

Collision Deformation Classification

RATIONALE

Five-Year Review of this document. Updated for current industry nomenclature, formatting, and clarification.

1. SCOPE

The purpose and scope of this SAE Recommended Practice is to provide a basis for classification of the extent of vehicle deformation caused by vehicle accidents on the highway. It is necessary to classify collision contact deformation (as opposed to induced deformation) so that the accident deformation may be segregated into rather narrow limits. Studies of collision deformation can then be performed on one or many data banks with assurance that the data under study are of essentially the same type.¹

The seven-character code is also an expression useful to persons engaged in automobile safety, to describe appropriately a field-damaged vehicle with conciseness in their oral and written communications. Although this classification system was established primarily for use by professional teams investigating accidents in depth, other groups may also find it useful.

The classification system consists of seven characters, three numeric, and four alphameric, arranged in a specific order. The characters describe the deformation detail concerning the direction, location, size of the area, and extent which, combined together, form a descriptive composite of the vehicle damage. The individual character positions are referred to by column number for identification and computer storage compatibility as illustrated in Figure 1. The definition of each classification is provided in subsequent sections. An appendix is also provided to assist in application and interpretation.

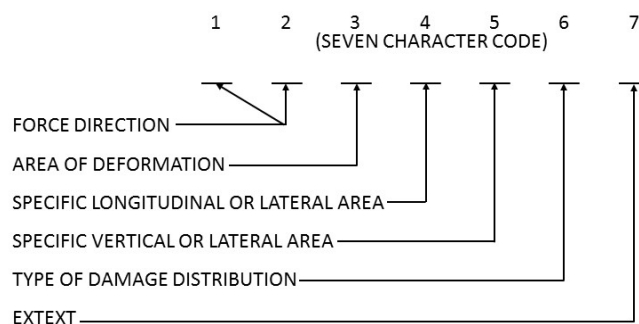


Figure 1

¹ Stonex, K., Nelson, W., Siegel, A., Garrett, J., et al., "Collision Damage Severity Scale," SAE Technical Paper 700136, 1970, doi:10.4271/700136.

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Documents

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2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

Stonex, K., Nelson, W., Siegel, A., Garrett, J., et al., "Collision Damage Severity Scale," SAE Technical Paper 700136, 1970, doi:10.4271/700136.

Hendricks, D., "Collision Deformation Classification for Trucks," SAE Technical Paper 810215, 1981, doi:10.4271/810215.

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 Other Publications

Hendricks, D.L., "Collision Deformation Classification Training Program: Intermediate Level Training/Reference Module." Calspan Field Service, Inc., NHTSA DOT HS-806-061, July 1981.

3. CLASSIFICATION OF COLLISION DAMAGE

Vehicle collision damage is classified in a three-dimensional system. Column 3 defines an orthogonal set of axes for columns 4, 5, and 7 (see Appendix A). Columns 1, 2, and 6 provide additional description. Individual character positions are defined as follows:

3.1 Columns 1 and 2 - Direction of Principal Force During Impact

The principal force is the force that caused the crush and sheet metal displacement on the damaged vehicle. The direction of the principal force is determined by the resultant of forces acting on the vehicle (that is, vector analysis) at the point of application. The direction of the principal force is designated by reference to hour sectors on a conventional clockface, positioned over the point of application.

The clockface is assumed to be in a plane referenced to the horizontal plane of the car. Twelve o'clock characterizes the direction of an oncoming force relative to the vehicle applied at the frontal area of vehicle deformation. Other examples of clock positions, such as 3, 6, and 9 o'clock, refer to forces directed from the right, rear, and left, respectively. The code classifications are the hour numerals from 01 to 12. Columns 1 and 2 of the classification system are used for direction of principal force (see Figure 2). The entry of 00 indicates that the impact is not horizontal, as in a rollover or undercarriage type impact.

Table 1

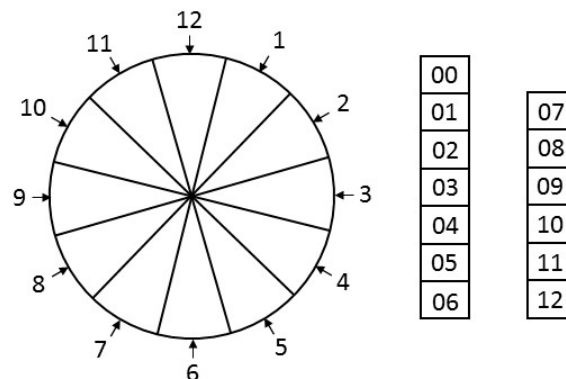
Direction of End Shift	Classification	Basic Rule ²
No shift of Damaged Area	01-12	Add 0
Vertical-Up	21-32	Add 20
Vertical-Down	41-52	Add 40
Lateral-Right	61-72	Add 60
Lateral-Left	81-92	Add 80

The direction of principal force classification is incremented to indicate vertical or lateral shifting of vehicle basic end structures which occurs during horizontal force applications. The shifting must be 4 inches (100 mm) or greater to be classified, and is not related to the extent of crush (see Appendix A). Specific increments related to direction of shift are shown in Table 1.

Codes are also provided to indicate longitudinal or lateral shifting of the top structure as a result of non-horizontal force applications (that is, 00 direction of force) to the top. Shifting should be classified when visually apparent. Specific classifications related to direction of shifting are shown in Table 2.

3.2 Column 3 - Deformation Location and Classification Code

This character of a classification expression broadly defines which projected area of the vehicle contains the deformation (see Figure 3). The windshield is included in the F projected area and the backlight is included in the B projected area. The U (undercarriage) character is defined as the bottom plane of the vehicle, including all projections, but excluding the tires and wheels. Impacts involving only the tires or wheels are classified, F, L, R, or B as determined by the projected area of initial contact (W must be entered in column 5 for these impacts).

**Figure 2****Table 2**

Direction of Top Shift	Classification
No Shift	00
Forward	20
Rearward	40
Lateral-Right	60
Lateral-Left	80

² Specific increment added to horizontal resultant direction of force (see Appendix A).

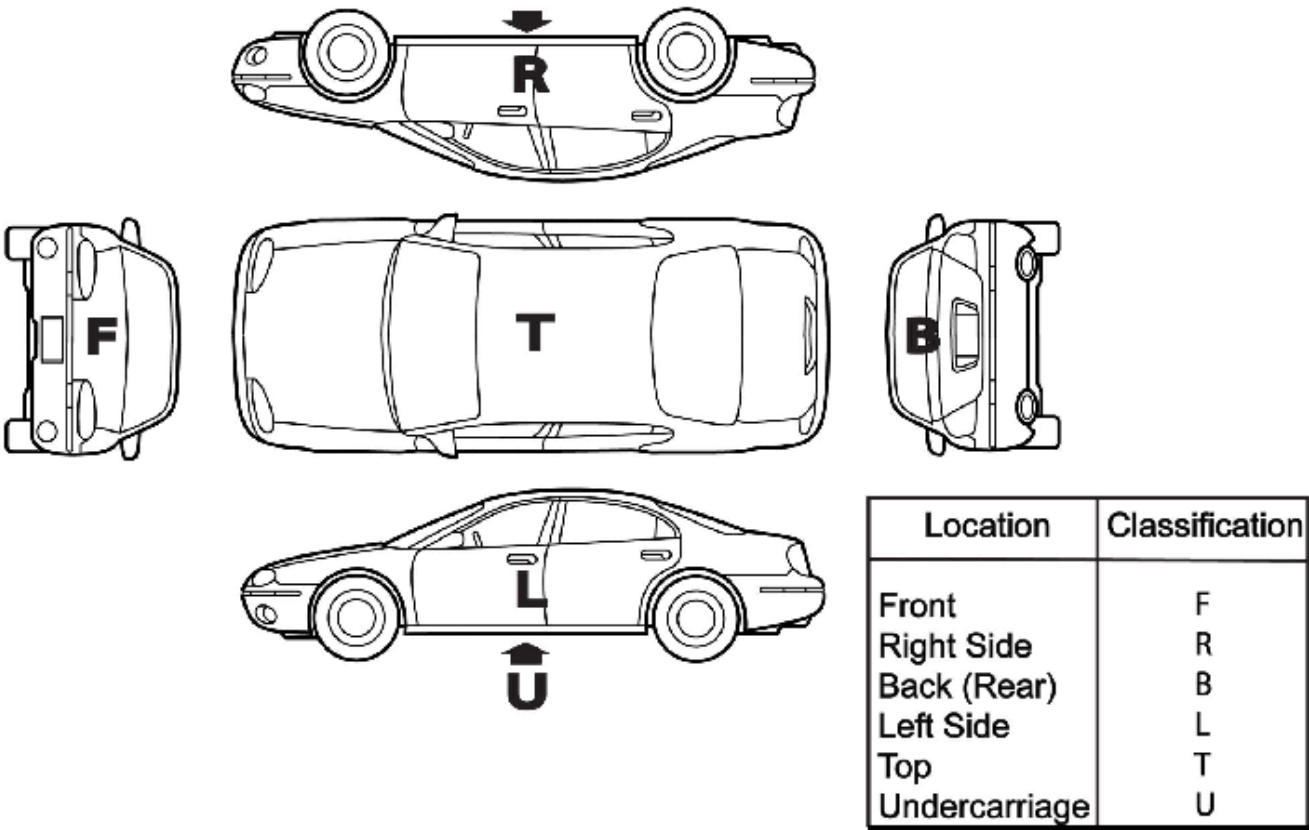


Figure 3

3.3 Column 4 - Specific Longitudinal or Lateral Location of Deformation and Classification Code

The plan view of the vehicle (Figure 4) illustrates the horizontal areas to be used in locating the deformation for F, B, R, or L in column 3. The letters shown at the front and rear of the vehicle can be for either the front or the rear. The letters shown on both sides can be used for either side. Classification codes for this column are orthogonal to either the longitudinal or lateral axis of the vehicle. Variations in vehicles require special definitions for the classification code P. P is defined as follows:

- a. Passenger cars—from the base of windshield to the rear of the rearmost seat.
- b. SUVs/crossovers/station wagons—from the base of windshield to the rear of the rearmost seat.
- c. Vans—from the front seat backrest to the center of the rear wheel.
- d. Pickups—from the base of windshield to the rear of the cab.
- e. Soft top jeeps—from the base of windshield to the center of the rear wheel.

F and B are side deformation areas forward and rearward of P, respectively. Column 4 has meaning only in connection with column 3; that is, it is a suffix of column 3, rather than being independent of it. This column also locates the longitudinal area of damage for vehicles with top or undercarriage deformation (T or U in column 3).

The classifications F, P, B, Y, Z, and D must be used in column 4 for vehicles with top or undercarriage deformation (T or U in column 3).

3.4 Column 5 - Specific Vertical or Lateral Location of Deformation and Classification Code

Figure 5A illustrates the classifications for the vertical location of deformations associated with impacts classified F, B, L, or R in column 3. Figure 5B illustrates the classifications for the lateral location of deformations associated with impacts classified as T or U in column 3.

3.5 Column 6 - General Type of Damage Distribution and Classification Code

Definition of the classifications is shown in Table 3 :

Table 3

Type	Classification
Wide Impact Area	W
Narrow Impact Area	N
Sideswipe	S
Rollover (Includes Rolling onto Side)	O
Overhanging Structures (Inverted Step)	A
Corner (Extends from Corner to ≤ 16 inches [410 mm])	E
Conversion in Impact Type (Requires Multiple CDC)	K
No Residual Deformation	U

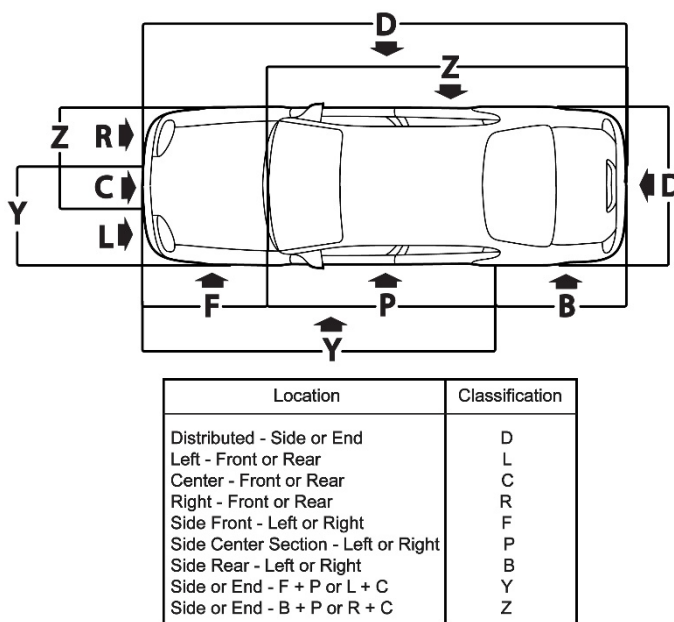
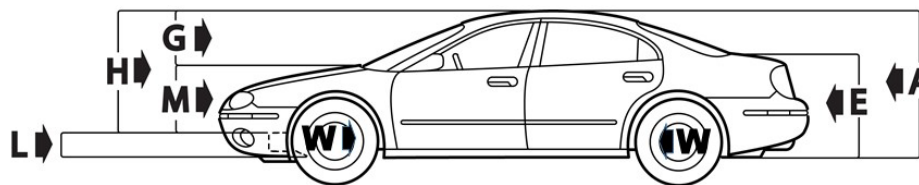
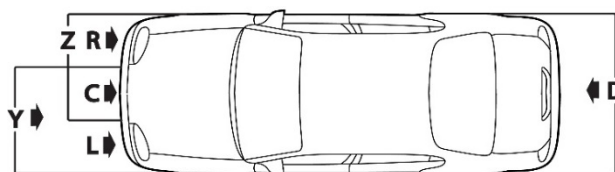


Figure 4



Vehicle Locations - Front, Rear or Side Impacts	Classifications
All	A
Top of Frame Top of Vehicle	H
Everything Below Belt Line	E
Belt Line and Above	G
Middle - Top of Frame to Belt Line or Hood	M
Frame - Top of Frame, Bottom of Frame (Incl. Undercarriage)	L
Below Undercarriage Level (Wheels and Tires Only)	W

Figure 5A



Lateral Location - Top and Undercarriage Impacts	Classification
Distributed	D
Left	L
Center	C
Right	R
L and C	Y
R and C	Z

Figure 5B

S is used to classify these types of damage:

- An impact which overlaps the corner of a vehicle by 4 inches or less and then swipes along the surface parallel to the direction of travel;
- A classical sideswipe; and
- A classical endswipe.

A is used to classify impacts where the vehicle deformation resulted from an overhanging structure shaped like an inverted step in which the vertical surfaces are at least 30 inches (760 mm) apart. Both vertical surfaces of the inverted step must have contributed to the direct damage. The resultant damage patterns do not have to occur simultaneously, but must be caused by the same struck object. An example of this circumstance is underriding the rear of some large trucks.

K is used to classify impacts where a vehicle deformation pattern sustained during a single continuous impact sequence resembles two distinct impact types (that is, front and side). Use of the character is limited to those deformation patterns where an initial wide contact area (W) converts to another impact type (generally sideswipe). For these deformation patterns, character K is substituted for W and a second collision deformation classification (CDC) is required to describe the remaining damage (see Appendix A).

U is used to classify impacts where no residual deformation of the vehicle is noted. An extent code of 1 in column 7 must be used with this character.

The use of S, O, A, E, K, and U takes precedence over N and W. W and N are used to distinguish between large and small areas of deformation which do not fall into one of the other six categories. If an area is less than 16 inches (410 mm) wide, or less than 6 inches (150 mm) high, N is the appropriate classification. For small rectangular or circular areas of deformation, if the perimeter is less than the perimeter of 64 inches (1616 mm), use the N; otherwise, use W.

3.6 Column 7 - Deformation Extent

The extent of residual deformation is classified using a nine-zone extent system as shown in Figures 6, 7, 8, and 9. Figures 6, 7, 8, and 9 are illustrative of passenger cars, SUVs/crossovers/station wagons, vans, and pick-ups, respectively. Extent zones are applied to front, rear, side, top, or undercarriage deformation, and should be selected so that they are compatible with the principal damage selection in column 3.

To achieve uniformity, the deformation extent zones have been established in relation to specific points on the vehicle.

If the passenger compartment is involved in the top damage, then the extent number should reflect the extent of damage to the passenger compartment. This is true even if the hood or deck lid are involved.

If the distance from the rearmost point of the vehicle to the top of the rear window (backlight) is greater than the distance from the top of the rear window to the front door latch pillar (start of zone 9), then use the passenger car deformation rear extent zone guide for classifying rear deformation. Other vehicles are classified using the rear extent guide for SUVs/crossovers/station wagons and vans.

The extent number should not be used as a tool for determining the collision severity or energy required to duplicate the damage. For vehicles of the same basic type, it does serve as a tool for gathering together vehicles which have similar damage characteristics.

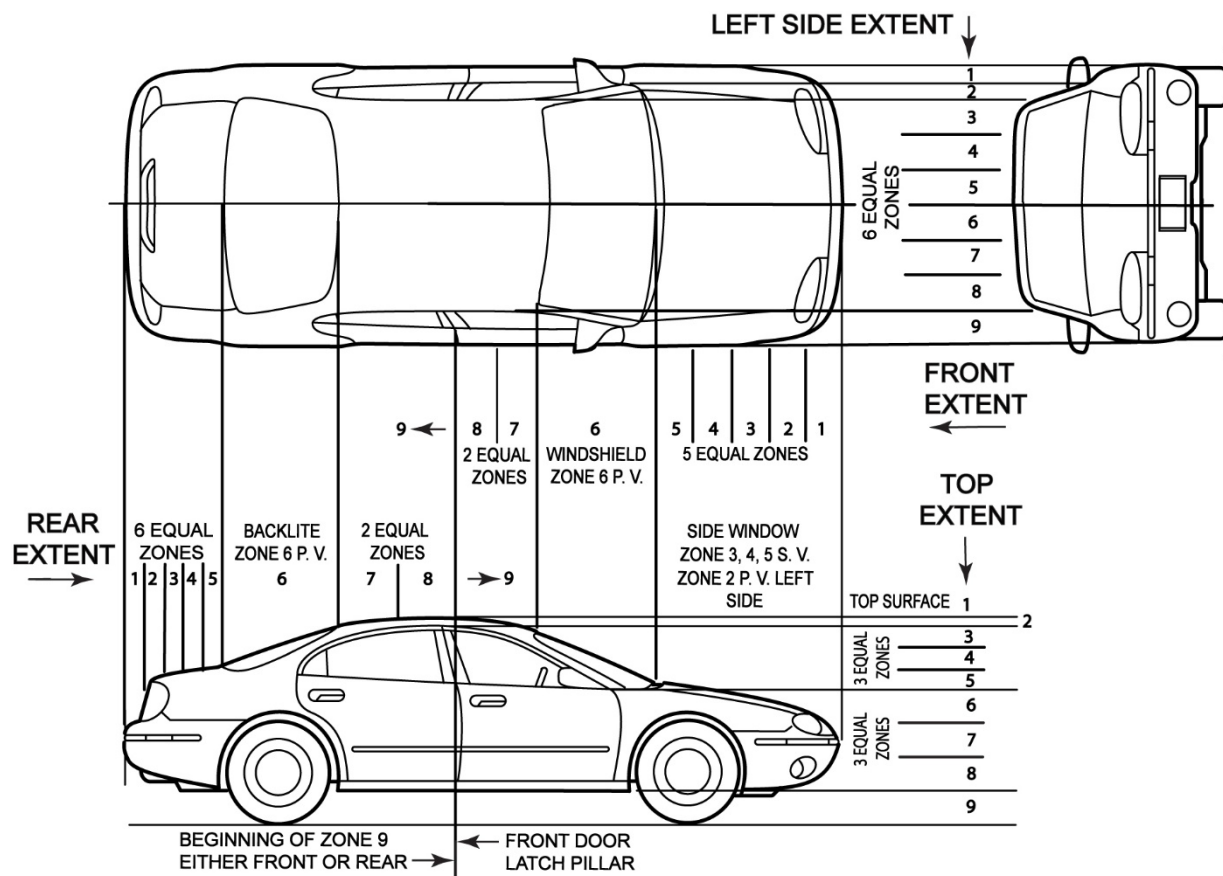


Figure 6 - Deformation extent zones (for passenger cars)