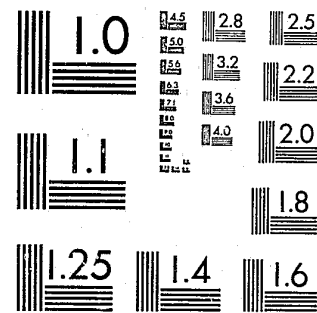


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EVALUATION OF SEMIMARKED POLICE VEHICLES

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Illinois Department of Law Enforcement
Bureau of Planning and Development
Springfield, Illinois

Ted L. Stocia
April 20, 1983

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Illinois Department of Law Enforcement

EVALUATION OF SEMIMARKED POLICE VEHICLES

U.S. Department of Justice
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ACQUISITIONS

EXECUTIVE SUMMARY

Research conducted by the Department of Law Enforcement in 1981 indicated that fuel consumption by patrol vehicles could be reduced by not equipping the vehicles with roof-mounted light bars (visabars). Savings were also projected through reduced equipment costs. Analyses of 1980 accidents involving marked and unmarked units indicated that no increase in accidents would result from removing the visabars.

As a result of that research, in 1982 sixty semimarked (decal but no visabars), vehicles were assigned to personnel. Sixty marked units were also assigned. The units were paired so a marked and a semimarked unit were assigned to similar patrols. Data on accidents worked, reports completed, motorist assists made, and warnings issued indicates that the patrols were similar for the two groups in terms of work load. Data indicated that officers assigned semimarked units also achieved better fuel mileage, and incurred fewer and less severe accidents than marked units. They also achieved higher productivity with regard to the issuance of citations for speeding.

The evaluation also included a survey of the perceptions of officers who were assigned semimarked units. Officers' perceptions with regard to semimarked vehicles indicated, among other things, a high degree of public approval, greater productivity, better performance (in terms of acceleration, fuel consumption and top speed), little impact on voluntary compliance, some degree of greater difficulty in vehicle recognition by the public, and, some level of reduced safety to the driver and the motoring public. For each of the five statements dealing with increased safety, at least half of the officers perceived "no difference" between

marked and semimarked units. A significant percentage of the remaining officers saw a limited degree of decreased safety associated with semimarked units and a few saw a high level of decreased safety. However, these feelings on safety are put into perspective by the fact that 90 percent of the responding officers did not want visabars put on their semimarked units while only 6 percent (three officers) would make such a request. The remainder (two officers) were undecided. Also, as already stated, accident experience indicates a lower incidence of accidents for semimarked units than for marked units.

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EVALUATION OF SEMIMARKED VEHICLES

INTRODUCTION

During 1981, the Illinois Department of Law Enforcement conducted research which concluded that fuel consumption by patrol vehicles could be reduced by not equipping vehicles with roof-mounted light bars.¹ Data indicated a potential savings of 5.5 to 12 percent in fuel, depending upon the model of light bars the vehicle had used. The research included an analysis of 1980 accidents involving Illinois State Police patrol cars. That analysis showed that unmarked cars had a lower incidence of accidents than marked units. This information coupled with other research findings² led to the conclusions that roof-mounted light bars played no significant role in reducing the accident potential for state police patrol vehicles and that substantial savings could be realized in terms of fuel and reduced equipment costs if roof-mounted equipment was no longer utilized. Consequently, the report recommended that the Illinois State Police utilize semimarked patrol units. These units would have traditional police markings but would not be equipped with roof-mounted light bars.

In the spring of 1982, the Illinois State Police issued sixty semimarked vehicles to officers. Each of these vehicles was a new 1982 model Ford. The vehicles were assigned to all districts except District 15 (toll road), and Districts 3 and 4 (Cook County). For each semimarked vehicle, the districts were also given a new marked vehicle (with roof-mounted light bars) which was to be assigned to a patrol similar to that of the semimarked unit. Discretion for choosing comparable patrols was given to the districts. The result of this process was sixty pairs of

similar vehicles assigned to similar patrols; one vehicle in each pair being a semimarked unit (no roof equipment) and the other being a fully marked unit.

FUEL CONSUMPTION

As already stated, research in this area indicated that vehicles equipped with roof-mounted light bars would consume more fuel than those without the equipment. This is the result of aerodynamic drag produced by the light bars. Because the tests supporting these conclusions were conducted in wind tunnels or under controlled situations where constant speeds were driven, the total impact on the fuel consumption of actual patrol vehicles was not known.³

The Department of Law Enforcement collected fuel consumption data on the test vehicles from the date they were put into service. For most pairs of vehicles, this involved a period of approximately six months. Fifty-six pairs were used for this part of the evaluation. Two of the semimarked units were paired with older marked units and, consequently, they are not included in the comparisons. Similarly, the patrols for two other pairs were thought to be dissimilar. Fuel consumption for the 112 vehicles was measured over more than 1.4 million miles.

The final data indicates that for 36 of the 56 pairs of vehicles, the semimarked unit obtained better fuel mileage (more miles per gallon) than the unit with a light bar. If the light bars had no effect on fuel consumption probability theory indicates that approximately half of the pairs marked units would achieve better mileage and, for the other half, semimarked units would achieve better mileage. The probability that the semimarked unit would achieve better mileage for 36 of the 56 pairs if the light bars had no impact is only .03 (3 times in

100). Thus, using the sign test, it is possible to conclude, at the .03 level of statistical significance, that removal of light bars increases the mileage of state police patrol vehicles.

A second, more powerful statistical test was also applied to the data. The Wilcoxon Test considers the number of pairs in which each type of vehicle achieved better mileage as did the sign test, but also considers the magnitude of the difference. Although more powerful, the Wilcoxon Test yielded results which were consistent with those of the sign test. The Z score of 2.12 is significant at the .02 level, indicating that the roof-mounted equipment does adversely affect fuel consumption.

The next question which naturally arises deals with the amount of difference in fuel consumption between the two groups. The vehicles with light bars averaged 11.79 m.p.g. while the semimarked units averaged 12.55 m.p.g., a 6.4 percent improvement over fully marked units.

The 6.4 percent figure reflects the fact that for 20 pairs of test vehicles, the fully marked vehicles obtained more miles per gallon of fuel consumed than the semimarked vehicles. Both the Wilcoxon and sign tests indicate that the 36 pairs in which the semimarked vehicles obtained better mileage than the marked unit represent the "norm". That is, realistically speaking, unless other factors came into play, all semimarked vehicles should get better mileage than fully marked units when they are appropriately paired or on a before and after test. The twenty cases in which the marked units achieved better mileage represent cases in which other factors came into play. There is further evidence of this when each score is compared to the median score for its group. For marked units, the median mileage

was 11.61 m.p.g. For semimarked units, the figure is 12.10 m.p.g. By definition, half the scores in each group should be above the median and half below. This distribution should hold true for smaller groups if those groups are randomly selected from the population of test vehicles. In other words, for those pairs of vehicles in which the semimarked unit obtained better mileage than the marked units, approximately half of the semimarked units should have scores above 12.10 and half below 12.10. This was true. As shown in Table 1, there is no significant difference in the distribution of scores, in terms of the number of scores above and below the median, when the semimarked vehicles that obtained better mileage than their paired counterpart (labelled high mileage SM units) are compared to the group of all semimarked cars. The Chi Square statistic of 1.711 with one degree of freedom is not significant at the .10 level. This indicates that these pairs (pairs in which semimarked units achieved better mileage than marked units) were representative of all pairs involved in the test.

TABLE 1
SCORES ABOVE AND BELOW THE MEDIAN
FOR SEMIMARKED UNITS

	Above Median (+)	Below Median (-)	Total
All Semimarked Test Units	28 (50%)	28 (50%)	56
High Mileage SM Units	23 (64%)	13 (36%)	36

$\chi^2 = 1.711$ Degrees of Freedom = 1 Not Significant @ .10

On the other hand, the twenty marked units that achieved better mileage than their semimarked counterparts were not representative of the population of all marked cars in the test. Table 2 shows that nearly all (90%) of the second group obtained mileage ratings above the median of the group. These vehicles not only achieved better mileage than their paired semimarked units, they also achieved better mileage than most other vehicles in the group of all marked test vehicles. In that sense, their mileage is not representative of marked units. Rather, it represents those few marked units which are achieving unusually high mileage, or, in other words, a situation which is outside the norm.

TABLE 2
SCORES ABOVE AND BELOW THE MEDIAN
FOR MARKED UNITS

	Above Median (+)	Below Median (-)	Total
All Marked Test Units	28 (50%)	28 (50%)	56
High Mileage Semimarked Units	18 (90%)	2 (10%)	20

Chi Square = 9.868 Degrees of Freedom = 1 Significance = .005

Given that the situation where the pairs for which marked units obtained better mileage than semimarked units appear to be an exception to the "norm", consideration should be given to including only the normal cases in computing potential savings. For the thirty-six pairs in which the semimarked units obtained

better mileage than the marked units, the average difference between the mileages for each pair was 2.55 miles per gallon or a 20 percent improvement. This figure should be considered the upper end of the range for potential savings. That is, any single vehicle from which roof lights are removed, the Department can expect a reduction in fuel costs as much as 20 percent. However, when a large number of vehicles are converted, savings could vary from 6.4 to 20 percent. A patrol vehicle driving 20,000 miles per year could save as much as 434 dollars per year (based on December, 1982 gas prices plus the 5 cent per gallon federal tax). If 500 vehicles were converted, the minimum expected annual savings would be 69,500 dollars and the maximum expected saving would be 217,000 dollars. Of course, in either case, additional savings would be realized from reduced equipment costs as long as alternatives selected to replace light bars remain less expensive than light bars.

ACCIDENTS

A major concern of Department management was that of officer safety. The 1981 analysis of accidents which occurred during the previous calendar year indicated that unmarked units were no more likely to be involved in accidents than marked units. However, because unmarked vehicles made up less than one of every four vehicles in the patrol fleet, that comparison was approached with caution. There were fears that because there were so few unmarked cars, they might not be given the same types of assignments as marked units.

During 1982, ten of the fifty-six marked test units were involved in accidents. By comparison, only half as many, five, of the semimarked units were involved in accidents. Using a chi square test, it is possible to compare these

accident rates to the data provided by the 1981 analysis and determine if the accident frequency for the test vehicles was significantly different than would be expected.

TABLE 3
COMPARISON OF TEST GROUP TO 1980 ACCIDENTS
FOR MARKED UNITS

	<u>Accident</u>	<u>No Accident</u>	<u>Total</u>
Marked Units 1981 Analysis	199 (27%)	542 (73%)	741
Marked Units 1982 Test	10 (18%)	46 (82%)	56
Chi Square = 2.179	Degrees of Freedom = 1		Not Significant @ .10

Table 3 illustrates the relationship between the accident experience of marked vehicles in 1980 and that of our test group. The 1980 analysis included 741 marked vehicles, 199 of which were involved in accidents. The chi square statistic of 2.179 with one degree of freedom indicates that there was no difference in the accident experience of the two groups. That is, the accident experience of the sample of 56 marked units used for the test was not significantly different than that of all marked patrol units in 1980. (The 1980 figures are used because no fleetwide analysis was conducted of 1981 or 1982 accidents.) This comparison would also support the conclusion that, from year to year, the number of marked units involved in accidents does not vary significantly.

TABLE 4
COMPARISON OF TEST GROUP TO 1980 ACCIDENTS
SEMIMARKED VS. MARKED VEHICLES

	<u>Accident</u>	<u>No Accident</u>	<u>Total</u>
Semimarked (1982 Test)	5 (9%)	51 (91%)	56
Marked (1981 Analysis)	199 (27%)	542 (73%)	741

$\chi^2 = 8.79$ Degrees of Freedom = 1 Signif @ .01

Table 4 again includes the accident experience of marked units in 1980, but this time compares it to that of the semimarked test units. The chi square statistic is significant at the .005 level, indicating that semimarked units had a significantly lower rate of accidents than marked units in 1980. Thus, it can be concluded that semimarked units incur a lower rate of accident involvement than marked units.

In addition to incurring accidents at a higher frequency than semimarked vehicles, marked units also incurred greater damage. The average repair estimate for the semimarked units involved in accidents was 165 dollars. No semimarked unit incurred more than 400 dollars in damage. The average repair estimate for marked units was 1,435 dollars, with eight of the units having damage above the 400 dollar level. The data supports the conclusion that marked units incur a greater frequency of accidents than semimarked units and that those accidents are more severe. Both conclusions are consistent with findings of the 1981 study which led to this project.

PRODUCTIVITY

A secondary issue raised in the original proposal on roof-mounted equipment was that of productivity. Literature introduced in the report indicated that unmarked vehicles were more productive than marked vehicles in enforcing the 55 mph speed limit.⁴ Comparisons were made to determine whether there were differences in the productivity of Illinois State Police semimarked and fully marked vehicles.

For purposes of the comparison, pairs of vehicles not assigned to regular patrol duties were eliminated. In all, 45 pairs of vehicles (90 vehicles) were included. Comparisons between the two groups were made using a t-test for paired comparisons to measure differences in the productivity of the two groups. Six areas of productivity were used: speeding citations, traffic citations, written warnings, reports completed, and assists made. Each of these productivity measures was placed in a ratio form to permit accurate comparisons between officers. For example, speeding citations were measured as a ratio of patrol hours per citation issued. Thus, for each ratio, the lower the number, the more productive was the unit.

There was no difference in the number of reports, assists or accidents between the two groups. This fact leads to the conclusion that the two groups were assigned to similar patrols. There was also no difference in productivity with regard to warnings.

However, in two categories, traffic citations and speeding citations, there was a difference in the productivity of the two groups. The marked vehicles patrolled an average of 6.38 hours per speeding citation issued while the rate for

semimarked vehicles was only 3.64 hours per arrest. Thus, the semimarked units were able to make more arrests for speeding than were the marked units but worked a similar number of accidents, made a similar number of arrests and completed a similar number of reports. The difference in the rate of speeding arrests is significant at the .059 level. There was also a significant difference in rate of productivity for all traffic citations. This difference may be the result of the difference in speeding citations since speeding citations are a major subgroup of traffic citations. Again, the marked units were less productive issuing one citation for each 4.48 hours of patrol as compared to the rate of one per 2.76 hours for semimarked units. The difference is significant at the .065 level indicating a significant but not overly strong difference. A Wilcoxon rank/sum test was also applied to the data and yielded similar results.

To reiterate, the two groups showed no difference in productivity with regard to accidents worked, motorist assists made, or reports completed, indicating a strong similarity in patrol assignments between the two groups. In spite of this similarity, semimarked units were more productive with regard to the issuance of speeding citations.

SURVEY OF OFFICERS

The final step in the evaluation was a survey of officers. A copy of the survey instrument is included in Appendix I. A survey was mailed to each of the fifty-six officers assigned semimarked vehicles. Forty-nine (87.5 percent) of the officers completed and returned the survey. These included one sergeant, five corporals and 43 troopers. The distribution of officers by type of patrol is shown in

Table 5. More than half of the officers were assigned to a patrol consisting of both Interstate and non-Interstate highways.

TABLE 5
TYPE OF PATROL

<u>Type</u>	<u>Number</u>	<u>Percent</u>
Urban Interstate	0	0
Rural Interstate	1	2%
Mixed Interstate	3	6%
Rural Highway	1	2%
Other Highway	15	30%
Combined Interstate & Highway	29	49%

The officers were of all levels of experience in terms of years of service with approximately 25 percent having under five years of experience, another 25 percent with 5-13 years, and the remaining officers (50 percent) having more than thirteen years of service with DLE. Each respondent had, at some time during their career, been assigned a marked vehicle. Also, each respondent had been assigned a semimarked vehicle during 1982.

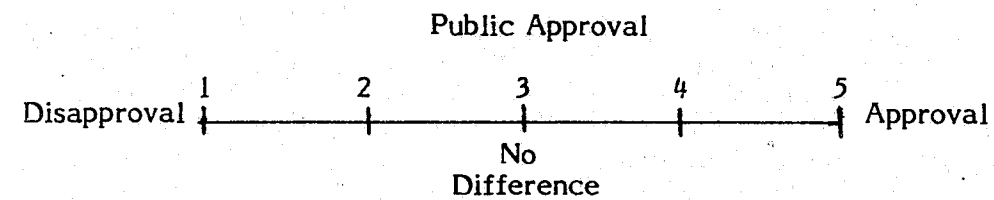
The remainder of this section will discuss response patterns to questions on the survey. Responses to the last question will be discussed first. It will provide the reader with a sense of perspective for reviewing the other questions. This is true because it was a summary question for which the officer had to weigh all of the issues involved and place his own value on them. The question was, "If given the choice, I would request that my unit be equipped with a visabar".

Responses to the question were as follows:

No	44	90%
Undecided	2	4%
Yes	3	6%

Thus, irregardless of responses to the remaining questions, only 3 officers are actually dissatisfied with semimarked vehicles to the degree that they would have roof-mounted light bars added.

The remaining questions used a Likert type scale where a response of "1" would equate to less of the dimension, "3" was an indication of indifference or "no difference", and "5" a high degree of the dimension. The responses of "2" and "4" indicated slightly less or slightly more. A sample scale is shown below for the dimension public approval.



One of the first issues to be addressed by the survey was that of visibility of the semimarked unit. Specifically, officers were asked to respond to the statement, "Patrol in a semimarked unit results in (less/more) voluntary compliance with traffic regulations by the motorists than does patrol in a marked unit".

Table 6 shows that nearly half of the officers saw no relationship between the type of vehicle (marked or semimarked) and the level of voluntary compliance; they chose a response of "no difference". The number of officers who felt that semimarked units caused greater compliance was similar to the number believing the units resulted in less compliance. That is, approximately half of the respondents thought there was no difference between the two types of vehicles, and the remaining officers were equally divided as to whether the cars resulted in more compliance or less compliance.

TABLE 6
VOLUNTARY COMPLIANCE IN A SEMIMARKED UNIT

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Less Compliance	1	4	8%
	2	9	18%
No Difference	3	24	49%
	4	11	22%
More Compliance	5	1	2%

Statement 9 also dealt with visibility. The statement was, "When they are seeking assistance, motorist have (less/greater) difficulty identifying a semimarked unit than a marked unit". Responses to the statement are shown in Table 7. More than 70 percent of the respondents saw no difference between marked and semimarked units with regard to identification by motorists for purpose of gaining assistance. Twenty percent of the respondents thought that some greater degree of difficulty was associated with the semimarked unit.

TABLE 7
STATEMENT #9
IDENTIFYING A SEMIMARKED UNIT
FOR A MOTORIST ASSIST

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Less Difficult	1	0	0%
	2	4	8%
No Difference	3	35	71%
	4	7	14%
More Difficult	5	3	6%

The final statement dealing with visibility of the units was more general in nature. It stated that, "The motoring public has (less/more) difficulty identifying a semimarked unit as an Illinois State Police vehicle than they would a marked unit". Responses to this statement were inconsistent with those of the previously discussed statements on aspects of visibility. Over half (57 percent) of the responding officers felt that the motoring public would have some degree of difficulty identifying the semimarked units as Illinois State Police vehicles. This response pattern is interesting in light of the ISP markings which are included on the semimarked units, especially when compared with response patterns for the two previous questions dealing with visibility. The responses are shown in Table 8.

TABLE 8
STATEMENT #15
RECOGNIZABLE AS AN ISP VEHICLE

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Less Difficulty	1	0	0%
	2	0	0%
No Difference	3	21	43%
	4	23	47%
More Difficult	5	5	10%

An issue related to visibility is that of public opinion. Only one dimension was used to address the issue. Officers were asked to respond to the statement, "Public opinion on our use of semimarked units is one of: ____". Officers selected an appropriate level of response. Over half of the officers thought that the public held positive opinions toward the new type squad car. Only 6 percent of the respondents thought that the public disapproved, and the level of disapproval was very slight. The responses are shown in Table 9.

TABLE 9
STATEMENT #8
PUBLIC APPROVAL

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Disapproval	1	0	0%
	2	3	6%
Indifference	3	21	43%
	4	20	41%
Approval	5	5	10%

A previous section of this report discussed the issue of productivity. The reader will recall that in the area of speed enforcement, semimarked units were found to be more productive than marked units. Officers were presented with a statement concerning productivity to obtain their perceptions on this topic. Specifically, officers were presented with the statement, "I would make (fewer/more) traffic arrests in a marked unit than I do in a semimarked unit". Consistent with the data, officers felt that their productivity would decrease if they were placed in marked units. Fifty-seven percent indicated some level of anticipated decrease if such a change were made. Only 22 percent thought their productivity would increase. The remainder, 26 percent, anticipated no change. Responses to the productivity issue are shown in Table 10. The reader should remember that "fewer arrests" indicates that productivity would decrease if the officers were reassigned to a marked unit.

TABLE 10
STATEMENT #13
IMPACT ON PRODUCTIVITY
IF REASSIGNED TO A MARKED UNIT

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Fewer Arrests	1	10	20%
	2	18	37%
No Difference	3	10	20%
	4	7	14%
	5	4	8%
More Arrests			

Possibly the most important issue covered in the survey was that of safety. Statements focused on whether the possible decrease in the unit's visibility increased risk to the officer or to the motoring public. Due to the importance of this issue, five statements on various aspects of increased risk or difficulty were included in the survey.

Statement #10 stated, "Responding to an emergency call is (less/more) dangerous in a semimarked unit than in a marked unit". Half of the officers felt that there was no difference between the two types of vehicles with regard to danger during emergency runs. An additional 40 percent of the respondents saw a slight level of increased danger. Only 10 percent of the respondents felt that the semimarked units were considerably more dangerous than marked units, as indicated by the "5" responses. Table 11 depicts the responses to question #10.

TABLE 11
STATEMENT 10
DANGER DURING EMERGENCY CALLS

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Less Dangerous	1	0	0%
	2	0	0%
No Difference	3	24	50%
	4	19	40%
More Dangerous	5	5	10%

Statement #11 focused on safety during non-emergency calls. "When responding to other types of calls (non-emergency), it is (less/more) difficult to get through traffic in a semimarked car than in a marked unit." Response patterns to

this statement were considerably different than those of the prior statement. Feelings of decreased safety only seem to be associated with emergency runs. Nearly two thirds of the officers saw no difference. While 14 percent of the officers felt that there is some difficulty associated with the use of a semimarked unit, 12 percent felt that there was less. An additional 6 percent (three officers) felt that there is a good deal more difficulty when driving a semimarked unit. Responses for this statement are shown in Table 12.

TABLE 12
STATEMENT #11
DANGER DURING NON-EMERGENCY CALLS

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Less Difficult	1	0	0%
	2	6	12%
No Difference	3	33	67%
	4	7	14%
More Difficult	5	3	6%

The next statement concerning safety addressed risk at accident investigations. "Use of a semimarked unit for accident investigations (decreases/increases) the amount of safety afforded the officer and motorist compared to that provided by a marked unit". Again, officers felt some degree of decreased safety. While approximately half of the officers saw no difference in the safety factor provided by the two types of units, 46 percent associated some level of decreased safety to semimarked units. Responses are shown in Table 13.

TABLE 13
STATEMENT #12
SAFETY AT ACCIDENT SCENES

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Decreases Safety	1	5	10%
	2	18	37%
No Difference	3	25	51%
	4	1	2%
Increases Safety	5	0	0%

Statement #14 addresses safety during vehicle stops. "Once I identify a traffic violator, I have (less/more) difficult time making the stop (apprehension) with a semimarked unit than I would with a marked unit". It appears that of the four situations addressed by the survey - emergency calls, non-emergency calls, accident scenes, and traffic stops - this situation, traffic stops, provides for the least amount of difference in regard to safety provided by the two types of vehicles. More than 70 percent of the officers saw no difference. However, nearly one fourth of the respondents felt that there is some greater degree of difficulty associated with traffic stops. Responses are shown in Table 14.

TABLE 14
STATEMENT #14
DIFFICULTY IN MAKING TRAFFIC STOPS

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Less Difficult	1	0	0%
	2	2	4%
No Difference	3	35	71%
	4	9	18%
More Difficult	5	3	6%

The final statement on the issue of safety was of a general nature. Officers were asked to respond to the statement, "Generally speaking, I feel (less/more) safe driving a marked unit than a semimarked unit". This statement should have caused officers to reflect not only on the four situations discussed earlier but also on their overall assignments and driving habits. Only 14 percent of the officers felt that marked cars, overall, provided them with a greater level of safety than semimarked units. Seventy-seven percent saw no difference. Four officers (8 percent) actually felt that semimarked units are more safe. Their response is consistent with data resulting from accident analyses conducted in a previous section of this report. Perhaps the opinion of these officers are best reflected in the comments of one officer;

" . . . I personally like my semimarked squad. In fact, it has made me even more safety conscious knowing that there is a possibility that I may not be seen."

Responses to statement #19 are shown in Table 15.

TABLE 15
STATEMENT #19
PERCEPTIONS ON SAFETY
IN A MARKED UNIT

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Less Safe	1	1	2%
	2	3	6%
No Difference	3	37	77%
	4	6	13%
More Safe	5	1	2%

To summarize the safety issue for each type of situation - emergency calls, non-emergency calls, accident scenes, traffic stops, and general - at least 50 percent of the respondents felt that there was no difference in the level of safety provided by the two types of vehicles, marked and semimarked. The greatest difference in levels of safety was during emergency runs and accident investigations. In both cases, nearly half of the officers perceived some degree of increased danger resulting from the use of semimarked units. However, to put these responses in proper perspective, the reader should remember that, generally speaking, only 15 percent of the officers felt less safe in a semimarked vehicle than a marked unit. Moreover, only 3 officers indicated a preference for marked units while 2 officers were undecided, and 44 officers stated a preference for their semimarked units. It should also be remembered that actual accident experience indicated that semimarked units incurred accidents at a significantly lower rate than marked units and that those accidents were less severe in nature.

The final issue addressed by the survey was vehicle performance. Analyses presented in previous sections of this report and various studies cited in the earlier report, Roof-Mounted Light Systems on Police Vehicles, supported conclusions that semimarked units would consume less fuel, have faster acceleration and greater top speed than vehicles equipped with light bars. Statements on vehicle performance were included in the survey to obtain officers perceptions of vehicle performance, and, in a less direct manner, to determine if they understood and agreed with the philosophies supporting implementation of the semimarked vehicle concept.

With regard to top speed, officers were asked to complete the statement, "If my unit were equipped with a roof-mounted visabar, the top speed would ___". Nearly 89 percent of the officers thought that top speed would decrease. These numbers were equally split between a slight decrease and a substantial decrease. Only 10 percent of the respondents expected no change. Table 16 illustrates the responses to vehicle top speed.

TABLE 16
STATEMENT #18
VEHICLE TOP SPEED WITH VISABAR

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Decrease Top Speed	1	22	45%
	2	22	45%
No Difference	3	5	10%
	4	0	0%
Increase Top Speed	5	0	0%

The second statement on vehicle performance concerned acceleration. Officers responded to the statement, "If equipped with a roof-mounted visabar, my unit would have (slower/faster) acceleration". Again, responses were overwhelming indicating that vehicle acceleration would decrease if semimarked units were equipped with roof-mounted visabars. Seventy-eight percent felt this way. Only 22 percent expected no change and no officer thought that vehicle performance (acceleration) would improve as a result of light bars. The responses are shown in Table 17.

TABLE 17
STATEMENT #17
VEHICLE ACCELERATION WITH VISABAR

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Slower Acceleration	1	13	27%
	2	25	51%
No Change	3	11	22%
	4	0	0%
Faster Acceleration	5	0	0%

The final performance issue was that of fuel consumption. Data presented earlier in this report, clearly indicated that semimarked units obtained better fuel mileage (more miles per gallon) than vehicles equipped with light bars. The perceptions of 78 percent of the respondents were consistent with those findings. In response to the statement, "My unit gets (less/more) miles per gallon than it would with a roof-mounted visabar," only 20 percent of the officers thought that there would be no difference. Responses are shown in Table 18.

TABLE 18
STATEMENT #18
VEHICLE FUEL CONSUMPTION WITH SEMIMARKED UNITS

<u>Literal</u>	<u>Response</u>	<u>Frequency</u>	<u>Percent</u>
Less M.P.G.	1	0	0%
	2	1	2%
No Difference	3	10	20%
	4	21	43%
More M.P.G.	5	17	34%

Data presented in the three tables show that officers overwhelmingly believe that semimarked vehicles have better performance in terms of top speed, acceleration and fuel economy. Their perceptions are consistent with the results of analyses conducted for this report and with findings of studies cited in a previous report on this topic, Roof Mounted Light Systems on Police Vehicles.

Officers' opinions on vehicle performance were stronger than on safety. On each of the statements dealing with performance, over half of the respondents felt that performance of semimarked units was superior to that of marked units. Opinions were very strong. Many responses of either "1" or "5", favoring the semimarked units in both instances. By comparison, for safety issues, at least half of the responses for each statement indicated no difference. While, in most cases, a number of officers felt that marked units were safer than semimarked units, their opinions were somewhat weak with very few extreme responses of "1" or "5". While response patterns for safety related statements might indicate a reluctance to use extreme responses, response patterns for performance indicate that officers were, in fact, distinguishing between a "4" and "5", or a "1" and a "2"; and, they would use the extreme ratings when those ratings were consistent with their opinions.

Appendix II contains a list of comments included on the surveys. Many of the comments are both supportive and constructive, and should be read in their entirety by State Police management. All comments were included for review.

CONCLUSIONS

The design used for this study and the resulting data very clearly indicate that semimarked cars obtained better fuel mileage (more miles per gallon) than units equipped with visabars. While this better fuel mileage is not present in every instance, the findings indicate a significant trend whereby a group of semimarked units will obtain significantly better mileage than they would with roof-mounted equipment. Officer responses to survey statements were consistent with the data. Officers were quite strong in their perceptions that semimarked units performed better than marked units. Specifically, responses to survey statements indicated that semimarked units have faster acceleration, greater top speed, and consume less fuel than marked units.

The data also show that, during 1982, semimarked units had significantly fewer accidents than marked units on comparable patrols. The accidents were also of a less severe nature. Thus, while some officers, according to the survey, perceive greater risk when driving a semimarked unit, those perceptions are in direct contrast with actual accident experience.

Finally, data clearly indicate that, while the two test groups represented similar patrols, productivity with regard to speeding citations was significantly greater for semimarked units. This finding is consistent with perceptions of fifty-seven percent of the officers responding to the survey.

In addition to issues supported by hard data, the survey also requested officer opinions on public approval of semimarked units. Only six percent of the respondents felt that the public disapproved of semimarked vehicles. Fifty-one percent felt that semimarked units were met by public approval.

RECOMMENDATIONS

The data presented in this report certainly support a recommendation for deployment of more semimarked units. Such action should result in less fuel consumption and increases in arrests for certain traffic violations. Side benefits would include a better performing squad car in terms of speed, acceleration and fuel consumption. Data indicate that some officers may perceive a decreased level of safety associated with these vehicles, but actual experience indicates that the incidence of accidents may decrease with an increase in the number of semimarked units in the fleet.

Equally important to these recommendations are those given by the officers in the comments section of their surveys. Their recommendations present various ideas for improved lighting on semimarked vehicles and, in some cases, also recommend that more semimarked units be deployed. The comments are included in Appendix II.

FOOTNOTES

¹Ted L. Stoica, Roof Mounted Light Systems On Police Vehicles, (Springfield, Illinois, Illinois Department of Law Enforcement, 1982).

²Department of California Highway Patrol, "Emergency Warning Light Systems: Gasoline Consumption and Safety (Unpublished Report, 1980).

³See Roof Mounted Light Systems On Police Vehicles.

⁴International Association of Chiefs of Police, Final Report: National Maximum Speed Limit Enforcement Practices and Procedures, (Washington, D.C.: U.S. Department of Transportation, 1977). See also: IACP, National Maximum Speed Limit Enforcement Practices and Procedures: Phase II, (Washington, D.C.: U.S. Department of Transportation, 1978).

APPENDIX I
SURVEY AND COVER MEMO

OFFICE MEMORANDUM

DEPARTMENT OF LAW ENFORCEMENT

DIVISION OF STATE POLICE

To:

Selected Illinois State Police Officers

From:

Superintendent R. J. Miller

RJM:sk

Subject

Semimarked Vehicles

Date:

February 16, 1983

For the past several months, you have been assigned one of 60 semimarked vehicles (decals, but no roof-mounted equipment) being utilized by the Department. These vehicles were issued as part of our efforts to reduce the Department costs for fuel and equipment. The Bureau of Planning and Development is now evaluating the project to determine future use of such vehicles. Your opinions regarding the vehicles are very important to the evaluation. Please answer the questions on the attached survey and return to Planning and Development using the enclosed envelope. Because only sixty officers were involved in this project, it is extremely important that each of you respond to the questions on the survey and return it as quickly as possible. I also encourage you to use the comments section of the survey to provide additional information which you feel should be considered by us in determining future deployment of semimarked vehicles.

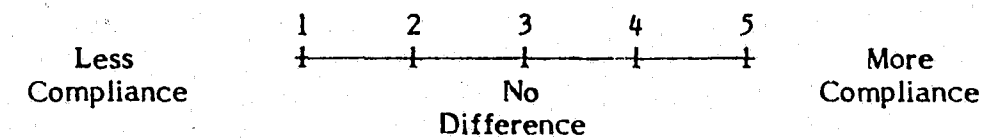
Thank you for your time and participation in this project. When the evaluation has been completed, copies of it will be provided to each district.

EVALUATION OF SEMIMARKED VEHICLES

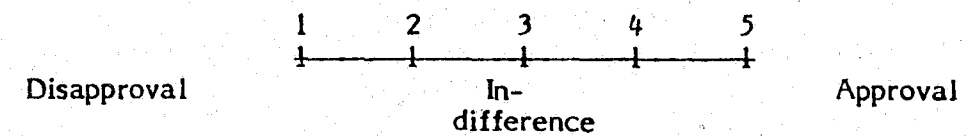
1. Select the response which best describes your normal patrol.
 - a) Urban Interstate
 - b) Rural Interstate
 - c) Mixed Interstate
 - d) Rural Highway
 - e) Other Highway
 - f) Combined - Interstate and Highway
2. Your Rank _____.
3. Your I.D. Number _____.
4. Years of Service _____.
5. During your career with the State Police, have you ever been assigned a marked car (with roof mount light bar)?
 Yes
 No
6. Are you currently assigned a semimarked car (markings but no roof equipment)?
 Yes
 No

The remaining statements on the survey require a comparison between traditional, fullymarked vehicles and the semimarked vehicles. Each statement describes a particular dimension such as visibility, safety, and effectiveness. Following each statement is a five step continuum representing possible opinions regarding the dimension. Circle the number which best reflects your opinion on the dimension.

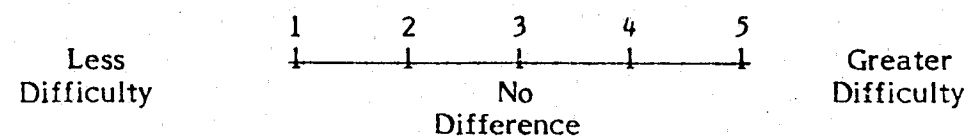
7. Patrol in a semimarked unit results in (less/more) voluntary compliance with traffic regulations by the motorists than does patrol in a marked unit.



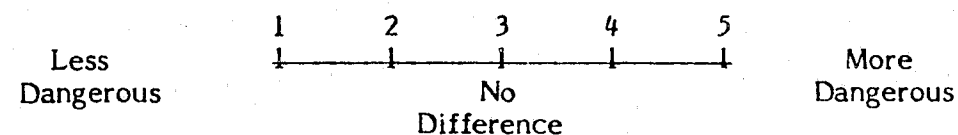
8. Public opinion on our use of semimarked units is one of:



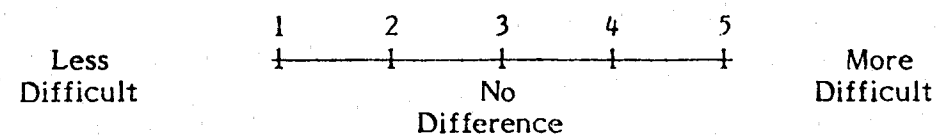
9. When they are seeking assistance, motorists have (less/greater) difficulty identifying a semimarked unit than a marked unit.



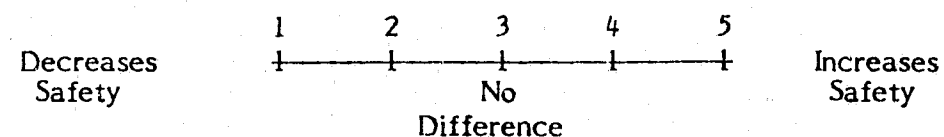
10. Responding to an emergency call is (less/more) dangerous in a semimarked unit than in a marked unit.



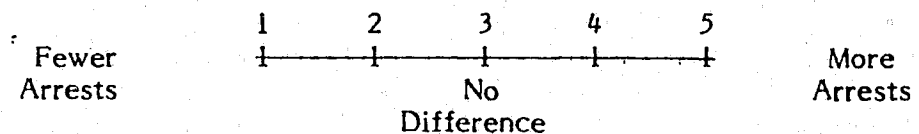
11. When responding to other types of calls (non-emergency), it is (less/more) difficult to get through traffic in a semimarked car than it would be in a marked unit.



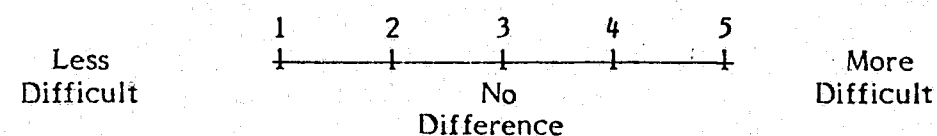
12. Use of a semimarked unit for accident investigations (decreases/increases) the amount of safety afforded the officer and motorist compared to that provided by a marked unit.



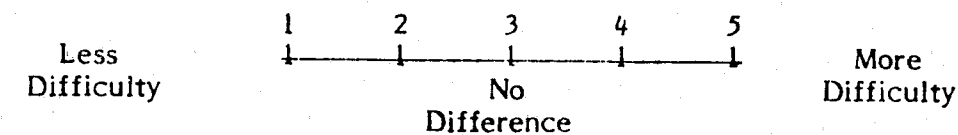
13. I would make (fewer/more) traffic arrests in a marked unit than I do in a semimarked unit.



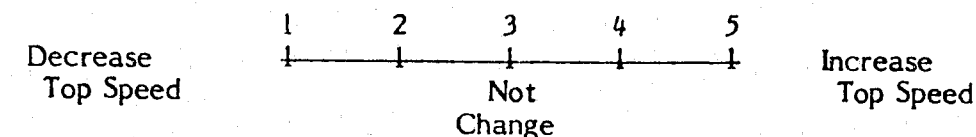
14. Once I identify a traffic violator, I have a (less/more) difficult time making the stop (apprehension) with a semimarked unit than I would with a marked unit.



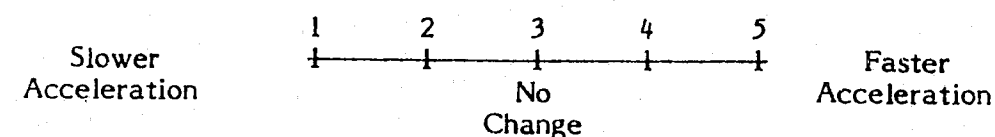
15. The motoring public has (less/more) difficulty identifying a semimarked unit as an Illinois State Police vehicle than they would a marked unit.



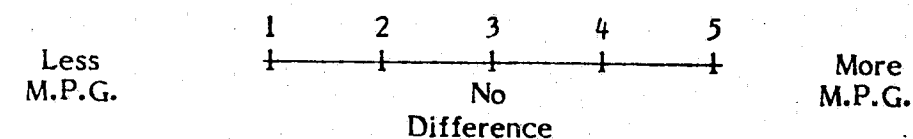
16. If my unit were equipped with a roof-mounted visabar, the top speed would:



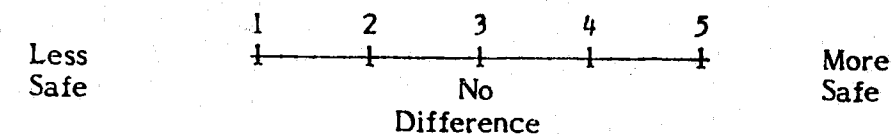
17. If equipped with a roof-mounted visabar, my unit would have (slower/faster) acceleration.



18. My semimarked unit gets (less/more) miles per gallon than it would with a roof-mounted visabar.



19. Generally speaking, I feel (less/more) safe driving a marked unit than semimarked unit.



20. If given the choice, I would request that my unit be equipped with a visabar.

___ Yes ___ Undecided ___ No

Comments: _____

APPENDIX II

COMMENTS

COMMENTS

The following comments are reprinted, without edit, from surveys completed by officers who were assigned semimarked vehicles. As such, they may include only clauses or sentence fragments. All comments made by officers are included.

1. Easy to clean, moving radar works better-the car is harder to spot head on. Better top end. Same as driving unmarked, it just requires a little more caution when driving as opposed to a marked. I would say the idea is a good one.
2. The semimarked unit works great with a moving radar unit. I also have good luck while working on alcohol details. I have followed drivers who were drinking and never knew a marked police car was behind them.
3. Public opinion seems to be in favor comments from public glad to see attempt to save money by the state. Works great with moving radar unit hard for violators to spot as police vehicle when meeting in traffic.
4. I feel that it should be up to each officer if he wants the semimarked car or roof lights. At first, I didn't like it but I am use to it now. I feel the only problem is the visibility to the sides while at an accident. The flip up red light helped out considerably.
5. I feel comfortable with my car and have no complaints with it so far.
6. The semimarked unit is very effective with the use of the moving radar. Most violator(s) are looking for the red lights on top of the police vehicle when they are speeding.
7. In a rural area such as I work in, I had no problems due to the lack of roof mounted red lights. There is always room for improvement. If anything would be changed, better grill lights could be installed.
#Note: I was satisfied with the lights on the squad, as they are now installed.
8. I prefer the semimarked unit. Without the red lights turned on it is not as visible and thereby gives the advantage of an unmarked unit. I have not experienced any problem stopping violators and when responding to an emergency call I have always felt that you still have to drive with care. I'm sure there is much better gas mileage on my semimarked car than the same year Fords that have the visabar on the top.
9. In view of high fuel costs and increased gasoline mileage of those squads without the visabar the Department should consider going entirely to the semimarked concept. The semimarked squad ensures better compliance due to the fact, even though the CB traffic usually alerts violators of their presence in the area, any white car could be a squad. Consideration should be given to use any color as a semimarked squad, thereby creating an additional

deterrent. As far as emergency or responding type situations there is no greater hazard if an officer exercises due care. No doubt, some officers will find they must reassess their driving habits in those situations. With proper use of flares and volunteers an accident scene is just as safe as with a marked car. There again, CB traffic and flashing lights usually alerts motorists of hazardous conditions before we arrive. There is no doubt I am issuing traffic citations that would not be possible in a "visabar" car. I have not encountered a situation where a violator ignored or pretended not to notice the lights.

To sum up, all visabars should be phased out as quickly as possible to reduce the fuel cost. Those officers, for whatever reason, who wish to retain the visabars should be given that consideration when possible. However, a date for complete retirement of visabars should be set and those now serviceable units should not be replaced as they wear out. Those funds saved might well be used to purchase more mobile extenders and other equipment.

10. Ref. #10. I see no difference here because a trooper should exercise extreme care and safety when responding regardless of the type of vehicle he is operating. Ref. #10 & #12. I had a pop-up light put in my vehicle so the red light could better be seen from the side. Ref. #16, 17 & 18. A definite plus. More squad cars should be semimarked.
11. Semimarked units should be equipped with another "fireball" to place on the dashboard of the vehicle, and to place on the roof, (outside), of the squad while handling accidents, for greater visibility. It doesn't need to be permanently affixed to the dash. I use one of my own, and have it laying in the back seat when not in use. Public opinion of the semimarked has been excellent to this officer.
12. While working moving radar the oncoming traffic has more difficulty identifying a squad car. I believe due to their failure to identify the squad car the unit records more speeding violations. As for handling accidents directing traffic I noticed no real difference. I recommend the use of interior mounted red lights.
13. Due to the fact that I work mostly hours of darkness most of my answers would not be in the extreme oneway or the other. Only one instance when I had trouble getting violator to stop but he didn't want to stop no matter what I was driving. Visibility out rear window is very poor in the instances when you must back up especially at night. I'm very satisfied with the unit.
14. The lights flashing inside of driver compartment is distracting, especially at night.
15. I have had no problems in the use of my semimarked squad. There is less wind noise and fuel consumption than I had on my marked squad. I am well pleased with the performance of my present assigned squad.

16. If this type of unit is continued I would recommend a public education program to make them aware of the semimarked unit. This would also increase its deterrent factor, since it is not quickly recognizable as a police vehicle from the front. My experience has been, when a CB report is given about my presence, traffic has a tendency to slow down over a greater distance because there is no visabar to readily identify my location.
 17. When off an Interstate, I have found the unit should be parked at an angle to, instead of straight with traffic lanes to increase side visibility of interior red lights to right angle traffic.
 18. For more effective enforcement (mainly Interstate) I would recommend removing the stripes. The grill lights need more intensity or visibility, for day light driving, at night they are adequate. Also the revolving light on the drivers side in rear is hidden by the drivers head and head rest. However, at night they are effective.
 19. I like the unit without the roof mount lights. I have had no difficulty in stopping violators or at accident scenes.
 20. In my opinion there isn't any difference between the two, as for the safety to the officer, therefor, if it means saving money I am all for it.
 21. In emergency situations, the semimarked unit tends to be more dangerous (daylight hours) because the public does not detect it as a squad car as easily compared to night emergency driving. You can see the red lights very well at night. I have observed more serious violations (criminal and DUI) in the semimarked unit due to the fact they do not recognize it as a squad (I work mostly night shift). I personally like my semimarked squad. In fact it has made me even more safety conscious knowing that there is a possibility that I may not be seen.
 22. #10 There is a side view problem with intersections, an additional tear drop type light would give better vision from the interior if it could be put on the dash board.
 23. The semimarked car equipped as is - is not a very safe patrol vehicle. It offers very limited visibility - especially from the front and particularly at night. I strongly suggest that the grill lights be intensified greatly or that some form of interior lighting such as the old pop-up lights be installed in these vehicles to make them safe to operate.
- I do enjoy being slightly less conspicuous than a marked car, however, I personally like the marked or unmarked versions.
24. I have equipped my semimarked unit with an additional rear "pop-up" light which I use when responding to emergency calls for greater side visibility. If available, I would also equip my unit with a "wig-wag" headlamp system.

25. The greatest problem within side lights is backing at night with the revolving lights on or when a U-turn is necessary - extremely limits visibility.
26. The only suggestion I would have would be to have a third red light that the driver could place on the dash for extra visibility from the front.
27. The semimarked unit is easily recognized as state squad as unit goes by but the unit has capability of getting radar check on violator prior to his seeing markings. Moving radar is as effective as a plain car but the general public can recognize squad as it goes by.
28. I like the semimarked unit as for myself being a ordnance officer and only being on the road part-time I feel it is O.K.
29. My experience with the semimarked unit has increased my traffic arrests. The unit is less identifiable to oncoming vehicles, but once near it is easily recognizable. I think if the Department used these vehicle in their entire fleet it decrease traffic violations because of the semimarking and the decrease of difficulty in identifying it.
30. A difficult choice - A semimarked seems to allow for more activity and the mileage is better but the visabar does allow for quicker recognition. A significant difference in stopping violators and seems to command a greater respect from motorists.
31. I prefer my semimarked unit over a marked unit.
32. I do not disagree with the new concept of the lights. However, I feel that more lighting is required for safer operation at accident scene's visibility at intersection is restricted.
33. The semimarked vehicle makes the job approximately 10 to 15 percent easier. Because the violators recognize that you are a patrol car at a closer range. The visibility of another seeing the semimarked vehicles' lights are poor only in bright sunlight.
34. By equipping the car with a center light or one mounted on the top of the dash you increase visibility and have greater ease in stopping traffic. My preference would be to keep my semimarked unit. I would suggest that the light be mounted more securely. In the event of a head on collision the lights have the potential of becoming projectiles. I have received many good comments from other troopers who would also be interested in semimarked units.
35. I enjoy my semimarked unit. There is no way I would want to trade my semimarked unit for a marked unit. So far I have not experienced any difficulties with my unit. I do not think the position of the lights makes much of a difference when stopping a violator. I would encourage the use of more semimarked units.

36. I suggest the head lamps be wired to flash on high beam on all patrol units to assist in making of the vehicle more visible. The semimarked unit in my opinion is a very good idea and should be utilized more.
37. The flashing red lights in front grill need to be brighter. It would be nice if we had extra cord so that the rear tear drop lights could be placed on roof if needed.
38. As a supervisor my patrol duties differ than the trooper on the road. The measure of compliance and opinion are hard to judge but through personal contact with truckers and motorist they have advised me that they watch the speed limit more closely when they know there are unmarked and semimarked cars working. I have found no difficulty in getting through traffic or stopping violators. In some cases it is easier, such as when the sun is setting and there is a glare off the visabar and the red flashing lights do not show up. The front grill lights and back window lights are not affected by this glare. Only one time in the last year have I had to use the siren. It is much easier to clock speeders with this car and identification is rare until the violator is right next to the unit. I feel this is one of the best programs the state has entered in a long time and more of these vehicles should be on the road.
39. We did not experience severe winter weather, so the semimarked did not experience it's biggest test. Where I have put a mark in between numbers there is a difference but not that great. Small problem at intersections, have to make sure you're seen (10) in emergency situations when requesting right of way (lights in blind spot).
40. I have had problems with gas mileage since car was new resulting in low gas mileage and as a result I have no true comparison. I do believe with the wig-wag lights on the 1983 models, the semimarked should be as safe as the cars with visabar.
41. The main problem I see with this unit is when two officers are sitting in the front seat the lights in the rear window are completely blocked out to approaching traffic. The only other problem I have experienced is while on normal patrol traffic will pull out from a side street or road, when you are closer than would happen with a squad equipped with bar lights. I personally like the squad equipped without bar lights. The only time I have had to make an emergency run I did not experience any problems but I make very few.
42. Reference #16. Speed is not that important any more except in very rare instances.

END