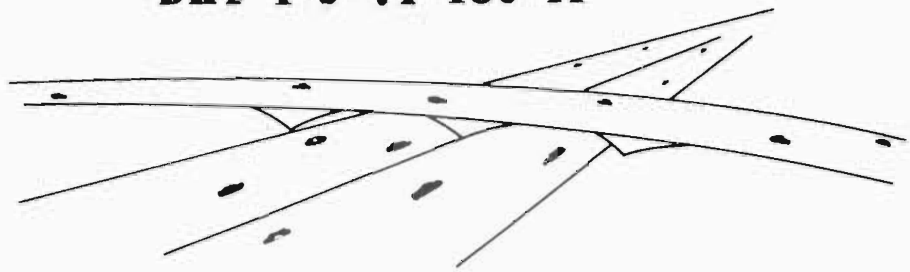
DHT 1-9-74-180-IF



DEPARTMENTAL RESEARCH

Report Number 180-IF

EVALUATION OF THE USE OF CERTAIN ELASTOMERS IN ASPHALT

____LGW____
____KKM____
____GenS____
__(2)__RES____
____CHR____
____A____
____B____
__(1)__C____
____D____
____E____
____F____
____I____
____K____
____

STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION

Mr. Hughes has copy

T LE PAGE

1. Report No.	2. Government Accession No.	3
FHWATX78180-1F		

4. Title and Subtitle
EVALUATION OF THE USE OF CERTAIN ELASTOMERS IN ASPHALT

5. Report Date
July 1978

6. Performing Organization Code

7. Author(s)
Charles W. Chaffin, Donald L. O'Connor and Charles H. Hughes, Sr.

8. Performing Organization Report No.
Research Report 180-1F

9. Performing Organization Name and Address
State Department of Highways and Public Transportation
Materials and Tests Division
Austin, Texas 78703

10. Work Unit No.

11. Contract or Grant No.
Study No. 1-9-74-180

12. Sponsoring Agency Name and Address
U. S. Department of Transportation
Federal Highway Administration
Washington, D. C. 20590

13. Type of Report and Period Covered
Final
8-73/8-76

14. Sponsoring Agency Code

15. Supplementary Notes
Study conducted in cooperation with the U. S. Department of Transportation, Federal Highway Administration.
Study Title: Evaluation of the Use of Certain Elastomers in Asphalt

16. Abstract

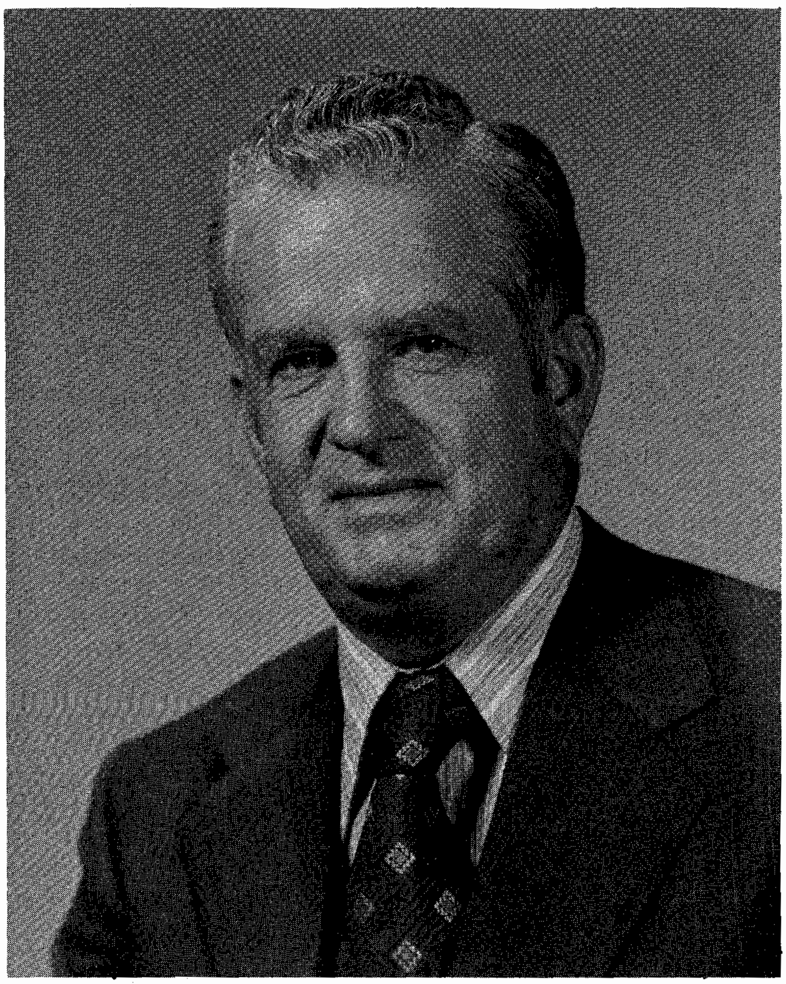
This report covers a laboratory evaluation of the properties of asphalts from eleven of the sources normally used in Texas and the effects of blending with three different elastomers on these properties. Butadiene-styrene and neoprene latexes and amorphous polypropylene were used in this study. The different asphalts had substantially different properties when blended with the elastomers and some asphalts demonstrated incompatibility with the latexes. In general the laboratory data indicate increases in low temperature ductility, decreases in temperature susceptibility, improved impact resistance or less brittleness at low temperatures and less change in properties after exposure in the thin film oven test. Some problem with storage stability is reflected by these data with beneficial effects of the latex being reduced with storage at elevated temperatures. One of the latexes tested was substantially less effective than the amorphous polypropylene or the other latex. Field test sections constructed in the summer of 1976 in three different locations in Texas are still performing well and appear to be more effective in controlling reflective cracking than the control sections without latex. A tentative specification is presented.

17. Key Words
Brittleness, amorphous polypropylene, Butadiene-styrene latex, neoprene latex, asphalt blending, low temperature ductility, temperature susceptibility

18. Distribution Statement
No restrictions. This report is available through the National Technical Information Service, Springfield, Virginia 22151

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	88	

Form DOT F 1700.7 (8-69)



Mr. Fred W. Clark, Jr.

DEDICATION

This report is dedicated to Mr. Fred W. Clark, Jr., District Engineer, State Department of Highways and Public Transportation, Del Rio, Texas in recognition of his 40 years of outstanding service.

Fred W. Clark was born October 30, 1916, in Van Horn, Texas. He graduated from Texas A&M University in 1938 with a BS degree in electrical engineering. Mr. Clark began working for the Department in 1938 as a rodman in Uvalde. He transferred to Leakey as an Instrumentman in 1940. From 1941 until 1946 he served as a Major in the United States Air Force in the Canal Zone and South America.

He returned to Leakey in 1946, then moved to Rocksprings in 1946 serving as Resident Engineer, and to Carrizo Springs in 1949 where he became Supervising Resident Engineer. He became Assistant District Engineer in 1971 and was promoted to District Engineer October, 1972 in Del Rio, Texas, where he served until his death on January 16, 1979.

Mr. Clark was a member of the Texas Society of Professional Engineers and served in many capacities at the Methodist Church. He belonged to a Culberson County pioneer family, and was interested in historical survey work and museums.

Mr. Clark was very interested in research, new ideas and improvement of the Departmental operations. He had to his credit publications dealing with stabilizing salvage base materials and the use of salvage steel.

Mr. Clark's civic and professional efforts endeared him to all with whom he worked as he practiced the Professional Engineer's Creed which states in part:

> "----To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations."

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

There was no invention or discovery conceived or first actually reduced to practice in the course of or under this contract, including any art, method, process, machine, manufacture, design, or composition of matter, or any new and useful improvement thereof, or any variety of plant which is or may be patentable under the patent laws of the United States of America or any foreign country.

ACKNOWLEDGEMENTS

C. W. Chaffin, Materials and Tests Chemical Engineer, was principal project supervisor and was assisted by D. L. O'Connor, Supervising Chemical Engineer. C. H. Hughes, Materials and Tests Field Engineer, assisted in writing the report.

Acknowledgement is given to the technicians performing the tests, Charles Jennings, Scott Boyd, Howard Stark, and Gene Coward.

Acknowledgement is given to the Lufkin, Atlanta, and El Paso Districts for their assistance with field sections and to John Nixon and his associates in the Research Section of the Transportation Planning Division for their assistance in data accumulation and reporting of the field trials for this study.

IMPLEMENTATION

The results of this study have been implemented in the Abilene District seal coat program for the summer of 1977. Other Districts use or have used latex emulsion blends or latex asphalt cement blends. Emulsified asphalt - latex blends are being used for crack pouring. This study indicates the need to evaluate each new proposed blend to obtain compatible blends with the most desirable characteristics.

SUMMARY

This study utilizes asphalts from eleven sources to evaluate the effect of adding three different elastomers on the basic properties of the asphalt. A butadiene-styrene latex, neoprene latex and amorphous-polypropylene were blended in various amounts to different grades of asphalt. The effect of the thin film oven test was considered as well as storage stability at elevated temperatures. Field test sections continue to be evaluated to compare these blends with control sections and other types of rubberized materials.

INTRODUCTION

Background

The history of modifying asphalt with rubber dates back at least 50 years when only natural rubber was available. The Dutch used rubber modified asphalt in Java and Europe in the thirties and their appraisal of these surfaces after heavy war time traffic created renewed interest in its use in Europe. Competition from war time developed synthetic rubber encouraged the Natural Rubber Bureau to vigorously start promoting the use of natural rubber in asphalt in this country in the late forties. The Texas State Department of Highways and Public Transportation (DHT) first used rubber in asphalt surfacing in 1949.

Due to the vast prospective market available by the use of even two to three percent natural rubber in highway asphalt, some of the American natural rubber producing companies joined the Natural Rubber Bureau in the fifties in promoting such use. Later, these same companies began promoting synthetic rubber as a modifier and reclaimed rubber companies also began promoting their product. Most of the asphalt manufacturers including the Asphalt Institute showed little enthusiasm or even interest in the idea. However, there was enough interest on the part of the various states to result in over half of them placing from small to rather large trials of rubber asphalt surfacing. A few states have been specifying it for seal coats on a regular basis for several years.

Following the initial 1949 DHT experiment, other trial sections were placed using natural rubber and these have been followed the last several years with considerable quantities of synthetic rubber (butadiene-styrene) modified asphalt. The Natural Rubber Bureau, Synthetic Rubber Institute as well as individual synthetic rubber manufacturers have investigated various forms and types of rubber. As a result during the early stages of development, the rubber industry offered various forms and types. At this time, a special butadiene-styrene synthetic rubber latex is readily available from both Goodyear and Firestone and DuPont offers their neoprene latex. U.S. Rubber Reclaiming, Atlos Rubber, and Midwest Rubber have their reclaimed products available. There are other potential suppliers of both latex and reclaimed rubber.

One asphalt supplier, Husky of Cody, Wyoming, became interested in the idea and was convinced that it has sufficient merit to offer rubberized asphalt. Husky's positive attitude is probably responsible for rubber modified asphalt (both neoprene and butadiene-styrene) now being used regularly for several years by two or three states in their market area. In addition, Cosden located at Big Spring, Texas, has offered excellent cooperation in making rubberized asphalt available to DHT and has the required blending facilities and excellent facilities for storing tank car quantities of latex.

Since the first DHT trial in 1949, it is estimated that the Department has used approximately 3,000,000 gallons (and maybe more) of rubberized asphalt. Most of this has been rubberized asphalt cement from Cosden using Goodyear latex (butadiene-styrene) Pliopave L-170 for seal coats predominantly in the

Amarillo, Lubbock, Odessa and San Angelo Districts. The Amarillo District has also used some rubberized MC-5 and the Austin District has used EA-HVRS with this same latex for seal coats. The Ft. Worth District has placed hot mix using rubberized AC from both Cosden and Gulf States (Houston) for bridge deck overlays and one sizable highway overlay. Some latex has been added to emulsion by DHT Maintenance for crack pouring and some has been added to emulsion for tack coat.

C. W. Chaffin, Materials and Tests Chemical Engineer, has given this basic idea of improving asphalt by addition of rubber close attention continuously since 1949. This has involved studying the literature, personal discussion with others throughout the United States and other countries, attending special conferences on this specific subject, testing and control of the DHT rubberized asphalt and working with various Districts during application and evaluation of results. Abstracts furnished by Transportation Research Board's HRIS and Texas Transportation Institute of the literature on this subject have been recently reviewed and many of these articles are in the Materials and Tests Division files.

Based on this close study and the results thus far, it is concluded that of all research to date on asphalt as a surfacing material, the modification with available rubber has by far the best possibilities of producing immediate and significant practical benefits.

Prior research has developed and made available special latex for blending with asphalt as well as practical equipment for blending and handling rubberized materials. Some rather thorough evaluations have been made on the use of rubber, but the bulk of it has not been used under close enough controlled and comparative conditions to fully justify its use over regular asphalt. By far the greatest shortcoming of research to date has been the failure to look at the possibility of developing a significantly different end product rather than just merely adding certain amounts of rubber to the grade and or type of asphalt that would have been used for the same work without rubber.

Specifically for seal coat purposes it is proposed to develop a rubberized material having improved temperature susceptibility characteristics, increased life, and other more desirable characteristics as compared to regular asphalt now used. Rubberizing asphalt makes possible the use of much softer asphalt than normally used for seal coats without danger of too low a film strength in hot weather. This means less brittleness in cold weather and increased longevity. The best amount and type of rubber needs to be determined for asphalt cements, cut-backs and emulsions as it is believed all have their particular place in surfacing.

Objectives of the Study

1. Conduct a laboratory investigation to determine the optimum amount and type of rubber to add to various asphalts to give improved properties for surfacing use.

2. Determine the volume of asphalt, that is, the number of Texas sources which give the desired modified properties. Due to the wide differences in composition of the numerous Texas asphalts, it is already known that all will not respond alike to modification. It will be necessary to

know if satisfactory modification can be obtained with at least sufficient number and distribution of sources so as to make general use competitive, economical and practical.

3. Develop adequate specifications, preferably on the finished product, so as to properly control the quality.

4. The overall objective of the study is to determine if modification of asphalt with rubber is justified mainly for use in asphalt surfacing but information gained will help evaluate it for other special uses such as tack coat and crack pouring.

LABORATORY INVESTIGATION

In order to provide as wide a base as possible for this study eleven of the asphalt sources commonly utilized in Texas were selected to evaluate the latex blends. The sources used were as follows.

American Petrofina of Texas

- Cosden, Big Spring, Texas
- American Petrofina, Mt. Pleasant, Texas

Gulf States Asphalt

- Houston Plant
- Corpus Christi Plant

Exxon, Baytown, Texas

Bell Oil and Gas, Ardmore, Oklahoma

Diamond Shamrock, Sheerin, Texas

APCO Oil Corp., Cyril, Oklahoma

Chevron, El Paso, Texas

Kerr-McGee, Wynnewood, Oklahoma

Texaco, Port Neches, Texas

Samples of AC-3 and AC-5 were taken from all of these plants in sufficient quantity to complete this study.

The two latex materials selected for blending were DuPont Neoprene Latex LD-260 and Goodyear Butadiene-Styrene Latex L-170 Pliopave. As the laboratory investigation progressed another polymer, which is a by-product of Eastman Chemical Products, Inc. polypropylene production, became available. It was amorphous polypropylene and preliminary tests and cost data showed that this material had promise as a satisfactory blending material. Specifications for these materials are given in the appendix.

Blending procedures in the laboratory were determined to be different for the three elastomers as follows:

Neoprene Procedure:

The asphalt (1000 grams) was heated to 360 F and the neoprene latex was added one drop at a time while agitating with an electric stirrer operated at 260 revolutions per minute. The temperature was maintained between 360 F and 400 F and stirring continued for 15 minutes after all latex was added. Total time from addition of first latex to completion of blending was 1-1/4 to 1-1/2 hours.

Goodyear Procedure:

The asphalt (1000 grams) was heated to 275 F and the butadiene-styrene latex added one drop at a time while agitating with an electric stirrer at 260 revolutions per minute. The temperature was maintained between 275 F and 300 F and stirring continued for 15 minutes after all latex was added. Total time from addition of first latex to completion of blending was 1-1/4 to 1-1/2 hours.

Amorphous-Polypropylene Procedure:

The asphalt (900 grams) and the polymer (100 grams) were both heated to 275 F and blended for 20 minutes with an electric stirrer at a speed of 250 revolutions per minute. Temperature of the blend was maintained between 275 F and 300 F during blending.

The resulting blends were subjected to the tests normally performed on an asphalt cement under our standard specifications. In addition, the ductility at 39.2 F, 5 cm per minute, and the low temperature brittleness were determined. The low temperature brittleness test procedure is described in the appendix but it consists of dropping a steel ball on an asphalt disk 3/8 inch thick and 2-1/2 inches in diameter to determine the height at which a single drop will cause the disk to break. Two ball weights (66.7 grams) or (130.5 grams) are used and the disk is normally chilled to 20 F or 50 F for testing depending on the low temperature characteristic of the material.

Results of these tests are presented in Table 1 of this report. It should be noted that tests on the amorphous polypropylene were made on only two of the sources selected for this study primarily due to the timing of availability of this material.

Because of concern with storage stability of these blends it was decided to arbitrarily age a number of the blends at 325 F for 72 hours. A comparison of the penetration, viscosity and ductility before and after aging is presented in Table 2 of this report.

Some effort at evaluation of latex and emulsion blends was made in this study. Unfortunately no successful methods were found to reduce the emulsion to a residual in the laboratory that would be comparable to residual asphalt in a seal or surface treatement application in the field.

Tests such as the "Toughness-Tenacity Test" and "Torsional Recovery Test" were attempted but eliminated because of equipment limitations in our laboratory.

Some testing with blends of asphalt and reclaimed rubber were made but were limited to the brittleness test primarily since the characteristics of this blend do not lend themselves to the standard asphalt cement tests utilized in the rest of this study. Reclaimed rubber data was deemed insufficient to include in this report.

DISCUSSION

The addition of rubber to asphalt has generally been reported to improve the following properties:

- Temperature susceptibility
- Low temperature ductility
- Impact resistance at low temperatures
- Toughness
- Recovery (elasticity)
- Softening Point
- Cold flow
- Tack and adhesion
- Bleeding resistance

It has also been reported that different types of synthetic rubbers behave quite differently in asphalt and produce blends with substantially different properties. The data in this study supports this statement. In addition this study established the wide variation in properties of a blend as the source of base asphalt in the blend is changed.

In general the data in this study demonstrates an improvement in the following listed properties for blends with most of the asphalts and one of the elastomers studied.

Temperature susceptibility

Low temperature ductility

Impact resistance at low temperatures

Tack and adhesion

Bleeding resistance

Field Trials

The last two properties have been evaluated by the several field test sections with latex blends (under another project but considered by this study) and in the 1977 seal program of one of our Districts which utilized the amorphous polypropylene. In the summer of 1976 the Department placed trial sections of seal coats using several different binders in three locations. These were on I-10 in far west Texas, SH-22 in north central Texas and SH-43 and US-80 in east Texas. These locations involve a variety of climatic and traffic conditions.

Although not to be compared directly to a typical chip seal, a reclaimed rubber asphalt seal called Overflex essentially as outlined in FHWA Implementation Package 73-1, Rubber-Asphalt Binder For Seal Coat Construction, was included. AC-3 blended with L-170 was used at only one location because a fire at Cosden Refinery prevented the blending of this material for the other locations. The chip seals except the Overflex were all placed with the same quantities, aggregates and construction practices as routine seals placed in those areas.

The various binders placed for evaluation are as follows:

1. AC-3, AC-5 and AC-10, no modification
2. AC-3 + 2% L-170

3. AC-3 + 10% Eastobond (amorphous polypropylene)

4. EA-HVRS

5. EA-HVRS + 2% L-170

6. Reclaimed Rubber Asphalt (Overflex)

There was essentially no difference in the initial results of all these binders as good aggregate retention was obtained on all sections. The increased tackiness of the modified binder over regular AC was readily apparent. It is planned to evaluate these sections for several years so as to get overall performance and durability.

Copies of the evaluation sheets for the field test sections are included in the Appendix. The indications at this time are that some improvement in the reduction of reflective cracking may be gained by the addition of rubber, however the test sections are only two years old and this preliminary judgement may not be valid.

Some of the blends in this study demonstrated incompatibility to a degree ranging from complete incompatibility through gel formation or livering to slightly grainy texture. Table 3 shows the notes made by the technician doing the blending. The neoprene latex demonstrated the greatest problem with compatibility in this study. The amorphous polypropylene blends smoothly without unusual effort since it can be treated and handled much the same as the asphalt.

Penetration And Viscosity Data

Blends of the two latexes usually produced properties of penetration and viscosity in the same range as the next harder grade (viscosity grading) of asphalt to the blend asphalt. Ten percent amorphous polypropylene increases the viscosity two grades harder than the original.

Reference to the data for Cosden AC-3 with L-170 shows that it meets with the minimum viscosity at 140 F and penetration at 77 F requirements for AC-5. This means that it would have similar film strength on warm days to prevent tenderness of seal coat (chip seal) in the early stage. Yet this AC-3 with L-170 is less viscous and brittle at lower temperatures than an AC-5. The blend has a viscosity of 0.278×10^6 poises at 77 F compared to 0.518×10^6 for Cosden AC-5. Also, the blend will withstand 8.06 inch-pounds impact without cracking whereas Cosden AC-5 shatters at 1.76 inch-pounds.

This improvement in less brittleness and hardness at lower temperatures compared to consistency at 140 F is also shown by the 186 pen (77 F) for the AC-3 L-170 blend compared to only 139 for an AC-5.

In cases of seals placed during hot Texas weather and subjected to heavy traffic, it has been found necessary to use AC-10. In such cases an AC-5 with L-170 would have as high or higher viscosity at 140 F yet much higher pen and less brittleness at low temperatures. This change in temperature susceptibility is considered highly significant.

Less stiffness or brittleness at low road temperatures has been related to beneficial performance. The increased value must be weighed against the cost.

LOW TEMPERATURE DUCTILITY AND IMPACT BRITTLENESS

Most improvement in low temperature ductility was obtained with the butadiene styrene L-170 with all blends achieving 141+ cm at 39.2 F. The neoprene latex LD-260 decreased the low temperature ductility in all but four blends and did not meet the 100 cm minimum specified by the Department for several years for rubberized asphalt. This specification used by the Department is given in the Appendix under Item 300. Amorphous polypropylene improved the low temperature ductility in two of the four blends tested but demonstrated poor results in this test on residue from the thin film oven test.

Impact resistance as reflected by the low temperature brittleness test was improved in eleven of the eighteen blends with L-170 and in eight of the eighteen blends with LD-260. None of the amorphous-polypropylene blends was tested at 20 F but did show good impact resistance at 50 F, 40 F and 30 F as shown in Table 1.

Storage Stability

Table 2 shows results after the storage stability test. In most samples the penetration was reduced about ten percent. The viscosity followed no pattern with about half of the samples increasing and about half decreasing in viscosity after storage. The most radical change was in the low temperature ductility. Except for one sample the ductility was substantially reduced.

Although asphalt-latex blends are more sensitive to loss of properties due to prolonged heating, it is considered practical to use the material. On prolonged storage it may be desirable to add a small additional amount of latex.

The thin film oven test shows that the heat and air exposed asphalt-latex blend is still superior in the desired properties to the regular asphalt.

The amorphous polypropylene results in improved impact resistance at low temperature, although the improvement is not as marked as that obtained with the L-170.

Thin Film Oven Test

There is less change after oven aging of a one-eighth inch thick film at 325 F for 5 hours of an asphalt L-170 blend than a comparable unblended asphalt. For example, the Cosden AC-3 + 2% L-170 blend with an initial viscosity at 140 F of 425 stokes and penetration at 77 F of 186 gave after aging a viscosity of 865 and pen of 114. This needs to be compared to the regular AC-5 (unblended) with an initial viscosity of 460 and pen of 139 which yielded after aging a viscosity of 1096 and pen of 75. Although there are no specific claims for correlation of this aging test with long range in-service durability, it is believed that there is reasonable evidence to expect better performance on this test to be reflected in service.

Cost Considerations

One of the major factors with improving asphalt by addition of other materials has been the relative low cost of asphalt as compared to the modifiers. For a number of years during the consideration of latex modifiers asphalt cost not much over one cent a pound. The latex price was 40 to 50 cents per pound (solids basis). This doubles the price of asphalt if you add 2 to 2 1/2 percent.

Asphalt has increased in price more than the additives the last three or four years but it is still only 3 1/2 to 4 cents per pound. Presently (1978) AC asphalt is about 30 cents per gallon at the refinery and the furnished AC + L-170 blend costs about 55 cents.

At first amorphous polypropylene (Eastobond) was offered at about the same price as asphalt so the only added cost was any extra freight and a small amount of blending cost. However, it now sells for about 25 cents per pound. The minimum to be used is about 6% by weight so the cost increase is considerable. Asphalt performs sufficiently well that definite benefits are needed to justify any of these modifiers.

CONCLUSIONS

1. Blending of asphalt with elastomers such as butadiene-styrene and neoprene latexes with as little as 2% (solids basis) of latex gives substantial improvements in temperature susceptibility, low temperature ductility, impact resistance and increased resistance to change by laboratory oven aging tests.

2. Each source of asphalt and elastomer must be evaluated for proper blending procedures and the amount needed to give desired properties.

3. There are adequate sources of supply in Texas of asphalt that may be blended satisfactorily to make general use competitive and practical.

4. Field use and trial sections of seal coats show improved tack and adhesion, better aggregate retention initially as well as less shelling during the first winter. Better documentation is anticipated through several controlled test sections placed in 1976.

5. A Tentative Specification has resulted based on this work and previous experience.

APPENDIX

APPENDIX (Continued)

TABLE 1

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE			
	AmPet AC-3	AmPet AC-3 + 2% LD 260	AmPet AC-3 + 2% L 170	AmPet AC-3 + 10% Amorphous Polypropylene
Pen. 77 F 100g, 5 sec.	259	232	197	164
Pen. 77 F 100g, 5 sec. *T.F.	147	156	153	78
Viscosity, 77 F Poises X 10^6	0.140	0.206	0.254	
Viscosity, 140 F Stokes	330	433	741	1386
Viscosity, 140 F T.F. Stokes	642	841	950	2912
Ductility, 39.2 F 5 cms per min, cms.	57	45	141+	129
Ductility, 39.2 F T.F., 5 cms per min, cms.		23	141+	26
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	2.35	4.90	6.90	19.5+ at 40 F 8.9 at 30 F

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	Bell Oil & Gas AC-3	Bell Oil & Gas AC-3 + 2% LD 260	Bell Oil & Gas AC-3 + 2% L 170
Pen. 77 F 100g, 5 sec.	269	269	239
Pen. 77 F 100g, 5 sec. *T.F.	171	171	184
Viscosity, 77 F Poises X 10^6	.043	.144	.455
Viscosity, 140 F Stokes	296	351	547
Viscosity, 140 F T.F. Stokes	557	543	722
Ductility, 39.2 F 5 cms per min, cms.	141+	78	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		34	141+
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76(s)	6.05	3.68

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE			
	Cosden AC-3	Cosden AC-3 + 2% LD 260	Cosden AC-3 + 2% L 170	Cosden AC-3 + 10% Amorphous Polypropylene
Pen. 77 F 100g, 5 sec.	211	216	186	122
Pen. 77 F 100g, 5 sec. *T.F.	106		114	74
Viscosity, 77 F Poises X 10^6	0.173	0.238	0.278	
Viscosity, 140 F Stokes	254	324	425	1090
Viscosity, 140 F T.F. Stokes	639	740	865	2160
Ductility, 39.2 F 5 cms per min, cms.	116	84	141+	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		18	76	7
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76(s)	1.76(s)	9.52	15.2 at 50 F

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	Exxon AC-3	Exxon AC-3 + 2% LD 260	Exxon AC-3 + 2% L 170
Pen. 77 F 100g, 5 sec.	257	264	221
Pen. 77 F 100g, 5 sec. *T.F.	188	204	185
Viscosity, 77 F Poises X 10^6	0.107	0.110	0.140
Viscosity, 140 F Stokes	302	315	503
Viscosity, 140 F T.F. Stokes	468	497	677
Ductility, 39.2 F 5 cms per min, cms.	141+	73	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		35	141+
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76(s)	1.76(s)	1.76(s)

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	Gulf States (Houston) AC-3	Gulf States (Houston) AC-3 + 2% LD 260	Gulf States (Houston) AC-3 + 2% L 170
Pen. 77 F 100g, 5 sec.	221	220	187
Pen. 77 F 100g, 5 sec. *T.F.	111	145	119
Viscosity, 77 F Poises X 10^6	0.212	0.234	0.319
Viscosity, 140 F Stokes	271	394	512
Viscosity, 140 F T.F. Stokes	563	545	764
Ductility, 39.2 F 5 cms per min, cms.	65	60	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		16	141+
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)			

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	Shamrock AC-3	Shamrock AC-3 + 2% LD 260	Shamrock AC-3 + 2% L 170
Pen. 77 F 100g, 5 sec.	270	248	235
Pen. 77 F 100g, 5 sec. *T.F.	172	176	177
Viscosity, 77 F Poises X 10^6	0.045	0.381	0.328
Viscosity, 140 F Stokes	331	400	541
Viscosity, 140 F T.F. Stokes	568	652	739
Ductility, 39.2 F 5 cms per min, cms.	17	45	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		12	60
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	2.50	7.78	9.52

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	Material and Source		
	Texaco AC-3	Texaco AC-3 +2% LD 260	Texaco AC-3 +2% L 170
Pen. 77 F 100g, 5 sec.	279	260	269
Pen. 77 F 100g, 5 sec. *T.F.	219	224	204
Viscosity, 77 F Poises X 10^6	.154	.099	0.158
Viscosity, 140 F Stokes	289	409	484
Viscosity, 140 F T.F. Stokes	428	586	557
Ductility, 39.2 F 5 cms per min, cms.	141+	103	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		60	141+
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76 (s)	4.90	5.18

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE			
	AmPet AC-5	AmPet AC-5 + 2% LD 260	AmPet AC-5 + 2% L 170	AmPet AC-5 + 10% Amorphous Polypropylene
Pen. 77 F 100g, 5 sec.	208	188	155	139
Pen. 77 F 100g, 5 sec. *T.F.	124	127	130	61
Viscosity, 77 F Poises X 10^6	0.462	0.395	0.480	
Viscosity, 140 F Stokes	457	617	1092	1753
Viscosity, 140 F T.F. Stokes	991	1410	1368	4861
Ductility, 39.2 F 5 cms per min, cms.	104	40	141+	18
Ductility, 39.2 F T.F., 5 cms per min, cms.		18	141+	5
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76(c)	1.76(s)	1.76(s)	11.2 at 40 F

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	APCO AC-5	APCO AC-5 + 2% LD 260	APCO AC-5 + 2% L. 170
Pen. 77 F 100g, 5 sec.	208	265	179
Pen. 77 F 100g, 5 sec. *T.F.	140	154	145
Viscosity, 77 F Poises X 10^6	0.382	0.358	0.476
Viscosity, 140 F Stokes	498	551	808
Viscosity, 140 F T.F. Stokes	820	877	1052
Ductility, 39.2 F 5 cms per min, cms.	132	44	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		24	141+
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)			

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	Bell Oil & Gas AC-5	Bell Oil & Gas AC-5 + 2% LD 260	Bell Oil & Gas AC-5 + 2% L 170
Pen. 77 F 100g, 5 sec.	204	194	174
Pen. 77 F 100g, 5 sec. *T.F.	126	125	130
Viscosity, 77 F Poises X 10^6	.238	.202	.640
Viscosity, 140 F Stokes	462	523	907
Viscosity, 140 F T.F. Stokes	1040	1142	1212
Ductility, 39.2 F 5 cms per min, cms.	45	17	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		22	99
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	2.21	3.38	2.80

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	Chevron AC-5	Chevron AC-5 + 2% LD 260	Chevron AC-5 + 2% L 170
Pen. 77 F 100g, 5 sec.	152	155	132
Pen. 77 F 100g, 5 sec. *T.F.	91	91	93
Viscosity, 77 F Poises X 10^6	0.240	0.287	0.402
Viscosity, 140 F Stokes	433	382	627
Viscosity, 140 F T.F. Stokes	973	1271	1146
Ductility, 39.2 F 5 cms per min, cms.	23	9	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.	5	5	27
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76(c)	1.76	2.50

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE			
	Cosden AC-5	Cosden AC-5 + 2% LD 260	Cosden AC-5 + 2% L 170	Cosden AC-5 + 10% Amorphous Polypropylene
Pen. 77 F 100g, 5 sec.	139	133	118	73
Pen. 77 F 100g, 5 sec. *T.F.	75	74	70	67
Viscosity, 77 F Poises X 10^6	0.518	0.518	1.580	
Viscosity, 140 F Stokes	460	679	1356	2162
Viscosity, 140 F T.F. Stokes	1096	1471	2033	3668
Ductility, 39.2 F 5 cms per min, cms.	9	66	141+	7
Ductility, 39.2 F T.F., 5 cms per min, cms.		15	50	1.5
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76(s)	1.76(s)	8.06	5.7 at 50 F

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	Exxon AC-5	Exxon AC-5 *** + 2% LD 260	Exxon AC-5 + 2% L 170
Pen. 77 F 100g, 5 sec.	202	203	181
Pen. 77 F 100g, 5 sec. *T.F.	135	148	137
Viscosity, 77 F Poises X 10^6	.187	.282	2.03
Viscosity, 140 F Stokes	414	413	645
Viscosity, 140 F T.F. Stokes	719	1312	908
Ductility, 39.2 F 5 cms per min, cms.	138	57	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		17	141+
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76(s)	1.76(s)	1.76(c)

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"
***This material exhibited incompatibility.

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	Gulf States (Corpus) AC-5	Gulf States (Corpus) AC-5 + 2% LD 260	Gulf States (Corpus) AC-5 + 2% L 170
Pen. 77 F 100g, 5 sec.	160	134	114
Pen. 77 F 100g, 5 sec. *T.F.		98	86
Viscosity, 77 F Poises X 10^6	0.425	0.430	0.525
Viscosity, 140 F Stokes	477	986	901
Viscosity, 140 F T.F. Stokes	895	1298	1252
Ductility, 39.2 F 5 cms per min, cms.	14	37	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		14	141+
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76(s)	1.76(s)	1.76(s)

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	Gulf States (Houston) AC-5	Gulf States (Houston) AC-5 + 2% LD 260	Gulf States (Houston) AC-5 + 2% L 170
Pen. 77 F 100g, 5 sec.	136	130	123
Pen. 77 F 100g, 5 sec. *T.F.	72	86	77
Viscosity, 77 F Poises X 10^6	0.338	0.583	1.10
Viscosity, 140 F Stokes	507	612	857
Viscosity, 140 F T.F. Stokes	1044	1098	1457
Ductility, 39.2 F 5 cms per min, cms.	9	30	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		8	76
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76(s)	1.76(s)	1.76(s)

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	Material and Source		
	Kerr McGee AC-5	Kerr McGee AC-5 + 2% LD 260	Kerr McGee AC-5 + 2% L 170
Pen. 77 F 100g, 5 sec.	181	178	154
Pen. 77 F 100g, 5 sec. *T.F.	97	110	110
Viscosity, 77 F Poises X 10^6	0.392	0.280	0.362
Viscosity, 140 F Stokes	477	465	681
Viscosity, 140 F T.F. Stokes	1101	1024	771
Ductility, 39.2 F 5 cms per min, cms.	42	19	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		7	113
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76 (s)	2.80	2.80

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	MATERIAL & SOURCE		
	Shamrock AC-5	Shamrock AC-5 + 2% LD 260	Shamrock AC-5 + 2% L 170
Pen. 77 F 100g, 5 sec.	194	180	164
Pen. 77 F 100g, 5 sec. *T.F.	129	127	109
Viscosity, 77 F Poises X 10^6	0.347	0.452	0.688
Viscosity, 140 F Stokes	512	596	718
Viscosity, 140 F T.F. Stokes	880	1033	1064
Ductility, 39.2 F 5 cms per min, cms.	12	19	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		10	80
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	2.21	5.47	5.75

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 1 (Continued)

COMPARISON OF PROPERTIES OF ASPHALTS AND ASPHALTS BLENDED WITH ELASTOMERS
USING ELEVEN ASPHALT SOURCES COMMONLY USED IN TEXAS

PROPERTY	Material and Source		
	Texaco AC-5	Texaco AC-5 +2% LD 260	Texaco AC-5 +2% L 170
Pen. 77 F 100g, 5 sec.	160	174	147
Pen. 77 F 100g, 5 sec. *T.F.	101	104	105
Viscosity, 77 F Poises X 10^6	0.343	0.330	0.440
Viscosity, 140 F Stokes	554	647	967
Viscosity, 140 F T.F. Stokes	1117	1309	1424
Ductility, 39.2 F 5 cms per min, cms.	74	64	141+
Ductility, 39.2 F T.F., 5 cms per min, cms.		14	141+
Brittleness-Inch Pounds at Failure or Minimum 12-inch drop at 20 F** (See Appendix for test)	1.76 (s)	3.23	3.82

*T.F. - Tests on residues from thin film oven test.
**At minimum 12" drop (c) denotes "cracked," (s) denotes "shattered"

TABLE 2

EFFECT OF STORAGE AT 325 F FOR 72 HOURS ON ASPHALTS
BLENDED WITH 2% BUTADIENE-STYRENE L-170

PRODUCER	AC GRADE	ORIGINAL BLEND			AFTER STORAGE		
		77 F PEN	140 F VIS	39.2 F DUC	77 F PEN	140 F VIS	39.2 F DUC
Cosden	3	186	425	141+	165	770	135
Cosden	5	118	1356	141+	114	864	90
Am.Pet.	3	197	741	141+	167	800	60
Am.Pet.	5	155	1092	141+	141	928	70
Chevron	5	132	627	141+	127	788	38
Gulf States (Houston)	3	187	512	141+	187	654	102
Gulf States (Houston)	5	123	857	141+	109	1004	59
Shamrock	3	235	541	141+	197	555	40
Shamrock	5	164	718	141+	147	781	12
APCO	5	179	808	141+	184	691	46
Gulf States (Corpus Christi)	5	114	901	141+	116	992	63
Bell Oil & Gas	3	239	547	141+	239	500	129
Bell Oil & Gas	5	174	907	141+	149	1048	58
Exxon	3	221	503	141+	237	491	141+
Exxon	5	181	645	141+	147	951	99

TABLE 2 (continued)

EFFECT OF STORAGE AT 325 F FOR 72 HOURS ON ASPHALTS
BLENDED WITH 2% BUTADIENE-STYRENE L-170

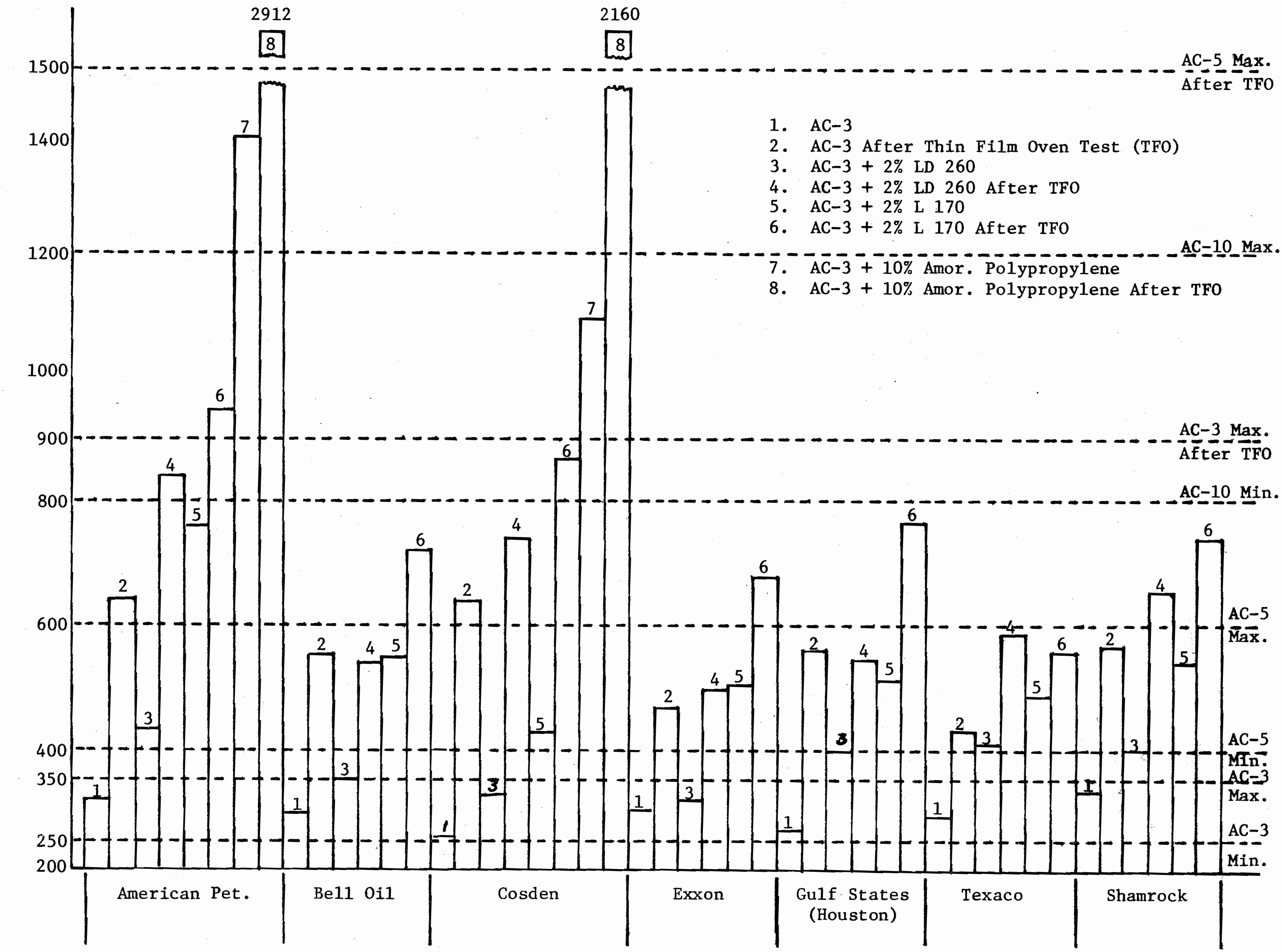
		ORIGINAL BLEND			AFTER STORAGE		
PRODUCER	AC GRADE	77 F PEN	140 F VIS	39.2 F DUC	77 F PEN	140 F VIS	39.2 DUC
Kerr-McGee	5	154	681	141+	137	893	45
Texaco	3	269	484	141+	245	553	141+
Texaco	5	147	967	141+	143	1089	141+
BLENDED WITH 10% AMORPHOUS POLYPROPYLENE							
Cosden	3	142	956	140	142	981	53

TABLE 3

COMPATIBILITY BY VISUAL EVALUATION

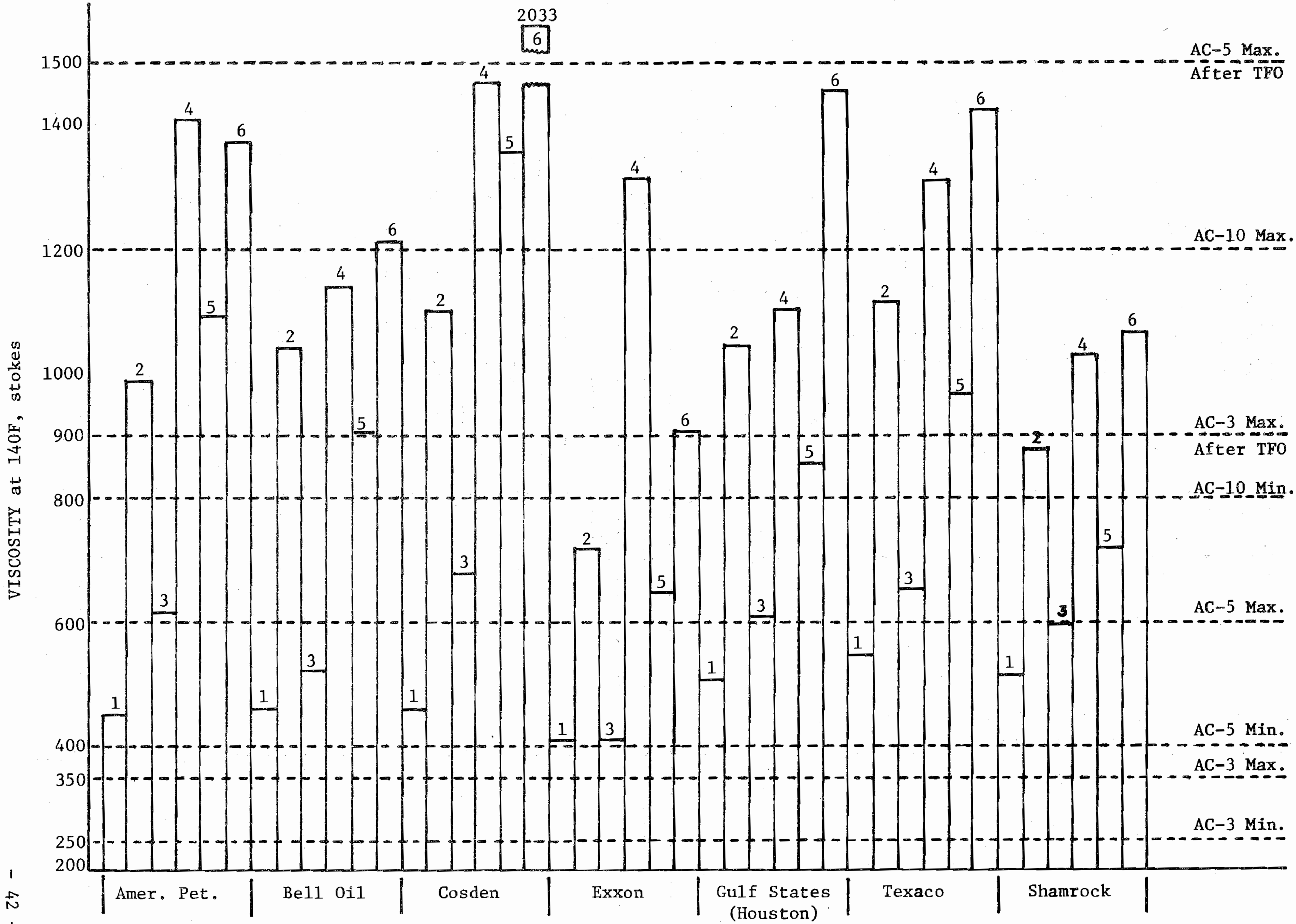
PRODUCER	GRADE	NEOP	GOODYEAR	3 days @ 325 NEOP	3 days @ 325 GOODYEAR
Am.Pet.	3	was not smooth	was not smooth	-	was not smooth
Am.Pet.	5	was not smooth	was not smooth	-	was not smooth
APCO	5	was not smooth	was not smooth	-	was not smooth
Bell Oil & Gas	3	blend okay	blend okay	-	blend okay
Bell Oil & Gas	5	not compatible	blend okay	-	blend okay
Chevron	5	blend okay	blend okay	-	blend okay
Cosden	3	blend okay	blend okay	-	blend okay
Cosden	5	blend okay	blend okay	-	blend okay
Gulf States (Corpus)	5	blend okay	blend okay	-	blend okay
Gulf States (Houston)	3	blend okay	blend okay	-	blend okay
Gulf States (Houston)	5	blend okay	blend okay	-	blend okay
Exxon	3	not compatible	blend okay	-	blend okay
Exxon	5	not compatible	blend okay	-	blend okay
Shamrock	3	not compatible	was not smooth	-	was not smooth
Shamrock	5	not compatible	was not smooth	-	was not smooth

NOTE: "not compatible" may cover a range of appearance from complete separation of the blend, gel formation or "livering" to grainy texture.



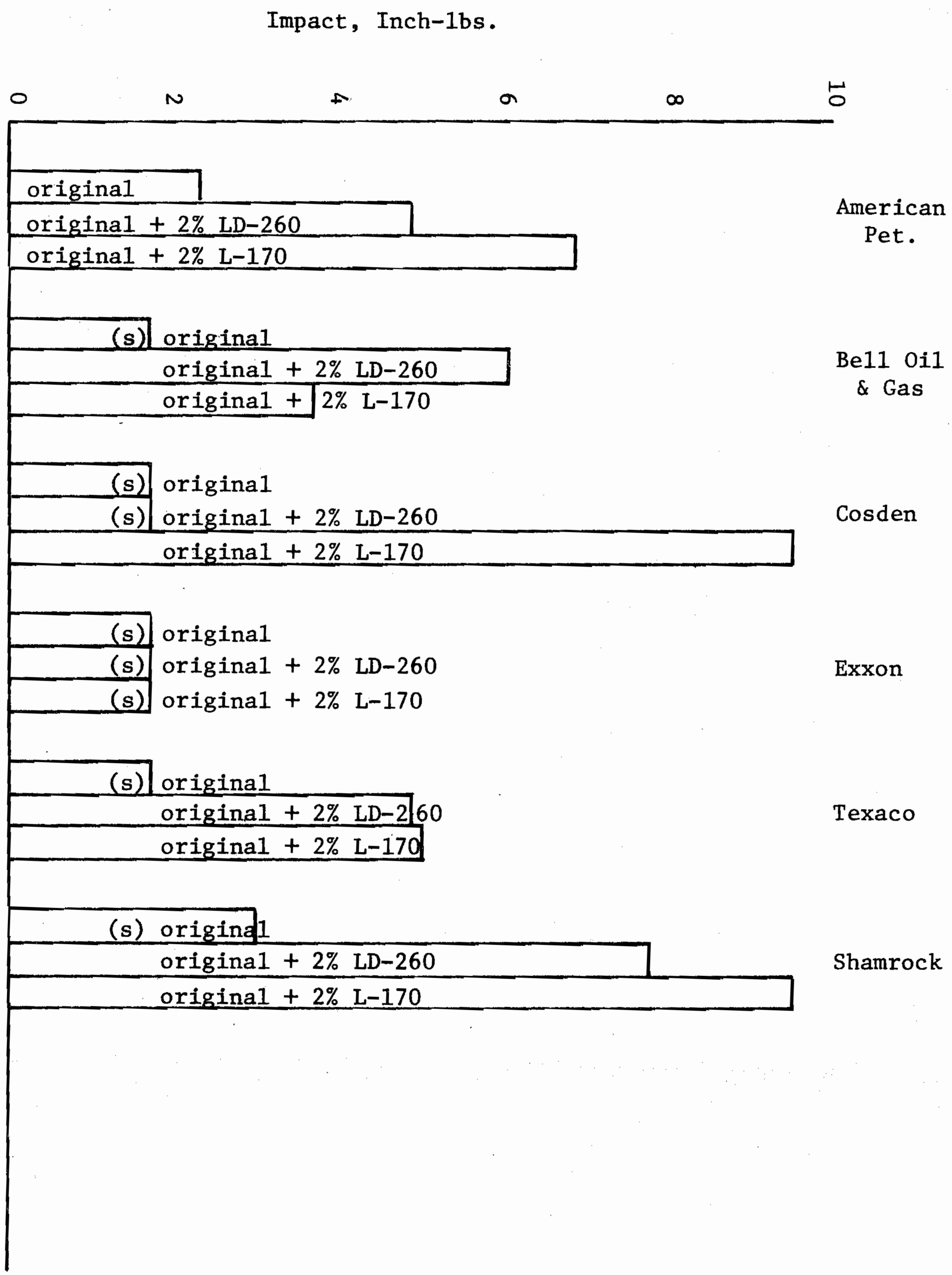
VISCOSITY at 140F, stokes
1500
1400
1200
1000
900
800
600
400
350
250
200
2912
2160
AC-5 Max.
After TFO
AC-10 Max.
AC-3 Max.
After TFO
AC-10 Min.
AC-5
Max.
AC-5
Min.
AC-3
Max.
AC-3
Min.
1. AC-3
2. AC-3 After Thin Film Oven Test (TFO)
3. AC-3 + 2% LD 260
4. AC-3 + 2% LD 260 After TFO
5. AC-3 + 2% L 170
6. AC-3 + 2% L 170 After TFO
7. AC-3 + 10% Amor. Polypropylene
8. AC-3 + 10% Amor. Polypropylene After TFO
American Pet.
Bell Oil
Cosden
Exxon
Gulf States (Houston)
Texaco
Shamrock

FIGURE 1



1. AC-5
2. AC-5 After Thin Film Oven Test
3. AC-5 + 2% LD 260
4. AC-5 + 2% LD 260 After TFO
5. AC-5 + 2% L 170
6. AC-5 + 2% L 170 After TFO

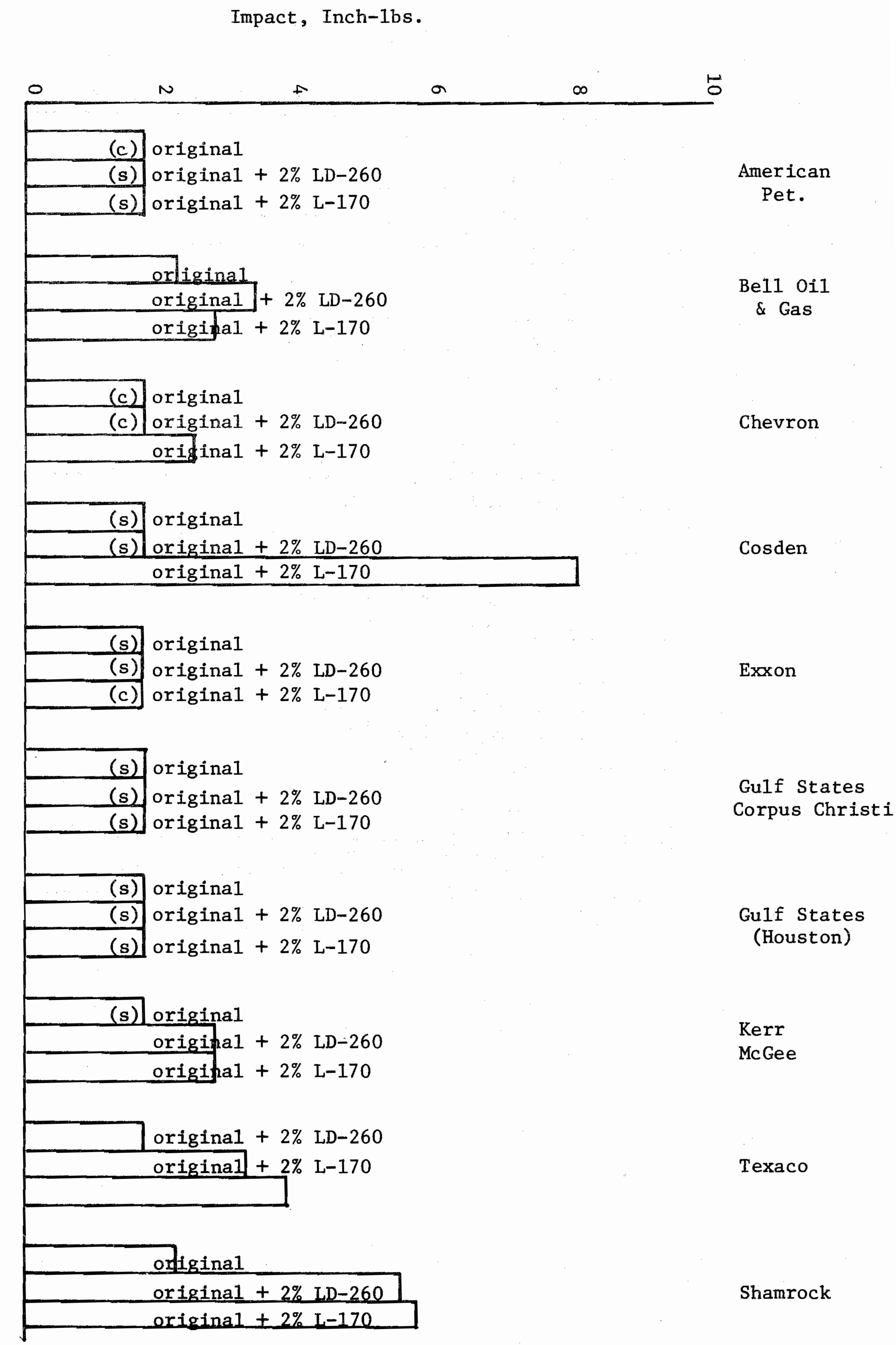
FIGURE 2



EFFECT OF 2% LD-260 AND 2% L-170
ON IMPACT BRITTLENESS OF AC-3 AT 20F

Note: (s) indicates shattering--actual value is less than 1.76

FIGURE 3



EFFECT OF 2% LD-260 AND 2% L-170
ON IMPACT BRITTLENESS OF AC-5 AT 20F

Note: (c) denotes cracked and (s) shattering
actual value is less than 1.76

FIGURE 4

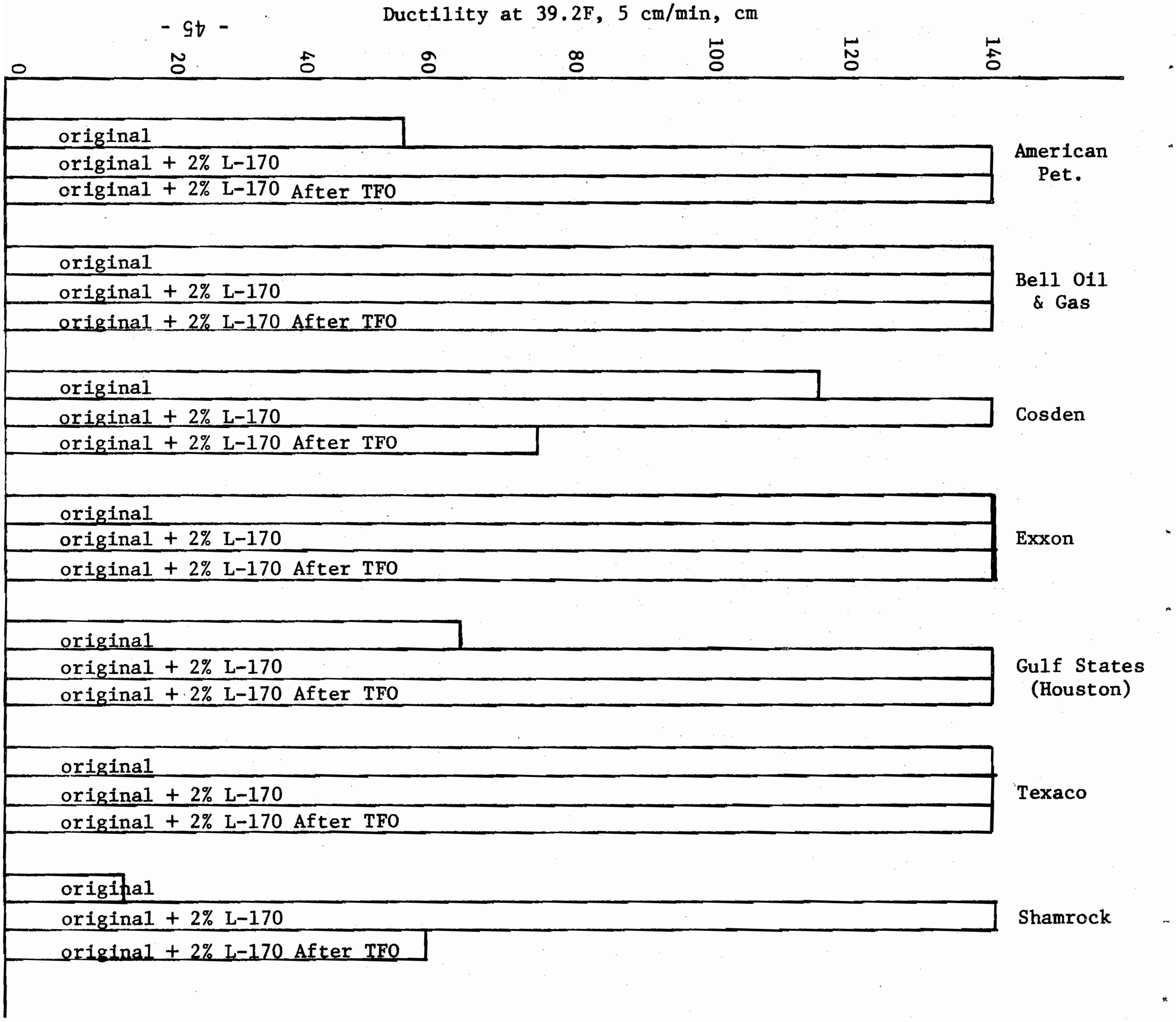


FIGURE 5

EFFECT OF 2% L-170 ON 39.2F DUCTILITY FOR SEVEN AC-3 SOURCES

Before and After TFO
(Thin Film Oven Test)

Ductility at 39.2F, 5 cm/min., cm

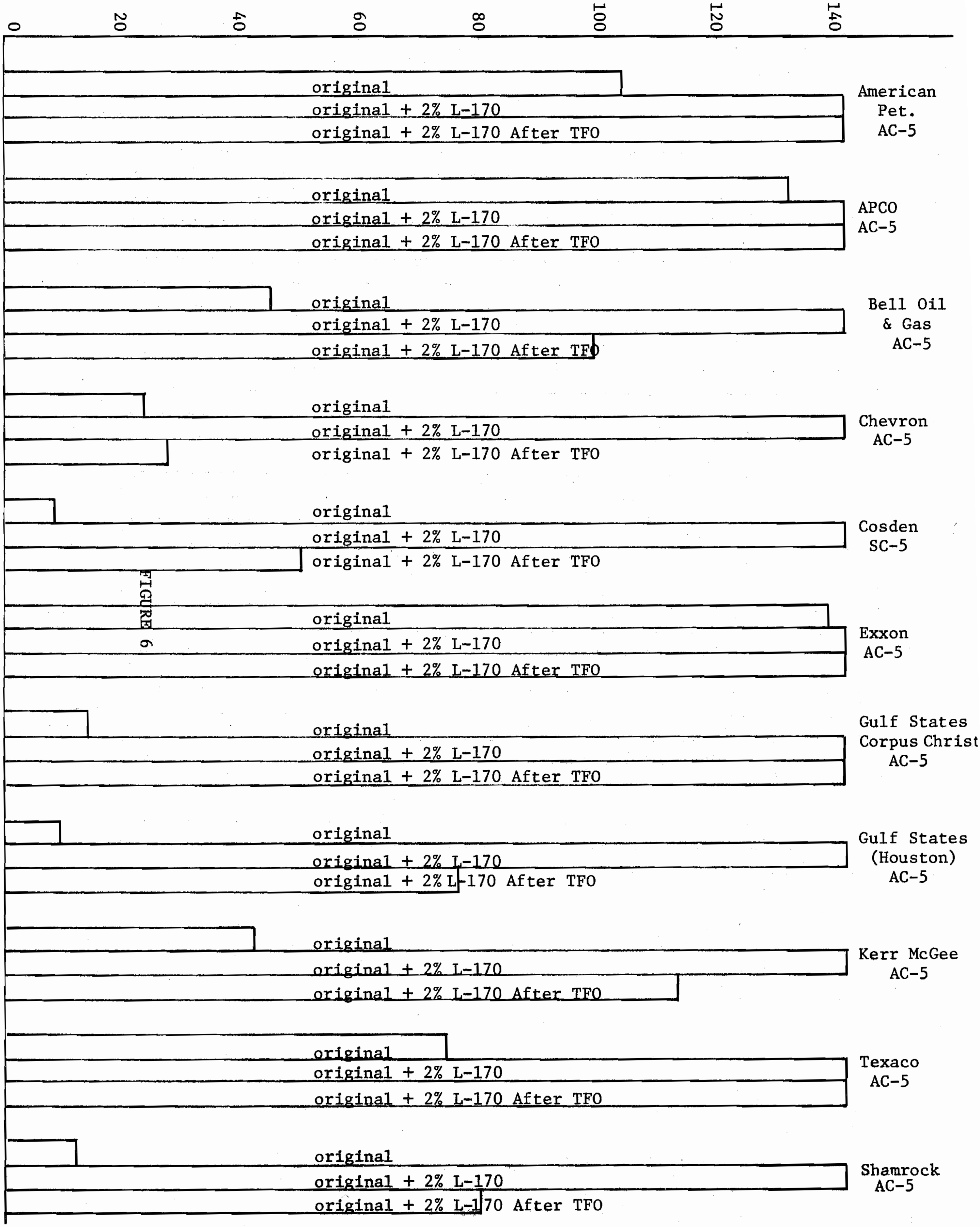


FIGURE 6

LABORATORY TEST PROCEDURES USED

PUBLISHED STANDARD PROCEDURES

1. Penetration at 77F - ASTM D-5-73, Penetration of Bituminous Materials.
2. Viscosity at 77F - ASTM D-3570-77, Viscosity of Materials With a Sliding Plate Microviscometer.
3. Viscosity at 140F - ASTM D-2171-72, Absolute Viscosity of Asphalts.
4. Ductility at 39.2F - ASTM D-113-77, Ductility of Bituminous Materials.
5. Thin Film Oven Test - ASTM D-1754-76, Effect of Heat and Air on Asphaltic Materials.

SPECIAL TESTS

1. Brittleness (Low Temperature Impact) of Asphalts. (in Appendix)
2. Storage Stability at High Temperature. (in Appendix)

TEST PROCEDURES FOR
BRITTLENESS AND STORAGE STABILITY

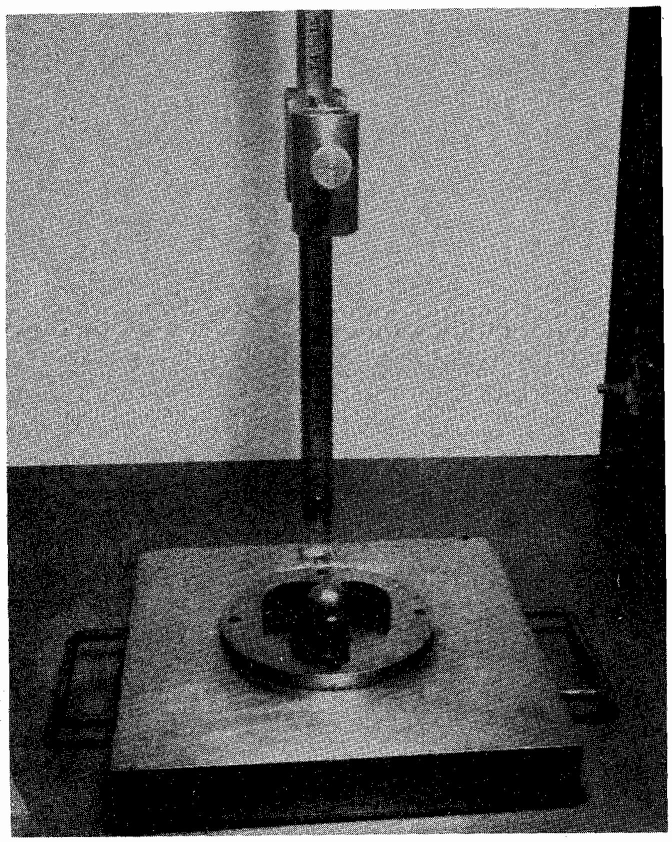
Low Temperature Impact

The effect of elastomers on the low temperature impact strength or brittleness of asphalt was determined by dropping steel balls from various heights onto the center of a disk of asphalt 2.5 inches in diameter and 0.37 inch in thickness. A temperature of 20 F was used for all tests performed. Two balls were used for the test--a 3/4 inch diameter ball, weighing 0.147 pound, and a 1-1/4 inch diameter ball weighing 0.288 pound.

The minimum height of drop was 12 inches, which resulted in an impact load of 1.76 inch-pounds with the 3/4 inch diameter ball. The disks were chilled to 20 ± 1 F in a freezer. A disk was removed from the freezer, placed on a polished steel plate and the ball immediately dropped to its center. A single disk was used to determine the approximate failure range. If failure did not occur at 1.76 inch-pounds impact, the disk was re-chilled and the impact load increased in increments until failure occurred. In obtaining the reported values, a set of six disks was used. Each disk was subjected to only one impact blow. Unless otherwise indicated, the values represent the maximum impact load the disks sustained without failure occurring. Increasing the height of drop one inch resulted in cracking or shattering of the asphalt.

Storage Stability Test

Change in properties of the various asphalts blended with the L-170 and amorphous polypropylene was determined by maintaining the asphalt at 325 ± 5 F in an insulated quart can for 72 hours. The can was completely filled with asphalt except that a small amount of space was allowed for expansion. A thermometer was mounted in a hole in the cap. This small opening also prevented pressure build-up during the hot storage period. At the end of the 72 hours, the sample was examined for any change such as coagulation, setting or lumping. If no significant change was noted, the sample was stirred and material poured up for testing.



Impact Brittleness Test

ITEM 300

ASPHALTS, OILS AND EMULSIONS

300.1. Description. This item establishes the requirements for oil asphalts, cut-back asphalts, road oils, emulsified asphalts, asphalt cement and other miscellaneous asphaltic materials and asbestos and latex additives.

300.2. Materials. When tested according to Texas Highway Department Test Methods, the various materials shall meet the applicable requirements of this specification.

(1) Oil Asphalt. The material shall be homogeneous, shall be free from water, shall not foam when heated to 347 F and shall meet the following requirements:

TYPE-GRADE	OA-30		OA-175**		OA-400	
	Min.	Max.	Min.	Max.	Min.	Max.
Penetration at 32 F, 200g., 60 sec	15	–	–	–	–	–
Penetration at 77 F, 100g., 5 sec	25	35	150	200	–	–
Penetration at 115 F, 50g., 5 sec	–	65	–	–	–	–
Ductility at 77 F, 5 cm/min., cms: Original OA	2	–	70	–	–	–
Flash Point C.O.C., F	450	–	425	–	425	–
Softening Point, R. & B., F	185	–	95	130	–	–
Thin Film Oven Test, 1/8 in. Film, 50 g., 5 hrs., 325 F, % Loss by wt	–	0.4	–	1.4	–	2.0
Penetration of Residue, at 77 F, 100g., 5 sec. % of Original Pen	–	–	40	–	–	–
Ductility of Residue at 77 F, 5 cm/min., cms	–	–	100	–	–	–
Solubility in Trichloroethylene, %	99.0	–	99.0	–	99.0	–
Spot Test on Original OA	Neg.		Neg.		Neg.	
Float Test at 122 F, sec	–	–	–	–	120	150
Tests on 85 to 115 Pen. Residue* Residue by Wt., %	–	–	–	–	75	–
Ductility, 77 F, 5 cm/min.: Original Res., cms	–	–	–	–	100	–
Subjected to Thin Film Test, cms	–	–	–	–	100	–

*Determined by Vacuum Distillation (by evaporation if unable to reduce by vacuum).

**For use with Latex Additive only.

(2) **Asphalt Cement.** The material shall be homogeneous, shall be free from water, shall not foam when heated to 347 F and shall meet the following requirements:

Test	VISCOSITY GRADE									
	AC-3		AC-5		AC-10		AC-20		AC-40	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity, 140 F stokes	300±50		500±100		1000±200		2000±400		4000±800	
Viscosity, 275 F stokes	1.1	–	1.4	–	1.9	–	2.5	–	3.5	–
Penetration, 77 F, 100g, 5 sec.	210	–	135	–	85	–	55	–	35	–
Flash Point, C.O.C. F	425	–	425	–	450	–	450	–	450	–
Solubility in trichloroethylene, percent	99.0	–	99.0	–	99.0	–	99.0	–	99.0	–
Tests on residues from thin film oven test: Viscosity, 140 F stokes	–	900	–	1500	–	3000	–	6000	–	12000
Ductility, 77 F 5 cms per min, cms.	100	–	100	–	70	–	50	–	30	–
Spot test	Negative for all grades									

(3) Latex Additive. A minimum of two percent, by weight, latex additive (solids basis) shall be added to the OA-175 Asphalt or to AC-5 Asphalt when specified on the plans or in other specifications in the contract. The latex additive shall be governed by the following specifications:

The latex is to be an anionic emulsion of butadiene-styrene low-temperature copolymer in water, stabilized with fatty-acid soap so as to have good storage stability, and possessing the following properties:

Monomer ratio, B/S	70/30
Minimum solids content	67%
Solids content per gal. @67%	5.3 lbs.
Coagulum on 80-mesh screen	0.1% max.
Type Anti-oxidant	staining
Mooney Viscosity of Polymer (M/L 4 @ 212 F)	100 min.
pH of Latex	9.4 - 10.5
Surface tension	28-42 dynes/cm^2
Brookfield Viscosity of Latex	1200 ps max. @ 67% solids

The finished latex-asphalt blend shall meet the following requirements:

Viscosity at 140 F, stokes	1500 max.
Ductility at 39.2 F. 1 cm. per min., cm . .	100 min.

(4) Cut-back Asphalt. The material shall meet the requirements shown in the following table:

TYPE-GRADE	RC-1		RC-2		RC-250		RC-3		RC-4		RC-5	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Water, %	–	0.2	–	0.2	–	0.2	–	0.2	–	0.2	–	0.2
Flash Point, T.O.C., F	80	–	80	–	80	–	80	–	80	–	80	–
Furol Viscosity, sec.:												
At 122 F	100	160	200	300	–	–	–	–	–	–	–	–
At 140 F	–	–	–	–	125	250	250	400	–	–	–	–
At 180 F	–	–	–	–	–	–	–	–	125	250	350	500
The Distillate, expressed as precent by volume of total distillate to 680 F, shall be as follows:												
Off at 437 F	55	80	50	75	35	–	50	70	35	60	20	55
Off at 500 F	70	90	70	90	60	–	65	85	60	80	55	75
Off at 600 F	90	–	90	–	80	–	85	–	80	–	75	–
Residue from 680 F Distillation, Volume, %	50	–	70	–	65	–	73	–	78	–	82	–
Tests on Distillation Residue:												
Penetration at 77 F, 100G., 5 sec	70	100	110	150	80	120	110	150	110	150	110	150
Ductility at 77 F, 5 cm/min., cms	100	–	100	–	100	–	100	–	100	–	100	–
Solubility in Trichloroethylene, %	99.0	–	99.0	–	99.0	–	99.0	–	99.0	–	99.0	–
Spot Test	Neg.		Neg.		Neg.		Neg.		Neg.		Neg.	

TYPE-GRADE	MC-30		MC-70		MC-250		MC-800		MC-3000	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Water, %	–	0.2	–	0.2	–	0.2	–	0.2	–	0.2
Flash Point, T.O.C., F	100	–	100	–	150	–	150	–	150	–
Kinematic Viscosity At 140 F, C St	30	60	70	140	250	500	800	1600	3000	6000
The Distillate, expressed as percent by volume of total distillate to 680 F, shall be as follows:										
Off at 437 F	–	25	–	20	–	10	–	–	–	–
Off at 500 F	40	70	20	60	15	55	–	35	–	15
Off at 600 F	75	93	65	90	60	87	45	80	15	75
Residue from 680 F Distillation, Volume, %	50	–	55	–	67	–	75	–	80	–
Tests on Distillation Residue:										
Penetration at 77 F, 100g, 5 sec	120	250	120	250	120	250	120	250	120	250
Ductility at 77 F, 5 cm/min., cms	100*	–	100*	–	100*	–	100*	–	100*	–
Solubility in Trichloroethylene, %	99.0	–	99.0	–	99.0	–	99.0	–	99.0	–
Spot Test	Neg.		Neg.		Neg.		Neg.		Neg.	

*If penetration of residue is more than 200 and ductility at 77 F is less than 100 cm., the material will be acceptable if its ductility at 60 F is more than 100.

(5) Road Oils. The material shall meet the following requirements:

TYPE-GRADE	RO-3		RO-4		RO-95		RO-Special	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Water, %	–	0.2	–	0.2	–	0.2	–	–
Asphalt content of 85 to 115 penetration by vacuum distillation	60	–	55	–	80	–	55	–
Flash Point, C.O.C., F	225	–	175	–	250	–	225	–
Furol Viscosity: At 122 F, sec	–	–	100	160	–	–	–	500
At 140 F, sec	200	320	–	–	–	–	–	–
Loss at 212 F, 20g., 5 hrs., %	–	6.0	–	6.0	–	–	–	6.0
Loss at 325 F, 50g., 7 hrs., %	–	–	–	–	2.0	6.0	–	–
Water and Sediment, %	–	–	–	–	–	–	–	2.0
Penetration of residue after evaporation loss, 100 g., 5 sec	–	–	–	–	175	250	–	–
Ductility of residue at 77 F, 5 cm/min., cms	100	–	100	–	–	–	–	–
Solubility in Trichloroethylene, %	99.0	–	99.0	–	99.0	–	–	–
Float Test at 122 F, sec	–	–	–	–	140	175	–	–
Spot Test	Neg.		Neg.		Neg.		–	
Tests on 85 to 115 penetration residue by vacuum distillation								
Residue by weight, %	–	–	–	–	80	–	–	–
Ductility, 77 F, 5 cms/min., Original Residue, cms	–	–	–	–	100	–	–	–
Subjected to Thin Film Test, cms	–	–	–	–	100	–	–	–

(6) Cracked Fuel Oils and Crude Oils. These materials shall meet the following requirements:

	CRACKED FUEL OIL		CRUDE OIL	
	Min.	Max.	Min.	Max.
Asphalt Content of 100 Penetration at 77 F, %	65	80	–	–
Asphalt Content of 260 Penetration at 77 F, %	–	–	65	80
Flash Point T.O.C., F	–	–	80	–
Flash Point C.O.C., F	250	–	–	–
Furol Viscosity at 77 F, Sec	–	–	–	500
Furol Viscosity at 122 F, Sec	–	500	–	–
Loss at 212 F, 20g., 5 hrs., %	–	3.0	–	–
Loss at 325 F, 50g., 7 hrs., %	–	–	–	3.0
Water and Sediment, %	–	2.0	–	2.0
Penetration of Residue after Evaporation Loss	–	–	–	300

- 52 -

(7) **Emulsions.** The material shall be homogeneous. It shall show no separation of asphalt after thorough mixing and shall meet the viscosity requirements at any time within 30 days after delivery.

ANIONIC EMULSIONS:

TYPE	Rapid Setting				Medium Setting				Slow Setting			
GRADE:	EA-HVRS		EA-HVRS-90		EA-HVMS		EA-HVMS-90		EA-11M		EA-10S	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Furol Viscosity at 77 F, sec.	–	–	–	–	–	–	–	–	30	100	30	100
Furol Viscosity at 122 F, sec.	100	300	100	300	100	300	100	300	–	–	–	–
Residue by Distillation, %	63	–	63	–	63	–	63	–	60	–	60	–
Oil Portion of Distillate, %	–	2.0	–	2.0	–	2.0	–	2.0	–	2.0	–	2.0
Sieve Test, %	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Miscibility (Standard Test)	–	–	–	–	–	–	–	–	Passing		Passing	
Coating	–	–	–	–	–	–	–	–	Passing		–	–
Cement Mixing, %	–	–	–	–	–	–	–	–	–	–	–	2.0
Demulsibility 50 cc of N/10 $CaCl_2$, %	–	–	–	–	–	–	–	–	–	70	–	–
Demulsibility 35 cc of N/50 $CaCl_2$, %	60	–	60	–	–	30	–	30	–	–	–	–
Settlement, 5 days, %	–	5.0	–	5 0	–	5.0	–	5.0	–	5.0	–	5.0
Freezing Test 3 Cycles (*)	–	–	–	–	Passing*		Passing*		Passing*		Passing*	
Tests on Residue:												
Penetration at 77 F, 100g., 5 sec.	120	160	80	110	120	160	80	110	120	160	120	160
Solubility in Trichloroethylene, %	97.5	–	97.5	–	97.5	–	97.5	–	97.5	–	97.5	–
Ductility at 77 F, 5 cm/min., cms.	100	–	100	–	100	–	100	–	100	–	100	–

*Applies only when Engineer designates material for winter use.

CATIONIC EMULSIONS:

TYPE	Rapid Setting				Medium Setting				Slow Setting			
GRADE	EA-CRS-2		EA-CRS-2h		EA-CMS-2		EA-CMS-2h		EA-CSS-1		EA-CSS-1h	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Tests on Emulsions:												
Viscosity, Saybolt Furol at 77 F, sec.	–	–	–	–	–	–	–	–	20	100	20	100
Viscosity, Saybolt Furol at 122 F, sec.	100	300	100	300	100	300	100	300	–	–	–	–
Settlement, [a] 5 days, %	–	5	–	5	–	5	–	5	–	5	–	5
Storage stability test, [b] 1 day, %	–	1	–	1	–	1	–	1	–	1	–	1
Demulsibility, [c] 35 ml 0.8 percent sodium dioctyl sulfosuccinate, %	40	–	40	–	–	–	–	–	–	–	–	–
Coating, ability and water resistance:												
Coating, dry aggregate	–	–	–	–	good		good		–	–	–	–
Coating, after spraying	–	–	–	–	fair		fair		–	–	–	–
Coating, wet aggregate	–	–	–	–	fair		fair		–	–	–	–
Coating, after spraying	–	–	–	–	fair		fair		–	–	–	–
Particle charge test	positive		positive		positive		positive		positive		positive	
Sieve Test, %	–	0.10	–	0.10	–	0.10	–	0.10	–	0.10	–	0.10
Cement mixing test, %	–	–	–	–	–	–	–	–	–	2.0	–	2.0
Distillation:												
Oil distillate, by volume of emulsion, %	–	3	–	3	–	12	–	12	–	–	–	–
Residue, percent	60	–	65	–	65	–	65	–	60	–	60	–
Tests on Residue from Distillation Test:												
Penetration, 77 F, 100g, 5 sec.	120	160	80	110	120	160	80	110	120	160	80	110
Ductility, 77 F, 5 cm/min., cm	100	–	100	–	100	–	100	–	100	–	100	–
Solubility in trichloroethylene, %	98	–	98	–	97.5	–	97.5	–	97.5	–	97.5	–
Ash, %	–	–	–	–	–	2.0	–	2.0	–	2.0	–	2.0

[a]The test requirement for settlement may be waived when the emulsified asphalt is used in less than 5 days time; or the Engineer may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than 5 days.
[b]The 24-h (1-day) storage stability test may be used instead of the 5-day settlement test.
[c]The demulsibility test shall be made within 30 days from date of shipment.

(8) **Flux Oil.** Fluxing material shall be free from foreign matter and shall meet the following requirements:

Type	Flux Oil Min.	Flux Oil Max.
Water, %	–	0.2
Furol Viscosity at 122 F, sec	50	100
Flash Point, C.O.C., F	250	–
Loss on Heating, 50g, 5 hrs. at 325 F, %	–	5
Asphalt Content of 85 to 115 Penetration by vacuum distillation, weight %	25	–

(9) **Precoat Material.** Precoat material may consist of any one of the various types of asphaltic materials listed in this specification, approved by the Engineer, including "Special Precoat Material".

Type	Special Precoat Material Min.	Special Precoat Material Max.
Water, %	–	0.2
Flash, C.O.C., F	200	–
Furol Viscosity at 140 F, sec	150	250
Distillation to 680 F:		
Initial Boiling Point, F	500	–
Residue by weight, %	70	–
Penetration residue, 77 F, 100g., 5 sec	200	300

(10) **Catalytically-Blown Asphalt Joint and Crack Sealer.** Catalytically-blown asphalt shall be uniformly blended with 10 percent diatomaceous earth filler which passes the No. 325 sieve. It shall form a suitable joint and crack sealer which may be melted to pouring consistency in the regular asphalt kettle at a temperature of approximately 450 to 475 F. The material shall

meet the following requirements:

TYPE-GRADE	68-88 Pen.		38-45 Pen.	
	Min.	Max.	Min.	Max.
Penetration, 77 F, 100g., 5 sec	68	88	38	45
Penetration, 32 F, 200g., 60 sec	38	–	–	–
Penetration, 115 F, 50g., 5 sec	–	160	–	–
Softening Point, R. & B., F	175	200	185	200
Flash, C.O.C., F	500	–	500	–
Ductility, 77 F, 5 cm/min., cms	5	–	3	–
Flow, 140 F, cm	–	0.5	–	0.5
Ash, Weight, %	8	–	8	–
Settlement Ratio	–	1.02	–	1.02
Brittleness Test, 32 F	No Cracking		No Cracking	

(11) Asbestos Additive. Asbestos fiber shall be used only when specified on the plans or in other specifications in the contract. Asbestos fiber shall be Chrysettle Asbestos. Asbestos fiber shall be 7M grade by Quebec Standard Screen Test.

GUARANTEED MINIMUM TEST

ROTAP (3-minute procedure)	35% minimum retained on No. 20 mesh sieve
WET WASH (QAMA Procedure)	20% minimum retained on No. 200 mesh sieve
PENETRATION-EFFICIENCY TEST	70-105%

The manufacturer will furnish a notarized certification that the asbestos meets the above requirements.

Storing and Handling. While stored at the site of the batch plant, the asbestos shall be given suitable protection from moisture. Any asbestos which is wet or damp shall be rejected for use.

300.3. Storage, Heating And Application Temperatures. Asphaltic materials should be applied at the temperature which provides proper and uniform distribution and within practical limits avoiding higher temperatures than necessary. Satisfactory application usually should be obtained within the

recommended ranges shown below. No material shall be heated above the following maximum temperatures:

TYPE-GRADE	Application and Mixing		Heating and Storage Maximum, F
	Recommended Range, F	Maximum Allowable, F	
AC-3, 5, 10, 20, 40, OA-175	275-325	350	400
OA-30	400-500	500	500
OA-400	220-300	350	350
RC-1	100-150	175	175
RC-2	125-180	200	200
RC-250	150-200	210	210
RC-3	160-210	230	230
RC-4	180-240	270	270
RC-5	215-270	285	285
MC-30	70-150	175	175
MC-70	125-175	200	200
MC-250	125-210	240	240
MC-800	175-260	275	275
MC-3000	225-275	290	290
RO-3	160-210	250	250
RO-4	100-150	200	200
RO-95	230-300	325	325
RO-Special	160-220	260	260
Cracked Fuel Oil	160-220	260	260
Crude Oil	100-150	175	175
EA-10S, EA-11M, EA-CSS-1, EA-CSS-1h	50-130	140	140
EA-HVRS, EA-HVMS, EA-HVRS-90, EA-HVMS-90, EA-CRS-2, EA-CRS-2h, EA-CMS-2, EA-CMS-2h	110-150	160	160
Cat. Blown Asph	425-475	500	500
Special Precoat Material	125-250	275	275

Note: Heating of asphaltic materials (except emulsions) constitutes a fire hazard to various degrees. Proper precautions should be used in all cases and especially with RC cut-backs.

Warning to Contractors: Attention is called to the fact that asphaltic materials are very flammable. The utmost care shall be taken to prevent open flames from coming in contact with the asphaltic material or the gases of same. The Contractor shall be responsible for any fires or accidents which may result from heating the asphaltic materials.

300.4. Measurement And Payment. All asphaltic materials included in this specification will be measured and paid for in accordance with the governing specifications for the items of construction in which these materials are used.

TYPICAL REFINERY PRODUCTION BATCH

COSDEN AC-5 + 2% L-170

Viscosity at 140F, stokes	1063
Penetration at 77F	121
Flash, F	600
Gravity at 77F	1.019
Ductility 39.2F, 5 cm/min., cm	141+
Brittleness 20F, inch-lbs.	5.8
Brittleness 30F, inch-lbs.	7.2

DATA FOR LATEXES USED IN PROJECT 1-9-74-180

GOODYEAR PLIOPAVE L-170 PRODUCED TO THE FOLLOWING SPECS:

Total Solids, %	68.5 min - 70.5 max
Brookfield Viscosity, cps	1000 min - 2000 max
Residual Styrene, %	0.10 max
Coagulum on 80 Mesh Screen, %	0.10 max
pH	9.5-10.5
Mooney Viscosity, M/L-4'	100 min
Surface Tension, dynes/cm	31-34
Bound Styrene, %	23.5-26.5

DUPONT NEOPRENE LATEX ANALYZED AS FOLLOWS:

NEOPRENE LATEX

LD-260

Solids Content = 38.5%

pH = 12.15

Brookfield Viscosity

Spindle #1

@ 6 rpm = 10 cps

30 rpm = 5 cps

60 rpm = 6.5 cps

Specification For Amorphous Polypropylene, Hot Liquid Bulk Form or Solid Block Form

(May 4, 1976)

This material is to be an amorphous polypropylene polymer which is a slightly tacky solid at ambient temperature and becomes gradually softer at elevated temperatures and will liquify to such extent that it can be readily pumped, transported and stored with equipment used for asphalt cements.

The polymer shall meet the following requirements when tested according to Standard Department Test Methods:

Viscosity at 375 F, cps	2000-5000
Sp. Gr. at 77 F	0.84-0.88
Ring & Ball Softening Point, F	203-239
Flash, C.O.C. F	400 Min.

Delivery may be specified in either of the two following forms:

1. Hot Liquid Bulk Form

   To be delivered hot so it can be transported, pumped and mixed with normal paving grade asphalt cement with equipment regularly used for asphalt cements.

2. Solid Block Form

   To be delivered in 50 lb blocks packaged in multi-walled paper bags adequately coated so as to be readily strippable. Blocks to be approximately 10 x 10 x 14 inches and suitable for handling on pallets.

TENTATIVE SPECIFICATION FOR LATEX MODIFIED ASPHALT CEMENT

(Study No. 1-9-74-180)

Materials

1. Asphalt Cement: The original asphalt cement used to blend with latex shall meet the requirements for that grade as follows:

Asphalt Cement. The material shall be homogeneous, shall be free from water, shall not foam when heated to 347 F and shall meet the following requirements:

TEST	VISCOSITY GRADE									
	AC-3		AC-5		AC-10		AC-20		AC-40	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity, 140 F stokes......	300±50		500±100		1000±200		2000±400		4000±800	
Viscosity 275 F stokes......	1.1	-	1.4	-	1.9	-	2.5	-	3.5	-
Penetration, 77 F 100g, 5 sec.......	210	-	135	-	85	-	55	-	35	-
Flash Point, C.O.C.F.	425	-	425	-	450	-	450	-	450	-
Solubility in trichloroethylene, percent..........	99.0	-	99.0	-	99.0	-	99.0	-	99.0	-
Test on residues from thin film oven test: Viscosity, 140 F stokes......	-	900	-	1500	-	3000	-	6000	-	12000
Ductility, 77 F 5 cms per min, cms..	100	-	100	-	70	-	50	-	30	-
Spot Test..........	Negative for all grades									

2. Latex Additive: The latex additive shall meet the following requirements:

The latex is to be an anionic emulsion of butadiene-styrene low-temperature copolymer in water, stabilized with fatt-acid soap so as to have good storage stability, and possessing the following properties:

Monomer ratio, B/S	70/30
Minimum solids content...............	67%
Solids content per gal. @ 67%........	5.3 lbs.
Coagulum on 80-mesh screen...........	0.1% max.
Type Anti-oxidant....................	staining
Mooney Viscosity of Polymer (M/L 4 @ 212F)...........................	100 min.
pH of Latex..........................	9.4 - 10.5
Surface tension......................	28-42 dynes/cm^2
Brookfield Viscosity of Latex........	1200 ps max. @ 67% solids

3. Asphalt Cement - Latex Modified:

a. Grade AC-3-LM

AC-3 asphalt shall be blended with a minimum of 2% by weight (solids basis) of latex. The finished blend shall meet the following specifications:

Viscosity @ 140F, stokes	450 - 750
Ductility, 39.2F, 5 cm/min., cm	100 min.

Tests on Residue from thin film oven test:

Viscosity @ 140F, stokes	1100 max.
Ductility, 39.2F, 5 cm/min., cm	50 min.

b. Grade AC-5-LM

AC-5 asphalt shall be blended with a minimum of 2% by weight (solids basis) of latex. The finished blend shall meet the following specifications:

Viscosity @ 140F, stokes	800 - 1300
Ductility, 39.2F, 5 cm/min., cm	100 min.

Tests on Residue from thin film oven test:

Viscosity @ 140F, stokes	2000 max.
Ductility, 39.2F, 5 cm/min. cm	50 min.

EVALUATION REPORT

(FOURTEENTH MONTH)

WESTBOUND TEST SECTIONS

EL PASO DISTRICT (IH 10)

The four test sections of seal coat from Milepost 101 to 106, consisting of: AC-5 (MP 101 to 102), AC-3 + 10 percent polypropylene (MP 102 to 103), AC-3 + 2 percent latex (MP 103 to 104), and AC-10 (MP 104 to 106), average from 5 to 10 transverse cracks and 100 to 150 feet of longitudinal cracking per station. Fatigue carcking is evident in all four sections. Ninety-five percent of all cracks first reported have come through the seal coats and have been resealed with a rubber-asphalt sealer. Most of the cracks showed evidence of pumping before being resealed and all cracks are in the outside lane.

The first skid resistance report was made on August 24, 1976, and the second on August 16, 1977. A comparison table of the skid resistance for the four sections is shown below with the inside lane coded first.

	Aug. 76	Aug. 77
AC-10: MP 104 to 106 WB	56-45	53-42
AC-3+2% Latex; MP 103 to 104 WB	55-49	55-35
AC-3+10% Polypropylene; MP 102 to 103 WB	55-51	53-46
AC-5; MP 101 to 102	58-48	53-45

EVALUATION REPORT
(FOURTEENTH MONTH)
EASTBOUND TEST SECTIONS
EL PASO DISTRICT (IH 10)

In the AC-10 seal, from Milepost 99 to 101 eastbound, 100 percent of the reflective cracking and approximately 82 percent of the longitudinal cracking has come through the seal coat. Most of the cracks have been resealed since the seal coat was placed. The skid resistance for the inside and outside lanes on August 24, 1976 was 56-49, respectively, compared to 54-50 on August 16, 1977.

The Rubberized Asphalt Seal, from Milepost 101 to 105, and the Rubberized Asphalt Seal using precoated aggregate, from Milepost 105 to 106, show very little cracking. From 3 to 5 percent of the reflective cracking and 5 to 7 percent of the longitudinal cracking has come through the seal. The pattern of fatigue cracking shows through the seal but only a few of the cracks are evident. The skid resistance of the inside and outside lanes for the regular and precoated aggregate on August 24, 1976 was 56-24, 50-24, respectively, compared to 55-24, 51-30 on August 16, 1977. The lapped joints are not as noticeable in the inside lane, as they are the outside lane. This condition has improved very little. Lapped joints should not be used in this type of construction.

The AC-10 seal, from Milepost 106-107, has virtually all the cracking coming through the seal. Some of the cracks had been pumping and all have been resealed. The skid resistance for the inside and outside lanes on August 24, 1976 was 56-44, respectively, compared to 54-46 on August 16, 1977.

All cracks from Milepost 99 to 107 are in the outside lane.

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-22 Dist. 9 Hill County

Test Section No. 403 & 404

Material AC-5

Date	Friction SN 0-100	Roughness SI 0-5	Deflection SCI	Deflection Stiffness Coef. Subgrade	Deflection Stiffness Coef. Pavement	Team Rating 0-40	Visual Rating 0-100	Crack Survey Average Width(In.)	% Cracks Area	% Cracks Reflective	Alligator Severity	Alligator % Area	Transverse Severity	Transverse No./Sta.	Longitudinal Severity	Longitudinal Ft./Sta.
6/76	25	3.3	0.28	0.40	0.43		57	0.045	48.6		Mod.	6-25	Mod.	5-9	Mod	10-99
8/76	56	3.6				31.9										
9/76							91		0	0	None		None		None	
2/77	53					31.9										
8/77	67						90									
9/77						31.0			1.4	2.9						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-22 Dist. 9 Hill County
Test Section No. 405 & 406
Material AC-3 with Eastobond

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width (In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	22	3.0	0.34	0.37	0.44		55	0.043	51.2		Mod.	6-25	Mod.	5-9	Mod.	10-99
8/76	56	3.4				32.2										
9/76									0	0						
2/77	55					33.3										
8/77	65						95									
9/77						32.5			0.3	0.6						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-22 Dist. 9 Hill County

Test Section No. 407 & 408

Material AC-3

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width(In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	22	3.4	0.29	0.34	0.48		57	0.028	49.4		Mod.	6-25	Mod.	> 10	Mod.	10-99
8/76	48	3.6				32.3										
9/76									0	0						
2/77	50					34.8										
8/77	60						90									
9/77						34.3			1.0	2.0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-22 Dist. 9 Hill County

Test Section No. 409 & 410

Material EA-HVRS

Date	Friction SN 0-100	Roughness SI 0-5	Deflection SCI	Deflection Stiffness Coef. Subgrade	Deflection Stiffness Coef. Pavement	Team Rating 0-40	Visual Rating 0-100	Crack Survey Average Width (In.)	% Cracks Area	% Cracks Reflective	Alligator Severity	Alligator % Area	Transverse Severity	Transverse No./Sta.	Longitudinal Severity	Longitudinal Ft./Sta.
6/76	23	3.2	0.38	0.35	0.44		57	0.035	68.9		Mod.	6-25	Mod	>10	Mod.	10-99
8/76	46	3.6				30.8										
9/76							94		0	0	None		None		None	
2/77	48					32.1										
8/77	51						89									
9/77						31.2			10.5	15.2						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-22 Dist. 9 Hill County
Test Section No. 411 & 412
Material EA-HVRS with Latex

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width(In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	23	3.2	0.38	0.35	0.44		55	0.039	45.2		Mod.	6-25	Mod	5-9	Mod.	10-99
8/76	57	3.8				32.3										
9/76							98		0	0	None		None		None	
2/77	52					34.0										
8/77	59						92									
9/77						33.0			1.6	3.5						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-525

Location SH-43 Dist. 19 Marion Co. Northbound Lane
Test Section No. 1 CSN - 517701
Material EA-HVRS + Latex Agg - Slag
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width (In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	51	3.3	1.30	0.38	0.26		28	0.044	82.0		Sev.	>25	Mod.	1-4	Sev.	10-99
10/76	58	3.2				35.7			0	0						
2/77						36.3										
5/77	58															
9/77						35.0			0	0						

- 99 -

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-43 DIST. 19 MARION CO. SOUTHBOUND LANE

Test Section No. 1 CSN - 517712

Material EA-HVRS + LATEX AGG-SLAG LONE STAR

Date	Friction SN 0-100	Roughness SI 0-5	SCI	Deflection Stiffness Coef.		Team Rating 0-40	Visual Rating 0-100	Crack Survey								
				Subgrade	Pavement			Average Width (In.)	% Cracks		Alligator		Transverse		Longitudinal	
									Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	60	3.2	1.11	0.39	0.27		28	0.029	35.2		Sev.	>25	Mod.	1-4	Sev.	10-99
10/76	56	3.8				35.7			0	0						
2/77						36.3										
8/77	59															
9/77						35.0			0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-525

Location SH-43 DIST. 19 MARION CO. NORTHBOUND LANE
Test Section No. 1 CSN - 517701
Material EA-HVRS + LATEX AGG - SLAG LONE STAR

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width (In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	51	3.3	1.30	0.38	0.26		28	0.044	87.0		SEV.	>25	MOD.	1-4	SEV.	10-99
10/76	58	3.2				35.7			0	0						
2/77						36.3										
5/77	58															
9/77						35.0			0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-43 Dist. 19 Marion Co. Northbound Lane
Test Section No. 2 CSN - 517702
Material EA-HVRS Control Agg. - Slag
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width(In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	51	3.4	1.33	0.36	0.26		28	0.022	14.5		Sev.	>25	Mod.	1-4	Sev.	10-99
10/76	59	3.4				35.7			0	0						
2/77						37.0										
8/77	56															
9/77						34.0			0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-43 Dist. 19 Marion Co. Southbound Lane

Test Section No. 2 CSN - 517711

Material EA-HVRS Control Agg. - Slag
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection SCI	Deflection Stiffness Coef. Subgrade	Deflection Stiffness Coef. Pavement	Team Rating 0-40	Visual Rating 0-100	Crack Survey Average Width (In.)	% Cracks Area	% Cracks Reflective	Alligator Severity	Alligator % Area	Transverse Severity	Transverse No./Sta.	Longitudinal Severity	Longitudinal Ft./Sta.
6/76	57	2.7	0.96	0.35	0.30		28	0.028	72.5		Sev.	>25	Mod.	1-4	Sev.	10-99
10/76	57	3.1				35.7			0	0						
2/77						37.0										
8/77	60															
9/77						34.0			0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location US-80 DIST. 19 HARRISON CO. OUTSIDE LANE
Test Section No. 3 CSN. 517616
Material AC-3 + EASTABOND AGG. SLAG
LONE STAR

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width(In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	44	3.2	0.49	0.31	0.39		20	0.028	66.6		SEV.	>25	SEV.	>10	MOD	10-99
10/76	49	3.2				36.0			0	0						
2/77						35.8										
8/77	51															
9/77						36.0			0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-75-526

Location US-80 Dist. 19 Harrison Co. Inside Lane
Test Section No. 3 CSN - 517607
Material AC-3 + Eastobond Agg - Slag
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width (In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	47	3.0	0.55	0.30	0.38		20	0.012	16.5		Sev.	>25	Sev.	>10	Mod.	10-99
10/76	54	3.5							0	0						
8/77	55															
9/77									0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-43 Dist. 19 Marion Co. Northbound Lane
Test Section No. 4 CSN - 517704
Material AC-3 + Eastobond Agg. - Scars
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection SCI	Deflection Stiffness Coef. Subgrade	Deflection Stiffness Coef. Pavement	Team Rating 0-40	Visual Rating 0-100	Crack Survey Average Width (In.)	% Cracks Area	% Cracks Reflective	Alligator Severity	Alligator % Area	Transverse Severity	Transverse No./Sta.	Longitudinal Severity	Longitudinal Ft./Sta.
6/76	60	4.0	0.96	0.32	0.31		28	0.059	64.7		SEV.	>25	MOD.	1-4	SEV.	10-99
10/76	57	3.5				36.5			0	0						
2/77						37.7										
8/77	56															
9/77						36.4			0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-43 Dist. 19 Marion Co. Southbound Lane

Test Section No. 4 CSN - 517709

Material AC-3 + Eastbond Agg - Slag Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width (In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	58	3.3	0.78	0.31	0.35		28	0.027	47.3		Sev.	>25	Mod.	1-4	Sev.	10-99
10/76	57	3.8				36.5			0	0						
2/77						37.7										
8/77	59															
9/77						36.4			0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location SH-43 Dist. 19 Marion Co. Northbound Lane.
Test Section No. 5 CSN - 517705
Material Overflex Agg Slag
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection SCI	Deflection Stiffness Coef. Subgrade	Deflection Stiffness Coef. Pavement	Team Rating 0-40	Visual Rating 0-100	Crack Survey Average Width (In.)	% Cracks Area	% Cracks Reflective	Alligator Severity	Alligator % Area	Transverse Severity	Transverse No./Sta.	Longitudinal Severity	Longitudinal Ft./Sta.
6/76	55	3.8	0.93	0.34	0.31		28	0.031	55.7		Sev.	>25	Mod.	1-4	Sev.	10-99
10/76	57	3.8				33.0			0	0						
2/77						34.7										
8/77	60															
9/77						34.0			0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location US-80 Dist. 19 Harrison Co. Inside Lane
Test Section No. 5 CSN-517605
Material AC-3 + Eastobond Agg.-Slag
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection SCI	Deflection Stiffness Coef. Subgrade	Deflection Stiffness Coef. Pavement	Team Rating 0-40	Visual Rating 0-100	Crack Survey Average Width (In.)	% Cracks Area	% Cracks Reflective	Alligator Severity	Alligator % Area	Transverse Severity	Transverse No./Sta.	Longitudinal Severity	Longitudinal Ft./Sta.
6/76	45	3.3	0.48	0.31	0.39		20	0.044	32.0		Sev.	>25	Sev.	>10	Mod.	10-99
10/76	55	3.4							0	0						
8/77	54															
9/77									0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location US-80 DIST. 19 HARRISON CO. OUTSIDE LANE
Test Section No. 5 CSN-517614
Material AC-3 + EASTOBOND AGG - SLAG
LONE STAR

Date	Friction SN 0-100	Roughness SI 0-5	Deflection SCI	Deflection Stiffness Coef. Subgrade	Deflection Stiffness Coef. Pavement	Team Rating 0-40	Visual Rating 0-100	Crack Survey Average Width(In.)	% Cracks Area	% Cracks Reflective	Alligator Severity	Alligator % Area	Transverse Severity	Transverse No./Sta.	Longitudinal Severity	Longitudinal Ft./Sta.
6/76	37	3.1	0.40	0.31	0.41		20		70.4		SEV.	>25	SEV.	>10	MOD.	10-99
10/76	46	3.4				37.3			0	0						
2/77						37.0										
8/77	48															
9/77						37.0			0.8	1.1						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location US-80 Dist. 19 Harrison Co. Outside Lane
Test Section No. 6 CSN 517613
Material AC-10 Con[illegible] Agg - Slag
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection SCI	Deflection Stiffness Coef. Subgrade	Deflection Stiffness Coef. Pavement	Team Rating 0-40	Visual Rating 0-100	Crack Survey Average Width (In.)	% Cracks Area	% Cracks Reflective	Alligator Severity	Alligator % Area	Transverse Severity	Transverse No./Sta.	Longitudinal Severity	Longitudinal Ft./Sta.
6/76	39	3.2	0.46	0.28	0.42		20		81.0		Sev.	>25	Sev.	>10	Mod.	10-99
10/76	49	3.1				36.2			0	0						
2/77						37.3										
8/77	49															
9/77						37.3			0	0						

- 78 -

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location US-80 Dist. 19 Harrison Co. Inside Lane
Test Section No. 6 CSN-517604
Material AC-10 Control Agg - Slag
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width (In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	45	3.0	0.52	0.28	0.40		20	0.045	43.5		Sev.	>25	Sev.	>10	Mod.	10-99
10/76	57	3.6							0	0						
8/77	57															
9/77									0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location US-80 Dist. 19 Harrison Co. Inside Lane
Test Section No. 8 CSN - 517602
Material EA-HVRS + Latex Agg. - Slag
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection SCI	Deflection Stiffness Coef. Subgrade	Deflection Stiffness Coef. Pavement	Team Rating 0-40	Visual Rating 0-100	Crack Survey Average Width(In.)	% Cracks Area	% Cracks Reflective	Alligator Severity	Alligator % Area	Transverse Severity	Transverse No./Sta.	Longitudinal Severity	Longitudinal Ft./Sta.
6/76	44	3.8	0.63	0.30	0.36		20	0.051	50.8		Sev.	>25	Sev.	>10	Mod.	10-99
10/76	59	3.5							0	0						
8/77	59															
9/77									0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location US-80 Dist. 19 Harrison Co. Outside Lane
Test Section No. 8 CSN - 517611
Material EA-HURS + Latex Agg - Slag Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	SCI	Deflection Stiffness Coef.		Team Rating 0-40	Visual Rating 0-100	Crack Survey								
				Subgrade	Pavement			Average Width(In.)	% Cracks		Alligator		Transverse		Longitudinal	
									Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	42	3.2	0.48	0.30	0.39		20		72.0		Sev.	>25	Sev.	> 10	Mod.	10-99
10/76	48	3.5				37.2			0	0						
2/77						37.3										
8/77	52															
9/77						37.3			0.5	0.7						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location US-80 DISTRICT 19 HARRISON COUNTY OUTSIDE LANE
Test Section No. 9 CSN - 517610
Material EA-HURS. CONTROL AGG. - SLAG LONE STAR

Date	Friction SN 0-100	Roughness SI 0-5	Deflection SCI	Deflection Stiffness Coef. Subgrade	Deflection Stiffness Coef. Pavement	Team Rating 0-40	Visual Rating 0-100	Crack Survey Average Width(In.)	% Cracks Area	% Cracks Reflective	Alligator Severity	Alligator % Area	Transverse Severity	Transverse No./Sta.	Longitudinal Severity	Longitudinal Ft./Sta.
6/76	38	3.5	0.35	0.29	0.42		20		?		SEV.	>25	SEV.	>10	MOD.	10-99
10/76	51	3.4				37.3			0	0						
2/77						37.5										
8/77	51															
9/77						37.3			0	0						

SUMMARY OF TEST RESULTS FOR PROJECT 1-10-76-526

Location US-80 Dist. 19 Harrison Co. - Inside Lane
Test Section No. 9 CSN-517601
Material EA-HURS Control Agg. Slag
Lone Star

Date	Friction SN 0-100	Roughness SI 0-5	Deflection			Team Rating 0-40	Visual Rating 0-100	Crack Survey								
			SCI	Stiffness Coef.				Average Width(In.)	% Cracks		Alligator		Transverse		Longitudinal	
				Subgrade	Pavement				Area	Reflective	Severity	% Area	Severity	No./Sta.	Severity	Ft./Sta.
6/76	44	3.5	0.49	0.29	0.40		20	0.055	51.0		Sev.	>25	Sev.	> 10	Mod	10-99
10/76	57	3.6							0	0						
8/77	59															
9/77									0	0						