

PERFORMANCE AUDIT REPORT

Reflective Sheeting Used For Kansas License Plates

**A Report to the Legislative Post Audit Committee
By the Legislative Division of Post Audit
State of Kansas
October 1987**

Legislative Post Audit Committee

Legislative Division of Post Audit

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PERFORMANCE AUDIT REPORT

REFLECTIVE SHEETING FOR KANSAS LICENSE PLATES

OBTAINING AUDIT INFORMATION

This audit was conducted by Ron Green, Senior Auditor, and Tom Vittitow, Auditor, of the Division's staff. If you need any additional information about the audit's findings, please contact Mr. Green at the Division's offices.

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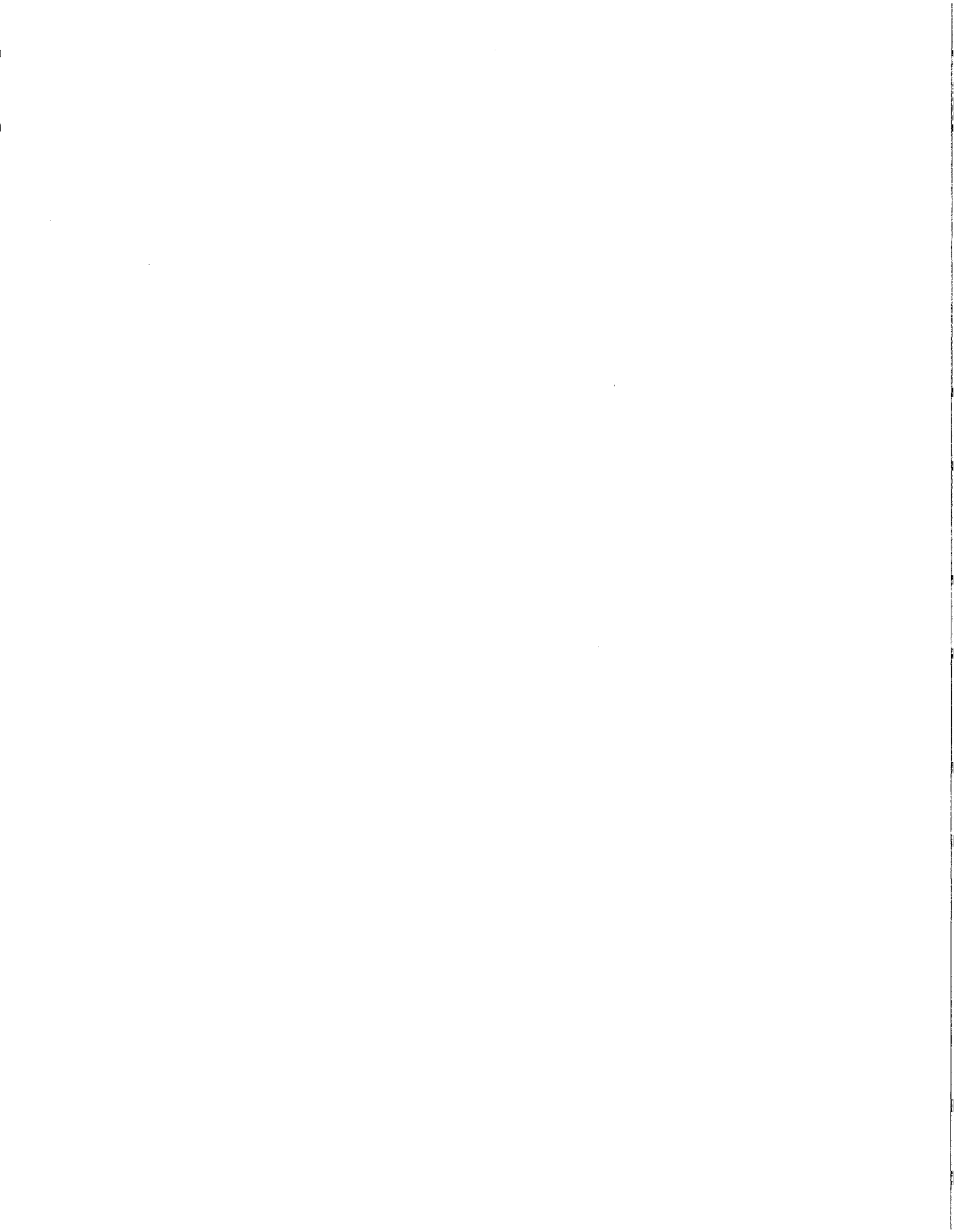
Reflective Sheeting For Kansas License Plates

Summary of Legislative Post Audit's Findings

Can the requirement for a directional security marking in the reflective sheeting for license plates be cost-justified? Kansas' price for reflective sheeting has not increased since directional security markings were added to State specifications in April 1985, but states that use these markings generally pay more for sheeting than other states. The 3M Company has been the only firm to bid on the State contract for reflective sheeting for license plates since 1982, when State law required that reflective sheeting be used. The directional security marking requirement may have deterred or precluded other firms from bidding on Kansas' license plate sheeting. The two expected advantages of security markings were to make counterfeiting of license plates more difficult, and to make it easier to control the inventory of reflective sheeting. However, security markings have not been useful in achieving either goal. Because of the lack of any real benefits from security markings on Kansas license plates, the presence of directional security markings in Kansas specifications cannot be justified.

Why is there such a high inventory of license plates without directional security markings? When directional markings were first added to reflective sheeting specifications in April 1985, the Department of Revenue did not have a high inventory of sheeting without the markings. Although the inventory of sheeting was not a problem, the Department of Revenue has failed to properly monitor the inventory of license plates issued to each county before the 1988 reissuance of license plates. As a result, the counties are projected to have a surplus of about 169,000 license plates at the end of 1987. This five-month oversupply of plates cost the State more than \$228,000.

Do the Department of Revenue's testing requirements for reflective sheeting appear to be reasonable, and how have they been applied? When State specifications and testing requirements were revised in 1986, the Division of Purchases and the Department of Revenue accepted 3M Company's bid even though the firm had not submitted a required certification statement. Kansas' testing requirements for reflective sheeting used on license plates appear to be reasonably related to the specifications, which are intended to ensure that sheeting meets quality standards. However, both past and current testing procedures have not always conformed with the tests called for in the written specifications. In the current round of testing, the Department has waived certain requirements to induce more firms to submit sheeting for testing. However, some of the testing now being done goes beyond the time periods stated in current specifications. The Secretary of Revenue has promised that new reflective sheeting specifications will be written. However, the Department does not intend to solicit bids on the major State reflective sheeting contract until 1991, precluding competitive bidding by vendors whose sheeting may pass the current tests.



REFLECTIVE SHEETING FOR KANSAS LICENSE PLATES

An April 1986 audit of reflective sheeting concluded that some of the Department of Revenue's specifications and practices for acquiring reflective materials for license plates precluded competition. In 1987, the Department complied with an audit recommendation to "unpackage" the bids for reflective sheeting, validation stickers, and decals. That action created greater competition for the stickers and decals, and could save the State up to \$72,000 over the next five years. However, specifications for reflective sheeting still require a "bold directional image" (visible only at a specified viewing angle) that is a patented process by the 3M Company. According to Department officials, this marking is designed to deter counterfeiting and to aid in controlling the sheeting inventory.

Since the earlier audit, a number of additional concerns have been raised in this area. Those concerns focus on the need for directional security markings in reflective sheeting for license plates, the reportedly large inventory of plates printed without this marking, and the reasonableness and uniformity of the Department's testing requirements for reflective sheeting. This audit addresses the following questions:

- 1. Can the requirement for a directional security marking in the reflective sheeting for license plates be cost-justified?**
- 2. Why is there such a high inventory of license plates without directional security markings?**
- 3. Do the Department of Revenue's testing requirements for reflective sheeting appear to be reasonable, and how have they been applied?**

To answer these questions, the auditors interviewed State officials and gathered data from the Departments of Revenue, Transportation, and Administration. They also obtained information from Center Industries Corporation (manufacturer of Kansas license plates), from other states that use reflective sheeting on license plates, and from firms that manufacture reflective sheeting for license plates.

In conducting this audit, the auditors found that directional security markings have not provided any benefits to Kansas thus far and may have served to restrict competition, so requiring such markings in license plate sheeting cannot be justified. Center Industries did not have an unreasonably high inventory of sheeting without directional security markings when those markings were first added to the State contract in April 1985. However, the Department of Revenue has apparently oversupplied counties with 1987 license plates that will never be used, at a cost to the State of about \$228,000. These plates will become surplus in January 1988, when all counties begin to issue new license plates in the "SAM 123" format. Finally, the Department of Revenue's testing requirements appear to be reasonable, but the actual testing of license plate sheeting has not always conformed to the procedures called for in the Department's written specifications. These findings are presented in this report.

Can the Requirement for a Directional Security Marking In the Reflective Sheeting for License Plates Be Cost-Justified?

To answer this question, the auditors attempted to identify the costs and benefits associated with the decision to add security markings to the reflective sheeting used on Kansas' license plates.

According to officials of the Department of Revenue, the addition of directional security markings to reflective sheeting for Kansas' license plates began in 1985 with an offer from 3M Company to provide the markings at no additional charge. On April 1, 1985, the Department of Revenue sent a memorandum to the Division of Purchases, requesting the following addition to the existing contract:

Imaged Sheeting

The sheeting shall display a bold directional positive identification image integral to the sheeting that appears and disappears at specified viewing angles and is extremely difficult to counterfeit. The bold directional image shall facilitate effective visual verification of license plate authenticity in the field as well as identification of the year of issue and sheeting manufacture. The image shall not interfere or be printed over the graphic design.

On April 16, 1985, the Division of Purchases issued the requested addendum to the contract. Since then, Kansas' price for reflective sheeting for license plates has not changed, but the auditors found that states that use 3M's directional security markings pay more for their sheeting than states that use sheeting without directional security markings. A lack of competition may also contribute to higher prices for reflective sheeting. Further, the State has not received any real benefit thus far from the additional of security markings to license plate sheeting. These findings are discussed in more detail in the sections that follow.

Kansas' License Plate System Will Be Revised in 1988

Kansas has used reflective sheeting on license plates since 1982, as required by K.S.A. 8-147. Under the current system, 16 categories of plates are produced specifically for each county. These include 11 categories of automobile plates (A,B,C,E,H,J,M,R,S,V,X), as well as separate categories for trucks, trailers, mobile homes, motorcycles, and motorized bicycles. Starting January 1, 1988, a new style of license plate will be issued in Kansas. All categories of plates will be in the "SAM 123" format, with three letters and three numbers. In addition, the county abbreviation and month of expiration will be shown on stickers rather than being printed on the plate in raised letters. (Appendix A depicts the current license plate and the new 1988 plate.)

Kansas' Price for Reflective Sheeting Has Not Increased Since Directional Security Markings Were Added in April 1985, But States That Use These Markings Pay More For Sheeting Than Other States

The auditors found that the State's cost for the primary type of reflective sheeting (two-color graphic) has not changed since 1983, well before the directional security markings were added. The current State contract with 3M Company continues to be \$.945 per square foot for two-color graphic sheeting. (For license plates to be issued in 1988, Kansas is using a three-color graphic sheeting that costs \$.97 per square foot.)

The auditors surveyed 10 other states to determine which ones used security markings and how much they paid for their sheeting. Two of those 10 states—Nevada and Oklahoma—reported that they use 3M's directional security markings on their license plates. Like Kansas, these states' prices have not increased since they started using the directional security markings. However, as shown in the accompanying table, Nevada, Kansas, and Oklahoma generally are paying higher prices than any other states surveyed. The states are listed in the order of the prices paid per square foot of sheeting.

**Kansas and Other States
Reflective Sheeting on License Plates**

<u>State</u>	<u>Type of Sheeting</u>	<u>Sheeting Supplier</u>	<u>Security Markings?</u>	<u>More Than One Bid?</u>	<u>Price Per Sq. Foot</u>
Nevada	2-Color Graphic	3M	Yes	No	\$.996
Oklahoma	2-Color Graphic	3M	Yes	No	.965
Kansas	2-Color Graphic	3M	Yes	No	.945
Illinois	2-Color Graphic	3M	No	No	.945
Tennessee	2-Color Graphic	3M	No	Yes	.925
Indiana	2-Color Graphic	3M	No	Yes	.922
Texas	1-Color Graphic	3M	No	Yes	.915
Nebraska	2-Color Graphic	3M	No	No	.890
No. Carolina	2-Color Graphic	Sakai	No	Yes	.845
California	1-Color Non-Graphic	3M	No	Yes	.835
Oregon	1-Color Non-Graphic	3M	No	—	.776

The type of sheeting is one factor that definitely influences the price paid for reflective sheeting. Graphic sheeting (with letters or designs) is more expensive than non-graphic (plain, all one color). In Kansas, for example, graphic sheeting costs 7.5 cents more per square foot than non-graphic sheeting. Likewise, the cost of graphic sheeting generally increases with the number of colors. Under the current Kansas contract, a square foot of three-color graphic sheeting is 2.5 cents more expensive than two-color sheeting.

A number of other factors may impact on the price each state pays for its license plate sheeting; these factors include the volume of sheeting purchased, and the number of years in the issuance cycle. Of the states surveyed, the states paying the highest prices (Nevada, Kansas, Oklahoma) all are relatively small in population, all use sheeting with security markings, and all had only one bidder for the most recent contract. The states with the lowest costs (California, Oregon) are using a one-color, non-graphic sheeting. Oregon's reflective sheeting contract is negotiated by a private firm rather than by the state itself, which may have contributed to Oregon's favorable price. Looking only at the states with five-year issuance cycles, the auditors found that Kansas' price per square foot is the same as Illinois, and is higher than Tennessee and North Carolina.

To get an idea of the cost impact of security markings, the auditors performed a number of comparisons in costs paid by states that use two-color graphic sheeting.

The comparisons showed that states that use sheeting with security markings paid about five cents more per square foot. The surveyed states that use security markings all buy 3M sheeting with directional security markings, visible only from certain angles. The auditors contacted three other firms that make sheeting with non-directional security markings; that is, the markings are visible from all angles. Two of these companies estimated that the markings increase their costs by one cent to five cents per square foot.

In the states surveyed, competition also appears to be a factor in the prices paid for reflective sheeting. For two-color sheeting without security markings, states with only one bidder paid about two cents more per square foot than the prices paid by states with more than one bidder. Due to limitations within the sample of states, the auditors could not make any estimate of the effect of competition among states that use sheeting with security markings.

An example of competition resulting in lower prices can be seen in Kansas' most recent bids for license plate validation stickers. When license plate sheeting bids were solicited in 1986, only 3M Company could bid on the complete package of sheeting, stickers, and decals. When bids for validation stickers were considered separately in 1987, the bid by American Decal was 90 cents per square foot, 43 cents cheaper than the \$1.33 bid by 3M in 1986 and 1987. The contract for validation stickers was awarded to American Decal in 1987, even though its bid did not meet the directional security image requirement in the specifications. In accepting this bid, the Department of Revenue determined that American Decal's non-directional security marks appeared to meet the intent of the specifications to prevent counterfeiting, and that the product had been used successfully by a number of other states. By accepting the lower bid from American Decal, the State could save more than \$72,000 on validation stickers during the next five years.

The Directional Security Marking Requirement May Have Deterred or Precluded Other Firms From Bidding on Kansas' License Plate Sheeting

The 3M Company has been the only firm to bid on the State contract for reflective sheeting for license plates since 1982, when State law required that reflective sheeting be used. At a meeting with the Secretary of Revenue in May 1987, representatives of several other sheeting manufacturers indicated that one reason they had not submitted bids on the State contract in recent years was that they could not produce sheeting with directional security markings. (As stated earlier, 3M's process for producing directional security markings is protected by a patent.) Three of the firms—Seibulite International, Avery International, and Sakai Trading—produce sheeting with non-directional security markings that are visible from all angles. The manufacturers pointed out that it would have been futile to submit materials for testing, knowing that the materials would not meet all State specifications.

Despite the fact that these three firms' sheeting lacks directional security markings, the Secretary of Revenue encouraged them to submit their sheeting for testing

by the State. The testing now being done apparently is intended to provide data for revising the specifications and improving the opportunity for competition on future sheeting contracts.

Kansas Has Not Received Any Real Benefit Thus Far from the Addition of Security Markings To License Plate Sheeting

To determine what benefits were expected from the addition of directional security markings to the State contract for reflective sheeting, the auditors reviewed available documentation and interviewed Department of Revenue officials. The two expected advantages of security markings were to make counterfeiting of license plates more difficult, and to make it easier for Center Industries to control the inventory of reflective sheeting. However, the auditors found that security markings have not been useful in achieving either goal.

Security markings may make counterfeiting more difficult, but counterfeiting license plates has not been a problem in Kansas or elsewhere. The auditors surveyed officials in 10 other states and contacted representatives of six law enforcement agencies within Kansas. No one the auditors talked with indicated any significant problems with counterfeit license plates. The only such problems noted were isolated cases of counterfeit validation stickers.

Even if counterfeit plates had been a real problem in Kansas, the addition of security markings in the middle of an issuance cycle would have made it extremely difficult for law enforcement officers to determine which "new" plates should have the markings, and which "old" plates were made without the markings. Further, the Department of Revenue did not inform State law enforcement agencies about the addition of security markings in sheeting purchased after April 1985. As a result, only three of the six Kansas law enforcement agency representatives were even aware of the existence of security markings in some Kansas license plates.

Security markings have not been used for controlling inventory at Center Industries. The directional security markings now in license plate sheeting include the year the sheeting was manufactured. In its response to the April 1986 audit, the Department of Revenue said that the security marking assists "in aging our inventory and insuring that the oldest material is used first because the year of manufacture is contained in the image."

However, when the auditors contacted the general manager of Center Industries, he said that the security markings are not used for any purpose. Rather, he said that Center Industries has other methods for ensuring that the oldest sheeting is used first, by monitoring the pallets and boxes of sheeting that are in storage.

Conclusion

Because of the lack of any real benefits from security markings on Kansas license plates, the presence of directional security markings in Kansas specifications cannot be justified.

Recommendation

To ensure the maximum level of competition for the State's reflective sheeting contract, the Department of Revenue should modify its license plate sheeting specifications to either:

- a. completely remove security markings as a required feature of the sheeting, or
- b. modify the specifications to allow any kind of a security marking (directional or non-directional) that will serve a legitimate State interest.

Why Is There Such a High Inventory of License Plates Without Directional Security Markings?

To answer this question, the auditors reviewed inventory records and license plate orders provided by Center Industries and the Department of Revenue. These records were used to determine when the inventory of sheeting without security markings was fully used up. The auditors also interviewed Department officials and reviewed relevant documents to determine how the Department has planned for the conversion to new "SAM 123" plates, starting in January 1988.

The auditors found that Center Industries did not have a high inventory of license plate sheeting without directional markings when the contract was amended in April 1985. On the other hand, the Department of Revenue has apparently oversupplied the counties with 1987 license plates that will never be used. This oversupply will cost the State about \$228,000, most of which could have been avoided by better planning. These findings are discussed in the following sections.

When Directional Markings Were First Added to Reflective Sheeting Specifications in April 1985, the Department of Revenue Did Not Have a High Inventory Of Sheeting Without the Markings

According to records provided to the auditors, Center Industries had 61.2 rolls of graphic sheeting without security markings at the end of April 1985. Center Industries' general manager reported that this was a fairly low level of inventory for that time of year. At 1,800 license plates per roll of sheeting, the 61.2 rolls would produce about 110,000 license plates.

It took about 3.5 months for Center Industries to use up these 61.2 rolls of old sheeting. The auditors found that the "breakpoint" between old sheeting (without security marks) and new sheeting (with security marks) actually occurred during the Al-

len County order, which was shipped from Center Industries on August 19, 1985. The master order for fiscal year 1986 included 261,315 automobile license plates; about one-third of these were made using the old sheeting.

All plates shipped from Center Industries after August 19, 1985, should have the security markings. Because of differences in population and inventory levels, however, it takes varying amounts of time for these plates to be issued by each county. In some counties, the county treasurers still have unsold plates that do not contain security markings.

**Although the Inventory of Sheeting Was Not a Problem,
The Department of Revenue Has Failed to Properly Monitor
The Inventory of License Plates Issued to Each County
Before the 1988 Reissuance of License Plates**

The Department of Revenue is responsible for ordering license plates to be issued by all Kansas counties. To keep track of the plates used by the counties, the Department has manually kept track of the 1,680 distinct categories of license plates (105 counties, 16 categories of plates). Based on quarterly inventory figures reported by the counties, the Department has compiled an annual "master" order of the license plates the counties would need for the coming year.

As of January 1988, motor vehicle owners will generally receive new plates when they pay their registration fees in 1988. At the end of 1987, the old plates that have never been issued will no longer be needed.

When the Department of Revenue prepared the master order for 1987, Department officials thought that they were ordering for an 11-month year. They "shorted" this order to prevent the counties from having a large surplus of plates at the end of 1987. Despite the Department's intent, the auditors found that, at the end of 1987, counties will have about a five-month oversupply of license plates. Using the most recent quarterly inventory figures available, the auditors projected the number of excess plates that would be surplus at the end of 1987. They found that the projected surplus is about 169,000 license plates. In 31 counties, the projected surplus exceeds 1,000 plates per county. These 31 counties are listed in the table on the next page, followed by the Statewide totals.

As the table shows, the number of surplus license plates is as high as 17,185

**Obvious Departmental Errors
Create \$10,700 Surplus in
Doniphan County License Tags**

The Department of Revenue ordered 1,740 motorized bicycle tags and 7,420 truck tags for Doniphan County in May 1982. These two orders were obviously caused by arithmetical errors because Doniphan County's average motorized bicycle tag usage is about six tags per year, and the average annual truck tag usage is about 500 tags. Doniphan County is projected to have a surplus of 1,751 motorized bicycle tags at the end of 1987, a 290-year supply. The truck tag surplus will be 5,528 tags, an 11-year supply. The surplus in all Doniphan County categories is expected to be 7,708 tags at the end of 1987. These 7,708 surplus tags cost the State about \$10,700.

in Johnson County, and the average months' surplus is as high as 58.8 months in Doniphan County. This surplus of license plates cost the State more than \$228,000. It may not have been possible to avoid any surplus, but if the Department of Revenue had been able to limit the surplus of plates to a one-month supply, or 33,688 plates, the excess cost would have dropped to about \$43,000.

Counties With the Largest Surplus of License Plates

<u>County</u>	<u>Projected Surplus, January 1988</u>	<u>Average Use Per Month</u>	<u>Projected Surplus In Months</u>
1. Johnson	17,185	4,383	3.9
2. Sedgwick	16,078	5,965	2.7
3. Wyandotte	10,407	2,242	4.6
4. Geary	8,447	756	11.2
5. Franklin	7,814	335	23.3
6. Doniphan	7,708	131	58.8
7. Lyon	7,585	439	17.3
8. Shawnee	6,893	1,947	3.5
9. Reno	6,461	771	8.4
10. McPherson	3,141	319	9.8
11. Barton	2,864	399	7.2
12. Greenwood	2,754	110	25.0
13. Pratt	2,752	148	18.6
14. Riley	2,574	562	4.6
15. Ellis	2,416	275	8.8
16. Seward	2,213	295	7.5
17. Saline	2,104	630	3.3
18. Douglas	1,933	929	2.1
19. Finney	1,915	474	4.0
20. Crawford	1,872	460	4.1
21. Leavenworth	1,746	861	2.0
22. Ford	1,348	388	3.5
23. Jackson	1,335	158	8.4
24. Montgomery	1,319	542	2.4
25. Butler	1,281	658	1.9
26. Marion	1,241	151	8.2
27. Rice	1,215	168	7.2
28. Grant	1,186	139	8.5
29. Neosho	1,080	228	4.7
30. Marshall	1,067	137	7.8
31. Ottawa	<u>1,049</u>	<u>98</u>	<u>10.7</u>
Surplus—31 Listed Counties	128,983	25,098	5.1
Surplus—Other 74 Counties	40,423	8,590	4.7
Statewide Total Surplus	169,406	33,688	5.0
Total Cost to State	\$ 228,591	\$ 43,343	

The oversupply of license plates to the counties is the result of a series of failures by the Department of Revenue. These failures included arithmetical errors, inaccurate projections, and failure to follow written procedures for ordering license plates.

In 1982 and 1983, the Department made several obvious arithmetical errors in preparing orders for a few small counties, resulting in orders so large that surpluses for those counties will remain at the end of 1987. The most extreme example is detailed in the profile on page seven, relating to excess plates ordered for Doniphan County. Errors made in the orders for Doniphan, Greenwood, and Pratt counties alone will result in about 11,000 surplus plates at the end of 1987.

**The Department Ordered
More Plates for Lyon County
Despite an Existing Surplus**

The Department ordered 350 B-tags for Lyon County in June 1986. This order was made even though an inventory taken in December 1985 showed that Lyon County had 956 B-tags on hand and would need only 696 through December 1987, leaving a surplus of 260 tags. With the addition of the 350 tags ordered in 1986, that projected surplus increased to 610 tags. Later projections show that Lyon County will actually have about 634 surplus B-tags at the end of 1987. These 634 surplus tags cost the State about \$800.

The auditors also found that, by the end of calendar year 1985, the Department had already ordered enough license plates for various counties to result in a surplus of 50,000 license plates by the end of 1987. The Department had written procedures for comparing the number of plates being ordered to the number needed through the end of the plate issue; thus, the oversupply of plates should have been apparent even in 1985. However, Department officials apparently did not follow those procedures on a consistent basis.

The Department made its last master order from Center Industries for 1987 license plates in June 1986. In compiling this order, Department officials again did not follow the written procedures for determining how many plates would be needed in each county. For example, Department officials did not fill out all worksheets designed to make adjustments (+ or -) in each county, and did not compute the excess at the end of the 1987 issue. As a result, it overestimated the number of tags needed in counties where usage was declining.

In compiling the master order for 1987, the Department of Revenue increased the projected use of plates in nine "growth counties" by nine percent across-the-board (in all 16 categories of license plates). The auditors' analysis showed that the sale of plates in individual categories within these counties (1984 to 1985) had actually shown changes ranging from -37 percent to +43 percent. By applying a uniform increase to all categories, the Department ordered far too many plates for some categories and not enough plates for other categories. (Shortages were covered by a later supplemental order.) Each of these nine counties will have a surplus of at least 1,700 plates at the end of 1987. The total surplus projected for these nine counties is about 63,500 license plates.

For at least two reasons, the Department of Revenue should not have a similar problem with excessive inventories at the end of the new issuance of license plates. First, with the SAM 123 plates, Center Industries will not have to manufacture plates that can be used only in one county. Under the new system, only one type of plate is made for all automobiles, trucks, trailers, and mobile homes. Stickers will be applied as necessary to show the county, the month of expiration, and the weight limit for trucks. Second, in 1988 the Department plans to put the license plate data onto its

Vehicle Information Processing System (VIPS). Among other purposes, this computerized system is to be used for monitoring counties' license plate inventories and signalling when more plates need to be ordered.

Conclusion

The Department of Revenue's failure to properly monitor the inventory of license plates issued to each county has resulted in a projected surplus of about 169,000 license plates at the end of 1987. This five-month oversupply of plates cost the State more than \$228,000. While it would not be possible to avoid some excess license plates at the end of the cycle, a five-month oversupply appears to be unreasonably large.

Do the Department of Revenue's Testing Requirements For Reflective Sheeting Appear to Be Reasonable, And How Have They Been Applied?

To answer this question, the auditors reviewed testing requirements in the 1982-1987 contract specifications for reflective sheeting for license plates. They interviewed officials from the Departments of Revenue and Transportation, and from the Division of Purchases. They also contacted officials from several other states to determine what testing requirements were common for license plate sheeting. Finally, the auditors compared past and current testing of reflective sheeting in Kansas with the contract requirements.

The auditors found that Kansas' testing requirements for the reflective sheeting used on license plates appear to be reasonably related to the specifications, which are intended to ensure that sheeting meets quality standards. However, both past and current testing have not always conformed with the tests called for in written specifications. The auditors also found that the current contractor, 3M Company, apparently did not submit a qualified bid on the current reflective sheeting contract. The Secretary of Revenue has promised that new reflective sheeting specifications will be written before soliciting bids for a new contract, but that may not occur until 1991. These findings are discussed in detail in the sections that follow.

Specifications, Tests, and Prequalification Requirements Were Revised for the 1986 Sheeting Contract

The auditors reviewed the technical requirements for reflective license plate sheeting listed in the bid specifications for the 1982 contract, the 1983 contract (which was renewed in 1984 and 1985), and the 1986 contract (which was renewed in 1987). Both the 1982 contract and the 1983 contract required that the sheeting material meet the specifications. However, neither contract required that the sheeting be tested against the requirements in the bid specifications. Those two contracts only required that a bidding firm provide evidence that the materials and services had been

successfully used in the manufacture of license plates, or provide data and performance history satisfactory to the Department of Revenue.

While most of the specifications for the 1986 contract were similar to earlier ones, some changes were made. For example, a diffuse daytime color specification was added to the 1986 specifications, and the requirements for retroreflectivity characteristics were increased. The current specifications and testing requirements for the 1986 and 1987 reflective sheeting contracts are shown in the table on the next page.

In addition to changes in the test specifications, the 1986 contract included a requirement that vendors have their materials tested for compliance with the specifications before they could bid on the sheeting contract. The contract provided an exception to this prequalification requirement for products already approved by the Department of Revenue. For such products, a corporate officer of the manufacturer was required to certify that the sheeting met all the specification requirements.

3M Company's bid on the current reflective sheeting contract is technically not a qualified bid because the firm did not certify that its sheeting met all the specifications. Because 3M Company was the only firm that had its sheeting approved by the Department of Revenue, it was the only firm eligible to use the certification exception. However, the 3M Company apparently failed to meet this certification requirement. The auditors and Division of Purchases' officials reviewed the bid file for the 1986 sheeting contract and could not locate such a certificate from a 3M officer. Department of Revenue officials also were unable to find such a certificate. The current 1987 contract is a renewal of the 1986 contract. While this might be considered a technical violation, it appears that 3M Company did not submit a qualified bid on the current reflective sheeting contract.

The Required Testing of Reflective Sheeting Appears to Be Reasonably Related to the Specifications

As the table on page 12 shows, the tests that are required in the specifications include specific requirements for measuring color, reflectivity, rainfall performance, cleanability, solvent resistance, and weather resistance. The auditors reviewed these tests, and found that they related to the qualities listed in the specifications. These tests are based directly on a federal standard, L-S-300C.

Seven of the 10 states surveyed test reflective sheeting, and all seven are using the same federal standard as Kansas. Generally, these other states said they were testing for the same physical characteristics that are included in Kansas' bid specifications.

Three of the 10 states surveyed require vendors to prequalify their reflective sheeting material before the states will accept bids from them. Four states test the materials furnished by the manufacturer after the contract is awarded, and the other three states require vendors to certify that the products meet the specifications as part of their bid proposals. Thus, by requiring vendors to prequalify, Kansas has chosen

**Current Specification Requirements for
Reflective Sheeting Used for Kansas License Plates**

<u>Specification Requirements</u>	<u>Testing Required?</u>
License Plate Sheeting:	
Diffuse Daytime Color: The sheeting shall be tested against color and reflectivity standards prior to applying a clear coating to the sheeting. (Added in 1986)	Yes
Adhesive and Protective Liner: The adhesive shall form a durable bond to flat metal license plate surface. The protective liner attached to the adhesive shall be easily removable.	No
Flexibility-Embossing: The reflective sheeting shall be sufficiently flexible to permit the embossing of the license plates.	No
Roll Coating: Sheeting surfaces shall be readily roll coated and compatible with transparent and opaque colors recommended by the sheeting manufacturer.	No
Finished License Plates:	
Protective Clear Coating: To complete and protect the retroreflective optical system, a clear coat shall be applied to the license plates.	No
Directional Positive Identification Image: The sheeting shall display a bold directional positive identification image that is visible only at a specified viewing angle and is extremely difficult to counterfeit. (Added in 1986)	No
Retroreflective Characteristics: Measurements shall be conducted in accordance with the standard test method for coefficient of retroreflection of reflective sheeting. (Revised in 1986)	Yes
Rainfall Performance: The coefficient of retroreflection of the license plates, totally wet by rainfall, shall not be less than 90 percent of the values of the Retroreflective Characteristics specification.	Yes
Color: The license plates shall be similar in daytime color and retro-reflected nighttime color.	No
Cleanability: Finished license plates shall be easily cleansed with water and a mild detergent.	Yes
Solvent Resistance: Finished license plates shall be sufficiently solvent resistant to permit cleaning with solvents commonly used on vehicle finishes.	Yes
Temporary Water Repellant Surface Coating: Test panel shall be exposed for 150 hours to Twin Arc Weathering. Following exposure, the panel shall be washed in an acid solution. The panel shall then be measured for coefficient of retroreflection and shall maintain not less than 90 percent of the Retroreflective Characteristics and Rainfall Performance specifications.	Yes

the most restrictive method of ensuring that these vendors' products will meet the State's specifications.

Kansas' Testing of License Plate Sheeting Has Not Always Been Done in Accordance with the Written Specifications

Before 1987, the only testing of reflective sheeting for license plates was done in 1982 by the Department of Transportation for the Department of Revenue. Materials submitted by 3M Company and Avery International were tested. Only the 3M sheeting was found to be satisfactory at that time. (Avery officials said that highway sign sheeting was inadvertently submitted instead of its license plate sheeting. Avery did not subsequently submit its license plate sheeting for testing until 1987.) Pretesting was first required in the specifications in 1986, but no actual testwork was done until September 1987. The auditors reviewed the testwork performed in 1982 and 1987, and found that the tests conducted by the Department of Transportation have not always matched the tests set out in the specifications.

Tests of reflective sheeting in 1982 did not conform to the procedures stated in the specifications. In 1982, the Department of Transportation did not test for all sheeting requirements included in the 1982 bid specifications. For example, the Department's testing lab did not conduct the following: rainfall test, day/night color comparison test, cleanability, temperature resistance, and the saline mist test. According to the chief chemist at the testing lab, these tests were not run because he did not receive a copy of the specifications. The Department also pointed out that the 1982 tests were done for information only, rather than for acceptance of the sheeting.

The testing actually done in 1982 by the Department of Transportation did not always follow the technical measurement specifications. For example, the specifications called for reflective sheeting to be tested at -4 degrees and at 40 degrees; the testing was done at -4 degrees and at 30 degrees. The specifications called for 150 hours in the weatherometer, but the materials were actually tested for 1,000 hours. The solvent resistance test was done with different solvents than those called for in the specifications. Despite the fact that the testwork did not properly measure compliance with the specifications, the Department of Transportation concluded that the 3M Company sheeting was suitable for license plate use for a five-year period. After the 1982 tests, no further tests of reflective sheeting were done until September 1987, because no other materials were submitted for testing.

Tests being conducted in 1987 also do not conform with the testing procedures called for in the specifications. In a May 1987 meeting with representatives of sheeting manufacturers, the Secretary of Revenue promised to test any sheeting materials the manufacturers submitted. The Secretary told the representatives that materials submitted would be tested for physical characteristics only, such as durability and performance.

To encourage firms to submit their materials for testing, the Secretary told the firms that directional security markings and clear coating would not be covered or re-

quired in this round of testing. (These firms' sheeting materials may have non-directional security markings, and some firms use a pre-coated sheeting that may offer an alternative to the currently specified procedure of clear-coating the plates after they are embossed.)

The Department of Transportation is currently testing reflective sheeting for license plates furnished by four manufacturers. Three firms—Avery International, Seibulite International, and Sakai Trading—recently submitted materials for testing. In addition, the Department of Revenue directed Center Industries to provide samples of the 3M sheeting to the testing lab for testing against the current bid specifications.

According to a Department of Transportation letter to the Department of Revenue, the tests now being done do not match the bid specifications in several cases. For example, the specifications call for 150 hours in the weatherometer, but the lab is extending that to observations at 500 hours and 1,000 hours. The specifications call for a rainfall test, but the lab does not have the equipment for this test so a substitute test will be done. No outdoor test is called for in the specifications; however, at the direction of the Department of Revenue, the lab is planning to conduct a two-year outdoor test.

The current testing of these materials is not being done to prequalify the materials for any specific future contract. According to the Department of Transportation, preliminary results of the testwork will be available in January 1988; the two-year outdoor tests would not be completed until October 1989.

The Secretary of Revenue Has Promised That New Reflective Sheeting Specifications Will Be Written, But Does Not Intend to Solicit New Bids Until 1991

In the May 1987 meeting with reflective sheeting firms, the Secretary said that new specifications would be written before bidding a new reflective sheeting contract.

A Small Change in Sheeting Costs Would Have a Significant Dollar Impact

For 1988 license plates, graphic sheeting is purchased under the contract originally awarded to 3M Company in April 1986. The 1986 notice to bidders estimated a need for 2,250,000 square feet of graphic reflective sheeting for Kansas license plates for a five-year period. The first million square feet of sheeting was to be supplied during 1986, the first year of the contract, with lesser amounts to be purchased in each of the next four years. If the sheeting cost could have been reduced five cents per square foot through a more competitive bidding process, the State would have saved \$50,000 during the first year and \$112,500 for the entire five-year period.

The Secretary indicated he would like the manufacturers to review and comment on the revised specifications before they are issued. He also told them that if it is decided that a security marking is appropriate, the specification would not be covered by a single, patented process.

It apparently will be several years before the Department of Revenue seeks new bids on the major State contract for license plate sheeting. The Secretary has indicated that he plans to take advantage of the annual renewal option in the current contract with 3M for license plate sheeting. The Secretary stated that the main

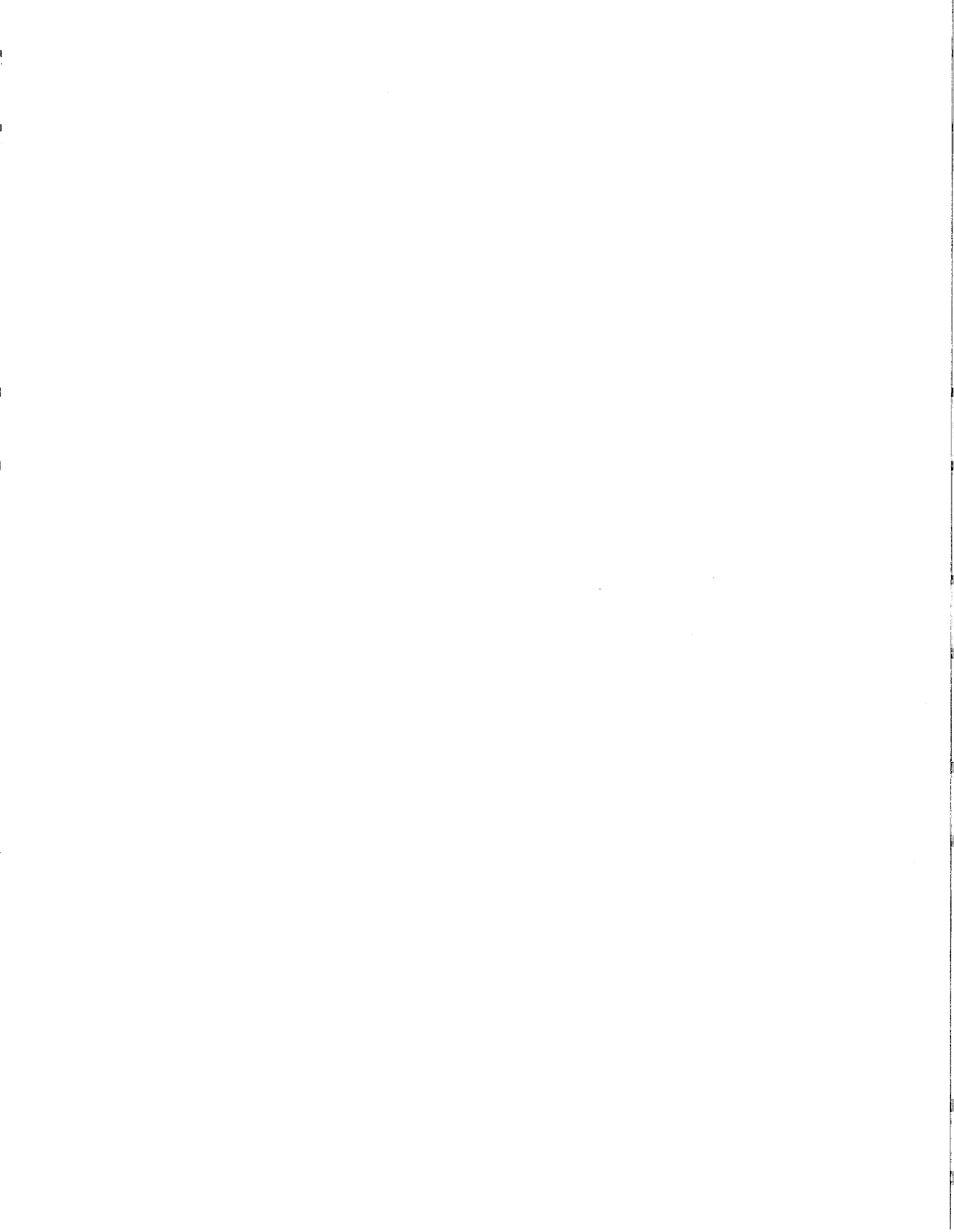
purpose for renewing the contract is to ensure that Kansas' license plates are standardized throughout the five-year issue period. Therefore, the first opportunity for other firms to bid will apparently be in mid-1991, about 18 months before the next issuance of new standard license plates in 1993.

Conclusion

While the Department of Revenue's testing requirements appear to be reasonable, the actual testing of license plate sheeting has not always followed procedures set out in the Department's written specifications. On the most recent bid for license plate sheeting, the Division of Purchases and the Department of Revenue accepted 3M Company's bid even though the firm had not submitted a required certification statement. In the current round of testing, the Department has waived certain requirements (directional security markings, clear coating) to induce more firms to submit sheeting for testing. However, some of the testing now being done goes beyond the time periods stated in current specifications. Furthermore, the Department does not intend to solicit bids on the major State contract until 1991, precluding competitive bidding by vendors whose sheeting may pass the current round of testing.

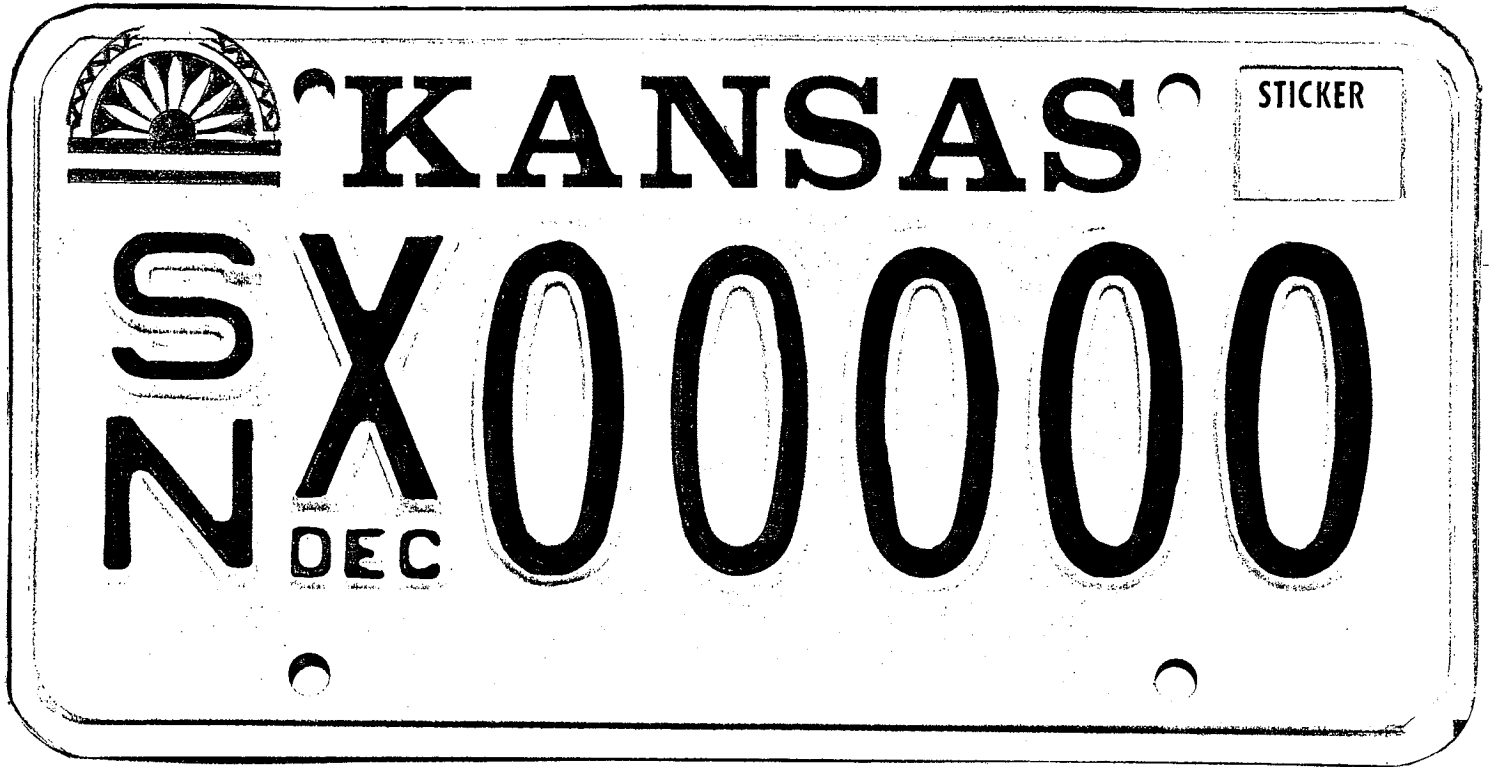
Recommendations

1. The Department of Revenue and the Department of Transportation should work together to ensure that the testing of reflective sheeting matches the requirements included in the bid specifications. Testing methods should not exceed what is required in the specifications, and all tests that are required should be performed.
2. Before awarding any contract for reflective sheeting for license plates, the Division of Purchases should determine whether each bidder's materials have been tested or otherwise prequalified as required in the bid specifications.
3. To ensure maximum competition for the State reflective sheeting contract, the Department of Revenue should remove or revise any specifications that could exclude firms that offer comparable sheeting of suitable quality. After revising the specifications, the Department should consider soliciting new bids for a State contract prior to 1991.

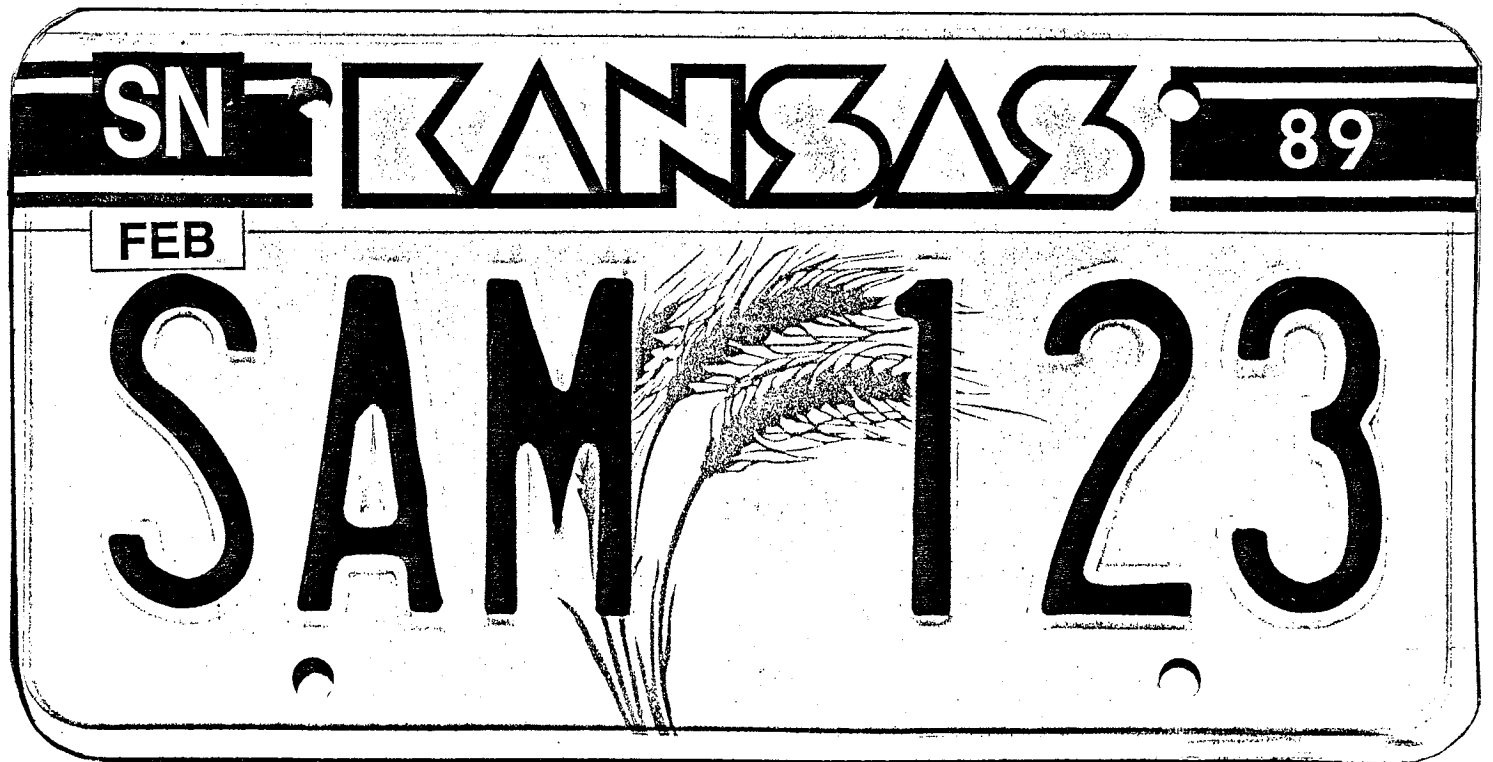


Appendix A

Examples of Current and Future Kansas License Plates



Example of the automobile license plates issued from 1982 through 1987



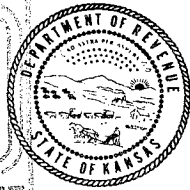
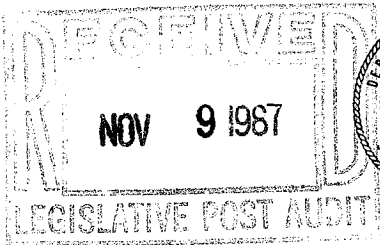
Example of the vehicle license plates to be issued from 1988 through 1992



APPENDIX B

Agency Responses

On October 26, 1987, copies of the draft audit report were sent to the Departments of Revenue, Administration, and Transportation for review and comment. The Departments' written responses are included in this appendix.



KANSAS DEPARTMENT OF REVENUE
Office of the Secretary
Robert B. Docking State Office Building
Topeka, Kansas 66612-1588

November 8, 1987

Mr. Meredith Williams
Legislative Post Auditor
Mills Building
Topeka, KS 66612

RE: Reflective Sheeting Audit Response

Dear Mr. Williams

Following is the Department of Revenue's response to the Legislative Post Audit report titled "Reflective Sheeting for Kansas License Plates."

DIRECTIONAL SECURITY MARKING

The report concludes that the directional security marking has not provided any real benefits to the State. Based thereon, you have recommended that the requirement for a security marking be deleted from subsequent license plate sheeting bids or be modified such that the specifications do not refer to a patented process and that either a directional or non-directional security marking be allowed.

As I have stated elsewhere prior to the commencement of this audit, the Department will review the issue of the security marking prior to the issuance of a new contract. If a security marking is required, it will be designed so as not to exclude potential bidders. Despite concurrence with the recommendation, I must take exception to two points made in this section of the audit report.

First, the report implies that the security markings or other features of our specifications have caused Kansas to pay a higher price for sheeting than other states. This is simply not supported by the data in the report. For those states in the table on page 3 using a product **comparable** to Kansas (security markings aside), the Kansas price is very competitive with the exception of North Carolina. Other states with a price significantly lower than Kansas have a product that is different from Kansas. For example, Texas is one color, Nebraska is a three-year (as opposed to a five-year) plate, and California and Oregon are non-graphic plates. While the report acknowledges that these other factors affect cost, it insists on displaying the data in the same table and making the statement that our costs could have been lower when it is not supported by the facts. The lack of supportive data also makes the "box" on page 14 gratuitous and misleading. The box states that if the cost of the sheeting could be reduced by 5 cents per square foot, the State would save \$112,500 over five years. While the arithmetic is correct, nowhere does the report provide substantiating data that Kansas could reasonably expect to reduce its costs by 5 cents per foot unless it changes to a non-graphic, one color plate or a plate with less than a five-year life that uses a lower grade of material.

General Information (913) 296-3909
Office of the Secretary (913) 296-3041 • Legal Services Bureau (913) 296-2381
Audit Services Bureau (913) 296-7719 • Planning & Research Services Bureau (913) 296-3081
Administrative Services Bureau (913) 296-2331 • Personnel Services Bureau (913) 296-3077

The only other "data" relating to cost appears on page. Three other firms which produce reflective sheeting without the security image were contacted. Two estimated that the security image increases the price of the sheeting by one to five cents per square foot. Without actual bids from these companies, this statements could well be considered self-serving. The fact still remains that our price for reflective sheeting did not increase when the security image was added, and that our current price would be the same regardless of this feature.

Second, I think statements by other vendors about the security marking reducing competition need to be viewed with a great deal of skepticism and caution. Their statements that they did not bid because of the specifications are convenient, but not persuasive with me. As we advised the auditors, since Kansas began using reflective sheeting, only one other firm ever submitted material for testing (prior to this summer), and it failed. No vendor has ever submitted a bid, and no vendor has ever addressed concerns regarding the specifications to the Department either orally or in writing prior to this summer.

INVENTORY

The report points out that the Department has maintained an extremely high level of inventory of license plates, five months, and at the end of our current issuance cycle, there will be a surplus of 169,000 plates, costing the State of Kansas more than \$228,000.

These statements exaggerate the actual situation. The figures presented are aggregate numbers only and it must be emphasized that the surplus plates are spread across more than 1,600 categories of license plates. The Department acknowledges that a five-month inventory level is larger than desirable. It is, we believe, the natural result of a manual inventory system and our present license plate structure, rather than any gross negligence on our part. Nebraska, for example, has only 32 plate combinations and had an estimated 100,000 plate surplus at the expiration of its cycle in 1987.

With the implementation of our Vehicle Information Processing System (VIPS) and the SAM 123 plate format, our inventory problems will be greatly reduced, if not eliminated. VIPS will include an automated inventory system, which will generate plate orders in the counties for a predetermined quantity when a two-month reorder point is reached. The SAM 123 plate format will reduce the plate combinations for which an inventory must be maintained from over 1,600 to 17.

MATERIAL TESTING

The report finds that the material testing requirements and procedures are reasonable, but expresses concern that they have not been uniformly applied and followed. In particular, it finds that the tests currently underway exceed what is required in the specifications and believes such tests should be discontinued.

The auditors apparently misunderstand the purpose of the current tests. They are not designed simply to determine if the material from all vendors can meet the required standards. Instead they are being conducted to take advantage of the intense interest shown by the various vendors earlier this year. We want to conduct a wide range of uniform tests at a uniform point in time on all types of material so that we can perhaps overcome the situation of having no qualified material from other than 3M. The tests have been recommended by the Department of Transportation as desirable to test completely the durability and quality of the material.

November 8, 1987

Obviously, we would not attempt to disqualify any vendor on the basis of tests not required in a specification.

REBID OF THE CONTRACT

The report finally recommends that the sheeting specifications be written so as to eliminate any specifications that could exclude firms offering comparable sheeting of suitable quality . Having done so, then, the Department should consider soliciting new bids prior to 1991 which is when we would normally do so for the reissuance cycle to begin in 1993.

As stated earlier, the Department intends to rewrite the bid specifications prior to the next contract. We have already solicited specifications from certain other states recommended by vendors other than 3M. Every effort will be made to write specifications that maximize competition without sacrificing quality material.

I do not intend, at this time, to rebid the contract because of the desire for uniformity in the type of plate used throughout this cycle. We will, however, be letting a contract for personalized license plates in 1989. The specifications will be rewritten by that time, and it should provide a good indication of whether competition is improved.

Thank you for the opportunity to review the report. If you should have any questions or wish to discuss our response in greater detail, please do not hesitate to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "H. T. Duncan", with a long, sweeping horizontal line extending to the right.

Harley T. Duncan
Secretary of Revenue

STATE OF KANSAS



DEPARTMENT OF ADMINISTRATION
Division of Purchases

MIKE HAYDEN,
Governor
NICHOLAS B. ROACH,
Director of Purchases

Landon State Office Building
900 Jackson, Room 102 N
Topeka, Kansas 66612-1286
(913) 296-2376

November 9, 1987

Mr. Meredith Williams
Legislative Post Auditor
409 West 9th Street, Suite 301
Mills Building
BUILDING MAIL



RE: Reflective Sheeting

Dear Mr. Williams:

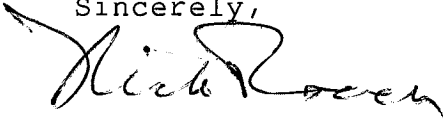
I have reviewed a preliminary draft copy of the performance audit report entitled Reflective Sheeting For Kansas License Plates and would like to make the following comments:

1. The report expresses a concern relative to the absence of a certification document stating that the 3M product met the specifications for a reflective sheeting bid. Since the 3M product was the specified product, the certification would have been redundant.
2. The report expresses a concern relative to prequalification of products being the most restrictive method of ensuring that a product meets the State's specifications. Prequalification is a process used in instances where there is an interest in minimizing the time lapse between opening the bids and making an award. Of the ten states surveyed, three prequalify, three require certification of product, and four test the product after award, as per the audit report. Of the three alternatives, prequalification, if accomplished objectively, provides the user the easiest and most convenient means of verification of acceptability. Certification, provided at the time of bidding, could delay the award process while said certification was being evaluated and reviewed. Testing, after award, presents major problems in the event the awarded product is unacceptable.
3. The Division of Purchases will require that the requesting agency verify, in writing, that testing and/or prequalification have taken place, prior to making any future award.

Mr. Meredith Williams
November 9, 1987
Page 2

It should be pointed out that the existence of only one acceptable product will always result in a higher cost than if two or more products are acceptable. The aspects of security and safety do impact this particular product.

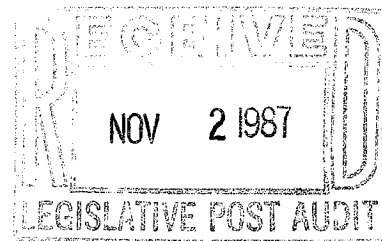
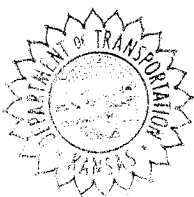
Sincerely,

A handwritten signature in cursive script, appearing to read "Nick Roach".

NICHOLAS B. ROACH
Director of Purchases

NBR:cl
cc:H. Edward Flentje

STATE OF KANSAS



KANSAS DEPARTMENT OF TRANSPORTATION

*Docking State Office Building
Topeka 66612-1568
(913) 296-3566*

Horace B. Edwards
Secretary of Transportation

October 30, 1987

Mike Hayden
Governor of Kansas

Mr. Meredith Williams
Legislative Post Auditor
Legislative Division of Post Audit
109 West 9th Street, Suite 301
Mills Building
Topeka, Kansas 66612-1285

Dear Mr. Williams:

Thank you for the opportunity to comment on the draft audit report, Reflective Sheeting for Kansas License Plates. I would like to provide some clarifications regarding the observations noted in the report on pages 13 through 15 on testing of reflective material by the Department of Transportation in 1982 and 1987.

On page 13 the statement is made that, "The testing actually done in 1982 by the Department of Transportation did not always follow the technical measurement specifications." This statement on its face would leave the mistaken impression that the Department knowingly or willfully deviated from Department of Revenue specifications. I have attached to this letter a copy of the testing report (D.O.T. Form No. 623) dated October 22, 1982 prepared on the 1982 tests. I would note two points, that no specifications were provided to the Department of Transportation as indicated by the blank "Specification No." line at the top of the report, and secondly that the tests were conducted for information only, as indicated on the "Type of Construction" line. Had the tests been conducted for materials acceptance, as is indicated in the audit report, it is common procedure to indicate on the testing report that it is for acceptance and to cite specifications numbers.

Since testing specifications were not provided by the Department of Revenue to the KDOT Materials Testing Laboratory, standard reflective sheeting tests were performed. These were standard tests run on highway reflective sheeting product.

The report also comments on the testing presently being conducted by the KDOT by stating on page 13 that, "Tests being conducted in 1987 also do not conform with testing procedures called for in the specifications." On page 14 the report states that KDOT testing does not match the bid specifications which call for 150 hours in a weatherometer and a rainfall test.

In a letter dated August 26, 1987 to Revenue Secretary Duncan from Mr. Lewis, Chief Chemist at the Department's Materials and Research Laboratory, clarification is provided on the product testing (copy attached). Mr. Lewis states on page two that,

The specification includes a rainfall performance test for which we do not have the apparatus. Instead, we have included a test for gloss which we intend to monitor under weatherometer and outdoor exposure condition.

The gloss test is considered an acceptable substitute for the rainfall performance test. The intent being to measure the ability of the product to shed moisture.

In response to the 150 hour testing specification, Mr. Lewis states on page two that,

The specification calls for 150 hours in the weatherometer, but we are extending this to observations at 500 hours and 1,000 hours as well. I believe these longer exposure times are more realistic for a five-year license tag. Also, for our information, we are reading the reflective intensity at more angles than is called for in the specification. (Emphasis added.)

The testing methodology employed for reflective sheeting, in fact any testing methodology, should provide a reliable measurement of the product tested. Tests are conducted to determine what the real-life experience will be. Tests are therefore merely surrogates for the real-life experience and are not the final, ultimate measurement. Additionally, there may be other acceptable alternate surrogates that may yield the desired measurement of performance.

I thank you for providing us with the opportunity to provide these clarifications to the report.

Sincerely,

Horace B. Edwards
Secretary of Transportation



W. M. Lackey, P.E.
State Transportation Engineer

Attachments

KANSAS DEPARTMENT OF TRANSPORTATION

REPORT OF SAMPLE OF License Tags

Laboratory No. 82-1757
10-22-82 19
 Received 8-6-82 19

Specification No. _____ Quantity Represented _____
 Source of material Kansas Department of Revenue Topeka, Ks.
 Sample from _____
 Submitted by Lee McMahan Dept. of Revenue
 Identification marks _____
 Project or POV _____
 Type of Construction Information Only
 Contractor _____

TEST RESULTS

Reflective Intensity @ 0.2° divergence angle:

Incidence angle	Original		1000 hrs. weathering	
	-4°	30°	-4°	30°
3M Co. Embossed and printed	10.6	5.6	13.1	5.6
3M Co. Embossed, printed and clear coated	48.4	29.7	36.5	22.8
Fasign Embossed and printed	49.2	32.2	42.9	27.9
Fasign Embossed, printed and clear coated	38.0	23.9	35.9	22.9

Reflective Intensity @ 0.5° divergence angle

3M Co. Embossed and printed	7.9	4.8	7.4	3.7
3M Co. Embossed, printed and clear coated	25.9	18.6	18.7	13.7
Fasign Embossed and printed	32.7	22.5	28.6	20.5
Fasign Embossed, printed and clear coated	26.1	18.2	24.3	16.8

Accelerated Weathering:

The 3M Co. clear coating tag darkened slightly during the accelerated weathering. The 3M Co. embossed and printed tag showed deterioration during the accelerated weathering (no clear coating).

The Fasign material cracks at the small radii of the embossing process, probably due to being a somewhat thicker sheeting. Neither the tags with nor the tags without clear coating showed any effect of accelerated weathering at the cracks, and showed no sign of discoloration or other deterioration.

The 3M Company sheeting must be clear coated to become sufficiently reflective and to be weather resistant. The Fasign material appears to not need a clear coating for durability, at least so far as the 1000 hours of accelerated weathering could determine. The clear coated 3M tag and the coated and uncoated Fasign tags showed no effect from petroleum solvent and alcohol, and was undamaged in an impact test.

Based on the above laboratory tests and experience with reflective sheeting used in signing it appears the useful life of the tags will extend to at least five years.

cc: J. M. Hemphill
 E. R. Lewis ✓
 Lee McMahan
 File

Reported by E. R. Lewis
 Title E. R. Lewis, Chief Chemist

D. O. T. FORM No. 623

August 26, 1987

Mr. Harley Duncan
Secretary of Revenue
Docking State Office Building
Second Floor
Topeka, Kansas 66612

Dear Mr. Duncan:

For your information, the testing on reflective sheeting for license plates is as follows:

First of all, in order to do all the testing involved, we prefer to have two (2) embossed, finished plates, two (2) unembossed plates with either no legend or with graphics, a section of at least two square feet of unapplied reflective sheeting and a section of reflective sheeting with graphics.

- A. The embossed and unembossed plates are cut into two pieces and are being weathered as follows:
 1. Accelerated weathering in Weatherometer and examined every 150 hours, 500 hours and 1,000 hours.
 2. Outdoor weathering at the Kansas Department of Transportation outdoor weathering deck and examined at 12 months and 24 months.
- B. The reflective sheeting with graphics is placed in the Weatherometer and at the outdoor weathering deck and is monitored in the same manner as the plates.
- C. The plain reflective sheeting is tested according to the specification for reflective sheeting to be used for license plates. This includes:

1. Reflective intensity at 0.2°, and 0.5° divergence angles and -4°, +10°, +20°, +30° and +40° observation angles.
2. Color
3. Liner removal.
4. Cleanability
5. Solvent resistance in naphtha.
6. Gloss
7. Weatherometer, 150 hours, 500 hours and 1,000 hours.
 - (a) Reflective intensity
 - (b) Gloss
 - (c) Color
 - (d) Condition
8. Outdoor weathering, 12 months and 24 months.
 - (a) Reflective intensity
 - (b) Gloss
 - (c) Color
 - (d) Condition

The specification includes a rainfall performance test for which we do not have the apparatus. Instead, we have included a test for gloss which we intend to monitor under Weatherometer and outdoor exposure conditions.

The specification calls for 150 hours in the Weatherometer, but we are extending this to observations at 500 hours and 1,000 hours as well. I believe these longer exposure times are more realistic for a five-year license tag. Also, for our information, we are reading the reflective intensity at more angles than is called for in the specification.

Finally, the outdoor weathering is not part of the specification but is being done at your instruction as a means of monitoring the tags and sheeting under real-world conditions. It will also give us a comparison with the accelerated weathering being done in the Weatherometer.

Mr. Harley Duncan
August 26, 1987
Page Three

If there is anything in our testing procedures that needs further explanation, please let me know.

Sincerely yours,

E. R. LEWIS
CHIEF CHEMIST

Materials and Research Center
2300 Van Buren
Topeka, Kansas 66611
(913) 296-2231

ERL:jg