codes for intruded area(s) or component(s).

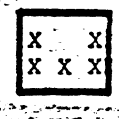
(01) Roof and/or headliner
(02) Windshield header
(03) Door window frame
(04) Roof side rails
(05) Backlight header
(06) Upper A-pillar
(07) Upper B-pillar
(08) Upper C-pillar
(09) Upper D-pillar
(10) Upper side panel (cargo vans, etc.)
(11) Upper back panel (back door surface)
(12) Other component--[specify]

(98) Not applicable
(99) Unknown

Column B: Roof Area Intruded Refer to roof area designations on reverse side of preceding page.

Column C: Occupant Space Intruded A two digit code denotes occupant seat space. The first digit (left digit) denotes the seat row, with code values from 1-5. The second digit (right digit) denotes the position on the seat and (in some instances) the width of the seat.

Example: Passenger Car--5 passengers



Column D: Associated Impact Code relevant impact from the bottom of page 3 of the CSS VEHICLE FORM as follows:

(1) Most severe impact [V15]
(2) Secondary impact [V22]
(3) Other recorded impact [i.e., remaining CDC's from top of page 3]
(4) Other impact [not recorded on page 3]
(9) Unknown impact

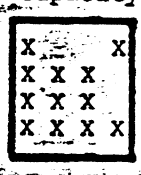
Column E: Intrusion Depth

(1) Inward crush less than 4 inches
(4) Inward crush greater than or equal to 4 inches
(9) Unknown

Second Digit Codes:

Seat Type	Code Value
Individual seat (bucket)	(1) Left, (3) Right
Bench: full width 3 passenger	(1) Left, (2) Center, (3) Right
Bench: full width 4 passenger	(1) Left, (2) L. center, (6) R. center, (3) Right
Bench: partial width --left justified	(1) Left, (2) Center, (5) Right + aisle space
Bench: partial width --centered	(0) L.+space, (2) Center, (5) R.+space
Cargo area	(4) Entire vehicle width

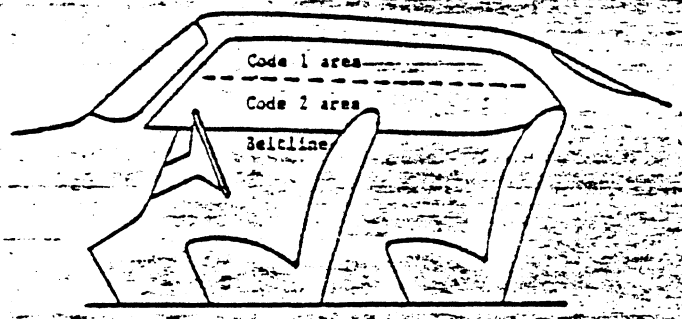
Example: Van--12 passenger capacity



Column F: Occupant Space Reduction Judge the inward intrusion of the interior roof surface with respect to the vehicle's beltline and seatbacks (see diagram)

(1) Less than one-half the distance to the beltline
(2) Greater than or equal to one-half the distance to the beltline
(3) Contact to a level at the beltline or deeper
(8) Not applicable
(9) Unknown

(NOTE: If *in contact with seatback and greater than one-half the distance to the beltline, code 2.*)



Column G: Contacted by Occupant Number:

(00) No contact
-- Number of the occupant contacting the intrusion--use occupant number from CSS OCCUPANT FORM, page 1, variable 007
(97) Contacted, occupant unknown
(98) Not applicable [vehicle not occupied]
(99) Unknown if contacted

Column H: Associated Injury-CSS Row Number Code the injury (if injured) associated wit the specific intrusion described on this line.

(0) No injury
(1-6) Injury row number as listed at the botto of page 7 of the CSS OCCUPANT FORM
(7) Other [unlisted] injury
(8) Not applicable [vehicle not occupied]
(9) Unknown if injured or unknown injury numbe

NATIONAL ACCIDENT SAMPLING SYSTEM — SPECIAL STUDIES SUBSY

ROOF INTRUSION STUDY: VEHICLE LOG

COMPLETED BY TEAM

Duplicate columns 1 through 6 from the first page of this form.

Record Number (7–8): 14

Card Number (9): 1

Duplicate columns 11 and 12 from the first page of this form in col(s) 10 and 11.

Investigator's Initials (12–14):

- = Not in error, not to be updated, and nc missing
1 = To be updated
2 = Error (not correctable)
3 = Error (correctable)
4 = Questionable
5 = Updated and corrected
6 = Sequencing error in CDC's or injury data
7 = Error incorrectly noted
8 = Data entry in error
9 = Unknown coded on field form

COMPLETED BY ZONE CENTER

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Response (15–42)																												
Variable	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Response (43–70)																												
Variable	57	58	59	60	61	62	63	64	65	66	**	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83
Response (71–26)											2																	

** Duplicate columns 1 through 8 and go to card number: