

THE SAFETY ASPECTS OF CHOPPER MOTORCYCLES

A Literature Survey in Response to HJR #90

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A Report Prepared by the Virginia Highway and Transportation  
Research Council Under the Sponsorship of the  
Highway Safety Division of Virginia

Virginia Highway and Transportation Research Council  
(A Cooperative Organization Sponsored Jointly by the Virginia  
Department of Highways and Transportation and  
the University of Virginia)

Charlottesville, Virginia

November 1974  
VHTRC 75-R18



## CONCLUSIONS AND RECOMMENDATIONS

The conclusions of this report are as follows:

- (1) At this time, there is no empirical evidence that would suggest that chopper motorcycles are overrepresented among motorcycle accidents.
- (2) In relation to chopper motorcycle design and demographic characteristics of chopper motorcycle drivers, there is indirect evidence that would lend support to the opinion that modified motorcycles may not present a safety hazard.
- (3) In relation to handling characteristics, chopper motorcycles may be more stable than stock motorcycles, although steering is slower and handling may be lighter or heavier.
- (4) Due to the importance of weld quality and the need for greater steering neck strength when front forks are extended, a safety hazard may be posed by a lack of quality control on motorcycles modified by amateur builders.

From these conclusions, the following actions are recommended:

- (1) Procedures should be initiated to distinguish between modified and non-modified motorcycles either at the time of registration or at the time of inspection. These procedures would provide information on the number and kinds of modified motorcycles in operation.
- (2) The Vehicle Equipment Safety Commission Standards, when released in final form, should be critically examined and evaluated prior to any administrative decision, to determine if they are applicable and adequate for adoption in Virginia.

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## INTRODUCTION

The increase in motorcycle sales, registrations, riders, and licensed operators has been unusually rapid in recent years. Since 1970 the numbers of licensed operators and registered motorcycles have increased almost 300% (see Table 1). These figures do not include motorcycles which are used off the highways or are classified as minibikes, nor do they include unlicensed operators who ride off the highways.

Fatal, personal injury, and property damage crashes have also increased since 1970 (see Table 1). Because off-highway riders do not need to be licensed and motorcycles used off-highway do not need to be registered, it is difficult to determine the size of the motorcycle population. Consequently, it is difficult to make any conclusive statements concerning accidents in terms of percentages of the total population. While registrations are not exact indicators of the size of this population at risk, they do portray certain trends and offer an indication of the magnitude of the chopper motorcycle problem. For instance, between 1969 and 1973, North Carolina's motorcycle registrations increased 104%, compared to an increase of 17% among passenger cars. During the same period, fatalities involving passenger cars increased 4%, while those involving motorcycles jumped 72.5%. The seriousness of motorcycle crashes is indicated by the fact that "once a motorcycle accident occurs, there is a high probability that a serious injury or fatality will result."<sup>1/</sup> More than half of all single vehicle and about 80% of all multiple vehicle motorcycle crashes

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<sup>1/</sup> Reiss, M. L., Berger, W. G., and Vallette, G. R., "The Utilization of a Motorcycle Accident Typology," Biotechnology, Incorporated, Falls Church, Virginia, unpublished.

Table 1

## VIRGINIA MOTORCYCLE DATA

Category	Year				
	1970	1971	1972	1973	1974
Licensed Motorcycle Operators (a)	43,182 (d)	60,166 (d)	85,473 (d)	Not Available	128,221 (Actual)
Registered Motorcycles (a, b)	33,583 (e)	42,609 (e)	53,727 (f)	Not Available	93,699 (g)
Fatal Crashes (c)	27	40	58	58	Not Available
Personal Injury Crashes (c)	1,297	1,650	1,984	2,592	Not Available
Property Damage Crashes (c)	316	430	564	752	Not Available
Total Crashes (c)	1,640	2,120	2,206	3,402	Not Available

- (a) Data obtained from A. D. Harvey, Va. DMV  
 (b) Minibikes and off street bikes not included  
 (c) Figures were taken from Crash Facts and are on a calendar year basis  
 (d) Average of calendar and fiscal year of following year  
 (e) License year ending on 31 March  
 (f) License year ending on 29 February  
 (g) Fiscal year ending 30 June

result in a serious injury or fatality.<sup>2/</sup> Thus, motorcyclists have been shown to be operating under more risk than passenger car drivers. The safety problem which motorcycling now constitutes has been termed "epidemical".<sup>3/</sup>

An interesting component of the motorcycle problem involves the role of vehicle defects in multiple vehicle accidents.<sup>4/</sup> In these crashes, defects among motorcycles were determined to be causal more often than were defects among corresponding passenger cars. This finding has implications for a phenomenon which has accompanied increased motorcycle sales and registrations: that of customizing or modifying the machine. This phenomenon, similar to the "hot rods" of the 1950's, allows an owner to create his own individualized transportation form, commonly known as a "chopper." Because some of these motorcycles appear to have a radical design which might affect handling, stability, and safety, and because some modifications are performed by amateur builders, the Virginia General Assembly requested a study of motorcycles and customized motorcycles (see Appendix A for a copy of H.J.R. 90).

#### PURPOSE

This study was initiated to examine certain safety characteristics of modified motorcycles. Are motorcycles which can be classified as "choppers" less safe than standard, retail, stock machines? Do personal modifications differ from professional modifications with respect to safety characteristics?

#### STATEMENT OF THE PROBLEM

Although there is no exact or universal definition of the term "chopper motorcycle", there are enough similarities in style, modification, and concept to reach a working definition. For the purpose of this study, the chopper motorcycle definition will be limited to modifications of the front end suspension and fork assembly. The design often includes extended front forks, a narrow wheel and tire, and, where legal, the absence of front brakes. There are other modifications which are commonly made including those to the handlebars, seat, gas tank, lights, and fenders, but these are beyond the scope of this study.

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<sup>2/</sup> Griffin, Lindsay, "Motorcycle Accidents: Who, When, Where, and Why," Highway Safety Research Center, Chapel Hill, North Carolina, March 1974.

<sup>3/</sup> Reiss, et al., op. cit.

<sup>4/</sup> Griffin, op. cit.

The term "chopper" originated with the process of cutting, or chopping, the frame so as to change the angle of the forks in relation to the frame (see Figure 1). A section is cut out of the top frame member, the frame below the steering head is heated, and the steering head is pulled back. The top member is then rewelded. Chopping the top frame member is not the only method used to modify the angle of the steering assembly. Other methods include: cutting and lengthening vertical frame members; cutting, repositioning, and rewelding the steering assembly; and using a "rake plate assembly" that replaces standard triple clamps and does not require cutting and welding (see Figure 2). Rake plates reposition the forks by supporting the stanchions farther away at the lower triple clamp.

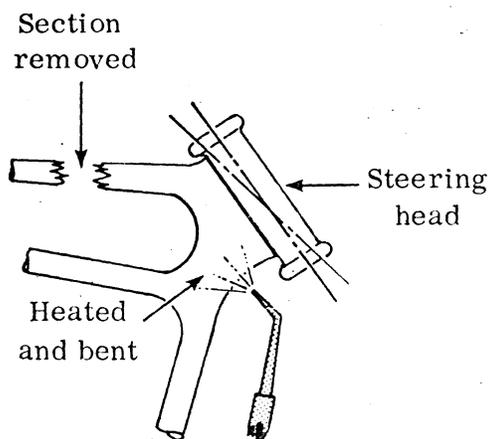


Figure 1. Modification by frame chopping.

(From "Choppers ... Yes or No,"  
The Air Force Driver, January  
 1972, p. 6.)

There are three terms which must be defined and illustrated because of their special significance in describing chopper motorcycles (see Figure 3). These are rake, trail, and extension. Rake refers to the angle or slope of the front end assembly, measured in degrees, between a line through the steering axis and a perpendicular line through the steering head. Trail is the distance, measured in inches, between the center of the tire contact patch and a line which is extended through the steering axis. Extension refers to the process of lengthening the front forks and is measured in inches.

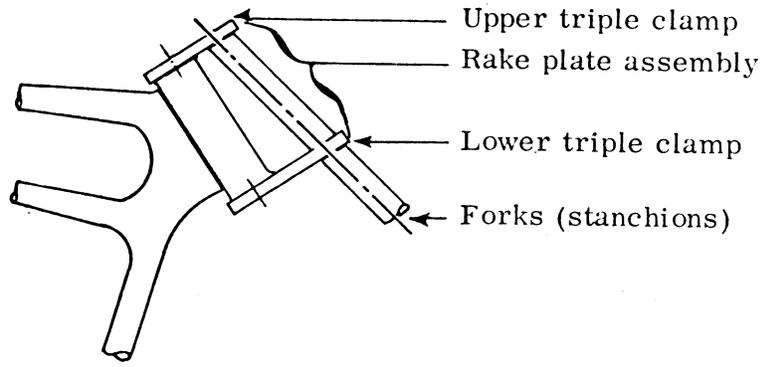


Figure 2. Modification using rake plate assembly.

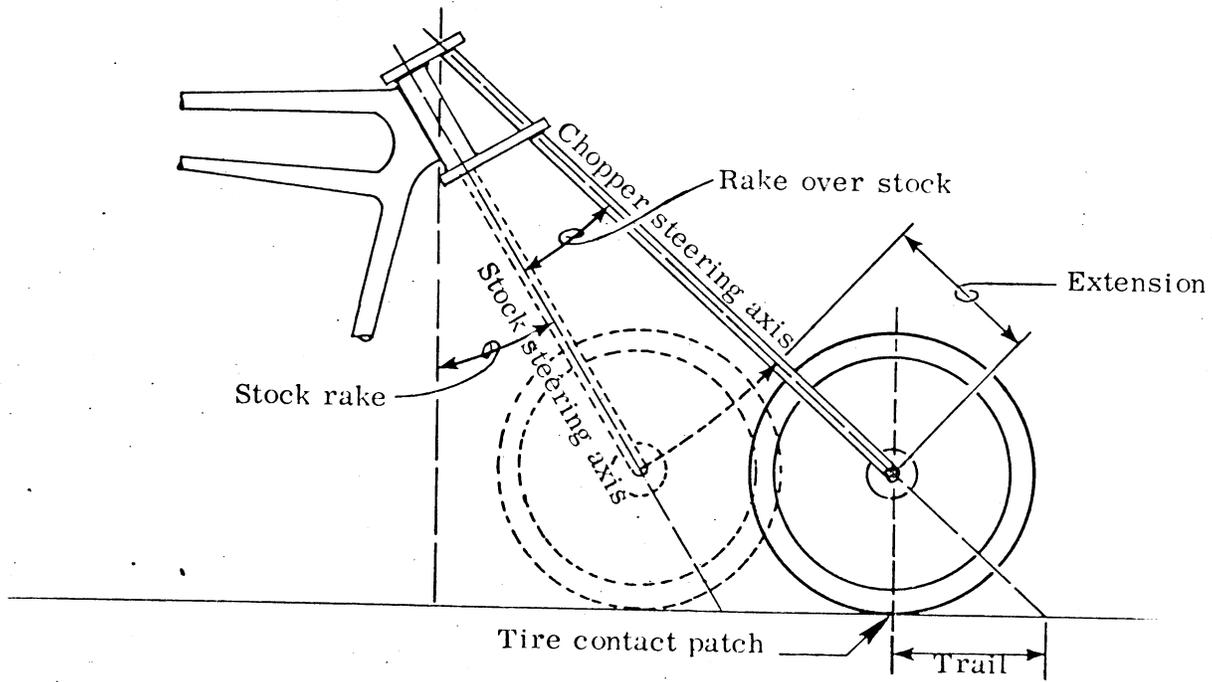


Figure 3. Illustration of terms.

On stock motorcycles rake angles vary between 25 and 30 degrees and the trail ranges between +2.5 to +4.0 inches. Custom motorcycle building can include modification to any or all of the rake, trail, or extension measurements. It can be accomplished through the use of commercially available custom parts, by the professional chopper shop modification of the stock bike, or by the personal modification of the stock bike.

The standard model stock motorcycle available through a retail dealer represents a consolidation of engineering design after careful consideration of multifaceted uses for the machine. Therefore, it may be possible to improve the design if the use of the machine is limited to a single purpose. However, the question remains whether there should be restrictions on the extent of modification. The issue is complicated by the fact that each standard model stock motorcycle has a variety of design characteristics. Structure, material, handling, stability, and center of gravity are factors considered in arriving at a particular design. Modifications which affect these design factors may also affect the safety characteristics of the machine.

The diversity of opinion on the modification issue can be characterized by the positions of two major groups. The motorcycle industry and the motorcycle dealers favor strict limitation of modifications, while ABATE and the National Custom Cycle Safety Institute advocate permitting great latitude in motorcycle modifications. The first group lobbies for strict and complete legislative control of the subject while the second group opposes "the arbitrary outlawing ... of certain modifications."<sup>5/</sup> Since most of the research summarized in this report was sponsored by one or another of these groups, the reader should give special attention to the origins of each report.

#### METHODOLOGY

Time limitations and lack of financial resources prohibited original research of metallurgical, handling, engineering, and accident characteristics of modified motorcycles for this study. Therefore a survey format was utilized in an attempt to reach an answer to the question of whether chopper motorcycles are less safe than stock motorcycles. A variety of individuals and organizations were contacted and replies were received from most of them (see Appendix B). Unfortunately very few research reports were received and few of the reports received dealt specifically with modified motorcycles.

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5/ An editorial comment prefacing an article by William M. Otto, "What is a Safe Rake?". ABATE, Seal Beach, California, October 1972.

## ANALYSIS

Research which was reviewed can be placed in three major categories according to the questions they attempt to answer. These categories are: (1) Studies which attempt to ascertain whether chopper motorcycles constitute a safety hazard in terms of accident experience (Injury and Crash Studies), (2) studies which assume that a safety hazard may exist and attempt to determine structural sources of the problem (Engineering Studies), and (3) studies which examine the states' attempts to regulate chopper motorcycles (Legal and Administrative Survey). These categories are discussed separately in the following subsections.

### Injury and Crash Studies

The small number of accident studies pertaining to modified motorcycles are subject to two major constraints. First, many of these studies deal exclusively with accidents which were reported through accident report forms. The literature has shown that this method drastically underestimates the problem involved, since many motorcycle accidents go unreported.<sup>6,7,8/</sup> For example a study of injury patterns in motorcycle collisions was conducted in Sacramento County, California, during 1970.<sup>9/</sup> The average length of stay for persons hospitalized as a result of these collisions was 12 days and the median length of stay was 6 days. The injuries reported were rather severe, but only 38.5% of the collisions were reported to the authorities. It is evident that studies which rely solely on reported accidents greatly understate the frequency of motorcycle injuries and accidents.

The second major limitation under which these studies must be interpreted involves comparison groups. Comparisons of absolute numbers of accidents for two groups of drivers are meaningless unless the total number of drivers in each group is known. The

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- 6/ Clark, D. W., and Morton, J. H., "The Motorcycle Accident: A Growing Problem," Journal of Trauma, 11:230-237, 1971.
- 7/ Haddon, W., "Energy Damage and the Ten Countermeasure Strategies," Journal of Trauma, 13: 321-331, 1973.
- 8/ Pieron, A. P., and Grogono, B. J. S., "Two Wheel Trauma," Manitoba Medical Review, 46:334-337, 1966.
- 9/ Drysdale, W. F., Kraus, J. F., Franti, C. E., and Riggins, R. S., "Injury Patterns in Motorcycle Collisions," The Departments of Orthopedic Surgery and Community Health, University of California School of Medicine, Davis, California, March 1974.

determination of the size of this "population at risk" enables researchers to compare accident experiences of different groups by converting numbers of accidents into percentages. In this case, in order to determine whether stock motorcycles and modified motorcycles have different accident experiences, it is necessary to determine the number of each in operation on the highways. The studies which are presented in this section do not determine the population at risk in relation to chopper motorcycles and therefore, are of limited usefulness.

During November of 1969, a special study was conducted in California to determine the relationship between motorcycle equipment modifications and crash experience.<sup>10/</sup> State and local police officers in several jurisdictions were asked to complete a special accident report form to determine whether certain modifications were present on motorcycles involved in accidents, and whether, in the opinion of the investigating officer, the motorcycle had modifications which contributed to the accident. Several types of modifications were surveyed, including: (1) Whether a windshield was present, (2) whether safety or roll bars were present, (3) whether the front forks had been extended, (4) whether the seat had been lowered, (5) whether the foot rests had been raised, (6) whether the handlebars had been raised, lowered, or otherwise altered, or (7) whether the front brakes had been removed. Of the accidents surveyed, none of the motorcycles had windshields, safety bars, or roll bars.

Of the 542 motorcycle fatality or injury crashes investigated, 42 (about 7.7%), involved a motorcycle with one or more of the above mentioned equipment modifications. Of these 42 crashes, the equipment modification was suspected to be causally related in seven cases, which represent 16.6% of modified motorcycle crashes and 1.3% of the total number of crashes. In these cases, modifications were distributed as shown in Table 2.

Because this study encompassed only one month and was not conducted on a statewide basis, the author of the study felt that the data might be misleading due to seasonal or geographic fluctuations known to influence motorcycle accidents. For this reason, study data were compared to yearly accident data for the entire state in relation to the percentages of accidents involving modified motorcycles by city size, weather conditions, road surface conditions, driver age, and vehicle model year. It was concluded that any variations between the study period (November 1969) and statewide annual data produced little or no misleading affect on survey results. However, because of the small number of accidents involving contributory modifications, and because the population at risk has not been determined, these findings cannot be considered conclusive in determining the relative accident potential of various modifications.

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<sup>10/</sup> Moss, Anthony, "Motorcycle Accident Survey," California Highway Patrol, Sacramento, January 1970.

Table 2

## DISTRIBUTION OF ACCIDENT CONTRIBUTING MODIFICATIONS

Motorcycle Number	Modification				
	Extended Front Forks	Lowered Seat	Raised Foot Rest	Irregular Handlebars	No Front Brakes
1	X			X	
2	X			X	
3	X	X	X		
4	X	X		X	
5	X	X		X	X
6	X	X	X	X	X
7	X	X	X	X	X

The basic findings of this study were similar to the results of a study conducted by the Virginia Department of State Police which followed a similar methodology.<sup>11/</sup> A memorandum summarizing results of this study is presented in Appendix C. During a three-month period between July 1 and September 30, 1974, 288 motorcycle accidents were investigated. Of these, 16 (5.6%) of the accidents involved motorcycles which were noted to have been modified. In two cases the investigating officer felt that the modification had contributed to the accident. However, due to difficulties in determining the total number of modified motorcycles and due to the small number of contributory modifications, the results of this study do not fully answer the safety question.

These studies demonstrate that there is no conclusive, empirical evidence to support the idea that chopper motorcycle operators are overrepresented in accidents, as compared to drivers of non-modified cycles. There is some evidence, however indirect, that chopper motorcycles may be less dangerous in design than stock bikes and that their drivers, as a group, may be less likely to be involved in accidents.

<sup>11/</sup> Virginia Department of State Police, Col. H. W. Burgess, Superintendent, from a memo on motorcycle safety dated October 18, 1974.

In a study conducted at the Institute of Transportation and Traffic Engineering at UCLA, a series of collision experiments were conducted.<sup>12/</sup> These collisions involved a stock motorcycle and dummy rider striking into the side of a passenger car and were conducted to determine crash effects on the motorcycle and the rider. After photographic and electronic measurements were recorded and analyzed, the authors concluded that in order to improve the safety aspects of stock motorcycles, "... minor design changes that would increase collapse distance and improve collapse performance" should be encouraged.<sup>13/</sup>

"For example, extending and strengthening the front forks may not appreciably alter handling characteristics and would improve collapse distance and collapse energy absorption for the motorcycle. Carried more to the extreme, the exceptionally extended front forks... provided greater bending distances before 'bottoming out' took place, and this fork action during collapse elevated the front of the motorcycle, serving to slow the rider's pitch against the opposing car."<sup>14/</sup> (Emphasis supplied.)

The redesign and strengthening of the front fork assembly in stock bikes has been recommended by several other researchers.<sup>15,16/</sup> This tends to lend support to the opinion that chopper motorcycles can be of safer design than non-modified motorcycles.

The demographic characteristics of chopper motorcyclists seem to indicate that they have a statistically smaller chance of being involved in accidents. It has been established that younger and less experienced motorcycle drivers have a higher proportion

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<sup>12/</sup> Severy, D. M., Brink, H. M., and Blaisdell, D. M., "Motorcycle Collision Experiments," SAE Technical Paper No. 700897, 1970.

<sup>13/</sup> Ibid., page 84.

<sup>14/</sup> Ibid., page 105.

<sup>15/</sup> Haddon, op. cit.

<sup>16/</sup> U. S. Department of Transportation, Proceedings of the Second International Conference on Automotive Safety, Volume 1: Motorcycle Safety, July 1973.

of accidents than older, more experienced operators.<sup>17,18,19/</sup> Since chopper motorcycles are expensive and rather complicated to build and maintain, it is logical (and has been established in the literature) that they will be owned and operated by older and more experienced individuals.<sup>20/</sup> These riders are less likely, as a group, to be involved in a crash. In addition, it was found that 20% of all motorcycle accidents which occurred in North Carolina in 1970 happened either the first or second time the victim had ridden a motorcycle, and that 23% of these accidents involved borrowed bikes.<sup>21/</sup> Neither of these conditions would be likely to apply to as complex and expensive a piece of machinery as a chopper motorcycle.

Thus, it appears that modified motorcycles have not been established to be a safety hazard in relation to accident experience. Such a determination should be a prerequisite to administrative action related to chopper motorcycle standards and regulations.

### Engineering Studies

Several studies have been conducted to determine which characteristics of motorcycle modification produced the greatest safety hazard. Studies dealing with the most common modifications, those to the front fork assembly, were investigated, as were studies concerned with the structure, handling, and rake angle. A report has been issued dealing with each of these factors. The first to be summarized here was conducted by William M. Otto for ABATE, a pro-modification organization.<sup>22/</sup> Both constant force, due primarily to the weight of the bike and rider, and varying forces, due primarily to road conditions, were investigated. A major conclusion was that as the front wheel is extended it supports less of the total

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<sup>17/</sup> Barry, Patricia Z., "The Role of Inexperience in Motorcycle Crashes," Highway Safety Research Center, Chapel Hill, North Carolina, 1970.

<sup>18/</sup> Harano, R. M., and Peck, R. C., "The California Motorcycle Study: Driver and Accident Characteristics," California Department of Motor Vehicles, Sacramento, California, July 1968.

<sup>19/</sup> Pieron and Grogono, op. cit.

<sup>20/</sup> Motorcycle Facts, National Safety Council, Statistics Division, September 1972.

<sup>21/</sup> Barry, op. cit.

<sup>22/</sup> Otto, op. cit.

weight of the bike but causes increased torque, or force, on the steering neck. This increased torque is a very significant factor when considering structural integrity. It is not sufficient to restore a steering neck only to original strength if an extension to the front fork increases the wheelbase. Another major conclusion of the study was that "contrary to popular belief, braking forces are not concentrated on the front wheel of long wheelbase bikes." The reader is cautioned against drawing the conclusion that a front wheel brake is unnecessary, as the braking forces have only been changed, not eliminated entirely.

The second report deals with instability and handling problems associated with raked necks and extended front forks.<sup>23/</sup> Velocity, gravity, centrifugal acceleration, gyroscopic action of the wheels (torque), torque supplied by actions of the rider, and nutation (vibration due to the spin of the wheel on the axle) were discussed individually and compositely. Among the conclusions drawn from the study, the following are of interest to this report:

- (1) The average chopper with raked neck and extended forks will tend to have a larger trail and will more likely be stable than the same bike when stock.
- (2) The feel of handling can be either heavier (sluggish) or lighter (quicker) than that of stock cycles depending upon several variables, including the amount of weight on the front wheel, increases or decreases in trail and increases or decreases in steering inertia. It is also possible to have a more stable and lighter handling bike by proper choice of steering neck setback (the distance between the axle and the steering axis).
- (3) Raking and extending will always slow down steering and make required steering motions larger.
- (4) It would appear that almost any handlebar arrangement would be adequate from a maximum torque point of view, but it would appear that a near optimum setup would have the bars with a two-foot span between handgrips and with the handgrips between mid-chest and shoulder level.

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<sup>23/</sup> Otto, William M., and Overton, R. K., "What is a Safe Rake? (Part II), Instability and Handling Problems." ABATE, Seal Beach, California, February 1973.

In summary, stability in chopper motorcycles tends to increase with increases in trail, rake angle, and extension of front forks, but these increases also tend to slow steering and make steering motions more severe. The handlebar arrangement in chopper motorcycles is nearly optimal in terms of maximum torque. The only aspect of chopper motorcycles which remains variable is that of the feel of handling, which is dependent upon a number of other possible modifications. These findings would indicate that the modification of a motorcycle does not necessarily result in an unsafe machine.

Another structural aspect of motorcycle modification which has been examined is the quality of construction done by private individuals. Telephone and personal conversations with chopper motorcycle builders pointed out the critical importance of the quality of welding in construction, a common component of modification. Builders need to be experienced in welding, use proper techniques, and use proper equipment. The absence of any of these factors influences whether the weld will be strong enough under normal use.

There are two methods for testing weld quality. One, destructive testing, is not a practical alternative; and the other, X-ray analysis, is expensive. Since weld quality cannot be conveniently tested at registration or inspection times one alternative would be to require the use of certified parts in the construction of modified motorcycles. Because commercial concerns have equipment available for testing and certification of weld quality, another alternative would be to develop a state certification procedure so that homemade parts could be used.

AEE Choppers, Inc., a motorcycle accessory company<sup>24/</sup> has published a paper which addressed several questions relating to the metallurgical and structural aspects of motorcycle construction and weld quality. They use the 16th edition of Machinery Handbook and the Alloy Digest as source documents for data concerning strengths and grades of steel, as well as for the diameter and wall thickness of tubing used in construction. In providing commercial custom parts to the builder, the firm states that they use engineering design, static testing, in use (actual highway use) testing, and data analysis of results to provide safe and reliable parts. However, the reader is reminded that all research must be considered in relation to its source.

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<sup>24/</sup> Brackett, D., "Traffic Safety and the Custom Motorcycle Builder."  
AEE Choppers, Inc., Placentia, California (no date).

The need for some sort of regulation of motorcycle modifications is almost universally agreed upon within the motorcycle industry, the special interest groups and among many riders. However, there is little agreement as to which components of modifications should be standardized. A set of standards is being developed by the Vehicle Equipment Safety Commission, of which Virginia is a member. In theory, these standards should constitute a fair representation of all concerned groups, since no one group's interests are involved to the exclusion of the others. However, there are reactions within the motorcycle industry to a draft version of the standards which indicate that this may not be the case.<sup>25/</sup> Since the exact content and final format of the VESC standards are not yet known, a discussion of them now would be superfluous. Suffice it to say that when the final version of the standards becomes available (and if the existence of the problem has been documented by that time), a careful examination and analysis will be necessary.

Finally, due to the small amount of material available through regular sources, D. C. Bischoff of the National Highway Traffic Safety Administration was contacted to determine federal involvement in research on modified motorcycles.<sup>26/</sup> His response appears in Appendix D. Although there is no ongoing research specifically concerning modified motorcycles, his letter expresses various opinions concerning motorcycle modification and standardization which can be inferred to represent the position of this agency. These include the following:

- (1) Frame and suspension modifications are a complex and difficult area to regulate. Research indicates that the handling and stability characteristics of motorcycles are a result of the combined effects of a large number of variables. Ruling out all modifications to frame and suspension is a naive approach, since stability can often be improved through front-end modification.
- (2) Legal requirements that specify only that the machine be equipped with a front brake will not suffice. It is recommended that a dynamometer test of retardation capability be employed at the time of state inspection.

<sup>25/</sup> Powers, L., "New Legislation, the VESC Affair," Motorcycle Industry, Vol. 3, No. 10, October 1974.

<sup>26/</sup> Bischoff, D. C., Technical Manager, Motorcycle Safety Improvement Program, U. S. Department of Transportation, National Highway Traffic Safety Administration, in a letter to W. S. Ferguson dated June 1974.

- (3) His agency is presently engaged in a study of stock motorcycle handling qualities which may yield information which would be applied to certain modified cycles. Standardization suggestions generated by this study will be forwarded to the states.

### Legislative and Administrative Efforts

A survey of various state legislative and administrative efforts was conducted to determine how other states have dealt with the regulation of motorcycle modifications. The survey began with a letter addressed to the attorneys general of each state, requesting information about regulation of motorcycle modifications in their states. The response of some attorneys general's offices was limited to legislative efforts and did not reflect detailed regulations promulgated by administrative agencies of the state; therefore, it was necessary to contact other agencies such as state police, divisions of motor vehicles, and departments of public safety. The table found in Appendix E provides a summary of state legislative and administrative efforts and indicates the source of the information contained therein.

Information contained in Appendix E indicates that 38 states have no statutes or regulations concerning modification of suspension or extension of the front fork of a motorcycle. The remainder of the states surveyed have diverse efforts ranging from vague and potentially invalid statutes and regulations to unusually precise requirements. Several states claim an ability to reach chopper motorcycles by the use of general statutes relating to all motor vehicles. For example, New Jersey and North Dakota prohibit changes in the manufacturer's original design of the frame, steering assembly or suspension system. These requirements are very similar to a Colorado statute which was invalidated by the Supreme Court of Colorado.<sup>27/</sup>

Several states have focused their legislative and regulatory efforts directly at the question of modification of frame, suspension and front forks. Some have chosen to regulate extensions of the front fork by defining allowable modifications in terms of variance from the manufacturer's stock motorcycle;<sup>28/</sup> other states limit the

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<sup>27/</sup> People v. Von Tersch, 505 P. 2d 5 (1973). A discussion of this case will be found at p.16 , infra.

<sup>28/</sup> See information contained in Appendix E for the following states: Hawaii (two counties), Maine, Mississippi, Pennsylvania, Rhode Island, Wisconsin, District of Columbia.

total length of the front fork regardless of stock specifications;<sup>29/</sup> and still other states require specific maneuverability of the motorcycle.<sup>30/</sup> Only two states include requirements as to rake and trail.<sup>31/</sup>

It would appear that states must be careful not to make their legislative or regulatory requirements overly broad in scope. A Colorado statute provided in part,

"No person shall operate a motor vehicle of a type required to be registered under the laws of this state upon a public highway with either the rear or front suspension system altered or changed from the manufacturer's original design. ..." <sup>32/</sup>

The Supreme Court of Colorado in People v. Von Tersch<sup>33/</sup> invalidated the statute on the basis that it was unconstitutionally overbroad. The court states, "A law cannot be so general in its scope that it includes within its prohibitions the right to engage in certain activities which cannot under the police powers be reasonably classified as unlawful and thus, subject to criminal sanctions."<sup>34/</sup> There may be modifications of the manufacturer's original design which do not adversely affect the safe operation of the vehicle and may in some instances improve the safety characteristics of the vehicle. Clearly the state interest involved is the safety of the operator and his passengers, as well as the safety of pedestrians and other drivers. It would appear that statutes and regulations in this area must not only bear a reasonable relationship to a legitimate state interest, but must also be sufficiently definitive so as to provide proper notice and not prohibit conduct which is not related to a legitimate state interest.

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<sup>29/</sup> See information contained in Appendix E for the following states: Hawaii (two counties), Oklahoma.

<sup>30/</sup> See information contained in Appendix E for the following states: New Mexico, Connecticut.

<sup>31/</sup> See information contained in Appendix E for the following states: Hawaii, Wisconsin.

<sup>32/</sup> Col. Rev. Stat. § 13-5-166.

<sup>33/</sup> 505 P. 2d 5 (1973).

<sup>34/</sup> Id. at 27.

As mentioned previously, the VESC is developing regulations to deal with modified motorcycles. Virginia is a member of the Vehicle Equipment Safety Compact and Virginia Code Ann. § 46.1-308.3 and § 46.1-319 allow the Superintendent of State Police to adopt the VESC Standard for Virginia. No additional legislative act would be necessary, however, the Superintendent would have to meet the requirements of the General Administrative Agencies Act<sup>35/</sup> before these standards could be promulgated into administrative rules.

## FINDINGS

This survey was divided into three sections: (1) crash and injury studies, (2) engineering and metallurgical studies, and (3) legislative and administrative efforts. Several conclusions can be drawn from each of these areas.

Motorcycle riders sustain severe injuries when involved in collisions but tend not to report their accidents. These victims compose a proportionally greater number of young and inexperienced riders. The riders of chopper motorcycles were not involved in a large number of accidents, but the frequency of these accidents could not be computed.

Available engineering research specifically related to modifications of rake, trail, fork extension, or the structural integrity of the frame indicated that some modifications improve the handling and stability of the motorcycle. The make and model of the motorcycle, its intended use, and the amount and degree of modification influence the safety characteristics of the motorcycle. At this time, there is no single set of limits which is recognized as setting the parameters of safe motorcycle modifications.

Weld quality, structural integrity, and metallurgical considerations are also important in modified motorcycle construction. The building of a long wheel base bike requires that reconstruction be guided by sound engineering principles. Restoration of originally specified strengths is not sufficient.

The survey of the various states' legislative and administrative efforts to define and control motorcycle modifications showed that most states (38) do not have statutes or regulations

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<sup>35/</sup> Va. Code Ann. § 9-6.1 et seq.

which deal with extension of front forks or modification of suspension. The remainder of the states have made a variety of efforts, but in only four jurisdictions (the city and county of Honolulu, the county of Hawaii, and the states of Wisconsin and Oklahoma) are they precise enough to include specific characteristics of the chopper motorcycle. The diversity of these efforts indicates that there is no definitive or clear solution to the regulation of modified motorcycles. Whenever legislative regulation of this area is attempted, the Colorado experience would indicate that legislation should not be over broad in its scope.

Finally, specific legislative acts of the General Assembly are not necessary to regulate motorcycle modifications because the Code of Virginia allows the Superintendent of State Police to adopt the VESC Standards when they become available.

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APPENDIX A

LD2221

1 HOUSE JOINT RESOLUTION NO. 90

2 Offered February 11, 1974

3 *Directing a study of "chopper" motorcycles.*

4

5 Patron—Mr. Durette

6

7 Referred to the Committee on Militia and Police

8

9 Whereas, there is an increasing number of motorcycles being  
10 operated on the highways of Virginia; and

11 Whereas, many of these motorcycles are being modified in vari-  
12 ous ways through the use of custom-made parts, and

13 Whereas, the highway safety characteristics of such modified  
14 motorcycles are currently unknown, but available evidence indi-  
15 cates that many are unsafe; and

16 Whereas, the Commonwealth needs to be able to assure the  
17 continued safety of the operators of these motorcycles along with  
18 others using Virginia's highways; now, therefore, be it

19 Resolved by the House of Delegates, the Senate concurring,  
20 That the Highway Safety Division and the Department of State Po-  
21 lice are directed to jointly make a study and investigation of motor-  
22 cycles and customized motorcycles on the highways of Virginia,  
23 and, with the assistance of the Virginia Motorcycle Dealers Associa-  
24 tion, the National Custom Cycle Safety Institute, the Vehicle Equip-  
25 ment Safety Commission and other interested groups and individu-  
26 als, to make a report to the Governor and the General Assembly not  
27 later than December one, nineteen hundred and seventy-four.

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Official Use by Clerks

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Agreed to By  
The House of Delegates  
with amendment  
without amendment

Agreed to By The Senate  
with amendment  
without amendment

Date: .....

Date: .....

.....

.....

Clerk of the House of Delegates

Clerk of the Senate

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## APPENDIX B

## SURVEY SOURCES OF DATA

Individual and/or Organization Contacted	Method Used	Reply Received	Research Received
(1) American Motorcycle Assoc.	Letter	Yes	None
(2) National Custom Cycle Safety Institute			
(a) Mr. E. P. Grant	Letter (2)	No	
	Phone	Yes	Yes
(b) Mr. Les Fitch	Phone	No	
(3) Motorcycle Safety and Education Foundation	Letter	Yes	None
(4) National Highway Traffic Safety Administration			
(a) Mr. Lewis Buchanan	Letter	No	
	Phone	Yes	None
(b) Mr. Don Bishoff	Letter	Yes	Yes
	Phone	Yes	None
(c) Mr. Harold Thursby	Phone	Yes	Yes
(5) Vehicle Equipment Safety Commission	Letter	Yes	None
(6) Virginia Motorcycle Dealers Association, Inc.			
Mr. C. B. Neblett	Letter	Yes	Yes
	Phone	Yes	None
(7) Motorcycle Industry Magazine	Letter	Yes	Yes
(8) Motorcycle Industry Council, Inc.	Letter	Yes	Yes
(9) Modified Motorcycle Assoc.			
Mr. Ronald Roloff	Letter	No	
(10) Triple A Accessories			
Mr. Marshall Yaokum	Letter	No	
(11) Texas Transportation Inst.			
Mr. J. E. Martinez	Letter	No	

(12) R. E. Sanford & Assoc.	Letter	Yes	None
(13) ABATE			
(a) Mr. Wm. Otto	Letter	No	
(b) Mr. Keith Ball	Letter	Yes	None
	Phone	Yes	None
(14) Denver Research Inst. Dr. Harry Peterson	Letter	No	
(15) Calspan Corporation Mr. R. Douglas Roland	Letter	Yes	Yes
(16) Virginia Division of Motor Vehicles	Phone	Yes	Yes
(17) J. & E. Cycles Staunton, Va.	Personal Visit	Yes	Yes
(18) Highway Research Information Service	Phone	Yes	Yes
(19) Office of Attorney General of each state	Letter	23	N/A
(20) Appropriate Administrative Agency in each state	Phone	Yes	Yes, if Available

COPY

## APPENDIX C

Richmond, Virginia 23261

October 18, 1974

To : Colonel H. W. Burgess

Subject: Motorcycle Study

In order to obtain some accident data for use in compliance with the provisions of House Joint Resolution # 90 adopted by the 1974 General Assembly, our departmental members were asked to complete a questionnaire containing eight items on each motorcycle crash which they worked between July 1, 1974 and December 31, 1974.

For the period of July 1 through September 30, two hundred eighty-eight (288) completed questionnaires were received in this office. An evaluation of these questionnaires revealed that in two hundred seventy-two (272) of the crashes, the motorcycle involved did not have any modifications made to the frame, fork or other components of the suspension system.

The crashes involving the motorcycle appeared to have occurred pretty much State wide. However, the jurisdictions having the largest number of crashes appeared to be from the central part of the State. Seventeen crashes occurred in Campbell County, twelve in Augusta County, eleven in Bedford County and eleven in Pittsylvania County. Attached to this report under Appendix A is a list of the jurisdictions in which the crashes included in this study occurred.

Listed below are the eight items contained in the questionnaire and the summary of the answers received:

1. Had any modification been made to the frame, fork, or other components of the suspension system of the involved motorcycle?

Answer: Sixteen reports reflected "yes".

Colonel H. W. Burgess

Page 2

October 18, 1974

2. Briefly describe the modifications which existed:

Answer: High rise handlebars - 1  
Fork extended - 12  
Frame reworked, lowered seat, raised handlebars - 1  
Hard tail, no shocks on rear, fork extended - 1  
Seat modified, clutch and brake pedals to accommodate  
extended handlebars - 1

3. Was there any evidence of failure in the motorcycle frame, fork, or other components of the suspension system?

Answer: One report reflected that there was evidence of failure and described the failure as follows:  
"The left side of the fork came unscrewed from the frame - this caused the frame to strike the highway and overturned the motorcycle several times".

4. Was the evidence of failure in the metal used to construct the frame or fork?

Answer: One report reflected that there was evidence of failure and described the failure as follows:  
"The front forks were slightly bent due to the impact of hitting an embankment".

5. Was the evidence of failure in the welding utilized in the construction of the frame or fork?

Answer: No evidence of such failure was reported.

6. In your opinion, did the modifications to the motorcycle contribute to the cause of the crash?

Two of the reports reflected "yes" answers to this question.

7. Was the motorcycle equipped with brakes on both the front and rear wheel or wheels?

Five of the reports reflected "no" answers to this question.

Colonel H. W. Burgess

Page 3

October 18, 1974

8. Please include any other information which you feel might be useful to the committee conducting the motorcycle study in compliance with the provisions of House Joint Resolution # 90 adopted by the 1974 General Assembly.
  - a. On four of the reports, the reporting member felt that if the motorcycle headlamp was required to burn during the daytime, the crash might have been prevented.
  - b. On one report, the member felt that the inspection of the sprocket chain should be made a part of the State inspection program.
  - c. On three of the reports, the member felt that had the motorcycle been equipped with side crash bars, injuries might have been prevented.

While motorcycles are operated in this State throughout the year, the months of July, August and September are peak months for such operation and it is questionable in my mind at the present time if we have sufficient cause based upon the crash experience for this period to recommend the need of having a law to prohibit modifications from being made to a motorcycle's frame, fork or other components of its suspension system.

Safety Officer

RMT/di

Enclosures

APPENDIX A

<u>JURISDICTION</u>	<u>NUMBER OF CRASHES</u>
Accomack	3
Albemarle	3
Alleghany	2
Amherst	8
Amelia	1
Appomattox	1
Arlington	1
Augusta	12
Bedford	11
Bland	1
Botetourt	5
Buchanan	4
Campbell	17
Caroline	2
Carroll	4
Charlotte	2
Charles City	2
Chesterfield	5
Clarke	3
Craig	2
Culpeper	4
Dickenson	4
Essex	1
Fairfax	3
Fauquier	5
Franklin	7
Frederick	3
Giles	3
Glouster	2
Goochland	3
Grayson	4
Greene	1
Halifax	6
Hampton	1
Hanover	1
Henrico	2
Henry	7
Highland	3
Isle of Wight	2
James City	1
King George	1
King William	2
Lee	2
Loudoun	3
Louisa	3
Lunenburg	1

JURISDICTIONNUMBER OF CRASHES

Madison	4
Mathews	1
Mecklenburg	2
Montgomery	3
Nelson	2
New Kent	1
Northampton	1
Northumberland	1
Nottoway	1
Orange	1
Pittsylvania	11
Powhatan	1
Prince Edward	1
Prince George	1
Pulaski	7
Roanoke	7
Rockbridge	5
Rockingham	6
Russell	4
Scott	4
Shenandoah	1
Smyth	3
Southampton	3
Spotsylvania	7
Stafford	4
Surry	2
Tazewell	6
Warren	2
Washington	6
Westmoreland	3
Wise	4
York	5
Alexandria	1
Chesapeake	1
Portsmouth	1
Newport News	2
Norfolk	6
Virginia Beach	3



APPENDIX D



U.S. DEPARTMENT OF TRANSPORTATION  
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION  
WASHINGTON, D.C. 20590

IN REPLY REFER TO:

June 28, 1974

N43-11

Mr. W. S. Ferguson  
Head, Safety Section  
Highway Research Council  
Commonwealth of Virginia  
Box 3817 Univeristy Station  
Charlottesville, Virginia 22903

Dear Mr. Ferguson:

I am replying to your request for information on the highway safety characteristics of modified motorcycles, commonly known as "choppers." The answers are numbered in the same sequence that the questions were posed.

1. I am not aware of any generally recognized definition of a "chopper" motorcycle. The term originated quite simply from the expression of "chopping" or cutting of the standard motorcycle to create a custom motorcycle. This chopping very typically took place at the steering neck in order to rake or angle the fork legs more toward the horizontal. I prefer to use the general term modified motorcycle, since there are an infinite number of combinations of possible alterations that can and are being made to production machines.
2. The NHTSA has promulgated six Federal Motor Vehicle Safety Standards (FMVSS) which are applicable to motorcycles; a brief summary of each is enclosed. I am sure you are aware that the FMVSS apply only to vehicles at the time of initial retail sale. There are no Federal regulations for safety equipment on vehicles currently in use and none are anticipated in the near future.
3. Organizations and individuals and their related areas of interest I would suggest contacting are the following:
  - a. Handling and Stability - R. Douglas Roland, Calspan Corporation, Buffalo, New York.
  - b. Crashworthiness and Rider Protection - Dr. Harry Peterson, Denver Research Institute, University of Denver, Denver, Colorado.

c. Front-end Modifications - William Otto, ABATE, Box 2280, Seal Beach, California.

4. The "Dynamics of Motorcycle Impact Study," which has been an on-going NHTSA funded project since 1969, has included crash testing of motorcycles with various typical custom modifications. Generally speaking, most modifications are contraindicated with regard to injury mitigation in a crash environment. Some of the modifications tested included hi-rise handlebars, sissy bars, upswept exhaust stacks, and custom seats. Copies of the report may be obtained from the National Technical Information Service, Springfield, Virginia 22151.

We are just beginning a research project entitled "Accident Avoidance Capabilities of Motorcycles" which has a two-fold objective (a) to develop a set of motorcycle accident avoidance test procedures and (b) to evaluate the accident avoidance capabilities of a representative sample of motorcycles using the above test procedures. The sample of vehicles is comprised entirely of production motorcycles, however, and there are no immediate plans to test modified motorcycles.

5. Specific suggestions with regard to your study of modified motorcycles:

a. My personal feeling regarding the modified motorcycle problem is that the single largest problem, and fortunately one of the easiest to remedy, is the trend toward complete removal or replacement of the front brake with an inadequate unit. Most production machines have 70% (it is recognized that this figure will be somewhat less for motorcycles with extended front-ends) of their braking capability in the front wheel, therefore, lack of a good front brake can double stopping distance. Since a legal requirement that specifies only that the machine must be equipped with a front brake will not suffice, I recommend a dynamometer test of retardation capability at time of state inspection.

b. Frame and suspension modification is a very complex and difficult area to regulate. Research indicates that the handling and stability characteristics of motor-

cycles are a result of the combined effect of a large number of variables. Since infinite combinations of these variables are found in custom motorcycles you can begin to appreciate the complexity of the problem at hand. Some states have chosen to regulate the amount of rake a front fork may have, arbitrarily choosing an angle such as 45° as maximum. Since in no way does rake alone define the stability of the machine, this is a very naive approach. Ruling out all modifications to frame and suspension is equally naive, since the stability can oft times be improved through front-end modification. The manufacturer uses a compromise geometry which he feels is the best trade-off for high-speed stability, ease of steering, banking, etc., and depending on the usage to which the particular vehicle is being put, improvements can often be made in a particular area. After completion of the handling research I described in (4) I hope we will know a lot more about this area and can offer you concrete suggestions.

c. Another major problem area is the structural integrity of modifications from a design and workmanship standpoint. Short of such things as destructive testing, I do not know of a way to cope with this problem.

I have been very brief and general in my answers to your questions because volumes could be written in answer. If you do have more specific questions in a particular area, please feel free to contact me.

Sincerely,



Donald C. Bischoff  
Technical Manager  
Motorcycle Safety  
Improvement Program

Enclosure



## APPENDIX E

## SUMMARY OF RELEVANT CODES AND ADMINISTRATIVE REGULATIONS

## ALABAMA — State Police

Motorcycle inspection is not required but may be conducted at the discretion of the State Police. No statutes or regulations deal with modification of suspension or extension of front fork.

## ALASKA — Attorney General; State Police

No statutes or regulations deal with modification of suspension or extension of front fork.

## ARIZONA — Attorney General

Motor vehicle inspection is not required but the State Police may inspect at their discretion. No statutes or regulations deal with modification of suspension or extension of front fork.

## ARKANSAS — State Police

No statutes or regulations deal with modification of suspension or extension of front fork.

## CALIFORNIA — State Police

13 Cal. Ad. Code § 24002 provides that "It is unlawful to operate any vehicle or combination of vehicles which is in an unsafe condition . . . ." Section 24008.5 provides that "an 'unsafe condition' within the meaning of Section 24002 includes, but is not limited to, the raising of the center of gravity or other modification of a vehicle so as to unsafely affect its operation or stability."

## COLORADO — Attorney General; Motor Vehicle Division of Department of Revenue

Col. Rev. Stat. § 13-5-166 reads in part, "No person shall operate a motor vehicle of a type required to be registered under the laws of this state upon a public highway with either the rear or front suspension system altered or changed from the manufacturer's original design. . . ." The statute has been successfully challenged in Colorado state courts on the ground that the manufacturer's original design was not necessarily the only safe design. At the present time Colorado has no statutes or regulations in force that deal with modification of suspension or extension of front fork.

## CONNECTICUT — Division of Motor Vehicles

Conn. Gen. Stat. § 14-103(a) provides in part, "Any motor vehicle, composed or assembled from the several parts of other motor vehicles, or the identification and body contours of which are so altered that the vehicle no longer bears the characteristics of any specific make of motor vehicle, shall be inspected by the Commissioner to determine whether the vehicle is properly equipped and in good mechanical condition." Further, the vehicle must be able to be navigated through a serpentine course of cones placed three feet apart on centers, and around cones placed fifteen feet apart on centers.

## DELAWARE — Department of Public Safety

No statutes or regulations deal with modification of suspension or extension of front fork.

## DISTRICT OF COLUMBIA — Department of Motor Vehicles

32 D. C. Code Ann § 6.103 provides in part, "The steering mechanism of every motor vehicle shall be assembled, adjusted, and maintained according to the vehicle manufacturer's specifications." The Code also states "Any modifications to the forks or frames of a motorcycle shall be approved by the Director." No guidelines or standards for the approval by the Director are specified.

## FLORIDA — Attorney General

No statutes or regulations deal with modifications of suspension or extension of front fork.

## GEORGIA — Attorney General; State Police

No statutes or regulations deal with modification of suspension or extension of front fork. However, Georgia Code Ann. § 68A-1305 prohibits operation of any motorcycle "with a back rest most commonly known as a sissy bar that is designed in such a way as to create a sharp point at its apex."

## HAWAII — Attorney General; Police Departments of two counties

No state statutes or regulations deal with modification of suspension or extension of front fork; however, two counties have developed regulations in these areas.

City and County of Honolulu: "The fork tube length shall not be extended more than eighteen (18) inches over the length of the original stock fork of the original vehicle.

"The altered 'RAKE' of the steering neck and frame shall be limited to a maximum of fifty (50) degrees of fork angle with a minimum of two (2) inches of 'Trail'.

factor on any frame, except when used on a servibike or a motorcycle with a sidecar attachment. "

County of Hawaii: "The front fork assembly of all motorcycles shall have shock absorbing springs either exposed or enclosed. Springs shall be of appropriate strength and capacity for absorbing normal road shock. . . . fork length shall not exceed 45 inches or shall not be greater than 16 inches above the original factory length of the standard fork assembly for the frame used on the vehicle.

"Original forks may not be lengthened by welding or otherwise extending their length. If longer than standard forks are to be used, they must be manufactured by a recognized supplier in the business of furnishing specialties of this type. Forks may not be heated, welded, home bent or shaped.

"Motorcycles shall present an almost 'level' appearance, with a slight 'pointing up' at the front no more than five (5) degrees.

"If longer than original forks are to be used the frame will have to be modified to retain a nearly level attitude of the motorcycle. This modification is usually called 'raking.' The accepted rake angle shall be restricted to an angle of not more than forty-five (45) degrees to keep the motorcycle approximately level. This 'level' shall be judged by the position of the engine or lower frame rails. Rake and trails shall be considered acceptable, if, with longer than standard forks, the machine is level or not 'pointed up' at the front more than five (5) degrees. "

#### IDAHO — State Police

No statutes or regulations deal with modification of suspension or extension of front fork.

#### ILLINOIS — Attorney General

Inspection of motor vehicles is required only for trucks. No statutes or regulations deal with modification of suspension or extension of front fork.

#### INDIANA — Department of Traffic Safety and Vehicle Inspection

No statutes or regulations deal with modification of suspension or extension of front fork.

#### IOWA — Department of Public Safety

No statutes or regulations deal with modification of suspension or extension of front fork. Department of Public Safety will soon adopt the Vehicle Equipment Safety Commission Standard in this area.

## KANSAS — State Highway Commission

Motor Vehicle inspection is not required. No statutes or regulations deal with modification of suspension or extension of front fork.

## KENTUCKY — Attorney General; Bureau of Motor Vehicle Regulation

No statutes or regulations deal with modification of suspension or extension of front fork.

## LOUISIANA — State Police

No statutes or regulations deal with modification of suspension or extension of front fork.

## MAINE — Attorney General; State Police

Regulations drafted by the Maine State Police pursuant to the authority of 29 Me. Rev. Stat. § 2122 provide that approval shall be refused when any modifications have been made to a motorcycle which increases the distance between axles to the point where the vehicle exceeds the measurements in the following table:

<u>Engine c. c.</u>	<u>Distance in Inches</u>
50 - 350	58
400 - 500	66
600 - 900	74
1000 - 1200	80
Over 1200	82

Also, the front fork may be extended not more than 16" beyond the original position. "Springer type forks" are acceptable if the extended length is not beyond 18.

## MARYLAND — State Police

No statutes or regulations deal with modification of suspension or extension of front fork.

## MASSACHUSETTS — Attorney General

No statutes or regulations deal with modification of suspension or extension of front fork.

## MICHIGAN — State Police

No statutes or regulations in effect deal with modification of suspension or extension of front fork. House Bill No. 5936 which was defeated on May 28, 1974 provided in part,

" A person shall not sell, or offer for sale, or operate on a highway a motorcycle which is manufactured or assembled having a front fork rake exceeding 41 degrees. . . .

"A motorcycle shall not be equipped with nor shall a person operate on the highways, a motorcycle equipped with slug or screw-in type fork extensions.

"A person shall not sell or offer for sale, or operate on a highway a motorcycle equipped with front forks greater than 45 inches in length, or measured from the center of the front wheel axle to the top of the upper front fork crown.

"A person shall not sell, or offer for sale, or operate on a highway a motorcycle having a front wheel rim of less than 16 inches in diameter."

## MINNESOTA — Attorney General

No statutes or regulations deal with modification of suspension or extension of front fork.

## MISSISSIPPI — Attorney General; Highway Patrol

Administrative regulations prohibit extension of the front fork that exceed 3 inches.

## MISSOURI — Attorney General; State Police

No statutes or regulations deal with modification of suspension or extension of front fork. Assistant Attorney General Mark D. Mittleman reports that "The Missouri Division of Highway Safety feels that this item is of a low priority in comparison to other matters such as compulsory seat belt legislation and has therefore not seriously investigated the problem."

## MONTANA — Attorney General

Section 32-21-154 of the Montana Code requires all motor vehicles to be "in safe mechanical condition as not to endanger the driver or other occupants or any person upon the highway."

## NEBRASKA — Attorney General

No statutes or regulations deal with modification of suspension or extension of front fork.

## NEVADA — Department of Motor Vehicles; Attorney General

No statutes or regulations deal with modification of suspension or extension of front fork.

## NEW HAMPSHIRE — Attorney General

No statutes or regulations deal with modification of suspension or extension of front fork. The matter is currently being considered by the Division of Motor Vehicles.

## NEW JERSEY — Division of Motor Vehicles

Administrative regulation (13:4-142) promulgated by the Division of Motor Vehicles states, "No certificate of approval shall be issued by an Examiner or Inspection Station of the New Jersey Division of Motor Vehicles for a motor vehicle which has the steering mechanism, frame, or suspension system in a condition not equivalent to the vehicle manufacturer's specifications."

## NEW MEXICO — Attorney General

N. M. Stat. Ann. § 64-20-42.2 provides that, "No motorcycle shall be equipped in a manner such that it is incapable of turning a ninety (90) degree angle within a circle having a radius of not more than fourteen (14) feet."

## NEW YORK — Department of Motor Vehicles

No statutes or regulations deal with modification of suspension or extension of front fork. Assistant Counsel Joyce M. Wrenn observed "New York has no statistics which indicate that choppers are less safe than stock motorcycles. Indeed, because of the lengthened wheel base caused by extending the front end, choppers may be more stable than stock cycles."

## NORTH CAROLINA — Attorney General; Division of Motor Vehicles

No statutes or regulations deal with modification of suspension or extension of front fork.

## NORTH DAKOTA — Highway Department

Section 39-21-45.1 of the North Dakota Century Code reads in part: "It shall be unlawful for any person to operate a motor vehicle of a type required to be registered under the laws of the state. . . with either the rear or front end suspension system or steering mechanism altered or changed from the manufacturer's original design . . ." (Note that this statute is almost identical to the Colorado statute which was invalidated by the Colorado Supreme Court).

## OHIO — Department of Highway Safety

No statutes or regulations deal with the modification of suspension or extension of front fork.

## OKLAHOMA — Attorney General; State Police

State Police report that length of the front fork cannot exceed 48" as measured from the top of the triple clamp (where the handle bars meet the frame) to the center of the front axle.

## OREGON — Traffic Safety Commission

No statutes or regulations in force deal with modification of suspension or extension of front fork. Senate Bill 855 (1973) which failed to pass the legislature would have prohibited operation of a motor vehicle "if the axles of the motor vehicle are wider than the manufacturer's recommended specifications."

## PENNSYLVANIA — Attorney General; Bureau of Traffic Safety

Administrative regulations promulgated by the Department of Transportation prohibit an extended fork on motorcycles except when the original manufacturer has made the installation or when the vehicle is titled and registered as a "reconstructed motor vehicle." The regulations further prohibit extension of the front fork that exceeds 6 inches and the modification of the front fork may not "raise or lower the plane originally designed for the body selected. . ." "Before a title or registration can be issued for a reconstructed motor vehicle the applicant must obtain a certification from an official inspection station stating that the vehicle meets all of the requirements as to inspection and equipment in the Vehicle Code and Inspection Station Requirements Manual."

## RHODE ISLAND — Department of Transportation

Administrative regulations require rejection of the motorcycle for "any fork that has been extended beyond the specifications of the manufacturer."

## SOUTH CAROLINA — Division of Motor Vehicles

No statutes or regulations deal with modification of suspension or extension of front fork.

## SOUTH DAKOTA — Attorney General

No statutes or regulations deal with modification of suspension or extension of front fork.

## TENNESSEE — Department of Safety; State Police

Motor vehicle inspection is not mandatory. No statutes or regulations deal with modification of suspension or extension of front fork.

## TEXAS — Department of Public Safety

No statutes or regulations deal with modification of suspension or extension of front fork.

## UTAH — Highway Patrol

No statutes or regulations deal with modification of suspension or extension of front fork.

## VERMONT — Department of Motor Vehicles

No statutes or regulations deal with modification of suspension or extension of front fork.

## VIRGINIA — State Police; Highway Research Council

No statutes or regulations deal with modification of suspension or extension of front fork. Va. Code Ann. §46.1-279.1 requires motorcycles manufactured after July 1, 1974 and operated upon State highways to be equipped with both front and rear brakes. This code section also prohibits disconnection of front or rear brakes on any model manufactured prior to July 1, 1974.

## WASHINGTON — Highway Patrol

No statutes or regulations deal with modification of suspension or extension of front fork.

## WEST VIRGINIA — Highway Patrol

No statutes or regulations deal with modification of suspension or extension of front fork. A bill (House Bill 1012) introduced on March 13, 1973 died in committee but would have provided that:

- (a) No motor vehicle shall be operated on any street or highway in this state with either the front or rear suspension altered or changed from the manufacturer's original design to the extent that such alteration or change shall adversely affect the control of the vehicle or alter the stance or plane of the vehicle from that originally intended by the manufacturer.
- (b) No motorcycle or motor driven cycle shall be operated on any street or highway in this state with either the front or rear suspension altered or changed from the manufacturer's original design to the extent that it shall adversely affect the control of the vehicle. Any alteration of the frame or extension of the front forks which causes the fork angle to exceed forty degrees shall be considered an adverse control modification.
- (c) Any homemade or rebuilt vehicle, including motorcycle and motor driven cycles, must have a front and rear suspension system which is in general conformity with standard engineering practices unless sufficient engineering data are presented . . . which would indicate that the design and use employed are safe and acceptable.

WISCONSIN — Attorney General

5 Wis. Admin. Code § MVD 5.12, which concerns steering and suspension of motorcycles, requires in part, "Any motor driven cycle with a modified front suspension system so modified before January 1, 1975, shall have a rake of no more than 43° nor a trail of less than 2 inches. Any motor driven cycle commencing with the 1975 models shall not be modified in any way to cause the front suspension system to have a rake of more than 40° nor a trail of less than 2 inches . . . . No alterations or modifications may be made to the suspension system, axles or chassis that would cause any portion of the vehicle to ride higher or lower by more than 2 inches from that specified by the manufacturer when measured from the level surface upon which the vehicle stands . . . . A motor driven cycle shall be equipped with a shock absorbing front suspension system. The main tubes or sliding tubes on a telescoping front suspension system shall be of one piece construction. Screw on extensions (slugs) shall not be used."

WYOMING — Highway Department

No statutes or regulations deal with modification of suspension or extension of front fork.

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