

## H. NCHRP Report 230—The Industry Perspective

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The National Cooperative Highway Research Program Report Number 230 (NCHRP 230) is a widely used document that gives guidance to those involved with researching, developing, evaluating and specifying highway safety appurtenances. While this document has been in use since 1981, it is currently being revised under the direction of NCHRP. The developer of the revised document will receive input from the various perspectives presented at this workshop. This presentation is presented from an industry perspective.

Some changes to improve NCHRP Report 230 from an industry perspective have been identified and can be broken down into five issues as follows:

- Interpretation
- Appurtenance application
- Occupant risk factors
- Vehicle characteristics
- Acceptance/Enforcement by appropriate agency

The interpretation issue involves developing a document that can be easily/clearly understood by the user organizations. Some are very skilled in understanding risk assessment, theoretical performance and testing specifications, while others may not have this expertise. Therefore, the document should be kept as simple as possible to allow user acceptance and proper use while being detailed enough to ensure that technical compliance is being met.

The appurtenance application issue is an area that is not clearly defined in NCHRP Report 230. General appurtenance categories (i.e., longitudinal barriers, terminals, crash cushions, etc.), test conditions, and evaluation criteria are described without guidance relative to where the appurtenances are to be used. As an example, a longitudinal barrier end may be terminated with a terminal section or with a crash cushion. The performance requirements for the selected system may be affected by where it is to be applied (i.e., edge of road, narrow median, wide median, for attachment to a rigid/semi-rigid/non-rigid longitudinal barrier, etc.). If a terminal is used in a narrow median application, it would not be appropriate to allow the vehicle to "gate" through the system and create a hazard in opposing traffic lanes. In wide median or roadside applications with appropriate clear zones, gating may be allowed.

The type of longitudinal barrier that the terminal protects also is an important application issue. If the terminal is attached to a rigid barrier, measures should be taken to ensure that proper transition between the terminal and the longitudinal barrier are implemented to obtain proper performance. Otherwise, the vehicle may

penetrate the terminal excessively and snag or impale itself on the end of the rigid barrier.

The use of non-redirective terminals such as inertial barriers present another application issue. The inertial barrier systems can be effective appurtenances when applied properly. However, it should be understood that these systems do not have redirective capacities and thus should not be used where there are modest probabilities of angled impacts into the sides of the system.

The application issue can be addressed in the new criteria by using flowcharts (Figure 3) or other decision matrices that instruct the document user about the proper testing and evaluation requirements for appurtenances.

The occupant risk factor issue centers around the topic of "design" and "limit" values when evaluating systems. The concept of having a design (desirable) value and limit (upper maximum) value for occupant risk factors is not new. These concepts have been in existence since the early 1970's (i.e., in NCHRP Reports 118 and 153). While NCHRP Report 230 was new in introducing the concepts of "occupant impact velocities" and "ridedown g levels" the concepts of desired and maximum acceptable levels were rightfully retained. This concept challenges the research and development professionals to advance the state-of-the-art performance toward the desired values while allowing acceptance of current state-of-the-art appurtenances to improve roadway safety conditions for the motoring public.

The Federal Highway Administration (FHWA) recently suggested that only appurtenances passing the "desired" occupant risk values should be accepted for use. This could have an adverse effect on new developments to improve the state-of-the-art and in the acceptance of current state-of-the-art systems. Therefore, the new criteria should retain the desired and maximum limits for occupant risk evaluations similar to those used in NCHRP Report 230.

The vehicle characteristics issue that should be addressed in the new criteria center around the 4500S vehicle in NCHRP Report 230. Vehicles in this weight range that are less than 6 years old are most difficult to locate. In the late 1970's and on into the 1980's, the weight of the larger, luxury vehicles became substantially less to provide better fuel economy. As a result, most of the current luxury vehicles are in the 3600 to 4000 pound weight range.

Current vehicles also have other characteristic differences such as the predominance of front wheel drive systems and changes to the bumper and center-of-mass height values. These characteristics should be taken into account when selecting the standard vehicle parameters in the new criteria.

# PROPOSED APPURTENANCE EVALUATION FLOWCHART

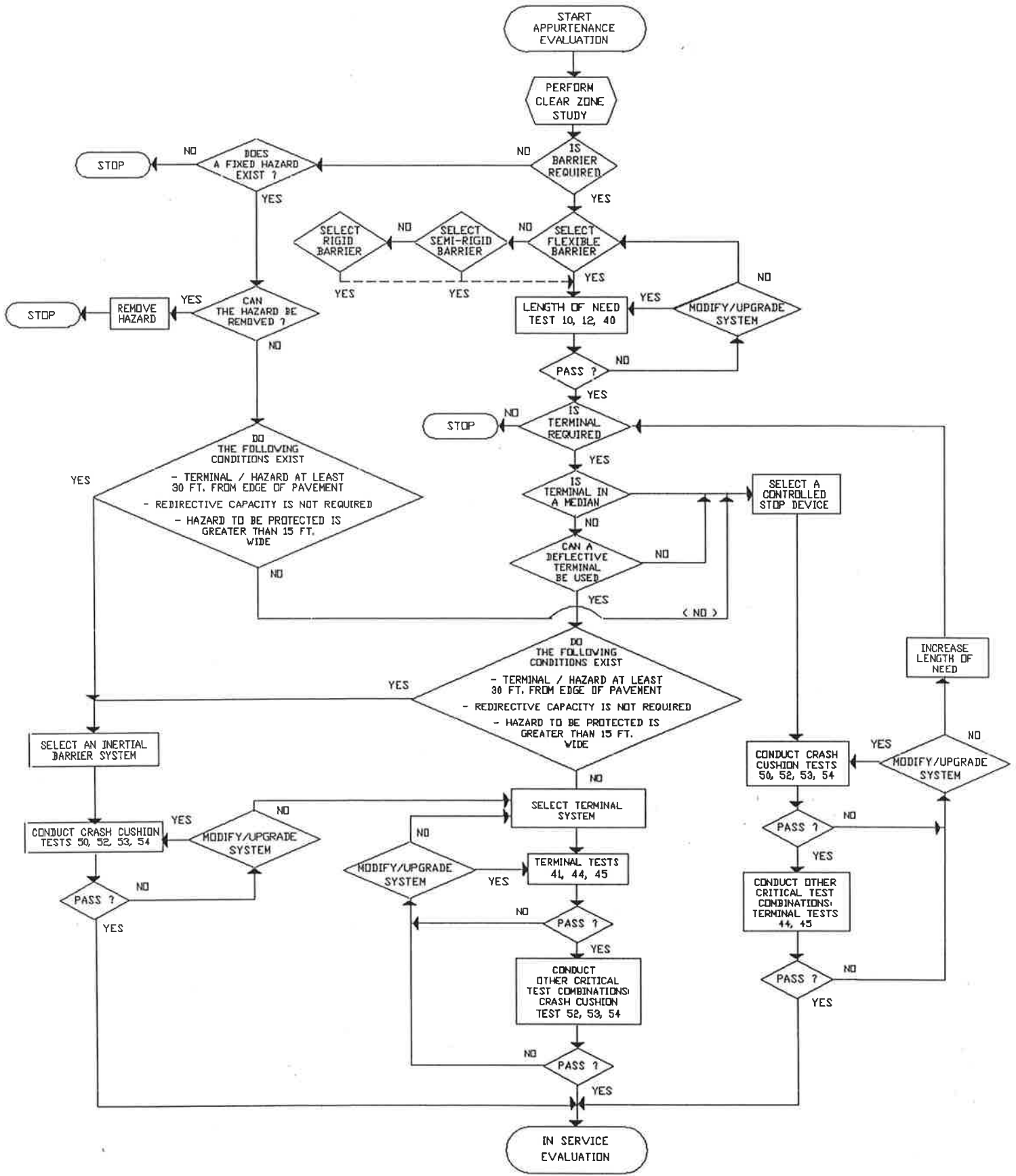


Figure 3

The acceptance/enforcement issue is not necessarily a topic that can be written into the new criteria. This issue deals more with coordination between the National Cooperative Highway Research Program, the Federal Highway Administration and the American Association of State Highway and Transportation Officials (AASHTO). There should be agreement between these groups prior to the completion of the new criteria to ensure the document will be accepted by all of the advisory, funding and enforcement agencies.

The major problem with NCHRP Report 230 is that there is not complete acceptance of the testing and evaluation guidelines set forth in the document. One agency or state will accept part of the criteria but not all, while another agency will accept another part. Thus, instead of having a uniform application of guidelines, there may be 50 or more variations that must be taken into account when new appurtenance systems are being developed. The result is confusion and a lack of directed effort to advance the state-of-the-art in these lifesaving devices.

Another concern with the acceptance/enforcement issue results from many agencies requiring that appurtenance systems be tested and/or perform in conformance to the guidelines set forth in NCHRP Report 230. The exact wording of the state specifications are vague. The problem is insufficient enforcement of the specifications due to a lack of understanding (by the state agencies) of the consequences of not using systems that meet the criteria. A desire for competition and alternate bids frequently overshadows performance to acceptable standards in a lifesaving safety appurtenance.

In summary, a revision of NCHRP Report 230 that addresses the issues of interpretation simplicity, evaluation of performance based on appurtenance application, maintaining "desired" and "maximum" occupant risk philosophy, updating vehicle characteristics and gaining prior acceptance of appropriate agencies will provide improved guidance to research, development, evaluation and specification professionals. This will result in the development and implementation of improved systems and safer roads for the motoring public.

## PART 3 DISCUSSION TOPICS

The workshop attendees were split up into the four discussion groups shown in Table 2 with color coding and nicknames to highlight their identities.

Table 2 Discussion Groups

Bogie Team (Green)	Dummy Team (Brown)
John Hinch,Ldr.	Jarvis Michie,Ldr.
Bronstad Copelan Hasbrouck Hatton Hunter Johnson Mak Marcel Marlow Shearin Tye	Campbell Denman Glauz Lisle Marek Peek Sicking Yang
Air Bag Team (Blue)	Work Zone Team (Yellow)
Hayes Ross,Ldr.	John Carney,Ldr.
Bishop Dinitz Duckett Hancock Hargrave Hedgecock Marley Turbell	Anderson Durkos Krage McCullagh Melvin Pivetti Post Stoughton Taylor Woodham

It was suggested that the discussion groups follow the procedures below:

1. The pre-appointed discussion leader was to select a secretary to keep notes that could be used by the discussion leader for his summary to the entire workshop gathering the next day.
2. The discussion leader was to select a timekeeper who would allow 15 minutes for each of the fifteen topics except for deviations approved by the leader.
3. The discussion leaders were free to modify the order of the discussion topics, to add topics and to use their own leadership style in order to promote discussion.

The discussion topics are given in Table 3. All four groups used the same list of discussion topics.

Table 3 Discussion Topics

### 1. Purpose of the Guidelines

Should the purpose be studied and redefined?

- a. Should the guidelines be relatively permissive to facilitate research studies?
- b. Should they be tightly written as a certification document so that it can be directly referenced in purchase specifications?
- c. Should both approaches be incorporated?

### 2. Updating the Test Matrix

Should multiple performance levels be added to the required test matrix?

- a. Should the new AASHTO bridge rail test matrix be adopted or should the test matrix be developed from scratch?
- b. Should all longitudinal barriers have the same test matrix?
- c. How great is the need for safety features designed specifically for the secondary road system?
- d. Should test conditions be representative of real world accidents or designed to reach imminent failure of the test barriers?
- e. Should the impact angle be studied? Should it vary with performance level?
- f. Should the location of the impact point be strictly defined?

Should work zone barriers be included in the required test matrix?

- a. Should they have a test matrix developed independently from permanent barriers and based on work site conditions?
- b. How will "work zone" or "temporary" barriers be defined?
- c. What safety devices other than longitudinal barriers should be included in a work zone barrier test matrix?

Should passenger vehicles be studied to select new standard vehicles for the test matrix?

- a. What vehicle should replace the 4500-lb. car?
- b. Should sub-1800-lb. vehicles be specified or made optional?