STUDY FINDINGS

Effect of Oversize Tires on Stopping Capability and Handling Stability of an Altered-Height Vehicle

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Altered-Height Vehicle Working Group
Vehicle Safety and Inspection Committee
American Association of Motor Vehicle Administrators

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EXECUTIVE SUMMARY

A trend to increase the ride height of light trucks by installing aftermarket body and/or suspension lift kits, and oversize tires was identified as a safety issue by several jurisdictions in the United States and Canada. The American Association of Motor Vehicle Administrators (AAMVA) assembled a working group to explore these safety concerns. As a pilot project, a series of low-speed braking tests on a flat plate tester were conducted with a light truck in the unmodified (as-built) state, and after body/suspension lift kits and incrementally larger size sets of radial tires were installed. A total of 147 braking tests employing two test drivers were executed with six different tire and suspension configurations. The results of the tests indicated that oversize tires had a profound effect on rollover propensity and substantially increased the applied pedal forces required to achieve equivalent levels of braking performance. Recommendations are provided to obtain further insight about, and moreover, to address safety issues associated with the installation of lift kits and/or oversize tires on altered-height vehicles.

INTRODUCTION

There has been a trend to raise the ride height of light trucks (mainly pickups) with the installation of body and suspension lift kits and/or oversize tires. The population and crash involvement of “altered-height” vehicles is difficult to assess because there is no standard approach or provision to distinguish the collision experience of vehicles equipped with oversize tires and/or lift kits. A number of jurisdictions in the 1980s relied on the American Association of Motor Vehicle Administrators (AAMVA) to establish guidelines that could be used as a proactive crash avoidance measure to help develop vehicle standards to reduce incidents of rollover and bumper override. Model legislation developed by the Motor Vehicle Manufacturers Association (MVMA) was adopted by AAMVA in 1988 to help jurisdictions structure and/or refine maximum bumper height requirements. The model legislation established the maximum height of bumpers mounted on passenger vehicles by gross vehicle weight (see Table 1).

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2 Ride height is the measured distance between the ground and a fixed reference point on a vehicle's body (e.g. rocker panel).
3 A tire is considered oversized if it is greater in diameter than the maximum recommended size established by the original equipment manufacturer as denoted on the safety compliance label.
### TABLE 1 – Maximum Recommended Bumper Heights (MVMA)

<table>
<thead>
<tr>
<th>Gross Vehicle Weight Rating (pounds)</th>
<th>Maximum Bumper Height (inches)</th>
<th>Front</th>
<th>Rear</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 4,500</td>
<td>4</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>4,501-7,500</td>
<td>4</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td>7,501-10,000</td>
<td>4</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Four-wheel drive and dual-wheel trucks</td>
<td>4</td>
<td>28</td>
<td>31</td>
</tr>
</tbody>
</table>

Jurisdictions with considerable experience inspecting altered-height vehicles have expressed concerns about the greater demands imposed by oversize tires on suspensions, steering components, and braking systems. Similar to newly manufactured light trucks and sport-utility vehicles, there is also apprehension about the rollover risk and significant differences between the weight and mismatched height structures of altered-height vehicles and passenger cars. The issue of vehicle incompatibility was summarized in testimony delivered by the National Highway Traffic Safety Administration on February 26, 2003 to the United States Senate Committee on Commerce, Science and Transportation:

In simple terms, incompatibility is the degree to which vehicles are matched in vehicle-to-vehicle crashes. Pickups, minivans, and SUVs represent about 36 percent of registered passenger vehicles in the United States. With light trucks now accounting for nearly 50 percent of new vehicle sales, their share of the total fleet is growing steadily. Light trucks are involved in about one-half of all fatal two-vehicle crashes with passenger cars. In these crashes, over 80 percent of the resulting fatalities are to occupants of passenger cars. The problem of incompatibility will continue to grow as the percentage of light trucks increases.

### BRAKING TESTS

In December 1998, AAMVA formed an Altered-Height Vehicle Working Group ("the Working Group") to identify safety issues that could be verified through testing. The Working Group consisted of representatives from Colorado, Texas, Missouri, New Jersey, Ontario and British Columbia; the National Highway Traffic Safety Administration (NHTSA); the Specialty Equipment Market Association (SEMA); the Virginia Commonwealth University’s Crash Investigation Team; an automotive equipment testing manufacturer; and an AAMVA staff member. The effect of oversize tires on road safety was deemed to be a safety issue that could be measured.

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4 Bumper height is the vertical distance between the ground and highest point at the bottom of the bumper, measured with the vehicle laden on a level surface and tires inflated to the Original Equipment Manufacturer's recommended pressure.

5 In 2002, 61 percent of all occupant fatalities in SUVs and 45 percent of pickup truck deaths in the U.S. resulted from rollover crashes.

6 Crash Incompatibility, Status Report, Vol.38, No. 4, 6 April 2003

7 SEMA represents the speciality automotive industry who manufacturer and market appearance, performance, comfort, convenience and technology products for passenger cars, minivans, trucks, SUVs and recreational vehicles <www.sema.org>.
A decision was made by the Working Group to conduct a series of low-speed braking tests on a flat plate tester to determine what effect, if any, the installation of lift kits and oversize tires may have on the stopping capability and handling stability of an “in-use” altered-height vehicle. The aftermarket modification of the body and suspension on the test vehicle were consistent with a current trend to predominantly raise, rather than lower, the frame height of sport trucks. It was hypothesized that a gradual change in braking performance and handling stability would be observed as incrementally larger diameter tires were mounted on the test vehicle.

**Test Vehicle**

A four-wheel drive 1992 Ford Regular cab F-150 (VIN # 1FTEF14N3NPA06521) with a gross vehicle weight rating of 6,250 pounds was supplied by the Colorado State Patrol to conduct the tests (“the test vehicle”). The test vehicle was equipped with factory-installed Twin I-Beam front suspension, rear leaf spring suspension, 5-speed manual transmission, 5.0L EFI V8 engine, standard size tires (P235/75R15), and an aluminum toolbox in the rear cargo area (see Figure 1). The foundation brake system was front/rear split design with rear drum brakes, front disc brakes, and a rear-wheel antilock brake system controlled by a ring gear sensor mounted in the rear differential.

![FIGURE 1 - Test Vehicle in “As-Built” Configuration](image)

A detailed inspection of the test vehicle was conducted to measure and record the condition of the braking system. The combination of a 3-inch body lift kit and 4-inch suspension lift kit were deemed to be “representative” of aftermarket modifications to raise the ride height of light trucks. Body and suspension lift kits are typically installed to accommodate oversize tires that may otherwise interfere with the operation of steering components or contact the vehicle body.

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8 Sanchez, D., Editorial, Sport Truck, September 2001, pp. 24
The front suspension was modified with aftermarket coil springs, metal spacers, dropped pitman arm, cross-member bracket assembly, and shock absorbers (see Figure 2). Ten rubber spacers were uniformly installed along each frame member.

**FIGURE 2** – Modified Front Suspension

The rear suspension was outfitted with aftermarket shock absorbers and block spacers positioned and secured by extended-length U-bolts at each leaf spring (see Figure 3).

**FIGURE 3** – Modified Rear Suspension

Four sets of radial tires with an overall diameter (as displayed on the sidewall) ranging between 32 and 39.5 inches, and two additional sets of wheels were installed on the test vehicle.
Testing Equipment

Flat Plate Tester – The braking tests were conducted at the Hunter Engineering Company Truck and Bus Center in St. Louis, Missouri. A fixed in-ground *HUNTER B400T* flat plate tester (“the flat plate tester”) and portable brake test computer were used to measure, record, and store test data. The instrumented plates of the flat plate tester recorded the braking performance of each tire/wheel assembly (see Figure 4).

![FIGURE 4 – Instrumented Plates of Flat Plate Tester](image)

Brake Test Computer – The maximum applied pedal force of each test was recorded with a portable *VERICOM VC2000PC* brake test computer (“the portable tester”) equipped with a dash mounted high-precision accelerometer (VC2000PC), data acquisition box (DAB), and load cell (see Figure 5).

![FIGURE 5 – Brake Test Computer in Test Vehicle](image)
Test Procedures

Before each series of tests were conducted, measurements were taken to determine the height of the front/rear bumpers, headlamps and tail lamps. The overall diameter, inflation pressures, tread depth/width, rubber hardness, and rolling radius height of each tire were also documented. A targeted entry speed of 8 to 10 miles per hour was achieved before the transmission was placed into neutral and the commencement of each brake test. The brake force and dynamic weight at each wheel location and entry speed were captured as the test vehicle rolled onto the instrumented plates and brakes were applied. The static weight of each wheel was measured after the test vehicle came to a complete stop. The braking performance, entry speed, and weight of the test vehicle were transmitted from the instrumented plates to a portable console station that controlled the functioning of the instrumented plates, and calculated, displayed, saved, and printed the results of each test (see Figure 6). The brake balance, weight transfer, and maximum deceleration were automatically calculated at the end of each test sequence.

Data collected by the flat plate tester was used to calculate the center of gravity (CG) height by comparing the dynamic and static weight distribution of the test vehicle while braking. The relative rollover prediction of the test vehicle was ranked using the static stability factor (SSF) equation adopted by the National Highway Traffic Safety Administration (NHTSA). The five-star rollover rating system was used to compare differences in the handling stability of the test vehicle by tire/suspension configuration. The rating system provides the best score of five stars to vehicles with the lowest risk of rollover (less than 10 percent). In contrast, the worst score of one star is affiliated with vehicles that have the highest risk of rollover (greater or equal to 40 percent).
RESULTS

Data was analyzed to determine the effect oversize tires and the installation of body and suspension lift kits had on the vertical height of the front bumper and headlamps. The data were also examined to determine what effect oversize tires had on the rollover propensity and maximum deceleration of the test vehicle. The results of straight-line slide-to-stop braking tests after the test vehicle was reconfigured to the as-built configuration are provided. An explanation is presented for anomalous differences in the rollover propensity and maximum deceleration of the test vehicle with 38-inch tires and 39.5-inch tires.

**Vertical Height**

The front bumper height on the test vehicle when equipped with 39.5-inch tires (measured from the ground to the bottom of bumper) increased about 13 inches as compared to the as-built configuration. The installation of 39.5-inch tires also increased the height of the headlamps (measured from the ground to the center of the lamp) about 12 inches. The installation of 38-inch and 39.5-inch tires raised the front bumper beyond the maximum height requirements contained in the model legislation developed by the Motor Vehicle Manufacturers Association and adopted by AAMVA (see Table 2). The height of the headlamps of the test vehicle with oversize tires was within the maximum height requirement of 54 inches for passenger vehicles as stipulated in Federal Motor Vehicle Safety Standard (FMVSS) 108. Compliance with FMVSS 108 may not be achieved, however, with the installation of tires that are larger in size than those included in the testing program and available for retail sale.

<table>
<thead>
<tr>
<th>Tire Size</th>
<th>Body Lift</th>
<th>Suspension Lift</th>
<th>Vertical Height (inches)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Front Bumper</td>
<td>Maximum Permitted&lt;sup&gt;9&lt;/sup&gt;</td>
</tr>
<tr>
<td>28-inch</td>
<td>As-built</td>
<td>As-built</td>
<td>16.0</td>
<td>27.0</td>
</tr>
<tr>
<td>28-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>22.8</td>
<td>27.0</td>
</tr>
<tr>
<td>32-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>24.3</td>
<td>27.0</td>
</tr>
<tr>
<td>35-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>26.8</td>
<td>27.0</td>
</tr>
<tr>
<td>38-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>(27.3)</td>
<td>27.0</td>
</tr>
<tr>
<td>39.5 inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>(29.0)</td>
<td>27.0</td>
</tr>
</tbody>
</table>

**TABLE 2** – Vertical Height Measurements by Tire/Suspension Configuration

<sup>9</sup> Model legislation on maximum bumper height requirements developed by the Motor Vehicle Manufacturers Association.

<sup>10</sup> Maximum headlamp height measured from the ground to the center of the lamp (FMVSS 108).
Rollover Propensity

The installation of larger size tires lowered the Static Stability Factor (SSF) and increased the calculated CG height of the test vehicle. The four-star SSF rating with 29-inch tires in the as-built configuration reduced to a single star rating with 38-inch tires. The change in rating increased the risk of rollover from 10 and 20 percent in the as-built state to more than 40 percent with 38-inch tires (see Table 3).

<table>
<thead>
<tr>
<th>Tire Size</th>
<th>Body Lift</th>
<th>Suspension Lift</th>
<th>Risk of Rollover</th>
<th>NHTSA SSF Star Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-inch</td>
<td>As-built</td>
<td>As-built</td>
<td>10 - 20 %</td>
<td>★★★★★</td>
</tr>
<tr>
<td>28-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>20 - 30 %</td>
<td>★★★</td>
</tr>
<tr>
<td>32-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>20 - 30 %</td>
<td>★★★</td>
</tr>
<tr>
<td>35-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>30 - 40 %</td>
<td>★★★</td>
</tr>
<tr>
<td>38-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>&gt; 40 %</td>
<td>★</td>
</tr>
<tr>
<td>*39.5-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>30 - 40 %</td>
<td>★★</td>
</tr>
</tbody>
</table>

* Anomalous data

**TABLE 3** – Propensity to Rollover by Tire/Suspension Configuration

Maximum Deceleration

The maximum deceleration of the test vehicle ranged from 0.53g and 0.71g. The oversize tires had a significant impact on maximum deceleration at various levels of applied pedal force. With the exception of 39.5-inch tires (anomalous data), braking performance reduced 20 to 25 percent by tire/suspension configuration regardless of the amount of applied pedal force (see Table 4). It is immediately evident that the ability to stop a vehicle with oversize tires depends on the amount of pedal force that can be applied.

<table>
<thead>
<tr>
<th>Tire Size</th>
<th>Body Lift</th>
<th>Suspension Lift</th>
<th>Pedal Force (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>As-built</td>
<td>As-built</td>
<td>76</td>
</tr>
<tr>
<td>28-inch</td>
<td>As-built</td>
<td>As-built</td>
<td>0.60g</td>
</tr>
<tr>
<td>28-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>0.59g</td>
</tr>
<tr>
<td>32-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>0.57g</td>
</tr>
<tr>
<td>35-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>0.51g</td>
</tr>
<tr>
<td>38-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>0.48g</td>
</tr>
<tr>
<td>*39.5-inch</td>
<td>3-inch</td>
<td>4-inch</td>
<td>0.53g</td>
</tr>
</tbody>
</table>

* Anomalous Data

**TABLE 4** – Maximum Deceleration by Tire/Suspension Configuration and Applied Pedal Force
Anomalous Test Results

The maximum deceleration of the test vehicle by applied pedal force was slightly greater with 39.5-inch tires and not lower than the maximum deceleration achieved with 38-inch tires (see Table 3). In addition, the Static Stability Factor (SSF) of the test vehicle was marginally greater with 39.5-inch tires than with 38-inch tires (see Table 4). The anomalous test results with 39.5-inch tires differed with the findings of all other tire/suspension configurations when the results of the test vehicle with smaller size tires were compared with the results of tests conducted with larger size tires. Although the disparity may have been due to slight differences in tire hardness and inflation pressures, the dissimilarity was more the result of contact being made between the front fenders and tires as the front fenders of the test vehicle pitched forward and dived downward during braking. A review and analysis of pitch angles indicated that the minimum available “static” tire/fender would have been breached and resulted in the front fenders making contact with the 39.5-inch tires (see Figure 7). This finding is consistent with and supported by a recommendation that the test vehicle as a 1992 Ford F-150 pickup truck should be equipped with an 8-inch suspension lift kit to accommodate 39-inch tires. Direct contact between the front tires and fenders while braking would have inadvertently improved vehicle deceleration and interfered with the transfer of weight thus affecting the calculated Center of Gravity height and Static Stability Factor.

FIGURE 7 - Reduced Tire/Fender Clearance with Oversize Tires

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11 What Fits, What Hits, 4 x 4 Directory, Winter 2003, pp. 30-31
Slide-to-Stop Braking Tests

After the test vehicle was returned to the as-built (unmodified) state, straight-line slide-to-stop braking tests were conducted by the Colorado State Patrol. The first braking test by the District One Accident Reconstruction Team had a pre-braking speed of 31.0 miles per hour and average deceleration rate of 0.70g. The second braking test conducted at a pre-braking of 21.3 miles per hour generated an average deceleration rate of 0.73g. The average deceleration rate of the slide-to-stop tests exceeded the minimum braking performance requirement of 0.52g for an in-use passenger-carrying vehicle built on a truck or bus chassis with a manufacturer’s gross vehicle weight rating of 10,000 pounds or less (see Figure 8).\(^\text{12}\)

![Deceleration Profile of Test Vehicle in As-Built State](image)

**FIGURE 8** – Deceleration Profile of Test Vehicle in As-Built State

DISCUSSION

The installation of oversize tires had the most profound effect on changes to rollover propensity and increased pedal forces for achieving equivalent levels of deceleration with oversize tires. Similar results were found when a series of straight-line braking tests sponsored by NHTSA were conducted to study the dynamic response properties of a modified light-duty truck, heavy-duty truck and sport-utility vehicle equipped with body/suspension lift kits and oversize tires.\(^\text{13}\) The reduction in braking performance of the test vehicle was primarily due to the installation of oversize tires and not the body and suspension lift kits. A 10-year research and investigation of crashes of modified vehicles by the Virginia Commonwealth

\(^{12}\) Braking Performance, Section 393.52(c)(2), Federal Motor Carrier Safety Regulations, United States Department of Transportation

University Crash Investigation Team concluded that oversize tires were likely the single most dangerous modification to “high-rise” vehicles.\textsuperscript{14}

Several initiatives have been taken to raise the awareness of vehicle owners about the consequences of equipping light trucks with oversize tires. Articles have been published to inform or remind owners about the need to upgrade braking systems to offset the effect oversize tires could have on the stopping capability of altered-height vehicles. \textsuperscript{15,16,17,18,19} Original Equipment Manufacturers attach warning labels to educate end users about the adverse effects of oversize tires (see Figure 9). Special supplements are also supplied to vehicle owners to warn about the installation of tires larger in size than those recommended by the Original Equipment Manufacturer or aftermarket lift kits that could adversely affect handling characteristics of vehicles and potentially lead to loss of control, rollover, and serious injury.\textsuperscript{20}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{warning_labels.png}
\caption{Factory-Equipped Warning Labels Applied to Light Trucks}
\end{figure}

There may be a trend toward installing larger size wheels and tires on new generation light trucks. The Chevrolet Cheyenne and Toyota FJ Cruiser were two “concept” vehicles outfitted with 35-inch tires on 22-inch wheels and 33-inch tires on 20-inch wheels, respectively, on display at the 2003 North American International Auto Show.\textsuperscript{21} Concept light trucks with large size wheels and tires were also revealed at the 2002 SAE Truck & Bus Conference & Exhibition.

\textsuperscript{14} Modified Vehicles, Special Report Number 9, Crash Investigation Team Report, May 1991
\textsuperscript{15} Big Tires NEED Big Brakes, Four Wheeler, December 2000, pp. 32-35
\textsuperscript{16} Big Wheels Demand Upgraded Stopping Power, Sport Truck, June 2003, pp. 36-45
\textsuperscript{17} What's Stopping You?, Truckin’, September 2002, pp. 294-290
\textsuperscript{18} Baer Down: Size Does Make a Difference, Truckin’, July 2003, pp. 131-140
\textsuperscript{19} Stopping by Stillen: Better Brakes for your Baby, 4-Wheel & Off-Road, May 2003, pp. 124-127
\textsuperscript{20} Four Wheeling, F751-19A285-AA, August 2000 (second printing)
\textsuperscript{21} NAIAS Concepts, Automotive Engineering, SAE International, February 2003, pp. 47-64
The diameter of tires on the Mighty F-350 Tonka concept light truck (LT315/60R22) are considerably greater in height (>5 inches) than the standard size tires (LT265/75R16) mounted on the F-350 light truck (see Figure 10). If manufactured for retail sale, concept light trucks with large tires would, unlike a proportion of in-use vehicles whose ride height has been excessively raised with lift kits and/or oversize tires, be required to comply with all federal standards until the first retail sale. Several safety issues associated with the installation of aftermarket body and suspension lift kits and/or oversize tires on the intended crash avoidance and crashworthiness design features of in-use vehicles may be addressed by the compliance of new generation light trucks with Federal Motor Vehicle Safety Standards (FMVSS). The solutions are not restricted and dependent, however, on the production of new vehicles but (as noted on pages 13-16) may be developed and implemented to address safety concerns with in-use altered-height vehicles.

The findings of this exploratory study are restricted to the test vehicle involved in the project and not the entire population of altered-height vehicles whose ride height has been raised by the installation of lift kits and/or oversize tires. Unlike tests conducted at higher speeds, the short duration of low-speed tests did not permit problems caused by a prolonged brake application to be detected by the flat plat tester. The front to rear balance braking at low speeds has been found to differ at higher speeds and the short duration of applied brake force make the repeatability of results hard to control. There are also limitations to the relative small sample size, and the test vehicle may not necessarily represent the typical approach taken to alter the ride height of light trucks. Despite these limitations, the results of the study indicate that

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Marting, P.G. and Colarelli, N.J., Low Speed Plate Brake Tester, SAE Paper Number 901701
additional research and initiatives are warranted to address several safety issues that surround the installation of body and suspension lift kits and/or oversize tires on light trucks.

RECOMMENDATIONS

Initiatives that could be taken to further understand, quantify or address safety issues associated with the excessive increase in ride height that can result from the installation of body and suspension lift kits and/or oversize tires are provided.

To the American Association of Motor Vehicle Administrators

1. Develop, for identification purposes, a clear definition of what constitutes an “altered-height” vehicle.

2. Assemble a Working Group to develop model legislation that contains uniform inspection guidelines for inspecting vehicles outfitted with aftermarket body and suspension lift kits and/or oversize tires. Such guidelines could be instrumental in assisting jurisdictions to develop, revise or enhance regulations with the requisite criteria for determining what conditions warrant an altered-height vehicle to be placed out-of-service when subjected to a periodic or random inspection. The Working Group may consider the feasibility of permitting certified inspection facilities to use performance-based brake testers as a tool for augmenting visual inspections conducted on altered-height vehicles.

3. Assemble a Working Group with participation from the International Association of Chiefs of Police and National Sheriffs’ Association to develop model legislation that could be adopted and implemented, when warranted, to enforce excessive ride height by tire size. Determine the feasibility of developing regulation based on a gross discrepancy between the tire size displayed on the sidewall of replacement tires and maximum recommended tire size stipulated by the original equipment manufacturer as denoted on the compliance label on light trucks. Similar regulation was established in Australia to restrict the overall diameter of tires to 15mm above the largest tire and wheel assembly specified for the vehicle.23

4. Explore the feasibility of developing model legislation, if warranted, that would require inspections to be conducted and certification labels installed when the ride height of an altered-height vehicle has been raised beyond a pre-determined and specified limit. Certification labels are currently required whenever a person or company revises axle or weight ratings before the first purchase by the final customer.24

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23 Guidelines for Alternative Wheels and Tyres, Vehicle Standards Information Number 9, Revision 2, Roads & Traffic Authority of New South Wales, April 1998
24 Requirements for Persons who Alter Certified Vehicles, 49CFR, Part 567.7
5. Schedule a meeting with the NHTSA Office of Chief Counsel to review the intent of specific Federal Motor Vehicle Safety Standards that may be compromised by the installation of aftermarket suspension and body lift kits and/or oversize tires.

To the National Transportation Safety Board

6. Conduct a “special” study to obtain a better understanding about the cause-effect relationship that may exist between the increased ride height and crash involvement of light trucks outfitted with aftermarket body and suspension lift kits and/or oversize tires. Consider establishing the requisite criteria to compare the severity of occupant injuries resulting from the crash involvement of light trucks in the as-built state (control group) with a representative sample of light trucks equipped with tires that exceed the maximum recommended size stipulated by the original equipment manufacturer (study group). If warranted, identify strategic measures and issue recommendations that could be instrumental in addressing safety issues associated with altered-height vehicles.

To the Society of Automotive Engineers

7. Assemble a technical committee to identify safe practices and develop guidelines that would be instrumental in providing pertinent information about what must be considered when installing replacement tires on light trucks. The intent of the document and scope of the committee would not be to endorse, regulate, or limit ride height, but raise awareness about safety issues that should be considered when decisions are being made about the installation of replacement tires on light trucks. A similar initiative for undertaking any form of vehicle suspension modification in SAE J2492 recommended that end users be warned that suspension modifications could change the handling characteristics from the vehicle manufacturer’s original design.  

To the Specialty Equipment Market Association

8. Develop and distribute warning messages and brochures to raise the awareness of end users about the effect oversize tires could have on the handling characteristics of light trucks. The initiative may be of interest and fulfilled by members of the Specialty Equipment Market Association (SEMA) who manufacturer, supply, promote or market for retail sale aftermarket components directed at increasing original ride height. Such measures are voluntarily being taken by the manufacturer of a suspension lift kit to notify motorists that warranty is dependent upon, and moreover, void if the “Warning to Driver” decal is not properly displayed on the vehicle (see Figure 11). In addition, due to the possibility of rollover, the manufacturer also recommends that vehicles whose ride height has been altered with the installation of an aftermarket suspension lift kit be equipped with a functional roll bar and cage system.

25 Considerations for Suspension Modification, Surface Vehicle Recommended Practice, SAE J2492, June 1999
http://www.superlift.com/lkb.htm
A campaign administered by SEMA to raise the awareness of end users about differences in handling and performance characteristics from increased ride height could be influential and effective in reducing the crash involvement and severity of light trucks outfitted with body and suspension lift kits and/or oversize tires.

To the National Highway Traffic Safety Administration

9. Examine collision data from the (a) Fatal Analysis Reporting System, (b) General Estimate System, and (c) Crashworthiness Data System to establish a problem size assessment associated with light trucks whose ride heights have been excessively raised by the installation of aftermarket body and suspension lift kits and/or oversize tires.

10. In cooperation with the Specialty Equipment Market Association determine whether strategic initiatives could be taken to estimate the population of light trucks whose ride heights (relative to the as-built state) have been excessively raised by the installation of body and suspension lift kits and/or oversize tires.

11. Expand on an initiative taken by NHTSA to publish a brochure on tire safety to further raise public awareness about the safety implications of equipping light trucks with replacement tires that exceed the maximum recommended size stipulated by the original equipment manufacturer.

12. Conduct a series of dynamic track tests at higher speeds and with a larger and more representative sample of light trucks whose ride heights have been excessively raised with lift kits and/or oversize tires to evaluate the full compliance of altered-height vehicles with Federal Motor Vehicle Safety Standards. Incorporate in the testing program the similar computerized steering system and “fishhook” maneuver that will be used to establish the rollover risk predictions of passenger vehicles, beginning with 2004 model year, and enhance the existing rollover ratings system.

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27 Tire Safety: Everything Rides On It, DOT HS 809 361, October 2001
28 NHTSA News, 7 October 2003
13. Include in the priority plan for 2005-2006 (in addition to newly manufactured light trucks) the testing and analysis for addressing the vehicle incompatibility between passenger cars and in-use light trucks equipped with body and suspension lift kits and/or oversize tires.\(^{29}\) A decision by NHTSA to perform track tests would support a recommendation from the U.S. General Accounting Office that research be sponsored by NHTSA to support state periodic motor vehicle inspection programs and promote public awareness for the need to properly maintain safety-critical components of vehicles.\(^{30}\)

**To Individual States and Provinces**

14. Conduct a search to determine the number of police-reported collisions between 1997 and 2003 that involved light trucks equipped with modified suspensions and/or oversize tires. If data limitations restrict the ability to conduct such an analysis, take measures to modify the existing collision report to permit law enforcement officials to indicate whether light trucks involved in collisions were equipped with aftermarket suspension or body lift kits and/or oversize tires.

**COMMENTS**

Written comments about information contained in this report or the subject of altered-height vehicles are encouraged. Forward submissions to:

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\(^{29}\) NHTSA News, 21 July 2003  
\(^{30}\) NHTSA Should Resume Its Support of State Periodic Inspection Programs, Report Number GAO/RCED-90-175