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**Rollover Resistance: Consumer Information Regulations
Request for Comments, 66 FR 35179 *et seq.*, July 3, 2001**

Advocates for Highway and Auto Safety (Advocates) and Public Citizen are pleased to submit these comments to assist the National Highway Traffic Safety Administration (NHTSA) in its development of a dynamic test to measure the rollover tendencies of light motor vehicles. This action partially fulfills Congressional direction to the agency in Section 12 of the Transportation Recall, Enhancement, Accountability, and Documentation Act (TREAD) to develop a dynamic test for consumer information purposes. The agency is required to carrying out a program of rollover testing and to adopt rules no later than November 1, 2002, for disseminating consumer information concerning the rollover resistance of vans, minivans, pickup trucks, and passenger cars.

NHTSA accurately portrays the severity of the rollover crash problem. The 1999 Fatal Analysis Reporting System (FARS) reports 10,140 occupant deaths in light vehicle rollover crashes, about 30 percent of the deaths sustained by light vehicle occupants in all types of crashes. About 80 percent of those deaths were in single-vehicle rollover crashes. In fact, the majority of occupant fatalities in single-

vehicle crashes – 55 percent – involve rollovers. Although slightly less than half of passenger car occupant fatalities are the result of single-vehicle rollovers, the percentage quickly rises through pickup trucks and vans, reaching 78 percent, or nearly four of every five deaths, for Sport Utility Vehicles (SUVs). 66 FR 35179, 35180. There is little question that the in-service stability of the current light vehicle fleet is inadequate, and this includes passenger cars in which nearly half of all occupant deaths in single-vehicle crashes involve rollovers, a fact which is crucial not to lose sight of in any policy decisions affecting vehicle stability, its testing, and crash morbidity.

NHTSA in this notice offers an appraisal of the preliminary results of its testing program involving vehicle maneuver tests, as well as a consideration of an alternative proposal for determining rollover propensity submitted by the University of Michigan Transportation Research Institute (UMTRI). The agency-conducted tests involve quick steering inputs, including steering wheel reversals, to simulate various crash avoidance actions by drivers, and include traversing courses in which test vehicles attempt to follow a path of lane changes, and executing “fishhook” maneuvers in which drivers or automated steering controllers steer at a sharp angle in one direction and then quickly reverse steering wheel direction severely in the opposite direction.

Preceding this evaluation of lane-change crash avoidance testing, NHTSA stresses that a recent National Automotive Sampling System (NASS) Crashworthiness Data System (CDS) review of 1992-1996 shows that

about 95 percent of rollovers in single vehicle crashes were tripped by mechanisms such as curbs, soft soil, pot holes, guard rails, and wheel rims digging into the pavement, rather than by tire/road interface friction as in the case of untripped rollover events.

Id (emphasis supplied). However, NHTSA proposes continuing to limit its research of on-road, crash avoidance maneuvering protocols to vehicle dynamics that lead to the identification only of a given vehicle’s on-road, untripped rollover threshold. In sum, the agency is only concentrating on a tiny percentage of the

stability problem.

Despite this commitment to study only on-road, untripped rollover, NHTSA emphasizes that it is unable to obtain sufficient data, even on high volume vehicles in the marketplace, to determine any correlation between maneuver testing results and vehicle untripped rollover involvement. *Id.* at 35182. The agency extends its generalization even further: it asserts that it “is unlikely that the choice of any particular maneuver test or tests can be justified on the basis of the correlation of the test results to real-world rollover rates.” *Id.* This means that the agency’s choice of a maneuver test to demonstrate rollover tendencies has no demonstrable correlation not only with so-called on-road, untripped rollover crashes, but also has no correlation with the overwhelming majority of rollovers which involve vehicles leaving their travel lanes and rolling over off-road because of encounters with tripping features in the roadside.

In general, the agency is claiming that maneuver tests, no matter how carefully crafted to purportedly control the numerous variables involved, and to avoid manufacturers “gaming” the tests in order to receive passing grades, fail to accord with actual in-service vehicle dynamics resulting in rollover crashes, both tripped and un-tripped, both on-road and off-road. The preliminary question, then, is whether this lack of correlation of the agency’s proposed maneuver tests with actual in-service rollover crashes of light vehicles defeats the agency’s ability to meet the intent of its statutory mandate to provide meaningful consumer information on specific vehicle make and model rollover tendencies, an issue to which Advocates will return later in these comments.

It is useful here to discuss the concepts of tripped versus untripped rollover because this can clarify why the agency’s proposal of vehicle maneuver tests may lack real-world application and, hence, may provide misleading consumer information.

There is no categorical distinction between tripped and untripped rollover events. Whether induced by the tire/pavement friction interface, a wheel rim digging into relatively soft asphalt within a road’s travel lanes or on a paved

shoulder, tread separation of a tire under dynamic loading, or encounters with off-road curbs, low barriers, and soft or unstabilized shoulders, every rollover event consists of a vehicle being “tripped.”

However, it is important to understand the major difference between attempted inducement of on-road rollovers by relying on tire/pavement interactions and lateral acceleration on a level, paved surface, and how most rollover crashes actually occur. The agency’s various maneuver tests, whether different path negotiations supposedly replicating potential crash avoidance maneuvers, or “fishhook” tests involving rapid and severe steering reversals, are efforts to determine, within the constraints of the chosen test protocols, whether a given vehicle stays upright at the conclusion of a test run or instead exceeds its dynamic stability as a result of steering inputs alone and rolls over because lateral acceleration of the vehicle overwhelms its ability to manage incipient roll energy.

But most rollover crashes do not involve a vehicle reaching and surpassing its rollover threshold as a result of on-road vehicle maneuvers before skidding or plowing out. Instead, the great majority of vehicles that roll over not only do so outside the travel lanes of a highway or street, but are already skidding or plowing out before they enter the roadside. This is a dangerous environment for a vehicle already out of control because this off-road area can be thickly populated by a wide variety of features with heights considerably lower than vehicle center of gravity. When a vehicle skids into these roadside features, a situation often aggravated by negative roadside slopes which increase vehicle body lean, lateral acceleration is abruptly ended by tire/wheel contact with a curb, a low guardrail, or soft soils, and the vehicle’s dynamic center of gravity is immediately transferred outboard. Put simply, the vehicle is tripped, and it often rolls over.¹

¹UMTRI points out in its submission to the current docket that “skidding sideways” is involved in 50 to 80 percent of rollovers. Bob Ervin and Chris Winkler, *Dynamic Rollover Propensity: Seeking a Test Metric That Is Pertinent, Objective, Repeatable, Continuous, and Differentiating*, University of Michigan Transportation Research Institute, April 23, 2001, NHTSA-2001-1963-03, July 24(?), 2001.

One of the paradoxes of NHTSA's proposed maneuver tests for on-road, "untripped" rollover is that vehicles that skid or plow out before rolling over under the chosen testing regime can be given passing grades, but under actual in-service conditions, many of these same vehicles will depart their travel lanes while skidding, enter the roadside, and roll over.² Even more critically, many real-world rollovers do not even involve vehicle skidding, yawing, or plowout. This is particularly true in highway fixed-site construction zones where temporary realignment of the travelway has been effected by means of temporary traffic control devices intended to supersede unremoved lane and edge lines, or because of the inadequate obliteration of the original pavement markings and application of new, temporary markings intended to change vehicle paths through the construction area. In these instances, drivers, misled by conflicting or incorrectly placed systems of temporary path delineation, unexpectedly drive into dangerous off-road areas, an action which often conclude with a rollover crash.

This discussion makes clear what is implied in NHTSA's disclaimer that none of its proposed vehicle on-road maneuver tests may be able to correlate with real-world rollover crashes. An on-road vehicle maneuver test might be able to show important, safety-related features of vehicle handling and tire/pavement interaction, including maneuvers leading to rollover under certain circumstances, but it fails to model the great preponderance of the actual behavior of vehicles resulting in rollover crashes. These crashes occur overwhelmingly off-road, not on-road; most vehicles are skidding or yawing and are therefore no longer under the control of their drivers; and these vehicles roll over because they encounter tripping mechanisms which abruptly overwhelm their ability to remain upright.

²NHTSA recognizes this in the instant notice:

In a path following maneuver, the test is terminated when the vehicle can no longer follow the path. For example, consider a vehicle that cannot negotiate the path beyond 38 mph, but it departs the path before it achieves two wheel lift. Consider a second vehicle that can follow the path at 45 mph but lifts the inside tires three inches off the pavement. Which vehicle should be rated higher? *Departing the roadway, as the first vehicle would seem likely to do more often than the second vehicle, can expose a vehicle to a high risk of tripped rollover.*

Id. at 35182 (emphasis supplied).

One of the most perplexing features of the current notice is the extent to which NHTSA provides an extensive list of the defects of its proposed research effort on vehicle maneuver tests. A recurrent agency observation is the extent to which passing or failing grades can be achieved depending on what driving maneuver test course variables are chosen, especially for a lane-change test.³ For one thing, it appears that vehicles which fail under one set of test course conditions will pass under another set which comprise different lane widths, changed time/distance relationships for the lane change maneuvers, different tires, and alteration of the pavement coefficient of friction on the test course. Moreover, manufacturers may change vehicle suspension and steering system designs, as well as substitute tires with reduced adhesion, in order to elevate a failed vehicle to a passing score. NHTSA emphasizes that differences in driving style/capabilities of test drivers may threaten objectivity and repeatability goals, thus introducing challengeable aspects of subjectivity which are alleged to undermine the meaningfulness of the test regime. One type of path negotiation test, the so-called “moose evasion test,” may not even induce vehicle roll momentum. In addition, the face validity of the chosen test may be unacceptably low because the maneuvers performed have low correlation with actual in-service driver behavior.⁴ In general, it

³*E.g.*, see *Id.* at 35184.

⁴For example, the Consumers Union “short-course” test involves neither throttle application nor braking from start to finish; rather, the test vehicle coasts through the lane-change, crash avoidance maneuver at an ever-decreasing speed. The agency obviously finds fault with this protocol as a real-world demonstration of driver crash avoidance behavior: “NHTSA believes that there are good arguments that simply braking without steering or braking and steering with an ABS equipped vehicle are better strategies to avoid the hypothetical object in the road that is the basis of the CU test.” *Id.* at 35183. Similarly, one version of the “fishhook” test adds “stab” or pulse braking – the rapid application and subsequent cessation of braking by the driver or automated driving controller during the fishhook maneuver, a doubtful scenario for ordinary passenger vehicle operators in panic maneuvers involving rapid steering wheel reversals to avoid a crash. In these instances, drivers are prone to steer wildly while “standing” on the brake pedal. The other main version of this test involves no braking at all during the steering reversals. However, NHTSA believes that fishhook maneuvers, including the lack of incentive to sacrifice vehicle handling to achieve passing grades in lane-change tests, do not really represent real-world driver behavior and, thus, have poor face validity from the start. *Id.* at 35183-

appears from its statements in the notice that NHTSA has doubts that any driving maneuver test can have sufficient face validity for consumer information use. “Ratings based on driving maneuvers may be complex and hard to communicate to the public . . .” *Id.* at 35182.

Nevertheless, the agency appears poised to continue its research program by relying overwhelmingly on course negotiation testing or, perhaps, some version of a J-maneuver or “fishhook” evaluation of on-road rollover propensity. The long catalogue of advantages and disadvantages near the end of the notice reviews a series of acknowledged pitfalls for any kind of maneuver test, shortcomings which the agency admits may not be overcome.⁵ *Id.* at 35188.

In contrast, NHTSA gives only brief consideration to the alternative approach offered by UMTRI relying on the use of a centrifuge to demonstrate vehicle rollover propensity before rejecting it, despite the fact that the agency provides a list of the many virtues of the proposed centrifuge test regime:

- the test may be viewed as a dynamic version of the quasi-static tilt table rollover test;
- the test can be expanded to accommodate controlled vehicle responses to roadway discontinuities (or “perturbations,” as the agency terms them);
- the test provides research control over suspension and tire deflection;
- the test can replicate both tripped and untripped rollover;
- the test appears to offer objectivity, repeatability, and high accuracy in its measurements; and,
- the costs of these measurements are fairly cheap.

Id. at 35188-35189.

Furthermore – and most importantly – the agency acknowledges that the

⁴(...continued)
35186.

⁵For example, NHTSA is not sanguine about the effort to overcome driver variation for tests based on course maneuvers through the use of automated driving controllers because the concept “may prove to be entirely impractical . . .” *Id.* at 35188.

measurements of a centrifuge test would be expected to correlate well with the actual rollover rates of vehicles. If this were borne out through further development and testing with some evolved version of the UMTRI centrifuge, the ability to correlate its results with real-world, in-service rollover rates would also supply an independent means of determining whether NHTSA's claim for close correlation of static stability factor (SSF) measurements with actual make and model rollover crash rates was borne out through the use of a dynamic testing regime which addressed all types of rollover crashes. This outcome is not an incidental corollary of centrifuge testing because it will show whether the continued use of a SSF rating is a valuable, additional means of informing consumers about marketplace choices to supplement a reliable rating system based on a realistic dynamic rollover stability rating.

Despite these advantages for the centrifuge, which, on balance, dramatically exceed even the best arguments the agency advances in this notice for path-following or driving maneuvers tests, NHTSA rejects the UMTRI test on two grounds. First, the agency invokes the potential for manufacturers to game even the centrifuge test by retuning suspension roll stiffness, a practice which could result in trading off desirable handling characteristics, arguably important for crash avoidance maneuvers as well as for reliable moment-to-moment operation of a vehicle, to achieve passing scores in the centrifuge. Advocates believes that this objection to the centrifuge may be overcome with a more refined protocol governing application of the test.

Second, NHTSA argues, in a single sentence, that embracing a centrifuge test, despite its manifold advantages, would be odds with Congressional intent in TREAD, *viz.*, that the agency "should give the American public information on performance in a driving maneuver that would evaluate the performance of new technologies like ESC [Electronic Stability Control]." *Id.* at 35186. Although Advocates agrees that only a driving maneuver can reveal the actual, salutary performance of ESC designs, this can be accomplished by a variety of driving tests which could be developed centering primarily on demonstration of controllable yaw response. This could be a feature of NHTSA's tentatively proposed path negotiation or fishhook maneuver testing, or some other test which would not

necessarily index successful operation of ESC to explicit tire lift-off, for example.

However, NHTSA's invocation of supposed Congressional intent that a dynamic measure of rollover resistance can be accomplished only through a driving maneuver test, will not withstand close scrutiny. Although it is clear that many concerned members of Congress intuitively link a demonstration of rollover stability with actual driving circumstances, and that they strongly support advances in technology which would increase a vehicle's resistance to rollover, these beliefs have no expression in the statutory direction to NHTSA in TREAD. Congress imposed no such restrictions on the agency in Section 12 of the Act, although it made it evident that it wants improved consumer understanding of the risk of rollover associated with different vehicle makes and models, and, equally clearly, that it wants this information to propel improved rollover resistance of light vehicles. The statutory instruction for agency action consists only of a directive to the Secretary to develop a dynamic test, carry out a program of testing, and conduct rulemaking to determine how best to get meaningful results of the testing to consumers. Neither the language of the provision itself nor its legislative history attempt to dictate that the only acceptable dynamic measure of rollover propensity is exclusively a driving maneuver test. This is a construction which has no support in the statute.

Advocates and Public Citizen do not believe that the agency faces a Hobson's choice of rejecting a centrifuge test whose balance sheet of virtues against vices appears far stronger than even NHTSA's own analysis of driving maneuver tests, while being forced to embrace one or more maneuver tests which do not correlate with real-world rollover rates and also fail to model the great majority of actual, in-service rollover behaviors of different vehicles. Congress nowhere demands that the agency accept an inferior test which does not accord with real-world rollover crash experience. Even more importantly, a rollover test awarding passing grades to many vehicles which are eventually shown to have consistently high rates of rollover crashes would be a serious blow to NHTSA's

credibility as a safety regulator in the public interest.⁶ NHTSA would face the indefensible facts of tragic deaths and injuries which resulted from poor guidance provided by the agency to the buying public. Certainly, such an outcome would provide the basis for renewed Congressional investigations and oversight hearings into the integrity of the agency's policy choices.

Advocates and Public Citizen believe that the agency's tentative proposal to go forward with its test program based on vehicle maneuvers can be supported on several grounds, but not to the exclusion of evaluating the centrifuge test. In the first instance, an evolving test program might discover refinements in test procedures and protocols which effectively discount many of the agency's own misgivings about the viability of maneuver tests to reveal rollover propensity. To stop the program at this juncture would be premature even if regarded only in this light. NHTSA has been commendably candid in its own, public appraisal of the serious difficulties besetting maneuver tests and it should be given the chance to document whether these are insuperable obstacles for rating vehicles for consumer information purposes or if these problems can be controlled or eliminated.

However, there are additional benefits beyond this rationale for continuing the current research program. In general, crash avoidance research has lagged over the years in the agency's research program. The current program of testing has substantial benefits, some of which the agency is no doubt aware, for understanding critical handling characteristics and performance limits of light passenger vehicles which can redound to the benefit of other areas of crash avoidance research and policymaking. One of the cardinal features of crash avoidance regulation strongly supported by both the agency and safety organizations such as Advocates and Public Citizen is to couch safety compliance

⁶It should not be forgotten that driving maneuver tests such as the one used by Consumer Union have never resulted in demonstrated rollover propensity of any passenger car. Yet nearly half of all passenger car single-vehicle crash fatalities are the result of rollovers. A driving maneuver test like those reviewed by NHTSA in this notice would inevitably accord passing grades to nearly all passenger cars, even sub-compacts which roll over more often than other, larger cars, yet high rates of car rollover crashes with deaths and injuries would continue to accrue.

requirements for new vehicles in performance terms as much as is feasible. Several years ago, NHTSA concluded a protracted rulemaking process to ensure increased stability and control for medium and heavy trucks and buses. The final rule for this important safety regulation primarily consisted of a technology mandate: anti-lock braking (ABS) equipment meeting specific requirements was required on newly manufactured large commercial vehicles in order to maintain steering control and reduce skidding and jackknifing, the latter by combination trucks. Performance requirements, however, were limited to a system of checking whether the equipment performed as intended by conducting a prescribed braking in a circle test which required a test vehicle to stay within a travel lane. 49 CFR §§ 571.105, 571.121.

It clearly is desirable for crash avoidance requirements to be enshrined primarily in performance criteria. In continuing its current driving maneuver research program, Advocates and Public Citizen believe that NHTSA may gain important insights into vehicle crash avoidance performance linked with specific vehicle design features and equipment which will improve the agency's ability to foster enhanced crash avoidance capabilities in the light vehicle fleet. Such initiatives can rely more strongly on establishing credible performance criteria to be met by manufacturers rather than mandating specific equipment or technologies. Continuing the agency's driving maneuver test program will provide important data about allied features of vehicle handling and response, and it can form part of a foundation of crash avoidance investigation which can extend far past the deadline in late 2001 for concluding consumer information rulemaking on light vehicle rollover. For example, the agency's maneuver tests may reveal important data about light vehicle loss of directional control, both with and without, *e.g.*, ESC and/or ABS, which can result in roadway departures. This would be germane to NHTSA's previous investigations into the performance of vehicles especially on road curves where, paradoxically, certain vehicles with ABS were found to have had more roadway departures than those without.⁷

However, Advocates and Public Citizen strongly recommend that the agency

⁷For an excellent summary of research efforts and past rulemaking by NHTSA, see <http://www-nrd.nhtsa.dot.gov/vrtc/ca/lvabs.html>.

also go forward with a priority assessment of the centrifuge test proposal from UMTRI. Congress did not prohibit this approach to establishing a dynamic measure of rollover propensity. Further, the test clearly holds considerable promise as a basis for consumer rollover resistance information and therefore should not be peremptorily dismissed by NHTSA, especially in light of the agency's own argument in the instant notice that the centrifuge test is an economical approach to determining all types of rollover propensity, both with regard to the costs of the equipment itself, as well as the costs of conducting the tests. The results of centrifuge testing can be matched with what may be the eventual beneficial aspects of rollover testing from conducting driving maneuvers and comparing the results with SSF calculations. Further, because the centrifuge test promises the capability of determining vehicle rollover tendencies in both "tripped" and "untripped" events, this action would demonstrate the commitment of NHTSA to finding the best, most comprehensive and accurate means of ascertaining vehicle rollover thresholds which accurately model real-world rollover crashes. It would show that the agency intends to provide consumer information which actually anticipates in-service rollover crash rates.

In the last analysis, the purpose of a carefully crafted consumer information program is to adopt measures of a given vehicle's rollover tendencies which have predictive capabilities so that appropriate safety guidance can be provided to the public to determine the extent of the prospective risk involved in purchasing one vehicle rather than another, a pivotal feature of the agency's current New Car Assessment Program for front and side impact crashworthiness. From the information and agency assessments of maneuver testing in the notice, it does not appear that this result can be gained by relying solely on driving maneuver tests. Something more is required so that the buying public can have an accurate anticipation of the actual, in-service rollover rates of light vehicles in the marketplace. Advocates and Public Citizen cannot understand how the agency could do less.

There is yet one more, crucial benefit in continuing an assessment of the centrifuge test. Any careful analysis of the on-road, "tripped" rollover testing regimes proposed in this notice, aided by the agency's own characterizations of the

research program's current deficiencies, clearly demonstrate that a consumer information program founded solely on the described driving maneuver tests not only does not seem capable of providing useful guidance for consumer choices, it also is a dead end for developing a rollover prevention or vehicle stability standard so that all light vehicles, including passenger cars, are designed to reduce the frequency of rollover crashes under all operating conditions.⁸ In contrast, realistic dynamic loading of light vehicles in a refined centrifuge test has the potential of generating data which could be used as the basis for a vehicle stability standard.

This data collection effort would provide information on rollover propensity and vehicle stability which avoids the inadequacies of previous attempts at a standard using metrics such as Critical Sliding Velocity which, as with SSF, models a vehicle as a rigid block while ignoring the kinematics of a vehicle's sprung mass. Advocates and Public Citizen continue to believe that a rollover prevention or vehicle stability requirement must eventually be adopted to supplement desirable changes in consumer buying habits and possible design changes by manufacturers encouraged by poor vehicle stability ratings. Without continuing to explore a promising avenue for generating meaningful data correlating well with real-world rollover crash experience of different makes and models of light vehicles, NHTSA's rollover research program as tentatively put forward in this notice is ultimately still-born. Furthermore, a rational understanding of vehicle design features and performance limits related to actual rollover propensity which can lead to the adoption of a vehicle stability standard has the important benefit of permitting the agency to use an informed perspective concerning crashworthiness countermeasures for addressing the rollover crashes which nevertheless will still occur among in-service light vehicles. Prevention of roof crush and of occupant ejection through vehicle portals, enhanced restraint system design and performance, and improved door latch and hinge crash performance can be policies judiciously

⁸In this connection, it should not be forgotten that approximately 20 percent of rollover crash deaths occur in multiple-vehicle collisions in which vehicles roll over after suffering impacts, especially side impacts, with other vehicles. Increasing the overall stability of the entire passenger vehicle fleet should also produce benefits by reducing some types of rollover crashes triggered by multiple vehicle collisions.

chosen to augment occupant protection in relation to known vehicle rollover propensity as controlled by both a vehicle stability standard and a substantive consumer information program.

For the reasons adduced in these comments, Advocates and Public Citizen strongly support continuation of NHTSA's research program investigating driving maneuver tests because of their potential in advancing agency understanding and regulation of vehicle safety performance, as well as the possibility that refined versions of these tests can aid consumer understanding of the risks of rollover with certain light vehicles. However, Advocates and Public Citizen strongly urge NHTSA to reconsider its decision not to pursue a research effort into vehicle rollover propensities with the UMTRI-proposed centrifuge. Advocates and Public Citizen are convinced that the multiple benefits of a reliable centrifuge test, as we discuss above, are compelling reasons for such reconsideration.

Respectfully submitted,

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