



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 39424.2-2020

**Road vehicles. Traffic accident analysis - Part 2: Guidelines for
the use of impact severity measures**

Issued on: November 19, 2020

Implemented on: June 1, 2021

Issued by: SAMR; SAC

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1 Scope

This Part of GB/T 39424 specifies the measures and use guidelines for the impact severity of road vehicle accident.

This Part applies to the measurement of the impact severity of road vehicle accident.

2 Normative references

The following documents are indispensable for the application of this document.

For the dated references, only the editions with the dates indicated are applicable to this document. For the undated references, the latest edition (including all the amendments) are applicable to this document.

GB/T 39424.1-2020 Road vehicles - Traffic accident analysis - Part 1:

Vocabulary (ISO 12353-1:2020, MOD)

3 Terms and definitions

For the purposes of this document, the terms and definitions given in GB/T 39424.1-2020 apply.

4.1 Overview

Evaluation of impact severity is divided into impact severity evaluation based on injury outcome and impact severity evaluation based on vehicle response.

There is a corresponding relationship between the impact severity and the injury mechanism and its outcome (dose-response). Figure 1 shows the subdivision phases of the corresponding relationship, i.e. three phases: pre-crash, crash and post-crash.

The complex dose-response model of vehicle impact is divided into several different

sub-response models. There are different sub-response models in or among the shaded areas in Figure 1. Among the parameters that affect the - Crash pulse;

- Parameters derived from the crash pulse, and - Dynamic and residual deformations.

Refer to A.9 for calculation of crash pulse.

In actual road vehicle accidents, residual deformation is often the only parameter describing vehicle response. When the occupant compartment is intruded, the residual deformation can replace the impact severity parameter, to evaluate the occupant response.

5 Use guidelines

For different impact types, when selecting severity parameters and measurement methods, the following principles can be followed:

- According to the input data available and the desired output data, select appropriate measurement parameters;
- For different types of impact, select the suitable measurement parameters (see Table 2);
- Combined use of multiple measurement parameters;
- When describing the injury outcome of different body regions in a crash, the protective performance of the occupant compartment during intrusion and the effect of the crash pulse shall also be considered;
- The uncertainty of different measurement parameters and the credibility of their results shall be considered (especially when indirectly-measured data is involved).

used. Select the coordinate origin randomly in the undeformed or less-deformed place on the vehicle (such as the center of mounting bolt on a bumper). Use the right-hand rule to establish a three-dimensional coordinate system along the three axis directions of the vehicle. Then the coordinates of any point can be determined.

A.1.2.2 Direct measurement In order to accurately locate the damage surface in the damage coordinate system, it is necessary to select enough points for measurement, which helps to improve the accuracy of the investigation. In the measurement, the actual damage surface is constructed by a series of nodes (except for individual small irregular surfaces). When selecting points on the actual damage surface for measurement, a unified selection standard needs to be used, such as a circle with a diameter of 8 cm, which can be used as a measurement node when the measurement site can accommodate the circle. For the irregular surface that cannot accommodate the circle, no measurement may be required; or feature vocabulary (such as hole) is used to describe the irregular surface.

Note: Easily-deformable coverings generally cannot be used as a representative actual damage surface (except when the covering and the internal structure are deformed at the

same time).

In order to accurately express the crush volume, damage shape, area of indirect crush, damage extent, and main distortion components in the three-dimensional coordinate system, it is necessary to select a sufficient number of nodes and number them. The nodes do not need to form a unified grid form;

just record the coordinates in the three-dimensional damage coordinate system.

The maximum error on the surface of the model determines the selection criteria for the location and number of nodes of the three-dimensional model.

The maximum error of the model surface is determined by the investigator, such as ± 5 cm or ± 10 cm (depending on the damage). The number of measurement nodes on the actual damage surface determines the upper and lower limits of the model surface deviation.

The damage model can be determined by connecting adjacent measurement nodes through a straight line. The actual damage surface refers to a series of triangular planes determined by the connection lines of the nodes.

For each design hard point of supporting structure, the deformation tear, bend, buckle mode of the structure, deformation location, and overall deformation (offsetting, bowing, twisting, etc.) that affect the total energy dissipation shall be recorded.

Each node shall be recorded in detail and clearly described, in order to verify a) Crush volume is the volume between the undamaged vehicle exterior surface and the exterior surface after it has been crushed by collision forces and can be empirically related to the energy dissipated during permanent deformation. When considering the mass of the vehicle, the energy dissipated during the collision is related to the energy equivalent speed (EES) and angular velocity changes. By analyzing the distribution of crush volume on the vehicle structure, the location of the collision impulse point can be determined.

b) The contour line of the contact zone indicates the position and orientation of the vehicle relative to the contacting object at maximum engagement.

c) The displacement vector starts at the position before the measurement point is damaged, and ends at the position after the point is damaged. The weighted average of each displacement vector characterizes the direction of the impact impulse.

d) The shape of the damage surface suggests the initial collision orientation and relative positions of the colliding objects at maximum engagement.

e) During the collision, the indirect damage area can dissipate most of the energy.

f) Even if the key structural parts produce the same displacement, their different deformation modes (such as bending, wrinkling, tearing) will absorb different energy, which will affect the estimation of the impact impulse location and the estimation of the energy absorption of the structural parts.

A.2 Energy equivalent speed (EES)

A.2.1 Information required for calculation Although the energy equivalent speed (EES) is expressed in the form of speed, it essentially represents the deformation energy; so the deformation features of the vehicle shall be studied first.

A.2.2 Calculation method The following methods can be used to determine the energy equivalent speed:

- a) In the crash test, look for a vehicle similar to the case vehicle; compare their deformation types; estimate the EES of the case vehicle through the calculation formula of deformation energy;
- b) On the basis of measuring the deformation value, the method of using the Since the closing velocity is the vector difference of the impact velocity between vehicles, the observed data for estimating the impact velocity is also applicable to the closing velocity. For impacting a fixed object, the closing velocity of the vehicle is equal to the impact velocity.

A.4.2 Calculation method The calculation method is the same as that for impact velocity.

A.4.3 Output characteristics The output result is expressed in meters per second (m/s).

A.5 Velocity change (Δv)

A.5.1 Information required for calculation Observed data for estimating impact velocity and closing velocity can also be used to calculate the velocity change (Δv), such as the accident scene information described in A.3.1; including the location of the impact point, the rest position of the vehicle, the tire mark of the ground during the collision, the road friction coefficient, the road surface material, the travel direction of the vehicle before the collision, etc. In the case of insufficient information at the accident scene, the velocity change (Δv) can be calculated by the direction of the impact force and the total energy dissipated when colliding with an object.

The direction of the impact force can be directly judged by the survey of the colliding vehicle. The energy dissipation is estimated by the vehicle stiffness coefficient table and measuring the crush profile.

A.5.2 Calculation method Both forward and backward calculation methods can be used to calculate the velocity change (Δv). For example, by analyzing the running out trajectory and reasonably assuming the movement characteristics of the vehicle in this phase, the separation velocity can be calculated. In the backward reconstruction, the impact velocity can be calculated using the laws of physics; such as the law of conservation of momentum, the law of conservation of energy, and the law of conservation of angular momentum, etc. In the same way, parameters such as the travel speed and the distance from the skid mark to the impact point in the forward reconstruction can also be used to calculate the impact