Table 3: Limitations Associated with the Use of Anthropometric Dummies to Evaluate Roadside Countermeasures

Limitations	Issues of Concern
Surrogate response interpretation	NHTSA pass/fail criteria Head injury criteria ≤1000 Chest acceleration ≤60 g Femur loads ≤2250 lb. Other injury measures proposed Repeated tests for statistical validity More research needed on relationship of dummy injury measures to human injury level probabilities Methodology for deriving relationships has been developed and implemented; work needs to be continued Current relationships interpret measures as indicators of overall injury probability
Relationships between surrogate response and performance of a roadside feature	What the response is measuring Roadside countermeasure and restraint-structure system performance combined Performance relative to "expected" vehicles Free flight distance/padding effects, etc. Repeatability--variations due to nature, positioning, instrumentation Problems in assessment in accordance with the Report 230 procedure--time of contact - different for various body regions, differences between driver and passenger Increased testing costs

Interpretation of dummy response is a second issue of concern. The FMVSS 208 criteria are a fail/pass standard directed specifically to restraint system development. The question concerning the suitability of using these criteria for evaluating roadside hardware is: Are they appropriate and suitable severity indicators? The FMVSS 208 criteria are being questioned as to their relationship to real-world collision results even in the most restrictive use; what does a Head Injury Criteria (HIC) of 1000 mean, and how does it relate to the probability and degree of occupant injury?

And third, the relationship between surrogate response and performance of a specific roadside feature is at present most tenuous. Given the variability of the vehicle occupant flail space and interior geometry and padding, sensitivity of positioning of dummies, increased costs associated with testing with dummies, etc., it is evident that considerable research is needed before the dummy can provide the linkage between crash test results and highway accident statistics. Specifically, research should be implemented to conduct further work on refining relationships between dummy injury measures and injury probabilities and to examine what the sources of variability in injury measures and injury levels for given crash severities and impact conditions are and their relative contributions to overall variability.

RELATIONSHIP OF CRASH PARAMETERS AND ACCIDENT INJURIES

William T. Hollowell, National Highway Traffic Safety Administration

In order to compete in the marketplace in the 1980s, automobile manufacturers are rapidly moving toward more sophisticated designs and design techniques that shall provide smaller, lighter in weight and energy-efficient vehicles. The smaller front-wheel-drive vehicles, diesel engines, material substitution and advanced computer technology will play significant roles in the future of this industry. Predictions by NHTSA and others indicate that the small car will comprise the majority of automobiles in the vehicle fleet by the mid-1980s. In addition, projections have been made indicating an increasing number of fatalities with nearly one million fatalities and tens of millions of serious injuries to occur in automobiles during the next 20 years. The goal of the safety community should be to reduce these numbers by as much as possible.

To reach this goal of reduced injuries and fatalities requires knowledge of the relative crash characteristics of automobile designs. A coordinated effort to establish a standardized computer data base from which this knowledge can be extracted should be pursued. The NHTSA has developed and is maintaining such a data base. Currently, this data base contains almost 400 crash tests of recent model vehicles. In addition, an effort to determine the relationship between crash tests and real-world accident experiences should be better defined. Again, NHTSA is pursuing this activity. In June 1981, at the SAE Conference in Detroit, Mr. Hackney discussed a methodology for determining the relationship of crash parameters and injury measures such as that between the Head Injury Criteria (HIC) and Chest Severity Index (CSI) and the Abbreviated Injury Scale (AIS). These relationships, shown in Figures 1 and 2, were further explored by Hackney to determine the probabilities of serious injuries and fatalities. Comparisons were made to relationships obtained from the accident data files (using the change in velocity as the common denominator) and are summarized in Figure 3. It must be emphasized that these results are preliminary and further refinements are in progress.

Figure 1. Relationship of HIC and Head AIS.

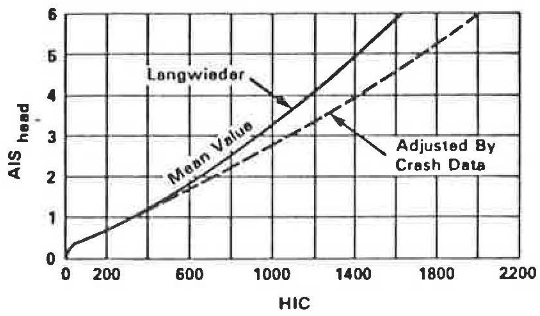


Figure 2. Relationship of CSI and Chest AIS.

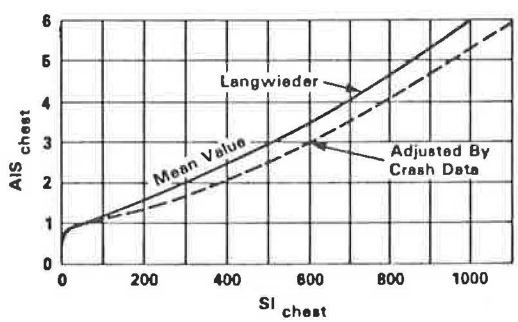
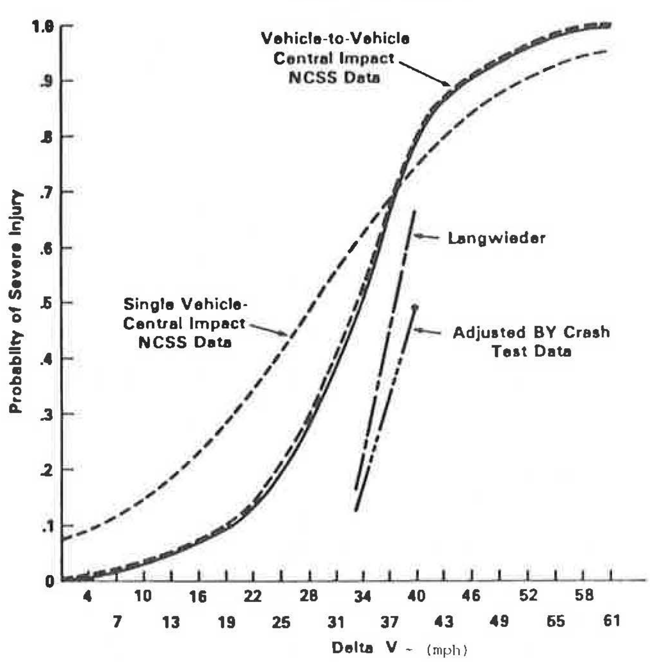


Figure 3. Logistic Curves for Front Impact Subsets (Age = 30 Yrs.).



SUMMARY OF PART 2

Jarvis D. Michie, Southsest Research Institute

In support of benefit/cost analysis procedures of roadside safety programs, the seven presenters in this session outlined data needs and limitations associated with current data acquisition methods using computer simulation and physical testing.

Ross delineated the need to have baseline data of the untreated roadside for use as a reference for safety improvement comparisons and appurtenances warrants development. Nordlin discussed the impracticality of using full-scale crash tests to investigate all possible collision conditions and the importance of evaluating appurtenance under field conditions. In evaluating field performance of appurtenances, Bronstad cautions the investigators of the importance in assessing the compatibility of the specific hardware with the traffic and site characteristics. Reilly stressed the need to acquire detailed clinical data from selected accident cases; in addition, he sees the need of establishing a substantial data base of inadvertent roadside encroachments that are generally not reported because the errant motorist is able to drive his vehicle from the accident site. With this information and with projections of vehicle sales trend, Reilly maintains that testing procedures and test matrices can then be validated or modified to correspond to actual conditions and, therefore, made more effective.

As a complement to vehicle crash testing methods during appurtenance development, computer simulations have been shown to be cost effective under certain conditions. However, Chiapetta has alerted the reader to difficulties and limitation of current simulation technology.

With regard to establishing a linkage between vehicle crash test severity and potential injury of vehicle occupants, Friedman discussed the use and limitation of anthropometric dummies and indicated that dummy responses are currently insufficient for use in the benefit-cost analysis procedures. On the other hand, Hollowell presented some promising findings from recent NHTSA efforts to establish a link between FMVSS 208 and accident severity.

From the standpoint of physical testing and analysis, data needs for cost-benefit analysis procedures have been assessed. Whereas considerable information pertaining to a specific appurtenance hardware items can be acquired before the item is introduced into actual service, it is recognized that extensive in-service evaluation including numerous collision cases is necessary to develop sufficient input to the cost-benefit equation.

Part 3: Session 2, Field Performance Studies: Evaluation and Data Issues

Forrest M. Council, Highway Safety Research Center, University of North Carolina

The second part of the overall program was designed to raise issues related to the use of field data in determining severity indices for highway hardware. To open the session, the moderator presented a brief introduction to the two basic issues or areas