

National Accident Sampling System

Special Studies Number Five

Roof Intrusion

Users' Guide
and
Coding Manual

Peter Cooley

Highway Safety Research Institute
The University of Michigan
Ann Arbor, Michigan 48109

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16. Abstract This Users' Guide describes the National Accident Sampling System (NASS) Special Studies data collection project number five: Roof Intrusion. It is for use by NASS accident investigators, data editors, and data coders. It describes correct entries to be made in the Roof Intrusion field data form when examining vehicles which have sustained direct roof damage when involved in a rollover crash.			
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ROOF INTRUSION

Purpose

The purpose of this Special Study is to gather data relative to vehicle roof performance in rollover crashes.

Vehicle Roof Defined

The vehicle roof is 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). In addition to the roof, this Special Study also includes attachments to the roof such as luggage racks, special lights, etc.

Organization of the Data Form

The data form is organized into three (3) general areas. These are (1) identification of roof type, roof material and attachments to the roof; (2) estimating area of the exterior roof deformed from impact, severity of deformation, and direction of force resulting in deformation; and (3) noting interior occupant space intruded, interior intrusion penetration and occupant space reduction, with any injuries to occupants.

Investigator responses to questions in these areas are entered on each of the two pages constituting this data form. The reverse sides of the two pages contain vehicle roof diagrams and tabular descriptive data to assist the investigator in choosing the proper variable in response to questions on the front sides.

CASE SELECTION

The basic case selection criteria are the same for this study as for the NASS Vehicle Selection.

This special study is to be completed whenever vehicle has met the initial NASS sample selection, was a towaway, and the roof impacted, with resulting direct damage.

Any variation or additional criteria which affect individual PSU's or the above-described case selection will be provided by NHTSA.

Additional Documentation--Photographic

The data form is designed to be a response-only data form with no additional drawing or sketching required.

To facilitate a complete understanding of the damage pattern, take at least two photographs of the exterior areas of roof and resulting interior areas of roof intrusion, so as to best depict the location and magnitude of the damage. These photographs should be taken from two different perspectives.

Supplemental Information

Additional notes, supplemental drawings, etc., are extremely valuable in understanding unusual situations. Such notation should be placed on the data form or supplemental paper as necessary. Extra pictures, brief descriptions, etc., are encouraged and should be included in the Special Studies documentation.

VARIABLE CODING AND DESCRIPTION

VARIABLE GROUP: Form Identification

VARIABLE NAME: 1-6. Form Header and Case Identification

FORMAT: 12 columns, numeric, beginning column 1*

ELEMENT VALUES: 1 Primary Sampling Unit Number
2 Case Number
3 Special Study Number
4 Record Number
5 Card Number
6 Vehicle Number

SOURCE: Vehicle forms

REMARKS: This information is obtained from the VEHICLE FORM.

*See data form for layout.

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, which is the most forward pillar in the vehicle, are noted so as to more accurately determine vehicle roof area types. Note that only station wagons, carry-alls, and vans contain D-pillars with six (6) definable roof sections. All others have only 4 or fewer roof areas.

A sequence of twelve (12) vehicle side views, with corresponding roof (plan) views of roofs for typical vehicles, is presented on the reverse side of data form page 1 under the heading ROOF AREA DESIGNATION.

VARIABLE GROUP: Roof Description

VARIABLE NAME: 11. Total Number of Roof Areas

FORMAT: 1 column, numeric, beginning column 17

ELEMENT VALUES: 2 Two
4 Four
6 Six
9 Unknown

SOURCE: Inspection

REMARKS: Total vehicle roof area is subdivided into two (2), four (4), or six (6) sections, as indicated by the number of roof pillars. Vehicle roof area, and the number of upper pillars supporting that roof area, is necessary to evaluate the performance of roofs in rollover crashes.

A sequence of twelve (12) vehicle side views, with corresponding roof (plan) views of roofs for typical vehicles, is presented on the reverse side of data form page 1 under the heading ROOF AREA DESIGNATION.

VARIABLE GROUP: Roof Attachments

VARIABLE NAME: 12. Roof Attachments

FORMAT: 1 column, numeric, beginning column 18

ELEMENT VALUES: 1 Lights
2 Horn or Siren
3 Car Top Carrier
4 Roof Rack
5 Wind Deflector
6 Other: _____
7 Combination of Above
8 Not Applicable
9 Unknown

SOURCE: Inspection

REMARKS: Attachments to the vehicle roof can affect roof crash performance.

VARIABLE GROUP: Roof Crash Performance Assessment

VARIABLE NAME: 13. Roof Material

FORMAT: 1 column, numeric, beginning column 19

ELEMENT VALUES: 1 Steel
2 Fiberglass
3 Fabric
4 Other: _____

SOURCE: Inspection

REMARKS: Vehicle roofs fabricated with various roof materials will perform differently in crashes. Roofs fabricated with materials other than steel, fiberglass, and fabric should be described with variable 4, Other.

VARIABLE GROUP: Roof Crash Performance Assessment

VARIABLE NAME: 14. Roof Options

FORMAT: 1 column, numeric, beginning column 20

ELEMENT VALUES: 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

SOURCE: Inspection

REMARKS: Optional roof designs that deviate from the conventional continuous, one-piece roof structure will affect how the roof performs in a crash. Roof options other than those listed for element values 1, 2, 3, 4, and 5 should be described for element value 6. Where no roof exists for the vehicle, i.e., a convertible with the top down, element value 9, Unknown, should be indicated.

VARIABLE GROUP: Roof Crash Performance Assessment

VARIABLE NAME: 15. Roll Bar Equipped

FORMAT: 1 column, numeric, beginning column 21

ELEMENT VALUES: 1 None
2 External
3 Internal
4 Roll Cage
9 Unknown

SOURCE: Inspection

REMARKS: Vehicles equipped with roll bars will evidence roof crash performance much different than vehicles not equipped with roll bars. Where a roll bar is attached for cosmetic purposes, and does not provide the type of structural strength comparable to roll bars with structural integrity, it should be noted and a description provided of the cosmetic roll bar. Element values 2, External, or 3, Internal, should also be selected, depending upon whether the cosmetic roll bar was internal or external to the vehicle.

Roof
Intrusion
Variables 16,
19,22,25,28,
31

VARIABLE GROUP: Roof Deformation and Crush Direction - Exterior

VARIABLE NAME: 16, 19, 22, 25, 28, 31. Roof Area Damaged

FORMAT: 1 column, numeric, beginning column 22

ELEMENT VALUES: 1 One
2 Two
3 Three
4 Four
5 Five
6 Six

SOURCE: Inspection

REMARKS: A listing for up to six (6) roof areas sustaining direct damage in a crash is provided. Noting exterior roof damage consistent with the roof area designations shown on the reverse side of page 1 of the data form will identify damaged roof areas of the vehicle. Where roof damage occurs at more than one place within a single roof area, that area will be noted once. Roof area damage should be listed in descending order of decreasing damage severity.

VARIABLE GROUP: Roof Deformation and Crush Direction - Exterior

VARIABLE NAME: 17, 20, 23, 26, 29, 32. Inward Crush \geq 4 Inches

FORMAT: 1 column, numeric, beginning column 23

ELEMENT VALUES: 1 Yes
2 No
8 Not Applicable
9 Unknown

REMARKS: A threshold of 4 inches of inward exterior roof crush has been selected for classifying external damage into two severity categories. While this threshold is somewhat arbitrary it does represent a threshold of damage severity believed significant in separating minor-to-moderate damage from moderate-to-severe damage. The ability to subset exterior roof crush into these two categories will permit the analyst to better correlate the effects of exterior damage with interior effects (occupant space reduction, occupant injury, etc.).

Up to six (17, 20, 23, 26, 29, 32) variables are provided. These should correlate directly with entries given in the six (16, 19, 22, 25, 28, 31) variables for roof areas damaged. Where roof damage \geq 4 inches, or $<$ 4 inches, occurs at more than one place within a roof area, that area will be noted once.

Roof
Intrusion
Variables 18,
21,24,27,30,
33

VARIABLE GROUP: Roof Deformation and Crush Direction - Exterior

VARIABLE NAME: 18, 21, 24, 27, 30, 33. Dominant Crush Direction

FORMAT: 1 column, numeric, beginning column 24

ELEMENT VALUES: 1 Vertical
2 Longitudinal
3 Lateral
4 Combination
9 Unknown

SOURCE: Inspection

REMARKS: The dominant direction of crush to the roof will permit a more thorough assessment of roof performance relative to objects on surfaces impacted, and how they were impacted. It can also assist in reconstructing vehicle kinematics during rollover.

Up to six (18, 21, 24, 27, 30, 33) variables are provided. These should correlate directly with the interior given in the six (22, 25, 28, 31, 34, 37) variables for roof areas damaged, and the six (17, 20, 23, 26, 29, 32) variables for inward crush \geq 4 inches. Schematics of the different directions for dominant crush direction are given on the reverse side of page 1 of the data form. Where crush direction is best described by any combination of (1) Vertical, (2) Longitudinal, (3) Lateral directions, element value (4) Combination, should be selected.

VARIABLE GROUP: Roof Area Intrusion - Interior

VARIABLE NAME: 34. Did Intrusion of the Interior Roof Surface Result From
the Roof Deformation

FORMAT: 1 column, numeric, beginning column 40

ELEMENT VALUES: 1 Yes
2 No
9 Unknown

SOURCE: Inspection

REMARKS: Where no internal intrusion of the roof results from exterior direct
damage, stop completion of the data form. This variable is included to pro-
vide for terminating completion of the data form when no internal intrusion
exists.

VARIABLE GROUP: Roof Area Intrusion - Interior

VARIABLE NAME: 35. Total number of Intrusions

FORMAT: 2 columns, numeric, beginning column 41

ELEMENT VALUES: __ __ Code the actual number
(99) Unknown

SOURCE: Inspection

REMARKS: Note here the total number of interior roof intrusions that can be visually observed.

Roof
Intrusion
Variables 36,
44,52,60,68,
76

VARIABLE GROUP: Roof Area Intrusion - Interior

VARIABLE NAME: 36, 44, 52, 60, 68, 76. Column A - Intruding Components

FORMAT: 2 columns, numeric, beginning column 43

ELEMENT VALUES: 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 Components -- (Specify): _____
98 Not Applicable
99 Unknown

SOURCE: Inspection

REMARKS: Components that can be identified as intruding into the interior, as well as those that cannot be identified, are listed in the six (36, 44, 52, 60, 68, 76) variables provided. Element value (12) should be noted with accompanying identification of intruding component(s) not provided for in the listing of elements. Element 98, Unknown, should be noted only where interior intrusion is unknown as noted by element (9) in variable 34.

Roof
Intrusion
Variables 37,
45,53,61,69,
77

VARIABLE GROUP: Roof Area Intrusion - Interior

VARIABLE NAME: 37, 45, 53, 61, 69, 77. Column B - Roof Area Intruded

FORMAT: 1 column, numeric, beginning column 45

ELEMENT VALUES: Refer to roof area designations on the reverse side of page 1 of the data form. Up to six (6) roof areas may be designated, depending on the type of vehicle.

SOURCE: Inspection

REMARKS: Exterior roof area designations must be noted and directly correlated with the intruding components listed in variables 37, 45, 53, 61, 69, 77.

Roof
Intrusion
Variables 38,
46,54,62,70,
78

VARIABLE GROUP: Roof Area Intrusion - Interior

VARIABLE NAME: 38, 46, 59, 62, 70, 78. Column C - Occupant Space Intruded

FORMAT: 2 columns, numeric, beginning column 46

ELEMENT VALUES: A two-digit code denotes occupant seat space. The first digit, or 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.

SOURCE: Inspection

REMARKS: Examples for application of the occupant space intruded code are given at the bottom of page 2 of the data form. It also includes an extensive listing of the type of seat for various vehicles and the correct code value for such seat configurations.

Entries for these variables (38, 46, 54, 62, 70, 78) should be directly correlated with the Intruding Components in Column A and the Roof Area.

Designations for the various seat configurations found in most vehicles are shown in Column B.

Roof
Intrusion
Variables 39,
46,54,62,70,
78

VARIABLE GROUP: Roof Area Intrusion - Interior

VARIABLE NAME: 39, 47, 55, 63, 71, 79. Column D - Associated Impact

FORMAT: 1 column, numeric, beginning column 49

ELEMENT VALUES: 1 Most Severe Impact (V15)
2 Secondary Impact (V22)
3 Other Recorded Impact (i.e., remaining CDC's from top of
page 3 of VEHICLE FORM)
4 Other Impact (not recorded on page 3 of the VEHICLE FORM)
9 Unknown Impact

SOURCE: Relevant impacts are obtained in their coded form from the bottom of
page 3 of the VEHICLE FORM

REMARKS: The impact code value for this variable, obtained from the VEHICLE
FORM, provides for the association of the impact noted on page 3 of the
VEHICLE FORM with the intrusion listed in this variable group.

Roof
Intrusion
Variables 40,
48,56,64,72,
80

VARIABLE GROUP: Roof Area Intrusion - Interior

VARIABLE NAME: 40, 48, 56, 64, 72, 80. Column E - Intrusion Depth

FORMAT: 1 column, numeric, beginning column 49

ELEMENT VALUES: 1 Inward Crush Less Than 4 Inches
2 Inward Crush Greater Than or Equal to 4 Inches
9 Unknown

SOURCE: Inspection and measurement

REMARKS: A threshold of 4 inches of inward interior roof crush has been selected for classifying into two severity categories. While this threshold is somewhat arbitrary, it does represent a threshold of damage severity believed significant in separating minor-to-moderate damage from moderate-to-severe damage. The ability to subset interior roof crush into these two categories will permit the analyst to better correlate the effects of interior roof damage with interior effects (occupant space reduction, occupant injury, etc.)

Up to six (40, 48, 56, 64, 72, 80) variables are provided. These should correlate directly with similar entries in Column A, Intruding Components; Column B, Roof Area Intruded; Column C, Occupant Space Intruded; and Column D, Associated Impact. Where roof damage \geq 4 inches, or $<$ 4 inches, occurs at more than one place within a roof area, that area will be noted once.

Roof
Intrusion
Variables 41,
49,57,65,73,
81

VARIABLE GROUP: Roof Area Intrusion - Interior

VARIABLE NAME: 41, 49, 57, 65, 73, 81. Column F - Occupant Space Reduction

FORMAT: 1 column, numeric, beginning column 50

ELEMENT VALUES: 1 Less than 1/2 the Distance to the Beltline
2 Greater Than, or Equal to, 1/2 the Distance to the Beltline
3 Contact to a Level at the Beltline or Deeper
8 Not Applicable
9 Unknown

SOURCE: Inspection

REMARKS: Roof inward penetration is estimated with respect to its original undamaged location and the beltline of the vehicle. A diagram is given on the reverse side of page 2 of the data form with a side profile view of a vehicle indicating zones between the roof line and beltline.

If inward penetration of the roof is down to the seatbacks, code value 2, Greater Than 1/2 Distance to Beltline, is selected. Up to six (41, 49, 57, 65, 73, 81) variables are provided. These should correlate directly with similar entries in Column A, Intruding Components; Column B, Roof Area Intruded; Column C, Occupant Space Intruded; Column D, Associated Impact; and Column E, Intrusion Depth.

Roof
Intrusion
Variables 42,
50,58,66,74,
82

VARIABLE GROUP: Roof Area Intrusion - Interior

VARIABLE NAME: 42, 50, 58, 66, 74, 82. Contacted by Occupant Number

FORMAT: 2 columns, numeric, beginning column 53

ELEMENT VALUES: 00 No contact

— — Number of the occupant contacting the intrusion. The occupant number associated with this contact is obtained from the CSS OCCUPANT FORM, Page 1, variable 007.

97 Contacted, Occupant Unknown

98 Not Applicable (vehicle not occupied)

99 Unknown

SOURCE: Inspection, with referce to CSS OCCUPANT FORM

REMARKS: Injured occupants of the vehicle must be associated with roof intrusion when such intrusion is relevant to their injury. Injury description and classification will exist on page 1, of the CSS OCCUPANT FORM. The occupant number is obtained from this form for entry in this column, Column G.

Up to six (42, 50, 58, 66, 74, 82) variables are provided. These should correlate directly with similar entries in Column A, Intruding Components; Column B, Roof Area Intruded; Column C, Occupant Space Intruded; Column D, Associated Impact; Column E, Intrusion Depth; and Column F, Occupant Space Reduction.

Roof
Intrusion
Variables 43,
51,59,67,75,
83

VARIABLE GROUP: Roof Area Intrusion - Interior

VARIABLE NAME: 43, 51, 59, 67, 75, 83. Associated Injury - CSS Row Number

FORMAT: 1 column, numeric, beginning column 53

ELEMENT VALUES: 0 No Injury
1-6 Injury row 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

SOURCE: CSS OCCUPANT FORM, Page 7

REMARKS: An injury received by an occupant from roof intrusion must not be entered into a data file more than once. By recording the injury associated with the intrusion from the CSS OCCUPANT FORM, page 7 in Column H, this eliminates the possibility of double counting. It also provides a mechanism for correlating injuries directly with the intruding components, occupant space intruded, and associated impact. All injuries sustained by an occupant from intrusion must be listed on page 7 of the CSS OCCUPANT FORM.

Up to six (43, 51, 59, 67, 75, 83) variables are provided. These should correlate directly with similar entries in Column A, Intruding Components; Column B, Roof Area Intruded; Column C, Occupant Space Intruded; Column D, Associated Impact; Column E, Intrusion Depth; Column F, Occupant Space Reduction; and Column G, Contacted by Occupant Number.