

ARIZONA DEPARTMENT OF TRANSPORTATION

REPORT NUMBER: FHWA/AZ-82/159/1

CHEMICAL AND PHYSICAL PROPERTIES OF ASPHALT- RUBBER MIXTURES — PHASE III

VOLUME 1

Prepared by:

J.C. Rosner, Ph.D., P.E.
J.G. Chehovits, P.E.

June 1982

Final Report

Prepared for:

U.S. Department of Transportation
Federal Highway Administration
Arizona Division

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Chemical and Physical Properties of Asphalt-Rubber Mixtures - Phase III, Volume 1 - Effects of Rubber Type, Concentration, and Asphalt		5. Report Date April, 1982	
		6. Performing Organization Code 2390J030	
7. Author(s) J. C. Rosner and J. G. Chehovits		8. Performing Organization Report No.	
9. Performing Organization Name and Address Western Technologies, Inc. 3737 East Broadway Road Phoenix, Arizona 85036		10. Work Unit No.	
		11. Contract or Grant No. HPR-1-19(159)	
12. Sponsoring Agency Name and Address Arizona Department of Transportation 206 South 17th Avenue Phoenix, Arizona 85007		13. Type of Report and Period Covered Final	
		14. Sponsoring Agency Code	
15. Supplementary Notes In cooperation with the U. S. Department of Transportation Federal Highway Administration			
16. Abstract This study had the objectives of (1) evaluating the effects of major components, rubber and asphalt, on physical properties of asphalt-rubber mixtures, and (2) evaluating the feasibility of using testing procedures studied for specifying asphalt-rubber mixtures. Forty-eight different asphalt-rubber mixtures formulated with six different rubber types at four concentrations with two asphalts were tested. Testing procedures utilized included absolute viscosity at 140F, Schwyer Rheometer and force-ductility at 39.2F, sliding plate microviscometer at 32.0F, and viscosity by the Torque-Fork and Haake viscometer during mixing at 375F. All mixtures were produced in a Torque-Fork mixer at 375F using a 1 hour mixing duration. A total of 31 measured or calculated parameters are reported and discussed. The study concluded that physical properties of asphalt-rubber mixtures can vary widely depending on rubber type, rubber concentration, asphalt grade, and interactions between component materials. The force-ductility and sliding plate microviscometer tests yielded several parameters with testing variability low enough to permit use in specifying asphalt-rubber physical properties.			
17. Key Words Asphalt-rubber, asphalt, viscosity, force-ductility, sliding plate microviscometer, Schwyer Rheometer, joint sealers, stress absorbing membranes, Torque-Fork.		18. Distribution Statement No restrictions. Available to the public through the NTIS, Springfield, Virginia 22161	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 118	22. Price

INDEX

	<u>PAGE NO.</u>
TECHNICAL REPORT DOCUMENTATION PAGE	i
1.0 EXPERIMENT DESCRIPTION	1
2.0 EXPERIMENTAL DESIGN.....	3
3.0 RESULTS AND DISCUSSIONS.....	8
3.1 Absolute Viscosity.....	8
3.2 Schwyer Rheometer Constant, G-tube.....	11
3.3 Schwyer Rheometer Constant, F-tube.....	13
3.4 Schwyer Rheometer Apparent Viscosity ($\eta_{0.05}$) at 39.2F (4C), G-tube.....	16
3.5 Schwyer Rheometer Apparent Viscosity ($\eta_{0.05}$) at 39.2F (4C), F-tube.....	18
3.6 Force-Ductility Load at Failure at 39.2F (4C)	21
3.7 Force-Ductility Elongation at Failure at 39.2F (4C).....	23
3.8 Force-Ductility Engineering Stress at Failure at 39.2F (4C).....	26
3.9 Force-Ductility Engineering Strain at Failure at 39.2F (4C).....	28
3.10 Force-Ductility True Stress at Failure at 39.2F (4C).....	30
3.11 Force-Ductility True Strain at Failure at 39.2F (4C).....	33
3.12 Force-Ductility Engineering Creep Compliance at Failure at 39.2F (4C).....	35
3.13 Force-Ductility True Creep Compliance at Failure at 39.2F (4C).....	38
3.14 Force-Ductility Maximum True Creep Compliance at 39.2F (4C).....	40
3.15 Force-Ductility Time to Maximum True Creep Compliance.....	43
3.16 Sliding Plate Apparent Viscosity at 32F (0C).....	46
3.17 Sliding Plate First Cycle Creep (30 min.) at 32F (0C).....	48
3.18 Sliding Plate First Cycle Recover (30 min.) at 32F (0C).....	51
3.19 Sliding Plate Second Cycle Creep (30 min.) at 32F (0C).....	53

3.20	Sliding Plate Second Cycle Recovery (30 min.) at 32F (0C).....	55
3.21	Sliding Plate Second Cycle Recovery (20 hour) at 32F (4C).....	57
3.22	Sliding Plate Second Cycle Recovery (20 hour minus 30 min.) at 32F (0C).....	60
3.23	Sliding Plate Elastic Rebound at 32F (0C)....	62
3.24	Sliding Plate First Cycle Creep Coefficient S_m	65
3.25	Sliding Plate First Cycle Creep Coefficient b.....	66
3.26	Sliding Plate First Cycle Creep Coefficient n.....	68
3.27	Sliding Plate First Cycle Recovery Coefficient S_m	69
3.28	Sliding Plate First Cycle Recovery Coefficient b.....	71
3.29	Sliding Plate First Cycle Recovery Coefficient n.....	72
3.30	Arizona Torque Fork Viscosity During Mixing at 375F (191C).....	74
3.31	Haake Viscosity During Mixing at 375F (191C).	75
4.0	CONCLUSIONS.....	77
	REFERENCES	81
	USE OF APPENDICES	82
	APPENDIX A - Vacuum Capillary Absolute Viscosity at 140F (60C)	85
	APPENDIX B - Schwyer Rheometer Constant (C), G-tube	106
	APPENDIX C - Schwyer Rheometer Constant (C), F-tube	120
	APPENDIX D - Viscosity ($\eta_{0.05}$) By Schwyer Rheometer at 39.2F (4C), G-tube ...	146
	APPENDIX E - Viscosity ($\eta_{0.05}$) By Schwyer Rheometer at 39.2F (4C), F-tube ...	172
	APPENDIX F - Force-Ductility Load at Failure at 39.2F (4C)	200
	APPENDIX G - Force-Ductility Elongation at Failure at 39.2F (4C)	220
	APPENDIX H - Force-Ductility Engineering Stress at Failure at 39.2F (4C)	252
	APPENDIX I - Force-Ductility Engineering Strain at Failure at 39.2F (4C)	272
	APPENDIX J - Force-Ductility True Stress at Failure at 39.2F (4C)	304
	APPENDIX K - Force-Ductility True Strain at Failure at 39.2F (4C)	324

APPENDIX L - Force-Ductility Engineering Creep Compliance at 39.2F (4C)	344
APPENDIX M - Force-Ductility True Creep Compliance at Failure at 39.2F (4C)	376
APPENDIX N - Force-Ductility Maximum True Creep Compliance at 39.2F (4C)	396
APPENDIX O - Force-Ductility Time to Maximum True Creep Compliance at 39.2F (4C)	416
APPENDIX P - Apparent Viscosity at 32.0F (0C) by Sliding Plate Microviscometer	436
APPENDIX Q - First Cycle Creep (30 min) at 32.0F (0C) by Sliding Plate Microviscometer	450
APPENDIX R - First Cycle Recovery (30 min) at 32.0F (0C) by Sliding Plate Microviscometer	464
APPENDIX S - Second Cycle Creep (30 min) 32.0F (0C) by Sliding Plate Microviscometer	478
APPENDIX T - Second Cycle Recovery (30 min) at 32.0F (0C) by Sliding Plate Microviscometer	492
APPENDIX U - Second Cycle Recovery (20 hour) at 32.0F (0C) by Sliding Plate Microviscometer	506
APPENDIX V - Second Cycle Recovery (20 hour minus 30 min) at 32.0F (0C) by Sliding Plate Microviscometer	520
APPENDIX W - First Cycle Percent Rebound at 32.0F (0C) by Sliding Plate Microviscometer	534
APPENDIX X - First Cycle Creep Rheological Coefficient S_m at 32.0F (0C) by Sliding Plate Microviscometer	548
APPENDIX Y - First Cycle Creep Rheological Coefficient b at 32.0F (0C) by Sliding Plate Microviscometer	555
APPENDIX Z - First Cycle Creep Rheological Coefficient n at 32.0F (0C) by Sliding Plate Microviscometer	563
APPENDIX AA -First Cycle Recovery Rheological Coefficient S_m at 32.0F (0C) by Sliding Plate Microviscometer	571
APPENDIX BB -First Cycle Recovery Coefficient b at 32.0F (0C) by Sliding Plate Microviscometer	578
APPENDIX CC -First Cycle Recovery Coefficient n at 32.0F (0C) by Sliding Plate Microviscometer	586
APPENDIX DD -Torque-Fork Viscosity During Mixing at 375F (191C), and 500 RPM	593
APPENDIX EE -Haake Viscosity During Mixing at 375F (191C)	603

1.0 EXPERIMENT DESCRIPTION

1.1 This experiment had the following objectives:

- A. To evaluate the effects of major components, rubber and asphalt, and related concentrations of these components on several physical properties of asphalt-rubber mixtures.
- B. To evaluate the feasibility of using the testing procedures employed in this investigation for asphalt-rubber specification purposes.

1.2 A high degree of success was realized for objective A.

Success was realized for objective B in that several parameters obtained from the force-ductility and sliding plate microviscometer tests have low enough testing variability to permit use in specifying asphalt-rubber materials properties.

1.3 The laboratory investigation was conducted to determine the effects of constituent materials, rubber and asphalt, on physical properties of asphalt-rubber mixtures. Six different rubber types at four concentrations, and two asphalt types were studied.

1.3.1 Granulated rubber utilized was produced from two different reclamation processes and materials:

- Ambient grind tread peel crumb (Atlos)
- Ambient grind high natural rubber content devulcanized crumb (U.S. Rubber Reclaiming)

1.3.2 Three different gradations (particle size distributions) from each rubber production process were used making the total of six different rubber types as follows:

- TPO44
- TPO27
- 50/50 mix (by weight) of TPO27 and TPO27
- GT274
- USRF
- 50/50 mix (by weight) of GT274 and USRF

- 1.3.3 Each rubber type was incorporated into asphalt rubber mixtures at four concentration levels - 15, 20, 25, and 30 percent by weight of total mixture.
- 1.3.4 The two asphalts used in the study were Sahuaro AR1000 and Arco AR4000 from sources commonly used in commercial production of asphalt-rubber mixtures. Two percent of an extender oil was used in AR4000 mixtures. Details on materials properties of asphalts and rubbers studied are contained in the project Summary Report (1).
- 1.3.5 Asphalt-rubber mixtures were all prepared for testing using a standard mixing procedure in the Arizona Torque Fork as described in the project Summary Report (1).
- 1.4 Materials properties assessed in this study are:
- Absolute viscosity at 140F (60C)
 - Apparent viscosity and shear rate sensitivity by the Schwyer Rheometer at 39.2F (4C)
 - Stress, strain, and creep compliance properties at 39.2F (4C) using Force-Ductility
 - Apparent viscosity, creep, strain recovery, rebound and rheological characteristics at 32.0F (0C) using the Sliding Plate Microviscometer
 - Viscosity during mixing at 375F (191C) using the Arizona Torque Fork
 - Viscosity during mixing at 375F (191C) using the Haake Rotational Viscometer.
- 1.4.1 Using the testing procedures described above, a total of 31 different parameters were evaluated, analyzed and reported. Testing details and calculations are contained in the project Summary Report (1).

2.0 EXPERIMENTAL DESIGN AND DATA ANALYSIS

2.1 The experiment was designed as a sequentially randomized, three factor fixed factorial model with two replications per cell. The experimental matrix is presented in Figure 1. The first randomization was by rubber type. Within rubber type, rubber concentration, asphalt cement, and replication were randomized.

2.1.1 The fixed factor model is:

$$Y_{ijkl} = \mu + R_i + Q_j + A_k + (RQ)_{ij} + (RA)_{ik} + (QA)_{jk} + (RQA)_{ijk} + \epsilon_{(ijk)l}$$

where:

Y_{ijkl} = Response variable (viscosity, Schwyer constants, etc.) for the i^{th} level of rubber type, j^{th} level of rubber concentration, k^{th} level of asphalt type and l^{th} replication.

μ = Effect of overall mean.

R_i = Effect of rubber type.

Q_j = Effect of rubber concentration.

A_k = Effect of asphalt type.

$(RQ)_{ij}$
 $(RA)_{ik}$
 $(QA)_{jk}$ = Second order interactions.

$(RQA)_{ijk}$ = Third order interaction.

$\epsilon_{(ijk)l}$ = Experimental error.

2.1.2 Degrees of freedom for the analysis are as follows:

<u>Source</u>	<u>Degrees of Freedom</u>
R_i	5
Q_j	3
A_k	1
$(RQ)_{ij}$	15
$(RA)_{ik}$	5
$(QA)_{jk}$	3
$(RQA)_{ijk}$	15
Error	48
Total	95

- 2.1.3 Data were analyzed using conventional three-way analysis of variance techniques.
- 2.1.4 Prior to analysis, homogeneity of variance was tested by the Foster and Burr q-test (2). Appropriate data transformations were used when necessary to comply with variance homogeneity constraints required for analysis of variance. It should be pointed out that due to the nature of tests and variability of some asphalt-rubber formulations, extensive use was made transformed data.

2.2 Levels of Independent Variables

2.2.1 Rubber at six levels as follows:

- TP044
- TP027
- 50/50 mix (by weight) of TP027 and TP044
- GT274
- USRF
- 50/50 mix (by weight) of GT274 and USRF

2.2.2 Rubber quantities at four levels, 15, 20, 25, and 30 percent, by weight of the asphalt-rubber mixture.

2.2.3 Asphalt at two levels - AR4000 and AR1000.

2.3 Analysis of Simple Main Effects.

2.3.1 Following completion of the three-way ANOVA, with many of the experimental parameters, two-way ANOVA on simple main effects were performed to aid in data interpretation. Analyses were performed for each rubber type, concentration, and asphalt grade.

2.3.1.1 The analysis model for each rubber type is:

$$Y_{ijk} = \mu + A_i + Q_j + (AQ)_{ij} + \epsilon_{(ij)k}$$

in which:

Y_{ijk} = Response variable for the i^{th} level of asphalt, the j^{th} level of rubber concentration, and k^{th} replication

μ	=	Effect of overall mean
A_i	=	Effect of asphalt type
Q_j	=	Effect of rubber concentration
$(AQ)_{ij}$	=	Effect of asphalt-concentration interaction
$(ij)_k$	=	Experimental error

Degrees of freedom for this analysis model are:

<u>Source</u>	<u>Degrees of Freedom</u>
A_i	1
Q_j	3
$(AQ)_{ij}$	3
Error	8
Total	15

2.3.1.2 The analysis model for each rubber concentration is:

$$Y_{ijk} = \mu + A_i + R_j + (AR)_{ij} + \varepsilon_{(ij)k}$$

in which:

Y_{ijk} = Response variable for the i^{th} level of asphalt, the j^{th} level of rubber type, and the k^{th} replication.

μ	=	Effect of overall mean
A_i	=	Effect of asphalt type
R_j	=	Effect of rubber type
$(AR)_{ij}$	=	Effect of asphalt-rubber type interaction
$\varepsilon_{(ij)k}$	=	Experimental error

Degrees of freedom for this analysis model are:

<u>Source</u>	<u>Degrees of Freedom</u>
A_i	1
R_j	5
$(AR)_{ij}$	5
<u>Error</u>	<u>12</u>
<u>Total</u>	<u>23</u>

2.3.1.3 The analysis model for each asphalt grade is:

$$Y_{ijk} = \mu + R_i + Q_j + (RQ)_{ij} + \varepsilon_{(ij)k}$$

in which:

Y_{ijk} = Response variable for the i^{th} level of rubber type, the j^{th} level of rubber concentration, and the k^{th} replication.

μ = Effect of overall mean

R_i = Effect of rubber type

Q_j = Effect of rubber concentration

$(RQ)_{ij}$ = Effect of rubber-concentration interaction

$\varepsilon_{(ij)k}$ = Experimental error

Degrees of freedom for this analysis model are:

<u>Source</u>	<u>Degrees of Freedom</u>
R_i	5
Q_j	3
$(RQ)_{ij}$	15
<u>Error</u>	<u>24</u>
<u>Total</u>	<u>47</u>

3.0 RESULTS AND DISCUSSIONS

3.1 Absolute Viscosity

3.1.1 Measured vacuum capillary absolute viscosity results at 140F (60C) are tabulated in Appendix A in Table A-1. Each value tabulated in Table A-1 is the average of viscosity values obtained from several bulbs of one viscometer. Two viscosity tests were performed for each matrix cell replication.

3.1.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 33.9 percent compared to 22.3 percent for the U.S. Rubber Reclaiming rubber.

3.1.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	63.4%	
●	TP027	-	13.5%	
●	50/50 TP044/TP027	-	24.8%	
●	GT274	-	31.7%	(16.8% if one measurement not considered)
●	USRF	-	18.6%	
●	50/50 GT274/USRF	-	16.6%	

3.1.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	26.0%
●	20%	-	26.0%
●	25%	-	27.7%
●	30%	-	32.8%

3.1.1.4 Average coefficients of variation for all mixtures containing AR4000 asphalt was 25.3 percent, and for the AR1000, 25.8 percent.

- 3.1.1.5 In several cases (TP044, AR1000, with 20 and 25 percent rubber; and 50/50 GT274/USRF, AR1000, with 25 percent rubber) large differences are noted between mean replicate values, but within replicates, variability was low. This may be due to segregation of the mixture during sampling, or in other words, separation by drainage of asphalt. It is interesting to note that these differences are noted only with the AR1000 asphalt, and not the AR4000 which would be less prone to drain or separate due to its higher viscosity.
- 3.1.1.6 Variability of measured absolute viscosity as indicated by coefficient of variation appears to be:
- greater for larger rubber particles than fine,
 - greater for higher rubber concentrations than low, and
 - not affected by asphalt grade.
- 3.1.2 The data which were statistically analyzed are tabulated in Appendix A in Table A-2. Each value tabulated in Table A-2 is the mean of the two measured values in Table A-1. Analyzed data are plotted in Appendix A in Figures A1 through A13.
- 3.1.3 During data analysis, several attempts were made to transform the data to comply with variance homogeneity requirements, but success was not realized due to the high variability of the TP044 data. Therefore, the data analysis were split and two separate ANOVA performed - one for the full factorial without TP044 and one for the TP044 data only. Transformations were not required to satisfy variance homogeneity requirements. These ANOVA summaries are tabulated in Tables A-3 and A-4.
- 3.1.3.1 For the analysis without TP044, rubber type, concentration, rubber-concentration interaction, rubber-asphalt interaction, and the rubber-concentration-asphalt interaction are significant effects at the 0.01 level. Asphalt is significant at the 0.05 level but not the 0.01, and the concentration-asphalt interaction is not significant at the 0.05 level.

- 3.1.3.2 For the analysis with only TP044, concentration is a significant effect at the 0.05 level but not the 0.01 level. Asphalt and asphalt-concentration interaction are not significant at the 0.05 level.
- 3.1.4 Analyses of results show that rubber type, rubber concentration, asphalt, and several interactions influence the measured absolute viscosity of asphalt-rubber mixtures at 140F(60C).
- 3.1.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing USRF rubber had the highest absolute viscosity (225,700 poise overall average) while mixtures containing TPO44 and GT274 rubber had the lowest (122,800 poise and 122,600 poise respectively). Mixtures containing Atlos rubber had approximately the same average absolute viscosity values (122,800 poise, TPO44; 127,900 poise, TPO27; and 129,100 poise, 50/50 TPO44/TPO27).

For mixtures containing U.S. Rubber Reclaiming rubber, the smaller particle size, USRF rubber, resulted in a higher average absolute viscosity than the larger, GT274 (225,700 poise, USRF; 122,600 poise, GT274).

- 3.1.4.2 Effect of Rubber Concentration. Examination of Figures A4 through A9 shows that for all asphalt-rubber mixtures tested, as rubber concentration increases, absolute viscosity increases (20,600 poise overall average at 15 percent rubber compared to 374,600 poise at 30 percent). Two-way ANOVA by rubber type shows that concentration is a significant effect for all rubber types. Two-way ANOVA by asphalt type shows that concentration is also significant for both AR1000 and AR4000. Two-way ANOVA by concentration shows that at 15 and 20 percent, differences in absolute viscosity of mixtures exist due to asphalt and rubber type. However, at 25 percent, differences exist only due to rubber type, and at 30 percent, differences are not noted due to asphalt or rubber type.

3.1.4.3 Effect of Asphalt. Two-way ANOVA by rubber type shows that asphalt is a significant effect for mixtures containing TPO27, GT274, and USRF but not for TPO44, 50/50 TPO44/TPO27, or 50/50 GT274/USRF. Two-way ANOVA by rubber concentration shows that asphalt is significant at 15 and 20 percent, but not at 25 or 30 percent rubber. These trends can be seen in Figures A4 through A9.

Absolute viscosity of asphalt-rubber mixtures containing AR4000 is slightly higher than that of mixtures containing AR1000 for all rubber types except USRF at 25 and 30 percent rubber. With these two mixtures, higher absolute viscosities were measured with the AR1000 asphalt as can be seen in Figure A8. These higher viscosities may be due to a greater degree of rubber and asphalt reaction resulting from the high surface area of the rubber and the thinner asphalt which could result in increased swelling of rubber particles.

3.2 Schwyer Rheometer Constant, G-tube

3.2.1 Measured rheometer constants using the G-tube are tabulated in Appendix B in Table B-1.

3.2.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 25.2 percent compared to 24.3 percent for the U.S. Rubber Reclaiming rubber.

3.2.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	31.9%
●	TP027	-	23.6%
●	50/50 TP044/TP027	-	20.2%
●	GT274	-	19.2%
●	USRF	-	19.0%
●	50/50 GT274/USRF	-	34.1%

- 3.2.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:
- | | | | |
|---|-----|---|-------|
| ● | 15% | - | 23.4% |
| ● | 20% | - | 28.3% |
| ● | 25% | - | 25.8% |
| ● | 30% | - | 21.5% |
- 3.2.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 23.1 percent, and for the AR1000, 26.5 percent.
- 3.2.1.5 Variability of measured rheometer constant G-tube data as indicated by coefficient of variation does not appear to be influenced by rubber particle size (although there is a possible increase in variability with TP044), rubber concentration, or asphalt grade.
- 3.2.2 The measured data did not require transformations to provide for variance homogeneity prior to analysis. Analyzed data are plotted in Appendix B, Figures B1 through B12.
- 3.2.3 The ANOVA summary for rheometer constant G-tube data is tabulated in Table B-2.
- 3.2.3.1 Rubber type was a significant effect at the 0.01 level. Concentration was significant at the 0.05 level but not at the 0.01 level. Asphalt and all interactions were not significant effects at the 0.05 level.
- 3.2.4 Analyses of results show that the type of rubber and rubber concentration influence rheometer constant C (shear susceptibility) measured with the G-tube of asphalt-rubber mixtures at 39.2F(4C).
- 3.2.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50/50 TP044/TP027 rubber mixture had the highest shear susceptibility constant in the G-tube, (0.76 overall average) while the USRF mixture had the lowest (0.46 overall average).

Mean shear susceptibility constant for mixtures containing Atlos rubber was 0.74 and for mixtures containing U.S. Rubber Reclaiming rubber, 0.50. Therefore, it appears that asphalt-rubber mixtures which contain U.S. Rubber Reclaiming rubber are more pseudoplastic in behavior than are mixtures which contain Atlos rubber.

3.2.4.2 Effect of Rubber Concentration. Average overall shear susceptibility constant at 15 percent rubber is 0.70 and at 30 percent rubber, 0.55. Examination of Figures B3 through B8 shows that the mean shear susceptibility constant slightly decreases as rubber concentration increases for each rubber type. Therefore, it appears that as rubber concentration increases, the asphalt-rubber mixtures become more pseudoplastic in behavior.

3.2.4.3 Effect of Asphalt. Asphalt grade was found not to have an effect on the shear susceptibility constant of asphalt-rubber mixtures tested in the G-tube.

3.2.4.4 With the exception of two mixtures (TPO44, AR1000 with 15 and 25 percent rubber) all mixtures had shear susceptibility constants which were less than 1.0 as shown in Figure B2 indicating that the asphalt-rubber mixtures tested were pseudoplastic (viscosity decreases as shear rate increases). Average shear susceptibility constant measured using the G-tube was 0.62.

3.3 Schwyer Rheometer Constant, F-tube

3.3.1 Measured rheometer constants using the F-tube are tabulated in Appendix C in Table C-1 and plotted in Figures C1 through C12.

3.3.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 26.7 percent compared to 30.3 percent for the U.S. Rubber Reclaiming rubber.

3.3.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	35.4%
●	TP027	-	15.5%
●	50/50 TP044/TP027	-	29.3%
●	GT274	-	30.1%
●	USRF	-	24.1%
●	50/50 GT274/USRF	-	36.8%

3.3.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	26.8%
●	20%	-	37.5%
●	25%	-	24.5%
●	30%	-	25.3%

3.3.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 35.7 percent, and for the AR1000, 21.4 percent.

3.3.1.5 Variability of measured rheometer constant F-tube data as indicated by coefficient of variation appears to be:

- greater for larger rubber particle sizes,
- greatest at a 20% rubber concentration,
- greater for AR4000 than for AR1000 asphalt cement

3.3.2 In order to satisfy variance homogeneity requirements, arctangent transformations of data were required prior to analysis. Arctangent transformed data are tabulated in Appendix C in Table C-2 and plotted in Figures C13 through C24.

3.3.3 The ANOVA summary for rheometer constant, F-tube, is tabulated in Table C-3.

3.3.3.1 Rubber type, concentration, rubber-concentration interaction and, rubber-asphalt interaction were significant at the 0.01 level. The rubber-concentration-asphalt interaction was significant at the 0.05 level, but not at 0.01. Asphalt and the concentration-asphalt interaction were not significant at the 0.05 level.

3.3.4 Analyses of results show that rubber type, rubber concentration, and several interactions influence rheometer constant C (shear susceptibility) measured with the F-tube of asphalt-rubber mixtures at 39.2F(4C).

3.3.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing TPO27 and the 50/50 TPO44/TPO27 mixture had the highest shear susceptibility constant in the F-tube (1.10 overall average for TPO27 and 1.09 for the 50/50 TPO44/TPO27 mixture) while the USRF mixtures had the lowest (0.82 overall average).

Mixtures containing Atlos rubber had higher shear susceptibility constants in the F-tube than mixtures containing U.S. Rubber Reclaiming rubber (1.01 overall average for Atlos compared to 0.87 overall average for U.S. Rubber Reclaiming).

As indicated by the measured shear susceptibility constant using the F-tube, asphalt-rubber materials containing Atlos rubber tend to be slightly dilatent in shear susceptibility behavior while mixtures containing U.S. Rubber Reclaiming rubber are slightly pseudoplastic.

3.3.4.2 Effect of Rubber Concentration. Examination of Figures C3 through C8 shows that rubber concentration appears to slightly influence shear susceptibility constant values in the F-tube mixtures containing Atlos Rubber, (1.30 average at 15 percent rubber compared to 0.94 at 30 percent rubber).

Data indicate that as rubber concentration increases, asphalt-rubber materials tend to become slightly more pseudoplastic in behavior.

3.3.4.3 Effect of Asphalt. Asphalt grade was found to not have an effect on shear susceptibility constant of asphalt-rubber mixtures tested in the F-tube.

3.3.4.4 It is interesting to note that differences exist in measured shear susceptibility constant values depending on rheometer tube size used (refer to sections 3.2.4.1 and 3.2.4.2). With the smaller tube size (F), shear susceptibility values are greater than with the larger tube (G). Considering the increased particle interference to flow in the smaller rheometer tube, asphalt-rubber mixtures would be expected to be more dilatant in behavior with smaller tubes than with larger tubes. This trend is indicated in the data.

3.4 Schwyer Rheometer Apparent Viscosity ($\eta_{0.05}$) at 39.2F (4C), G-tube

3.4.1 Measured apparent viscosity data using the G-tube are tabulated in Appendix D in Table D-1 and plotted in Figures D1 through D12.

3.4.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 86.8 percent compared to 48.9 percent for the U.S. Rubber Reclaiming rubber.

3.4.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

● TP044	-	78.4%
● TP027	-	97.0%
● 50/50 TP044/TP027	-	67.3%
● GT274	-	41.1%
● USRF	-	31.6%
● 50/50 GT274/USRF	-	73.7%

3.4.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

● 15%	-	74.2%
● 20%	-	76.1%
● 25%	-	65.8%
● 30%	-	55.4%

3.4.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 71.3 percent, and for the AR1000, 64.4 percent.

3.4.1.5 Variability of measured apparent viscosity G-tube data as indicated by coefficient of variation appears to be:

- greater for Atlos rubber than for U.S. Rubber Reclaiming rubber possibly due to larger particle sizes of Atlos rubber,
- greater for lower rubber concentrations, and
- not affected by asphalt type.

3.4.2 In order to satisfy variance homogeneity requirements, logarithmic transformations of the data were required prior to analysis. Log transformed data are tabulated in Appendix D in Table D-2 and plotted in Figures D13 through D24.

3.4.3 The ANOVA summary for apparent viscosity, G-tube is tabulated in Table D-3.

3.4.3.1 Rubber type was a significant effect at the 0.01 level. Asphalt was significant at the 0.05 level but not at 0.01. Rubber concentration and all interactions were not significant at the 0.05 level.

3.4.4 Analyses of results show that the type of rubber and asphalt influence measured apparent viscosity at a 0.05 sec^{-1} shear rate of asphalt-rubber mixtures at 39.2F(4C) using the G-tube.

3.4.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50/50 TPO44/TPO27 mixture had the highest average apparent viscosity in the G-tube ($231 \times 10^6 \text{ Pa-s}$ overall average) while mixtures containing USRF rubber had the lowest ($33 \times 10^6 \text{ Pa-s}$ overall average).

Mixtures containing Atlos rubber had higher viscosities than mixtures containing U.S. Rubber Reclaiming rubber ($184 \times 10^6 \text{ Pa-s}$ overall average for Atlos compared to $41 \times 10^6 \text{ Pa-s}$ for U.S. Rubber Reclaiming).

3.4.4.2 Effect of Rubber Concentration. Rubber concentration was not found to influence apparent viscosity in the G-tube. This can be noted in Figures D3 through D8.

- 3.4.4.3 Effects of Asphalt. Examination of Figures D3 through D12 shows that mixtures containing AR4000 asphalt generally have slightly higher apparent viscosity in the G-tube than mixtures containing AR1000 (181 Pa-s overall average for AR4000 compared to 12.6 Pa-s for AR1000).
- 3.4.5 It is noted that for many of the asphalt-rubber mixtures tested reporting the mixture viscosity at a 0.05 sec^{-1} shear rate required extrapolation of the data in several cases by as much as 2 orders of magnitude which could be a contributing factor to the high degree of variability of apparent viscosity test results. More extrapolation was required with Atlos than with U.S. Rubber Reclaiming mixtures. Reporting viscosity at a shear rate closer to the measured data may decrease variability of results.
- 3.5 Schweyer Rheometer Apparent Viscosity ($\eta_{0.05}$) at 39.2F (4C), F-tube
- 3.5.1 Measured apparent viscosity data using the F-tube are tabulated in Appendix E in Table E-1 and plotted in Figures E1 through E12.
- 3.5.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 59.1 percent compared to 60.4 percent for the U.S. Rubber Reclaiming rubber.
- 3.5.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:
- | | | | |
|---|-------------------|---|-------|
| ● | TP044 | - | 70.3% |
| ● | TP027 | - | 39.5% |
| ● | 50/50 TP044/TP027 | - | 67.5% |
| ● | GT274 | - | 59.9% |
| ● | USRF | - | 56.0% |
| ● | 50/50 GT274/USRF | - | 53.7% |
- 3.5.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:
- | | | | |
|---|-----|---|-------|
| ● | 15% | - | 65.2% |
| ● | 20% | - | 68.0% |
| ● | 25% | - | 71.5% |
| ● | 30% | - | 34.3% |

- 3.5.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 73.8 percent, and for the AR1000, 45.8 percent.
- 3.5.1.5 Variability of measured apparent viscosity F-tube data as indicated by coefficient of variation appears to be:
- greater for larger rubber particles,
 - least at high rubber concentrations, and
 - less for AR1000 than for AR4000 asphalt cement
- 3.5.2 In order to satisfy variance homogeneity requirements, log log transformations of the data were required prior to analysis. Log log transformed data are tabulated in Appendix E in Table E-2 and plotted in Figures E13 through E24.
- 3.5.3 The ANOVA summary for apparent viscosity, F-tube is tabulated in Table E-3.
- 3.5.3.1 Rubber type, concentration, asphalt, rubber-concentration interaction, and rubber-asphalt interactions were significant effects at the 0.01 level. Other interactions were not significant at the 0.05 level.
- 3.5.4 Analyses of results show that rubber type, rubber concentration, asphalt, and several interactions influence the measured apparent viscosity at a 0.05 sec^{-1} shear rate of asphalt-rubber mixtures at 39.2F(4C) using the F-tube.
- 3.5.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50/50 GT274/USRF mixture had the highest average apparent viscosity in the F-tube ($1583 \times 10^6 \text{ Pa-s}$ overall average) and the USRF mixtures, the lowest ($654 \times 10^6 \text{ Pa-s}$ overall average). It should be noted that averaged data are misleading due to high variability and presence of several extreme values.

- 3.5.4.2 Effect of Rubber Concentration. Average data show that for Atlos rubber mixtures containing 15 percent rubber, average apparent viscosity is 1027×10^6 Pa-s compared to 1618×10^6 Pa-s at 30 percent rubber in the F-tube. For mixtures containing U.S. Rubber Reclaiming rubber, average apparent viscosity is $11,675 \times 10^6$ Pa-s at 15 percent rubber and 85×10^6 Pa-s for 30 percent rubber. These data indicate that for Atlos mixtures, as concentration increases, apparent viscosity increases, and that for U.S. Rubber Reclaiming mixtures, as concentration increases, viscosity decreases. It is noted, though, that presence of several extreme values and resulting high variability of data may cause these observations to be misleading.
- 3.5.4.3 Effect of Asphalt. Overall average apparent viscosity in the F-tube for AR4000 mixtures was 2113×10^6 Pa-s compared to 655×10^6 Pa-s for AR1000 mixtures which tends to indicate that AR4000 mixtures have a higher apparent viscosity in the F-tube than AR1000 mixtures. Once again, this observation may be misleading due to high variability.
- 3.5.4.4 It is interesting to note that the measured apparent viscosity of asphalt-rubber mixtures in the F-tube are higher than in the G-tube (section 3.4.4.1). Additionally, testing variability as indicated by coefficient of variation is greater in the F-tube. It is believed that the smaller capillary diameter of the F-tube (4.65 mm compared to 9.700 mm for the G-tube) is the cause of these differences due to increased flow interference from the rubber particles.
- 3.5.5 Again, as with apparent viscosity measured with the G-tube, extrapolation of data was required to report viscosity at a 0.05 sec^{-1} shear rate with many of the mixtures which may be causing the high degree of testing variability.

3.6 Force-Ductility Load at Failure at 39.2F (4C)

3.6.1 Measured force ductility load at failure data are tabulated in Appendix F in Table F-1. Three measurements were obtained for each matrix cell replicate.

3.6.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 9.2 percent compared to 7.6 percent for the U.S. Rubber Reclaiming rubber.

3.6.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	10.1%
●	TP027	-	11.3%
●	50/50 TP044/TP027	-	6.2%
●	GT274	-	5.5%
●	USRF	-	6.2%
●	50/50 GT274/USRF	-	11.0%

3.6.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	8.9%
●	20%	-	7.8%
●	25%	-	8.8%
●	30%	-	8.0%

3.6.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 8.5 percent, and for the AR1000, 8.3 percent.

3.6.1.5 Variability of measured force ductility load at failure data as indicated by coefficient of variation does not appear to be effected by rubber particle size, rubber concentration, or asphalt grade.

3.6.2 Analyzed load at failure data are tabulated in Table F-2 and plotted in Figures F1 through F12. Each entry in Table F-2 is the mean of three measurements from Table F-1.

3.6.3 The ANOVA summary for force ductility load at failure is tabulated in Table F-3.

- 3.6.3.1 All main effects and two-way interactions are significant at the 0.01 level, and the rubber-concentration-asphalt interaction is significant at the 0.05 level but not at the 0.01.
- 3.6.4 Analyses of results show that rubber type, rubber concentration, asphalt, and several interactions influence load at failure in the force-ductility test at 39.2F(4C).

- 3.6.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50/50 TPO44/TPO27 rubber had the highest load at failure (24.6 pound overall average) while mixtures containing GT274 rubber had the lowest (13.8 pound overall average).

Mixtures containing Atlos rubber failed at higher loads (18.6 pound overall average) than mixtures containing U.S. Rubber Reclaiming rubber (14.6 pound overall average).

It is interesting to note that for Atlos rubber, the 50/50 mixture of TPO44 and TPO27 rubbers resulted in higher loads at failure than either of the two individual rubbers. This trend was not noted with the 50/50 GT274/USRF rubber mixture.

- 3.6.4.2 Effect of Rubber Concentration. Examination of Figures F3, F4, and F5 shows that for Atlos rubber mixtures, as rubber concentration increases, load at failure increases (13.3 pound average at 15 percent rubber compared to 25.1 pound average at 30 percent). Two-way ANOVA by rubber type shows that for each of the Atlos rubbers, concentration is a significant effect.

Examination of Figures F6, F7, and F8 shows that rubber concentration does not greatly influence load at failure of U.S. Rubber Reclaiming mixtures to the extent as with Atlos rubber.

Average loads at failure for U.S. Rubber Reclaiming mixtures tend to increase slightly as rubber concentration increases, reach a maximum at 20 to 25 percent rubber, and then drop slightly at 30 percent rubber (overall average loads at failure of 13.2 pounds at 15 percent rubber, 16.2 pounds at 20 percent, 15.2 pounds at 25 percent, and 14.4 pounds at 30 percent). Two-way ANOVA by rubber type shows that concentration is a significant effect for GT274 mixtures, but not for USRF or the 50/50 GT274/USRF mixtures.

- 3.6.4.3 Effect of Asphalt. Examination of Figures F3 through F12 shows that with only one exception, mean load at failure values are higher for asphalt-rubber mixtures containing the AR4000 asphalt than the AR1000 asphalt (19.9 pound overall average for AR4000 compared to 13.2 pounds for AR1000).

As rubber concentration increases, differences between loads at failure of AR4000 and AR1000 mixtures are observed to decrease indicating that at high rubber concentration loads at failure are influenced to a lesser extent by asphalt characteristics than at low rubber concentrations.

3.7 Force-Ductility Elongation at Failure at 39.2F (4C)

- 3.7.1 Measured force ductility elongation at failure data are tabulated in Appendix G in Table G-1. Three measurements were obtained for each matrix cell replicate.

- 3.7.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 8.1 percent compared to 8.9 percent for the U.S. Rubber Reclaiming rubber.

- 3.7.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

● TP044	-	9.0%
● TP027	-	7.5%
● 50/50 TP044/TP027	-	7.8%
● GT274	-	6.0%
● USRF	-	8.6%
● 50/50 GT274/USRF	-	12.6%

- 3.7.1.3 Average coefficient of variation for each rubber concentration for all rubber types and both asphalts are:
- | | | | |
|---|-----|---|------|
| ● | 15% | - | 8.8% |
| ● | 20% | - | 7.5% |
| ● | 25% | - | 8.4% |
| ● | 30% | - | 9.2% |
- 3.7.1.4 Average coefficients of variation for all mixtures containing AR4000 asphalt was 8.1 percent, and for the AR1000, 9.1 percent.
- 3.7.1.5 Variability of measured elongation at failure data as indicated by coefficient of variation does not appear to be affected by rubber particle size, rubber concentration, or asphalt grade.
- 3.7.2 Reduced elongation at failure data are tabulated in Table G-2 and plotted in Figures G1 through G12. Each entry in Table G-2 is the mean of three values from Table G-1.
- 3.7.3 In order to satisfy variance homogeneity requirements, logarithmic transformations of data were required prior to analysis. Log transformed data are tabulated in Appendix G in Table G-3 and plotted in Figures G13 through G24.
- 3.7.4 The ANOVA summary for elongation at failure is tabulated in Table G-4.
- 3.7.4.1 Rubber type, concentration, asphalt, rubber-concentration interaction and concentration-asphalt interaction are significant effects at the 0.01 level. The rubber-concentration-asphalt interaction is significant at the 0.05 level but not at 0.01. The rubber-asphalt interaction is not significant at the 0.05 level.
- 3.7.5 Analyses of results show that rubber type, rubber concentration, asphalt, and several interactions influence elongation at failure test results at 39.2F(4C).

- 3.7.5.1 Effect of Rubber Type. Asphalt-rubber mixtures containing GT274 rubber had the highest elongation at failure (413 mm overall average) while TPO44 mixtures had the lowest (207 mm overall average).

Atlos rubber mixtures had lower elongations at failure (268 mm average) than U.S. Rubber Reclaiming mixtures (378 mm average).

For Atlos mixtures, data indicates that rubber composed of small particles (TPO27) results in larger elongations at failure than rubbers with larger particles (TPO44). This trend is not noted with U.S. Rubber Reclaiming rubbers as mixtures containing GT274 (larger particles) had higher elongations at failure than those containing USRF (smaller particles).

- 3.7.5.2 Effect of Rubber Concentration. Examination of Figures G3, G4, and G5 shows that for Atlos rubber mixtures as rubber concentration increases, elongation at failure decreases (316 mm average at 15 percent rubber compared to 239 mm average at 30 percent). Two-way ANOVA by rubber type for each Atlos rubber indicates that concentration is a significant effect.

Two-way ANOVA by rubber type for each of the U.S. Rubber Reclaiming rubbers indicate that concentration is significant with GT274 and the 50/50 GT274/USRF mixture, but, is not with USRF. These trends can be seen in Figures G6, G7, and G8.

- 3.7.5.3 Effect of Asphalt. Except for four of the asphalt-rubber mixtures investigated, mixtures containing AR1000 asphalt cement failed at higher elongation values than mixtures containing AR4000 (347 mm overall average for AR1000 compared to 299 mm for AR4000). Examination of Figures G3 through G12 shows that as rubber concentrations increase, differences in elongation at failure between mixtures containing AR4000 and AR1000 tend to decrease indicating that at high rubber concentrations, elongations at failure are influenced to a lesser extent by asphalt characteristics than at low rubber concentrations.

3.8 Force-Ductility Engineering Stress at Failure at 39.2F (4C)

3.8.1 Engineering stress at failure data are tabulated in Appendix H in Table H-1. Three determinations were obtained for each matrix cell replication.

3.8.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 9.3 percent compared to 7.6 percent for the U.S. Rubber Reclaiming rubber.

3.8.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	10.1%
●	TP027	-	11.4%
●	50/50 TP044/TP027	-	6.2%
●	GT274	-	5.5%
●	USRF	-	6.2%
●	50/50 GT274/USRF	-	10.9%

3.8.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	9.0%
●	20%	-	7.9%
●	25%	-	8.8%
●	30%	-	8.0%

3.8.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 8.5 percent, and for the AR1000, 8.3 percent.

3.8.1.5 Variability of measured engineering stress at failure data as indicated by coefficient of variation does not appear to be influenced by rubber particle size, rubber concentration, or asphalt grade

3.8.2 Analyzed engineering stress at failure data are tabulated in Appendix H in Table H-2 and plotted in Figures H1 through H12. Each entry in Table H-2 is the mean of three values from Table H-1.

3.8.3 The ANOVA summary for engineering stress at failure is tabulated in Table H-3.

- 3.8.3.1 Rubber, concentration, asphalt, rubber-concentration interaction, rubber-asphalt interaction, and concentration-asphalt interaction are significant effects at the 0.01 level. The rubber-concentration-asphalt interaction was not significant at the 0.05 level.
- 3.8.4 Analyses indicate that rubber type, rubber concentration, asphalt, and several interactions influence engineering stress at failure of asphalt-rubber mixtures during the forceductility test.

- 3.8.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50-50 TPO44/TPO27 mixture had the highest average engineering stress at failure values (153.7 psi overall average) while the GT274 mixtures had the lowest (85.9 psi overall average).

Data indicate that mixtures containing Atlos rubber had higher engineering stress at failure values (121.6 psi overall average) than mixtures containing U.S. Rubber Reclaiming rubber (91.3 psi overall average).

Additionally, it is noted that the mixture of TPO44 and TPO27 rubber resulted in higher engineering stress at failure values than either of the individual rubbers alone.

- 3.8.4.2 Effect of Rubber Concentration. Examination of Figures H3, H4, and H5 shows that for asphalt-rubber mixtures containing Atlos rubber, as rubber concentration increases, engineering stress at failure increases. Engineering stress at failure for asphalt-rubber mixtures which contain U.S. Rubber Reclaiming rubber, on the other hand, is not influenced by rubber concentration to the extent as mixtures containing Atlos rubber as shown in Figures H6, H7, and H8. Two-way ANOVA by rubber type indicates that rubber concentration is a significant effect at the 0.01 level for all rubber types except USRF and the 50-50 GT274/USRF mixture.

3.8.4.3 Effect of Asphalt. Examination of Figures H3 through H8 shows that mixtures containing AR4000 asphalt have higher engineering stress at failure than mixtures containing AR1000 asphalt. This may be due to the greater viscosity and stiffness of the AR4000 as compared to the AR1000. Overall average engineering stress at failure for mixtures containing AR4000 is 129.3 psi compared to 83.6 psi for mixtures containing AR1000 asphalt.

3.9 Force-Ductility Engineering Strain at Failure at 39.2F (4C)

3.9.1 Engineering strain at failure values are tabulated in Appendix I in Table I-1. Three determinations were obtained for each matrix cell replication.

3.9.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 7.4 percent compared to 7.8 percent for the U.S. Rubber Reclaiming rubber.

3.9.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	8.3%
●	TP027	-	8.0%
●	50/50 TP044/TP027	-	5.8%
●	GT274	-	4.5%
●	USRF	-	6.6%
●	50/50 GT274/USRF	-	12.2%

3.9.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	7.5%
●	20%	-	6.3%
●	25%	-	8.2%
●	30%	-	8.2%

3.9.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 6.9 percent, and for the AR1000, 8.2 percent.

- 3.9.1.5 Variability of measured engineering strain at failure data as indicated by coefficient of variation does not appear to be affected by rubber particle size, concentration, or asphalt grade.
- 3.9.2 Reduced engineering strain at failure data are tabulated in Appendix I in Table I-2 and plotted in Figures I1 through I12. Each entry in Table I-2 is the mean of three values from Table I-1.
- 3.9.3 In order to satisfy variance homogeneity requirements, log transformations of the data were required prior to analysis. Log transformed data are tabulated in Appendix I in Table I-3 and plotted in Figures I13 through I24.
- 3.9.4 The ANOVA summary for engineering strain at failure is tabulated in Table I-4.
- 3.9.4.1 Rubber, concentration, asphalt, rubber-concentration interaction, and concentration-asphalt interaction are significant effects at the 0.01 level. Rubber-concentration-asphalt interaction is significant at the 0.05 level but not at the 0.01. Rubber-asphalt interaction is not significant at the 0.05 level.
- 3.9.5 Analyses indicate that rubber type, rubber concentration, asphalt, and several interactions influence engineering strain at failure of asphalt-rubber mixtures during the force-ductility test.
- 3.9.5.1 Effect of Rubber Type. Asphalt-rubber mixtures containing GT274 rubber had the highest engineering strain at failure (8.12 mm/mm overall average) and mixtures containing TP044 rubber, the lowest (3.92 mm/mm overall average).

Data indicates that for asphalt-rubber mixtures containing Atlos rubber, as particle size increases, for all rubber concentrations, engineering strain at failure decreases (see Figures I9 through I12). For mixtures containing U.S. Rubber Reclaiming rubber, GT274 rubber, the largest rubber of this type investigated, resulted in highest average engineering strain at failure results (8.12 mm/mm).

Mixtures containing Atlos rubber failed at lower average engineering strains (5.2 mm/mm average) than those containing U.S. Rubber Reclaiming rubber (7.4 mm/mm average).

3.9.5.2 Effect of Rubber Concentration. Examination of Figures I3 through I8 shows that as rubber concentration increases, engineering strain at failure decreases for all rubber types except USRF. Two-way ANOVA performed by rubber type indicate that rubber concentration is a significant effect for all rubber types except USRF. Overall average engineering strain at failure for mixtures containing 15 percent rubber was 6.6 mm/mm and for 30 percent rubber, 5.5 mm/mm.

3.9.5.3 Effect of Asphalt. Examination of Figures I3 through I12 shows that generally, at 15 and 20 percent rubber concentrations, mixtures containing AR1000 asphalt failed at higher engineering strains than mixtures containing AR4000 asphalt.

At 25 and 30 percent rubber concentrations, there are less differences in failure strains between AR1000 and AR4000 mixtures than at 15 and 20 percent rubber. Two-way ANOVA by rubber concentration shows that asphalt is a significant effect at 15 and 20 percent rubber, but not at 25 and 30 percent rubber.

3.10 Force-Ductility True Stress at Failure at 39.2F (4C)

3.10.1 Force-ductility true stress at failure data are tabulated in Appendix J in Table J-1. Three determinations were obtained for each matrix cell replication.

3.10.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 11.8 percent compared to 10.9 percent for the U.S. Rubber Reclaiming rubber.

- 3.10.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:
- TP044 - 13.7%
 - TP027 - 13.4%
 - 50/50 TP044/TP027 - 8.3%
 - GT274 - 9.1%
 - USRF - 9.2%
 - 50/50 GT274/USRF - 14.3%
- 3.10.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:
- 15% - 9.8%
 - 20% - 9.6%
 - 25% - 12.3%
 - 30% - 13.6%
- 3.10.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 11.8 percent, and for the AR1000, 10.8 percent.
- 3.10.1.5 Variability of measured true stress at failure data as indicated by coefficient of variation does not appear to be influenced by rubber particle size or asphalt grade. Increasing rubber concentrations may slightly increase variability.
- 3.10.2 Analyzed true stress at failure data are tabulated in Appendix J in Table J-2 and plotted in Figures J1 through J12.
- 3.10.3 The ANOVA summary for true stress at failure data is tabulated in Table J-3.
- 3.10.3.1 Rubber, concentration, asphalt, rubber-concentration interaction and concentration-asphalt interaction are significant effects at the 0.01 level. Rubber-asphalt and rubber-concentration-asphalt interactions are not significant at the 0.05 level.
- 3.10.4 Analyses indicate that rubber type, rubber concentration, asphalt, and several interactions influence true stress at failure of asphalt-rubber mixtures during the force-ductility test.

- 3.10.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50/50 TPO44/TPO27 rubber had the highest true stress at failure (878 psi overall average) while mixtures containing TPO44 rubber had the lowest (532 psi overall average). For mixtures containing Atlos rubber, the smaller particle size (TPO27) resulted in higher true stress at failure than the TPO44 (730 psi compared to 532 psi). The mixture of TPO44 and TPO27 resulted in higher true stress at failure than either TPO44 or TPO27.

Mixtures containing U.S. Rubber Reclaiming rubber failed at approximately the same average true stress values, 767 psi for GT274, 786 psi for USRF, and 700 psi for the GT274/USRF mixture.

- 3.10.4.2 Effect of Rubber Concentration. Examination of Figures J3, J4, and J5 shows that for asphalt-rubber mixtures containing Atlos rubber, as concentration increases, true stress at failure tends to increase (545 psi at 15 percent rubber compared to 860 psi at 30 percent). Two-way ANOVA by rubber type shows that for each of the Atlos rubbers, concentration is a significant effect.

Figure J6 shows that for mixtures containing GT274, as concentration increases, true stress at failure increases, but then drops when rubber concentration exceeds 25 percent. Two-way ANOVA on GT274 mixtures indicate that concentration is a significant effect.

Two-way ANOVA on USRF and GT274/USRF mixtures, on the other hand shows that concentration is not a significant effect. This can be noted in Figures J7 and J8.

Two-way ANOVA performed by asphalt indicates that concentration is a significant effect for asphalt-rubber containing AR1000, but not for mixtures containing AR4000.

3.10.4.3 Effect of Asphalt. Examination of Figures J3 through J12 shows that true stress at failure for mixtures containing AR4000 asphalt is higher than for mixtures containing AR1000 asphalt (854 psi overall average for AR4000 compared to 610 psi for AR1000). Two-way ANOVA by rubber type shows that asphalt is a significant effect. The same is noted when ANOVA is performed by rubber concentration.

3.11 Force-Ductility True Strain at Failure at 39.2F (4C)

3.11.1 True strain at failure data are tabulated in Appendix K in Table K-1. Three determinations were obtained for each matrix cell replication.

3.11.1.1 Average coefficients of variation for Atlos rubber at all concentrations and both asphalts was 3.4 percent compared to 3.3 percent for the U.S. Rubber Reclaiming rubber.

3.11.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	4.2%
●	TP027	-	3.3%
●	50/50 TP044/TP027	-	2.7%
●	GT274	-	2.0%
●	USRF	-	2.8%
●	50/50 GT274/USRF	-	5.0%

3.11.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	3.3%
●	20%	-	2.7%
●	25%	-	3.6%
●	30%	-	3.8%

3.11.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 3.1 percent, and for the AR1000, 3.6 percent.

- 3.11.1.5 Variability of measured true strain at failure data as indicated by coefficient of variation is low (less than 5 percent based on averages) and does not appear to be effected by rubber particle size, concentration, or asphalt grade.
- 3.11.2 Analyzed true strain at failure data are tabulated in Appendix K in Table K-2 and plotted in Figures K1 through K12.
- 3.11.3 The ANOVA summary for true strain at failure is tabulated in Table K-3.
 - 3.11.3.1 Rubber, concentration, asphalt, rubber-concentration interaction, and concentration-asphalt interaction are significant effects at the 0.01 level. The rubber-concentration-asphalt interaction is significant at the 0.05 level but not at 0.01. The rubber-asphalt interaction is not significant at the 0.05 level.
- 3.11.4 Analyses indicate that rubber type, rubber concentration, asphalt, and several interactions influence true strain at failure of asphalt-rubber mixtures during the force-ductility test.
 - 3.11.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing GT274 rubber failed at highest true strains (2.20 mm/mm overall average) and mixtures containing TPO44, the lowest (1.59 mm/mm overall average). For mixtures containing Atlos rubber at all concentrations, the smaller rubber particle size (TPO27) resulted in higher true strain at failure than for TPO44, the largest rubber particle size (2.03 mm/mm compared to 1.59 mm/mm). This trend can be seen in Figures K9 through K12.

For mixtures containing U.S. Rubber Reclaiming rubber, smaller differences in average results were noted than for the Atlos rubber mixtures (2.20 mm/mm overall average for GT274, 2.06 mm/mm for USRF, and 2.07 mm/mm for 50-50 GT274/USRF).

3.11.4.2 Effect of Rubber Concentration. Examination of Figures K3 through K8 shows that for all rubber types except USRF, as concentration increases, true strain at failure tends to slightly decrease (2.08 mm/mm overall average for 15 percent rubber compared to 1.87 mm/mm for 30 percent rubber). Two-way ANOVA by rubber type indicates that concentration is a significant effect for all rubbers except USRF.

3.11.4.3 Effect of Asphalt. Examination of Figures K3 through K12 shows that generally, true strains at failure for mixtures containing AR4000 asphalt are less than for AR1000 asphalt (1.90 mm/mm overall average for the AR4000 compared to 2.01 mm/mm for AR1000 mixtures).

Additionally, it is noted that as rubber concentration increases, true strains at failure obtained for AR4000 and AR1000 mixtures tend to become closer for all rubber types indicating that at higher rubber concentrations, asphalt characteristics have a lesser effect on true strain at failure than at lower rubber concentrations..

3.12 Force-Ductility Engineering Creep Compliance at Failure at 39.2F (4C)

3.12.1 Engineering creep compliance data are tabulated in Appendix L in Table L-1. Three determinations were made for each matrix cell replication.

3.12.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 11.0 percent compared to 10.4 percent for the U.S. Rubber Reclaiming rubber.

3.12.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

● TP044	-	12.3%
● TP027	-	12.3%
● 50/50 TP044/TP027	-	8.4%
● GT274	-	7.8%
● USRF	-	7.8%
● 50/50 GT274/USRF	-	15.6%

- 3.12.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:
- | | | | |
|---|-----|---|-------|
| ● | 15% | - | 13.3% |
| ● | 20% | - | 9.1% |
| ● | 25% | - | 10.2% |
| ● | 30% | - | 9.6% |
- 3.12.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 9.6 percent, and for the AR1000, 11.8 percent.
- 3.12.1.5 Variability of engineering creep compliance data as indicated by coefficient of variation does not appear to be influenced by rubber type, rubber concentration, or asphalt grade.
- 3.12.2 Reduced data are tabulated in Appendix L in Table L-2 and plotted in Figures L1 through L12. Each entry in Table L-2 is the mean of three values in Table L-1.
- 3.12.3 In order to satisfy variance homogeneity requirements, log log arctangent square root transformations of the data were required prior to analysis. Transformed data are tabulated in Appendix L in Table L-3 and plotted in Figures L13 through L24.
- 3.12.4 The ANOVA summary for engineering creep compliance at failure is tabulated in Table L-4.
- 3.12.4.1 All main effects and interactions were significant at the 0.01 level.
- 3.12.5 Analyses indicate that rubber type, rubber concentration, asphalt, and all interactions influence engineering creep compliance at failure of asphalt-rubber mixtures during the force-ductility test.
- 3.12.5.1 Effect of Rubber Type. Asphalt-rubber mixtures containing GT274 rubber had the highest engineering creep compliance at failure (0.1042 psi^{-1} overall average) and mixtures containing the 50-50 TPO44/TPO27 rubber, the lowest (0.0398 psi^{-1} overall average).

For asphalt-rubber mixtures containing Atlos rubber, mixtures containing large rubber particles (TPO44) have lower engineering creep compliance values (0.0440 psi^{-1} overall average) than mixtures containing the smaller TPO27 particles (0.0950 psi^{-1} overall average). The mixture of TPO44 and TPO27 had lower values than mixtures containing either of the two individual rubbers (0.0398 psi^{-1} overall average).

For mixtures containing U.S. Rubber Reclaiming rubber, the small USRF particles resulted in lower engineering creep compliance values (0.0744 psi^{-1} overall average) than mixtures containing the larger GT274 particles (0.1042 psi^{-1} overall average). The mixture of GT274 and USRF had average engineering creep compliance at failure (0.0944 psi^{-1} overall average) which was between that obtained for GT274 and USRF.

- 3.12.5.2 Effect of Rubber Concentration. Examination of Figures L3, L4, and L5 shows that for asphalt-rubber mixtures containing AR1000 asphalt and Atlos rubber, as rubber concentration increases, engineering creep compliance at failure decreases. This effect is present with Atlos mixtures containing AR4000 asphalt, but differences are not as great.

For asphalt-rubber mixtures containing U.S. Rubber Reclaiming rubber and AR1000 asphalt, as rubber concentration increases from 15 to 25 percent, engineering creep compliance at failure decreases, but then tends to remain the same at 30 percent rubber as seen in Figures L6, L7, and L8. Engineering creep compliance values for mixtures containing AR4000 asphalt do not decrease as much as for mixtures containing AR1000 asphalt as rubber concentration increases.

Two-way ANOVA by rubber type shows that for all rubbers investigated, rubber concentration is a significant effect on engineering creep compliance at failure results. Two-way ANOVA by asphalt type indicates that concentration is significant for both AR1000 and AR4000 asphalt.

3.12.5.3 Effect of Asphalt. Examination of Figures L3 through L12 shows that with one exception, asphalt-rubber mixtures containing AR1000 asphalt have higher mean engineering creep compliance at failure values than mixtures containing AR4000 asphalt for all rubber types investigated and all rubber concentrations. Differences in results between asphalts decrease as rubber concentration increases for all rubber types.

3.13 Force-Ductility True Creep Compliance at Failure at 39.2F (4C)

3.13.1 True creep compliance data are tabulated in Appendix M in Table M-1. Three determinations were made for each matrix cell replication.

3.13.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 9.9 percent compared to 8.3 percent for the U.S. Rubber Reclaiming rubber.

3.13.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	11.4%
●	TP027	-	11.5%
●	50/50 TP044/TP027	-	6.7%
●	GT274	-	5.4%
●	USRF	-	7.6%
●	50/50 GT274/USRF	-	12.4%

3.13.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	8.8%
●	20%	-	8.8%
●	25%	-	9.5%
●	30%	-	9.6%

3.13.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 9.7 percent, and for the AR1000, 8.6 percent.

- 3.13.1.5 Variability of true creep compliance at failure data as indicated by coefficient of variation does not appear to be influenced by rubber particle size, rubber concentration, or asphalt grade.
- 3.13.2 Analyzed true creep compliance at failure data are tabulated in Appendix M in Table M-2 and plotted in Figures M1 through M12. Each entry in Table M-2 is the mean of three values from Table M-1.
- 3.13.3 The ANOVA summary for true creep compliance at failure data is tabulated in Table M-3.
- 3.13.3.1 All main effects and interactions are significant at the 0.01 level.
- 3.13.4 Analyses indicate that rubber type, rubber concentration, asphalt, and all interactions influence true creep compliance at failure of asphalt-rubber mixtures during the force-ductility test.
- 3.13.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50/50 GT274/USRF rubber had the highest average true creep compliance at failure values (0.00412 psi^{-1} overall average) while the 50/50 TPO44/TPO27 rubber had the lowest (0.00227 psi^{-1} overall average).

For asphalt-rubber mixtures containing Atlos rubber, TPO44, and TPO27 mixtures had approximately the same average true creep compliance values (0.00329 psi^{-1} overall average for TPO44 compared to 0.00331 psi^{-1} for TPO27). The mixture of the two rubbers resulted in a lower value (0.00227 psi^{-1}) indicating a stiffer mixture.

The asphalt-rubber mixtures containing U.S. Rubber Reclaiming rubber had approximately the same average true creep compliance values (0.00308 psi^{-1} overall average for GT274, 0.00272 psi^{-1} for USRF, and 0.00320 psi^{-1} for the 50/50 GT274/USRF mixture).

- 3.13.4.2 Effect of Rubber Concentration. Examination of Figures M3, M4, and M5 shows that for mixtures containing Atlos rubber, as concentration increases, true creep compliance at failure decreases. The effect is greater with AR1000 than AR4000 asphalt.

For asphalt-rubber mixtures containing U.S. Rubber Reclaiming rubber, as concentration increases from 15 to 25 percent, true creep compliance at failure decreases, but, then, as seen in Figures M6, M7, and M8, tends to remain the same or slightly increase at 30 percent rubber. As with Atlos rubber, the effect is greater with AR1000 than the AR4000 asphalt.

Two-way ANOVA by rubber type shows that for all rubber types investigated, except for the 50-50 GR274/USRF mixture, concentration is a significant effect on true creep compliance at failure. Two-way ANOVA by asphalt type indicates that concentration is a significant effect for both AR1000 and AR4000.

- 3.13.4.3 Effect of Asphalt. Examination of Figures M3 through M12 shows that asphalt-rubber mixtures containing AR1000 asphalt have higher mean true creep compliance at failure values than mixtures containing AR4000 asphalt for all rubber types and concentrations. Differences in results decrease as rubber concentration increases for all rubber types indicating that at high rubber concentration, asphalt characteristics have a lesser effect on true creep compliance at failure than at lower rubber concentrations.

3.14 Force-Ductility Maximum True Creep Compliance at 39.2F (4C)

- 3.14.1 Maximum true creep compliance data are tabulated in Appendix N in Table N-1. Three determinations were made for each matrix cell replication.

- 3.14.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 8.0 percent compared to 6.9 percent for the U.S. Rubber Reclaiming rubber.

3.14.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	8.8%
●	TP027	-	9.7%
●	50/50 TP044/TP027	-	5.6%
●	GT274	-	6.4%
●	USRF	-	5.0%
●	50/50 GT274/USRF	-	9.2%

3.14.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	8.1%
●	20%	-	7.2%
●	25%	-	7.4%
●	30%	-	7.0%

3.14.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 8.1 percent, and for the AR1000, 6.8 percent.

3.14.1.5 Variability of maximum true creep compliance data as indicated by coefficient of variation does not appear to be influenced by rubber particle size, rubber concentration, or asphalt grade.

3.14.2 Analyzed maximum true creep compliance data are tabulated in Appendix N in Table N-2 and plotted in Figures N1 through N12. Each entry in Table N-2 is the mean of three values in Table N-1.

3.14.3 The ANOVA summary for maximum true creep compliance data is tabulated in Table N-3.

3.14.3.1 All main effects and interactions are significant at the 0.01 level.

3.14.4 Analyses indicate that rubber type, rubber concentration, asphalt, and all interactions influence maximum true creep compliance of asphalt-rubber mixtures during the force-ductility test.

- 3.14.4.1 Effect of Rubber Type. Asphalt-rubber mixtures containing GT274 and the 50/50 GT274/USRF rubbers had the highest maximum true creep compliance values (0.00812 psi⁻¹ overall average for GT274 and 0.00814 psi⁻¹ for the 50/50 GT274/USRF mixture) while the 50/50 TPO44/TPO27 mixture had the lowest (0.00421 psi⁻¹ overall average).

For asphalt-rubber mixtures containing Atlos rubber, TPO44 mixtures had lower average maximum true creep compliance than TPO27 mixtures (0.00505 psi⁻¹ overall average for TPO44 compared to 0.00675 psi⁻¹ for TPO27). The mixture of the two rubbers resulted in a the lowest average maximum true creep compliance (0.00421 psi⁻¹ overall average).

For asphalt-rubber mixtures containing U.S. Rubber Reclaiming rubber, USRF mixtures had slightly lower average maximum true creep compliance (0.00730 psi⁻¹ overall average) than the GT274 or 50/50 GT274/USRF rubbers (0.00812 psi⁻¹ and 0.00814 psi⁻¹ overall averages respectively).

- 3.14.4.2 Effect of Rubber Concentration. Examination of Figures N3, N4, and N5 show that for TPO44 and the 50/50 TPO44/TPO27 mixtures with AR1000 asphalt, as rubber concentration increases, maximum true creep compliance tends to decrease. For mixtures containing TPO27 rubber and AR1000 asphalt, maximum true creep compliance decrease as rubber concentration increases from 15 to 25 percent, but then increases at 30 percent. For mixtures containing AR4000 asphalt and Atlos rubber, maximum true creep compliance tend to remain constant or slightly increase as rubber percentage increases.

For mixtures containing U.S. Rubber Reclaiming rubber and AR1000 asphalt, as rubber concentration increases, maximum true creep compliance tend to remain approximately the same. Slight increases are noted for GT274 and USRF mixtures at 30 percent rubber. On the other hand, with AR4000 asphalt, as rubber concentration increases, maximum true creep compliance tends to increase.

Two-way ANOVA by rubber type shows that concentration is a significant effect on maximum true creep compliance.

Two-way ANOVA by asphalt shows that concentration is a significant effect for both AR1000 and AR4000 mixtures.

- 3.14.4.3 Effect of Asphalt. Examination of Figures N3 through N12 shows that with one exception, asphalt-rubber mixtures containing AR1000 asphalt have higher mean maximum true creep compliance than mixtures containing AR4000 asphalt for all rubber types and concentrations. Differences between asphalt types decrease as rubber concentration increases for all rubber types indicating that at higher rubber concentrations asphalt characteristics have a lesser effect on maximum true creep compliance than at lower concentrations.

Two-way ANOVA by rubber type shows that asphalt is a significant effect for all rubber types.

Two-way ANOVA by concentration shows that asphalt is a significant effect at all concentrations.

3.15 Force-Ductility Time to Maximum True Creep Compliance

- 3.15.1 Time to maximum true creep compliance data are tabulated in Appendix O in Table O-1. Three determinations were made for each matrix cell replication.

- 3.15.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 4.5 percent compared to 5.3 percent for the U.S. Rubber Reclaiming rubber.

- 3.15.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:
- | | | | |
|---|-------------------|----|------|
| ● | TP044 | -- | 6.1% |
| ● | TP027 | -- | 2.2% |
| ● | 50/50 TP044/TP027 | -- | 5.3% |
| ● | GT274 | -- | 3.9% |
| ● | USRF | -- | 5.9% |
| ● | 50/50 GT274/USRF | -- | 6.1% |
- 3.15.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:
- | | | | |
|---|-----|---|------|
| ● | 15% | - | 3.8% |
| ● | 20% | - | 4.3% |
| ● | 25% | - | 5.1% |
| ● | 30% | - | 6.4% |
- 3.15.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 4.5 percent, and for the AR1000, 5.3 percent.
- 3.15.1.5 Variability of time to maximum true creep compliance data as indicated by coefficient of variation is low (4.9 percent overall average) and does not appear to be influenced by rubber particle size, rubber concentration, or asphalt grade.
- 3.15.2 Analyzed time to maximum true creep compliance data are tabulated in Appendix N in Table O-2 and plotted in Figures O1 through O12. Each entry in Table O-2 is the mean of three values in Table O-1.
- 3.15.3 The ANOVA summary for time to maximum true creep compliance data is tabulated in Table O-3.
- 3.15.3.1 Rubber, concentration, asphalt, rubber-concentration interaction, and concentration-asphalt interaction are significant effects at the 0.01 level. Rubber-asphalt and rubber-concentration-asphalt interaction are not significant at the 0.05 level.

3.15.4 Analyses indicate that rubber type, rubber concentration, asphalt and several interactions influence time to reach maximum true creep compliance of asphalt-rubber mixtures during the force-ductility test.

3.15.4.1 Effect of Rubber Type. Average time to maximum true creep compliance failure for asphalt-rubber mixtures containing Atlos rubber were approximately the same (9.3 minutes overall average for TPO44, 9.9 minutes for TPO27, and 9.4 minutes for the 50/50 TPO44/TPO27 mixture). Average results for U.S. Rubber Reclaiming mixtures were also approximately the same (11.4 minutes overall average for GT274, 11.1 minutes for USRF, and 11.3 minutes for the 50/50 GT274/USRF mixture).

3.15.4.2 Effect of Rubber Concentration. Examination of Figures O3 through O8 shows for all rubber types and both asphalts, that as rubber concentration increases, time to maximum true creep compliance decreases (13.2 minutes overall mean at 15 percent rubber compared to 8.1 minutes for 30 percent rubber).

Two-way ANOVA by rubber type shows that concentration is a significant effect for all rubber types investigated.

Two-way ANOVA by asphalt shows that concentration is a significant effect for both AR1000 and AR4000 asphalts.

3.15.4.3 Effect of Asphalt. Examination of Figures O3 through O12 shows that with one exception time to maximum true creep compliance of asphalt-rubber mixtures containing AR4000 is slightly higher than for mixtures containing AR1000 asphalt (10.9 minute overall average for AR4000 asphalt compared to 9.9 minutes for the AR1000 mixtures).

Two-way ANOVA by rubber type shows that asphalt is a significant effect for all rubber types except the 50/50 GT274/USRF mixture.

Two-way ANOVA by concentration shows that asphalt is a significant effect at all concentrations.

3.16 Sliding Plate Apparent Viscosity at 32F (0C)

3.16.1 Measured and analyzed sliding plate apparent viscosity data are tabulated in Appendix P in Table P-1 and plotted in Figures P1 through P12.

3.16.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 26.0 percent compared to 23.9 percent for the U.S. Rubber Reclaiming rubber.

3.16.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

● TP044	-	31.5%
● TP027	-	20.1%
● 50/50 TP044/TP027	-	25.9%
● GT274	-	16.7%
● USRF	-	30.6%
● 50/50 GT274/USRF	-	24.5%

3.16.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

● 15%	-	16.9%
● 20%	-	30.7%
● 25%	-	22.1%
● 30%	-	30.0%

3.16.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 24.2 percent, and for the AR1000, 25.7 percent.

3.16.1.5 Variability of measured sliding plate apparent viscosity data as indicated by coefficient of variation does not appear to be influenced by rubber particle size, rubber concentration, or asphalt grade.

3.16.2 The ANOVA summary for sliding plate apparent viscosity is tabulated in Table P-2.

- 3.16.2.1 Rubber, asphalt, and all interactions are significant effects at the 0.01 level. Concentration is significant at the 0.05 level but not at 0.01.
- 3.16.3 Analyses indicate that rubber type, rubber concentration, asphalt, and all interactions influence apparent viscosity of asphalt-rubber mixtures as measured by the sliding plate microviscometers.

- 3.16.3.1 Effect of Rubber Type. Asphalt-rubber mixtures containing TPO44 rubber had the highest average apparent viscosity (6.21×10^9 poise overall average) while the 50/50 GT274/USRF rubber had the lowest (2.22×10^9 poise overall average). For asphalt-rubber mixtures containing Atlos rubber, data indicate that as particle size increases, apparent viscosity increases (3.37×10^9 poise overall average for TPO27 compared to 6.21×10^9 poise for TPO44).

For mixtures containing U.S. Rubber Reclaiming rubber, average apparent viscosity is not greatly affected by rubber particle size (2.29×10^9 poise overall average for GT274, 2.63×10^9 poise for USRF, and 2.22×10^9 poise for the 50/50 GT274/USRF mixture).

- 3.16.3.2 Effect of Rubber Concentration. Examination of Figures P3, P4, and P5 show for mixtures containing AR1000 asphalt and Atlos rubber, that as rubber concentration increases, apparent viscosity tends to increase. This trend is not noted with the AR4000 asphalt.

Examination of Figures P6, P7, and P8 indicate for mixtures containing U.S. Rubber Reclaiming rubber, that as rubber concentration increases, apparent viscosity remains approximately the same for mixtures containing both asphalts.

Two-way ANOVA by rubber type shows that concentration is a significant effect for TPO44, 50/50 TPO44/TPO27 mixture, GT274, and the 50/50 GT274/USRF mixture.

Two-way ANOVA by asphalt shows that concentration is a significant effect for both AR1000 and AR4000 asphalts.

- 3.16.3.3 Effect of Asphalt. Examination of Figures P3, P4, and P5 shows that for mixtures containing Atlos rubber, those with AR4000 asphalt have higher apparent viscosity than mixtures containing AR1000 asphalt (6.52×10^9 poise overall average for AR4000 compared to 3.66×10^9 poise for AR1000).

Figures P6, P7, and P8 show that for mixtures containing U.S. Rubber Reclaiming rubber, those with AR4000 asphalt have slightly higher apparent viscosities than those containing AR1000 asphalt (2.71×10^9 poise overall average for AR4000 compared to 2.04×10^9 poise for AR1000).

Two-way ANOVA by rubber type shows that asphalt is a significant effect for all mixtures except those containing USRF and the 50/50 GT274/USRF mixture.

Two-way ANOVA by concentration shows that asphalt is a significant effect at all concentrations investigated.

3.17 Sliding Plate First Cycle Creep (30 min.) at 32F (0C)

- 3.17.1 Measured and analyzed sliding plate first cycle creep data are tabulated in Appendix Q in Table Q-1 and plotted in Figures Q1 through Q12.

- 3.17.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 13.2 percent compared to 15.1 percent for the U.S. Rubber Reclaiming rubber.

- 3.17.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

● TP044	-	11.8%
● TP027	-	14.3%
● 50/50 TP044/TP027	-	13.6%
● GT274	-	13.3%
● USRF	-	23.7%
● 50/50 GT274/USRF	-	8.4%

- 3.17.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:
- | | | | |
|---|-----|---|-------|
| ● | 15% | - | 15.7% |
| ● | 20% | - | 12.9% |
| ● | 25% | - | 14.8% |
| ● | 30% | - | 13.3% |
- 3.17.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 14.3 percent and for the AR1000, 13.2 percent.
- 3.17.1.5 Variability of measured sliding plate first cycle creep (30 min.) data as indicated by coefficient of variation does not appear to be influenced by rubber particle size, rubber concentration, or asphalt grade.
- 3.17.2 The ANOVA summary for sliding plate first cycle creep (30 min.) is tabulated in Table Q-2.
- 3.17.2.1 Rubber, concentration, asphalt, rubber-concentration interaction, and concentration-asphalt interaction are significant effects at the 0.01 level. Rubber-asphalt and rubber-concentration-asphalt interactions are not significant at the 0.05 level.
- 3.17.3 Analyses indicate that rubber type, rubber concentration, asphalt and several interactions influence first cycle sliding plate creep (30 min.) of asphalt-rubber mixtures.
- 3.17.3.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50-50 GT274/USRF rubber had the highest 30 minute first cycle creep (648 microns overall average) while the TPO44 mixtures had the lowest (305 micron overall average). Data indicate that in general, as rubber particle size increases, for both Atlos and U.S. Rubber Reclaiming rubber, 30 minute first cycle creep decreases.

3.17.3.2 Effect of Rubber Concentration. The effects of rubber concentration on 30 minute first cycle creep vary depending on rubber type. For TPO44 mixtures, first cycle creep does not appear to be affected by rubber concentration for either AR1000 or AR4000 asphalt. TPO27 mixtures containing AR4000 asphalt tend to creep more as rubber concentration increases whereas mixtures containing AR1000 asphalt do not seem to be affected by concentration. The same trends noted with TPO27 are noted for the 50/50 TPO44/TPO27 rubber. Above trends can be seen in Figures Q3, Q4, and Q5.

All mixtures containing U.S. Rubber Reclaiming rubber and AR4000 asphalt tend to creep more as rubber concentration increases (288 micron average at 15 percent rubber compared to 779 microns at 30 percent rubber). U.S. Rubber Reclaiming mixtures containing AR1000 asphalt exhibit the same trend (599 micron overall average at 15 percent rubber, compared to 840 microns at 30 percent) but not to the extent as with AR4000 mixtures. Above trends can be seen in Figures Q6, Q7, and Q8.

Two-way ANOVA by rubber type shows that concentration is a significant effect for all rubber types except TPO27.

Two-way ANOVA by asphalt type shows that concentration is a significant effect for both AR1000 and AR4000 asphalts.

3.17.3.3 Effect of Asphalt. Examination of Figures Q3 through Q12 shows that with one exception mixtures containing AR4000 asphalt experienced less 30 minute first cycle creep than mixtures containing AR1000 asphalt (383 micron overall average for AR4000 compared to 592 microns for AR1000).

Two-way ANOVA by rubber type shows that asphalt is a significant effect for all rubber types investigated.

Two-way ANOVA by concentration shows that asphalt is a significant effect for all concentrations investigated.

3.18 Sliding Plate First Cycle Recovery (30 min.) at 32F (0C)

3.18.1 Measured and analyzed sliding plate first cycle recovery data are tabulated in Appendix R in Table R-1 and plotted in Figures R1 through R12.

3.18.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 13.1 percent compared to 16.8 percent for the U.S. Rubber Reclaiming rubber.

3.18.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	11.1%
●	TP027	-	15.5%
●	50/50 TP044/TP027	-	20.0%
●	GT274	-	15.4%
●	USRF	-	17.2%
●	50/50 GT274/USRF	-	16.43

3.18.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	20.4%
●	20%	-	15.6%
●	25%	-	13.0%
●	30%	-	10.9%

3.18.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 16.6 percent and for the AR1000, 19.2 percent.

3.18.1.5 Variability of measured sliding plate first cycle recovery (30 min.) data as indicated by coefficient of variation appears not to be influenced by rubber particle size, less for high rubber concentrations than for low, and not influenced by asphalt grade.

3.18.2 The ANOVA summary for sliding plate first cycle recovery (30 min.) is tabulated in Table R-2.

- 3.18.2.1 Rubber, concentration, asphalt, and rubber-concentration interaction, are significant effects at the 0.01 level. All other interactions are not significant at the 0.05 level.
- 3.18.3 Analyses indicate that rubber type, rubber concentration, asphalt, and the rubber-concentration interaction influence first cycle sliding plate recovery (30 min.) of asphalt-rubber mixtures.

3.18.3.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50/50 GT274/USRF rubber had the highest average 30 minute first cycle recovery (249 micron overall average) while the 50/50 TPO44/TPO27 mixtures had the lowest (140 micron overall average). Particle size within Atlos or U.S. Rubber Reclaiming rubbers does not appear to influence 30 minute first cycle recovery. U.S. Rubber Reclaiming mixtures had higher recovery (240 micron overall average) than Atlos mixtures (151 micron overall average).

3.18.3.2 Effect of Rubber Concentration. Examination of Figures R3 through R8 show that as rubber concentration increases 30 minute first cycle recovery increases for all rubber types and both asphalts (128 micron overall average at 15 percent rubber compared to 280 microns at 30 percent).

Two-way ANOVA by rubber type shows that concentration is a significant effect for all rubber types investigated.

Two-way ANOVA by asphalt shows that concentration is a significant effect for both AR1000 and AR4000 asphalts.

3.18.3.3 Effect of Asphalt. Examination of Figures R3 through R12 show that asphalt-rubber mixtures containing AR1000 asphalt experience more 30 minute first cycle recovery than mixtures containing AR4000 asphalt for all rubber types and concentrations.

Two-way ANOVA by rubber type shows that asphalt is a significant effect for all rubber types.

Two-way ANOVA by concentration shows that asphalt is a significant effect for all concentrations investigated.

3.19 Sliding Plate Second Cycle Creep (30 min.) at 32F (0C)

3.19.1 Measured and analyzed sliding plate second cycle creep data are tabulated in Appendix S in Table S-1 and plotted in Figures S1 through S12.

3.19.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 9.1 percent compared to 10.8 percent for the U.S. Rubber Reclaiming rubber.

3.19.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	9.2%
●	TP027	-	7.8%
●	50/50 TP044/TP027	-	10.4%
●	GT274	-	10.2%
●	USRF	-	11.8%
●	50/50 GT274/USRF	-	10.2%

3.19.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	8.8%
●	20%	-	13.4%
●	25%	-	12.0%
●	30%	-	5.7%

3.19.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 10.1 percent, and for the AR1000, 9.8 percent.

3.19.1.5 Variability of measured sliding plate second cycle creep (30 min.) data as indicated by coefficient of variation does not appear to be influenced by rubber particle size, rubber concentration, or asphalt grade.

3.19.2 The ANOVA summary for sliding plate second cycle creep (30 min.) is tabulated in Table S-2.

3.19.2.1 All main effects and interactions are significant at the 0.01 level except for the rubber-concentration-asphalt interaction which is significant at the 0.05 level but not at the 0.01.

3.19.3 Analyses indicate that rubber type, rubber concentration, asphalt, and all interactions influence second cycle sliding plate creep (30 min.) of asphalt-rubber mixtures.

3.19.3.1 Effect of Rubber Type. Asphalt-rubber mixtures containing 50/50 GT274/USRF rubber had the highest average 30 minute second cycle creep (479 micron overall average) while the TPO44 mixtures had the lowest (230 micron overall average). Data indicate that as rubber particle size increases, for both Atlos and U.S. Rubber Reclaiming rubbers, 30 minute second cycle creep may slightly decrease.

3.19.3.2 Effect of Rubber Concentration. Examination of Figures S3, S4, and S5 indicates for asphalt-rubber mixtures containing Atlos rubber and AR4000 asphalt, that as rubber concentration increases, 30 minute second cycle creep increases, while with AR1000 asphalt, the amount of creep remains approximately the same at all rubber concentrations.

Examination of Figures S6, S7, and S8 shows for asphalt-rubber mixtures containing U.S. Rubber Reclaiming rubber and both asphalts, that as rubber concentration increases, 30 minute second cycle creep increases (320 micron overall average at 15 percent rubber compared to 622 microns at 30 percent).

Two-way ANOVA by rubber type shows that concentration is a significant effect for all rubber types except TPO44.

Two-way ANOVA by asphalt shows that concentration is a significant effect for both AR1000 and AR4000 asphalts.

- 3.19.3.3 Effect of Asphalt. Examination of Figures S3 through S12 shows that with one exception mixtures containing AR4000 asphalt experienced less 30 minute second cycle creep than mixtures containing AR1000 asphalt (265 micron overall average for AR4000 compared to 451 microns for AR1000).

Two-way ANOVA by rubber type indicates asphalt is a significant effect for all rubber types.

Two-way ANOVA by concentration indicates asphalt is a significant effect at all concentrations investigated.

3.20 Sliding Plate Second Cycle Recovery (30 min.) at 32F (0C)

- 3.20.1 Measured and analyzed sliding plate second cycle recovery (30 min.) data are tabulated in Appendix T in Table T-1 and plotted in Figures T1 through T12.

- 3.20.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 11.5 percent compared to 16.2 percent for the U.S. Rubber Reclaiming rubber.

- 3.20.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

● TP044	-	9.8%
● TP027	-	9.9%
● 50/50 TP044/TP027	-	13.3%
● GT274	-	11.6%
● USRF	-	13.8%
● 50/50 GT274/USRF	-	20.0%

3.20.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	16.5%
●	20%	-	12.3%
●	25%	-	17.5%
●	30%	-	8.9%

3.20.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 15.3 percent and for the AR1000 10.9 percent.

3.20.1.5 Variability of measured sliding plate second cycle recovery (30 min.) data as indicated by coefficient of variation appears to be:

- not influenced by particle size
- possibly less for high rubber concentration than for low
- less for AR1000 than for AR4000 asphalt cement

3.20.2 The ANOVA summary for sliding plate second cycle recovery (30 min.) is tabulated in Table T-2.

3.20.2.1 Rubber, concentration, asphalt, and the rubber-concentration interaction are significant effects at the 0.01 level. The rubber-concentration-asphalt interaction is significant at the 0.05 level but not at 0.01. Rubber-asphalt and concentration-asphalt interactions are not significant at the 0.05 level.

3.20.3 Analyses indicate that rubber type, rubber concentration, asphalt, and several interactions influence second cycle sliding plate recovery (30 min.) of asphalt-rubber mixtures.

3.20.3.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50-50 GT274/USRF rubber had the highest average 30 minute second cycle recovery (275 micron overall average) while the TPO44 mixtures had the lowest (141 micron overall average). Particle size within Atlos or U.S. Rubber Reclaiming rubbers does not appear to affect 30 minute second cycle recovery. U.S. Rubber Reclaiming mixtures had higher recovery values (255 micron overall average) than Atlos mixtures (156 micron overall average).

- 3.20.3.2 Effect of Rubber Concentration. Examination of Figures T3 through T8 shows that as rubber concentration increases, 30 minute second cycle recovery increases for all rubber types and both asphalts (131 micron overall average at 15 percent rubber compared to 295 microns at 30 percent).

Two-way ANOVA by rubber type shows that concentration is a significant effect for all rubber types investigated.

Two-way ANOVA by asphalt shows that concentration is a significant effect for both AR1000 and AR4000 asphalts.

- 3.20.3.3 Effect of Asphalt. Examination of Figures T3 through T12 show asphalt-rubber mixtures containing AR1000 asphalt experience more 30 minute second cycle recovery than mixtures containing AR4000 asphalt for all rubber types and concentrations (144 micron overall average for AR4000 compared to 266 microns for AR1000).

Two-way ANOVA by rubber type shows that asphalt is a significant effect for all rubber types investigated.

Two-way ANOVA by concentration shows that asphalt is a significant effect for all concentrations investigated.

3.21 Sliding Plate Second Cycle Recovery (20 hour) at 32F (0C)

- 3.21.1 Measured and analyzed sliding plate second cycle recovery (20 hour) data are tabulated in Appendix U in Table U-1 and plotted in Figures U1 through U12.

- 3.21.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 21.3 percent compared to 29.2 percent for the U.S. Rubber Reclaiming rubber.

- 3.21.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:
- TP044 - 22.5%
 - TP027 - 19.0%
 - 50/50 TP044/TP027 - 22.6%
 - GT274 - 22.4%
 - USRF - 40.7%
 - 50/50 GT274/USRF - 24.5%
- 3.21.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:
- 15% - 39.0%
 - 20% - 31.5%
 - 25% - 19.5%
 - 30% - 13.0%
- 3.21.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 31.4 percent and for the AR1000, 19.1 percent.
- 3.21.1.5 Variability of measured sliding plate second cycle recovery (20 hour) data as indicated by coefficient of variation appears to be:
- not influenced by rubber particle size
 - less for high rubber concentration than for low
 - less for the AR1000 than the AR4000 asphalt cement
- 3.21.2 The ANOVA summary for sliding plate second cycle recovery (20 hour) is tabulated in Table U-2.
- 3.21.2.1 Rubber, concentration, asphalt, and rubber-concentration interaction are significant effects at the 0.01 level. The other interactions are not significant at the 0.05 level.
- 3.21.3 Analyses indicate that rubber type, rubber concentration, asphalt and the rubber-concentration interaction influence second cycle sliding plate recovery (20 hour) of asphalt-rubber mixtures.

- 3.21.3.1 Effect of Rubber Type. Asphalt-rubber mixtures containing USRF rubber had the highest average 20 hour second cycle recovery (493 micron overall average) while the TPO44 and 50/50 TPO44/TPO27 rubbers had the lowest (219 micron overall average for each). Particle size within Atlos rubber mixtures does not appear to influence 20 hour recovery at 15 and 20 percent rubber concentrations, but differences in mean values were noted at 25 and 30 percent concentrations.

For U.S. Rubber Reclaiming mixtures, as particle size increases 20 hour recovery decreases. U.S. Rubber Reclaiming mixtures had higher 20 hour recovery values (438 micron overall average) than Atlos mixtures (233 micron overall average).

- 3.21.3.2 Effect of Rubber Concentration. Examination of Figures U3 through U8 shows that as rubber concentration increases, 20 hour second cycle recovery increases for all rubber types and both asphalts (219 micron overall average at 15 percent rubber compared to 459 microns at 30 percent).

Two-way ANOVA by rubber type shows that concentration is a significant effect for all rubber types investigated.

Two-way ANOVA by asphalt shows that concentration is a significant effect for both AR1000 and AR4000 asphalts.

- 3.21.3.3 Effect of Asphalt. Examination of Figures U3 through U12 shows that asphalt-rubber mixtures containing AR1000 asphalt experience higher 20 hour second cycle recoveries than mixtures containing AR4000 asphalt for all rubber types and concentrations (252 micron overall average for AR4000 compared to 418 microns for AR1000).

Two-way ANOVA by rubber type shows that asphalt is a significant effect for all rubber types investigated.

Two-way ANOVA by concentration shows that asphalt is a significant effect at all concentrations investigated.

3.22 Sliding Plate Second Cycle Recovery (20 hour minus 30 min.) at 32F (0C)

3.22.1 Measured and analyzed sliding plate second cycle recovery (20 hour minus 30 min.) data are tabulated in Appendix V in Table V-1 and plotted in Figures V1 through V12.

3.22.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 61.9 percent compared to 61.6 percent for the U.S. Rubber Reclaiming rubber.

3.22.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	62.0%
●	TP027	-	62.9%
●	50/50 TP044/TP027	-	60.8%
●	GT274	-	58.3%
●	USRF	-	71.9%
●	50/50 GT274/USRF	-	54.7%

3.22.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	95.0%
●	20%	-	62.7%
●	25%	-	53.7%
●	30%	-	35.6%

3.22.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 68.9 percent and for the AR1000, 54.7 percent.

3.22.1.5 Variability of measured sliding plate second cycle recovery (20 hour minus 30 min.) data as indicated by coefficient of variation appears to be:

- not influenced by rubber particle size
- less for high rubber concentrations than for low
- less for the AR1000 than the AR4000 asphalt cement

3.22.2 The ANOVA summary for sliding plate second cycle recovery (20 hour minus 30 min.) is tabulated in Table V-2.

3.22.2.1 Rubber, concentration, and asphalt are significant effects at the 0.01 level. Rubber-concentration interaction is significant at the 0.05 level but not at the 0.01. The other interactions are not significant at the 0.05 level.

3.22.3 Analyses indicate that rubber type, rubber concentration, asphalt and the rubber-concentration interaction influence second cycle sliding plate recovery (20 hour minus 30 minute) of asphalt-rubber mixtures.

3.22.3.1 Effect of Rubber Type. Asphalt-rubber mixtures containing USRF rubber had the highest recovery between 30 minutes and 20 hours (240 micron overall average) while the 50-50 TPO44/TPO27 rubber had the lowest (64 micron overall average). Particle size within Atlos rubber does not appear to affect data. For U.S. Rubber Reclaiming mixtures, as particle size increases, 20 hour minus 30 minute recovery appears to decrease (240 micron overall average for USRF mixtures compared to 140 microns for GT274).

U.S. Rubber Reclaiming mixtures had higher 20 hour minus 30 minute recovery values (183 micron overall average) than Atlos mixtures (78 micron overall average).

- 3.22.3.2 Effect of Rubber Concentration. Examination of Figures V3 through V12 shows that consistent effects due to rubber concentration are not noted. With several mixtures, as concentration increases, 20 hour minus 30 minute recovery tends to increase, while with other mixtures, recovery tends to decrease.

Two-way ANOVA by rubber type shows that concentration is a significant effect only for TPO44 and 50/50 GT274/USRF rubbers.

Two-way ANOVA by asphalt shows that concentration is a significant effect only for AR4000 asphalt.

- 3.22.3.3 Effect of Asphalt. Examination of Figures V3 through V12 shows, that for most asphalt-rubber mixtures, mixtures which contained AR1000 asphalt had higher 20 hour minus 30 minute second cycle recovery than mixtures containing AR4000 asphalt (109 micron overall average for AR4000 compared to 153 microns for AR1000).

Two-way ANOVA by rubber type shows that asphalt is a significant effect only for TPO27 rubber.

Two-way ANOVA by concentration shows that asphalt is a significant effect only at 20 percent rubber.

3.23 Sliding Plate Elastic Rebound at 32F (0C)

- 3.23.1 Measured and analyzed sliding plate elastic rebound data are tabulated in Appendix W in Table W-1 and plotted in Figures W1 through W12.

- 3.23.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 10.6 percent compared to 19.0 percent for the U.S. Rubber Reclaiming rubber.

3.23.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	6.8%
●	TP027	-	11.6%
●	50/50 TP044/TP027	-	12.4%
●	GT274	-	17.6%
●	USRF	-	16.4%
●	50/50 GT274/USRF	-	15.1%

3.23.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	16.4%
●	20%	-	13.2%
●	25%	-	16.7%
●	30%	-	12.9%

3.23.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 12.5 percent and for the AR1000, 14.2 percent.

3.23.1.5 Variability of measured sliding plate elastic rebound data as indicated by coefficient of variation appears to be:

- less for Atlos rubber than U.S. Rubber Reclaiming,
- not influenced by rubber concentration, and
- not influenced by asphalt cement.

3.23.2 The ANOVA summary for sliding plate elastic rebound is tabulated in Table W-2.

3.23.2.1 Rubber, concentration, and asphalt are significant effects at the 0.01 level. All two-way interactions are significant at the 0.05 level but not at 0.01. The three-way interaction is not significant at the 0.05 level.

3.23.3 Analyses indicate that rubber type, rubber concentration, asphalt and several interactions influence sliding plate elastic rebound of asphalt-rubber mixtures.

- 3.23.3.1 Effect of Rubber Type. Asphalt-rubber mixtures containing TPO44 had the highest percent rebound (47.8 percent average) while mixtures containing U.S. Rubber Reclaiming rubber had the lowest (36.0 percent average for GT274, 36.6 percent for USRF, and 36.8 percent for the 50/50 GT274/USRF rubber).

For Atlos rubber, smaller rubber particles (TPO27) resulted in less rebound than the larger TPO44 rubber (40.4 percent for TPO27 compared to 47.8 percent for TPO44).

- 3.23.3.2 Effect of Rubber Concentration. Examination of Figures W3 through W8 shows that except for the 50/50 TPO44/TPO27 mixtures as rubber concentration increases percent rebound tends to increase (32.3 percent average at 15 percent rubber compared to 48.0 percent at 30 percent).

Two-way ANOVA by rubber type shows that concentration is a significant effect for all rubber types.

- 3.23.3.3 Effect of Asphalt. Examination of Figures W3 through W12 shows that for mixtures containing U.S. Rubber Reclaiming rubber, AR1000 mixtures experience more rebound than mixtures containing AR4000 asphalt (40.9 percent average for AR1000 compared to 32.0 percent for AR4000). For mixtures containing Atlos rubber, lesser differences exist in percent rebound of mixtures containing AR4000 and AR1000 asphalt (45.7 percent average for AR1000 compared to 43.9 percent for AR4000).

Two-way ANOVA by rubber type shows that asphalt is a significant effect for all rubbers except TPO44 and TPO27.

Two-way ANOVA by concentration shows that asphalt is significant at 15 and 25 percent rubber concentrations, but not at 20 and 30 percent.

3.24 Sliding Plate First Cycle Creep Coefficient S_m

3.24.1 Calculated creep coefficient S_m data are tabulated in Appendix X in Table X-1.

3.24.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 30.0 percent compared to 30.5 percent for the U.S. Rubber Reclaiming rubber.

3.24.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	40.2%
●	TP027	-	17.5%
●	50/50 TP044/TP027	-	37.6%
●	GT274	-	19.5%
●	USRF	-	63.7%
●	50/50 GT274/USRF	-	14.9%

3.24.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	40.2%
●	20%	-	26.2%
●	25%	-	22.3%
●	30%	-	32.4%

3.24.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 41.7 percent and for the AR1000 22.8 percent.

3.24.1.5 Variability of calculated creep coefficient S_m data as indicated by coefficient of variation appears to vary widely with rubber type and concentration, but without exhibiting any trends with respect to particle size or increasing concentration. Variability of data for AR4000 mixtures is greater than that of AR1000 mixtures.

3.24.2 Numerous attempts were made to transform the creep coefficient S_m data in order to comply with variance homogeneity requirements, but all were unsuccessful. Therefore, ANOVA could not be performed with the data. The following discussion is based only on average data from Table X-1. Data were not plotted.

3.24.2.1 Average creep coefficient S_m for asphalt-rubber mixtures containing Atlos rubber is 0.126 compared to 0.227 for U.S. Rubber Reclaiming rubber mixtures. Average creep coefficient S_m does not vary widely (Atlos - 0.135 for TPO44, 0.127 for TPO27, and 0.115 for the 50/50 TPO44/TPO27 mixture; U.S. Rubber Reclaiming - 0.200 for GT274, 0.264 for USRF, and 0.216 for the 50/50 GT274/USRF mixture).

3.24.2.2 For Atlos rubber mixtures, as rubber concentration increases, creep coefficient S_m tends to increase (0.099 overall average at 15 percent rubber compared to 0.187 at 30 percent rubber). Creep coefficients S_m for asphalt-rubber mixtures containing U.S. Rubber Reclaiming rubber do not appear to be influenced by rubber concentration to the extent as Atlos rubber mixtures (0.246 overall average at 15 percent rubber compared to 0.253 at 30 percent).

3.24.2.3 Average creep coefficient S_m for mixtures containing AR4000 is 0.157 compared to 0.195 for AR1000.

3.25 Sliding Plate First Cycle Creep Coefficient b

3.25.1 Calculated and analyzed creep coefficient b data are tabulated in Appendix Y in Table Y-1.

3.25.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 27.5 percent compared to 37.6 percent for the U.S. Rubber Reclaiming rubber.

3.25.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

● TP044	-	14.8%
● TP027	-	31.8%
● 50/50 TP044/TP027	-	36.3%
● GT274	-	37.8%
● USRF	-	47.8%
● 50/50 GT274/USRF	-	27.2%

- 3.25.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:
- | | | | |
|---|-----|---|-------|
| ● | 15% | - | 48.0% |
| ● | 20% | - | 34.5% |
| ● | 25% | - | 27.5% |
| ● | 30% | - | 20.2% |
- 3.25.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 32.2 percent and for the AR1000, 33.1 percent.
- 3.25.1.5 Variability of calculated creep coefficient b data as indicated by coefficient of variation is lowest for TPO44 mixtures, but otherwise does not appear to be influenced by rubber type, tends to decrease as rubber concentration increases, and does not appear to be influenced by asphalt type.
- 3.25.2 The ANOVA summary for creep coefficient b data is tabulated in Table Y-2.
- 3.25.2.1 Rubber and concentration are significant at the 0.01 level. Rubber-concentration interaction and rubber-asphalt interaction are significant at the 0.05 level but not at 0.01. Asphalt and other interactions are not significant at the 0.05 level.
- 3.25.3 Analysis indicates that rubber type, concentration and two interactions influence creep coefficient b data.
- 3.25.3.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50/50 TPO44/TPO27 rubber mixture had the highest creep coefficient b (0.265 overall average) while GT274 mixtures had the lowest (0.157 overall average).
- Average creep coefficient b for Atlos rubber mixtures was 0.228 compared to 0.171 for U.S. Rubber Reclaiming mixtures.
- 3.25.3.2 Effect of Rubber Concentration. For Atlos rubber mixtures lowest creep coefficient b was at 25 percent rubber (0.130 average) and highest at 30 percent rubber (0.262 average).

For U.S. Rubber Reclaiming mixtures, as concentration increases, creep coefficient b increases (0.139 average at 15 percent rubber compared to 0.220 at 30 percent).

- 3.25.3.3 Effect of Asphalt. Asphalt grade was determined not to influence creep coefficient b of asphalt-rubber mixtures tested.

3.26 Sliding Plate First Cycle Creep Coefficient n

- 3.26.1 Calculated and analyzed creep coefficient n data is tabulated in Appendix Z in Table Z-1.

- 3.26.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 14.3 percent compared to 12.0 percent for the U.S. Rubber Reclaiming rubber.

- 3.26.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	-	13.9%
●	TP027	-	10.2%
●	50/50 TP044/TP027	-	25.5%
●	GT274	-	12.1%
●	USRF	-	12.6%
●	50/50 GT274/USRF	-	7.5%

- 3.26.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	17.2%
●	20%	-	13.9%
●	25%	-	14.8%
●	30%	-	6.7%

- 3.26.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 14.9 percent and for the AR1000 11.2 percent.

- 3.26.1.5 Variability of calculated creep coefficient n data as indicated by coefficient of variation does not appear to be influenced by rubber type or asphalt grade, but tends to decrease as rubber concentration increases.

3.26.2 The ANOVA summary for creep coefficient n data is tabulated in Table Z-2.

3.26.2.1 Concentration and the rubber-asphalt interaction are significant effects at the 0.01 level. All other main effects and interactions are not significant.

3.26.3 Analysis indicates that rubber concentration and the rubber-asphalt interaction influence creep coefficient n data.

3.26.3.1 Effect of Rubber Concentration. Overall average creep coefficient n for asphalt-rubber mixtures tested is 0.725. The highest creep coefficient n value is obtained at 20 percent rubber (0.796 overall average) and lowest at 30 percent rubber (0.674 overall average).

3.27 Sliding Plate First Cycle Recovery Coefficient S_m

3.27.1 Calculated recovery coefficient S_m data are tabulated in Appendix AA in Table AA-1.

3.27.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 20.4 percent compared to 26.9 percent for the U.S. Rubber Reclaiming rubber.

3.27.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

● TP044	-	29.7%
● TP027	-	15.1%
● 50/50 TP044/TP027	-	18.9%
● GT274	-	21.9%
● USRF	-	26.2%
● 50/50 GT274/USRF	-	34.9%

3.27.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

● 15%	-	39.7%
● 20%	-	30.1%
● 25%	-	10.9%
● 30%	-	13.7%

- 3.27.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 28.5 percent and for the AR1000 20.6 percent.
- 3.27.1.5 Variability of calculated recovery coefficient S_m data as indicated by coefficient of variation does not appear to be affected by rubber type, tends to decrease as rubber concentration increases, and may be less for AR1000 than AR4000 asphalt.
- 3.27.2 Numerous attempts were made to transform recovery coefficient S_m data in order to comply with variance homogeneity requirements, but all were unsuccessful. Therefore, ANOVA could not be performed with the data. The following discussion is based only on average data from Table AA-1. Data were not plotted.

- 3.27.2.1 Average recovery coefficient S_m for Atlos rubber mixtures is 0.079 compared to U.S. Rubber Reclaiming mixtures, 0.130.

Within Atlos rubber mixtures average recovery coefficient S_m does not vary widely (0.081 for TPO44, 0.80 for TPO27, and 0.075 for the 50/50 TPO44/TPO27 mixture). Recovery coefficients S_m of U.S. Rubber Reclaiming mixtures vary to a greater extent (0.109 for GT274, 0.134 for USRF, and 0.148 for the 50/50 GT274/TPO27 mixtures).

- 3.27.2.2 For Atlos rubber mixtures, average recovery coefficient S_m does not vary with rubber concentration as much as with U.S. Rubber Reclaiming mixtures.

For U.S. Rubber Reclaiming mixtures as rubber concentration increases, average recovery coefficient S_m increases (0.097 at 15 percent rubber compared to 0.181 at 30 percent rubber).

- 3.27.2.3 For all rubber types and concentrations, asphalt-rubber mixtures containing AR4000 asphalt have lower average recovery coefficients S_m than mixtures containing AR1000 asphalt (0.078 overall average for AR4000 compared to 0.131 for AR1000).

3.28 Sliding Plate First Cycle Recovery Coefficient b

3.28.1 Calculated and analyzed recovery coefficient b data are tabulated in Appendix BB in Table BB-1.

3.28.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 22.7 percent compared to 24.1 percent for the U.S. Rubber Reclaiming rubber.

3.28.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:

●	TP044	--	22.0%
●	TP027	--	26.2%
●	50/50 TP044/TP027	--	18.2%
●	GT274	--	18.3%
●	USRF	--	30.0%
●	50/50 GT274/USRF	--	25.4%

3.28.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:

●	15%	-	39.0%
●	20%	-	20.3%
●	25%	-	17.0%
●	30%	-	17.3%

3.28.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 19.8 percent and for the AR1000 27.6 percent.

3.28.1.5 Variability of calculated recovery coefficient b data as indicated by coefficient of variation does not appear to be affected by rubber type, decreases as rubber concentration increases, and is less for AR4000 mixtures than AR1000 mixtures.

3.28.2 The ANOVA summary for recovery coefficient b is tabulated in Table BB-2.

3.28.2.1 Rubber type, concentration, and asphalt are significant effects at the 0.01 level. The rubber-concentration-asphalt interaction is significant at the 0.05 level but not at 0.01. All two-way interactions are not significant at the 0.05 level.

3.28.3 Analyses indicate that rubber type, rubber concentration, asphalt, and one interaction influence recovery coefficient b data.

3.28.3.1 Effect of Rubber Type. Asphalt-rubber mixtures containing the 50/50 TPO44/TPO27 mixture had the highest average recovery coefficient b (0.183 overall average) while the GT274 mixtures had the lowest (0.125 overall average).

Mixtures containing Atlos rubber had higher average recovery coefficient b (0.166 overall average) than U.S. Rubber Reclaiming mixtures (0.130 overall average).

Within both Atlos and U.S. Rubber Reclaiming rubber mixtures recovery coefficient b data do not vary greatly with rubber size (Atlos - 0.166 overall average for TPO44, 0.148 for TPO27, and 0.183 for the 50/50 TPO44/TPO27 mixture; U.S. Rubber Reclaiming - 0.125 for GT274, 0.130 for USRF, 0.136 for the 50/50 GT274/USRF mixture).

3.28.3.2 Effect of Rubber Concentration. For asphalt-rubber mixtures containing Atlos rubber, as rubber concentration increases, average recovery coefficient b tends to increase (0.150 average at 15 percent rubber as compared to 0.178 at 30 percent).

Average recovery coefficient b of mixtures containing U.S. Rubber Reclaiming rubber tends to increase to a greater extent as rubber concentration increases (0.088 average at 15 percent rubber compared to 0.164 at 30 percent) than with Atlos rubber.

3.28.3.3 Effect of Asphalt. Average recovery coefficient b for mixtures containing AR4000 asphalt was lower than for mixtures containing AR1000 (0.135 overall average for AR4000 compared to 0.161 for AR1000).

3.29 Sliding Plate First Cycle Recovery Coefficient n

3.29.1 Calculated creep coefficient n data are tabulated in Appendix CC in Table CC-1.

- 3.29.1.1 Average coefficient of variation for Atlos rubber at all concentrations and both asphalts was 15.6 percent compared to 19.5 percent for the U.S. Rubber Reclaiming rubber.
- 3.29.1.2 Average coefficients of variation for each rubber type at all concentrations and for both asphalts are:
- | | | | |
|---|-------------------|---|-------|
| ● | TP044 | - | 13.3% |
| ● | TP027 | - | 21.5% |
| ● | 50/50 TP044/TP027 | - | 12.5% |
| ● | GT274 | - | 24.8% |
| ● | USRF | - | 13.5% |
| ● | 50/50 GT274/USRF | - | 20.0% |
- 3.29.1.3 Average coefficients of variation for each rubber concentration for all rubber types and both asphalts are:
- | | | | |
|---|-----|---|-------|
| ● | 15% | - | 32.8% |
| ● | 20% | - | 13.2% |
| ● | 25% | - | 11.9% |
| ● | 30% | - | 12.3% |
- 3.29.1.4 Average coefficient of variation for all mixtures containing AR4000 asphalt was 20.8 percent, and for the AR1000, 15.1 percent.
- 3.29.1.5 Variability of calculated recovery coefficient n data as indicated by coefficient of variation does not appear to be greatly influenced by rubber type, or asphalt grade, but appears to decrease as rubber concentration increases.
- 3.29.2 Numerous attempts were made to transform recovery coefficient n data in order to comply with variance homogeneity requirements, but all were unsuccessful. Therefore, ANOVA could not be performed on the data. The following discussion is based only on average data from Table CC-1. Data were not plotted.

- 3.29.2.1 Average recovery coefficient n for Atlos rubber mixtures is 0.767 compared to 0.740 for U.S. Rubber Reclaiming mixtures. Within both Atlos and U.S. Rubber Reclaiming rubber types, recovery coefficient n does not appear to vary with rubber size (Atlos - 0.783 average for TPO44, 0.779 for TPO27, and 0.738 for the 50/50 TPO44/TPO27 mixtures; U.S. Rubber Reclaiming - 0.767 for GT274, 0.783 for USRF, and 0.672 for the 50/50 GT274/USRF mixture).
 - 3.29.2.2 Average recovery coefficient n data do not appear to vary with rubber concentration for either Atlos or U.S. Rubber Reclaiming mixtures (0.735 overall average at 15 percent rubber compared to 0.753 at 30 percent).
 - 3.29.2.3 Average recovery coefficient n data do not appear to vary with asphalt grade (0.768 overall average for AR4000 compared to 0.739 for AR1000).
- 3.30 Arizona Torque Fork Viscosity During Mixing at 375F (191C)
- 3.30.1 Measured mixing viscosity data at 15 minutes and 1 hour by the Torque Fork are tabulated in Appendix DD in Table DD-1. Since mixtures were not replicated, statistical analysis could not be performed.
 - 3.30.2 Measured mixing viscosity data are plotted in Appendix DD in Figures DD1 through DD12.
 - 3.30.3 From Figures DD1 through DD6, it can be seen that as rubber concentration increases for all rubber types and both asphalts, viscosity as measured by the Torque-Fork at both 15 minutes and 1 hour of mixing increases. These viscosity increases are the result of increased internal friction in the mixture due to increased particle-to-particle contact as rubber concentration increases. Average viscosities at 15 minutes are 13.2 poise at 15 percent rubber compared to 87.3 poise at 30 percent rubber. Average one hour viscosities are 15.3 poise at 15 percent rubber compared to 154.3 poise at 30 percent.

3.30.4 Examination of Figures DD7 through DD12 shows that for all mixtures investigated viscosities at 1 hour of mixing were higher than at 15 minutes indicating that mixtures become thicker during extended periods of mixing at 375F. Greater increases in viscosity between 15 minutes and 1 hour of mixing are noted at higher rubber concentrations than low. Asphalt-rubber mixtures containing U. S. Rubber reclaiming rubbers experienced greater viscosity increases at 25 and 30 percent rubber than mixtures containing Atlos rubber.

3.31 Haake Viscosity During Mixing at 375F (191C)

3.31.1 Measured mixing viscosity data at 15 minutes and 1 hour by the Haake viscometer are tabulated in Appendix EE in Table EE-1. Since readings were not replicated, statistical analyses could not be performed.

3.31.2 Measured mixing viscosity data are plotted in Appendix EE in Figures EE1 through EE12.

3.31.3 From Figures EE1 through EE6, it can be seen that as rubber concentration increases for all rubber types and both asphalts, viscosity as measured by the Haake viscometer at both 15 minutes and 1 hour of mixing increases. Increases in viscosity is due to increased interval friction as rubber concentration increases. Average Haake viscosity at 15 minutes mixing are 9.8 poise for 15 percent rubber compared to 260 poise for 30 percent rubber. After one hour of mixing, average Haake viscosity at 15 percent rubber is 18.9 poise compared to 294 poise at one hour.

3.31.4 Examination of Figures EE7 through EE12 shows, that with several exceptions, Haake viscosities increase between 15 minutes and one hour of mixing. Additionally, it is noted that the highest viscosities during mixing are obtained with U.S. Rubber Reclaiming rubbers than with Atlos rubbers.

- 3.31.5 Figure 8 is a plot of mixture viscosity as measured by the Torque-Fork versus viscosity as measured by the Haake viscometer. Data at both 15 minutes and 1 hour is plotted. From Figure 8, it is noted that the Haake viscometer measures a higher viscosity than the Torque-Fork. Linear regression of the data yields the following relationship:

$$H = -6.53 + 2.62 (TF)$$

in which

H = Haake viscosity at 375F, Poise

TF = Torque-Fork viscosity at 375F and 500 RPM,
Poise

The r^2 value for this fit is 0.72. The fit, as indicated by the F test, is highly significant at the 0.01 level.

- 3.31.6 Differences which exist in viscosities as measured by the Torque-Fork and Haake may be due to the different rotational speeds of the two devices (500 RPM for the Torque-Fork and 62.5 RPM for the Haake).

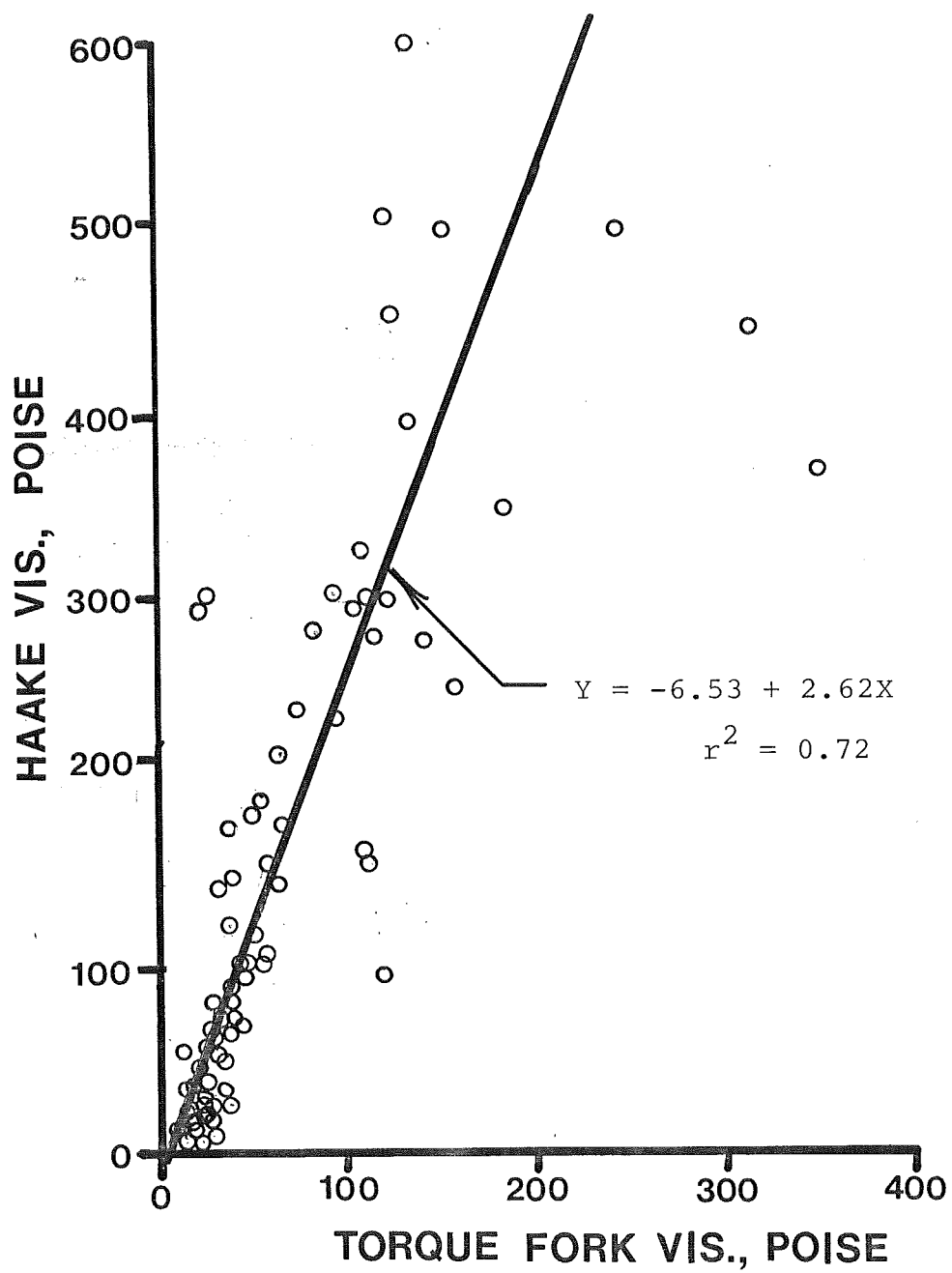


Figure 8 Torque-Fork Versus Haake Viscosity Relationship

4.0 CONCLUSIONS

4.1 A summary of three-way ANOVA results is tabulated in Table 1. This table indicates independent variables and interactions which were found to significantly affect test parameters studied during this investigation. From Table 1 it is easily seen that constituent materials in an asphalt-rubber mixture, rubber type and concentration, and asphalt, significantly influence many of the test parameters considered in this study.

4.2 The following specific conclusions are based on test results, statistical analyses, and interpretation performed during this study.

4.2.1 Results indicate that the absolute viscosity at 140F (60C) of asphalt-rubber mixtures is different for mixtures containing different rubber types and particle sizes, different rubber concentrations, and different asphalt grades. Variability of test results is high (coefficients of variation of 20 percent were common during testing) even with the large capillary tube bore sizes utilized. Data generated tend to indicate that increasing rubber particle size and concentration may increase testing variability.

Test results varied from a low of 7,636 poises to a high of 691,256 poises for different formulations.

4.2.2 Shear susceptibility and apparent viscosity of asphalt-rubber mixtures as measured by the Schweyer Rheometer at 39.2F (4C) were found to be different for different rubber types and sizes and concentration. Asphalt grade did not influence shear susceptibility, but did influence apparent viscosity.

Testing variability for the parameters considered was high (many coefficients of variation in excess of 25 percent for shear susceptibility and 50 percent for apparent viscosity). Data indicate that rubber particle size may influence testing variability. Test results for larger rubbers (TPO44) are more variable than with smaller rubbers (USRF). These differences may be due to increased flow interference as particle size increases.

Table 1 Summary of Three-Way ANOVA Results
at the 0.05 Level of Significance

	TEST PARAMETER						
	EFFECT						
	R	Q	A	RQ	RA	QA	RQA
ABSOLUTE VISCOSITY (140F)	Y*	Y	Y	Y	Y	-	Y
SCHWEYER RHEOMETER (39.2F)							
Constant(C), G-tube	Y	Y	-	-	-	-	-
Constant(C), F-tube	Y	Y	-	Y	Y	-	Y
App. Viscosity, G-tube	Y	-	Y	-	-	-	-
App. Viscosity, F-tube	Y	Y	Y	Y	Y	-	-
FORCE DUCTILITY (39.2F)							
Load at Failure	Y	Y	Y	Y	Y	Y	Y
Elongation at Failure	Y	Y	Y	Y	-	Y	Y
Eng. Stress at Failure	Y	Y	Y	Y	Y	Y	-
Eng. Strain at Failure	Y	Y	Y	Y	-	Y	Y
True Stress at Failure	Y	Y	Y	Y	-	Y	-
True Strain at Failure	Y	Y	Y	Y	-	Y	Y
Eng. Creep Compliance	Y	Y	Y	Y	Y	Y	Y
True Creep Compliance	Y	Y	Y	Y	Y	Y	Y
Max.True Creep Compliance	Y	Y	Y	Y	Y	Y	Y
Time to Max.T.Creep Compl.	Y	Y	Y	Y	-	Y	-
SLIDING PLATE MICRO-VISCOMETER (32F)							
App. Viscosity	Y	Y	Y	Y	Y	Y	Y
1st Cycle 30 min. Creep	Y	Y	Y	Y	-	Y	-
1st Cycle 30 min.Recovery	Y	Y	Y	Y	-	-	-
2nd Cycle 30 min. Creep	Y	Y	Y	Y	Y	Y	Y
2nd Cycle 30 min.Recovery	Y	Y	Y	Y	-	-	Y
2nd Cycle 20 hr. Recovery	Y	Y	Y	Y	-	-	-
2nd Cyc.20 hr.30 min.Recov.	Y	Y	Y	Y	-	-	-
1st Cycle % Rebound	Y	Y	Y	Y	Y	Y	-
1st Cycle b	Y	Y	-	Y	Y	-	-
1st Cycle n	-	Y	-	-	Y	-	-
2nd Cycle b	Y	Y	Y	-	-	-	Y

*NOTE: Y = Significant at the 0.05 level
- = Not significant at the 0.05 level

Asphalt-rubber mixtures tested tended to be more pseudoplastic in nature than dilatant as indicated by the Schwyer Rheometer.

Viscosity of mixtures tested varied from a low of 17.5×10^6 Pa-s to a high of $55,210 \times 10^6$ Pa-s for different formulations.

- 4.2.3 Stress, strain, and creep compliance characteristics of asphalt-rubber mixtures, as measured by the force-ductility test at 39.2F (4C) were found to be different for mixtures containing different rubber types and particle sizes, different rubber concentrations, and different asphalt grades. Testing variability for many of the parameters considered was rather low, coefficients of variation were generally less than 10 percent, when compared to other test types considered. It is suggested that lower testing variability is related to the unconfined tensile nature of the test which would not result in rubber particle interference with testing apparatus as with absolute viscosity, Schwyer Rheometer, or sliding plate microviscometer testing.

True stress at failure varied from a low of 296 psi to a high of 1279 psi while true strain at failure varied from 1.41 mm/mm to 2.46 mm/mm for different formulations.

- 4.2.4 Apparent viscosity, creep, recovery, and rebound characteristics of asphalt-rubber mixtures, as measured by the sliding plate microviscometer, were found to be different for different rubber types and particle sizes, different rubber concentrations, and different asphalts. Interactions between mixture components were identified by several of the measurements. Testing variability was rather low (less than 15 percent coefficients of variation) for several of the parameters - second cycle creep and recovery, and first cycle percent rebound and creep, but high (coefficients of variation between 15 and 50 percent) for others.

- 4.2.5 Viscosity during mixing at 375F (191C) as measured to Arizona Torque-Fork or Haake Viscometer of asphalt-rubber varies depending on rubber types, rubber concentration, and asphalt type. The reaction between rubber and asphalt can be monitored during mixing using either device by monitoring mixture viscosity changes. A significant relationship between Haake and Torque-Fork viscosity measurements was found to exist.
- 4.3 The following general conclusions were reached based on results of this study.
 - 4.3.1 Physical properties of asphalt-rubber mixtures from 32F (0C) to 375F (191C) can vary widely and depend on the type of rubber utilized, rubber concentration, and asphalt grade.
 - 4.3.2 The force-ductility test is the most sensitive to changes in mixture components and is the least variable test investigated in this study.

References

1. Rosner, J. C. and Chehovits, J. G., "Chemical And Physical Properties Of Asphalt-Rubber Mixtures - Phase III - Summary Report," Research Project Arizona HPR 1-19 (159), Arizona Department of Transportation, April 1982.
2. Burr, I. W. and Foster, L. A., "A Test for Equality of Variances," Mimeograph Series No. 282, Statistics Department, Purdue University, Layfayette, Indiana, 1972.

USE OF APPENDICES

Data generated during this portion of the experiment are presented in both tabular and graphical form. Due to the size of the test matrix (Figure 1), data are tabulated and summarized by rubber type in each appendix in a format shown in Figure 9. Data are summarized by computing the cell mean ($\bar{x}$), cell standard deviation (s), and cell coefficient of variation (cv). At the bottom of each page of tables, a small reproduction of the overall test matrix is shown with the position of the rubber type for which data are presented heavily outlined.

Data which are tabulated and summarized are:

- Measured data which may consist of up to three observations per cell replication.
- Reduced data which consist of averages of measured observations for each cell replication.
- Analyzed data which are the data for input for analyses of variance. In many cases, transformations were required.

Due to the number of measured data observations and transformation requirements, in many cases, measured data are the same as reduced data, and possibly even analyzed data. Tables are numbered by data type presented, and carry the same number for each of the six rubber types. Therefore, each table which presents data is six pages in length. Analysis of variance summaries for the analyzed data are the last tables presented in each appendix.

Reduced data and, transformed data (when present) are plotted as follows:

- Full test matrix, means plus and minus two standard deviations
- Full test matrix, means only
- Data for each rubber type, means plus and minus two standard deviations
- Data for each rubber concentration, means plus and minus two standard deviations.

Asphalt Type (A)
Percent Rubber (Q)
Rubber Type (R)

a. Measured Data

TP 044				
	15%	20%	25%	30%
A R 4 0 0 0	_____	_____	_____	_____
A A R 1 0 0 0	_____	_____	_____	_____

Asphalt Type (A)

Percent Rubber (Q)

Rubber Type (R)

b. Summary

TP 044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	_____	_____	_____	_____
	s	_____	_____	_____	_____
	cv	_____	_____	_____	_____
A R 1 0 0 0	$\bar{X}$	_____	_____	_____	_____
	s	_____	_____	_____	_____
	cv	_____	_____	_____	_____

FIGURE 9 Data Presentation Format

APPENDIX A
VACUUM CAPILLARY ABSOLUTE
VISCOSITY AT 140F (60C)

a. Measured Data

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>7684</u>	<u>49402</u>	<u>147731</u>	<u>375964</u>
	S	<u>1833.19</u>	<u>37783.58</u>	<u>59654.07</u>	<u>449819.24</u>
	CV	23.86	76.48	40.38	119.64
A R 1 0 0 0	$\bar{x}$	<u>8463</u>	<u>16764</u>	<u>68561</u>	<u>310117</u>
	S	<u>2365.36</u>	<u>9037.66</u>	<u>52005.89</u>	<u>277461.29</u>
	CV	27.95	53.91	75.85	89.47

[illegible]

Table A-1 Absolute Viscosity (140F), Poise

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	13,413	36,668	134,355	479,333
	12,460	40,387	132,946	374,524
	16,660	35,271	137,474	392,809
	19,444	35,416	140,170	370,771
A R 1 0 0 0	7,684	30,057	88,444	276,687
	7,554	29,503	134,792	334,791
	7,895	24,143	79,420	295,017
	7,409	21,709	66,047	309,811

b. Summary

		TP027			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>15494</u>	<u>36936</u>	<u>13236</u>	<u>404359</u>
	S	<u>3394.22</u>	<u>2486.38</u>	<u>3510.86</u>	<u>52761.13</u>
	CV	21.91	6.73	2.58	13.05
A R 1 0 0 0	$\bar{x}$	<u>7636</u>	<u>26353</u>	<u>92176</u>	<u>304077</u>
	S	<u>236.20</u>	<u>4057.13</u>	<u>33410.07</u>	<u>28238.54</u>
	CV	3.09	15.40	36.25	9.29

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP046				TP027				60% TP046 40% TP027				RT076				U.S. Rubber Firm				60% RT076 40% U.S. Rubber Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Asphalt	100																																				
	200																																				
Rubber	100																																				
	200																																				

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	10,859	58,043	91,724	557,059
	<u>15,518</u>	<u>78,353</u>	<u>107,232</u>	<u>293,415</u>
	19,883	63,660	118,567	403,089
	24,475	40,905	95,976	210,458
A R 1 0 0 0	9,745	32,251	78,287	333,427
	<u>9,211</u>	<u>50,957</u>	<u>90,483</u>	<u>273,118</u>
	8,425	35,499	86,563	469,984
	7,996	29,188	83,542	343,975

b. Summary

		50% TP044 & 50% TP027			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>17684</u>	<u>60240</u>	<u>103375</u>	<u>366005</u>
	s	<u>6617.38</u>	<u>18199.73</u>	<u>13045.70</u>	<u>168448.09</u>
	cv	37.42	30.21	12.62	46.02
A R 1 0 0 0	$\bar{x}$	<u>8844</u>	<u>36974</u>	<u>84719</u>	<u>355126</u>
	s	<u>850.01</u>	<u>10579.73</u>	<u>5927.26</u>	<u>95676.88</u>
	cv	9.61	28.61	7.00	26.94

[illegible]

Table A-1 Absolute Viscosity (140F), Poise

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	219,174	57,678	148,695	355,810
	<u>23,118</u>	<u>59,360</u>	<u>139,532</u>	<u>379,741</u>
	19,959	58,363	149,752	391,745
	22,597	63,662	148,516	299,739
A R 1 0 0 0	17,128	30,421	96,104	230,175
	<u>19,274</u>	<u>35,608</u>	<u>112,326</u>	<u>219,715</u>
	15,760	42,063	85,615	218,015
	15,643	23,686	27,257	195,420

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>71212</u>	<u>59766</u>	<u>146624</u>	<u>356759</u>
	s	<u>96818.49</u>	<u>2908.22</u>	<u>4966.92</u>	<u>44714.92</u>
	cv	135.96	4.87	3.39	12.53
A R 1 0 0 0	$\bar{x}$	<u>16951</u>	<u>32945</u>	<u>80326</u>	<u>215831</u>
	s	<u>1764.67</u>	<u>8931.22</u>	<u>41343.53</u>	<u>16890.93</u>
	cv	10.41	27.11	51.47	7.83

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (R)

	TP044			TP027			50% TP044 & 50% TP027			GT274			U.S. Rubber Fine			50% GT274 & 50% U.S. Rubber Fine		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Asphalt Type	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Percent Rubber	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rubber Type	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

a. Measured Data

b. Summary

		U. S. RUBBER FINE			
		15%	20%	25%	30%
A R 4 0 0 0	-x	<u>30529</u>	<u>114301</u>	<u>231928</u>	<u>381204</u>
	s	<u>4378.37</u>	<u>25220.00</u>	<u>66250.06</u>	<u>81057.51</u>
	cv	14.34	22.06	28.56	21.26
A R 1 0 0 0	-x	<u>18242</u>	<u>64988</u>	<u>273542</u>	<u>691256</u>
	s	<u>2724.03</u>	<u>16138.12</u>	<u>36049.05</u>	<u>66102.32</u>
	cv	14.93	24.83	13.18	9.56

[illegible]

Table A-1 Absolute Viscosity (140F), Poise

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	28,156	65,415	232,064	365,024
	28,452	60,449	215,537	352,473
	29,439	83,961	148,237	463,143
	27,685	72,315	146,220	349,019
A R 1 0 0 0	17,721	41,338	192,904	281,463
	17,258	43,183	211,064	289,109
	15,263	45,403	93,172	394,542
	14,272	45,724	98,305	452,334

b. Summary

50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	28433	70535	185515	382415
	S	741.31	11426.83	41720.18	55464.26
	CV	2.61	16.20	22.49	14.50
A R 1 0 0 0	$\bar{x}$	16129	43912	148861	354362
	S	1676.21	2131.60	57295.51	83043.31
	CV	10.39	4.85	38.49	23.43

		ASPHALT TYPE (A)									PERCENT RUBBER (B)									RUBBER TYPE (B)																			
		TPD44			TPD57			50% TPD44 & 50% TPD57			GT274			U.S. Rubber Fine			50% GT274 & 50% U.S. Rubber Fine																						
		15	25	30	15	25	30	15	25	30	15	25	30	15	25	30	15	25	30	15	25	30	15	25	30	15	25	30	15	25	30	15	25	30	15	25	30		
RUBBER TYPE (B)	TPD44																																						
	TPD57																																						
	50% TPD44 & 50% TPD57																																						
	GT274																																						
	U.S. Rubber Fine																																						
	50% GT274 & 50% U.S. Rubber Fine																																						

a. Analyzed Data

b. Summary

[illegible]

Table A-2 Absolute Viscosity (140F), Poise

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	12,937	38,528	133,651	426,929
	18,052	35,344	138,822	381,790
A R 1 0 0 0	7,619	29,780	111,618	305,739
	7,652	22,926	72,734	302,414

b. Summary

		TP027			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>15,494</u>	<u>36,936</u>	<u>136,236</u>	<u>404,359</u>
	s	<u>4,531</u>	<u>2,821</u>	<u>4,588</u>	<u>39,993</u>
	cv	29.24	7.64	3.4	9.9
A R 1 0 0 0	$\bar{x}$	<u>7,636</u>	<u>26,353</u>	<u>92,176</u>	<u>304,076</u>
	s	<u>29.2</u>	<u>6,072</u>	<u>34,451</u>	<u>29,046</u>
	cv	0.4	23.04	37.4	1.0

ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)															
TP044				TP027				50% TP044 & 50% TP027				GT374				U.S. Rubber Firm				50% B7974 & 50% B7966			
15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30

Table A-2 Absolute Viscosity (140F), Poise

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	13,189	68,198	99,478	425,237
	22,179	52,283	107,272	306,774
A R 1 0 0 0	9,478	41,604	84,385	303,273
	8,211	32,344	85,053	406,980

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	17,684	60,240	103,375	366,005
	s	7,965	14,100	6,905	104,958
	cv	45.04	23.4	6.7	28.7
A R 1 0 0 0	$\bar{x}$	8,845	36,974	84,719	355,127
	s	1,123	8,204	592	91,884
	cv	12.7	22.2	0.7	25.9

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				50% TP044 & 50% TP027				GT27E				U.S. Rubber Fms				50% GT27E & 50% R Fms															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30				
Viscosity	140F																																				
	100F																																				
Density-150																																					

Table A-2 Absolute Viscosity (140F), Poise

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	121,146	58,519	144,114	367,776
	21,278	61,013	149,134	345,742
A R 1 0 0 0	18,201	33,015	104,215	224,945
	15,702	32,875	56,436	206,718

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	71,212	59,766	146,624	356,759
	s	88,483	2,209	4,447	19,522
	cv	1.24	3.70	3.0	5.5
A R 1 0 0 0	$\bar{x}$	16,951	32,945	80,326	215,831
	s	2,214	124	42,332	16,149
	cv	13.0	0.4	52.7	7.5

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP644				TP637				50% TP644 & 50% TP637 *				GT274				U.S. Rubber Firm				50% GT274 50% R.F. Inc.															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
GRADE	100																																				
	200																																				
GRADE	300																																				
	400																																				
GRADE	500																																				
	600																																				
GRADE	700																																				
	800																																				
GRADE	900																																				
	1000																																				

Table A-2 Absolute Viscosity (140F), Poise

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	27,424	126,926	183,685	421,085
	33,634	101,676	280,172	341,323
A R 1 0 0 0	17,275	63,132	247,677	663,513
	19,209	66,843	299,408	718,999

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	30,529	114,301	231,928	381,204
	s	5,502	22,371	85,487	70,669
	cv	18.0	19.6	36.86	18.54
A R 1 0 0 0	$\bar{x}$	18,242	64,689	273,542	691,256
	s	1,714	3,289	45,833	49,160
	cv	9.4	5.1	16.8	7.1

		ASPHALT TYPE (A)										PERCENT RUBBER (B)										RUBBER TYPE (C)									
		TP044					TP027					80% TP044 & 20% TP027					Q1274					U.S. Rubber Fine					80% Q1274 & 20% U.S. Rubber Fine				
		15	20	25	30	35	15	20	25	30	35	15	20	25	30	35	15	20	25	30	35	15	20	25	30	35	15	20	25	30	35
100-100	100-100																														
100-90	100-90																														
100-80	100-80																														
100-70	100-70																														
100-60	100-60																														
100-50	100-50																														
100-40	100-40																														
100-30	100-30																														
100-20	100-20																														
100-10	100-10																														
100-0	100-0																														

Table A-2 Absolute Viscosity (140F), Poise

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	28,304	62,932	223,801	358,749
	28,562	78,138	147,229	406,081
A R 1 0 0 0	17,490	42,261	201,984	285,286
	14,768	45,564	95,739	423,438

b. Summary

50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	28,433	70,535	185,515	382,415
	s	228	13,473	67,843	41,936
	CV	0.8	19.1	36.6	11.0
A R 1 0 0 0	$\bar{x}$	16,129	43,913	148,862	354,362
	s	2,411	2,926	94,133	122,403
	CV	15.0	6.7	63.2	34.5

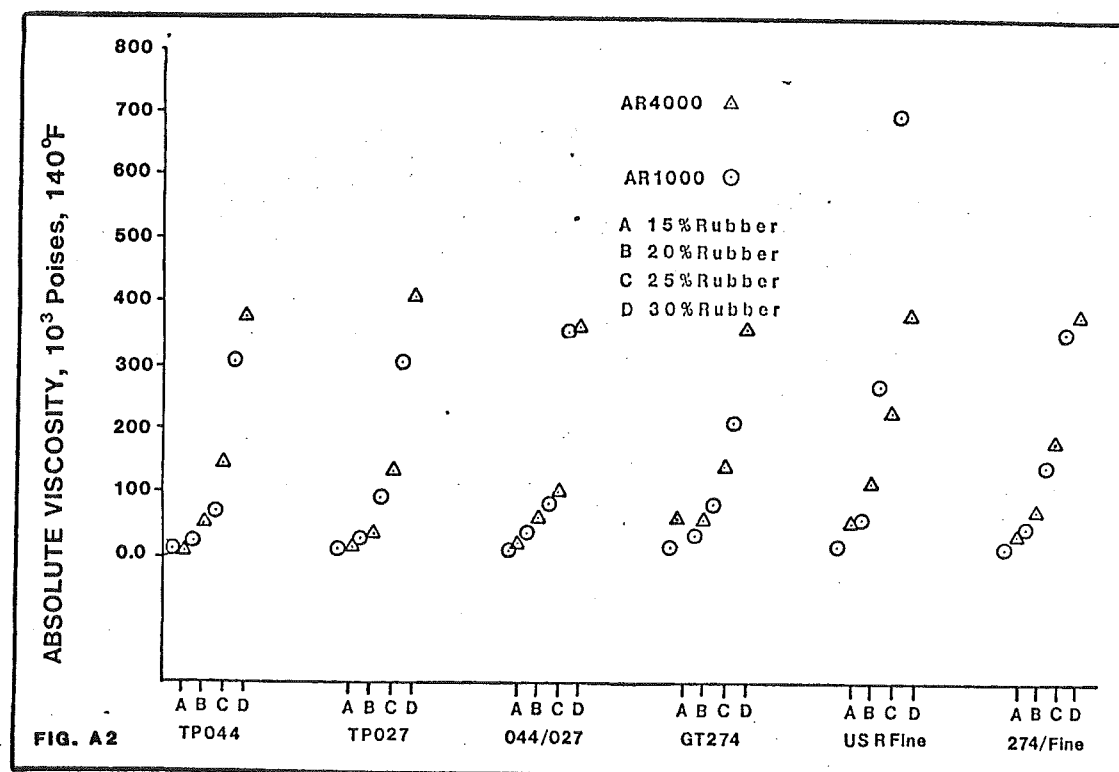
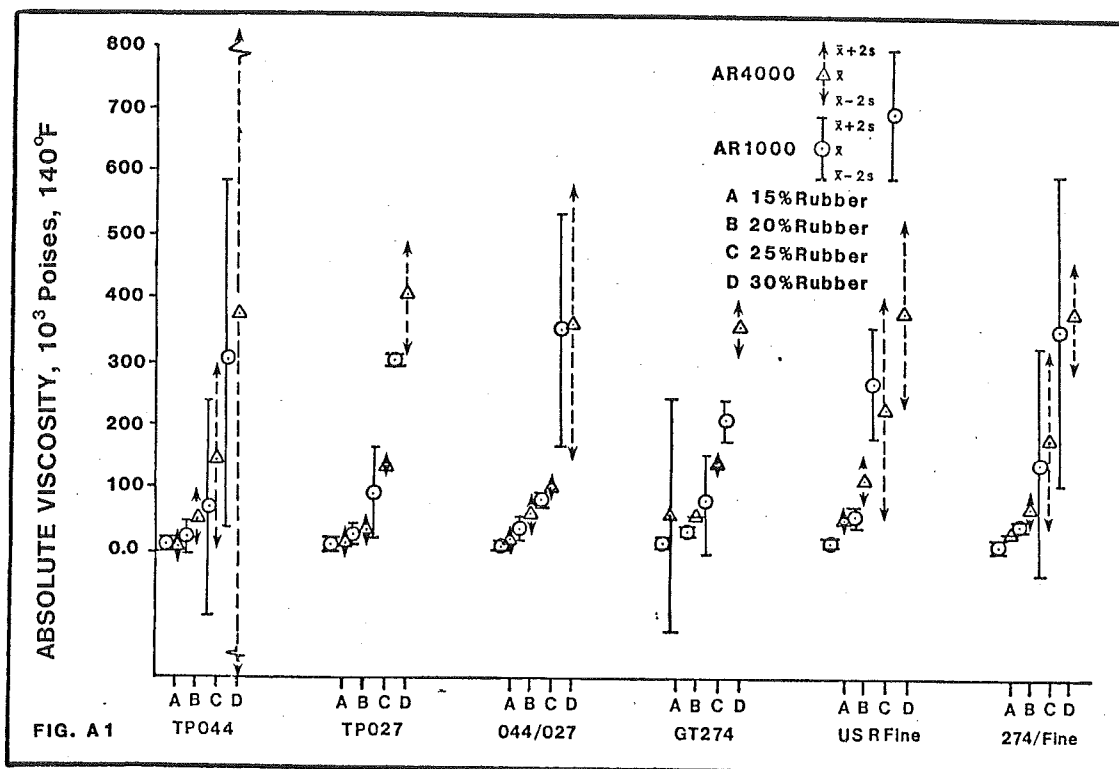
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP057				50% TP044 50% TP057				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30				
Viscosity (Poise)	140F																																				
	100F																																				
	70F																																				
	40F																																				

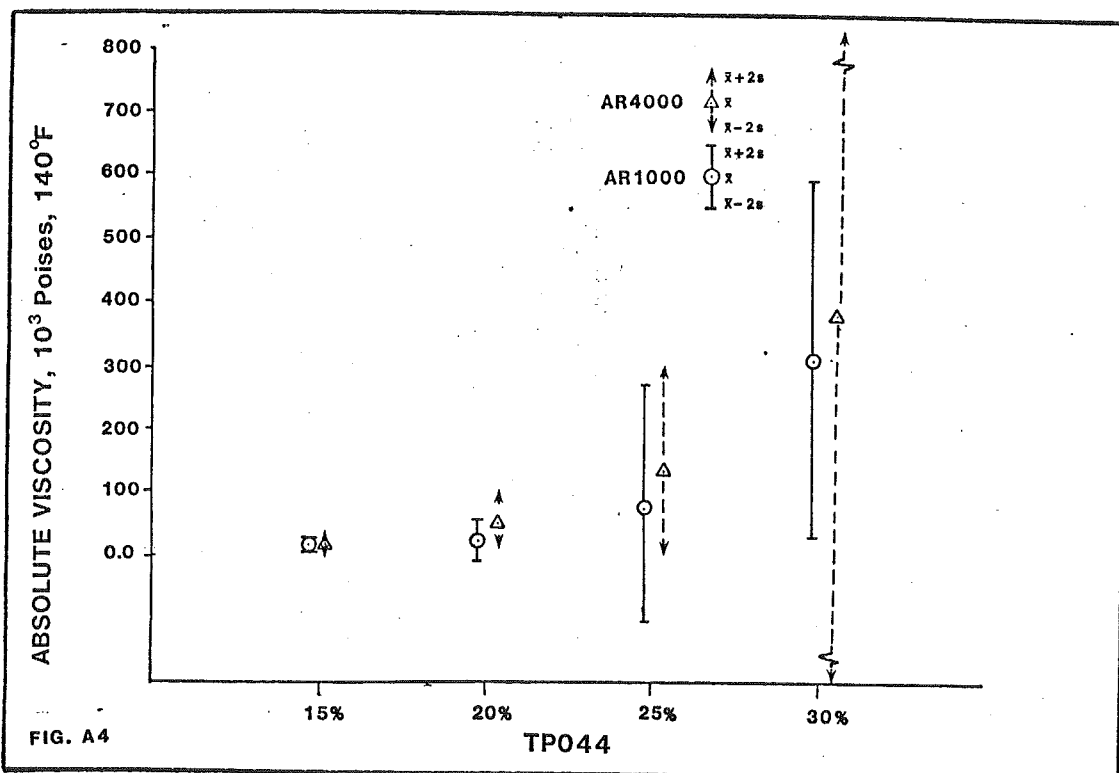
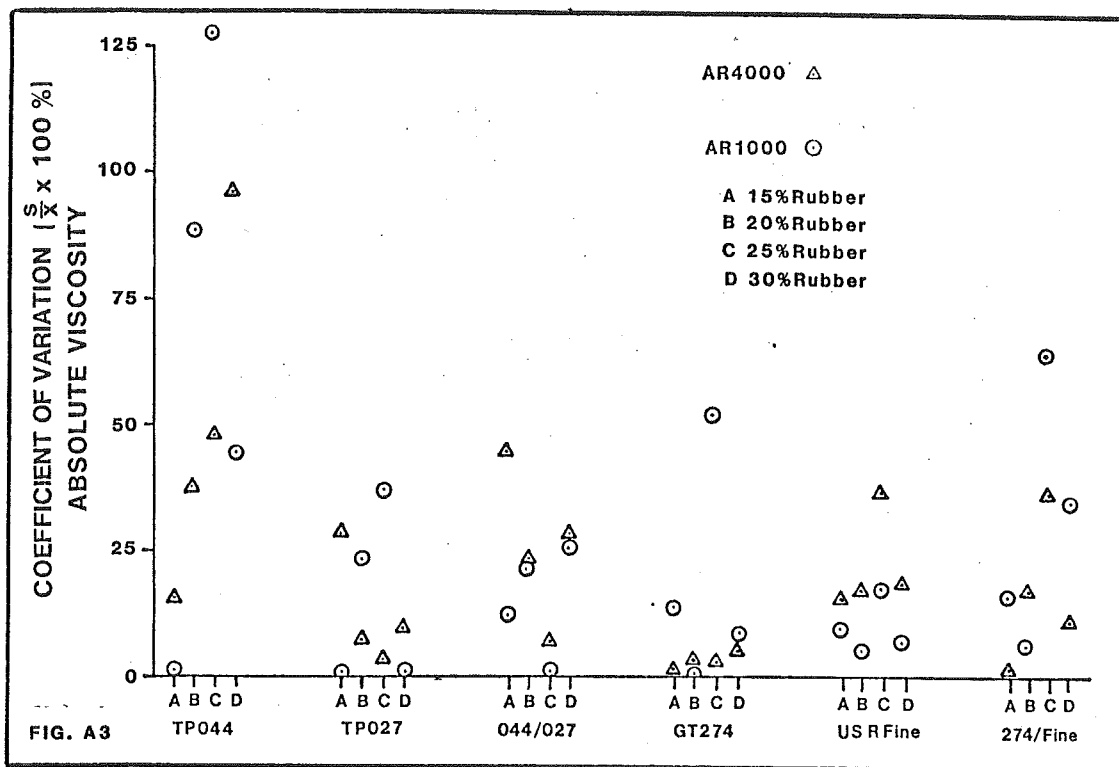
Table A-3 Anova Summary, Absolute Viscosity
(140F), TPO44 Removed

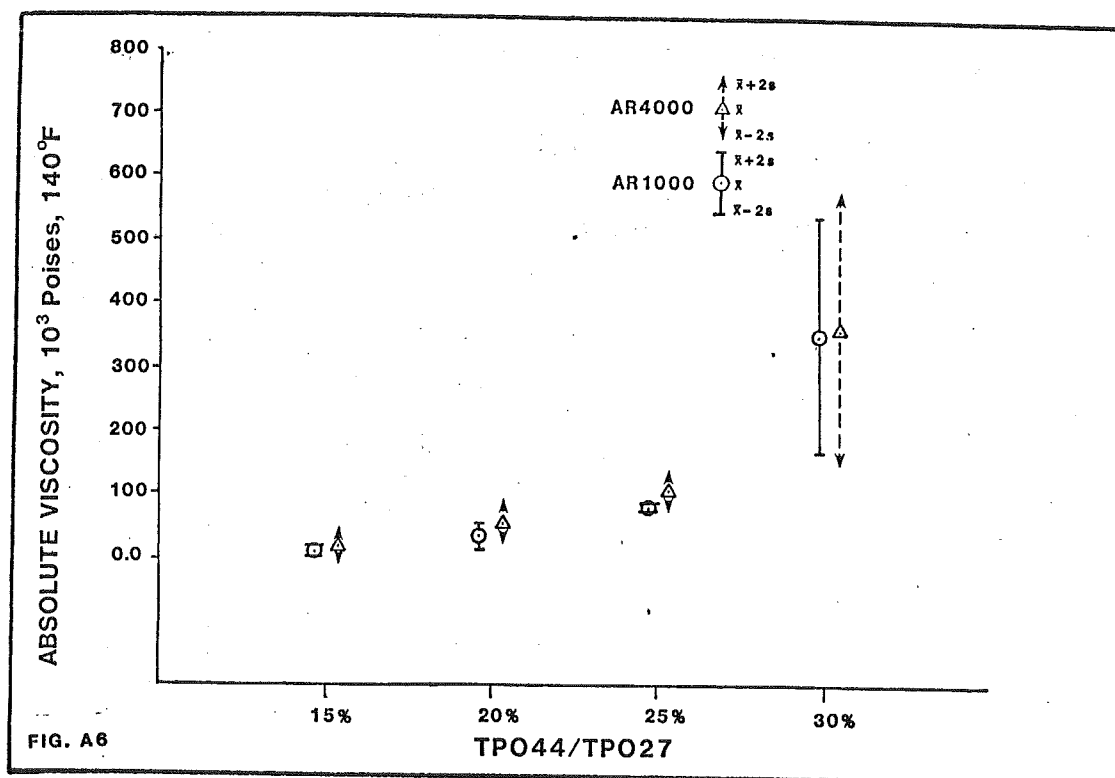
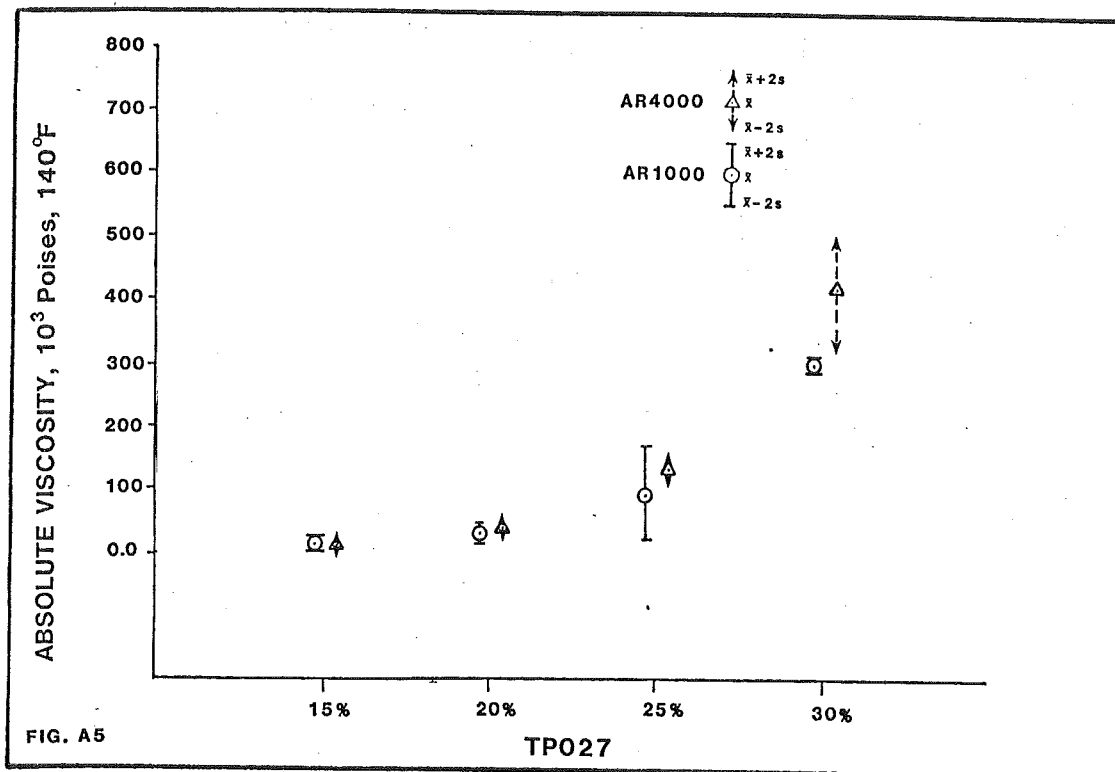
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	4	118586010256	29646502564	23.05	2.61	3.83
Q	3	1571951624825	523983874942	407.37	2.84	4.31
A	1	5316294225	5316294225	4.13	1.08	7.31
RQ	12	95282599929	7940216661	6.17	2.00	2.66
RA	4	46751218687	11687804672	9.09	2.61	3.83
QA	3	3487598107	1162532702	.90	2.84	4.31
RQA	12	89051156017	7420929668	5.77	2.00	2.66
Error	40	51450312511	1286257813			
TOTAL	79	1981876814557				

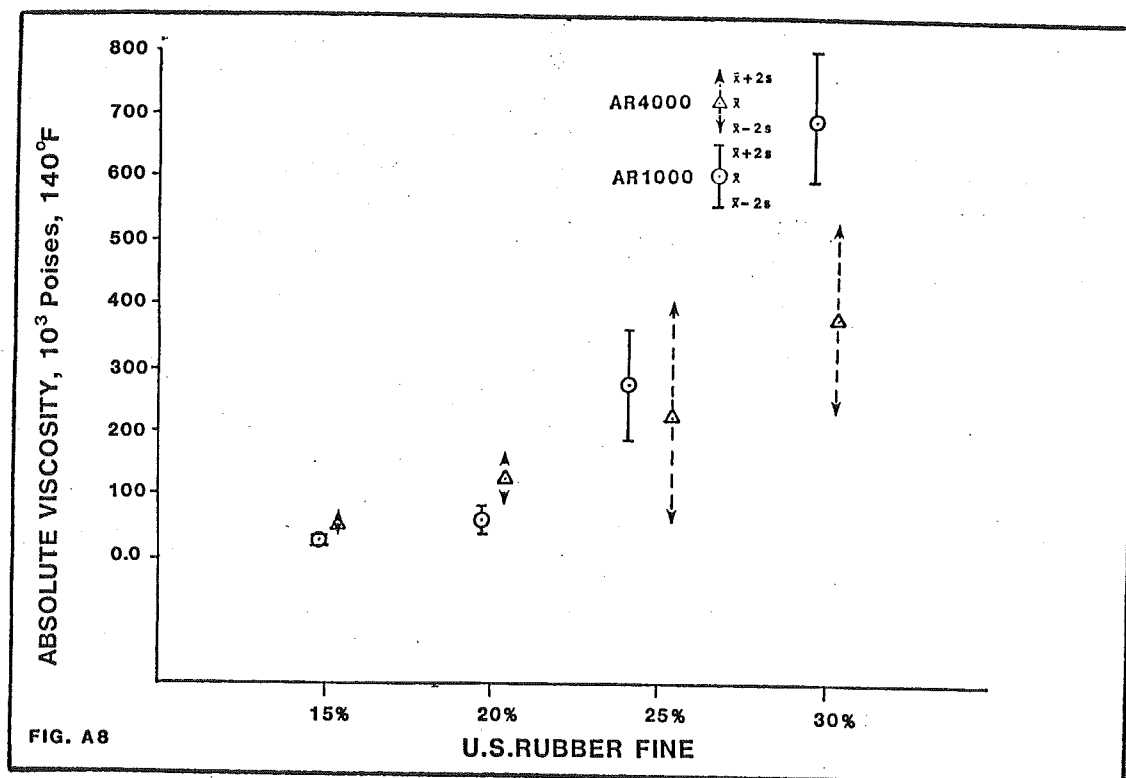
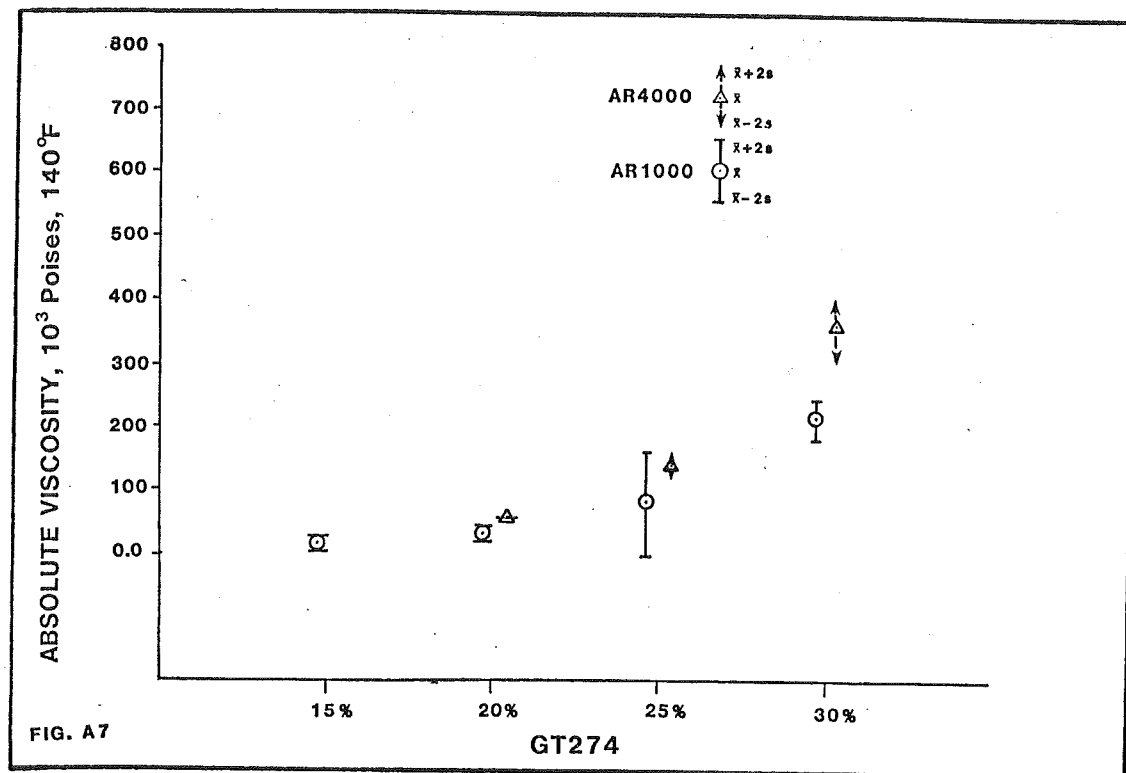
Table A-4 Anova Summary, Absolute Viscosity
(140F), TPO44 Only

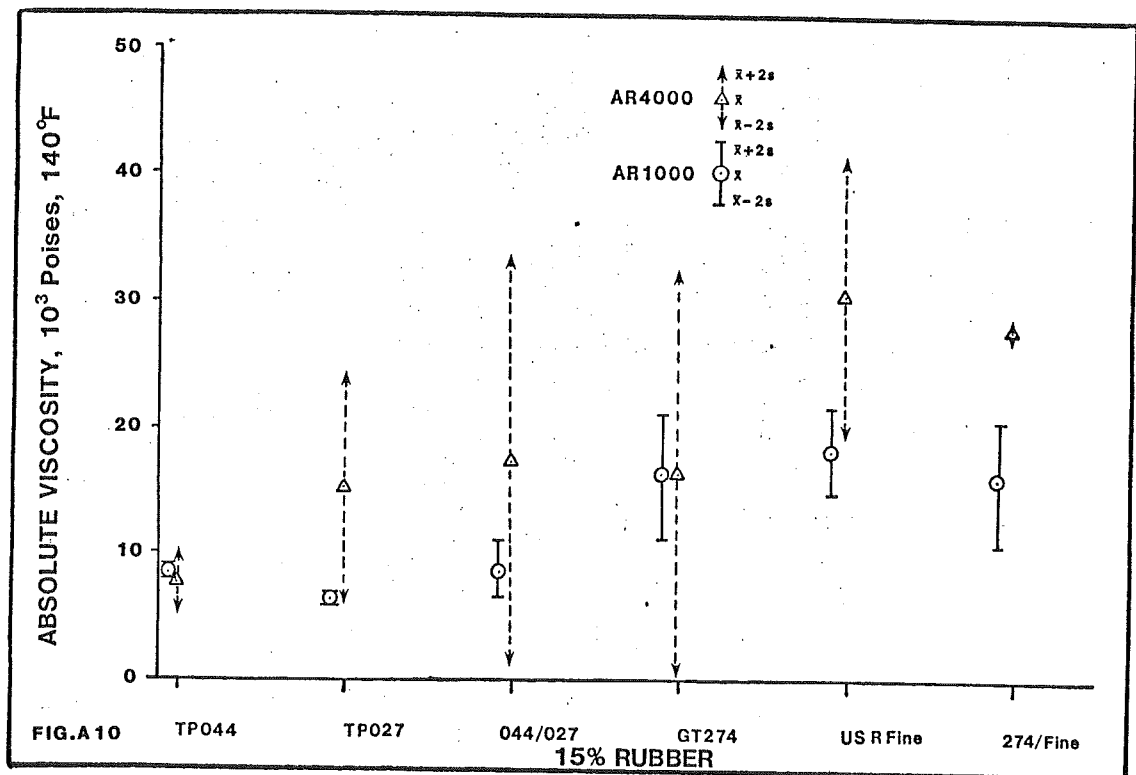
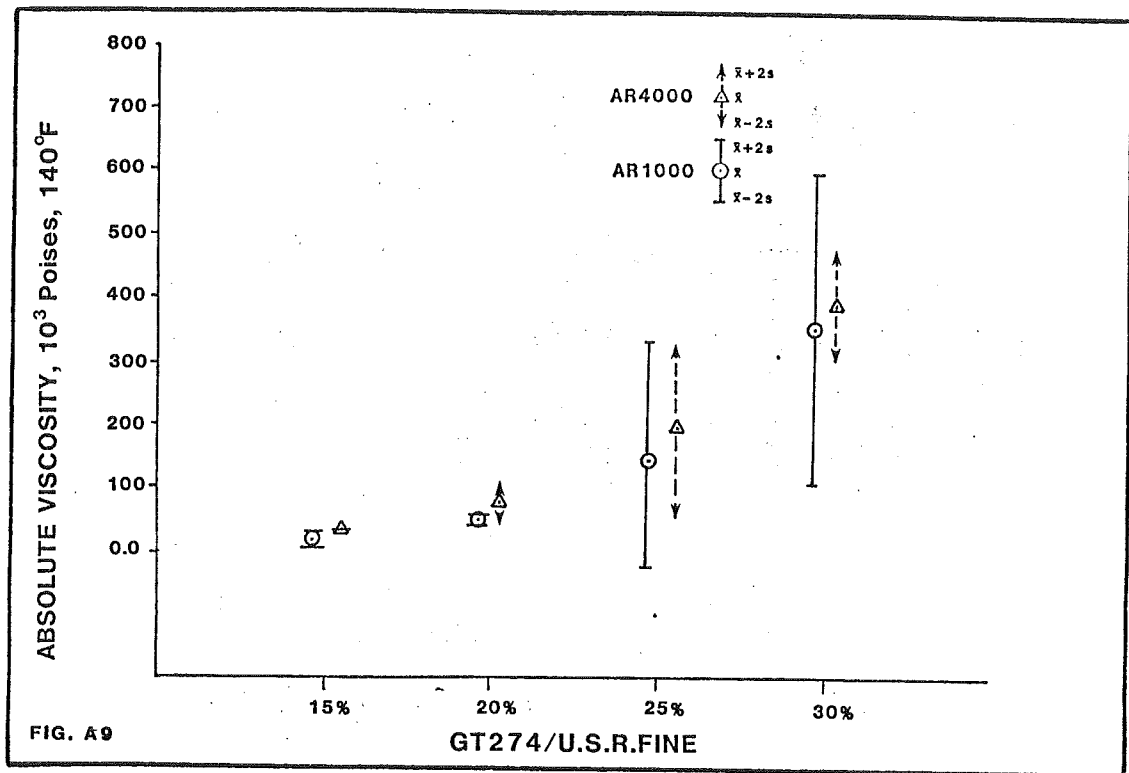
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
A	1	8043847647	8043847647	.62	5.32	11.26
Q	3	277531651876	92510550625	7.09	4.07	7.59
AQ	3	3961190266	1320396755	.10	4.07	7.59
Error	8	104409839506	13051229938			
TOTAL	15	393946529297				

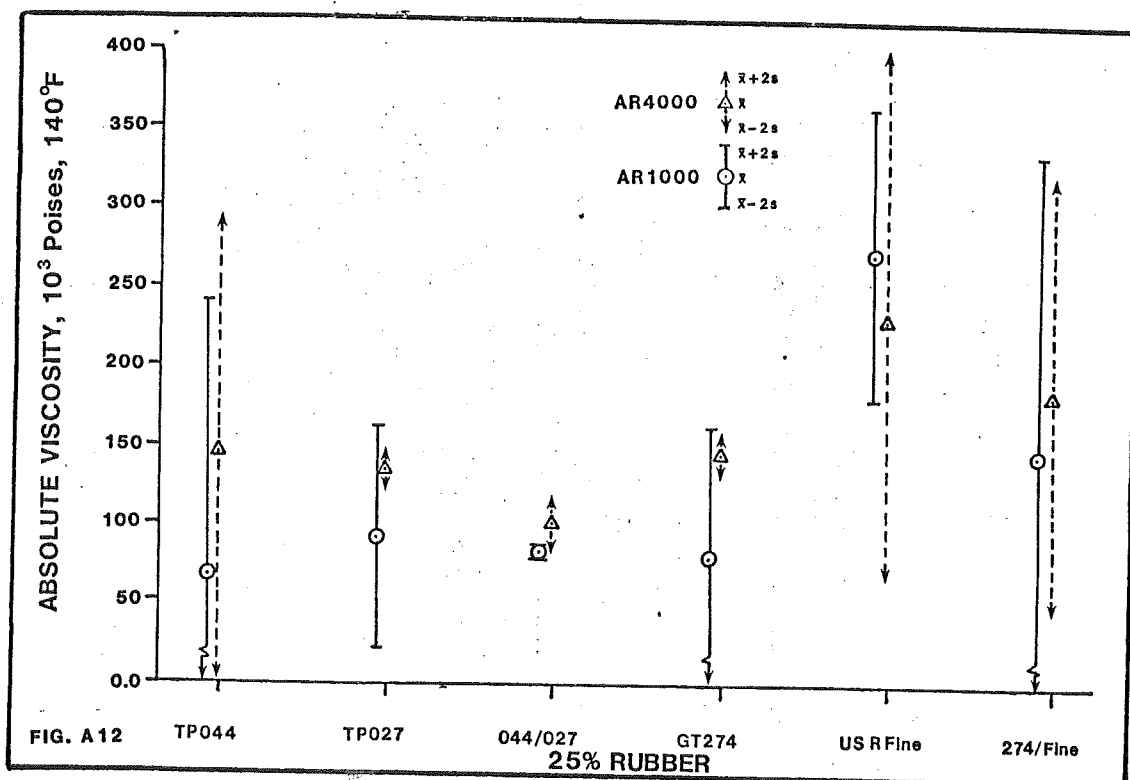
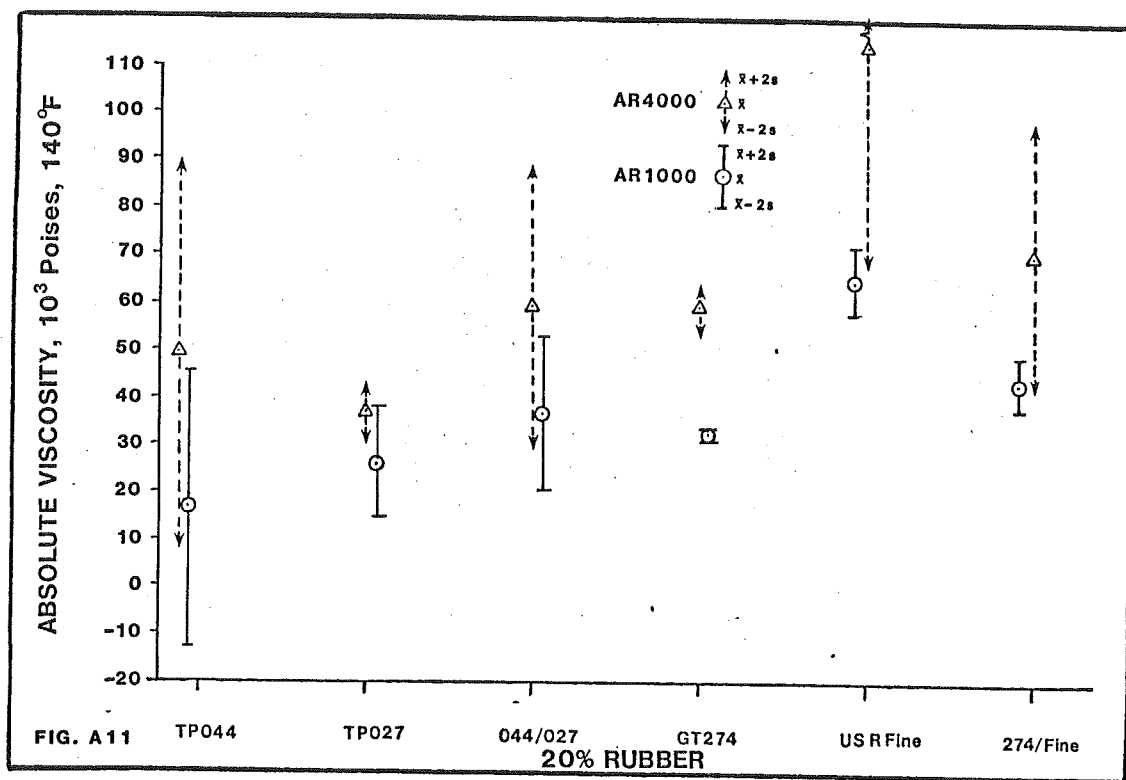


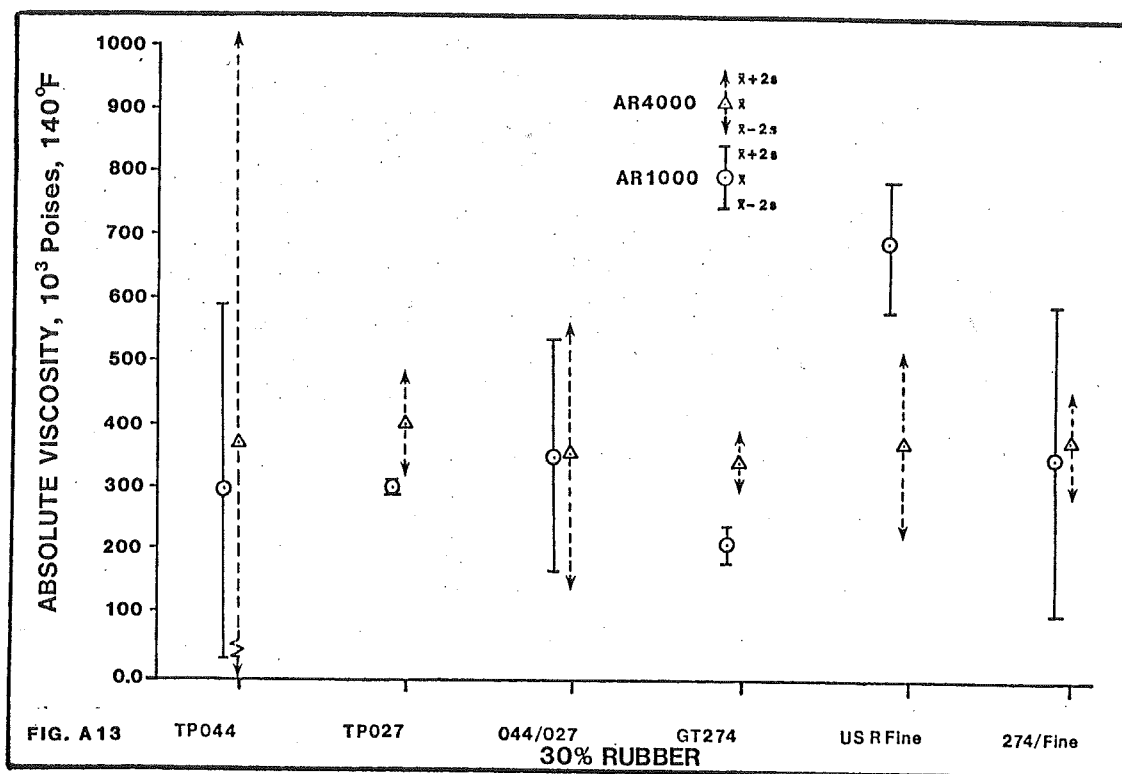












APPENDIX B
SCHWEYER RHEOMETER CONSTANT
(C) , G-TUBE

Table B-1 Schwyer Rheometer Constant (C), G-tube

a. Measured and Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	.69	.52	.54	.50
	.64	.91	.61	.54
A R 1 0 0 0	.84	.74	1.5	.54
	1.2	.29	.74	.64

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.67</u>	<u>.72</u>	<u>.58</u>	<u>.52</u>
	S	<u>.044</u>	<u>.346</u>	<u>.062</u>	<u>.035</u>
	CV	6.57	48.06	10.69	6.73
A R 1 0 0 0	$\bar{x}$	<u>1.02</u>	<u>.52</u>	<u>1.12</u>	<u>.59</u>
	S	<u>.319</u>	<u>.399</u>	<u>.673</u>	<u>.089</u>
	CV	31.27	76.73	60.09	15.08

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (R)

	TP044			TP007			80% TP044 20% TP007			G1210			U.S. Rubber Pave.			80% G1210 20% Pave. B		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
1000-100																		
1000-200																		
1000-300																		
1000-400																		
1000-500																		
1000-600																		
1000-700																		
1000-800																		
1000-900																		
1000-1000																		

Table B-1 Schwyer Rheometer Constant (C), G-tube

a. Measured and Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.82	.61	.72	.66
	.63	.91	.98	.67
A R 1 0 0 0	.51	1.0	.69	.58
	.92	.69	.71	.70

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	0.73	0.76	0.85	0.67
	S	0.168	0.266	0.230	.009
	CV	23.01	35.00	27.06	1.34
A R 1 0 0 0	$\bar{x}$	0.72	.845	0.70	0.64
	S	6.363	0.275	.018	0.106
	CV	50.42	32.54	2.57	16.56

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP027			DOT TP044 & 50% TP027			Q1276			U.S. Rubber Firm			DOT S1276		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
ASPHALT TYPE (A)																		
PERCENT RUBBER (B)																		
RUBBER TYPE (C)																		

Table B-1 Schweyer Rheometer Constant (C), G-tube

a. Measured and Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	1.1	.59	.58	.55
	.68	.82	.57	.85
A R 1 0 0 0	.84	.91	.73	.56
	.97	1.0	.80	.63

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	0.89	0.71	0.58	0.70
	s	0.372	0.204	.009	0.266
	cv	41.80	28.73	3.28	38.00
A R 1 0 0 0	$\bar{x}$	0.91	0.95	0.77	0.60
	s	.115	0.080	.062	.062
	cv	12.64	8.39	8.05	10.33

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				50% TP044 / 50% TP027				G1374				U.S. Rubber Firm				80% G1374 20% S. Firm.															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30				
Schweyer	Constant																																				
	Factor																																				
SBC-90	Constant																																				
	Factor																																				

Table B-1 Schwyer Rheometer Constant (C), G-tube

a. Measured and Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	.72	.44	.48	.74
	.74	.41	.46	.37
A R 1 0 0 0	.60	.57	.43	.49
	.79	.61	.71	.53

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	0.73	0.43	0.47	0.56
	s	.018	.027	.018	0.328
	CV	2.47	6.28	3.83	58.57
A R 1 0 0 0	$\bar{x}$	0.70	0.59	0.57	0.51
	s	0.168	.035	0.248	.035
	CV	26.57	5.93	43.52	6.86

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP604				TP607				50% TP604 50% TP607				GT374				U.S. Rubber Fms				50% GT374			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Asphalt																								
Rubber																								
Temp																								

Table B-1 Schwyer Rheometer Constant (C), G-tube

a. Measured and Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.53	.42	.31	.36
	.58	.49	.43	.50
A R 1 0 0 0	.55	.37	.41	.47
	.48	.38	.34	.63

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	0.56	0.46	0.37	0.43
	S	.044	.062	0.106	0.124
	CV	7.86	13.48	28.65	28.84
A R 1 0 0 0	$\bar{x}$	0.52	0.38	0.38	0.55
	S	.062	.009	.062	0.142
	CV	11.92	23.68	16.31	25.82

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				SOL TP044 SOL TP027				G1276				U.S. Rubber Fine				SOL G1276 SOL U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Temperature	°C																																				
Time	sec																																				

Table B-1 Schwyer Rheometer Constant (C), G-tube

a. Measured and Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.39	.42	.41	.34
	.75	.35	.63	.26
A R 1 0 0 0	.46	.43	.29	.58
	.52	.64	.66	.43

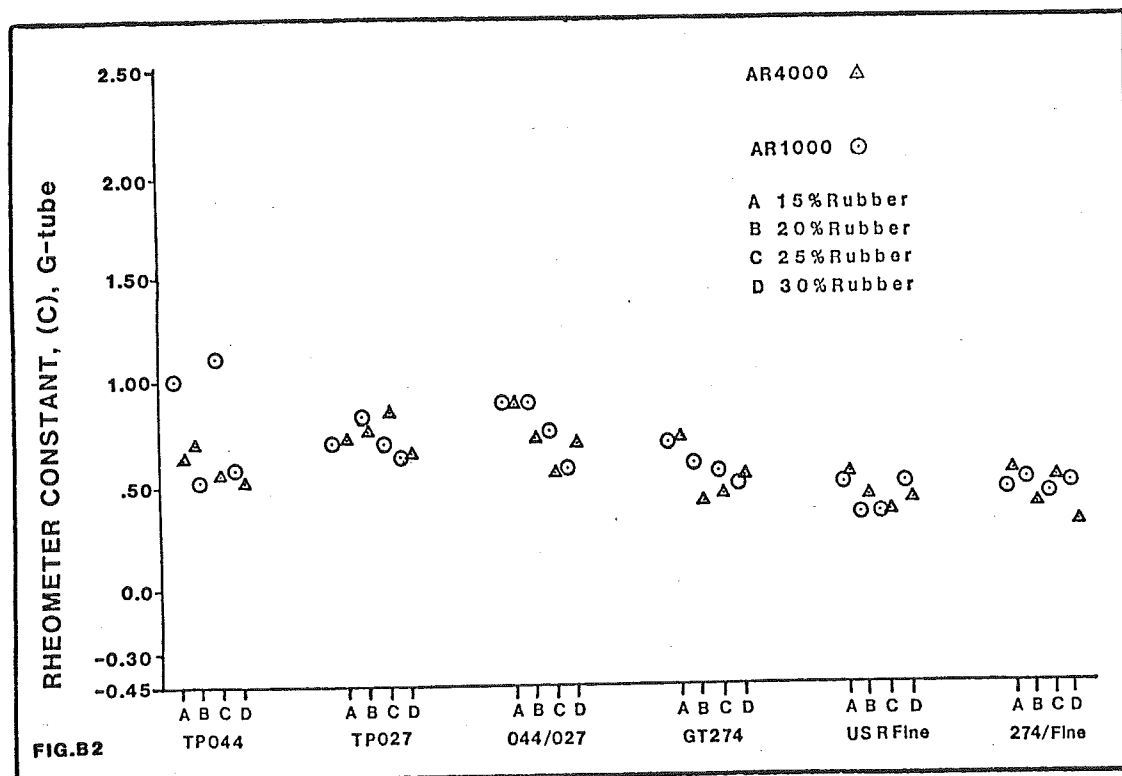
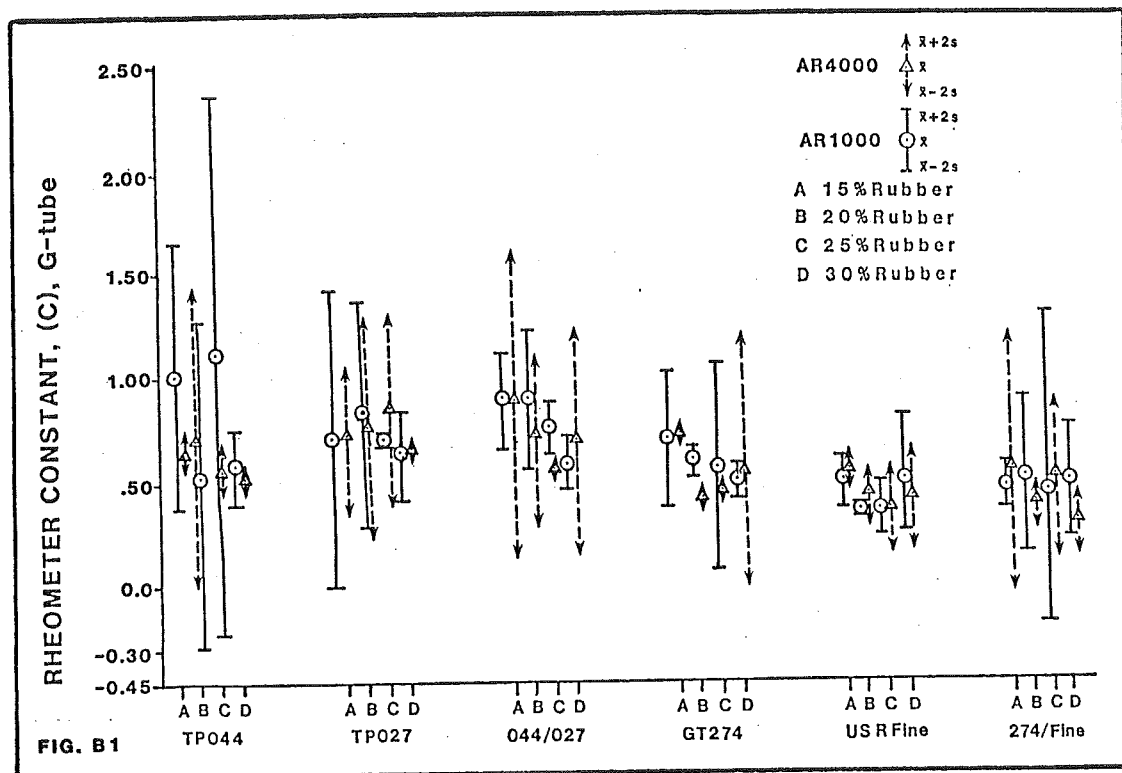
b. Summary

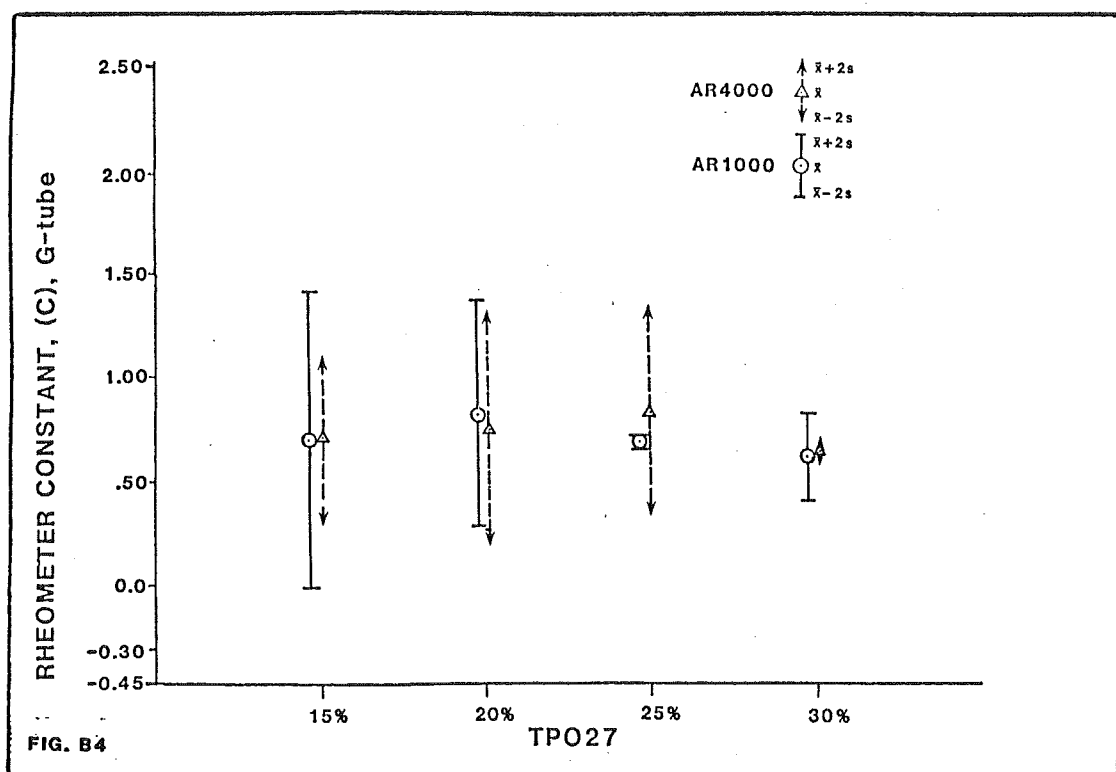
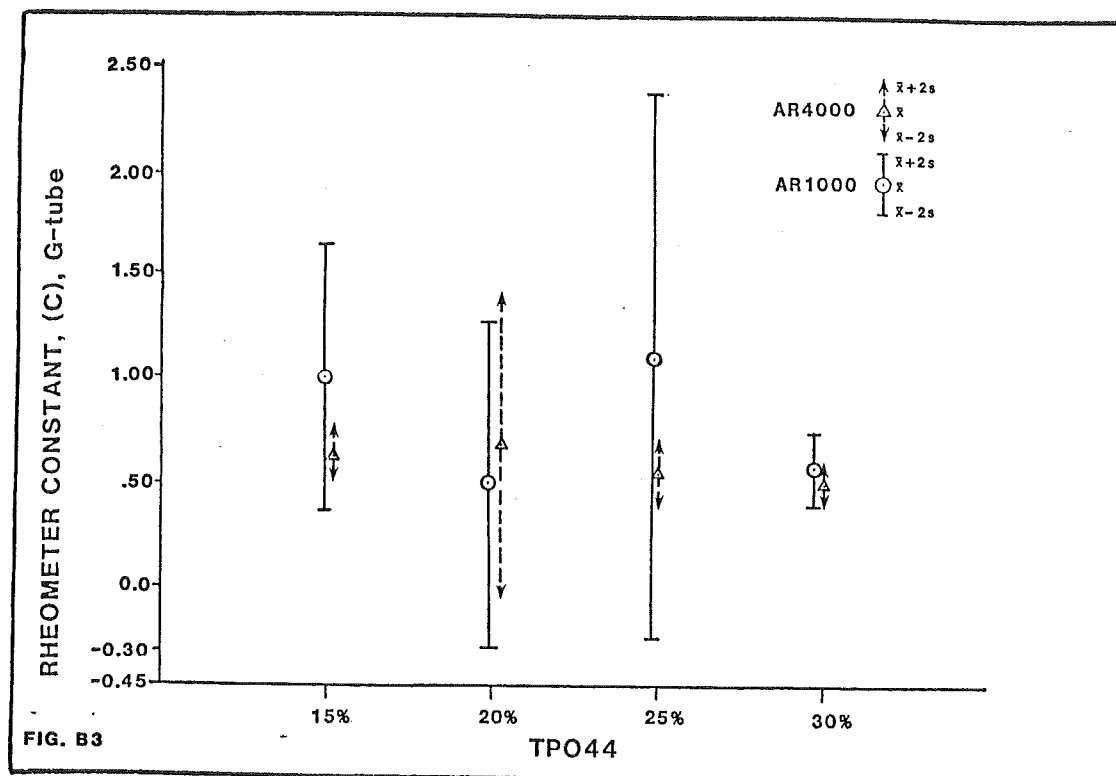
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	0.57	0.39	0.52	0.30
	S	0.319	.062	0.195	.071
	CV	55.96	15.90	37.50	23.67
A R 1 0 0 0	$\bar{x}$	0.40	0.54	0.48	0.51
	S	.063	0.186	0.328	0.133
	CV	10.82	34.44	68.33	26.08

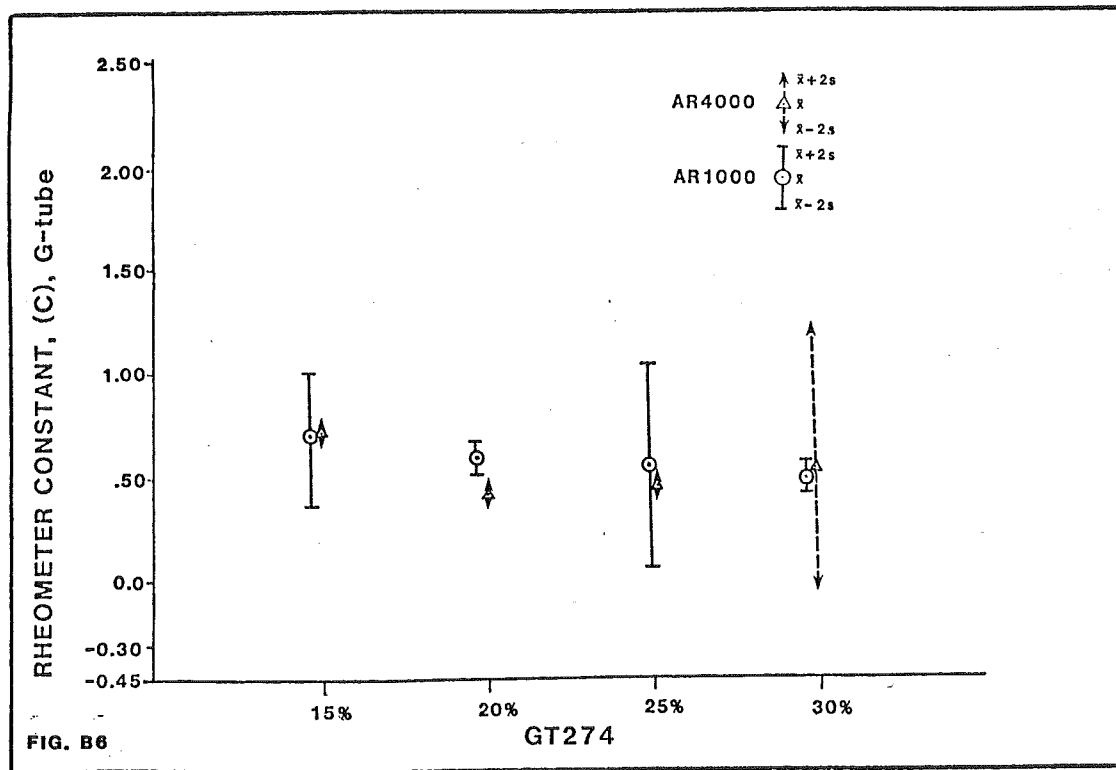
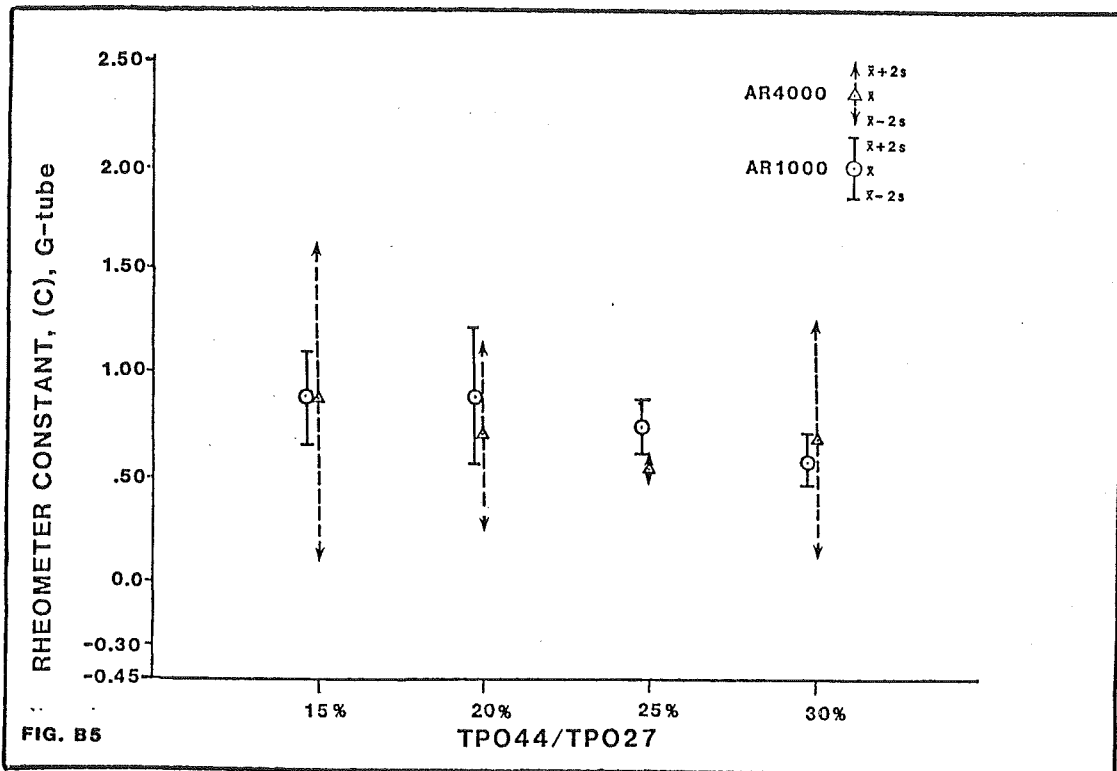
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (B)																	
		TP064				TP067				50% TP064 50% TP067				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber																					
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30		
C	100-200																																										
	200-300																																										
D	100-200																																										
	200-300																																										

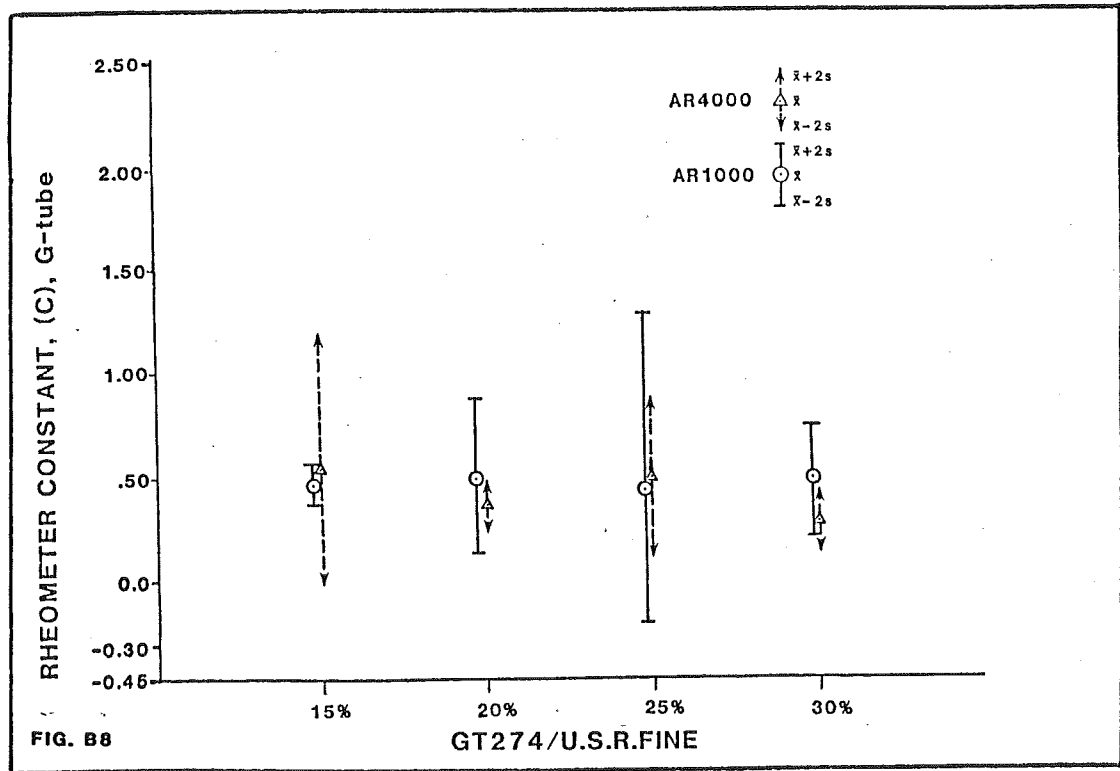
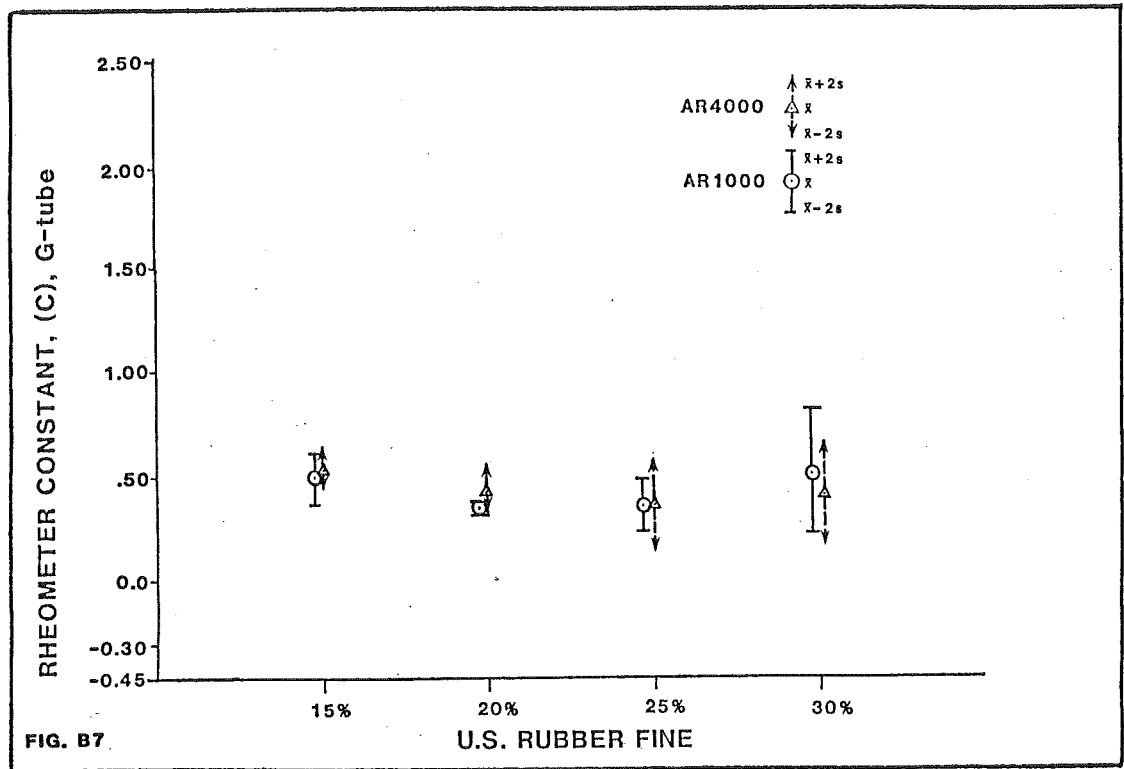
Table B-2 Anova Summary, Schweyer Rheometer
Constant (C), G-tube

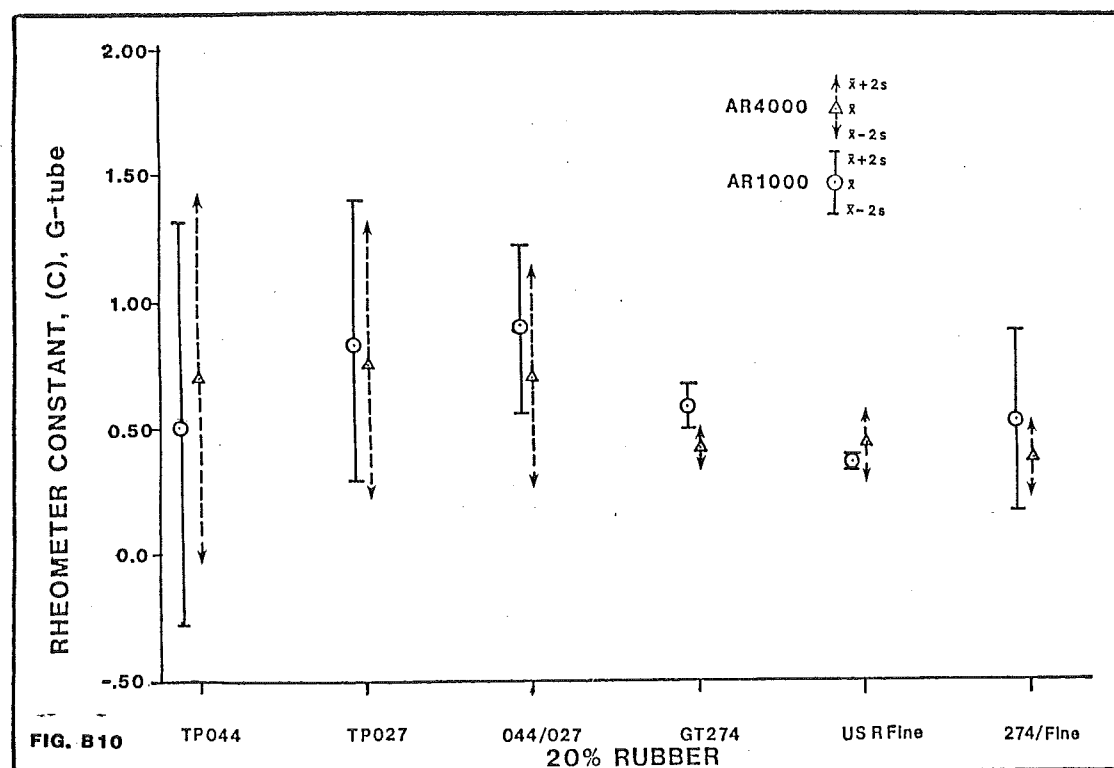
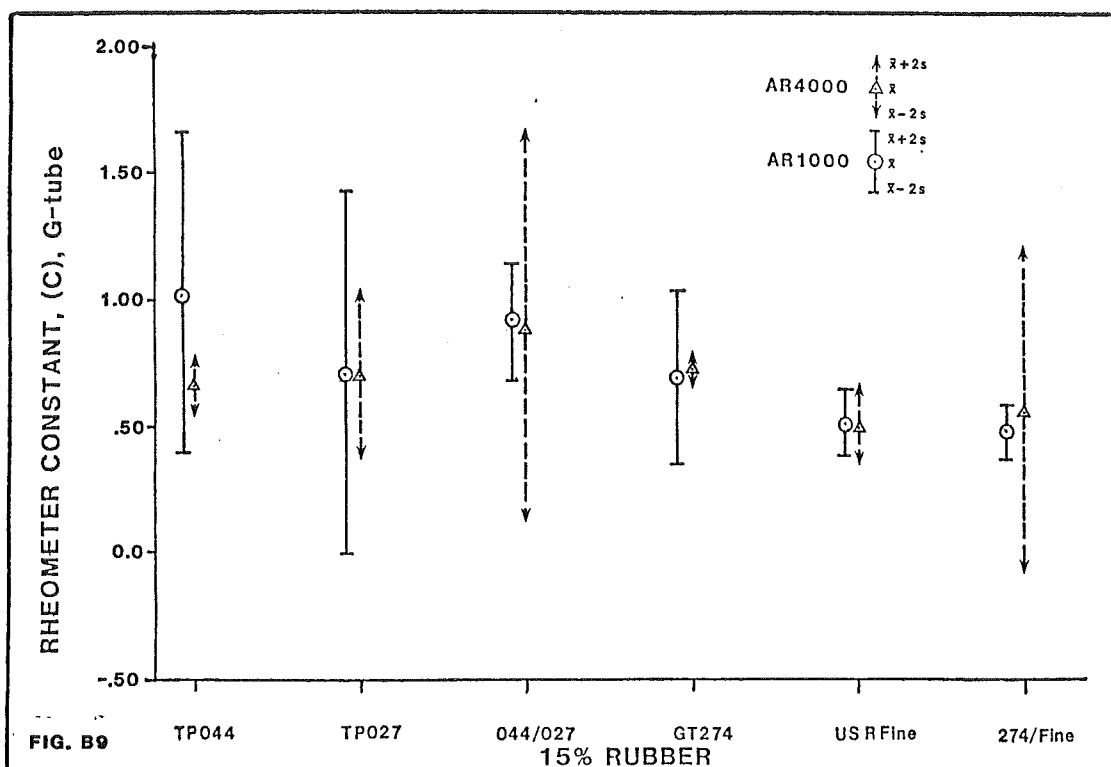
<u>ANOVA</u>						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	1.49267	0.2985350	10.75	2.43	3.48
Q	3	.31642	0.1054736	3.79	2.82	4.27
A	1	.08050	0.0805042	2.89	4.06	7.27
RQ	15	.39266	0.0261777	0.94	1.90	2.49
RA	5	.11450	0.0229016	0.82	2.43	3.48
QA	3	.02097	0.0069902	0.25	2.82	4.27
RQA	15	.50561	0.0337077	1.21	1.90	2.49
Error	48	1.33270	0.0277645			
TOTAL	95	4.25606				

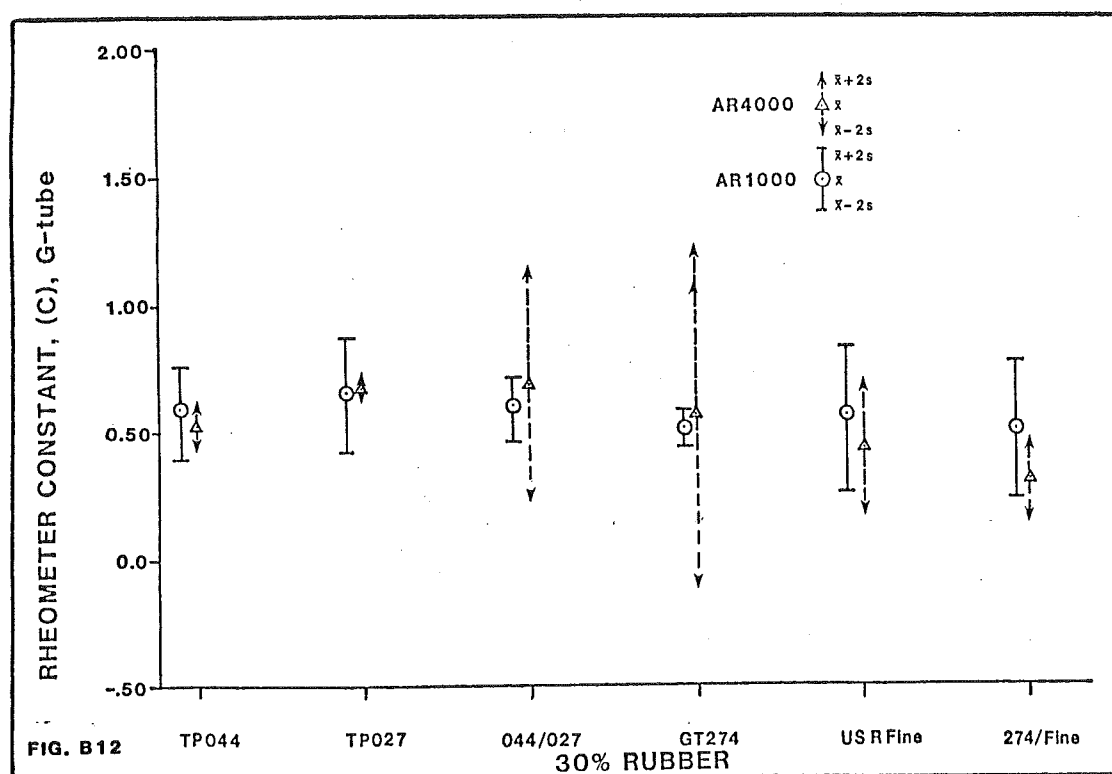
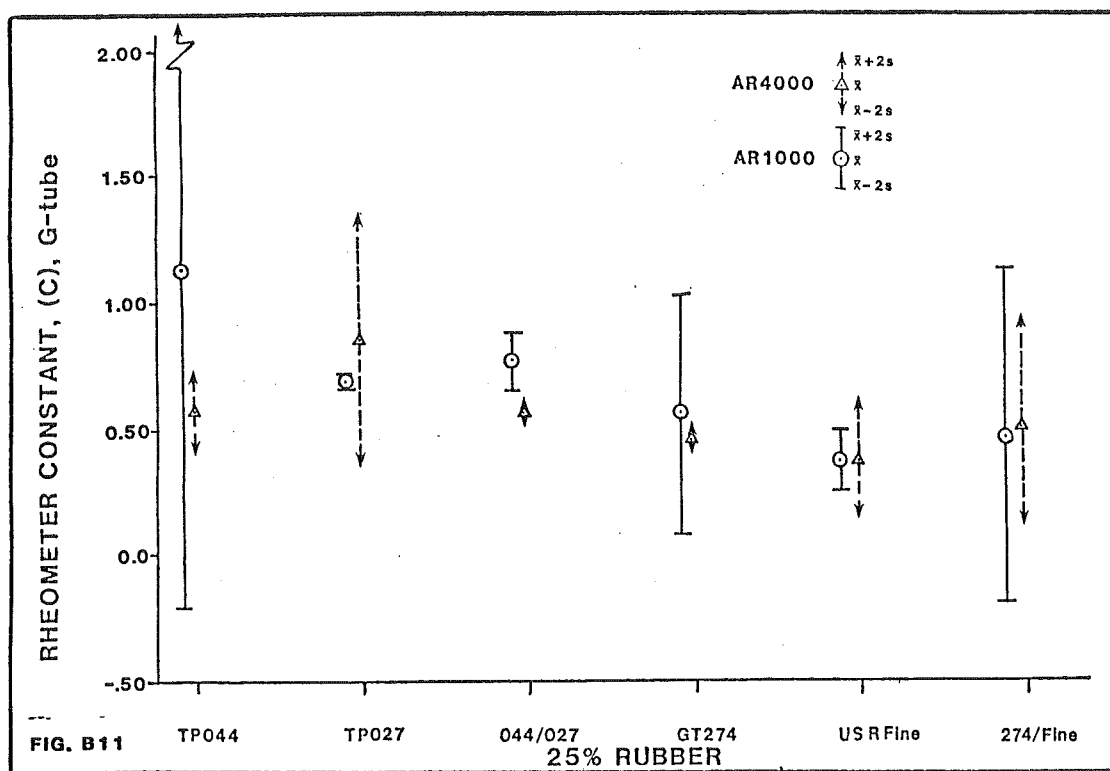












APPENDIX C
SCHWEYER RHEOMETER CONSTANT
(C) , F-TUBE

Table C-1 Schwyer Rheometer Constant (C), F-tube

a. Measured Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	1.1	.68	1.1	.68
	.88	.59	.70	.46
A R 1 0 0 0	1.3	.13	1.1	.68
	1.3	.98	.98	1.0

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	0.99	0.64	0.90	0.56
	S	0.19	.08	0.35	0.18
	CV	19.69	12.56	39.38	31.64
A R 1 0 0 0	$\bar{x}$	1.30	0.56	1.04	0.84
	S	0	0.75	0.11	0.28
	CV	0	135.69	10.22	33.75

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (H)

	TP044				TP087				60% TP044 & 40% TP087				GT374				U.S. Rubber FINE				60% GT374 & 40% U.S. FINE			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								
15																								
16																								
17																								
18																								
19																								
20																								
21																								
22																								
23																								
24																								
25																								
26																								
27																								
28																								
29																								
30																								

Table C-1 Schwyer Rheometer Constant (C), F-tube

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	1.1	.50	.61	1.6
	1.3	.76	.88	1.4
A R 1 0 0 0	1.5	1.1	1.2	.88
	1.7	.98	1.1	.88

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	1.20	0.63	0.75	1.50
	S	0.18	0.23	0.24	0.18
	CV	14.77	36.57	32.11	11.81
A R 1 0 0 0	$\bar{x}$	1.60	1.04	1.15	0.88
	S	0.18	0.11	.09	0
	CV	11.08	10.22	7.70	0

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP046			TP027			90% TP046 50% TP027			GT274			U.S. Rubber Fine			90% GT274 50% U.S. Rubber Fine		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Control	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
100-100	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Table C-1 Schwyer Rheometer Constant (C), F-tube

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	1.2	.72	.87	.38
	1.1	.65	.37	.47
A R 1 0 0 0	1.6	.97	1.1	1.5
	1.5	2.6	.97	1.4

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	1.15	0.69	0.62	0.43
	s	.09	.06	0.44	.08
	cv	7.70	9.05	71.45	18.76
A R 1 0 0 0	$\bar{x}$	1.55	1.79	1.04	1.45
	s	.09	1.44	0.12	0.09
	cv	5.72	80.91	11.13	6.11

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)												
		TP044				TP027				50% TP044 50% TP027				BT074				U.S. Rubber Fm.				50% BT074 50% R Fm.																
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	
Schwyer	4000																																					
	1000																																					

Table C-1 Schweyer Rheometer Constant (C), F-tube

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	1.4	.90	1.1	.37
	2.3	1.7	1.5	.80
A R 1 0 0 0	1.1	1.1	.75	.53
	.90	.92	.82	.59

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	1.85	1.30	1.30	0.59
	s	0.80	0.71	0.35	0.38
	cv	43.10	54.52	27.26	65.12
A R 1 0 0 0	$\bar{x}$	1.00	1.01	0.79	0.56
	s	0.18	0.16	.06	.05
	cv	17.72	15.79	7.90	9.49

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)												
		TPG44				TPG27				50% TPG44 50% TPG27				GT274				U.S. Rubber Firm				50% GT274 50% S. Firm.																
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	
CONCRETE	1000																																					
	2000																																					
GRAVEL	1000																																					
	2000																																					

Table C-1 Schwyer Rheometer Constant (C), F-tube

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.93	1.7	.84	.60
	.51	1.3	.60	.74
A R 1 0 0 0	.60	.73	.66	.62
	.83	.99	.75	.60

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	-X	0.72	1.50	0.72	0.67
	S	0.37	0.35	0.21	0.12
	CV	51.68	23.63	29.53	18.51
A R 1 0 0 0	-X	0.72	0.86	0.71	0.61
	S	0.20	0.23	.08	.02
	CV	28.50	26.79	11.31	2.90

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TPOL4				TPOL7				80% TPOL4 80% TPOL7				B1216				U.S. Rubber Fine				80% B1216 80% B1216															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
GROUP	GROUP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GROUP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1 Schweyer Rheometer Constant (C), F-tube

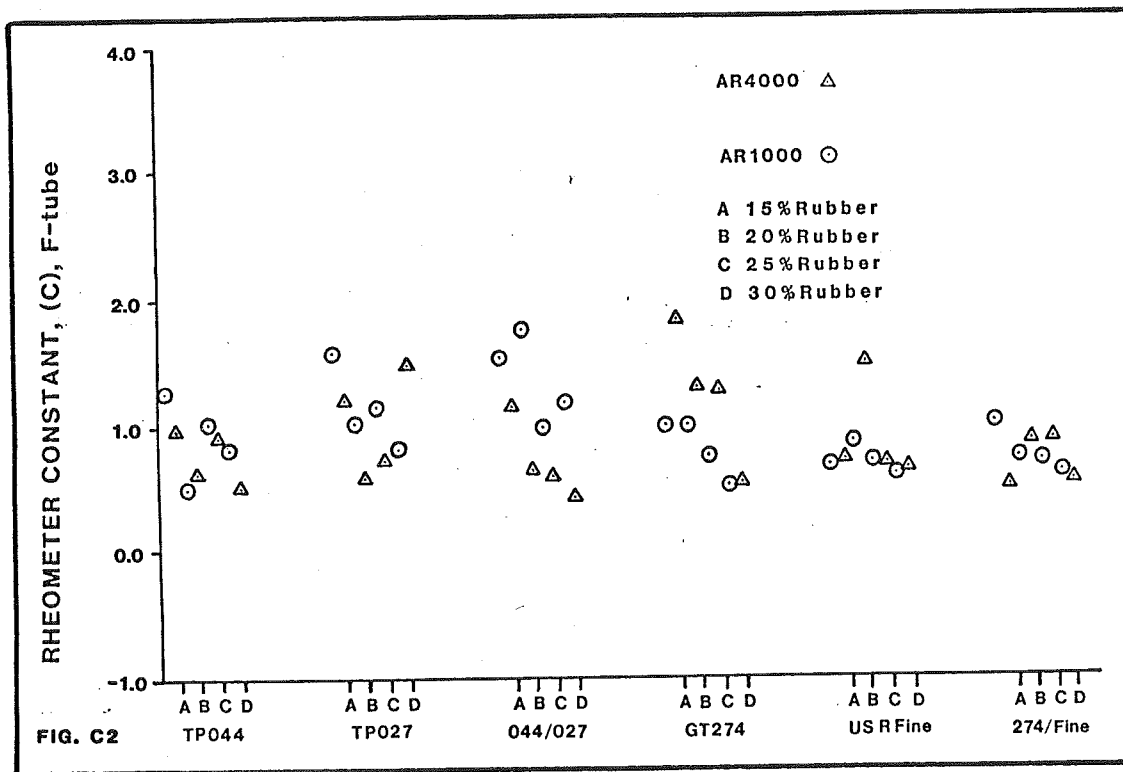
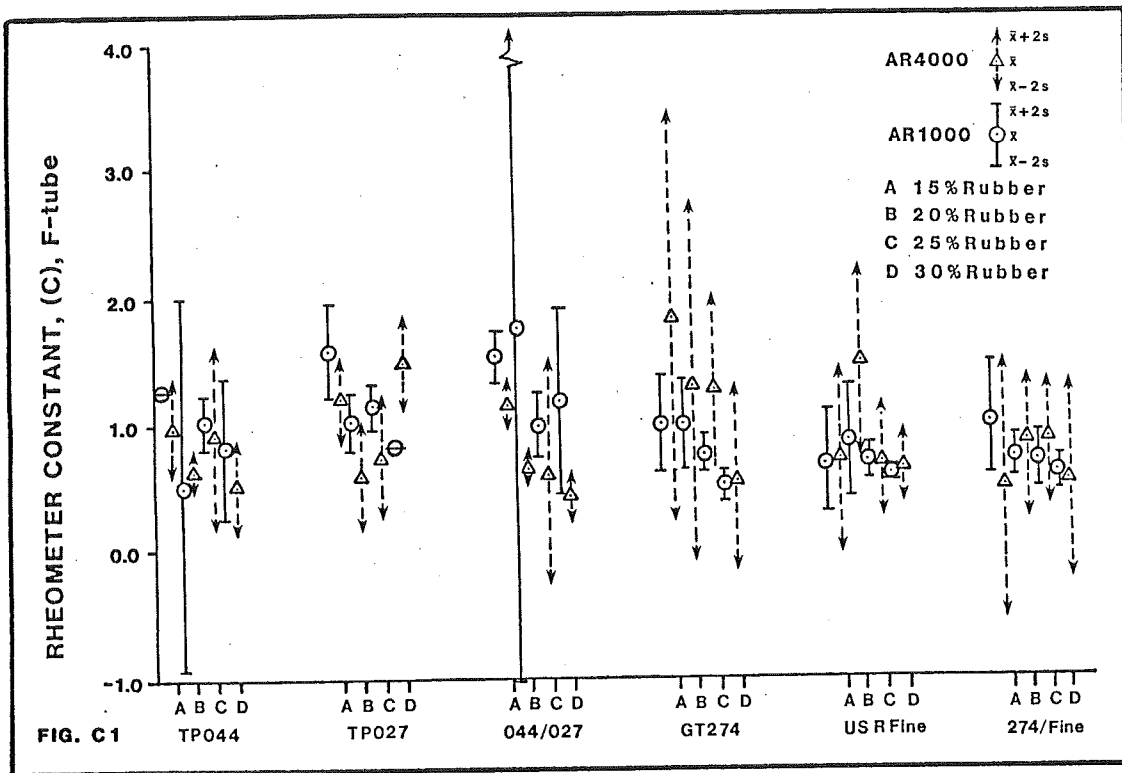
a. Measured Data

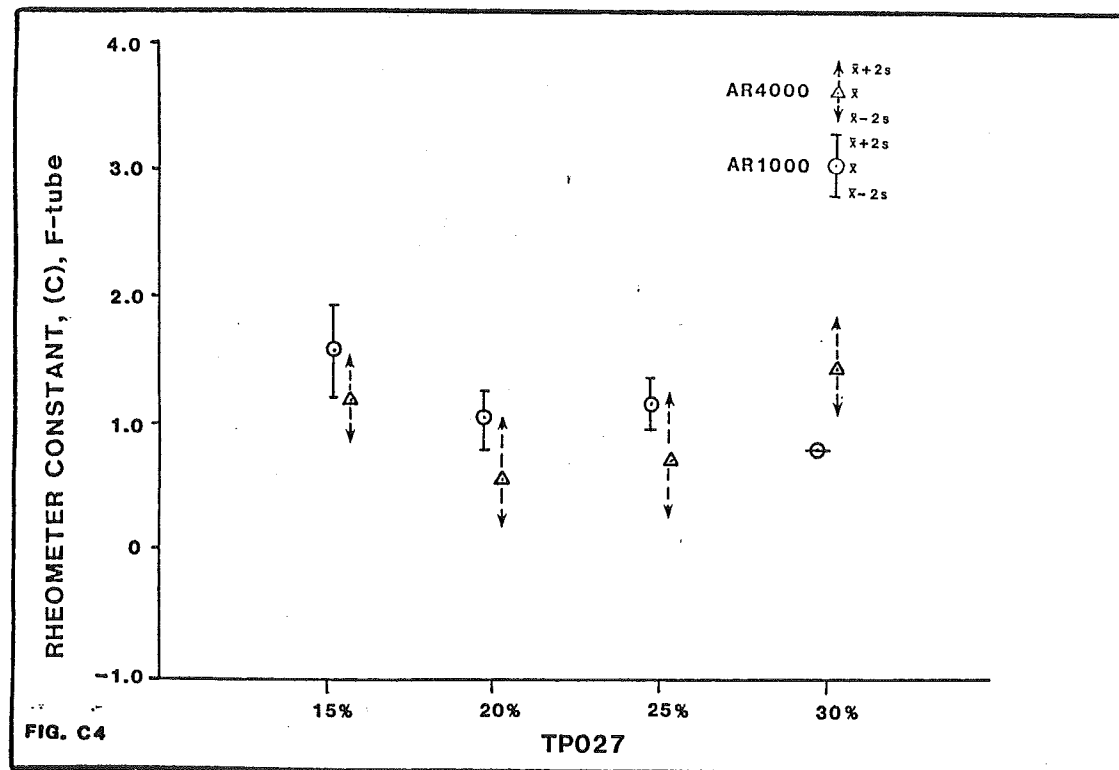
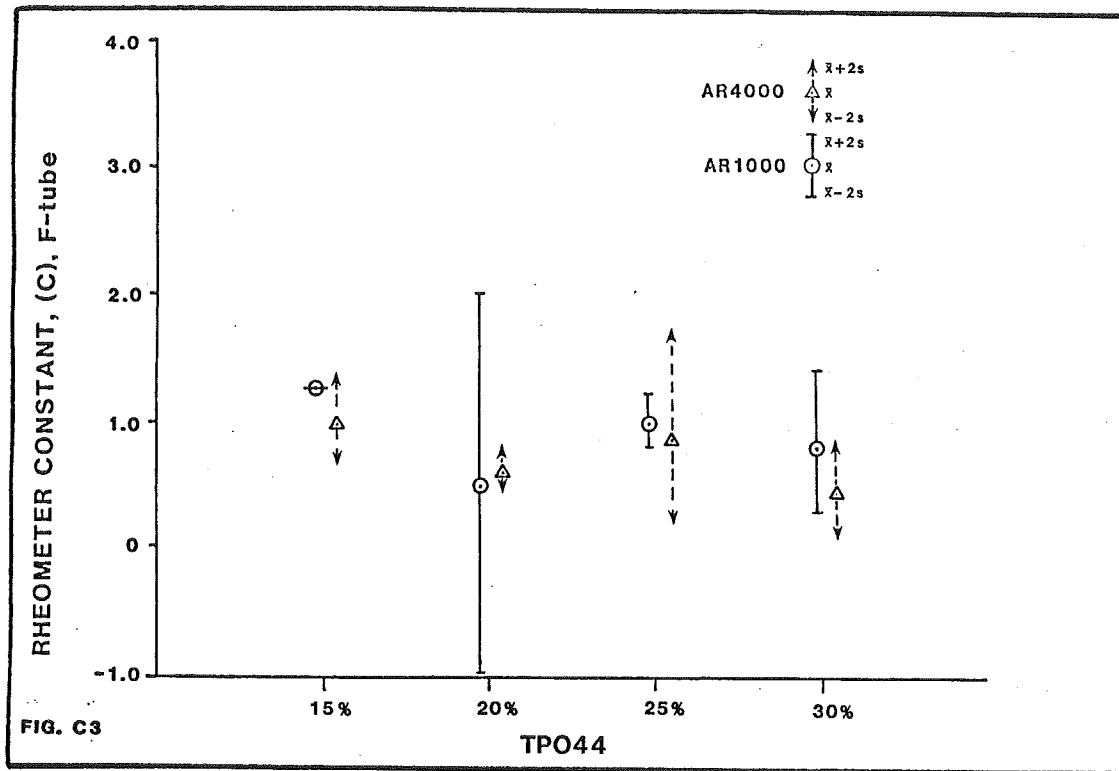
50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.86	1.0	1.0	.79
	.24	.67	.70	.93
A R 1 0 0 0	1.2	.80	.64	.59
	.94	.72	.76	.67

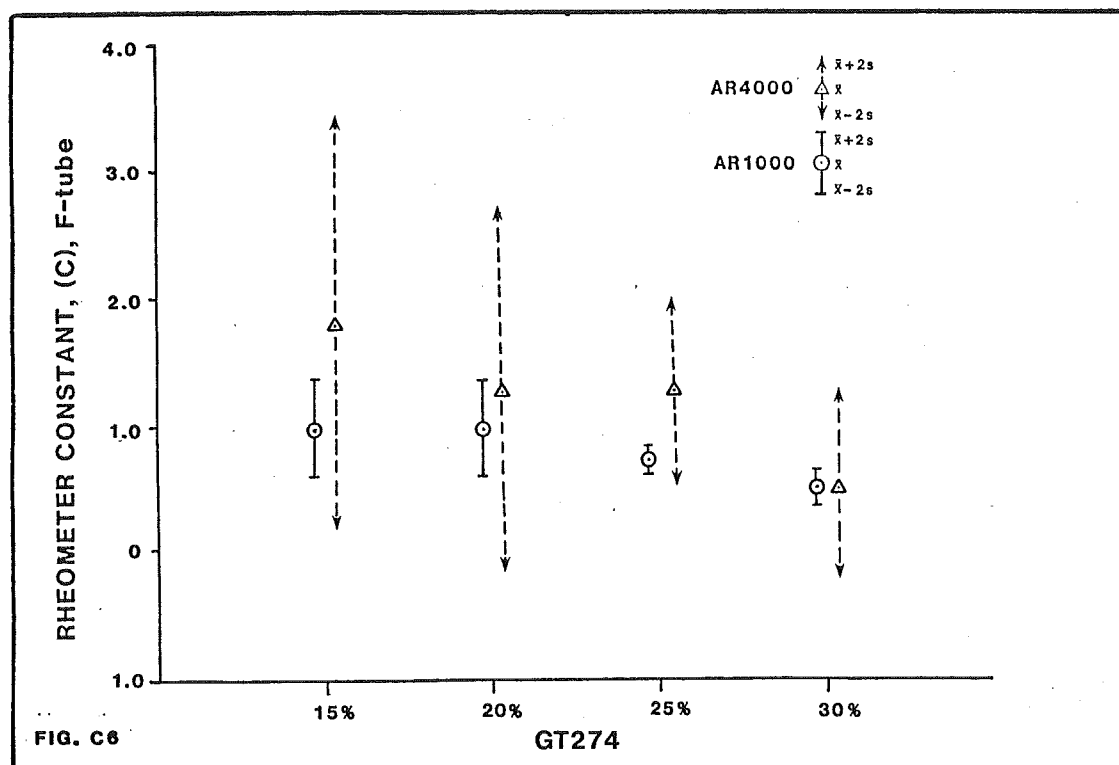
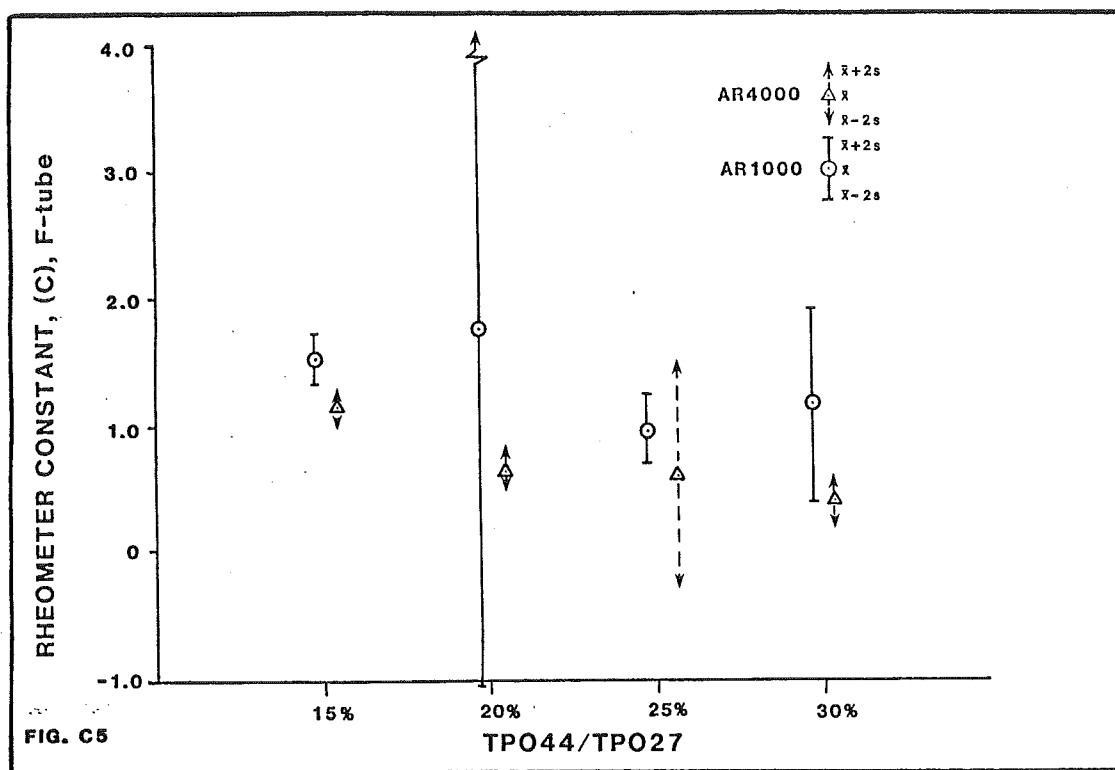
b. Summary

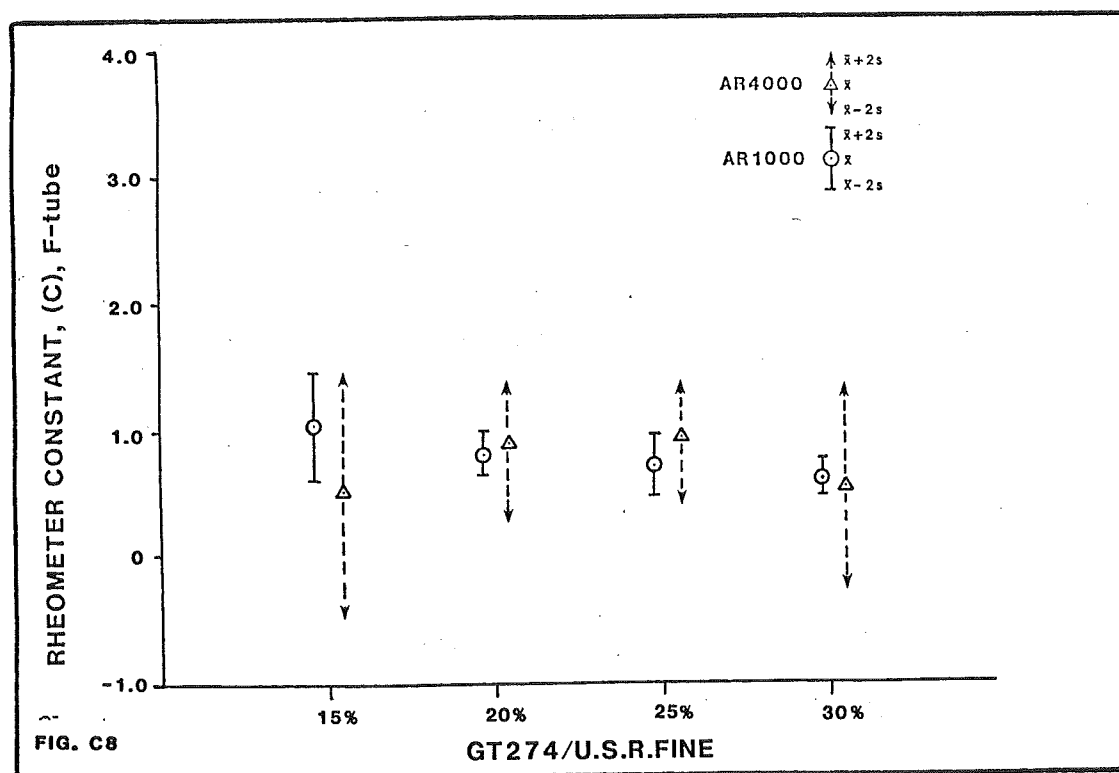
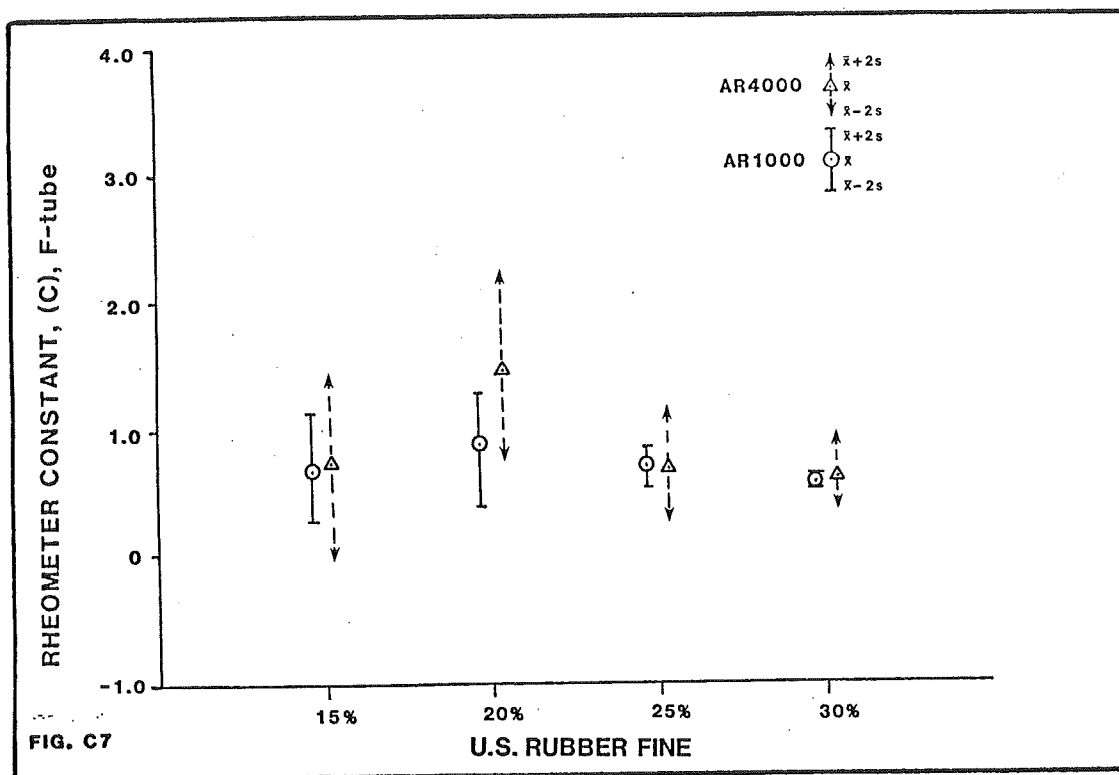
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	0.55	0.84	0.85	0.57
	s	0.55	0.29	0.27	0.40
	CV	.9988	35.02	31.27	70.57
A R 1 0 0 0	$\bar{x}$	1.07	0.76	0.70	0.63
	s	0.23	.07	0.11	.07
	CV	21.53	9.33	15.19	11.25

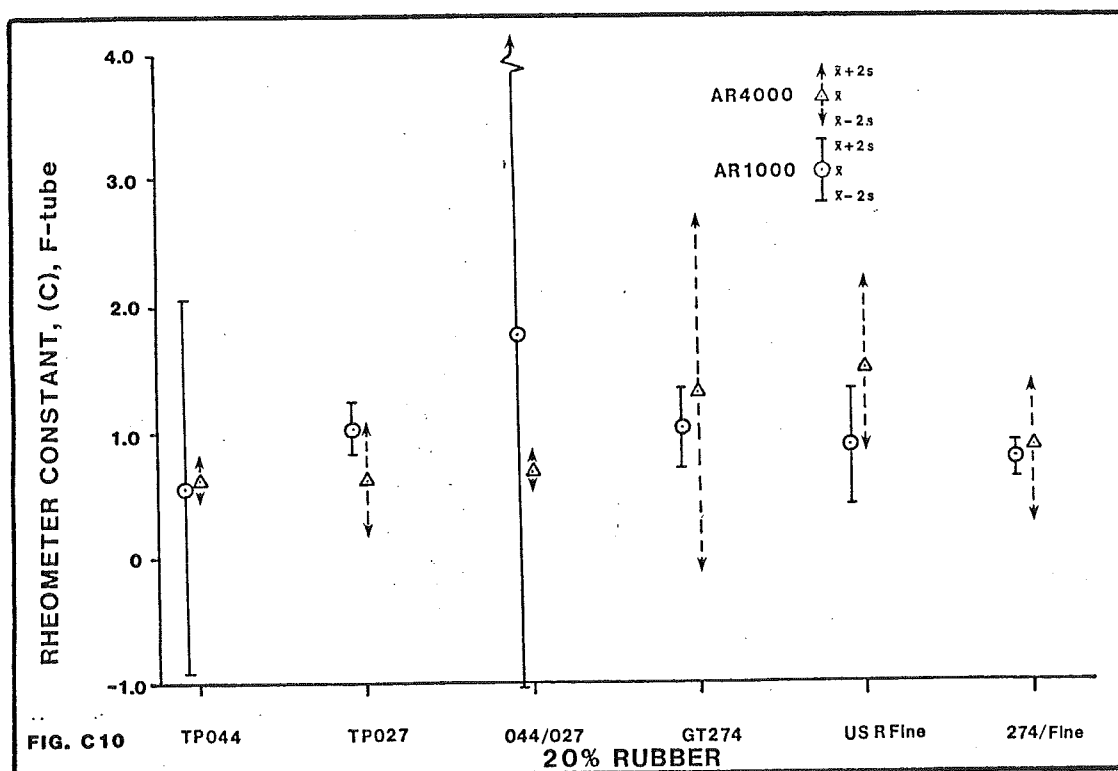
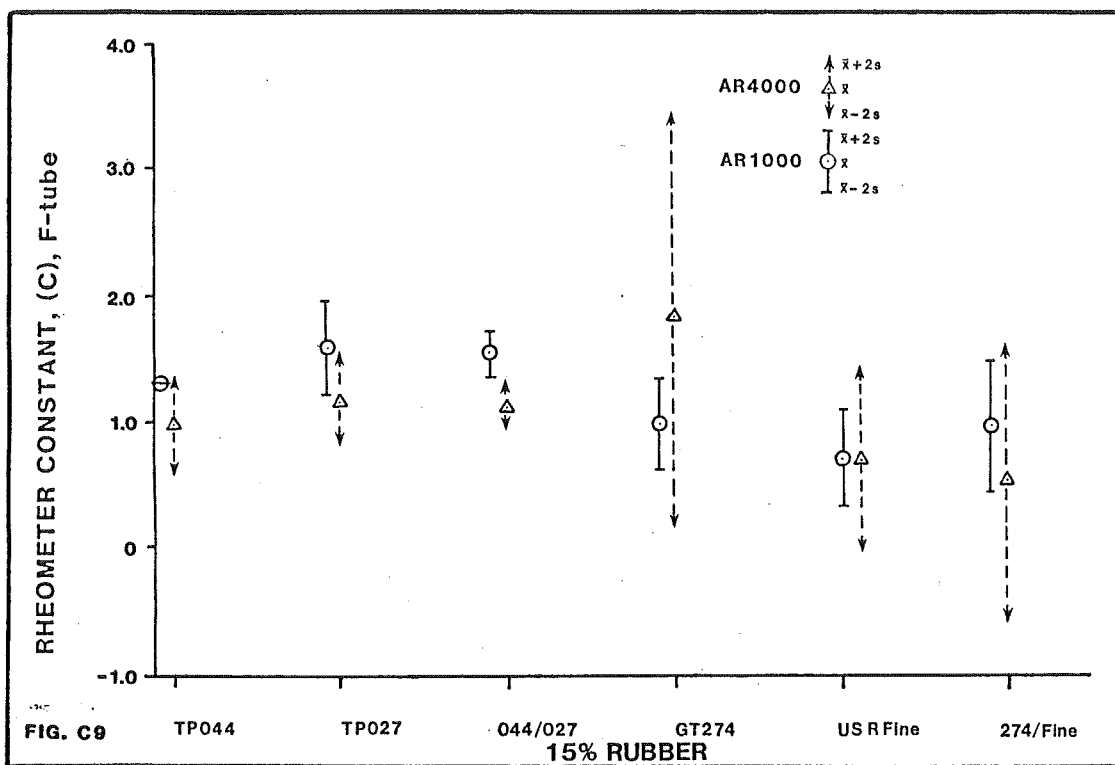
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TPQ46				TPQ67				50% TPQ46 50% TPQ67				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Schweyer	Constant																																				
	Factor																																				
Schweyer	Constant																																				
	Factor																																				











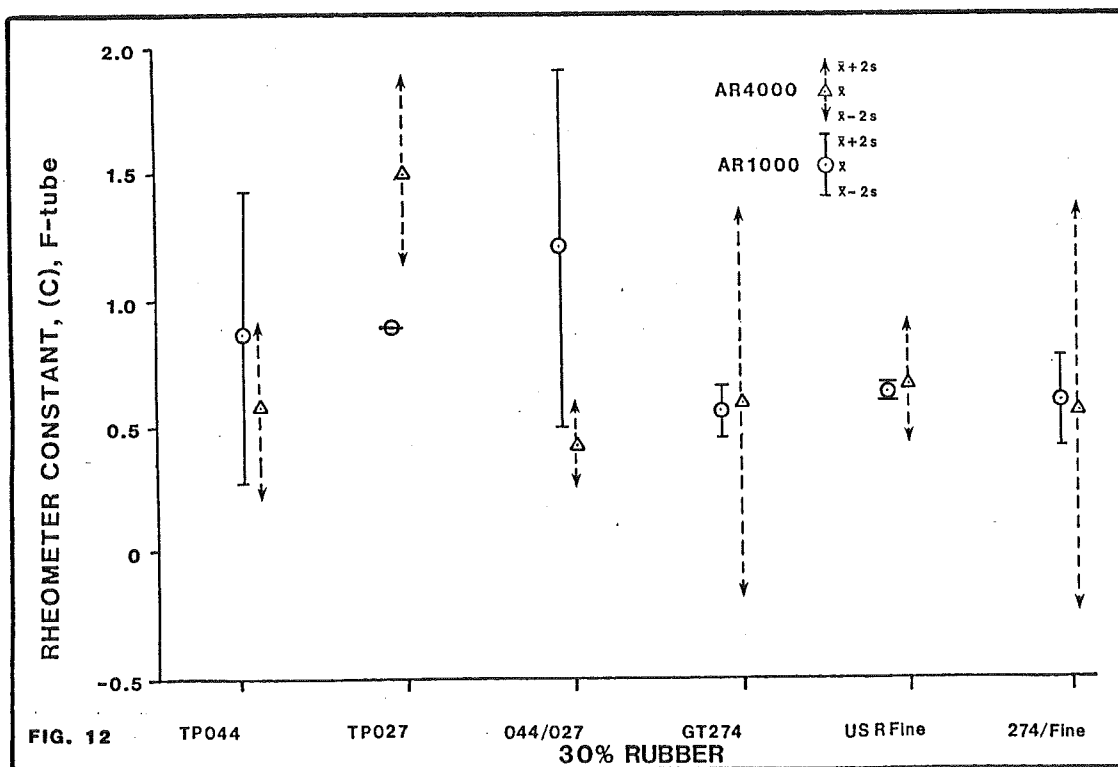
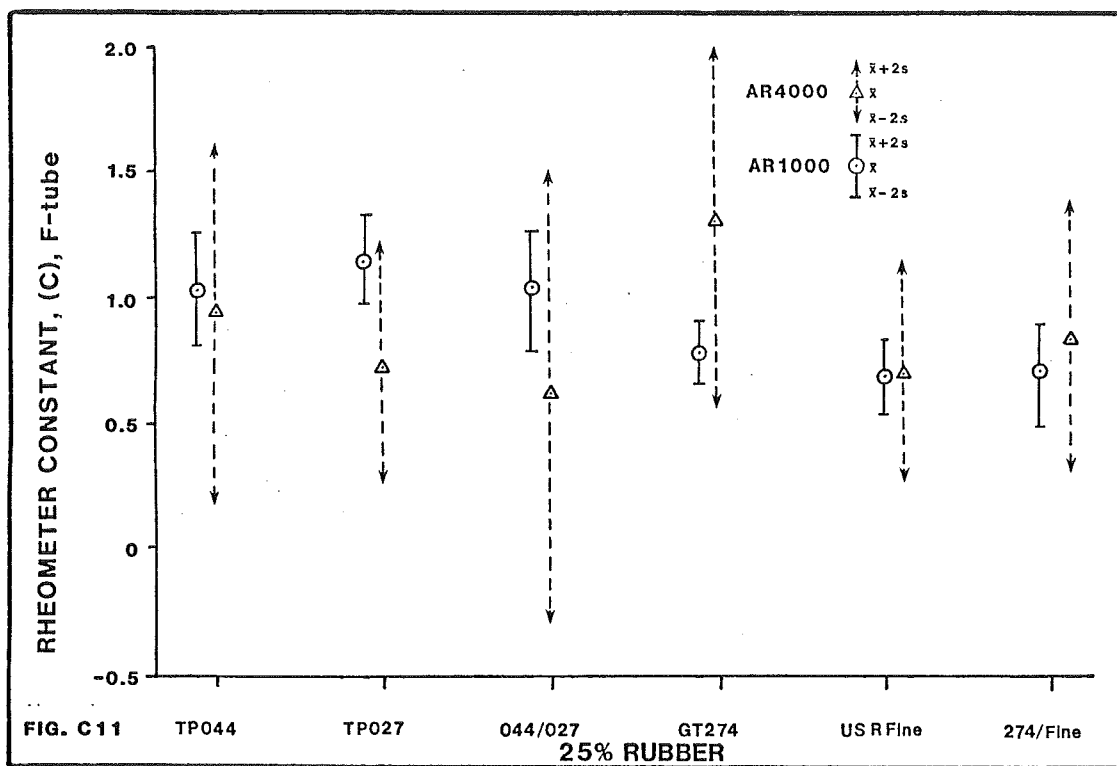


Table C-2 Schwyer Rheometer, Arctan
Constant (C), F-tube

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	47.72631	34.21570	47.72631	33.42481
	41.34778	30.54060	35.99202	24.70243
A R 1 0 0 0	52.43141	7.40691	47.72631	34.21570
	52.43141	44.42127	44.42127	45.00000

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	44.53704	32.37815	41.35917	29.06362
	S	5.65138	3.25614	11.28258	7.72803
	CV	12.69	10.06	27.28	26.59
A R 1 0 0 0	$\bar{x}$	52.43141	25.91409	46.07379	39.60785
	S	0	32.79473	2.92826	9.55489
	CV	0	126.55	6.36	24.12

— ASPHALT TYPE (A)
 — PERCENT RUBBER (B)
 — RUBBER TYPE (C)

	TP044			TP047			50% TP044 & 50% TP047			GT276			U.S. Rubber Firm			50% GT276 & 50% U.S. Rubber Firm		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
TP044																		
TP047																		
50% TP044 & 50% TP047																		
GT276																		
U.S. Rubber Firm																		
50% GT276 & 50% U.S. Rubber Firm																		

a. Analyzed Data

b. Summary

[illegible]

Table C-2 Schweyer Rheometer, Arctan
Constant (C), F-tube

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	50.19443	35.75389	41.02327	20.80679
	47.72631	33.02387	20.30447	25.17352
A R 1 0 0 0	57.99462	44.12754	47.72631	56.30993
	56.30993	68.96249	44.12754	54.46232

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	48.96037	34.38888	30.66387	22.99016
	s	2.18675	2.41880	18.35685	3.86893
	CV	4.47	7.03	59.86	6.83
A R 1 0 0 0	$\bar{x}$	57.15227	56.54501	45.92693	55.38613
	s	1.49263	22.00376	3.18851	1.63698
	CV	2.61	38.91	6.94	2.96

		ASPHALT TYPE (A)				PERCENT RUBBER (R)				RUBBER TYPE (R)			
		TP044				TP027				50% TP044 & 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
Sample No.	1												
	2												
Sample No.	3												
	4												
Sample No.	5												
	6												
Sample No.	7												
	8												
Sample No.	9												
	10												
Sample No.	11												
	12												
Sample No.	13												
	14												
Sample No.	15												
	16												
Sample No.	17												
	18												
Sample No.	19												
	20												
Sample No.	21												
	22												
Sample No.	23												
	24												
Sample No.	25												
	26												
Sample No.	27												
	28												
Sample No.	29												
	30												

Table C-2 Schweyer Rheometer, Arctan
Constant (C), F-tube

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	54.46232	41.98721	47.72631	20.30447
	66.50143	59.53446	56.30993	38.65981
A R 1 0 0 0	47.72631	47.72631	36.86990	27.92359
	41.98721	42.61406	39.35175	30.54060

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	60.48188	50.76083	52.01812	29.48214
	s	10.66665	15.54686	7.60509	16.26282
	CV	17.64	30.63	14.62	55.16
A R 1 0 0 0	$\bar{x}$	44.85676	45.17018	38.11083	29.23210
	s	5.08484	4.52946	2.19892	2.31868
	CV	11.34	10.03	5.77	7.93

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)											
		TP644				TP687				50% TP644 50% TP687				Q1974				U.S. Rubber Firm				50% Q1974 50% U.S. Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30				
100-100	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				

Table C-2 Schwyer Rheometer, Arctan
Constant (C), F-tube

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	42.92283	59.53446	40.03026	30.96376
	27.02158	52.43141	30.96376	36.50144
A R 1 0 0 0	30.96376	36.12944	33.42481	31.79891
	39.69267	44.71208	36.86990	30.96376

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	34.97220	55.98293	35.49700	33.73260
	S	14.08850	6.29330	8.03292	4.90639
	CV	40.28	11.24	22.63	14.54
A R 1 0 0 0	$\bar{x}$	35.32821	40.42076	35.14735	31.38133
	S	7.73382	7.60421	3.05235	0.73994
	CV	21.89	18.81	8.68	2.35

		ASPHALT TYPE (A)			PERCENT RUBBER (B)			RUBBER TYPE (C)		
		TP044			TP027			80% TP044 & 20% TP027		
		15	20	25	15	20	25	15	20	25
Rheometer	F-tube	---	---	---	---	---	---	---	---	---
		---	---	---	---	---	---	---	---	---
U.S. Rubber Fine	80% U.S. Rubber Fine & 20% TP044	---	---	---	---	---	---	---	---	---
		---	---	---	---	---	---	---	---	---

Table C-2 Schwyer Rheometer, Arctan
Constant (C), F-tube

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	40.69553	45.00000	45.00000	38.30874
	13.49573	33.82209	34.99202	42.92283
A R 1 0 0 0	50.19443	38.65981	32.61924	30.54060
	43.22853	35.75389	37.23483	33.82209

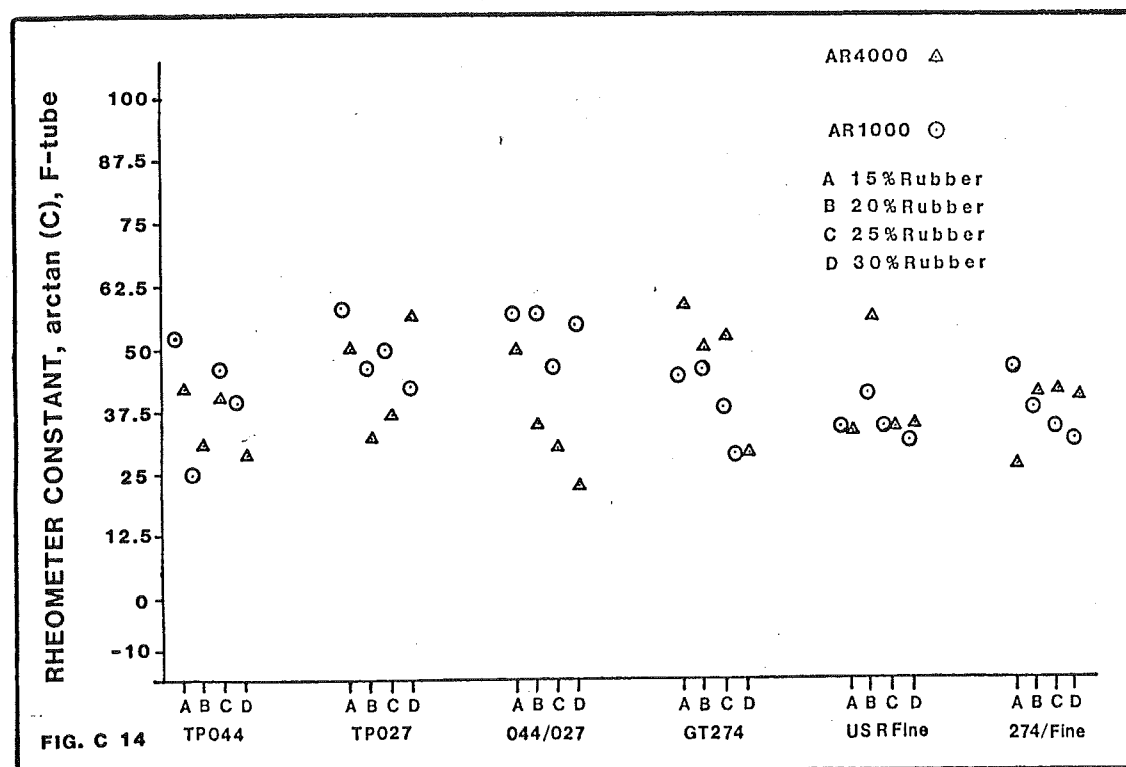
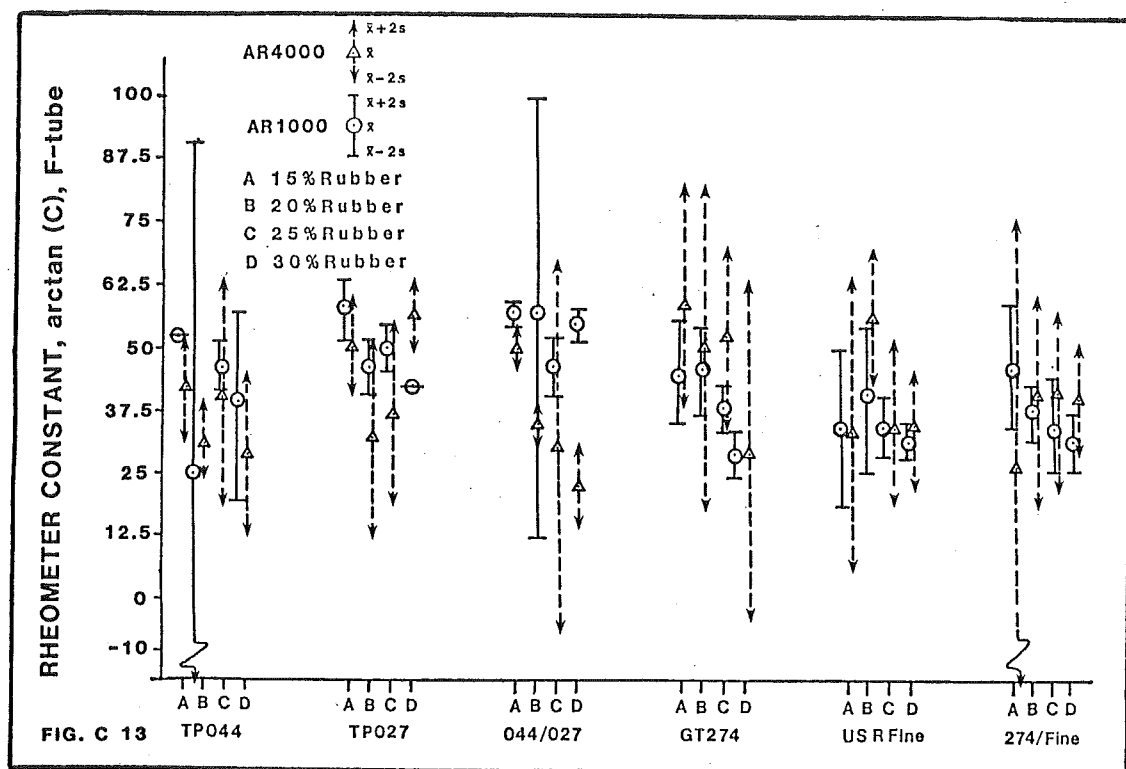
b. Summary

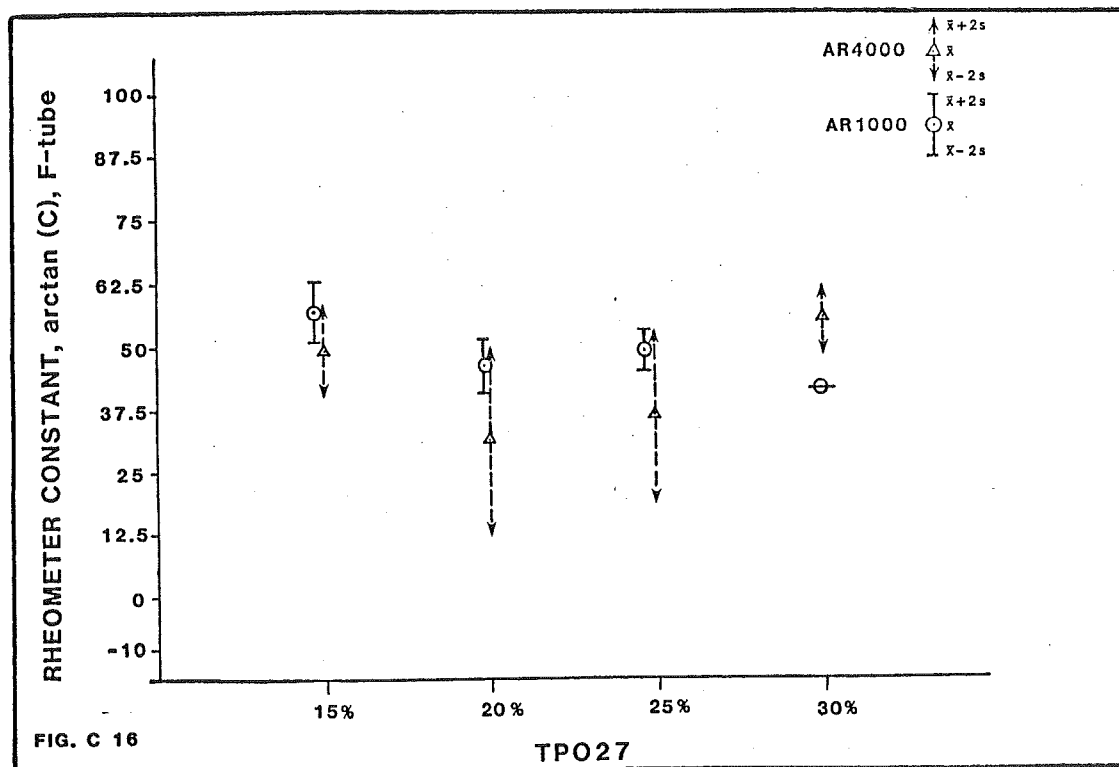
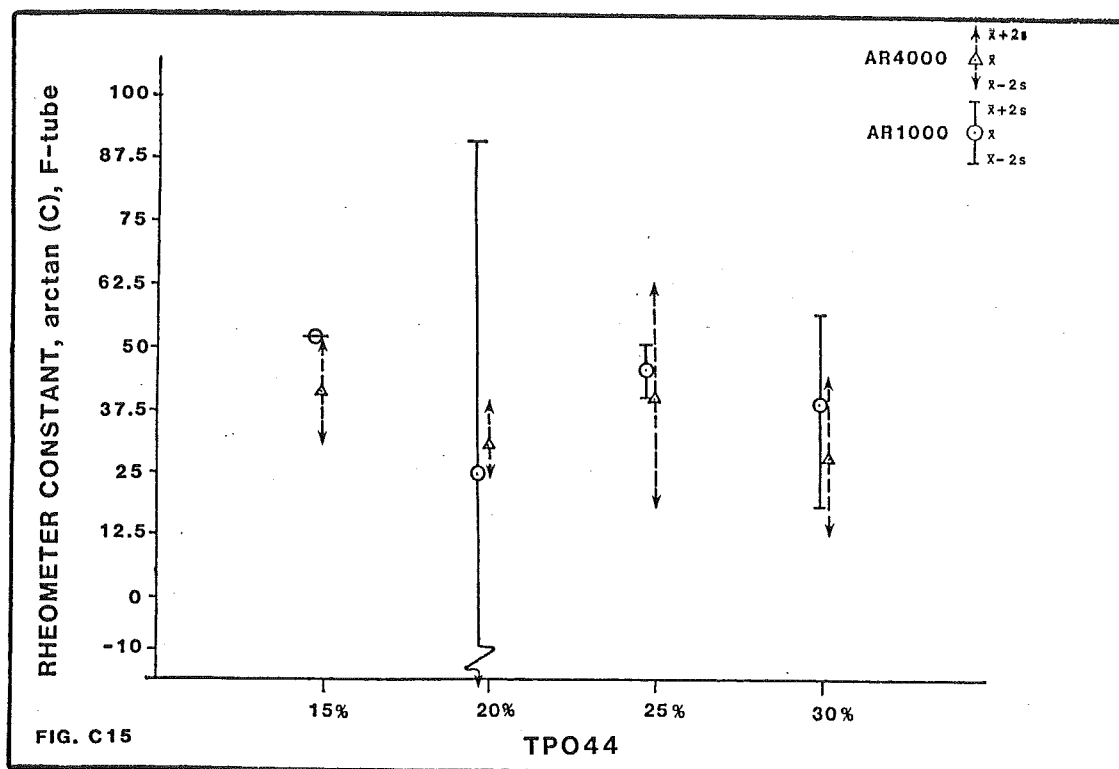
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	-X	27.09563	39.41104	39.99601	40.61578
	S	24.09902	9.90363	8.86707	4.08808
	CV	88.94	25.13	22.17	10.07
A R 1 0 0 0	-X	46.71148	37.20685	34.92704	32.18135
	S	6.17179	2.57465	4.08941	2.90740
	CV	13.21	6.92	11.71	9.03

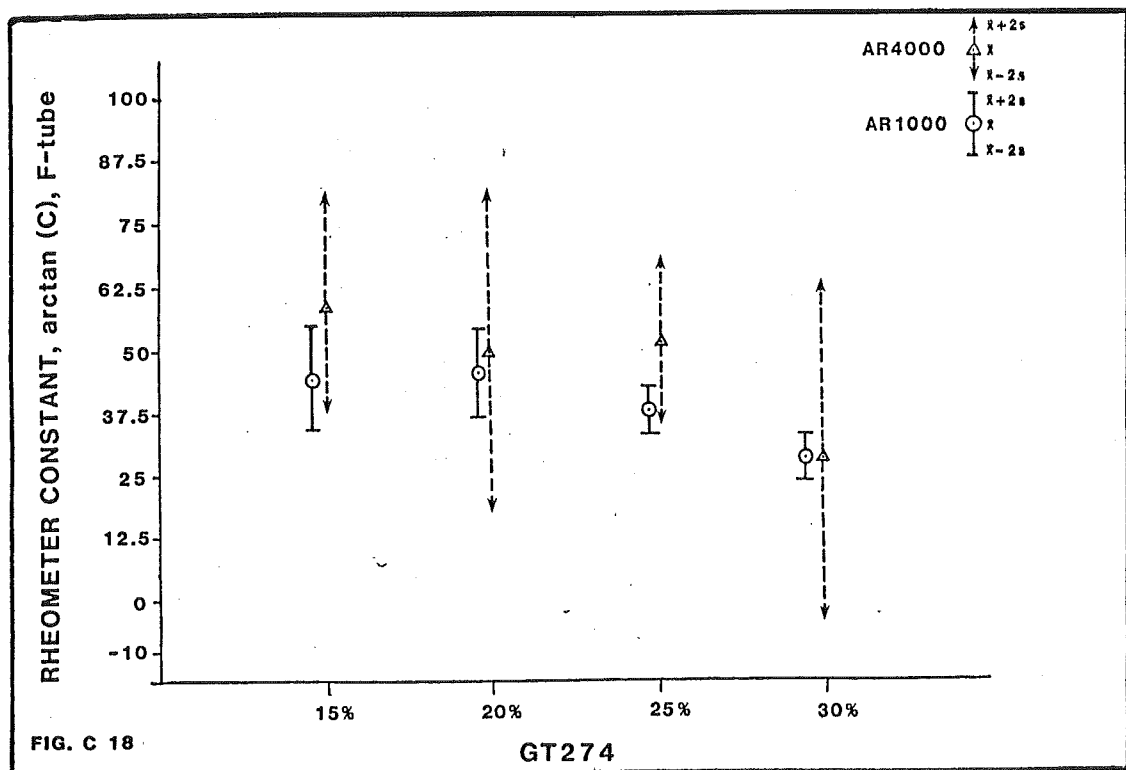
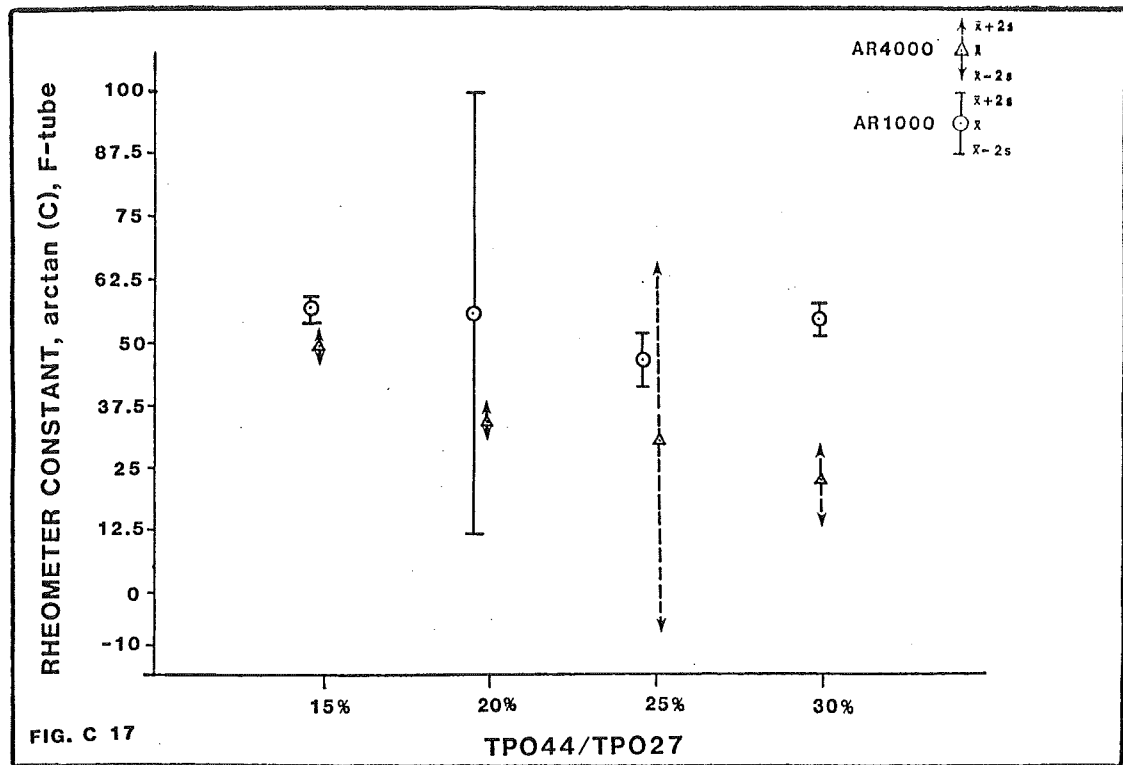
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				50% TP044 50% TP027				GT 274				U.S. Rubber Fine				50% GT 274 50% U.S. Rubber Fine															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30												
A	R	40.69553	45.00000	45.00000	38.30874	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578												
		13.49573	33.82209	34.99202	42.92283	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808												
A	R	50.19443	38.65981	32.61924	30.54060	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135												
		43.22853	35.75389	37.23483	33.82209	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740												
A	R	40.69553	45.00000	45.00000	38.30874	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578												
		13.49573	33.82209	34.99202	42.92283	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808												
A	R	50.19443	38.65981	32.61924	30.54060	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135												
		43.22853	35.75389	37.23483	33.82209	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740												
A	R	40.69553	45.00000	45.00000	38.30874	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578	27.09563	39.41104	39.99601	40.61578												
		13.49573	33.82209	34.99202	42.92283	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808	24.09902	9.90363	8.86707	4.08808												
A	R	50.19443	38.65981	32.61924	30.54060	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135	46.71148	37.20685	34.92704	32.18135												
		43.22853	35.75389	37.23483	33.82209	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740	6.17179	2.57465	4.08941	2.90740												

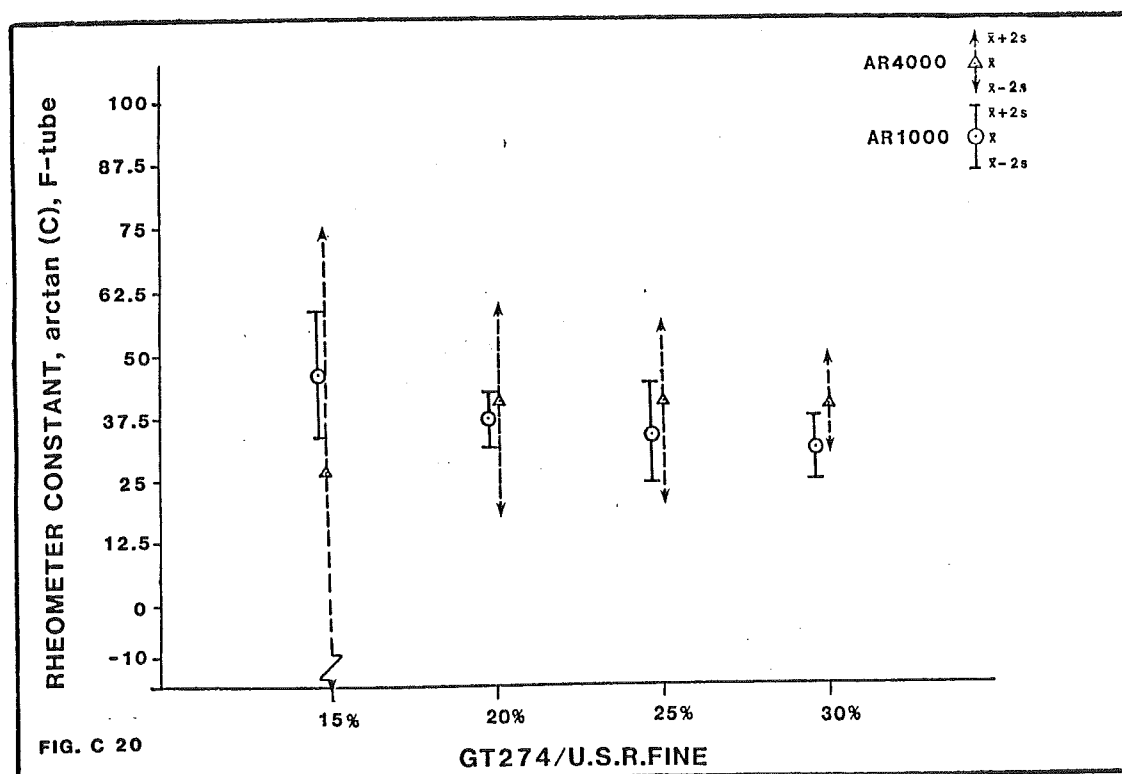
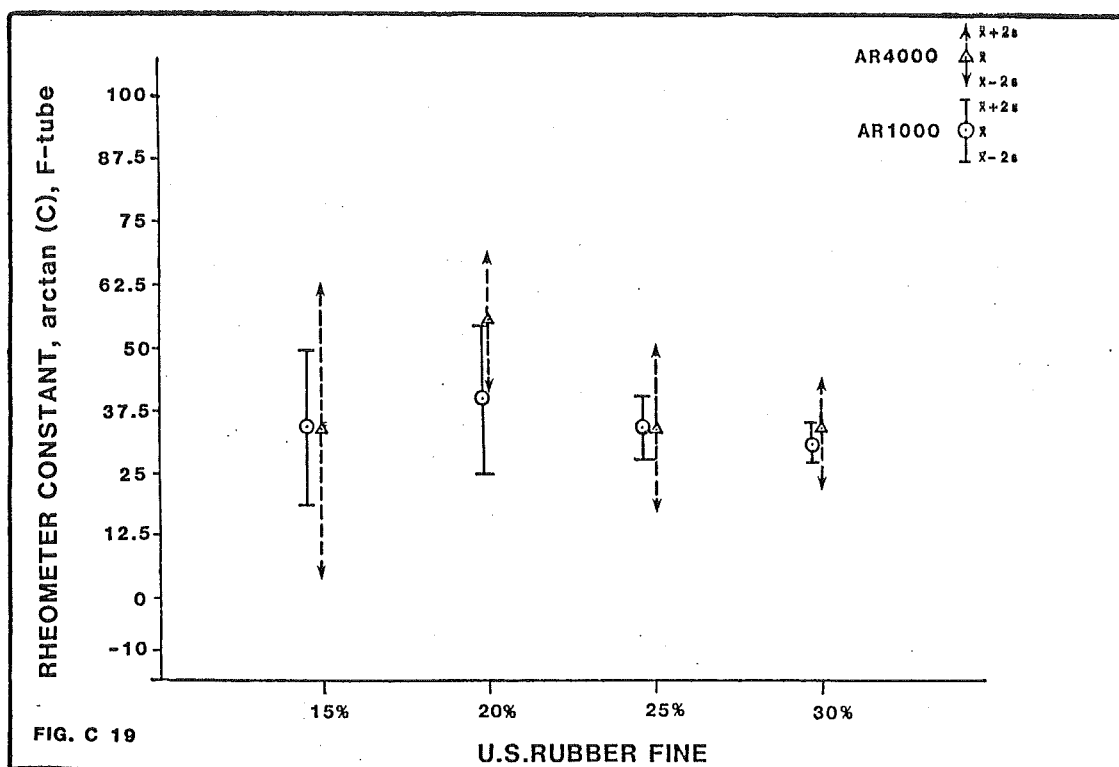
Table C-3 Anova Summary, Schweyer Rheometer,
Arctan Constant (C), F-tube

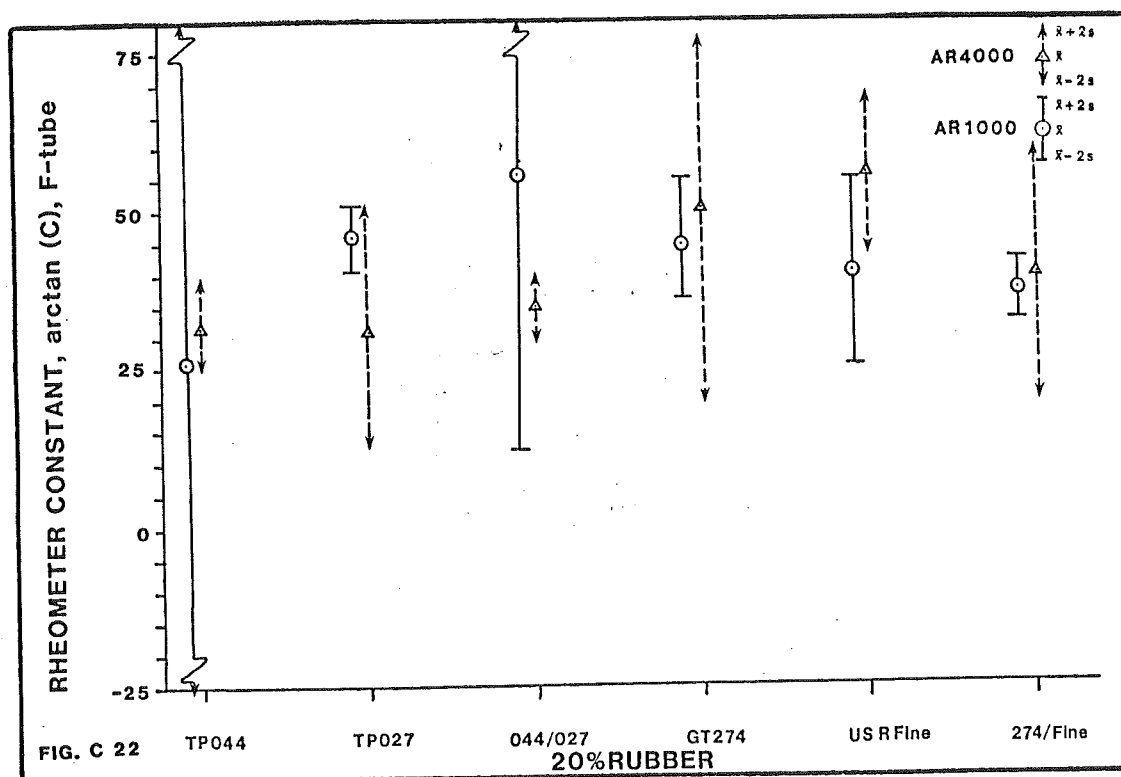
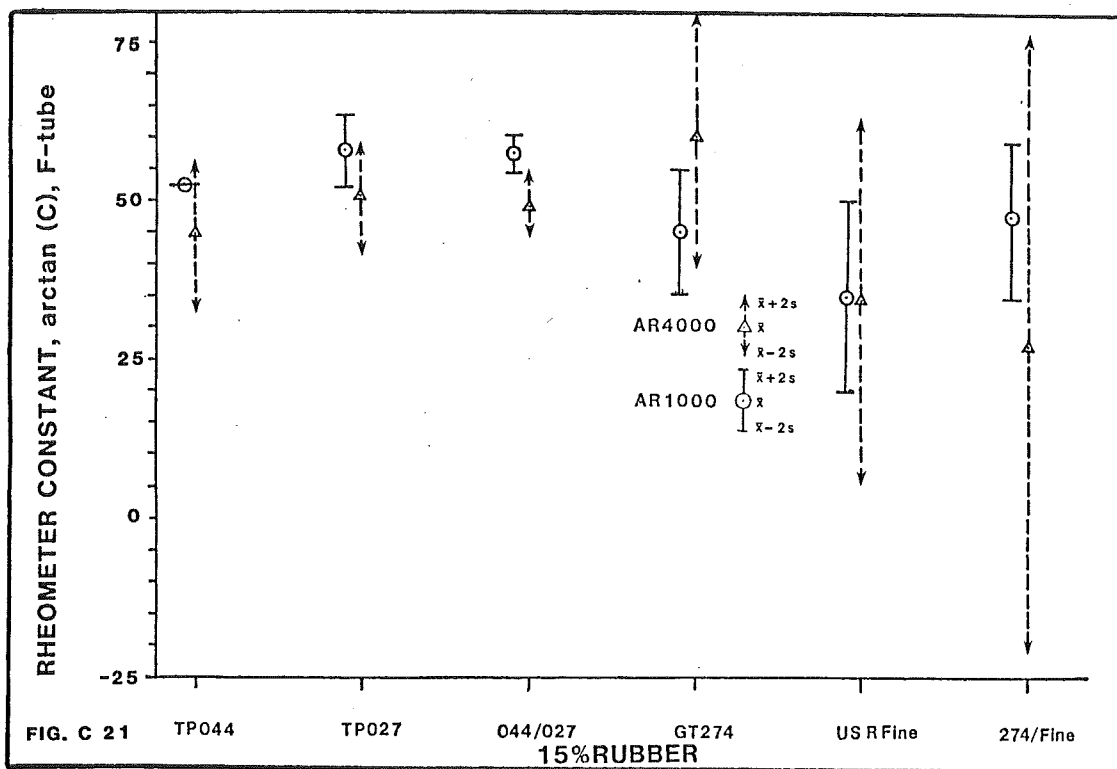
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	1129.84	225.96	3.77	2.43	3.48
Q	3	1213.54	404.5	6.75	2.82	4.27
A	1	176.34	176.34	2.94	4.06	7.27
RQ	15	2626.48	175.09	2.92	1.90	2.49
RA	5	1908.69	381.73	6.37	2.42	3.48
QA	3	41.52	13.84	0.23	2.82	4.27
RQA	15	1797.20	119.81	1.99	1.90	2.49
Error	48	2876.06	59.91			
TOTAL	95	11769.70				

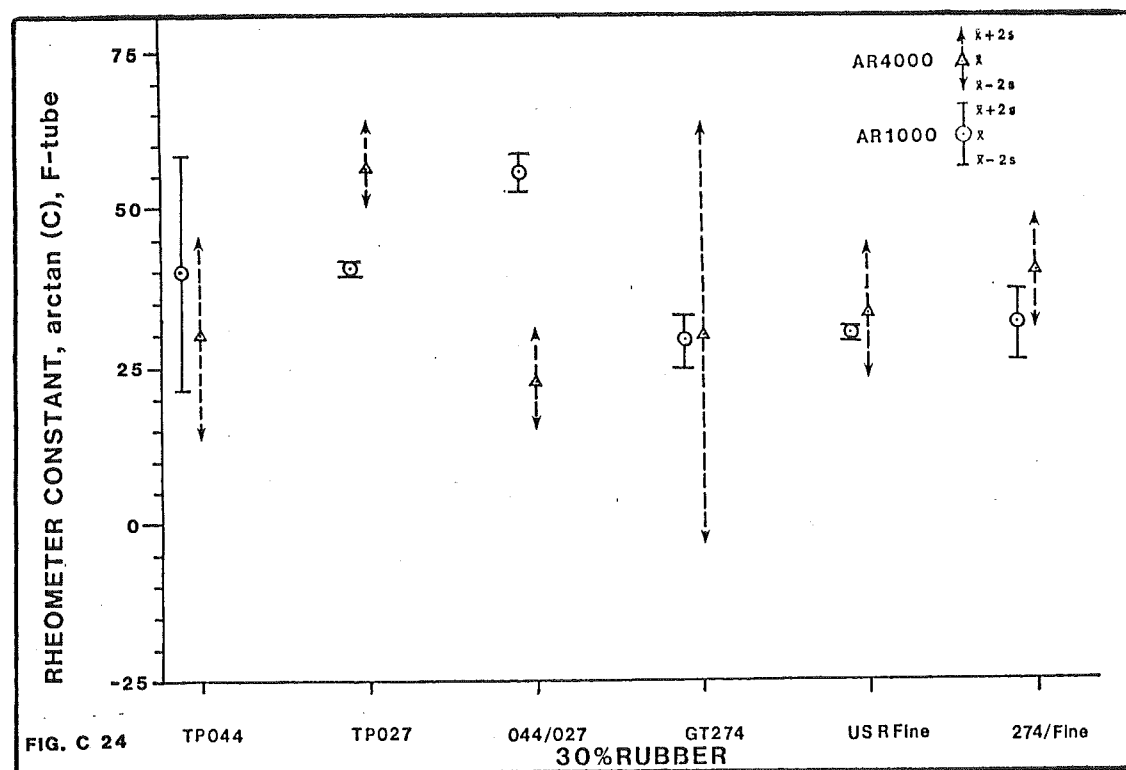
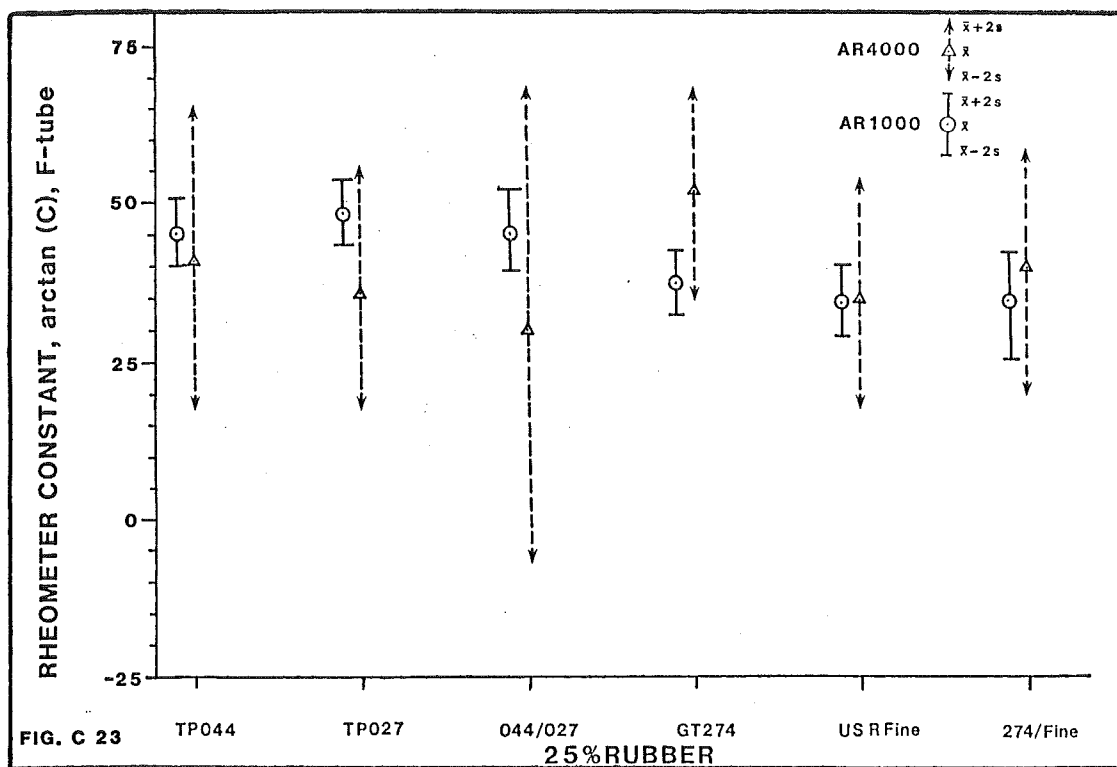












APPENDIX D

VISCOSITY ($\eta_{0.05}$) BY SCHWEYER
RHEOMETER AT 39.2F (4C), G-TUBE

Table D-1 Schwyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s, G-tube

a. Measured Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	150	24	130	42
	68	410	150	140
A R 1 0 0 0	56	95	2500	76
	400	8.8	230	69

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	109.0	217.0	140.0	91.0
	s	72.65	342.00	17.72	86.83
	cv	66.65	157.60	12.66	95.42
A R 1 0 0 0	$\bar{x}$	228.0	51.9	1365.0	72.5
	s	304.78	76.37	2011.2	6.20
	cv	133.68	147.15	147.34	8.55

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (B)			
		TP044				TP027				50% TP044 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
G-TUBE	15												
	20												
1/8 RUBBER FINE	15												
	20												
50% 50%	15												
	20												

Table D-1 Schwyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s , G-tube

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	330	130	110	84
	59	520	780	130
A R 1 0 0 0	9	260	100	39
	87	52	79	100

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	194.5	325.0	445.0	107.0
	S	240.11	345.54	593.62	40.76
	CV	137.60	106.32	133.40	38.09
A R 1 0 0 0	$\bar{x}$	48.0	156.0	89.5	69.5
	S	69.11	184.29	18.61	54.05
	CV	143.98	118.13	20.79	77.77

		ADPHLY TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (R)			
		TP044				TP027				50% TP044 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
G-TUBE	1000-150												
	1000-150												

Table D-1 Schweyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s, G-tube

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	810	100	110	120
	170	340	150	730
A R 1 0 0 0	69	120	150	100
	130	300	160	150

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	490.0	220.0	130.0	425.0
	s	567.04	212.64	35.44	540.46
	cv	115.72	96.65	27.26	127.17
A R 1 0 0 0	$\bar{x}$	99.5	210.0	155.0	125.0
	s	54.05	159.48	8.86	44.30
	cv	54.27	75.94	5.72	35.44

ASPHALT TYPE (A)
 PERCENT RUBBER (R)
 RUBBER TYPE (R)

	TP044			TP027			50% TP044 & 50% TP027			G1814			U.S. Rubber Firm			50% G1814 & 50% U.S. Rubber Firm		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Asphalt																		
Rubber																		

Table D-1 Schwyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s , G-tube

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	140	34	34	27
	120	21	49	17
A R 1 0 0 0	30	35	16	21
	60	42	91	20

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	130.0	27.5	41.5	22.0
	s	17.72	11.52	13.29	8.86
	cv	13.63	41.89	32.02	40.27
A R 1 0 0 0	$\bar{x}$	45.0	38.5	53.5	20.5
	s	26.58	6.20	66.45	0.89
	cv	59.07	16.10	124.21	4.34

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (B)			
		TP046				TP037				50% TP046 & 50% TP037			
		15	20	25	30	15	20	25	30	15	20	25	30
Temperature	150	---	---	---	---	---	---	---	---	---	---	---	---
	160	---	---	---	---	---	---	---	---	---	---	---	---
Shear Rate	100	---	---	---	---	---	---	---	---	---	---	---	---
	200	---	---	---	---	---	---	---	---	---	---	---	---

Table D-1 Schweyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s, G-tube

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	68	49	16	20
	74	58	33	37
A R 1 0 0 0	25	18	25	12
	21	17	23	36

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	71.0	53.5	24.5	28.5
	S	5.32	7.97	15.06	15.06
	CV	7.49	14.90	61.47	52.84
A R 1 0 0 0	$\bar{x}$	23.0	17.5	24.0	24.0
	S	3.54	0.89	1.77	21.26
	CV	15.33	5.09	7.38	88.58

ASPHALT TYPE (A)
 PERCENT RUBBER (B)
 RUBBER TYPE (R)

	TPD44			TPG37			50% TPD44 A 50% TPG37			GT274			U.S. Rubber Fine			50% GT274 50% U.S. Rubber F		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
1000-100																		
1000-200																		
1000-300																		
1000-400																		
1000-500																		
1000-600																		
1000-700																		
1000-800																		
1000-900																		
1000-1000																		

Table D-1 Schweyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s, G-tube

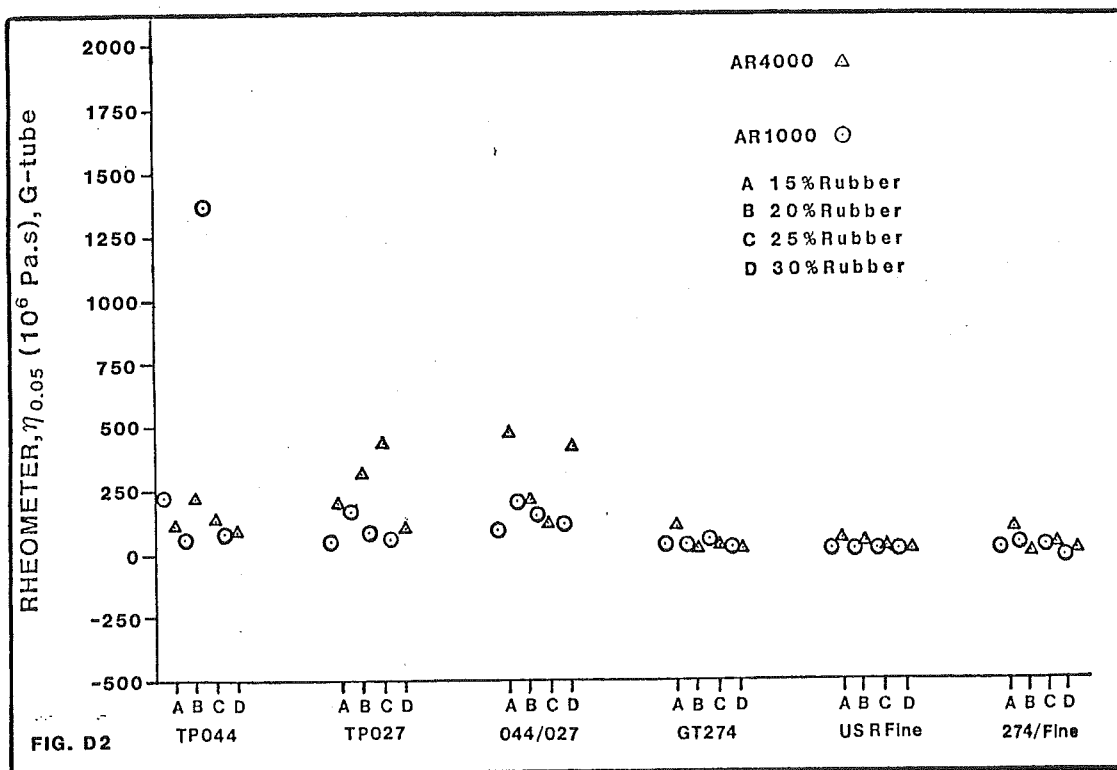
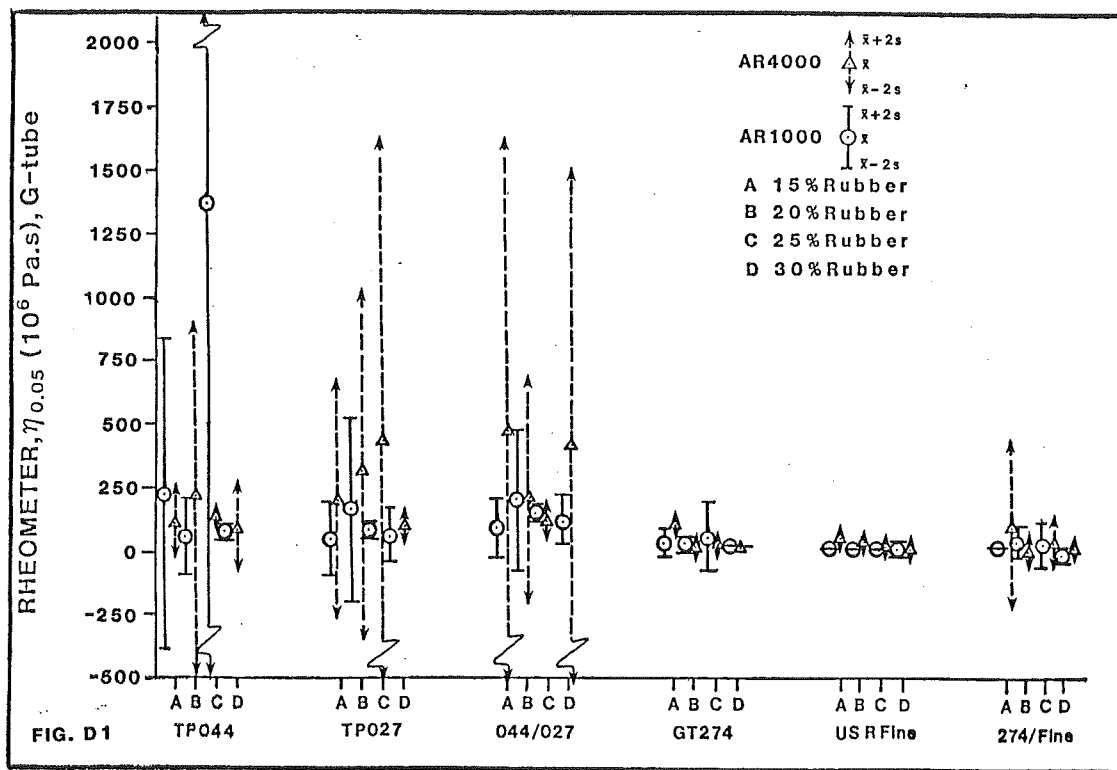
a. Measured Data

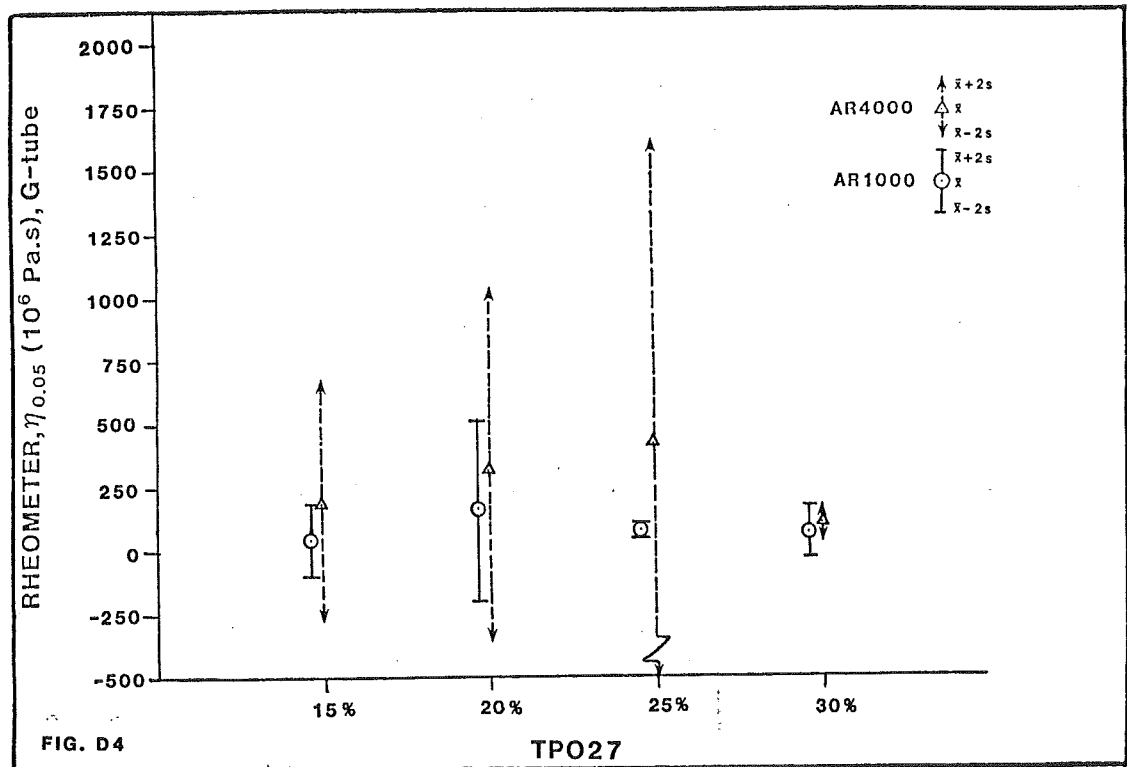
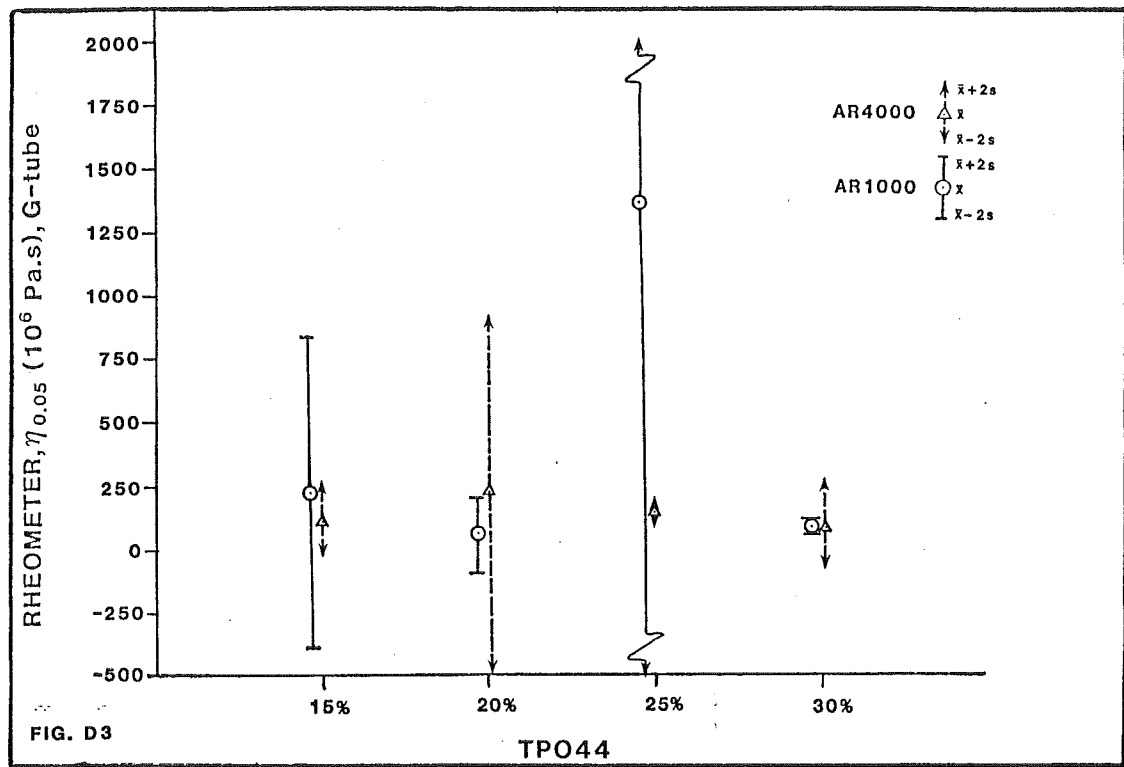
50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	37	47	23	20
	220	20	80	13
A R 1 0 0 0	19	29	11	26
	23	60	56	13

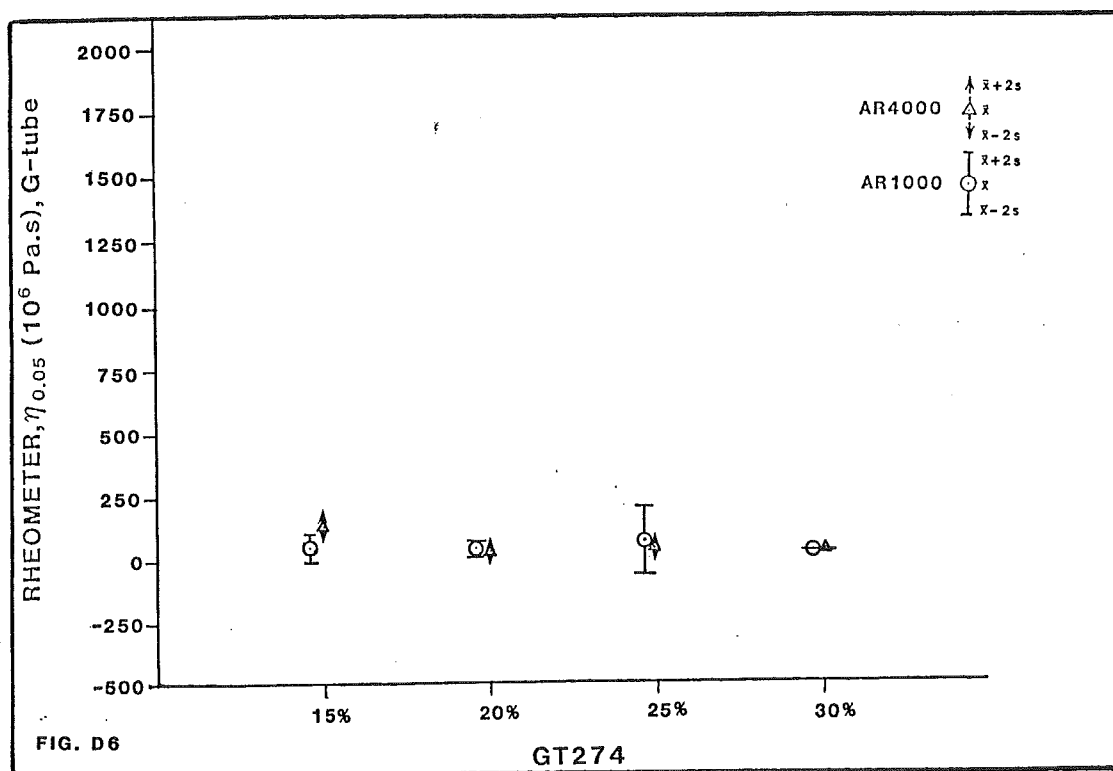
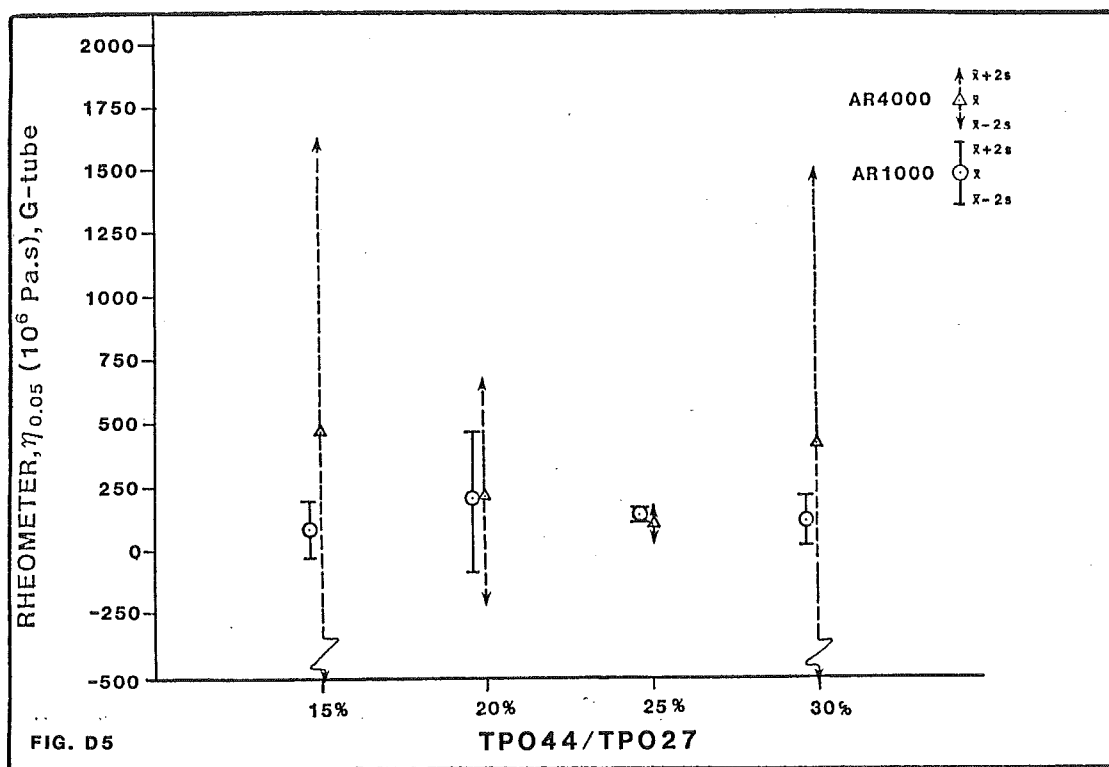
b. Summary

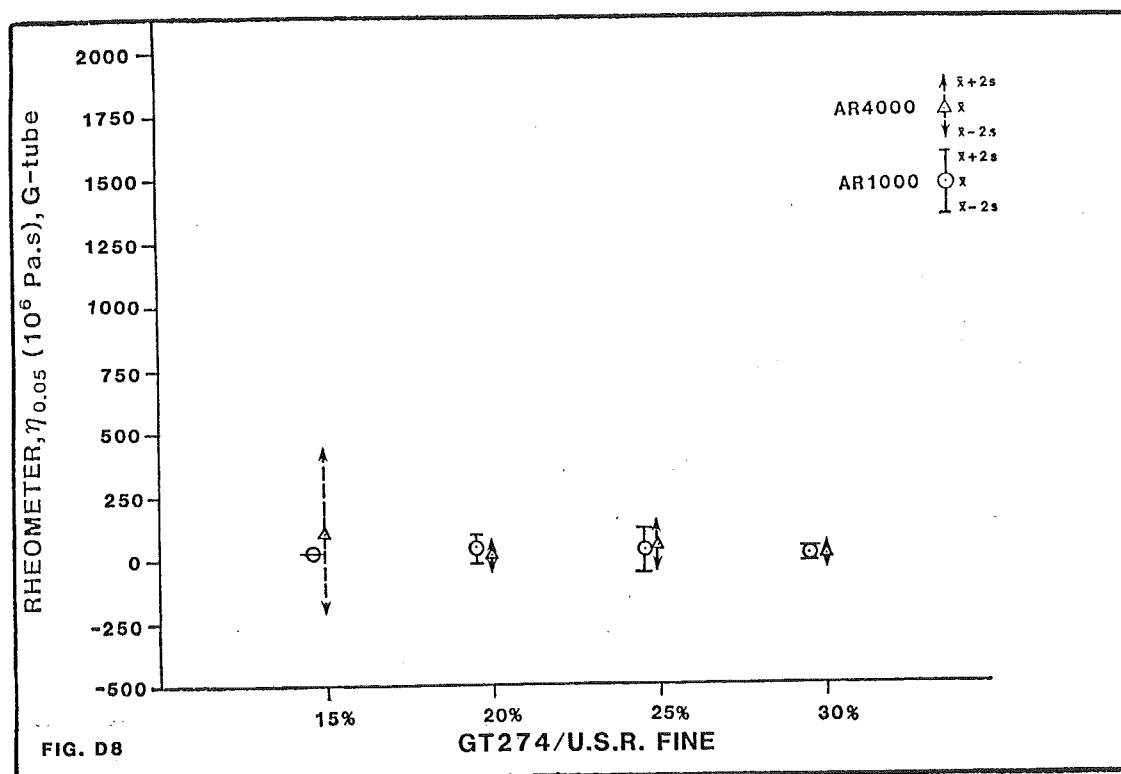
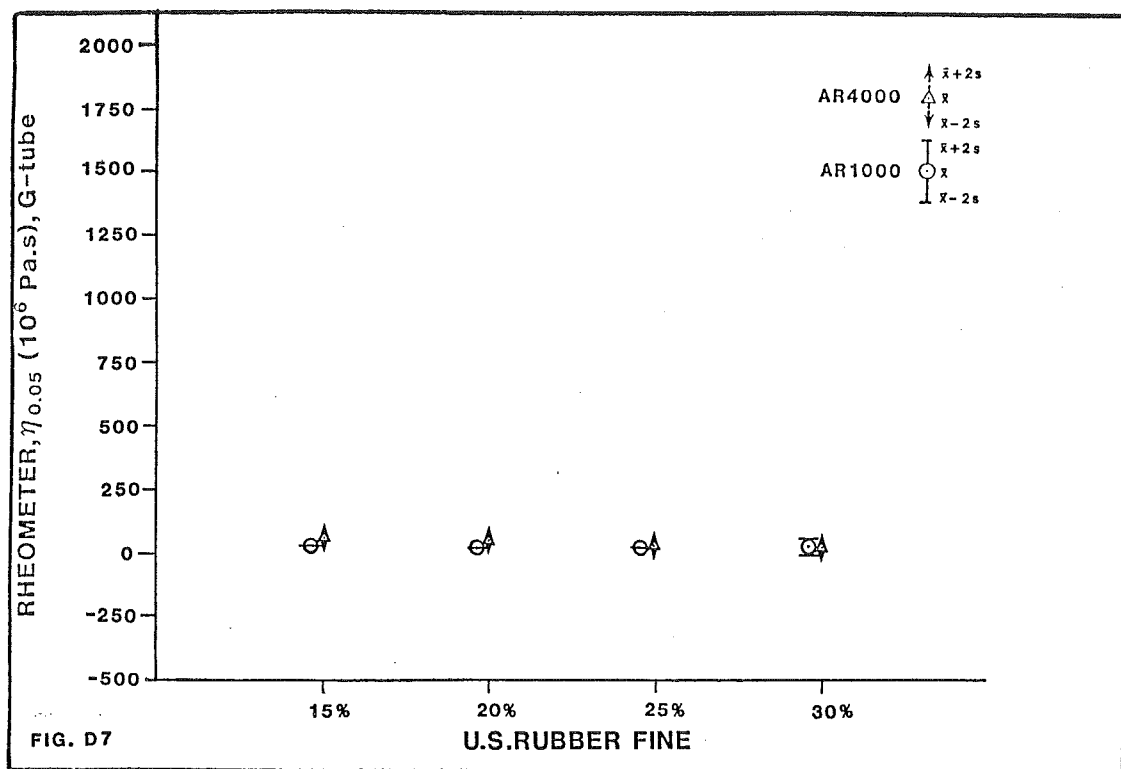
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	128.5	33.5	51.5	16.5
	s	162.14	23.92	50.50	6.20
	cv	126.18	71.40	98.06	37.58
A R 1 0 0 0	$\bar{x}$	21.0	44.5	33.5	19.5
	s	3.54	27.47	39.87	11.52
	cv	16.86	61.73	119.01	59.08

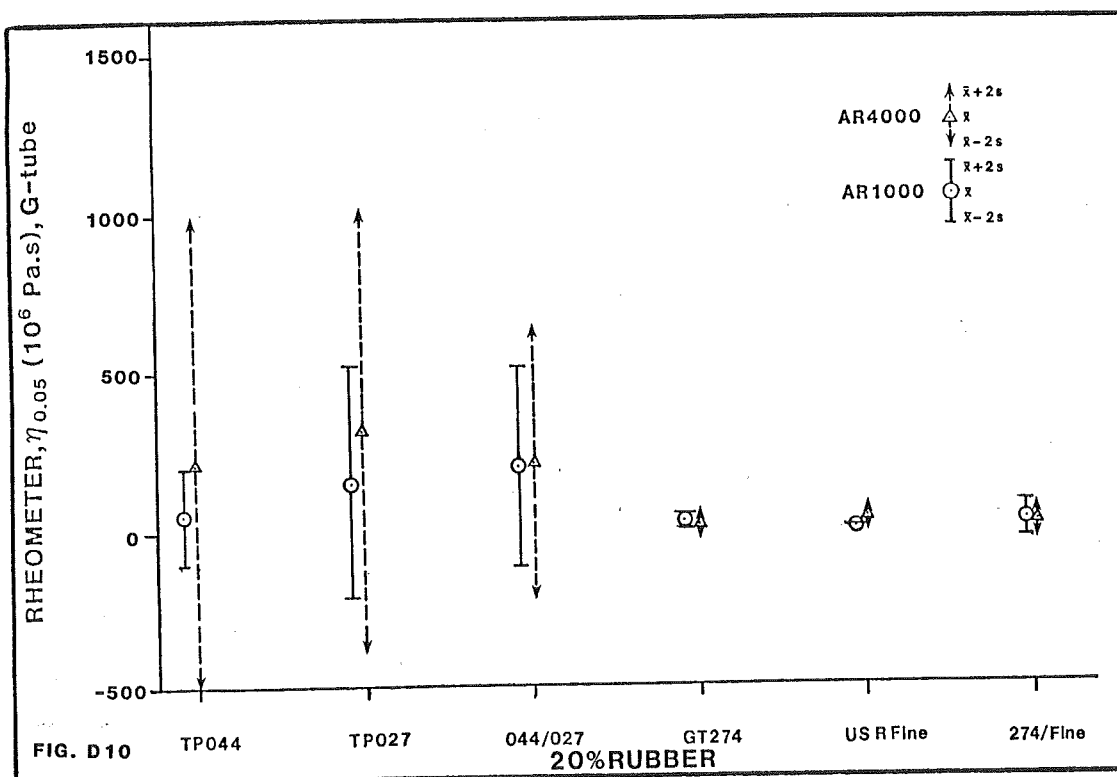
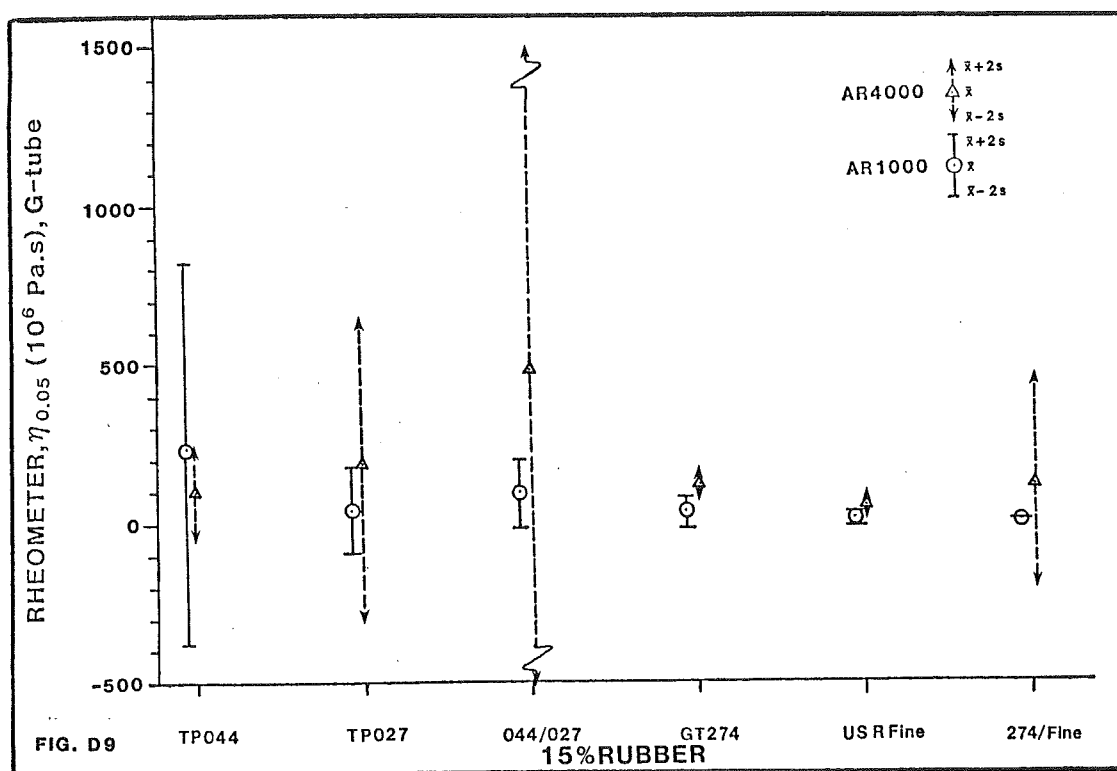
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP087				50% TP044 50% TP087				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber Fine															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
G T T U B E	100																																				
	200																																				
	300																																				
	400																																				

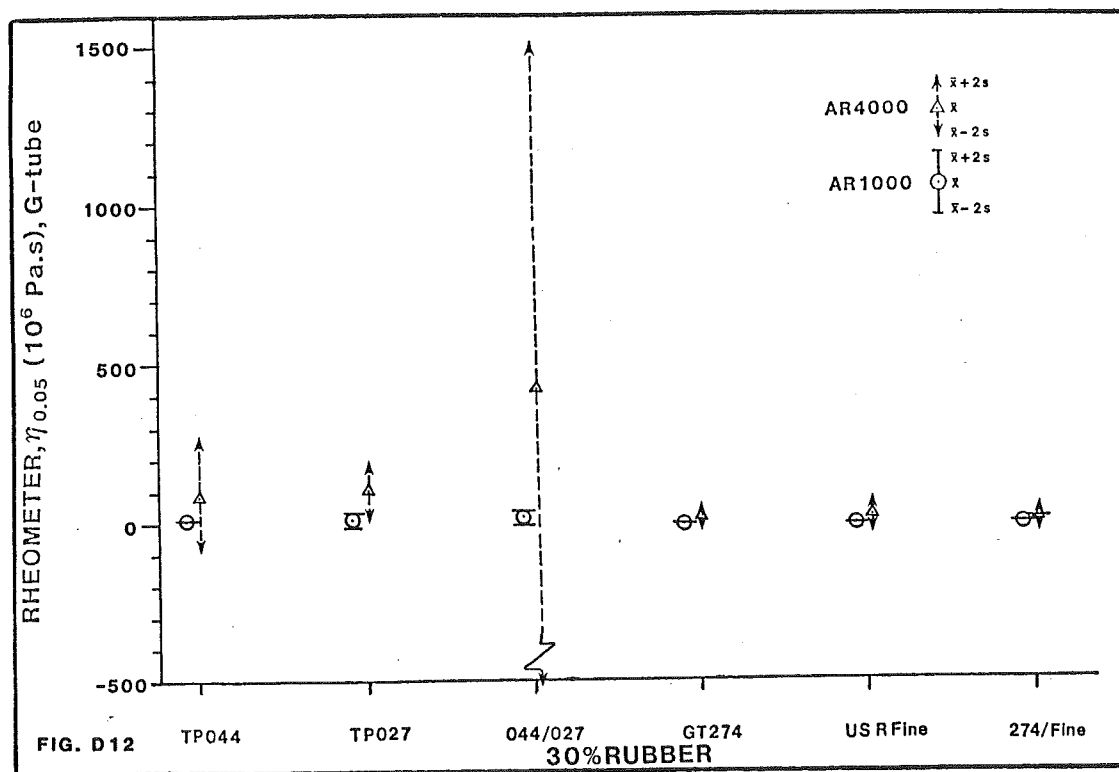
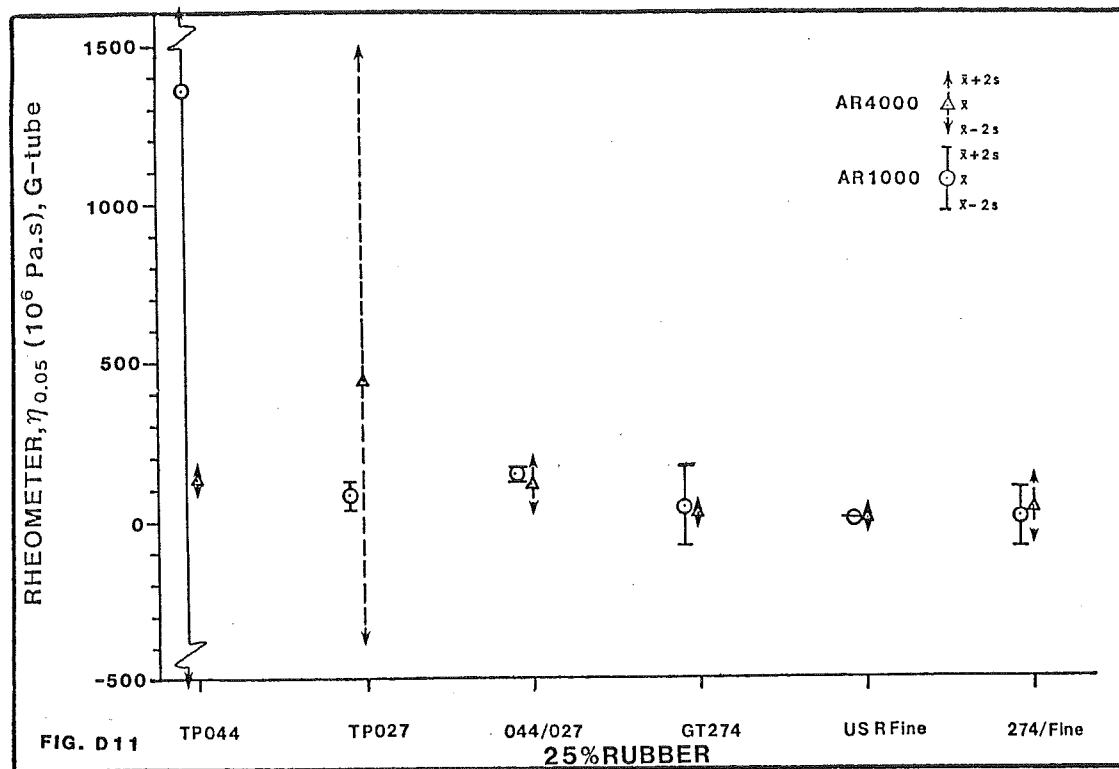












a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
AR 4 0 0 0	2.17609 	1.38021 	2.11394 	1.62325
	1.83251	2.61278	2.17609	2.14613
AR 1 0 0 0	1.74819 	1.97772 	3.39794 	1.88081
	2.60206	0.94448	2.36173	1.83885

b. Summary

		TP044			
		15%	20%	25%	30%
A	$\bar{x}$	2.00430	1.99650	2.14502	1.88469
R	s	.30441	1.09206	.05506	.46327
4	cv	15.19	54.70	2.57	24.58
0					
0					
0					
A	$\bar{x}$	2.17512	1.46110	2.87983	1.85983
R	s	.75653	.91545	.91808	.03718
1	cv	34.78	62.65	31.88	2.00
0					
0					
0					

[illegible]

Table D-2 Schwyer Rheometer, Log Apparent Viscosity, $\eta_{0.05}$, 10^6 Pa-s, G-tube

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	2.51851	2.11394	2.04139	1.92428
	1.77085	2.71600	2.89209	2.11394
A R 1 0 0 0	0.95424	2.41497	2.00000	1.59106
	1.93952	1.71600	1.89763	2.00000

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	2.14468	2.41497	2.46674	2.01991
	S	.66243	.53343	.75372	.16804
	CV	30.89	22.09	30.56	8.32
A R 1 0 0 0	$\bar{x}$	1.44688	2.06549	1.94881	1.79553
	S	.87296	.61929	.09070	.26232
	CV	60.33	29.98	4.65	20.18

		TP044				TP027				TP044 SON TP027				G1876				U.S. Rubber Type				SON G1876 SON R Plus 6			
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Asphalt Type (A)	TP044																								
	TP027																								
Percent Rubber (B)	TP044																								
	TP027																								
Rubber Type (C)	TP044																								
	TP027																								

Table D-2 Schwyer Rheometer, Log Apparent Viscosity, $\eta_{0.05}$, 10^6 Pa-s, G-tube

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	2.90849	2.00000	2.04139	2.07918
	2.23045	2.53148	2.17609	2.86332
A R 1 0 0 0	1.83885	2.07918	2.17609	2.00000
	2.11394	2.47712	2.20412	2.17609

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	2.56947	2.26574	2.10874	2.47125
	S	.60074	.47089	.11934	.69475
	CV	23.38	20.78	5.66	28.11
A R 1 0 0 0	$\bar{x}$	1.97640	2.27815	2.19011	2.08805
	S	.24373	.35257	.02483	.15602
	CV	12.33	15.48	1.13	7.47

		ASPHALT TYPE (A)			PERCENT RUBBER (B)			RUBBER TYPE (R)											
		TP044			TP027			50% TP044 50% TP027			G7576			U.S. Rubber Firm			50% G7576 50% U.S. Firm		
		15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		
Rheometer	G-tube																		

Table D-2 Schwyer Rheometer, Log Apparent Viscosity, $\eta_{0.05}$, 10^6 Pa-s , G-tube

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	2.14613	1.53148	1.53148	1.43136
	2.07918	1.32221	1.69020	1.23045
A R 1 0 0 0	1.47712	1.54407	1.20412	1.32222
	1.77815	1.63325	1.95904	1.30103

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	2.11265	1.42685	1.61084	1.33091
	s	.05931	.18540	.14062	.17801
	cv	2.81	12.99	8.73	13.38
A R 1 0 0 0	$\bar{x}$	1.62764	1.58366	1.58158	1.31162
	s	.26671	.07015	.66886	.01877
	cv	16.39	4.43	42.29	1.43

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP067				50% TP044 50% TP067				G1174				U.S. Rubber Firm				50% G1174 50% U.S. Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
ASPHALT TYPE (A)	Temperature																																				
	Viscosity																																				
	Flow																																				
	Penetration																																				
PERCENT RUBBER (B)	Temperature																																				
	Viscosity																																				
	Flow																																				
	Penetration																																				
RUBBER TYPE (C)	Temperature																																				
	Viscosity																																				
	Flow																																				
	Penetration																																				

Table D-2 Schweyer Rheometer, Log Apparent Viscosity, $\eta_{0.05}$, $10^6 \text{ Pa}\cdot\text{s}$, G-tube

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	1.83251	1.69020	1.20412	1.30103
	1.86923	1.76343	1.51851	1.56820
A R 1 0 0 0	1.39794	1.25527	1.39794	1.07918
	1.32222	1.23045	1.36173	1.55630

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	1.85087	1.72681	1.36132	1.43462
	s	.03254	.06488	.27855	.23671
	cv	1.76	3.76	20.46	16.50
A R 1 0 0 0	$\bar{x}$	1.36008	1.24286	1.37983	1.31774
	s	.06709	.02199	.03208	.42273
	cv	4.93	1.77	2.33	32.08

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TPQ44				TPQ37				80% TPQ44 & 20% TPQ37			
		15	20	25	30	15	20	25	30	15	20	25	30
G-Tube	15												
	20												
G-Tube	25												
	30												
G-Tube	35												
	40												
G-Tube	45												
	50												
G-Tube	55												
	60												
G-Tube	65												
	70												
G-Tube	75												
	80												
G-Tube	85												
	90												
G-Tube	95												
	100												

Table D-2 Schwyer Rheometer, Log Apparent Viscosity, $\eta_{0.05}$, $10^6 \text{ Pa}\cdot\text{s}$, G-tube

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	1.56820	1.67210	1.36173	1.30103
	2.34242	1.30103	1.90309	1.11394
A R 1 0 0 0	1.27875	1.46240	1.04139	1.41497
	1.36173	1.77815	1.74819	1.11394

b. Summary

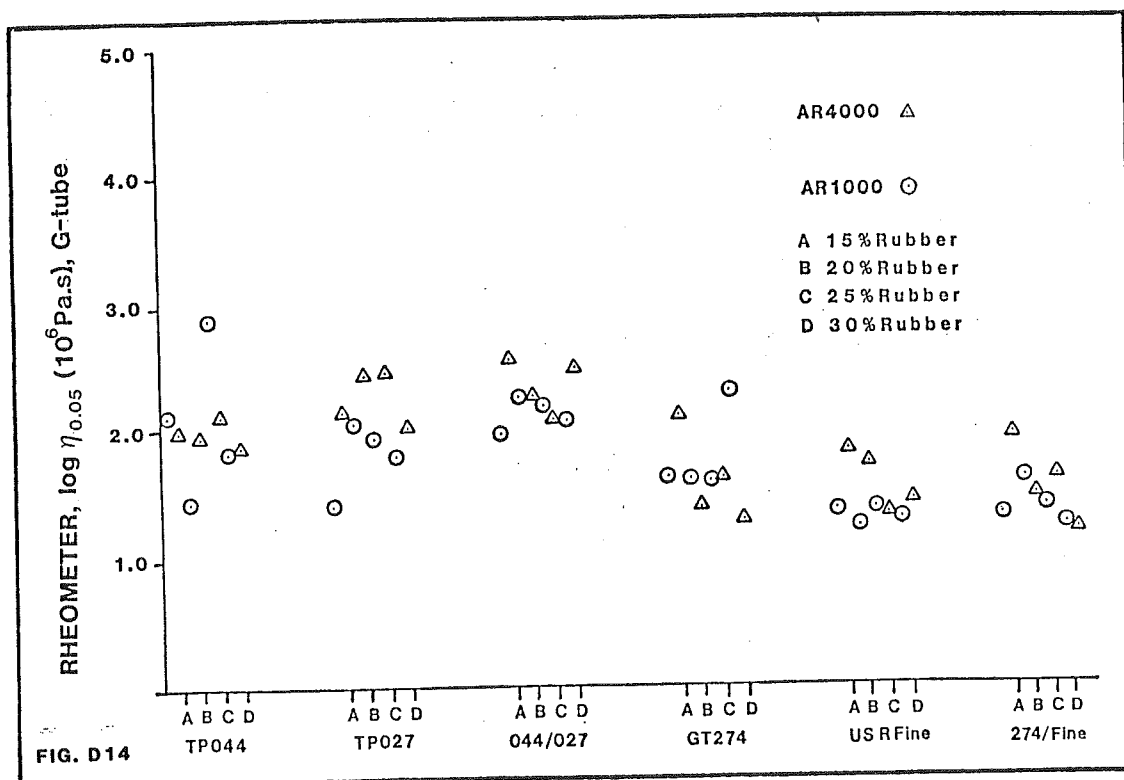
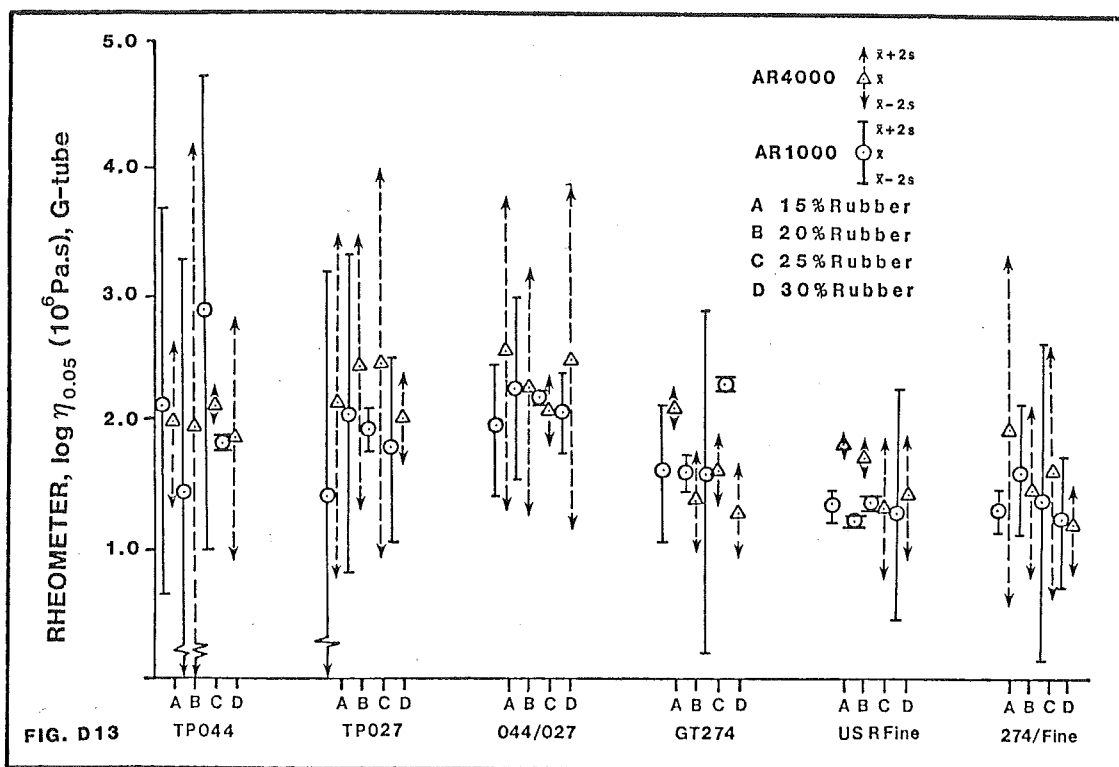
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	X	1.95531	1.48656	1.63241	1.20749
	S	.68596	.32877	.47965	.16576
	CV	35.08	22.12	23.38	13.73
A R 1 0 0 0	X	1.32024	1.62027	1.39479	1.26416
	S	.07352	.27976	.62622	.26671
	CV	5.51	17.27	44.90	21.09

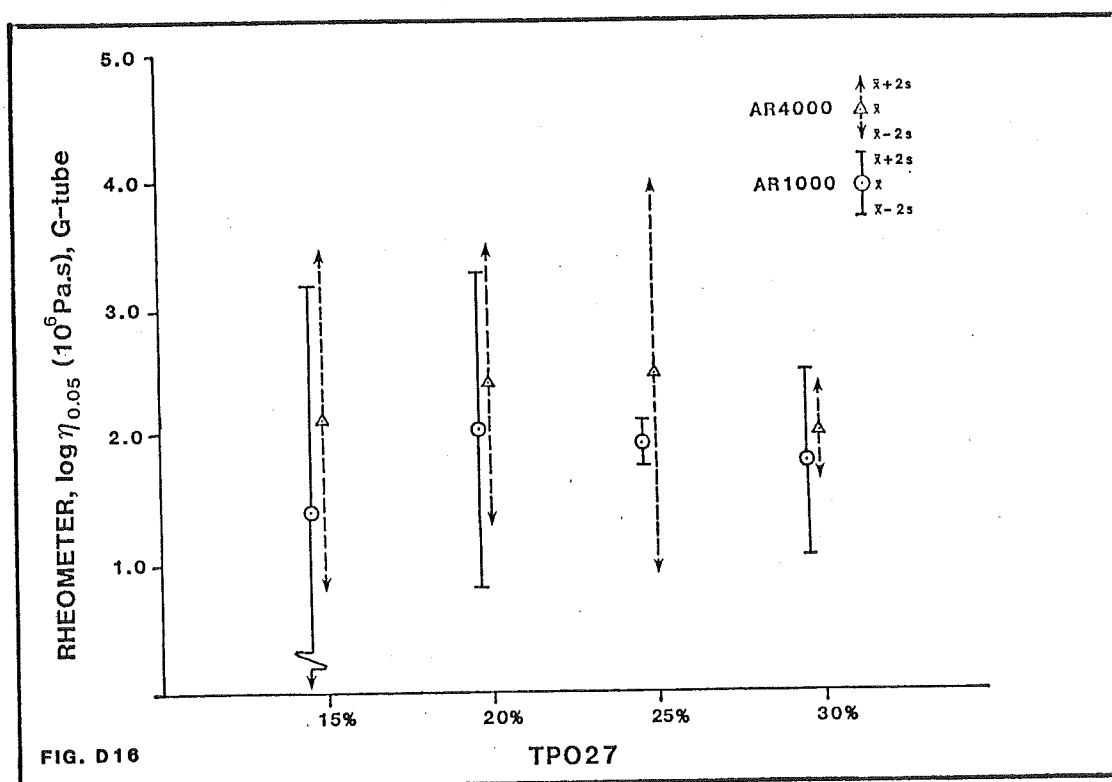
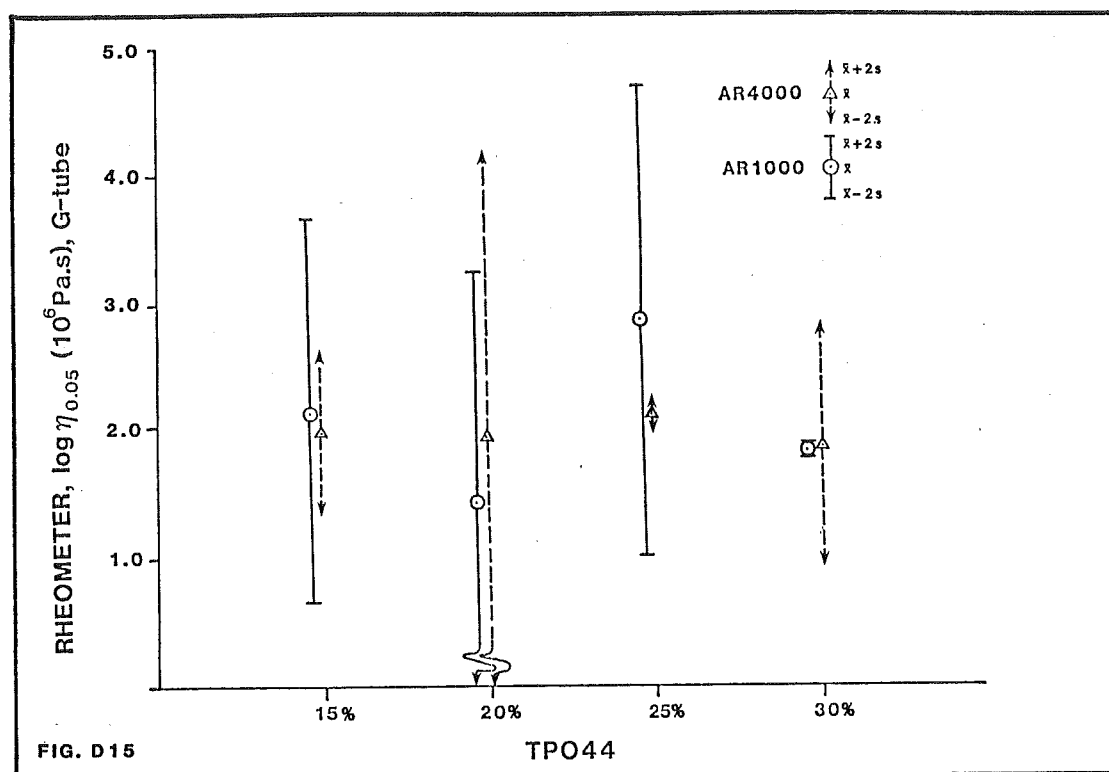
ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

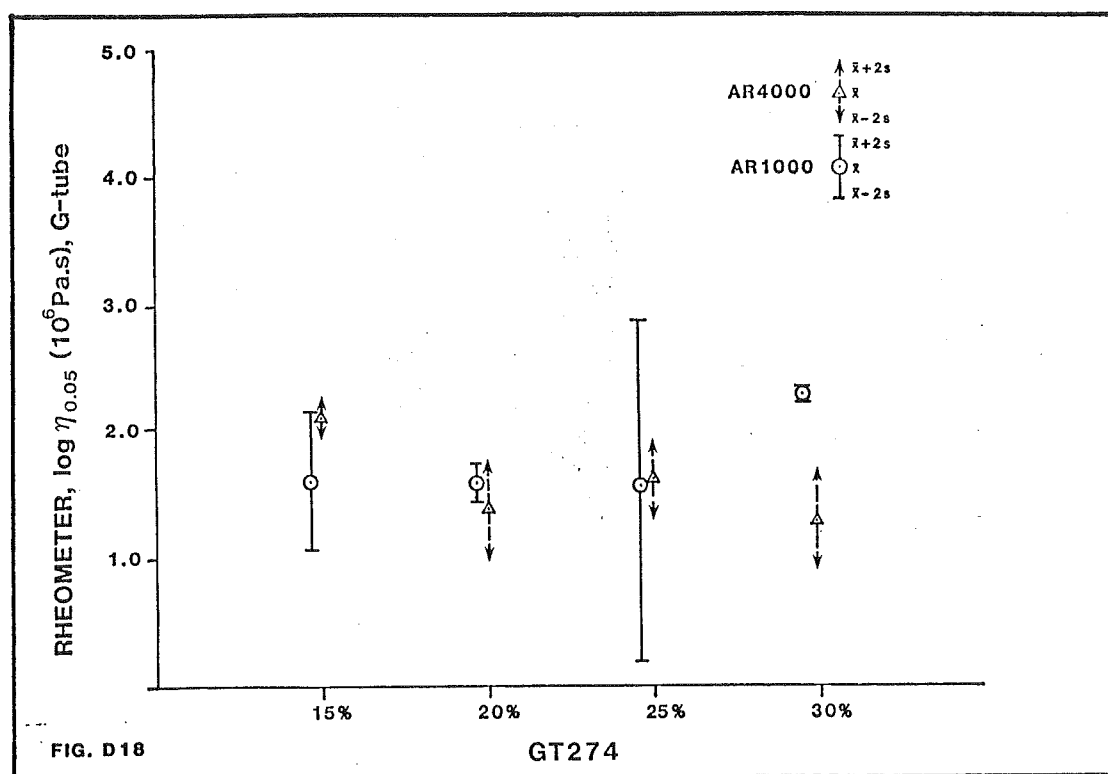
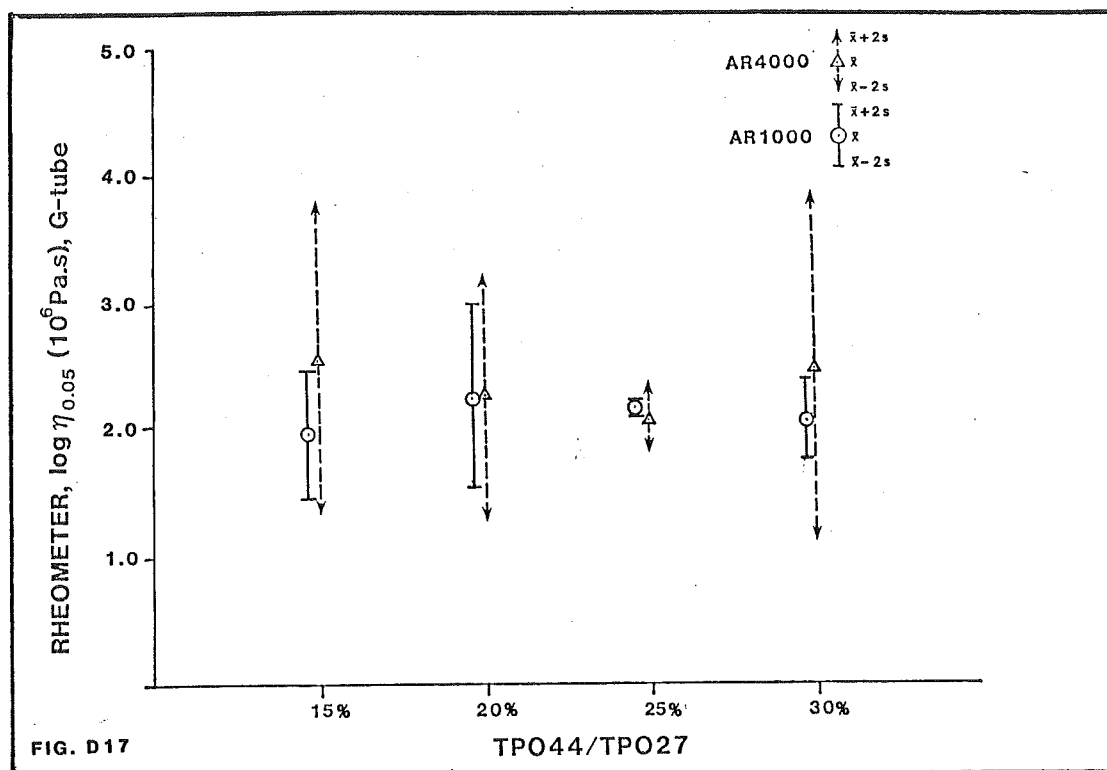
	TP045				TP047				50% TP045 & 50% TP047				GT274				U.S. Rubber Fine				50% GT274 & 50% U.S. Rubber Fine			
	18	20	25	30	18	20	25	30	18	20	25	30	18	20	25	30	18	20	25	30	18	20	25	30
TP045																								
TP047																								
50% TP045 & 50% TP047																								
GT274																								
U.S. Rubber Fine																								
50% GT274 & 50% U.S. Rubber Fine																								

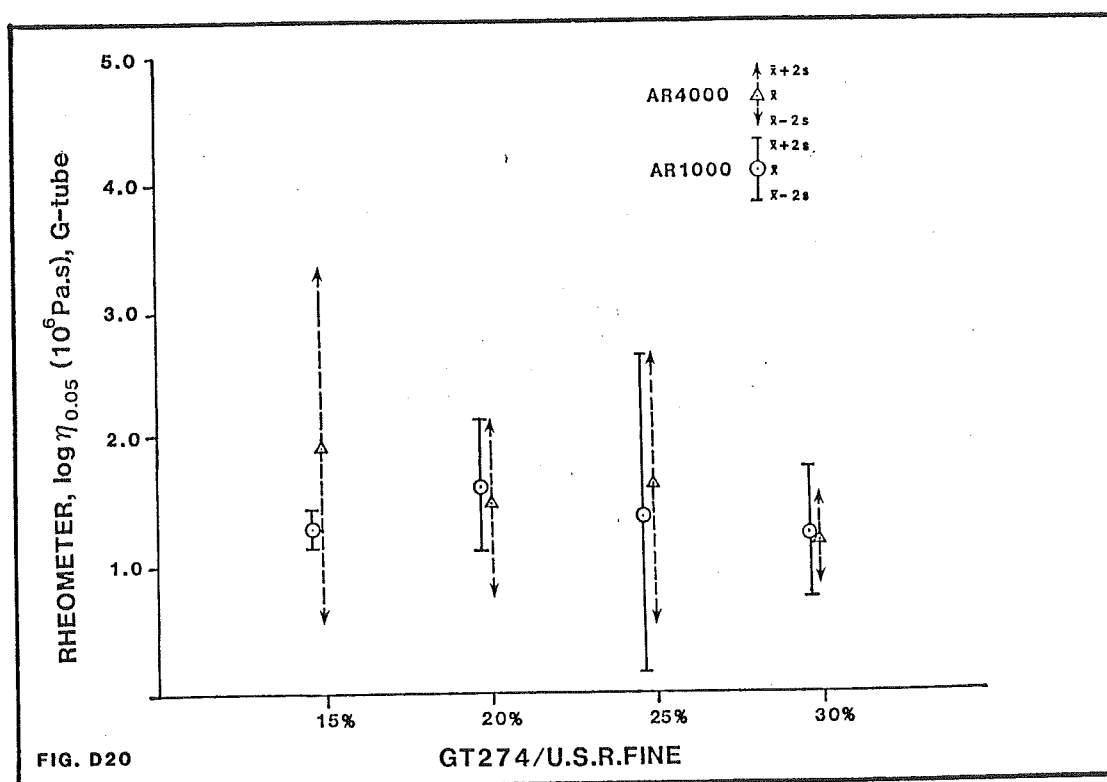
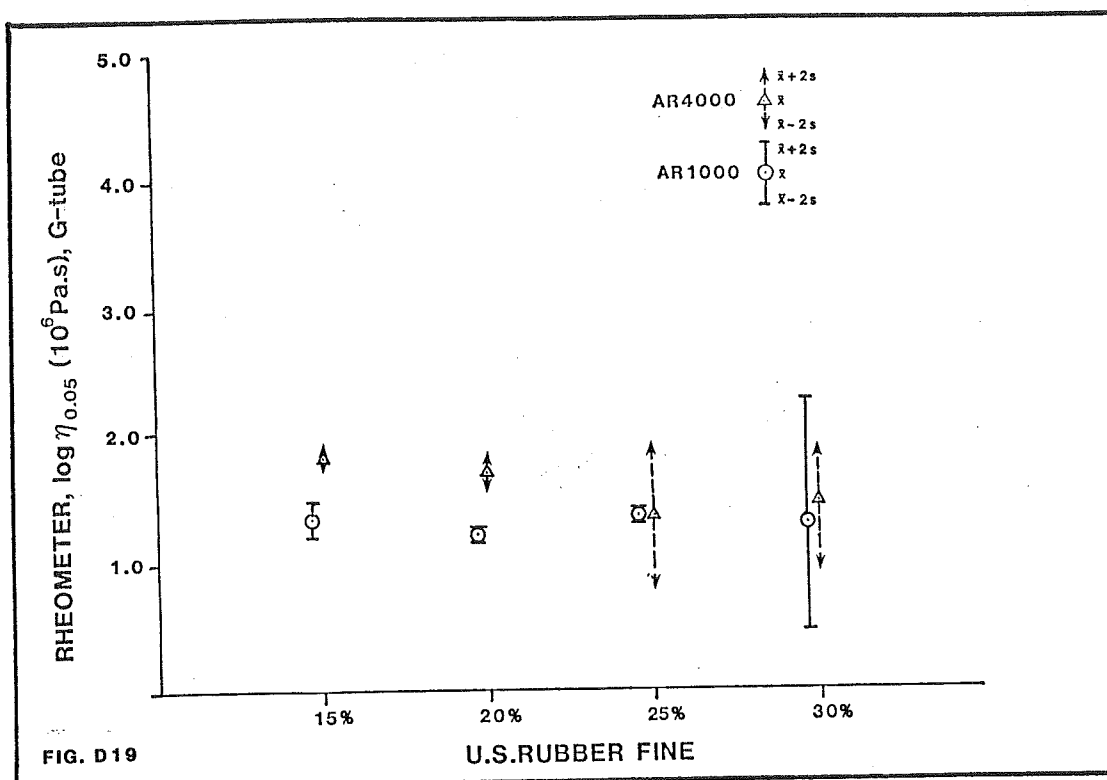
Table D-3 Anova Summary, Schweyer Rheometer,
Log Apparent Viscosity, G-tube

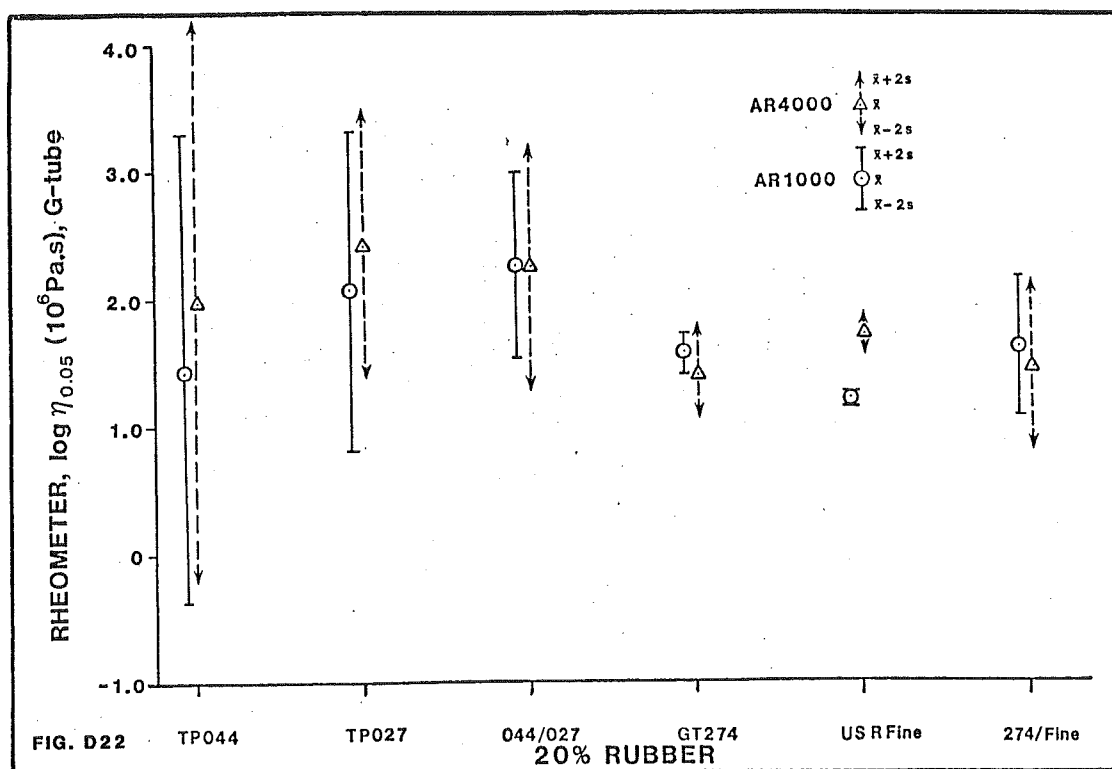
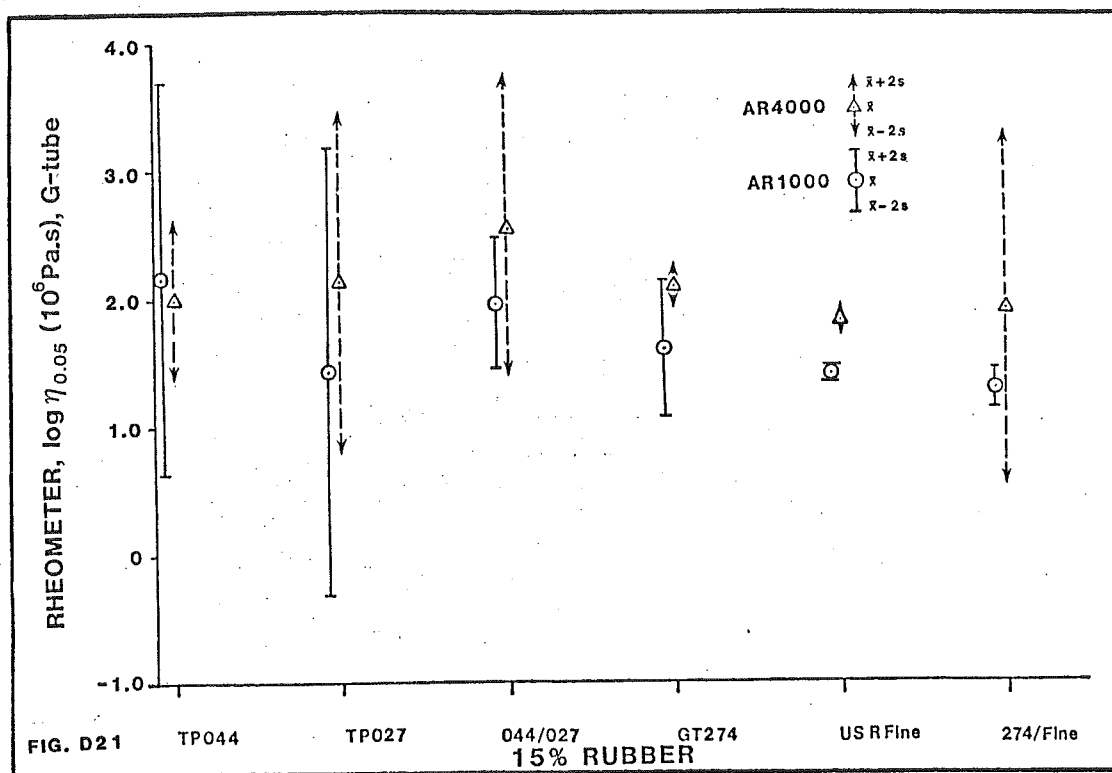
<u>ANOVA</u>						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	9.3175265	1.8635	14.085	2.43	3.48
Q	3	.7782100	.2594	1.960	2.82	4.28
A	1	.8279806	.8279	6.258	4.07	7.27
RQ	15	2.3895041	.1593	1.204	1.91	2.49
RA	5	.6361470	.1272	.961	2.43	3.48
QA	3	.6889810	.2297	1.736	2.82	4.28
RQA	15	1.3670319	.09114	.689	1.91	2.49
Error	48	6.3507064	.1323064			
TOTAL	95	22.3560875				

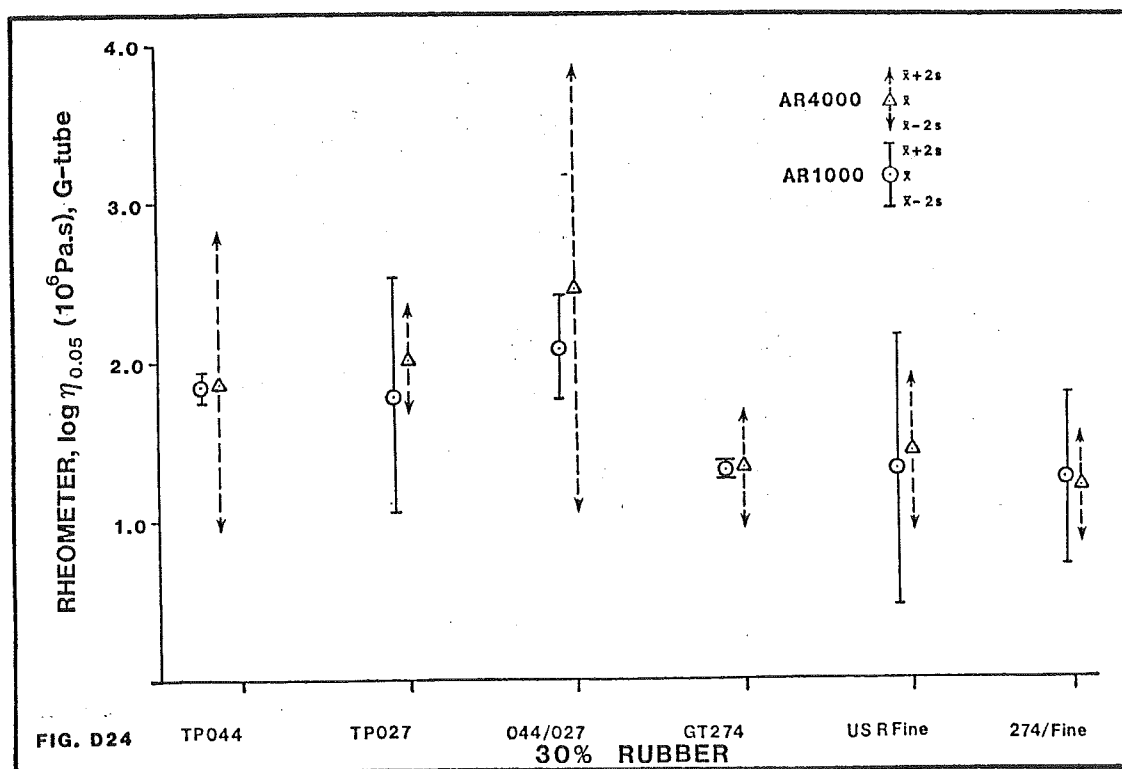
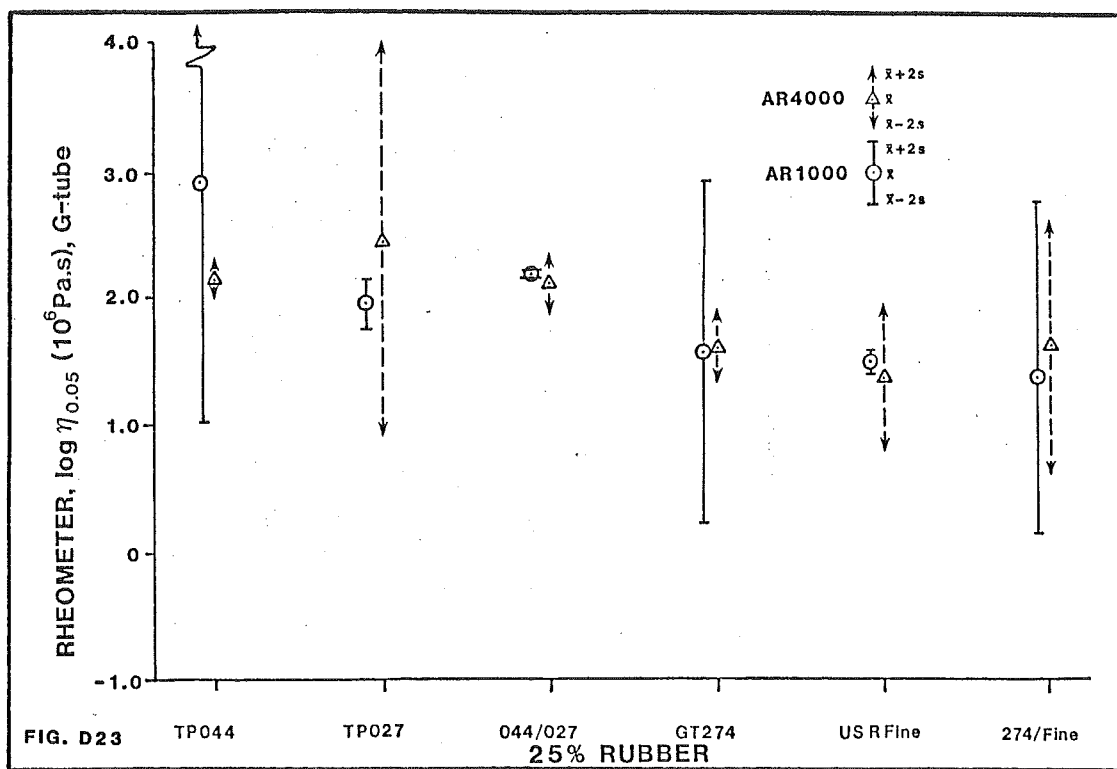












APPENDIX E

VISCOSITY ($\eta_{0.05}$) BY SCHWEYER RHEOMETER

AT 39.2F (4C), F-TUBE

Table E-1 Schwyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s , F-tube

a. Measured Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	1300	290	3200	380
	660	280	310	170
A R 1 0 0 0	570	1500	910	150
	490	420	510	870

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	980	285	1755	275
	s	567.04	8.86	2560.54	186.06
	cv	57.86	3.11	145.90	67.65
A R 1 0 0 0	$\bar{x}$	530.0	960.0	710.0	510.0
	s	70.88	956.88	354.40	637.92
	cv	13.37	99.68	49.92	125.08

ASPHALT TYPE (A)

PERCENT RUBBER (B)

RUBBER TYPE (R)

	TP044				TP087				80% TP044 & 20% TP087				BT274				U.S. Rubber Firm 80% Rubber Film				80% BT274 80% Rubber Film			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
1000																								
800																								
600																								
400																								
200																								
100																								
50																								
25																								
10																								
5																								
2																								
1																								

1000

800

600

400

200

100

50

25

10

5

2

1

a. Measured Data

b. Summary

[illegible]

Table E-1 Schwyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s, F-tube

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	1800	400	880	100
	1100	300	100	170
A R 1 0 0 0	590	240	580	2300
	1000	13000	280	2500

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	1450.0	350.0	490.0	135.0
	s	620.2	88.60	691.08	62.02
	cv	42.77	25.31	141.04	45.94
A R 1 0 0 0	$\bar{x}$	795.0	6620.0	430.0	2400.0
	s	363.26	11305.36	265.80	177.20
	cv	45.69	170.78	61.81	7.38

ARPHALY TYPE (A)
 PERCENT RUBBER (B)
 RUBBER TYPE (C)

	TP044			TP027			50% TP044 & 50% TP027			G7876			U.S. Rubber Fine			50% G7876 & 50% U.S. Rubber Fine		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
ARPHALY TYPE (A)																		
PERCENT RUBBER (B)																		
RUBBER TYPE (C)																		

Table E-1 Schwyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s, F-tube

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	2300	370	400	160
	26000	2700	200	120
A R 1 0 0 0	150	160	55	27
	97	97	69	43

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	14150.0	1535.0	300.0	140.0
	S	20998.20	2064.38	88.6	35.44
	CV	148.40	134.49	29.50	25.31
A R 1 0 0 0	$\bar{x}$	123.50	128.50	62.0	35.0
	S	46.96	55.82	12.40	14.18
	CV	38.02	43.44	20.00	40.51

ASPHALT TYPE (A)
 PERCENT RUBBER (B)
 RUBBER TYPE (C)

	TPQ44			TPQ87			55% TPQ44 & 45% TPQ87			GT274			U.S. Rubber Firm			55% GT274 & 45% U.S. Rubber		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
Asphalt Type	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Percent Rubber	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rubber Type	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table E-1 Schwyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s , F-tube

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	480	6700	150	86
	160	2100	110	110
A R 1 0 0 0	47	56	49	30
	93	160	110	31

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	320.0	4400.0	130.0	98.0
	S	283.52	4075.60	35.44	21.26
	CV	88.60	92.63	27.26	21.69
A R 1 0 0 0	$\bar{x}$	70.0	108.0	75.5	30.5
	S	40.76	92.14	54.05	0.89
	CV	58.23	85.31	71.59	2.92

ASPHALT TYPE (A)
 PERCENT RUBBER (B)
 RUBBER TYPE (R)

	TP644			TP927			50% TP644 50% TP927			BT776			U.S. Rubber Fine			50% BT776 50% U.S. Rubber Fine		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Asphalt																		
Rubber																		
Temp																		

Table E-1 Schweyer Rheometer Apparent Viscosity,
 $\eta_{0.05}$, 10^6 Pa-s, F-tube

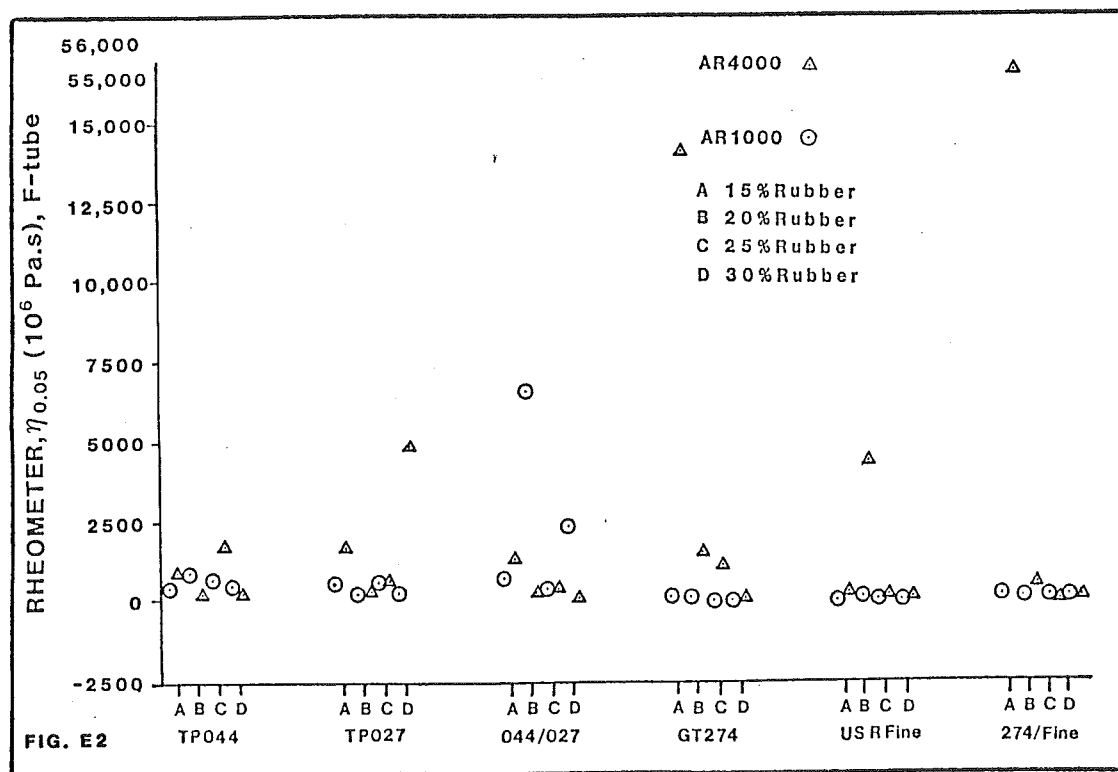
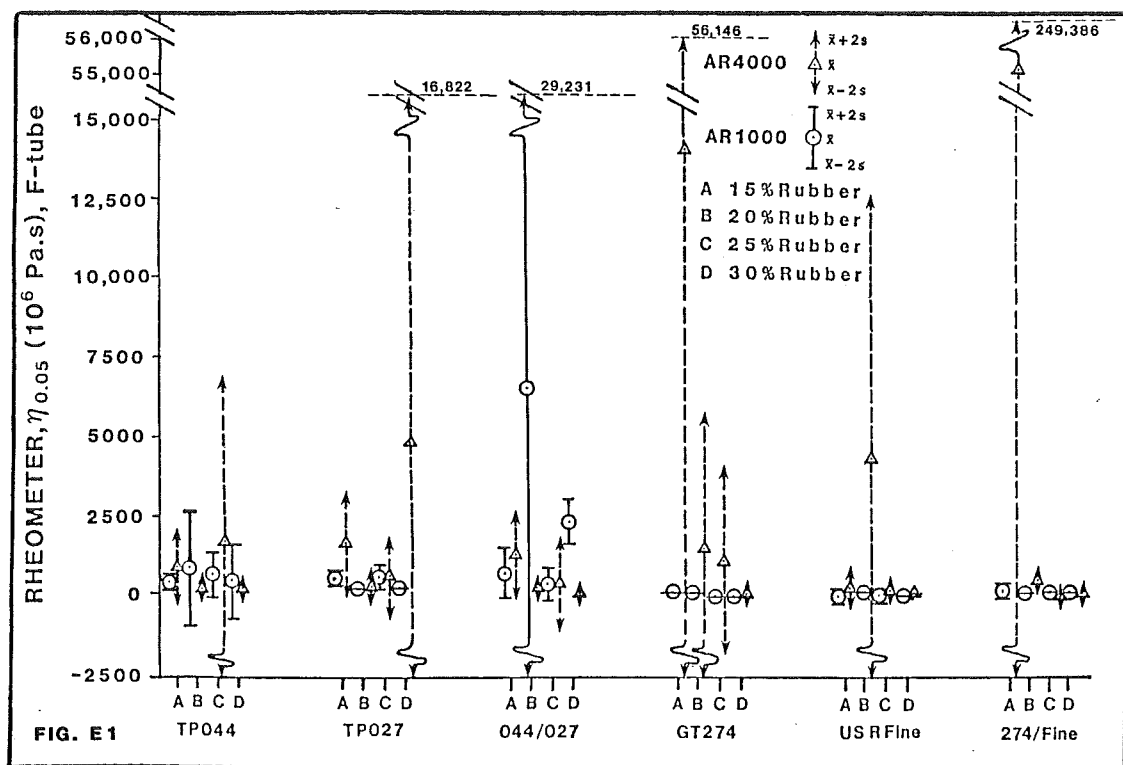
a. Measured Data

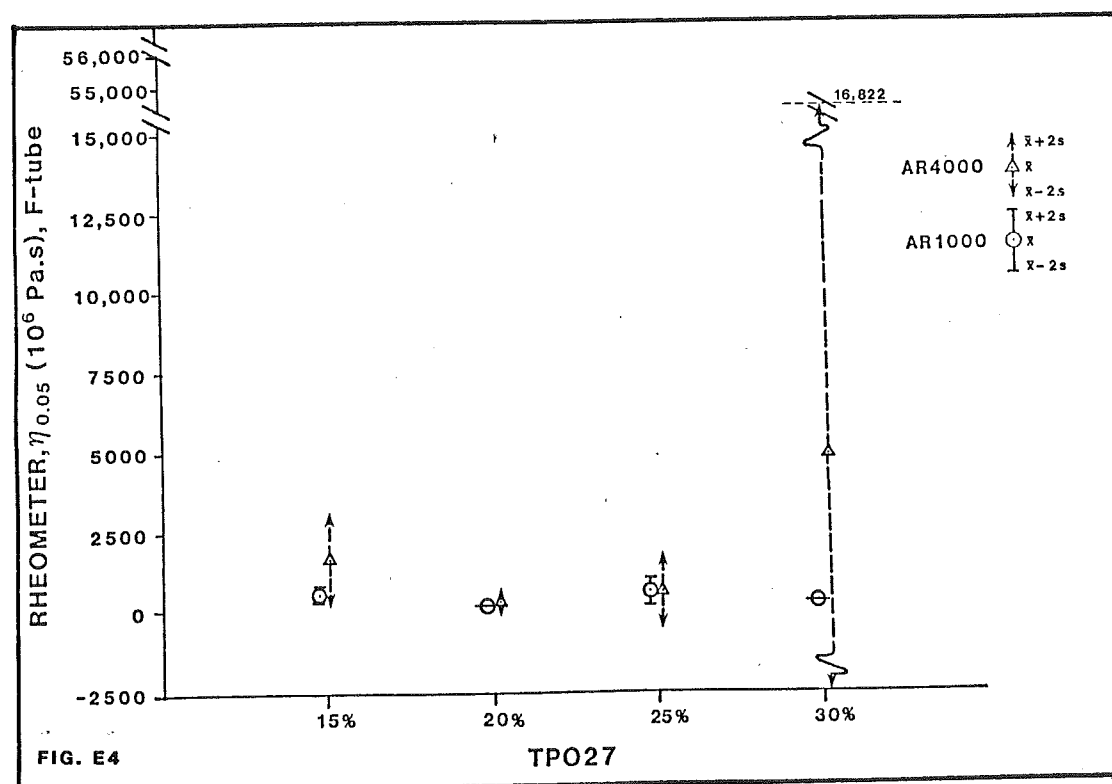
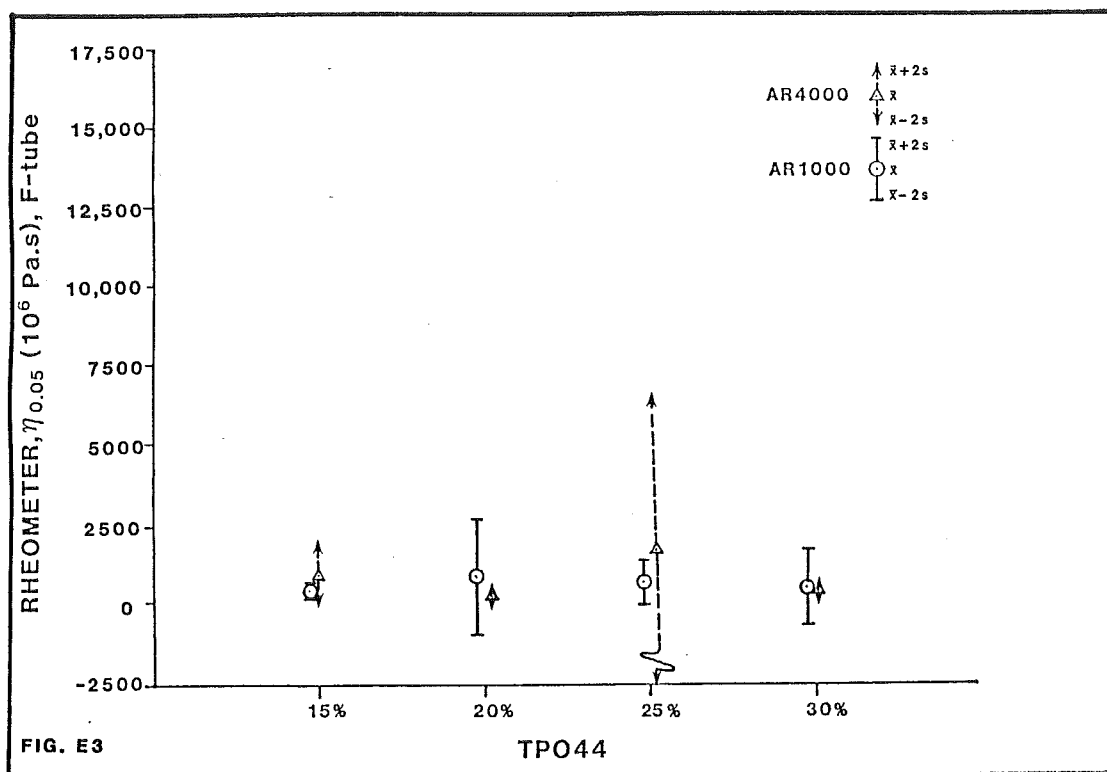
50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	420	660	200	120
	110000	340	99	200
A R 1 0 0 0	220	99	59	48
	130	86	84	46

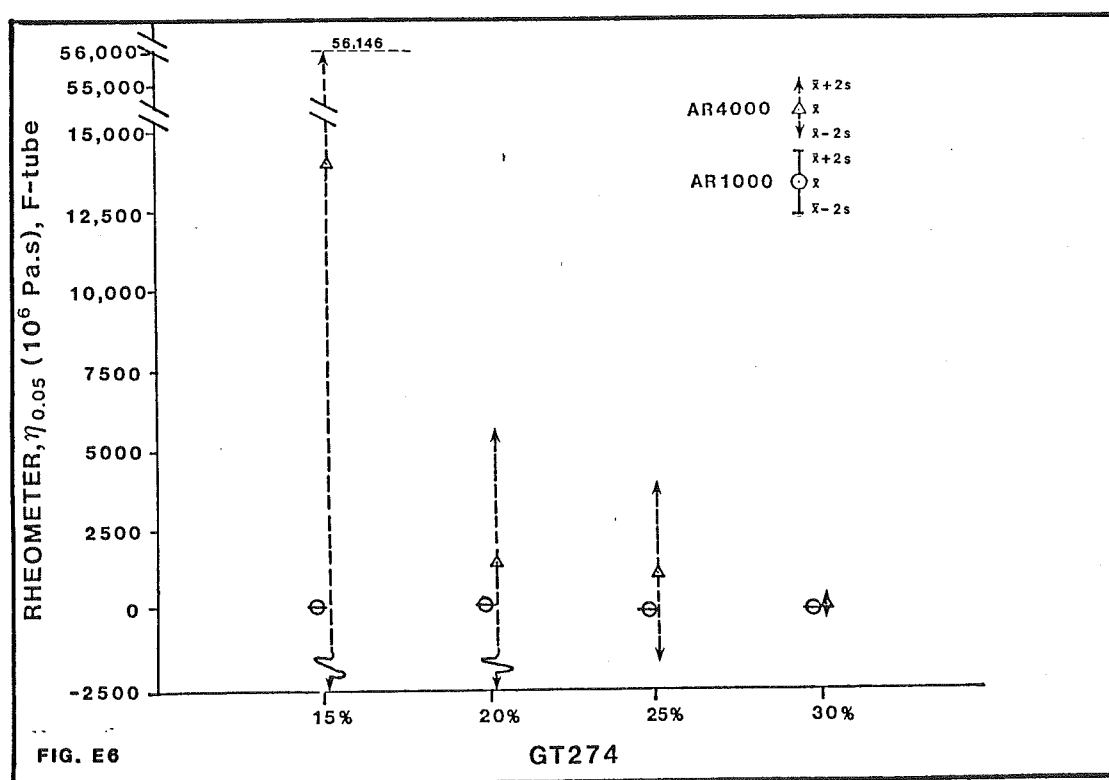
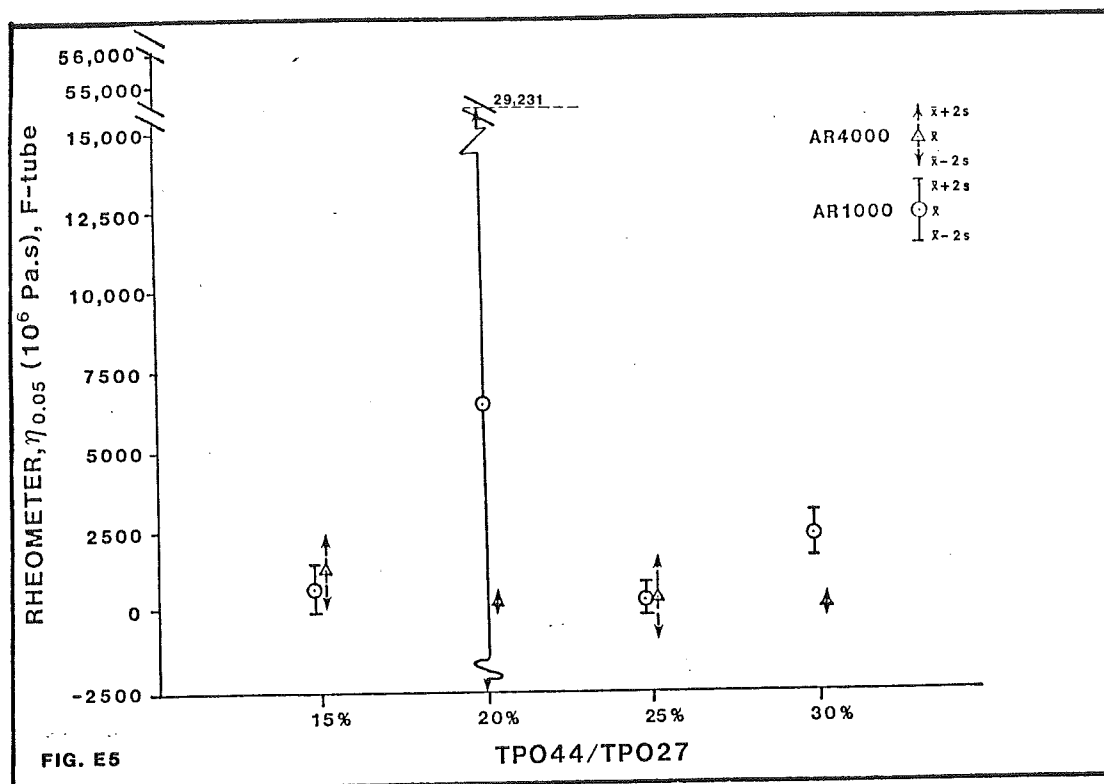
b. Summary

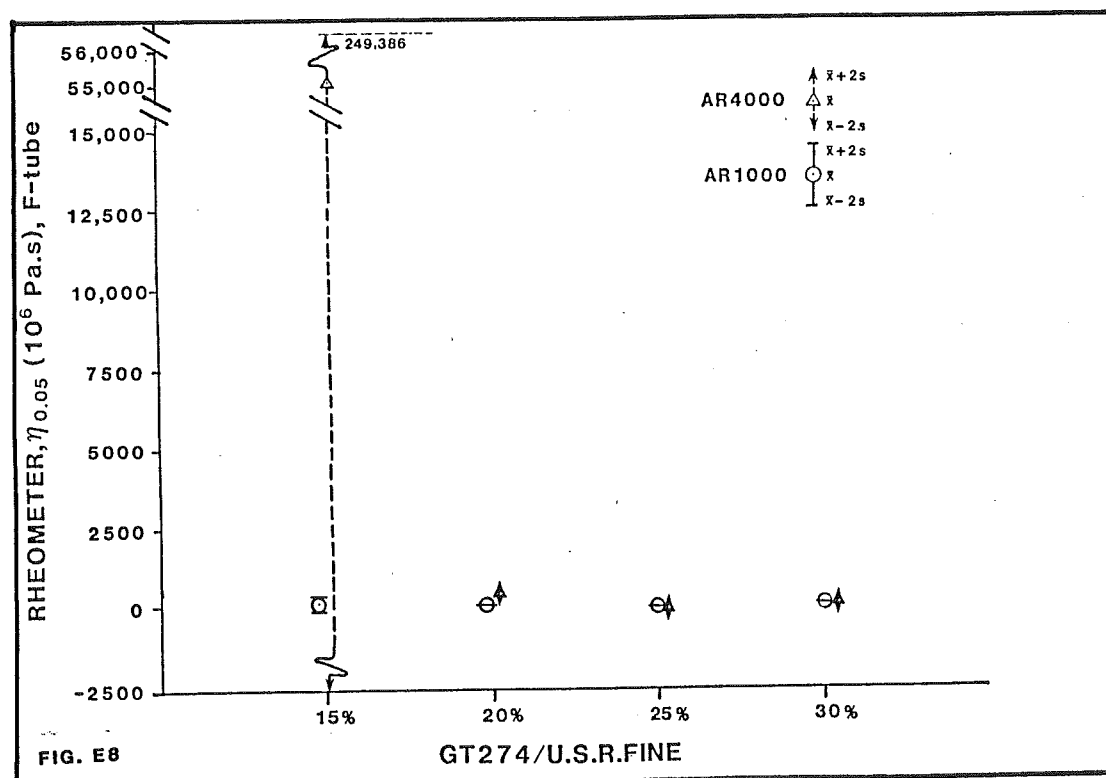
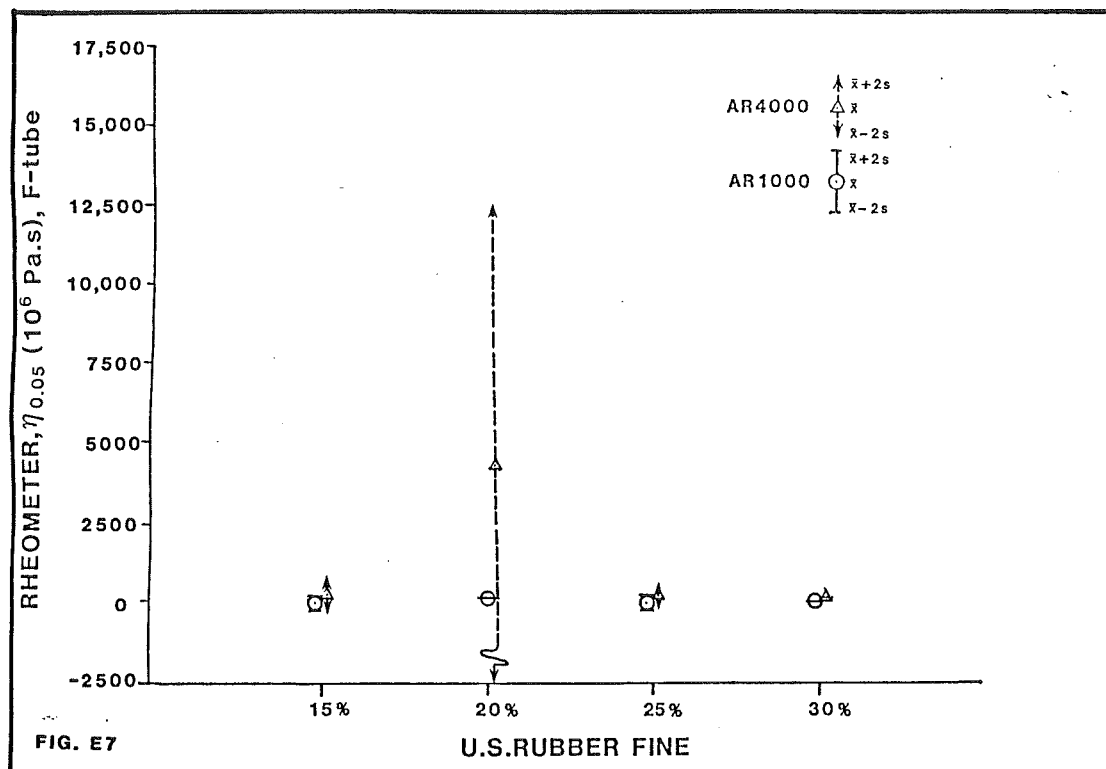
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	55210.0	500.0	149.5	160.0
	S	97087.88	283.52	89.49	70.88
	CV	175.85	56.70	59.86	44.30
A R 1 0 0 0	$\bar{x}$	175.0	92.5	71.5	47.0
	S	79.74	11.52	22.15	1.77
	CV	45.57	12.45	30.98	3.77

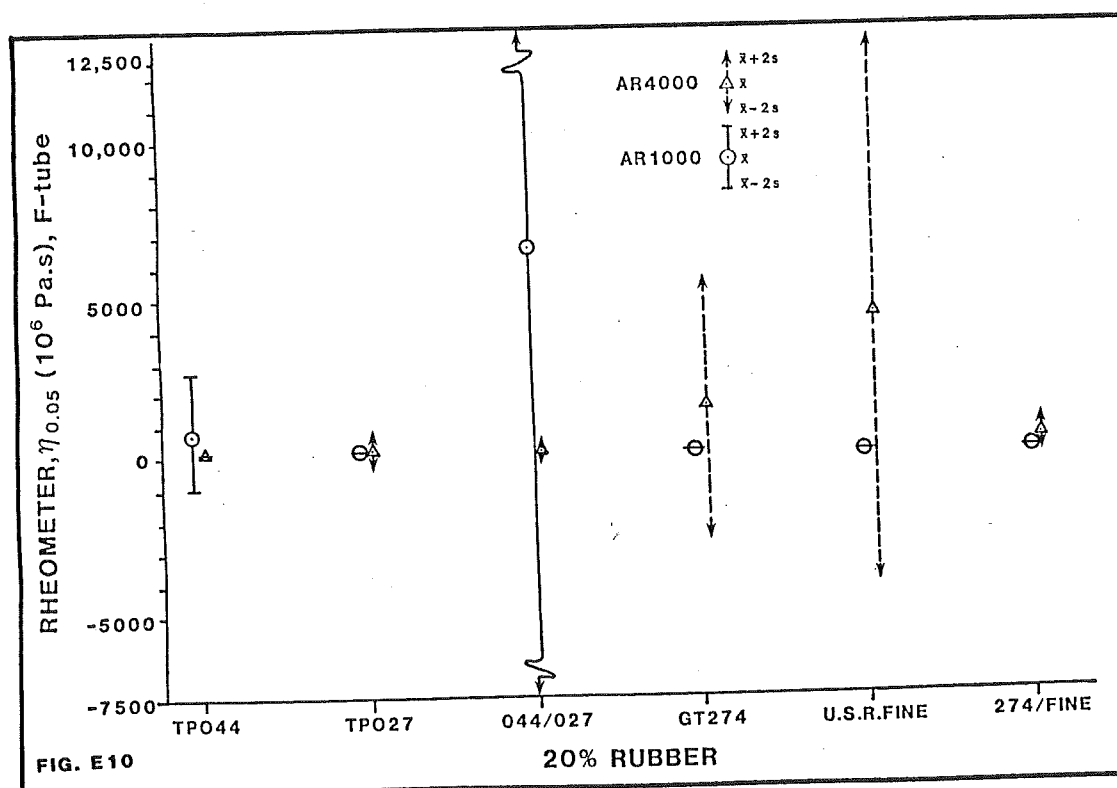
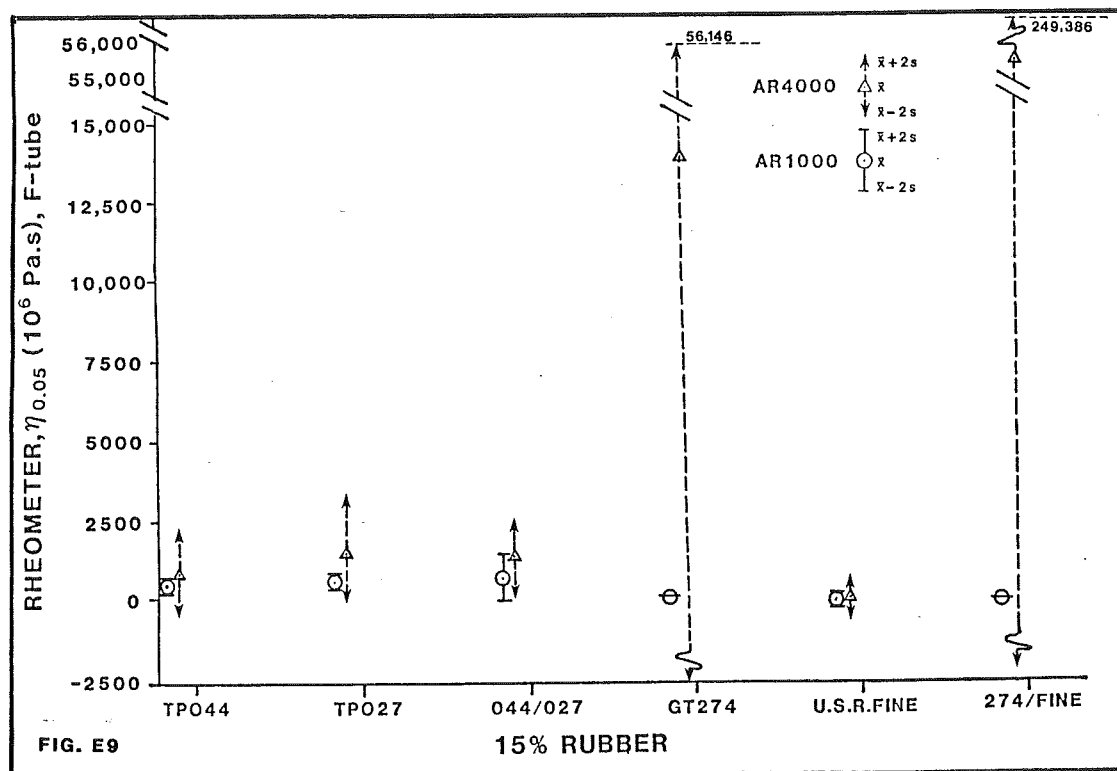
		ASPHALT TYPE (A)									PERCENT RUBBER (B)									RUBBER TYPE (C)								
		17044			17047			50% 17044 50% 17047			GT274			U.S. Rubber Fine			50% GT274 50% U.S. Rubber Fine			50% GT274 50% U.S. Rubber Fine								
		15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25						
Observed	Viscosity																											
	Temperature																											











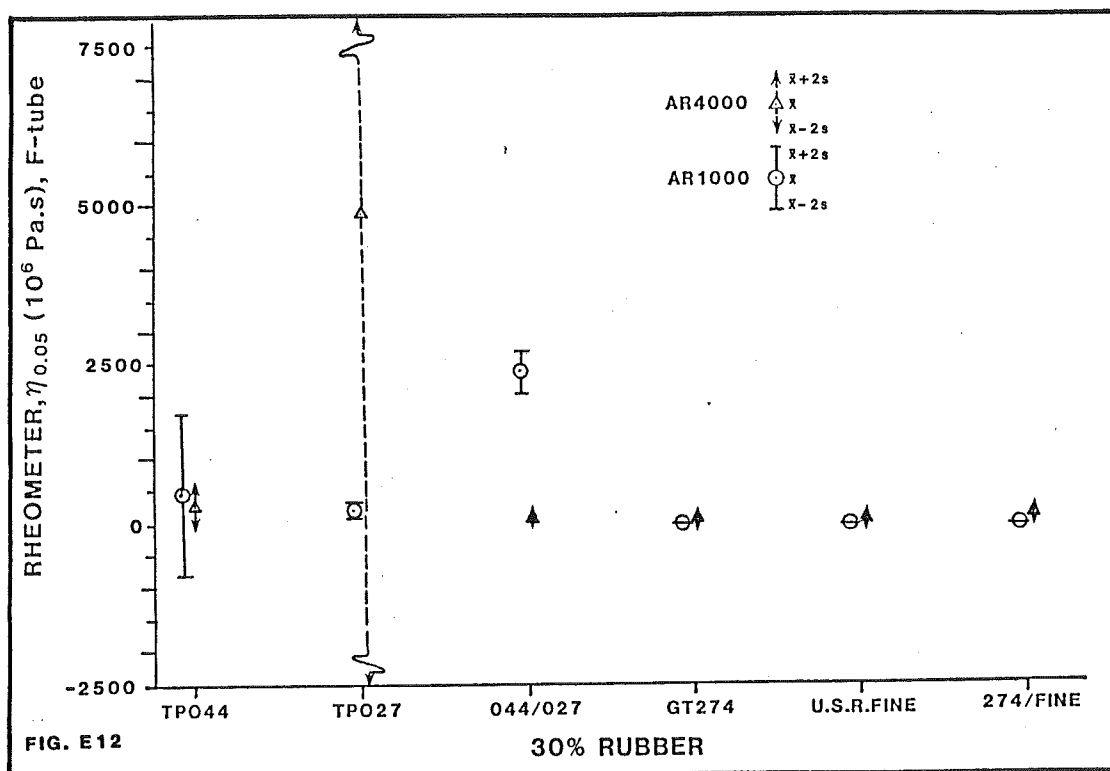
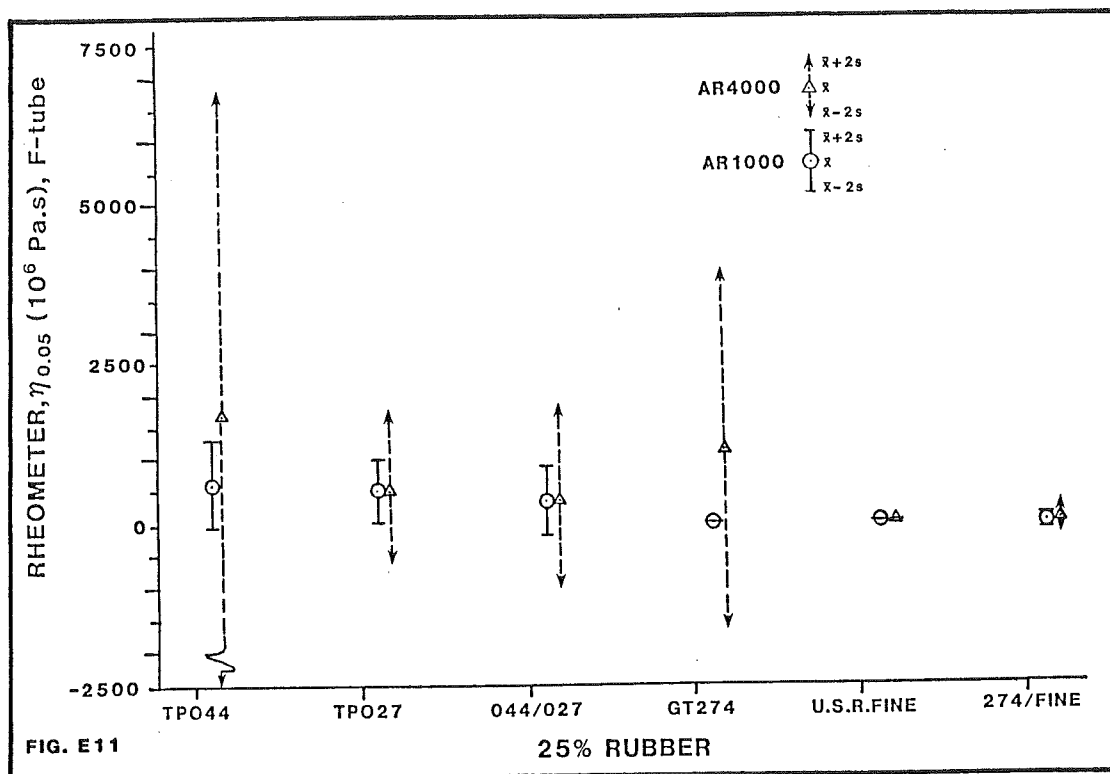


Table E-2 Schwyer Rheometer, Log Log Apparent Viscosity, $\eta_{0.05}$, 10^6 Pa-s, F-tube

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	.49331	.39136	.54471	.41158
	.45018	.38866	.39644	.34839
A R 1 0 0 0	.44026	.50189	.47115	.33768
	.42978	.41884	.43258	.46828

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.47174	.39001	.47057	.37999
	s	.03821	.00239	.13137	.00560
	cv	8.10	0.61	27.92	14.73
A R 1 0 0 0	$\bar{x}$	.43502	.46037	.45187	.40298
	s	.00928	.07359	.03417	.11571
	cv	2.13	15.98	7.56	28.71

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP087			80% TP044 & 20% TP087			BT874			U.S. Rubber Fm			80% BT874 & 20% Fm A		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
100-200																		
200-300																		
300-400																		
400-500																		
500-600																		
600-700																		
700-800																		
800-900																		
900-1000																		

Table E-2 Schweyer Rheometer, Log Log Apparent Viscosity, $\eta_{0.05}$, 10^6 Pa-s, F-tube

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.49331	.34839	.39644	.59318
	.52406	.43258	.47388	.50571
A R 1 0 0 0	.44026	.38291	.45777	.37323
	.45777	.37984	.42834	.37984

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.50869	.39049	.43516	.54945
	S	.02725	.07459	.06862	.07750
	CV	5.36	19.10	15.77	14.11
A R 1 0 0 0	$\bar{x}$	.44901	.38138	.44305	.37653
	S	.01551	.00272	.02607	.00586
	CV	3.45	0.71	5.89	1.55

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP027				60% TP044 & 40% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
Shear Rate (dynes/cm ²)	10												
	100												
	1000												
	10000												

Table E-2 Schweyer Rheometer, Log Log Apparent Viscosity, $\eta_{0.05}$, 10^6 Pa-s , F-tube

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.51259	.41532	.46901	.30103
	.48307	.39395	.30103	.34839
A R 1 0 0 0	.44261	.37662	.44145	.52656
	.47712	.61426	.38866	.53122

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	X	.49783	.40463	.38502	.32471
	S	.02615	.01893	.14883	.04196
	CV	5.25	4.68	38.66	12.92
A R 1 0 0 0	X	.45987	.49544	.41506	.52889
	S	.03057	.21055	.04677	.00412
	CV	6.65	42.50	11.27	0.78

		TP044				TP027				50% TP044 50% TP027				G1874				U.S. Rubber Pass				94% G1874 50% G1874			
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Asphalt Type (A)																									
Percent Rubber (R)																									
Rubber Type (R)																									

Table E-2 Schwyer Rheometer, Log Log Apparent Viscosity, $\eta_{0.05}$, 10^6 Pa-s, F-tube
a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	.52656	.40963	.41532	.34324
	.64493	.53547	.51865	.31789
A R 1 0 0 0	.33768	.34324	.24064	.15575
	.29815	.29815	.26455	.21311

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.58575	.47255	.46698	.33056
	S	.10487	.11149	.09155	.02245
	CV	17.90	23.59	19.61	6.79
A R 1 0 0 0	$\bar{x}$	.31791	.32069	.25259	.18443
	S	.03502	.03995	.02118	.05082
	CV	11.02	12.46	8.39	27.56

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP000				TP007				50% TP004 50% TP007			
		15	20	25	30	15	20	25	30	15	20	25	30
GT274	U.S. Rubber Pass												
	50% GT274 50% U.S. Rubber												
GT274	U.S. Rubber Pass												
	50% GT274 50% U.S. Rubber												

Table E-2 Schwyer Rheometer, Log Log Apparent Viscosity, $\eta_{0.05}$, 10^6 Pa-s, F-tube

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.42824	.58275	.33768	.28657
	.34324	.52143	.30993	.30993
A R 1 0 0 0	.22326	.24259	.22794	.16942
	.29413	.34324	.30993	.17358

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.38579	.55209	.32380	.29825
	S	.07540	.05433	.02459	.02070
	CV	19.54	9.84	7.59	6.94
A R 1 0 0 0	$\bar{x}$	.25870	.29291	.26893	.17150
	S	.06279	.08917	.07264	.00369
	CV	24.27	30.44	27.01	2.15

		TP044			TP017			50% TP044 50% TP017			GT274			U.S. Rubber Fine			50% GT274 50% U.S. Rubber		
		15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
1000-300	1000-300																		
	1000-300																		
500-150	500-150																		
	500-150																		

Table E-2 Schwyer Rheometer, Log Log Apparent Viscosity, $\eta_{0.05}$, 10^6 Pa-s, F-tube

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.41884	.45018	.36192	.31789
	.70255	.40337	.30008	.36192
A R 1 0 0 0	.36967	.30008	.24818	.22563
	.32509	.28657	.28427	.22083

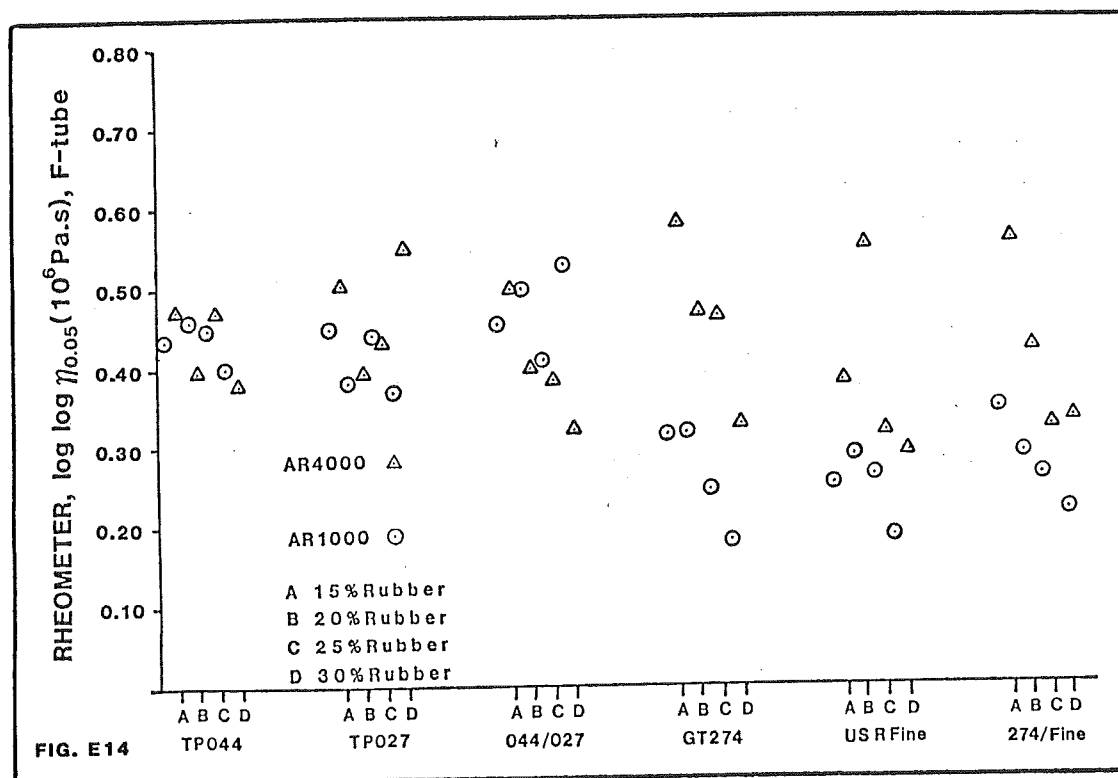
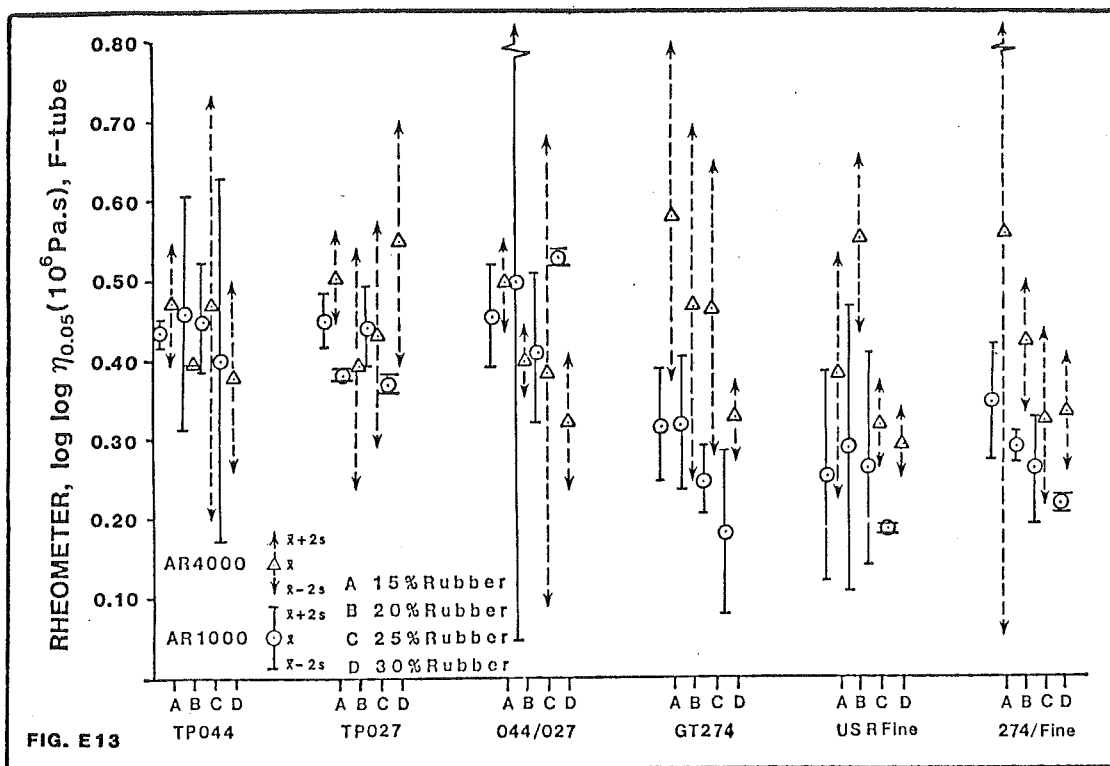
b. Summary

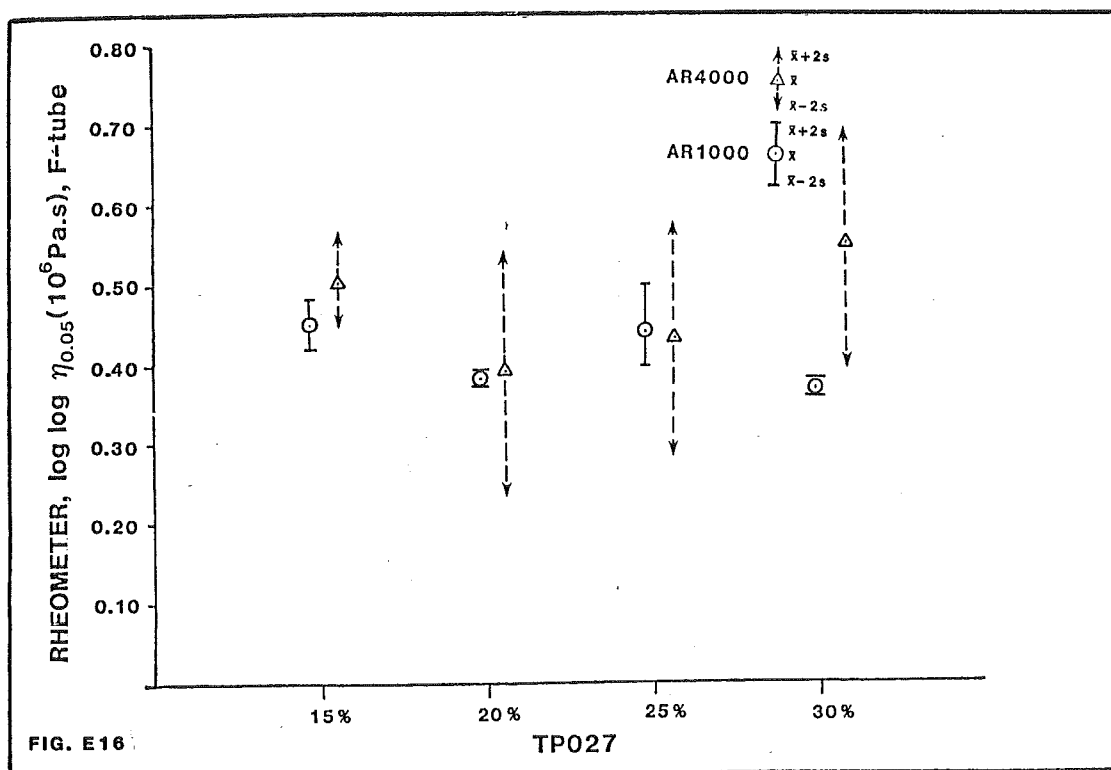
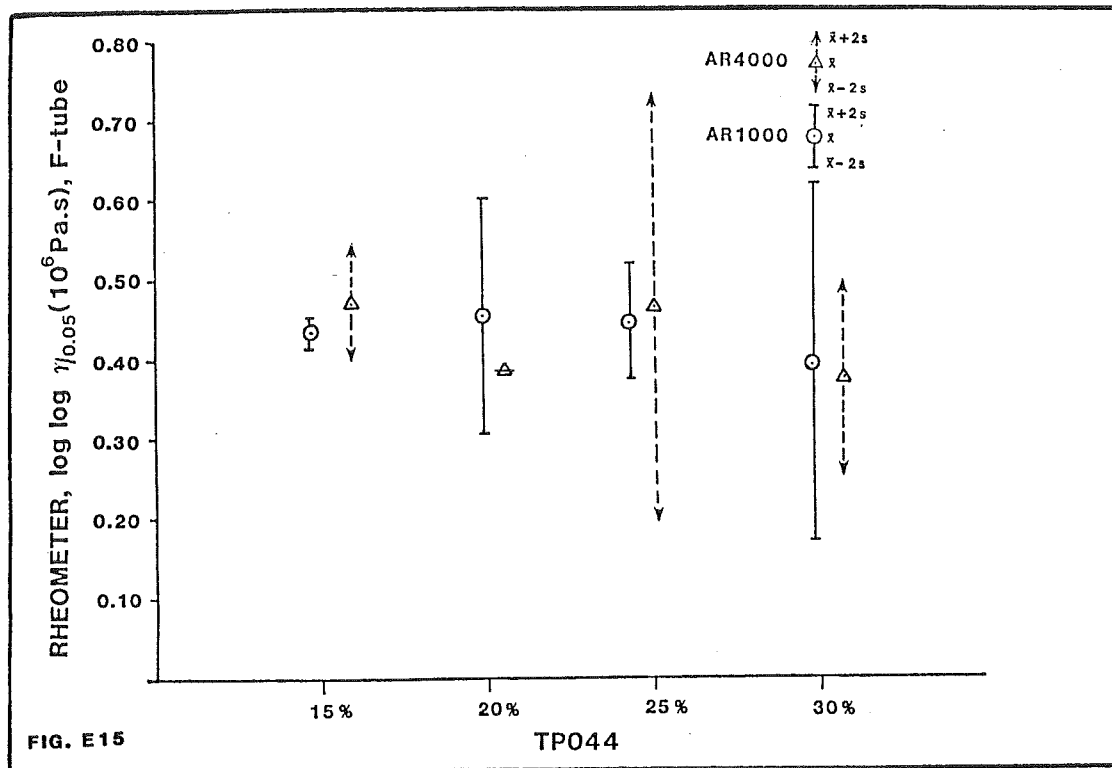
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.56070</u>	<u>.42678</u>	<u>.33100</u>	<u>.33991</u>
	S	<u>.25137</u>	<u>.04147</u>	<u>.05479</u>	<u>.03901</u>
	CV	44.83	9.72	16.55	11.48
A R 1 0 0 0	$\bar{x}$	<u>.34738</u>	<u>.29332</u>	<u>.26623</u>	<u>.22323</u>
	S	<u>.03949</u>	<u>.01197</u>	<u>.03197</u>	<u>.00425</u>
	CV	11.37	4.08	12.01	1.91

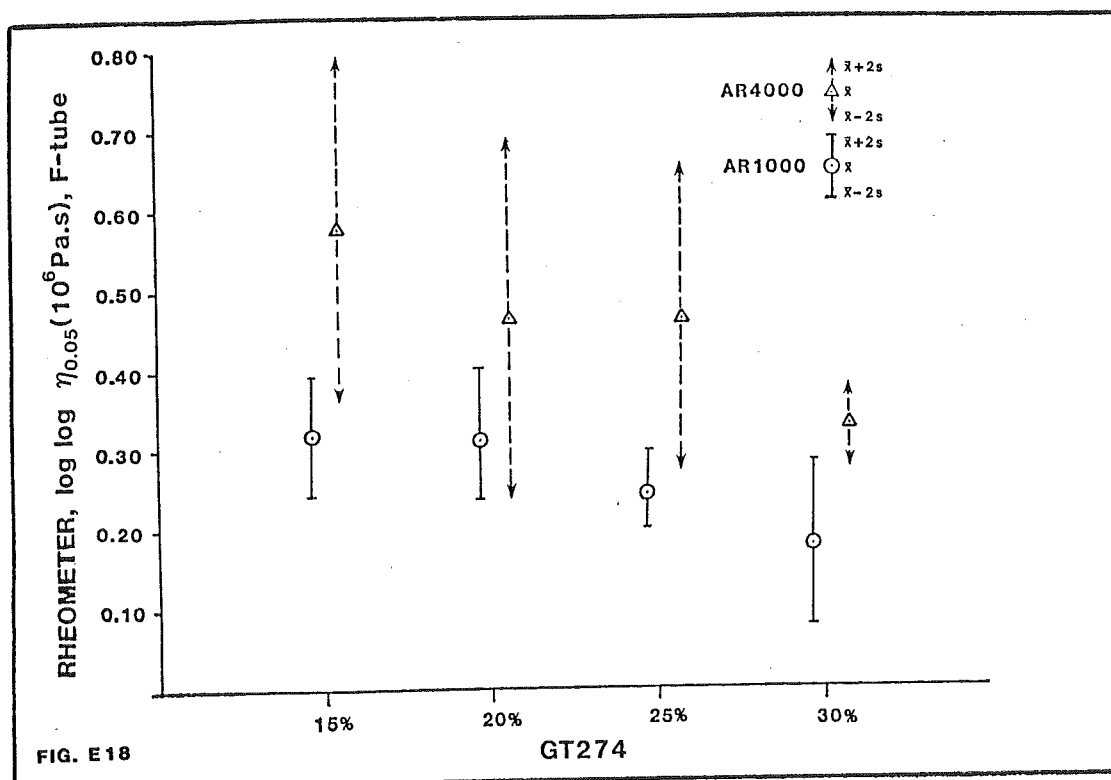
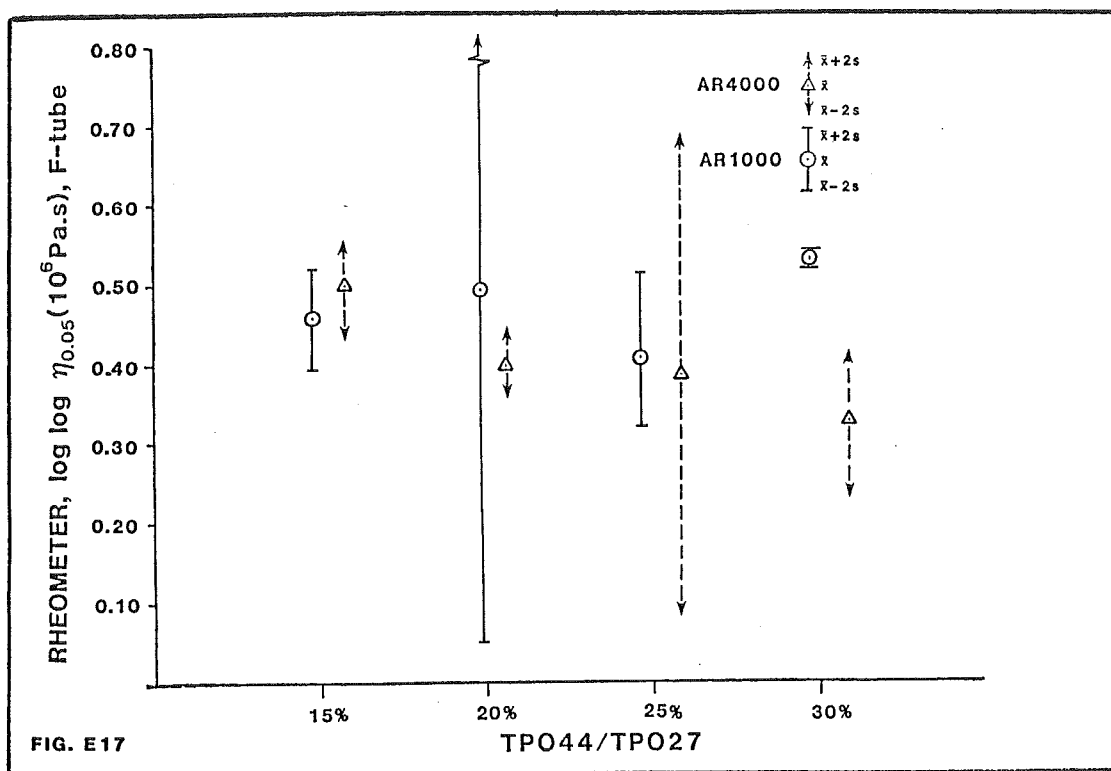
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)												
		TP044			TP007			50% TP044 50% TP007			GT274			U.S. Rubber Fine			50% GT274 50% R.Fine																					
		15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	
SOURCE	100/200																																					
	100/100																																					

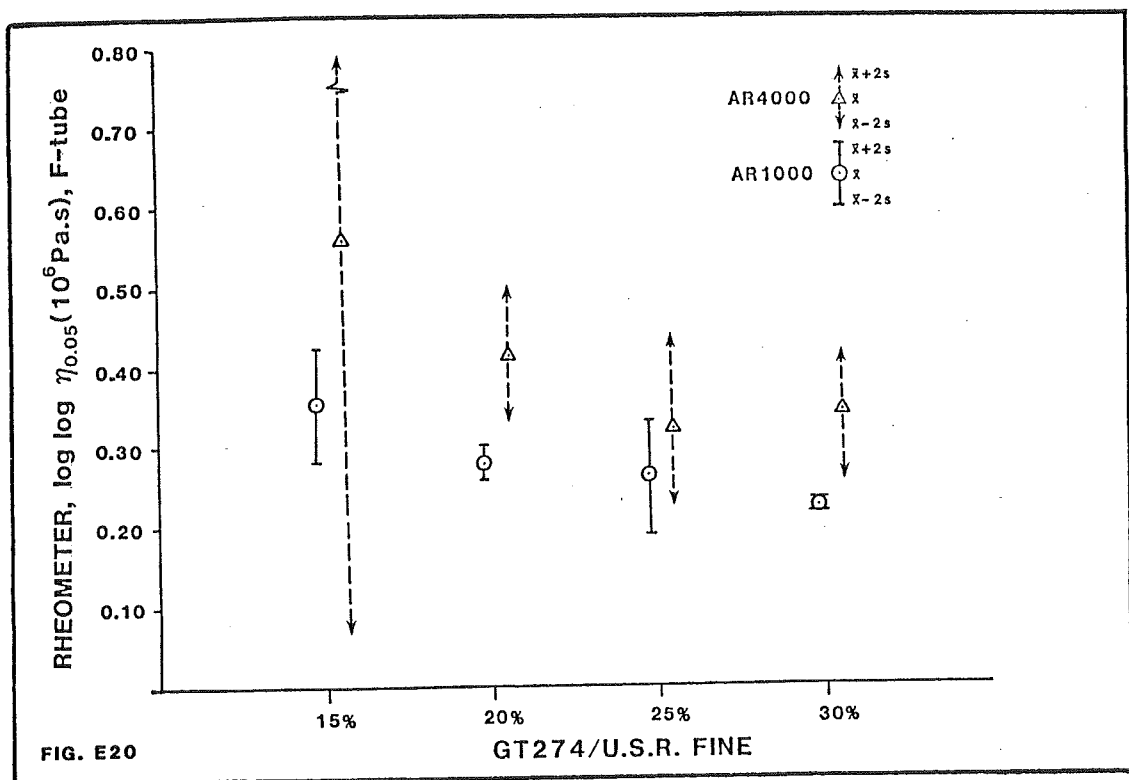
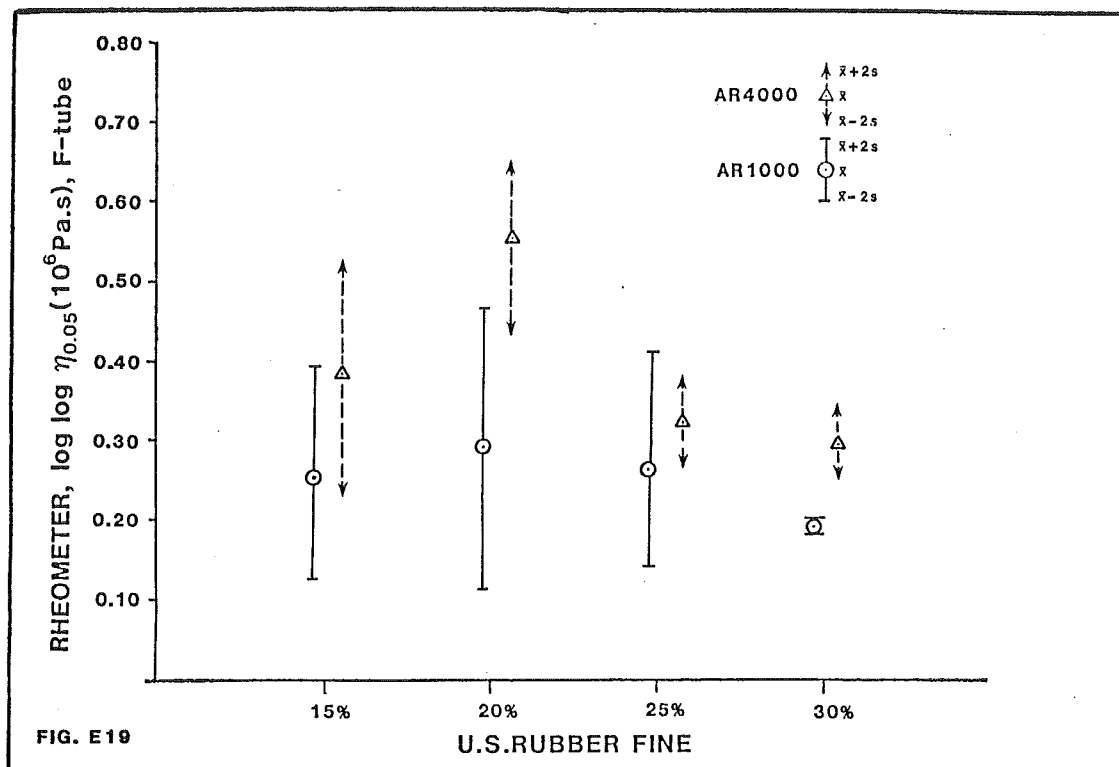
Table E-3 Anova Summary, Schweyer Rheometer,
Log Log Apparent Viscosity, F-tube

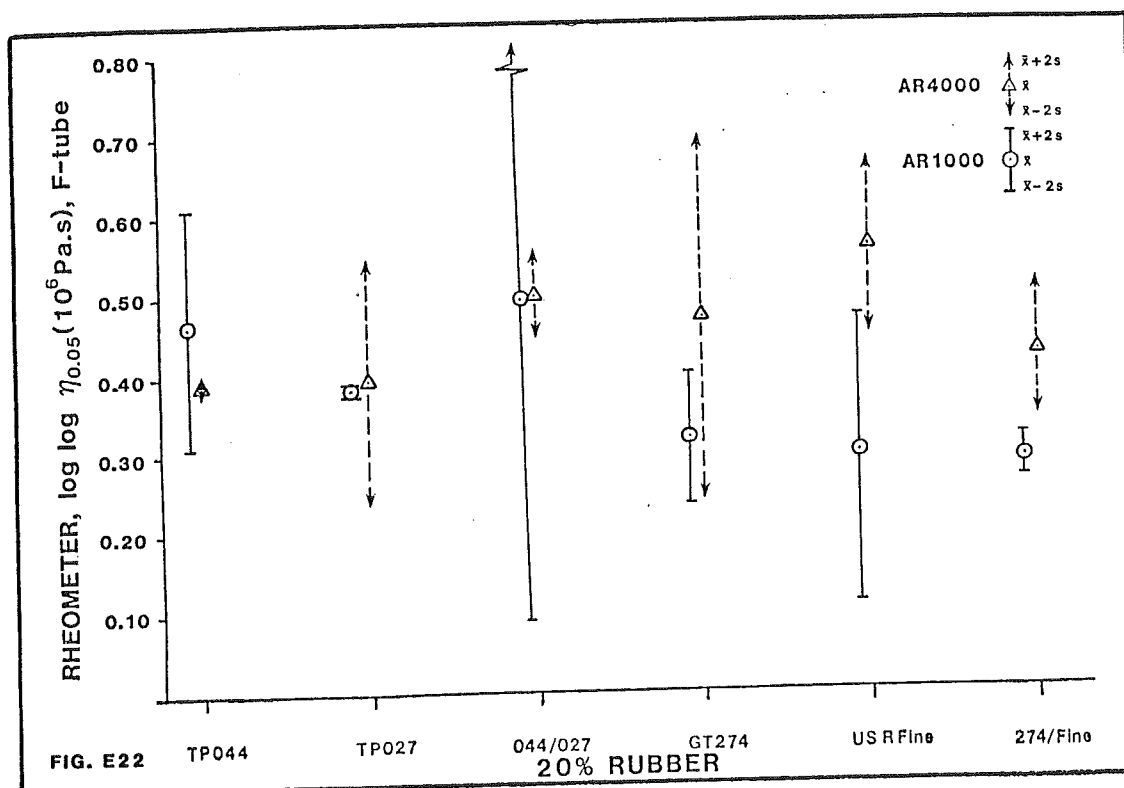
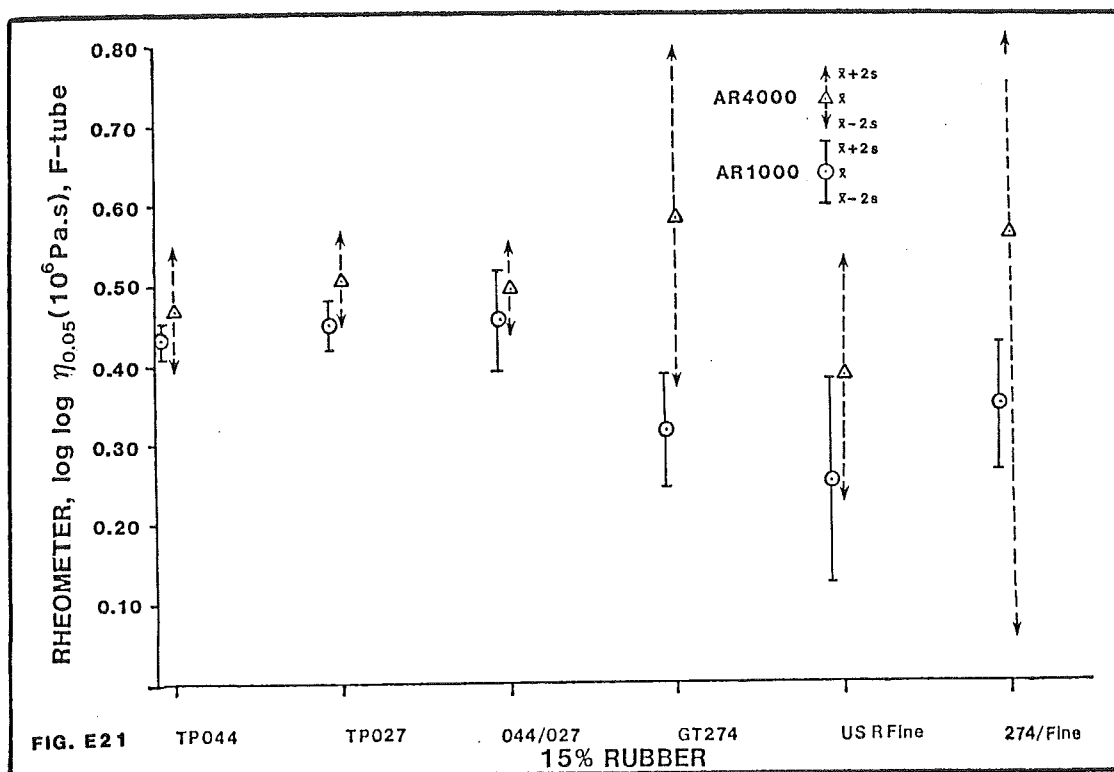
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	.2273379	.0455	12.710	2.43	3.48
Q	3	.1251344	.0417	11.660	2.82	4.28
A	1	.1327817	.13278	37.116	4.07	7.27
RQ	15	.1468480	.0098	2.737	1.91	2.49
RA	5	.2044303	.04089	11.429	2.43	3.48
QA	3	.0200466	.00668	1.868	2.82	4.28
RQA	15	.0814745	.00543	1.518	1.91	2.49
Error	48	.1717174	.0035774			
TOTAL	95	1.1097708				

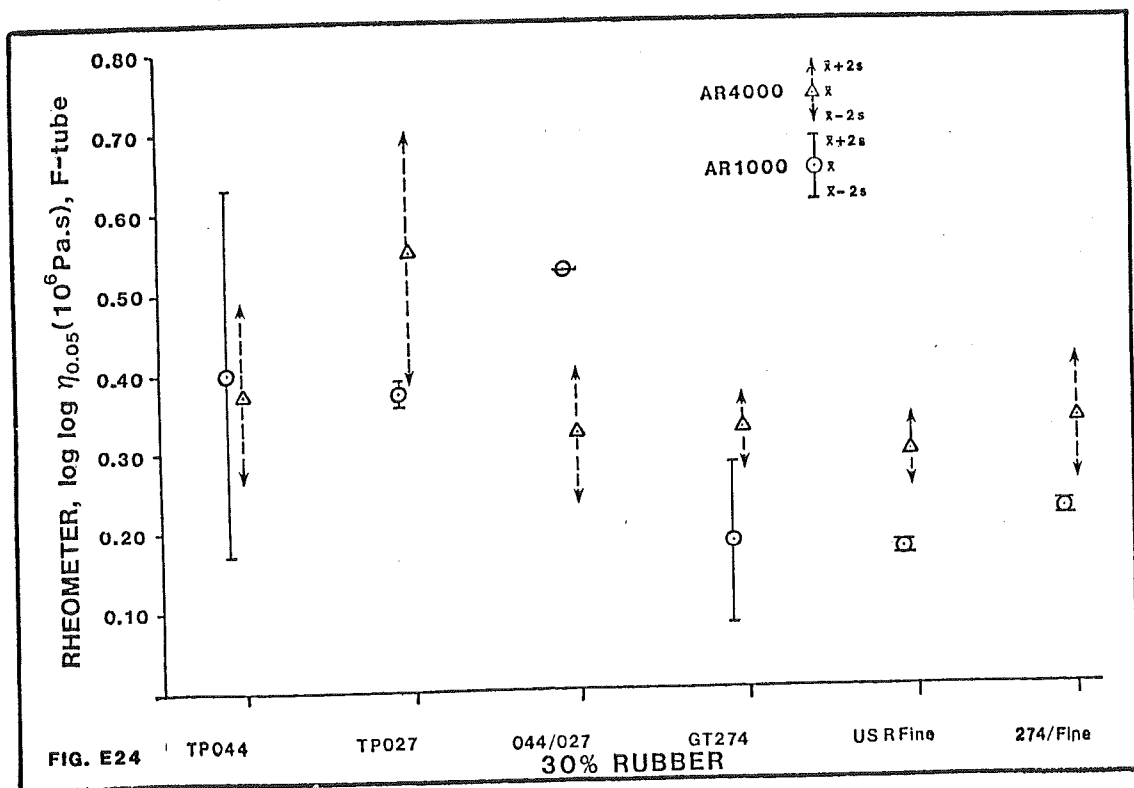
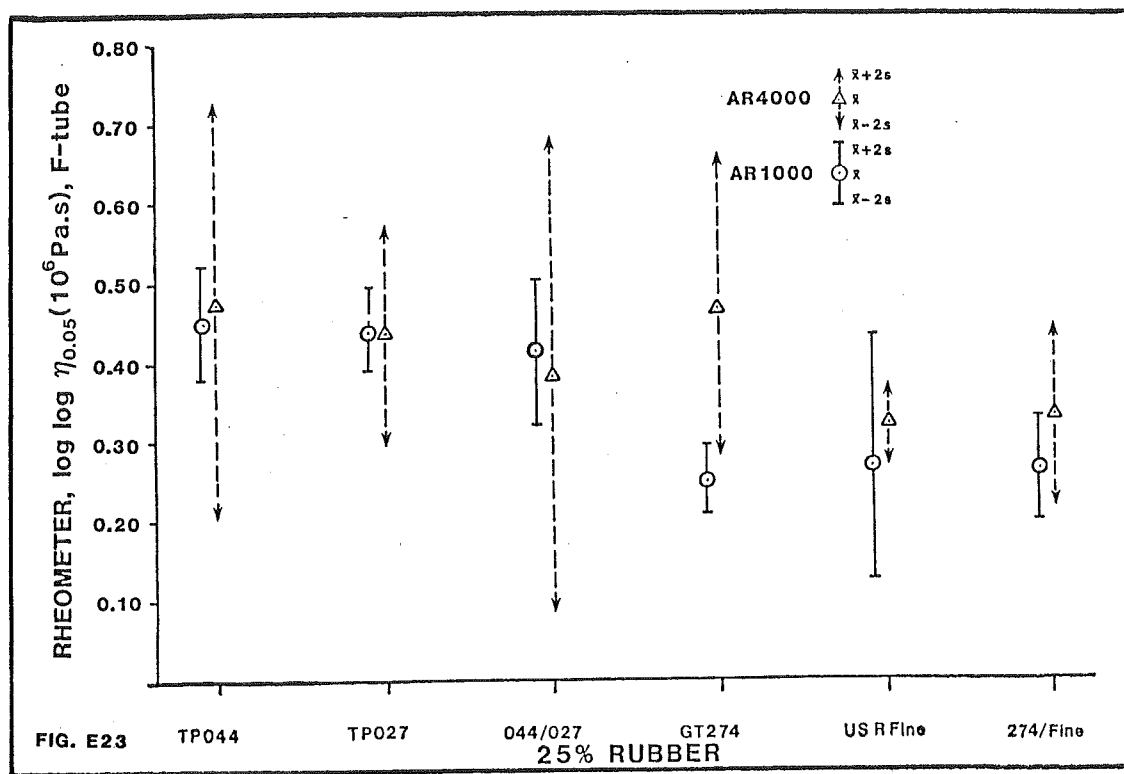


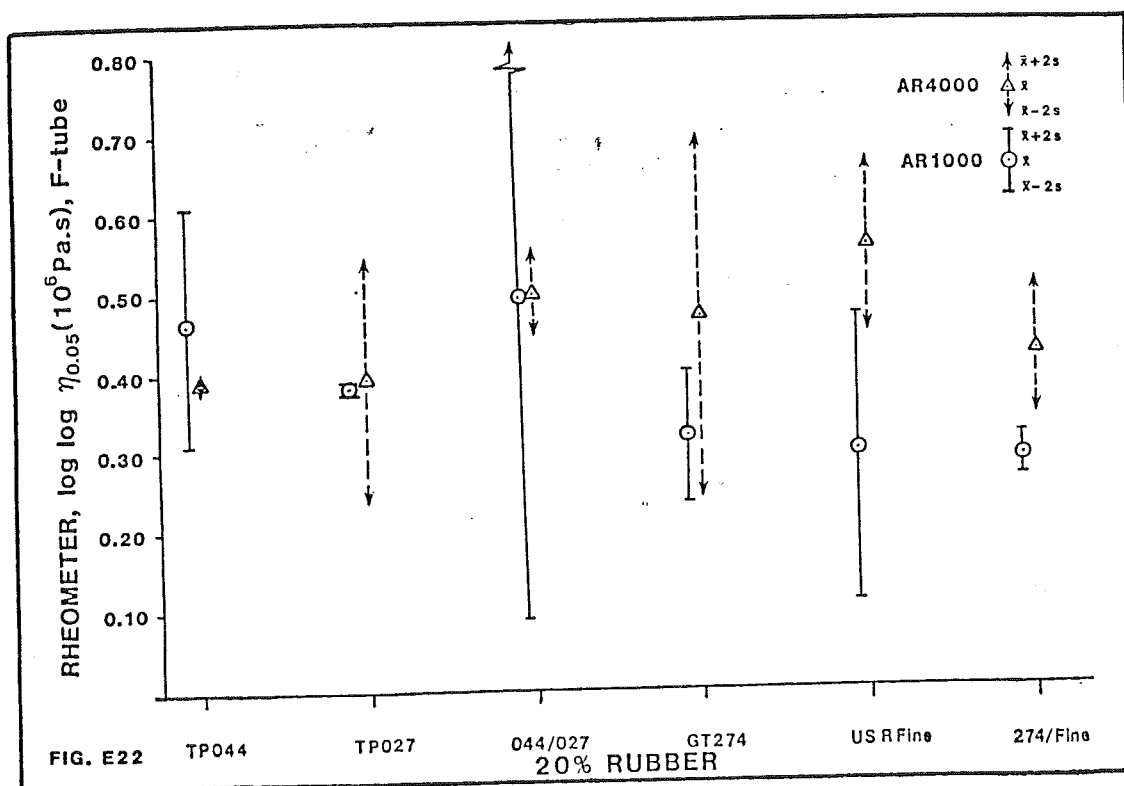
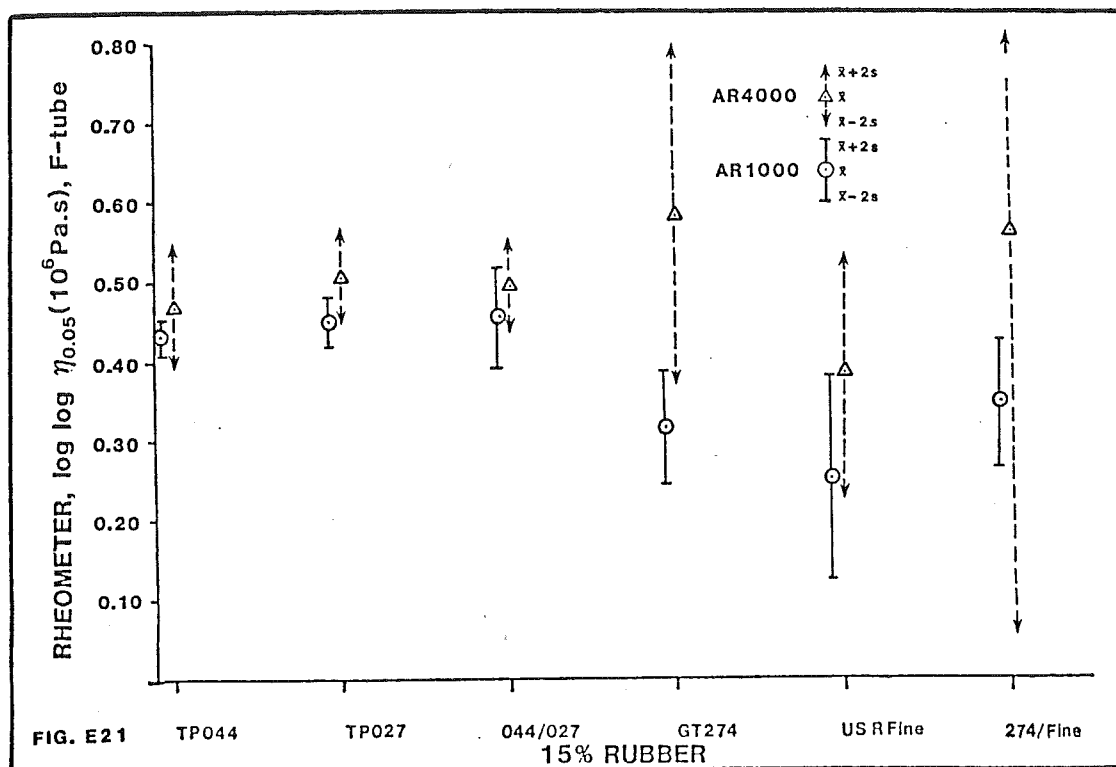


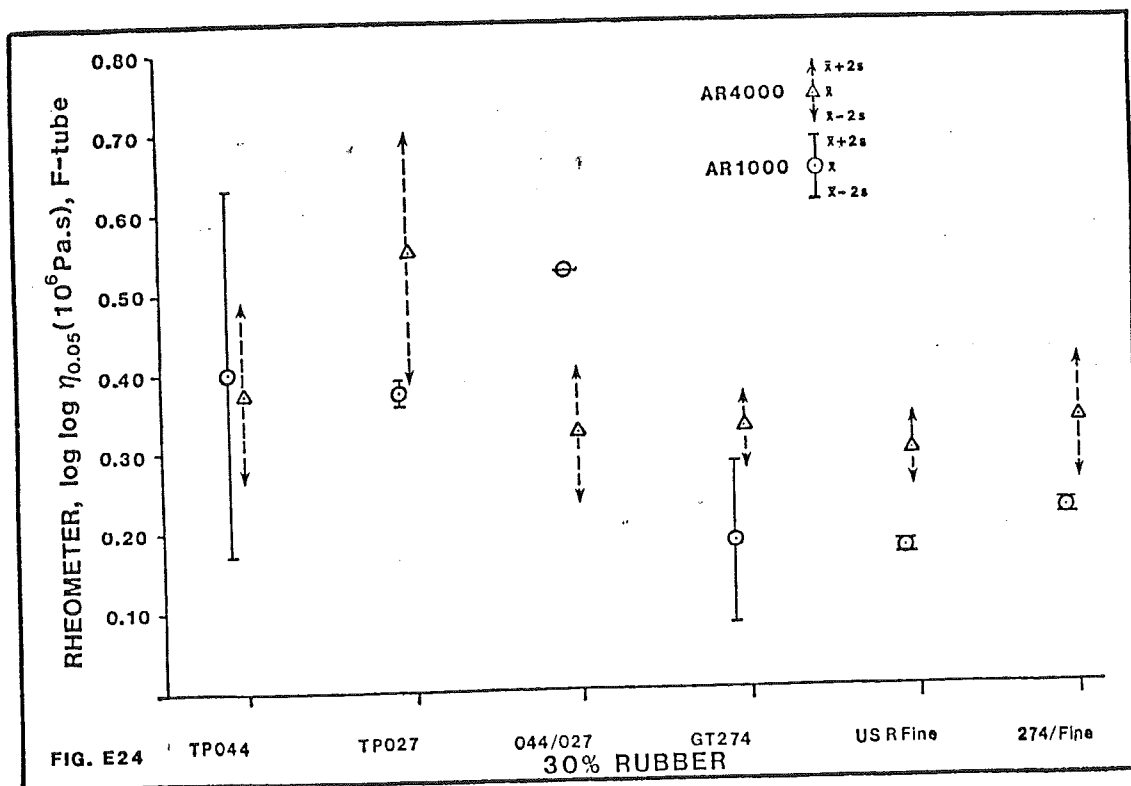
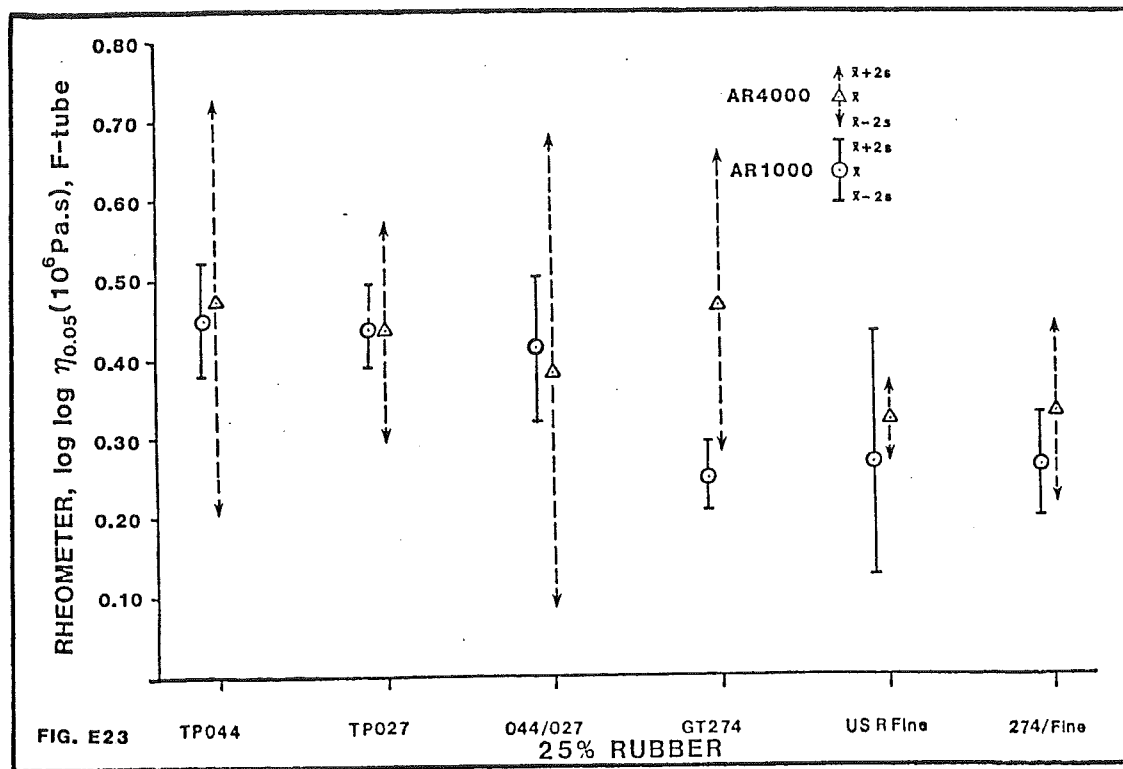












APPENDIX F
FORCE-DUCTILITY LOAD AT
FAILURE AT 39.2F (4C)

Table F-1 Load at Failure, pounds

a. Measured Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	19.19	23.04	23.71	23.12
	18.90	21.62	23.47	25.38
	<u>18.33</u>	<u>18.79</u>	<u>21.29</u>	<u>25.65</u>
	15.56	21.64	23.20	24.87
	18.71	20.89	22.13	28.18
	<u>18.82</u>	<u>19.89</u>	<u>18.87</u>	<u>27.61</u>
A R 1 0 0 0	6.07	9.27	17.18	22.23
	8.09	13.28	18.68	20.65
	<u>8.03</u>	<u>10.12</u>	<u>20.24</u>	<u>17.82</u>
	8.33	13.79	16.21	17.66
	7.20	12.74	16.37	17.07
	<u>7.71</u>	<u>12.10</u>	<u>14.19</u>	<u>16.56</u>

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	<u>X</u>	<u>18.25</u>	<u>20.98</u>	<u>22.11</u>	<u>25.80</u>
	S	<u>1.348</u>	<u>1.489</u>	<u>1.831</u>	<u>1.854</u>
	CV	7.39	7.10	8.28	7.19
A R 1 0 0 0	<u>X</u>	<u>7.57</u>	<u>11.88</u>	<u>17.15</u>	<u>18.67</u>
	S	<u>.833</u>	<u>1.806</u>	<u>2.104</u>	<u>2.252</u>
	CV	11.00	15.20	12.27	12.06

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP087				50% TP044 & 50% TP087				G174				U.S. Rubber Pave				50% G174 & 50% U.S. Pave															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30												
RESEARCH	100-100																																				
	100-100																																				

Table F-1 Load at Failure, pounds

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	15.30	18.95	28.58	23.44
	15.81	18.95	25.03	23.17
	14.73	17.10	30.97	24.06
	21.48	19.46	22.34	21.78
	16.02	19.11	21.70	20.08
	10.94	18.82	19.33	19.81
A R 1 0 0 0	4.75	10.43	13.25	18.50
	4.97	9.54	12.55	17.34
	4.54	9.24	12.44	17.61
	4.92	10.99	20.35	16.51
	4.89	11.58	14.30	16.69
	4.51	10.11	13.84	16.08

b. Summary

		TP027			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>15.71</u>	<u>18.73</u>	<u>24.66</u>	<u>22.06</u>
	S	<u>3.385</u>	<u>.829</u>	<u>4.424</u>	<u>1.800</u>
	CV	21.54	4.43	17.94	8.16
A R 1 0 0 0	$\bar{x}$	<u>4.76</u>	<u>10.32</u>	<u>14.46</u>	<u>17.12</u>
	S	<u>.199</u>	<u>.880</u>	<u>2.976</u>	<u>.875</u>
	CV	4.17	8.53	20.59	5.11

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (R)

	TP046				TP057				50% TP046 50% TP057				50% TP046 50% TP057				50% TP046 50% TP057			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
ASPHALT TYPE (A)																				
PERCENT RUBBER (B)																				
RUBBER TYPE (R)																				

Table F-1 Load at Failure, pounds

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	23.26	30.41	28.82	34.71
	25.49	28.66	30.33	35.65
	24.44	27.18	30.03	35.22
	22.61	24.25	30.52	37.86
	22.53	25.30	32.80	38.53
A R 1 0 0 0	22.39	25.43	34.07	41.95
	10.11	14.95	21.32	29.14
	10.45	15.56	22.48	30.54
	10.02	15.59	23.07	28.69
	9.67	15.89	23.15	28.07
	9.81	15.91	23.44	29.47
	8.01	17.04	23.26	32.08

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>23.46</u>	<u>26.87</u>	<u>31.10</u>	<u>37.32</u>
	s	<u>1.261</u>	<u>2.334</u>	<u>1.949</u>	<u>2.728</u>
	CV	5.38	8.69	6.27	7.31
A R 1 0 0 0	$\bar{x}$	<u>9.68</u>	<u>15.82</u>	<u>22.79</u>	<u>29.67</u>
	s	<u>.860</u>	<u>.690</u>	<u>.789</u>	<u>1.443</u>
	CV	8.89	4.36	3.46	4.86

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				50% TP044 + 50% TP027				G1274				U.S. Rubber Firm				50% G1274 50% U.S. Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
UNDESIGNATED	UNDESIGNATED																																				
	UNDESIGNATED																																				
DESIGNATED	DESIGNATED																																				
	DESIGNATED																																				

Table F-1 Load at Failure, pounds

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	14.97	18.1	18.17	15.62
	15.46	18.98	18.93	13.47
	<u>17.31</u>	<u>19.0</u>	<u>19.22</u>	<u>16.02</u>
	13.55	19.95	19.30	15.40
	14.03	19.41	19.41	13.25
	<u>14.03</u>	<u>18.25</u>	<u>18.98</u>	<u>13.09</u>
A R 1 0 0 0	8.3	11.1	12.66	10.27
	7.8	10.6	12.58	9.99
	<u>7.34</u>	<u>10.8</u>	<u>13.90</u>	<u>10.83</u>
	9.06	10.0	13.7	10.78
	8.28	10.27	14.0	10.72
	<u>8.49</u>	<u>10.94</u>	<u>12.7</u>	<u>10.94</u>

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>14.89</u>	<u>18.95</u>	<u>19.00</u>	<u>14.48</u>
	S	<u>1.376</u>	<u>.697</u>	<u>.447</u>	<u>1.340</u>
	CV	9.24	3.68	2.35	9.26
A R 1 0 0 0	$\bar{x}$	<u>8.21</u>	<u>10.62</u>	<u>13.26</u>	<u>10.59</u>
	S	<u>.590</u>	<u>.418</u>	<u>.676</u>	<u>.373</u>
	CV	7.18	3.93	5.10	3.52

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)											
		TP644				TP627				50% TP644 50% TP627				GT274				U.S. Rubber Type				50% GT274 50% R Type B															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Asphalt Type	TP644																																				
	TP627																																				
Percent Rubber	50% TP644 50% TP627																																				
	GT274																																				
Rubber Type	U.S. Rubber Type																																				
	50% GT274 50% R Type B																																				
Load at Failure	TP644																																				
	TP627																																				
Standard Deviation	50% TP644 50% TP627																																				
	GT274																																				
Coefficient of Variation	U.S. Rubber Type																																				
	50% GT274 50% R Type B																																				

Table F-1 Load at Failure, pounds

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	17.93	21.40	13.95	17.80
	18.41	21.94	13.84	17.58
	19.38	22.83	14.65	18.28
	19.65	16.72	16.75	18.52
	19.30	17.37	16.18	18.66
	19.81	20.49	16.08	18.85
A R 1 0 0 0	10.97	14.68	18.60	13.22
	11.37	14.46	15.05	13.95
	11.34	15.27	15.25	12.47
	10.37	15.11	16.02	12.39
	10.45	15.16	15.46	12.23
	10.32	15.40	15.32	11.34

b. Summary

		U. S. RUBBER FINE			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>19.08</u>	<u>20.13</u>	<u>15.24</u>	<u>18.28</u>
	S	<u>.744</u>	<u>.2512</u>	<u>1.252</u>	<u>.500</u>
	CV	3.90	12.48	8.22	2.73
A R 1 0 0 0	$\bar{x}$	<u>10.80</u>	<u>15.01</u>	<u>15.95</u>	<u>12.60</u>
	S	<u>.486</u>	<u>.364</u>	<u>1.339</u>	<u>.894</u>
	CV	4.50	2.43	8.39	7.09

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP037			SOL TP044 & SOL TP037			QT074			U.S. Rubber Fine			SOL QT074 & SOL U.S. Rubber Fine		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
1000-150																		
1000-200																		
1000-250																		
1000-300																		
1000-350																		
1000-400																		
1000-450																		
1000-500																		
1000-550																		
1000-600																		
1000-650																		
1000-700																		
1000-750																		
1000-800																		
1000-850																		
1000-900																		
1000-950																		
1000-1000																		

Table F-1 Load at Failure, pounds

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	18.90	23.23	12.42	12.23
	17.53	23.71	14.95	13.47
	<u>17.64</u>	<u>23.36</u>	<u>14.11</u>	<u>14.22</u>
	18.39	18.93	13.84	19.09
	20.03	19.68	15.38	18.01
A R 1 0 0 0	<u>18.60</u>	<u>18.07</u>	<u>14.19</u>	<u>16.61</u>
	9.06	10.91	14.35	12.15
	8.87	10.03	13.33	12.18
	<u>8.65</u>	<u>10.51</u>	<u>14.11</u>	<u>11.91</u>
	6.13	12.77	12.74	12.39
	6.48	12.53	13.06	10.94
	<u>6.15</u>	<u>13.12</u>	<u>12.77</u>	<u>9.00</u>

b. Summary

50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>18.52</u>	<u>21.16</u>	<u>14.15</u>	<u>15.61</u>
	s	<u>.906</u>	<u>2.543</u>	<u>1.024</u>	<u>2.713</u>
	CV	4.89	12.02	7.24	17.39
A R 1 0 0 0	$\bar{x}$	<u>7.56</u>	<u>11.65</u>	<u>13.39</u>	<u>11.43</u>
	s	<u>1.439</u>	<u>1.316</u>	<u>.6869</u>	<u>1.294</u>
	CV	19.04	11.30	5.13	11.33

		ASPHALT TYPE (A)									PERCENT RUBBER (B)									RUBBER TYPE (C)								
		TPQ44			TPQ47			50% TPQ44 50% TPQ47			GT274			U.S. Rubber Fine			50% GT274 50% U.S. Rubber											
		15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30									
Reference	Asphalt																											
	TPQ44																											
	TPQ47																											
	50% TPQ44 50% TPQ47																											

Table F-2 Load at Failure, pounds

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	18.807	21.150	22.823	24.717
	17.697	20.807	21.400	26.887
A R 1 0 0 0	7.397	10.890	18.700	20.233
	7.747	12.877	15.590	17.097

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	18.252	20.979	22.112	25.802
	S	.983	.304	1.261	1.923
	CV	5.39	1.45	5.70	7.45
A R 1 0 0 0	$\bar{x}$	7.572	11.884	17.145	18.665
	S	.310	1.760	2.755	2.778
	CV	4.10	14.81	16.07	14.89

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP044 80% TP027				RT574			
		15	20	25	30	15	20	25	30	15	20	25	30
Reference	1												
	2												
	3												
	4												

Table F-2 Load at Failure, pounds

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	15.280	18.333	28.193	23.557
	16.147	19.130	21.123	20.557
A R 1 0 0 0	4.753	9.737	12.747	17.817
	4.773	10.893	16.163	16.427

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	15.714	18.732	24.658	22.057
	S	.768	.7061	6.264	2.658
	CV	4.89	3.77	25.40	12.05
A R 1 0 0 0	$\bar{x}$	4.763	10.315	14.455	17.122
	S	.018	1.024	3.027	1.231
	CV	.37	9.93	20.94	7.19

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (R)

	TP044				TP027				50% TP044 & 50% TP027				GT274				US Rubber Fms				50% GT274 & 50% R Fms			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
ASPHALT TYPE (A)																								
PERCENT RUBBER (B)																								
RUBBER TYPE (R)																								

Table F-2 Load at Failure, pounds

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	<u>24.413</u>	<u>28.750</u>	<u>29.727</u>	<u>35.193</u>
	22.510	24.993	32.463	39.447
A R 1 0 0 0	<u>10.193</u>	<u>15.367</u>	<u>22.290</u>	<u>29.457</u>
	9.163	16.280	23.283	29.873

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>23.462</u>	<u>26.872</u>	<u>31.095</u>	<u>37.320</u>
	s	<u>1.686</u>	<u>3.329</u>	<u>2.424</u>	<u>3.769</u>
	CV	7.19	12.39	7.80	10.10
A R 1 0 0 0	$\bar{x}$	<u>9.678</u>	<u>15.824</u>	<u>22.787</u>	<u>29.665</u>
	s	<u>.913</u>	<u>.809</u>	<u>.880</u>	<u>.369</u>
	CV	9.43	5.11	3.86	1.24

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044		TP027		50% TP044 & 50% TP027		G1374		U.S. Rubber Firm		50% G1374 & 50% Rubber Firm	
		15	30	25	30	15	30	25	30	15	30	25	30
ASPHALT TYPE (A)	TP044												
	TP027												
	50% TP044 & 50% TP027												
	G1374												
PERCENT RUBBER (B)	U.S. Rubber Firm												
	50% G1374 & 50% Rubber Firm												
	TP044												
	TP027												
RUBBER TYPE (C)	50% TP044 & 50% TP027												
	G1374												
	U.S. Rubber Firm												
	50% G1374 & 50% Rubber Firm												

Table F-2 Load at Failure, pounds

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	15.913	18.693	18.773	15.037
	13.870	19.203	19.230	13.913
A R 1 0 0 0	7.813	10.833	13.047	10.363
	8.610	10.403	13.467	10.813

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	14.892	18.948	19.002	14.475
	S	1.81	.452	.405	.996
	CV	12.16	2.38	2.13	6.88
A R 1 0 0 0	$\bar{x}$	8.212	10.618	13.257	10.588
	S	.706	.381	.372	.399
	CV	8.60	3.59	2.81	3.77

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TPQ44				TPQ37				50% TPQ44 50% TPQ37				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber A															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Reference	Load at Failure																																				
	Standard Deviation																																				
5000-35	Load at Failure																																				
	Standard Deviation																																				

Table F-2 Load at Failure, pounds

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	18.573	22.057	14.147	17.887
	19.587	18.193	16.337	18.677
A R 1 0 0 0	11.227	14.803	16.300	13.213
	10.380	15.223	15.600	11.987

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	19.080	20.125	15.242	18.282
	S	.898	3.424	1.940	.700
	CV	4.71	17.01	12.73	3.83
A R 1 0 0 0	$\bar{x}$	10.804	15.013	15.950	12.600
	S	.750	.372	.620	1.086
	CV	6.95	2.48	3.89	8.62

ASPHALT TYPE (A)																							
PERCENT RUBBER (B)																							
RUBBER TYPE (C)																							
TPQ46				TPQ27				80% TPQ46 80% TPQ27				BT274				U.S. Rubber Fine				80% BT274 80% R Fine			
15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30

Table F-2 Load at Failure, pounds

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
AR 4000	<u>18.040</u>	<u>23.433</u>	<u>13.827</u>	<u>13.307</u>
	19.007	18.893	14.470	17.903
AR 1000	<u>8.860</u>	<u>10.483</u>	<u>13.930</u>	<u>12.080</u>
	6.253	12.807	12.857	10.957

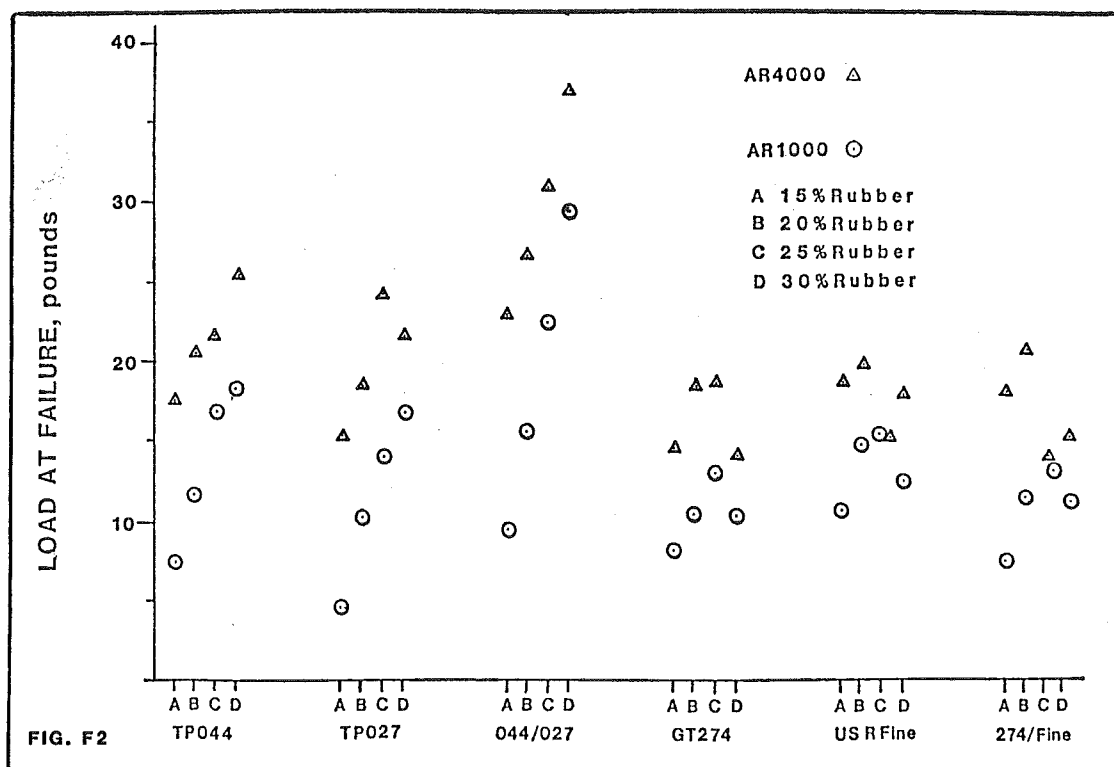
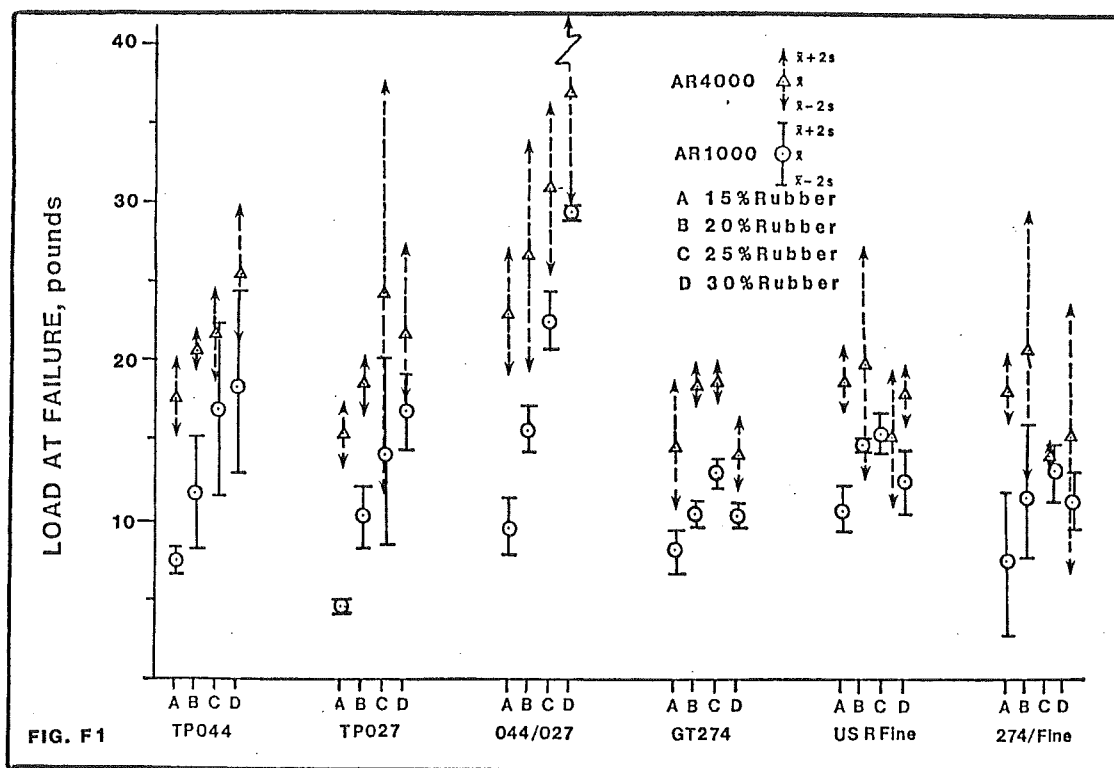
b. Summary

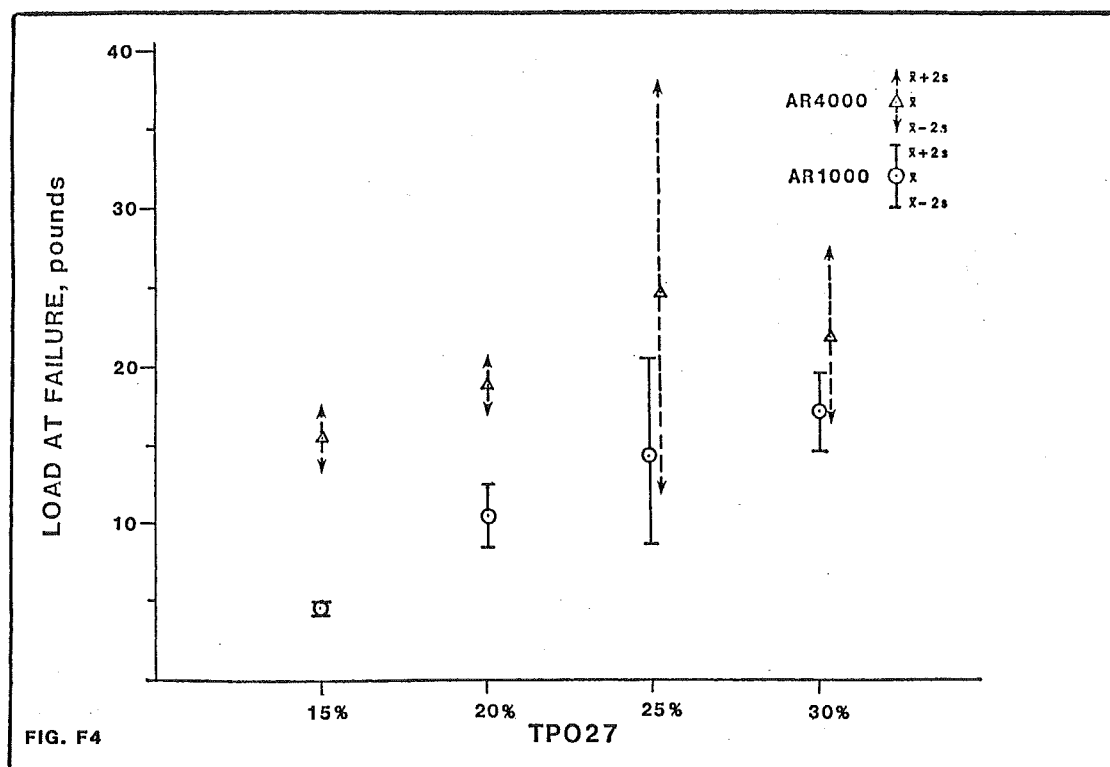
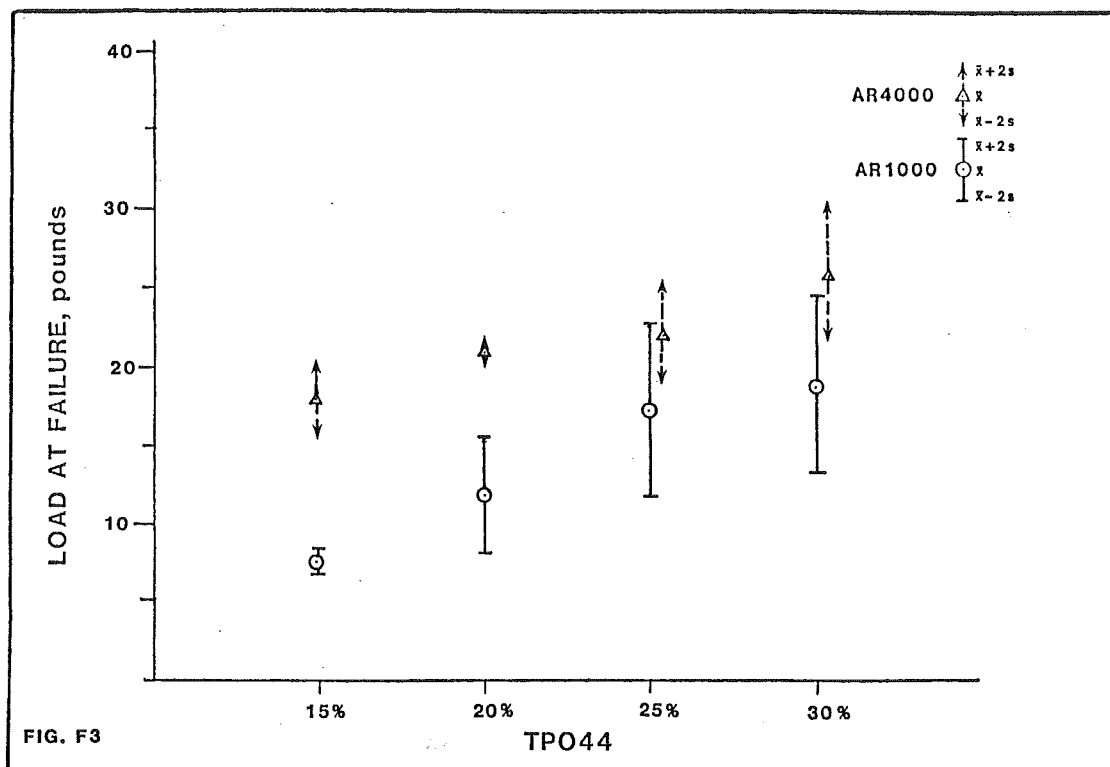
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	<u>18.524</u>	<u>21.163</u>	<u>14.149</u>	<u>15.605</u>
	S	<u>.857</u>	<u>4.022</u>	<u>.570</u>	<u>4.07</u>
	CV	4.63	19.01	4.03	26.09
AR 1000	$\bar{x}$	<u>7.557</u>	<u>11.645</u>	<u>13.394</u>	<u>11.519</u>
	S	<u>2.310</u>	<u>2.059</u>	<u>.951</u>	<u>.995</u>
	CV	30.57	17.68	7.10	8.64

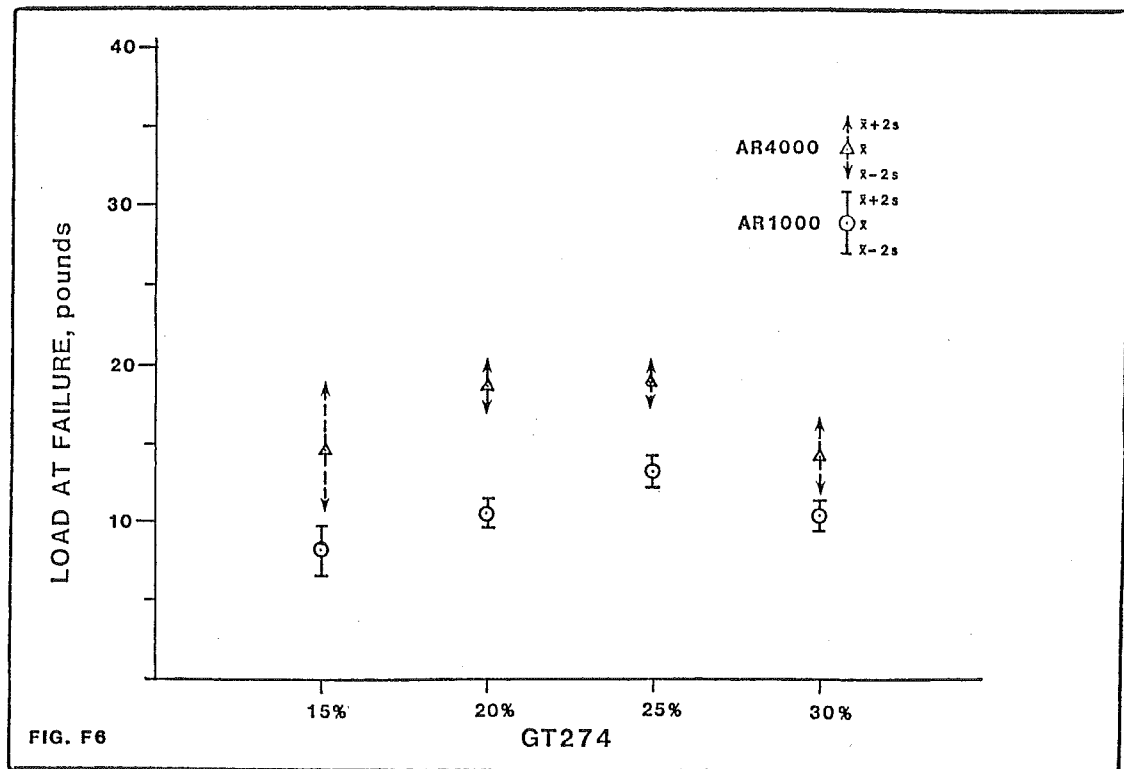
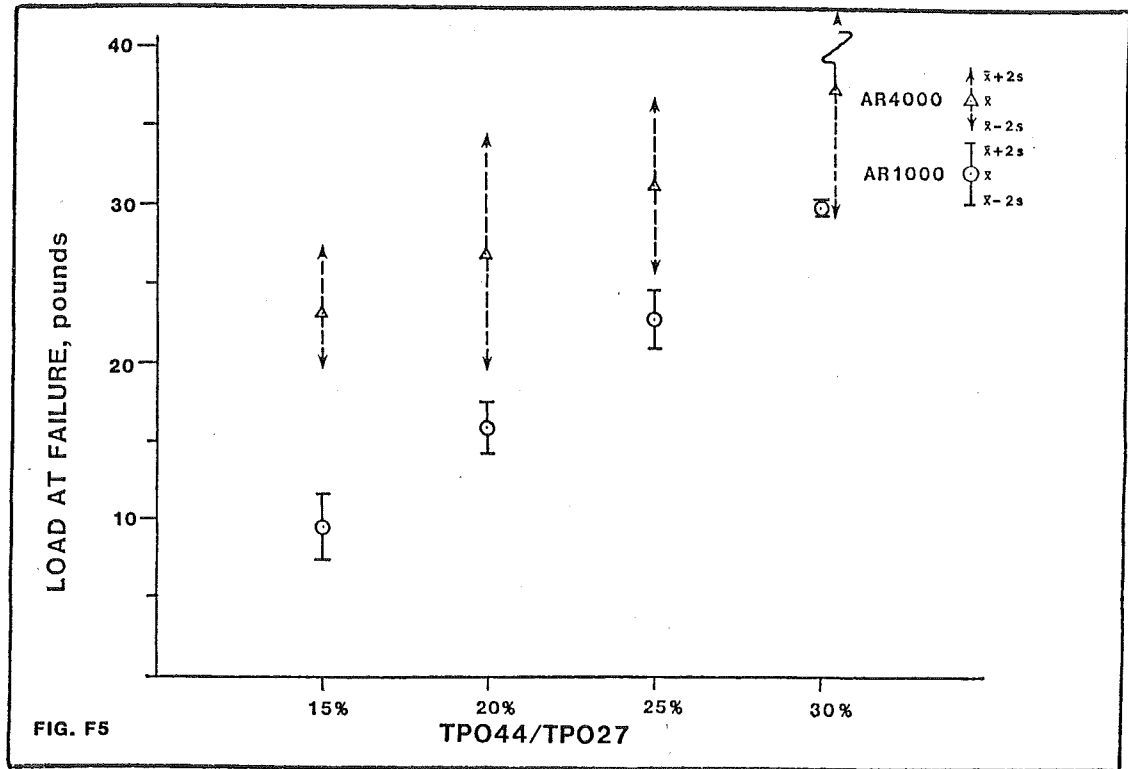
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)											
		TP044				TP007				50% TP044 50% TP007				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber Fine															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
RUBBER TYPE	TP044																																				
	TP007																																				
	50% TP044 50% TP007																																				
	GT274																																				

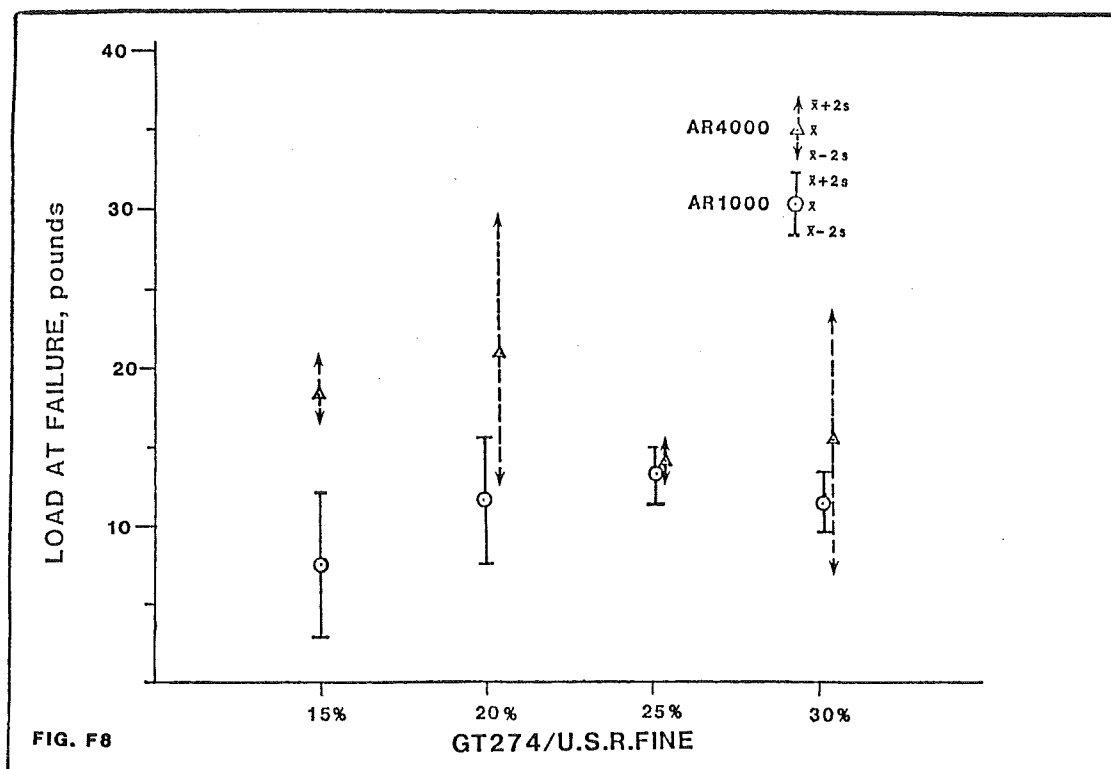
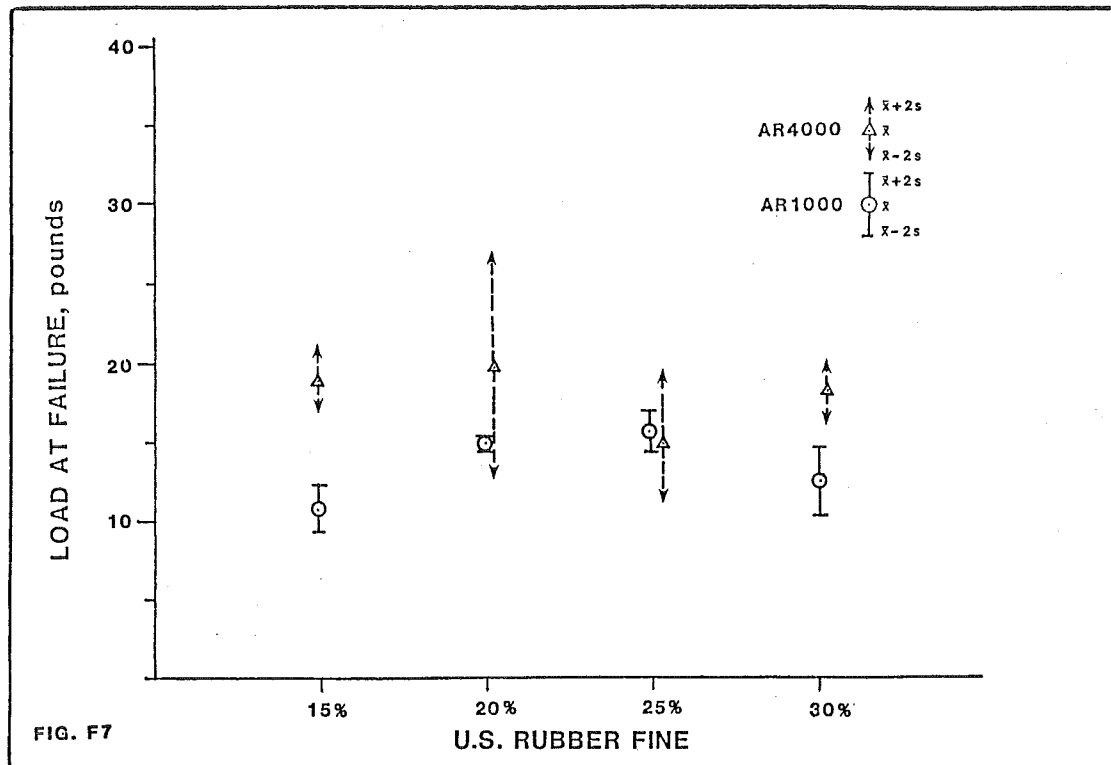
Table F-3 Anova Summary, Load at Failure

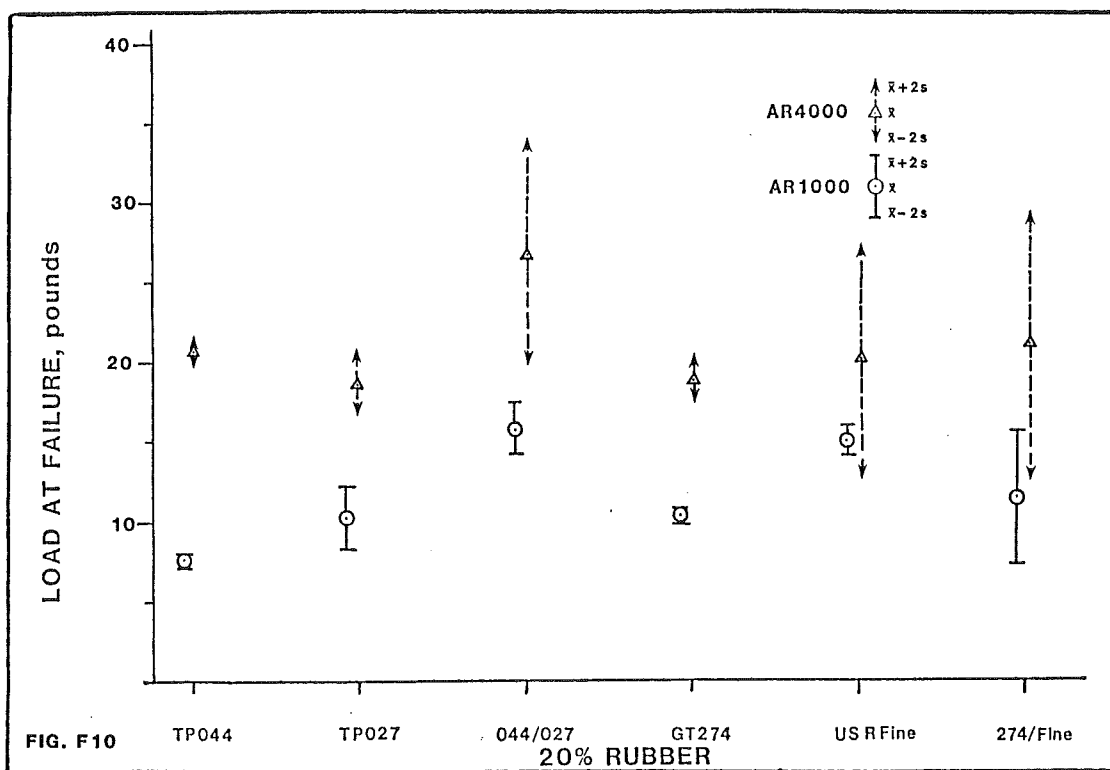
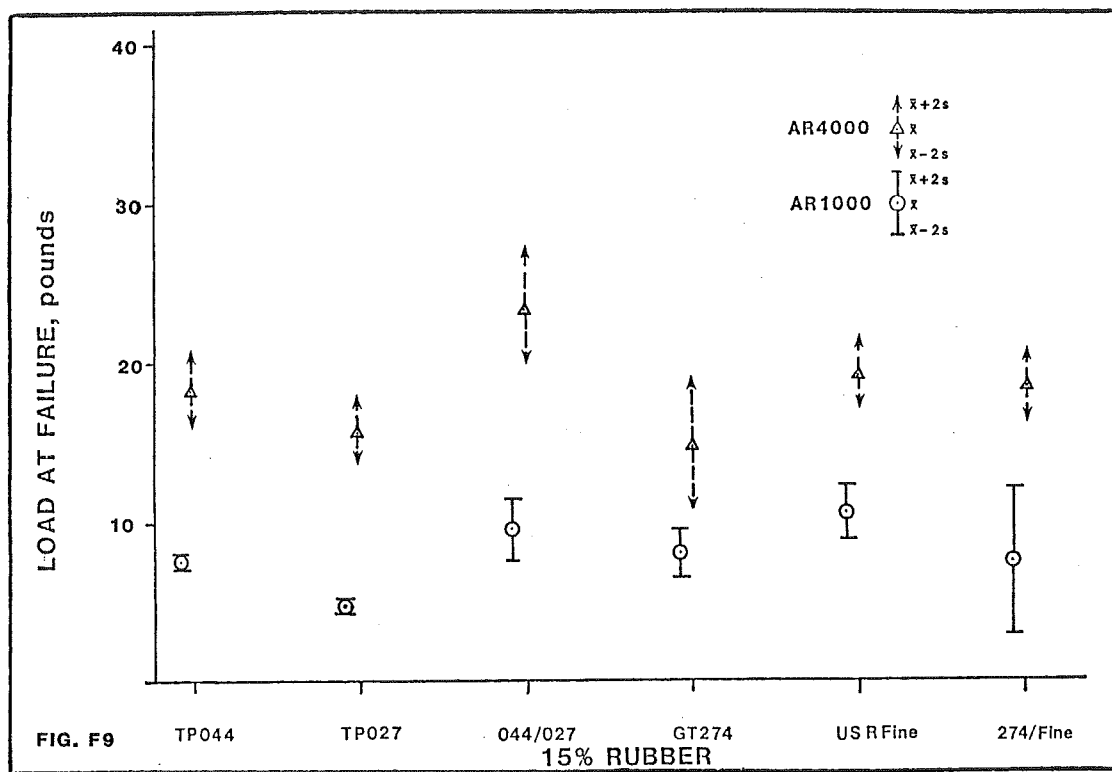
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	1267.15740	253.43148	101.30	2.43	3.48
Q	3	559.13589	186.37863	74.50	2.82	4.27
A	1	1278.92350	1278.92350	511.24	4.069	7.27
RQ	15	616.58407	41.10560	16.43	1.90	2.49
RA	5	81.50148	16.30029	6.51	2.43	3.48
QA	3	112.62153	37.54051	15.00	2.82	4.27
RQA	15	72.20719	4.81381	1.92	1.90	2.49
Error	48	120.07600	2.50158			
TOTAL	95	4108.20708				

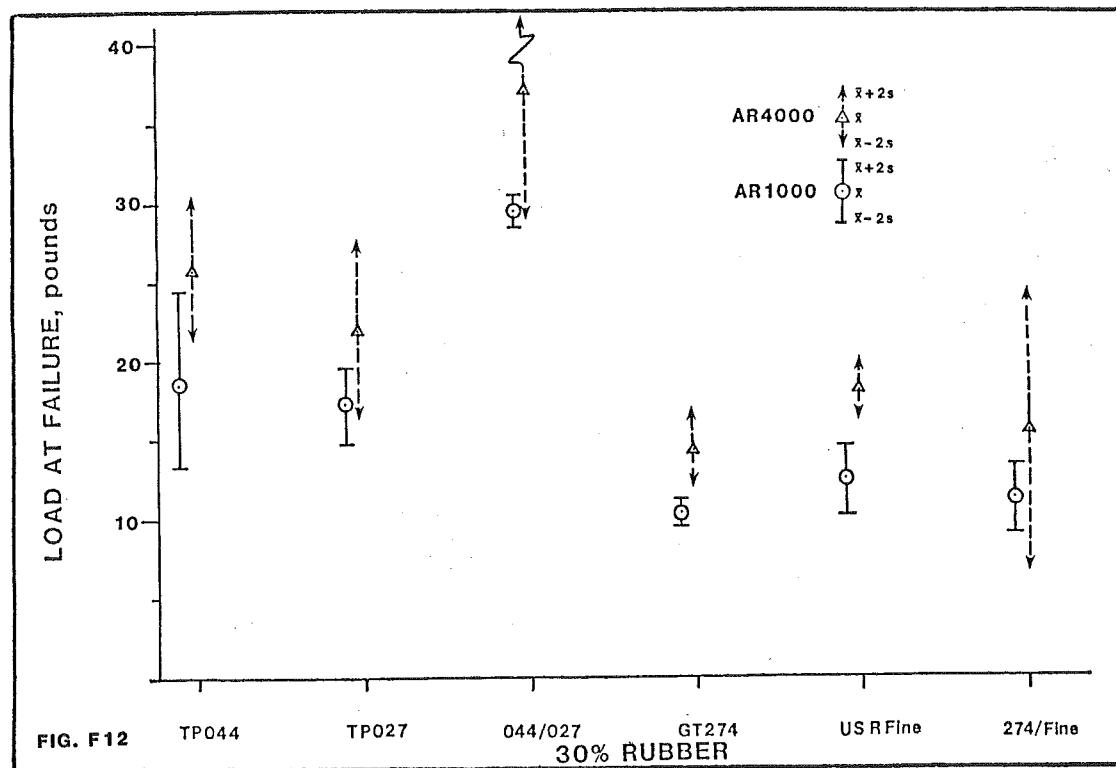
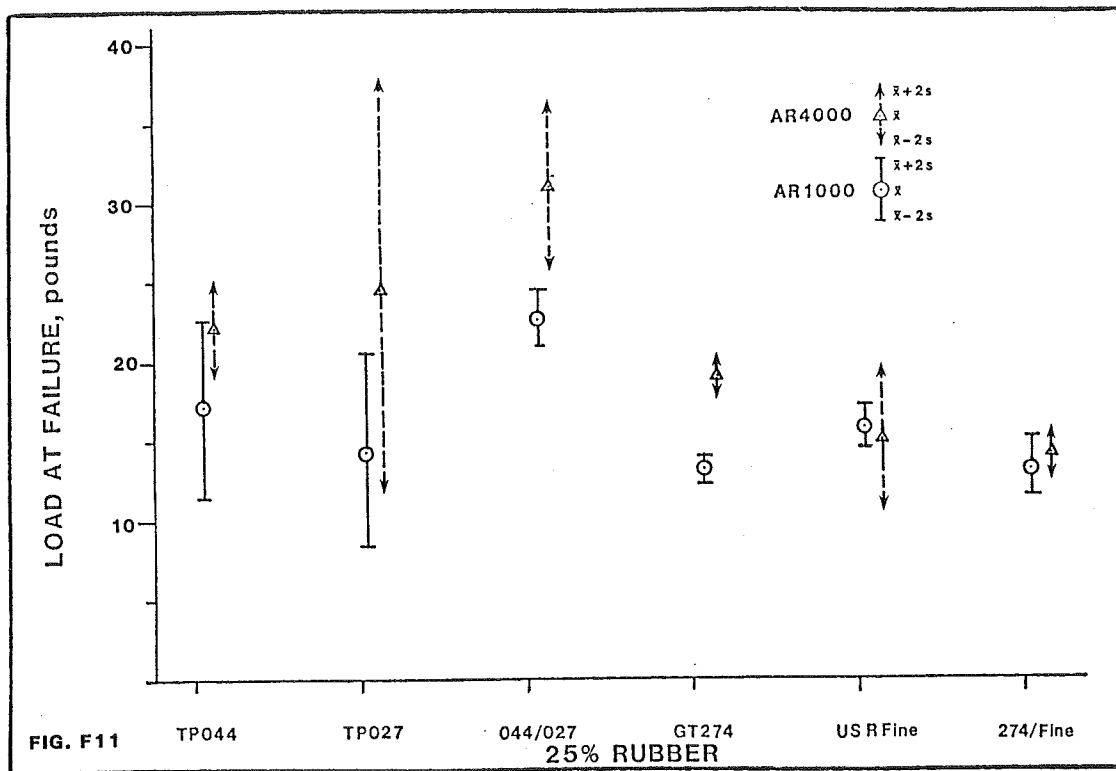












APPENDIX G
FORCE DUCTILITY ELONGATION AT
FAILURE AT 39.2F(4C)

a. Measured Data

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>216</u>	<u>200</u>	<u>194</u>	<u>169</u>
	S	<u>9.8</u>	<u>7.7</u>	<u>26.8</u>	<u>25.8</u>
	CV	4.52	3.87	13.81	15.25
A R 1 0 0 0	$\bar{x}$	<u>275</u>	<u>243</u>	<u>186</u>	<u>179</u>
	S	<u>43.9</u>	<u>23.3</u>	<u>9.4</u>	<u>7.1</u>
	CV	15.95	9.60	5.09	3.97

221

Table G-1 Elongation at Failure, mm

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	380	319	324	311
	374	321	289	313
	360	320	267	359
	326	319	321	296
	327	309	272	296
A R 1 0 0 0	363	314	237	288
	471	410	255	331
	463	455	259	337
	466	459	317	325
	461	381	300	295
	534	374	329	303
	474	408	328	352

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>355</u>	<u>317</u>	<u>285</u>	<u>311</u>
	s	<u>23.2</u>	<u>4.6</u>	<u>33.5</u>	<u>25.6</u>
	cv	6.55	1.45	11.7	8.26
A R 1 0 0 0	$\bar{x}$	<u>478</u>	<u>415</u>	<u>298</u>	<u>324</u>
	s	<u>27.8</u>	<u>35.9</u>	<u>33</u>	<u>21.4</u>
	cv	5.81	8.66	11.23	6.60

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (H)											
		TP064				TP057				50% TP064 50% TP057				G1374				U.S. Rubber Fine				50% G1374 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Elongation at Failure (mm)	TP064																																				
	TP057																																				
Elongation at Break (mm)	TP064																																				
	TP057																																				

Table G-1 Elongation at Failure, mm

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	225	226	211	245
	259	247	220	236
	249	233	235	222
	246	222	203	244
	267	244	213	239
	292	209	242	256
A R 1 0 0 0	310	287	234	208
	279	294	248	261
	341	281	275	210
	319	246	268	169
	331	279	228	210
	335	274	252	183

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	<u>256</u>	<u>230</u>	<u>221</u>	<u>240</u>
	S	<u>22.5</u>	<u>14.2</u>	<u>15.0</u>	<u>11.3</u>
	CV	8.78	6.19	6.79	4.70
A R 1 0 0 0	$\bar{X}$	<u>319</u>	<u>277</u>	<u>251</u>	<u>208</u>
	S	<u>22.6</u>	<u>16.6</u>	<u>18.4</u>	<u>31.9</u>
	CV	7.10	6.00	7.34	15.30

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				50% TP044 50% TP027				S1374				U.S. Rubber Firm				50% S1374 50% A.P. 6															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
RUBBER TYPE	NR																																				
	SR																																				
600-130																																					
600-130																																					

Table G-1 Elongation at Failure, mm

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	369	387	358	413
	352	378	351	398
	399	388	376	389
	416	357	367	401
	405	392	397	410
A R 1 0 0 0	384	412	346	357
	446	499	451	372
	557	452	421	426
	511	462	445	431
	493	409	425	423
	477	394	406	417
	472	463	406	380

b. Summary

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>388</u>	<u>386</u>	<u>366</u>	<u>395</u>
	s	<u>23.9</u>	<u>18.0</u>	<u>18.7</u>	<u>20.4</u>
	cv	6.18	4.67	5.12	5.16
A R 1 0 0 0	$\bar{x}$	<u>493</u>	<u>447</u>	<u>426</u>	<u>408</u>
	s	<u>38.3</u>	<u>38.6</u>	<u>19.0</u>	<u>25.5</u>
	cv	7.77	8.65	4.47	6.24

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP644				TP627				50% TP644 50% TP627				GT 274				U.S. Rubber Firm				50% GT274 50% R Plus 6															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Elongation at Failure, mm	Asphalt																																				
	Rubber																																				
Elongation at Break, %	Asphalt																																				
	Rubber																																				

Table G-1 Elongation at Failure, mm

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	284	338	422	272
	293	335	355	327
	371	324	412	304
	365	257	374	379
	347	279	388	321
	374	325	380	353
A R 1 0 0 0	426	403	357	415
	421	407	341	371
	406	421	308	368
	397	378	358	378
	371	347	359	476
	395	420	360	428

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	339	310	389	326
	S	40.3	33.5	24.8	37.3
	CV	11.89	10.81	6.39	11.45
A R 1 0 0 0	$\bar{x}$	403	396	347	406
	S	19.9	28.6	20.4	42.2
	CV	4.95	7.23	5.89	10.40

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TPQ66				TPQ37				80% TPQ66 20% TPQ37				BT274				U.S. Rubber Fine				80% BT274 20% U.S. Rubber Fine															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30				
Elongation	mm																																				
	in.																																				

Table G-1 Elongation at Failure, mm

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	355	365	345	247
	390	359	308	260
	<u>351</u>	<u>316</u>	<u>302</u>	<u>356</u>
	371	283	262	311
	330	330	333	269
	409	311	308	280
A R 1 0 0 0	442	348	397	317
	451	410	411	254
	<u>479</u>	<u>302</u>	<u>375</u>	<u>340</u>
	701	437	312	288
	548	415	291	237
	599	351	362	251

b. Summary

50% GT274 & 50% U. S. RUBBER FINE				
	15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$ <u>368</u>	$\bar{X}$ <u>327</u>	$\bar{X}$ <u>310</u>	$\bar{X}$ <u>287</u>
	S <u>28.5</u>	S <u>30.9</u>	S <u>28.7</u>	S <u>40.1</u>
	CV 7.77	CV 9.46	CV 9.28	CV 13.96
A R 1 0 0 0	$\bar{X}$ <u>537</u>	$\bar{X}$ <u>377</u>	$\bar{X}$ <u>358</u>	$\bar{X}$ <u>281</u>
	S <u>100.6</u>	S <u>51.5</u>	S <u>47.4</u>	S <u>40.9</u>
	CV 18.75	CV 13.66	CV 13.24	CV 14.57

ASPHALT TYPE (A)																	
PERCENT RUBBER (B)																	
RUBBER TYPE (R)																	

Table G-2 Elongation at Failure, mm

a. Reduced Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	222.3	199.7	185.3	169.0
	210.0	200.3	203.3	169.7
A R 1 0 0 0	308.3	242.7	182.7	183.0
	242.3	242.7	188.3	174.3

b. Summary

TF044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	216.2	200.0	194.3	169.4
	S	10.898	.532	15.948	.620
	CV	5.04	.27	8.21	.37
A R 1 0 0 0	$\bar{x}$	275.3	242.7	185.5	178.7
	S	58.476	0	4.962	7.708
	CV	21.24	0	2.67	4.31

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)											
		TPO44				TPO47				50% TPO44 & 50% TPO47				GT210				U.S. Rubber Fm				50% GT210 & 50% U.S. Fm				50% GT210 & 50% U.S. Fm				50% GT210 & 50% U.S. Fm				50% GT210 & 50% U.S. Fm			
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Elongation	mm																																				
	in.																																				

Table G-2 Elongation at Failure, mm

a. Reduced Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	371.3	320.0	293.3	327.7
	338.7	314.0	276.7	293.3
A R 1 0 0 0	466.7	441.3	277.0	331.0
	489.7	387.7	319.0	316.7

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	355.0	317.0	285.0	310.5
	S	28.884	5.316	14.708	30.478
	CV	8.14	1.68	5.16	9.82
A R 1 0 0 0	$\bar{x}$	478.2	414.5	298.0	323.9
	S	20.378	47.490	37.21	12.670
	CV	4.26	11.46	12.49	3.91

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP027				50% TP044 + 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
Elongation at Failure (mm)	TP044												
	TP027												
50% TP044 + 50% TP027	50% TP044												
	50% TP027												
U.S. Rubber Type	U.S. Rubber Type												
	50% Rubber Type												
50% Rubber Type	50% Rubber Type												
	50% Rubber Type												

Table G-2 Elongation at Failure, mm

a. Reduced Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	244.3	235.3	222.0	234.3
	268.3	225.0	219.3	246.3
A R 1 0 0 0	310.0	287.3	252.3	229.3
	328.3	266.3	249.3	187.3

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	256.3	230.2	220.7	240.3
	S	21.264	9.126	2.392	10.632
	CV	8.30	3.97	1.08	4.42
A R 1 0 0 0	$\bar{x}$	319.2	276.8	250.8	208.3
	S	16.214	18.606	2.658	37.212
	CV	5.08	6.72	1.06	17.86

		ASPHALT TYPE (A)				PERCENT RUBBER (R)				RUBBER TYPE (B)			
		TP044				TP027				50% TP044 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
Elongation at Failure (mm)	AR 4000	244.3	268.3	235.3	225.0	222.0	219.3	234.3	246.3	256.3	230.2	220.7	240.3
	AR 1000	310.0	328.3	287.3	266.3	252.3	249.3	229.3	187.3	319.2	276.8	250.8	208.3
Standard Deviation (mm)		21.264	21.264	9.126	9.126	2.392	2.392	10.632	10.632	16.214	16.214	2.658	37.212
Coefficient of Variation (%)		8.30	8.30	3.97	3.97	1.08	1.08	4.42	4.42	5.08	5.08	1.06	17.86

Table G-2 Elongation at Failure, mm

a. Reduced Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	373.3	384.3	361.7	400.0
	401.7	387.0	370.0	389.3
A R 1 0 0 0	504.7	471.0	439.0	409.7
	480.7	422.0	412.3	406.7

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	387.5	385.7	365.9	394.7
	S	25.162	2.392	7.354	9.480
	CV	6.49	.62	2.01	2.40
A R 1 0 0 0	$\bar{x}$	492.7	446.5	425.7	408.2
	S	21.264	43.41	23.65	2.658
	CV	4.32	9.72	5.56	.65

		ASPHALT TYPE (A)									PERCENT RUBBER (R)									RUBBER TYPE (R)																
		TP64			TP67			50% TP64 & 50% TP67			G1274			U.S. Rubber Fm			50% G1274 50% U.S. Fm																			
		15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25		
500-50	500-50																																			
	500-50																																			

Table G-2 Elongation at Failure, mm

a. Reduced Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	316.0	332.3	396.3	301.0
	362.0	287.0	380.7	351.0
A R 1 0 0 0	417.7	410.3	335.3	384.7
	387.7	381.7	359.0	427.3

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	339.0	309.7	388.5	326.0
	S	40.756	40.136	13.822	44.300
	CV	12.02	12.96	3.56	13.59
A R 1 0 0 0	$\bar{X}$	402.7	396.0	347.2	406.0
	S	26.580	25.340	20.998	37.744
	CV	6.600	6.40	6.05	9.30

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP644				TP627				TP644 & TP627			
		15	20	25	30	15	20	25	30	15	20	25	30
Elongation at Failure (mm)	TP644												
	TP627												
Elongation at Failure (mm)	TP644 & TP627												
	U.S. Rubber Fine												
Elongation at Failure (mm)	TP644 & TP627												
	U.S. Rubber Fine												

Table G-2 Elongation at Failure, mm

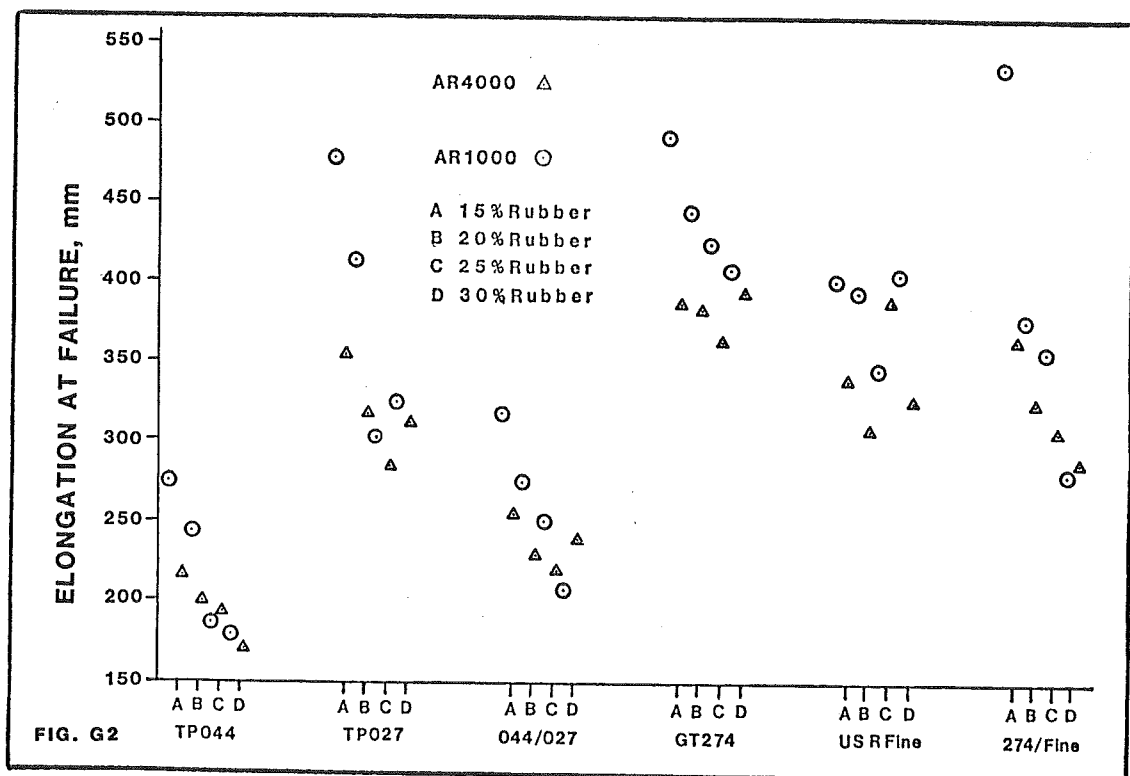
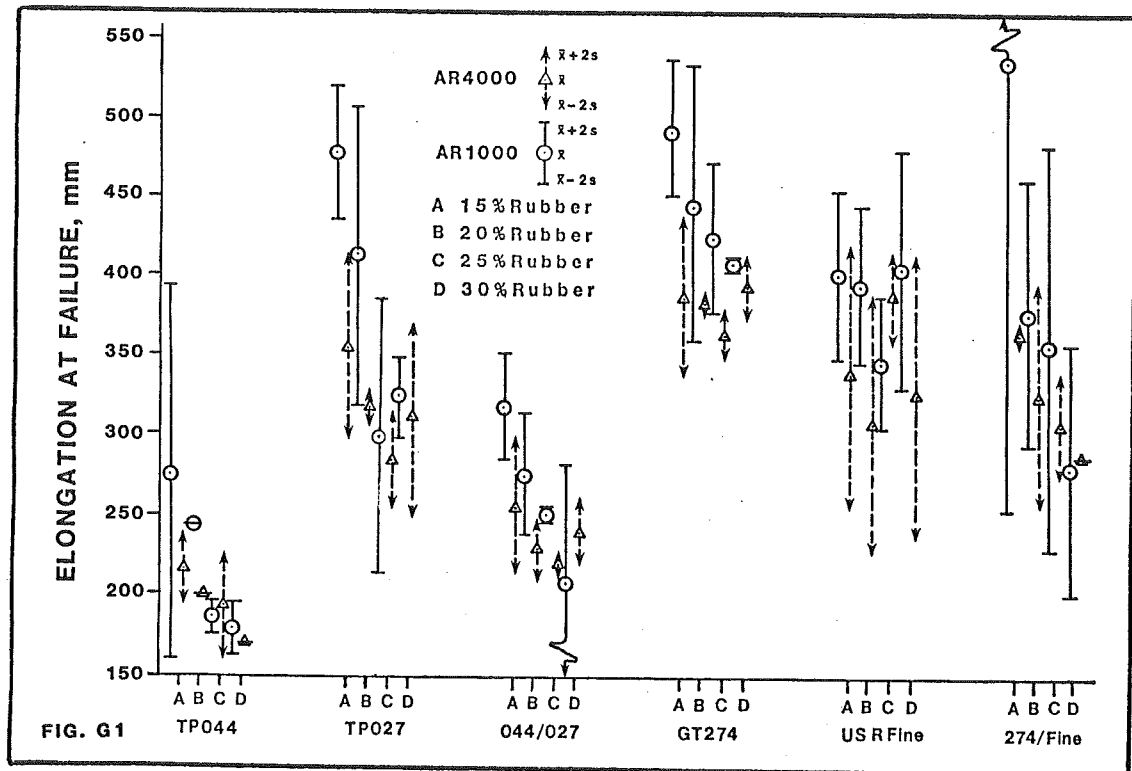
a. Reduced Data

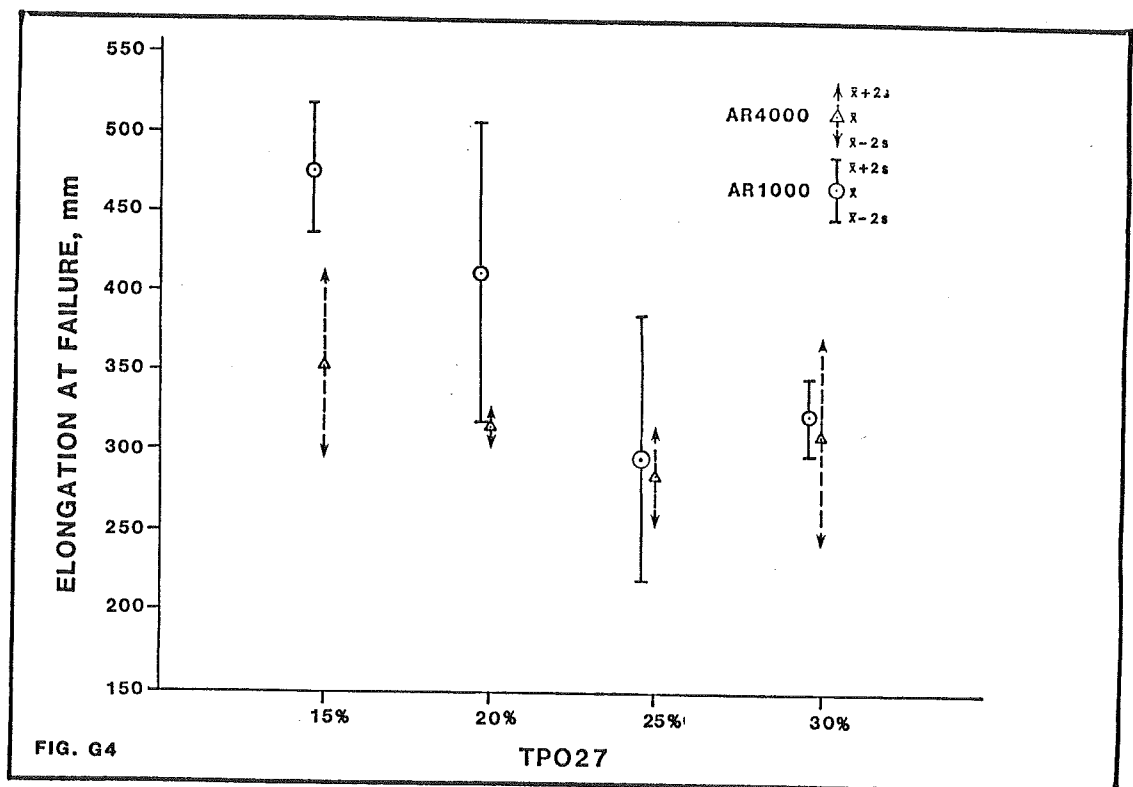
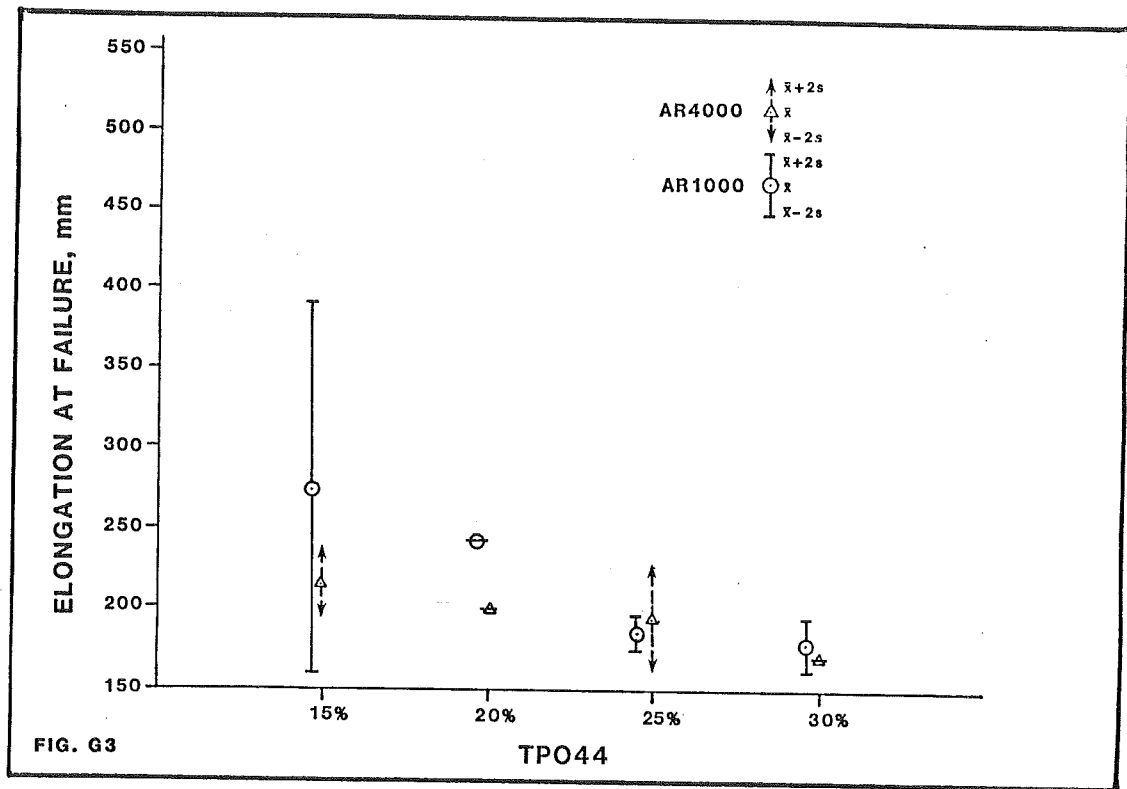
50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	365.3	346.7	318.3	287.7
	370.0	308.0	301.0	286.7
A R 1 0 0 0	457.3	353.3	394.3	303.7
	616.0	401.0	321.7	258.7

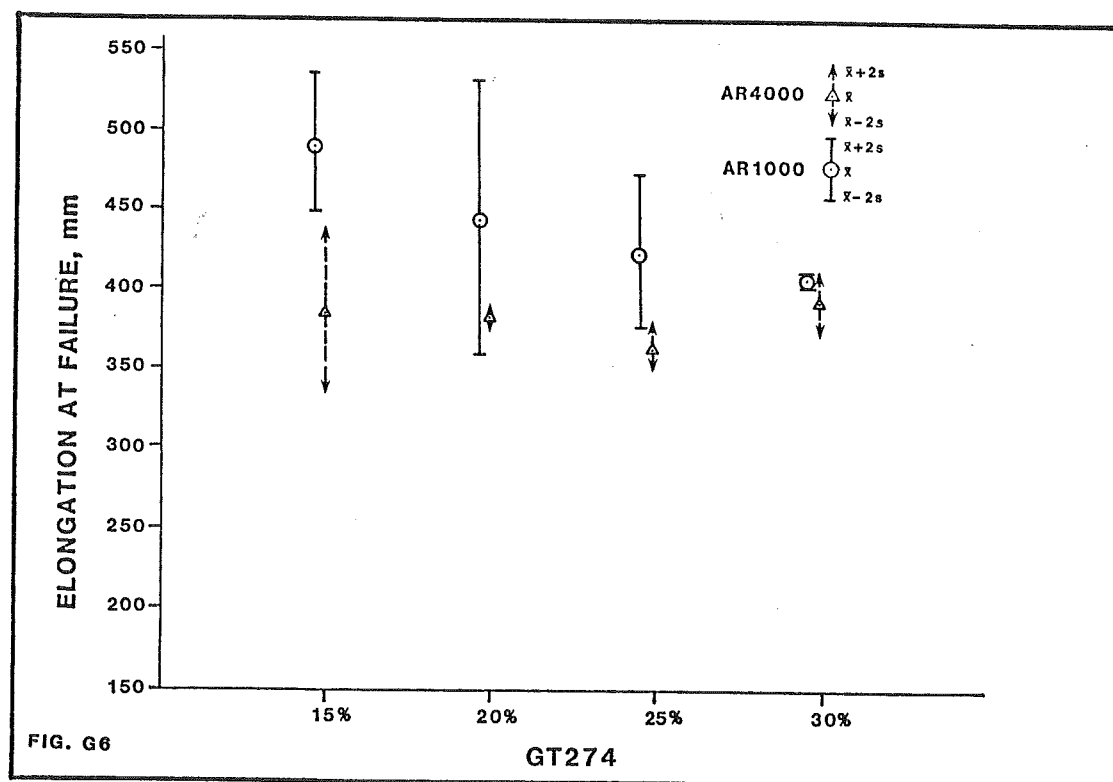
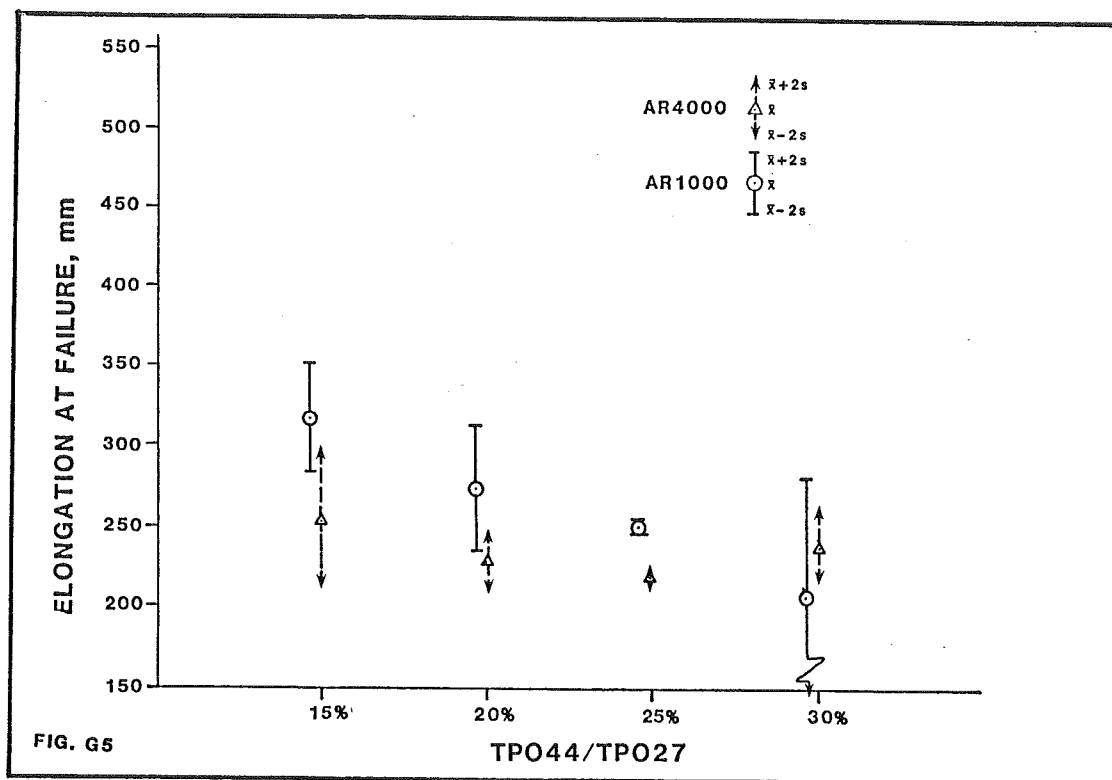
b. Summary

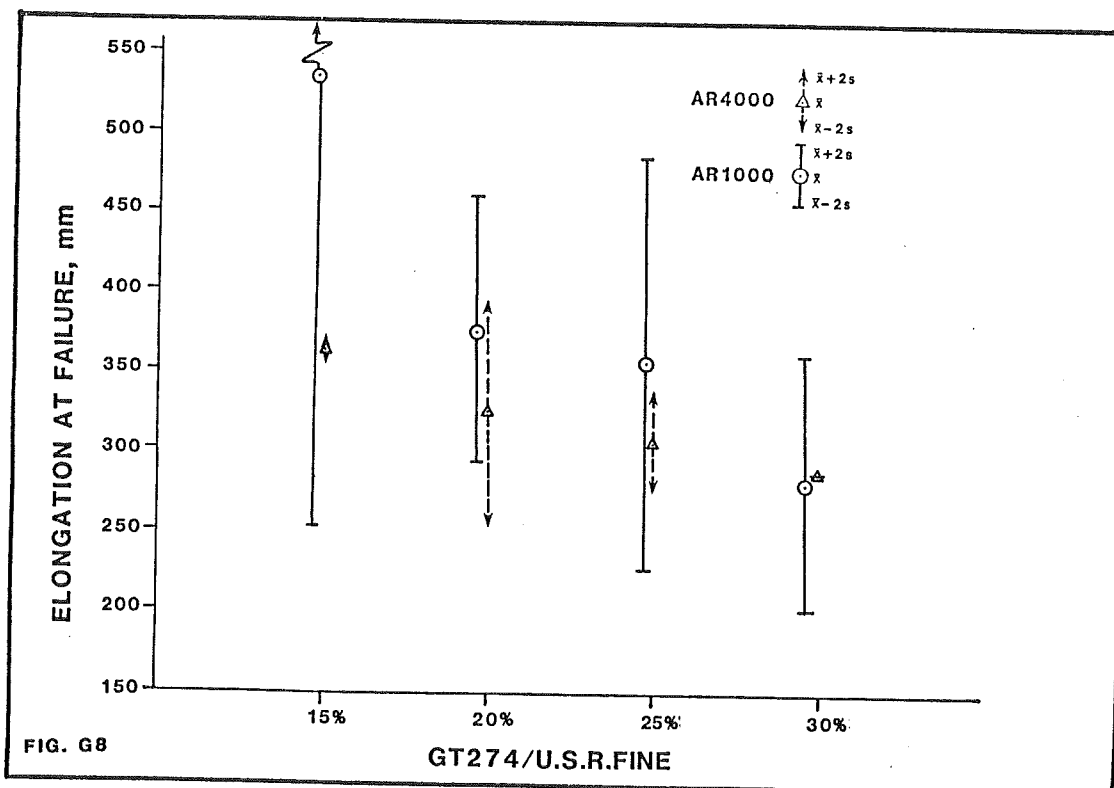
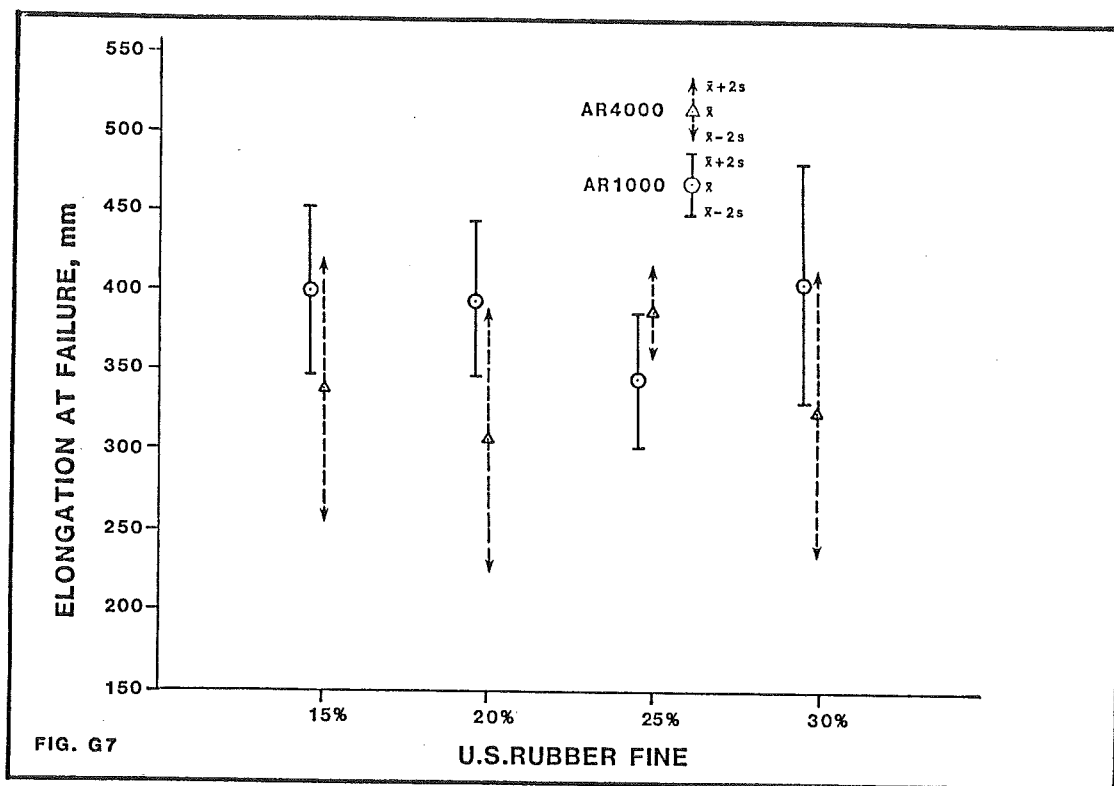
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	367.7	327.4	309.7	287.2
	S	4.164	34.288	15.328	.886
	CV	1.13	10.47	4.95	.31
A R 1 0 0 0	$\bar{x}$	536.7	377.2	358.0	281.2
	S	140.608	42.262	64.324	39.870
	CV	26.20	11.21	17.97	14.18

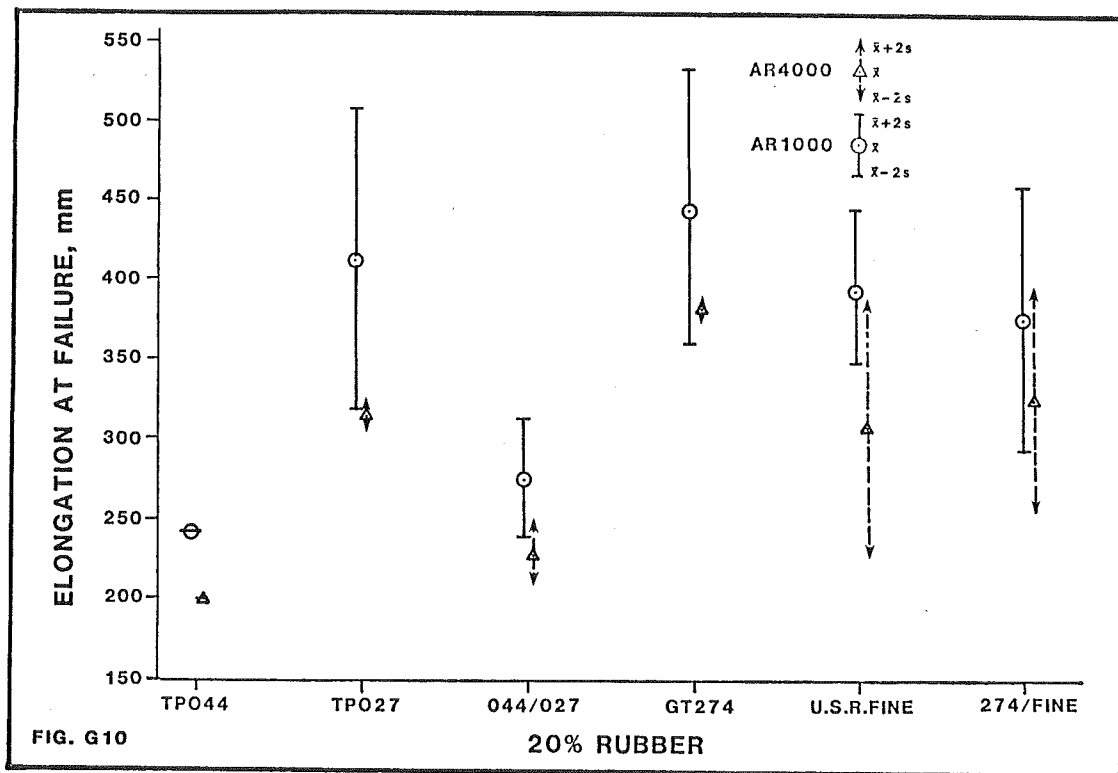
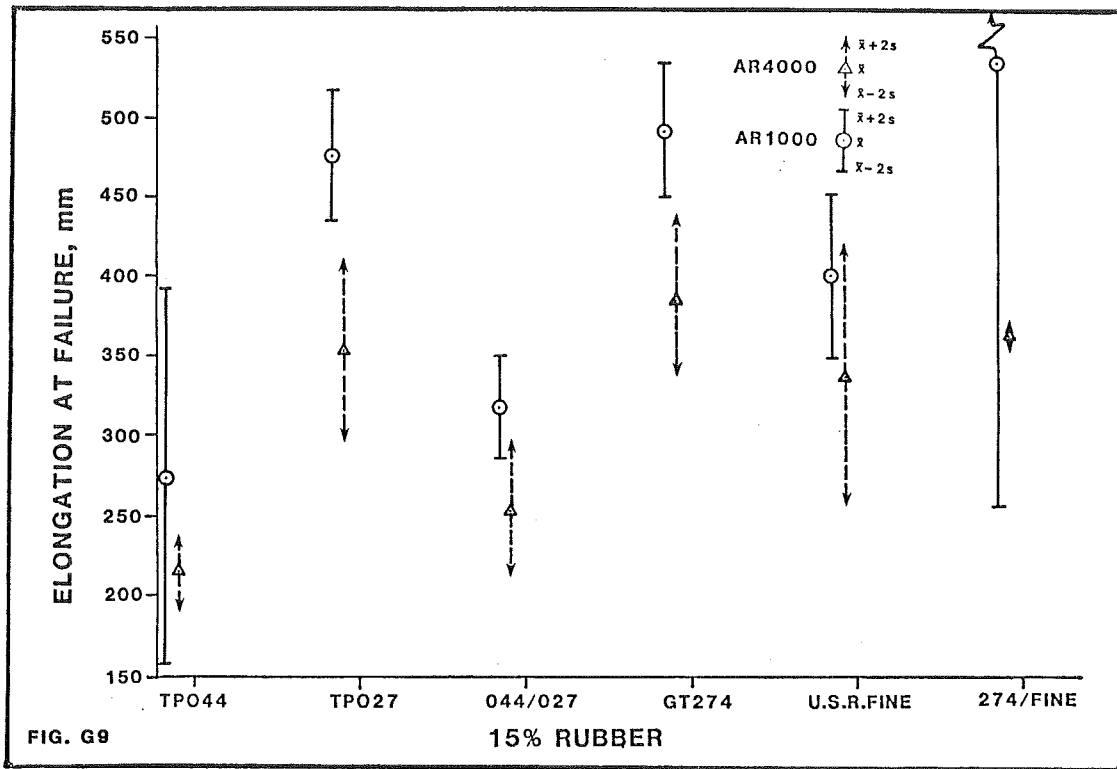
		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP644				TP627				50% TP644 50% TP627			
		15	20	25	30	15	20	25	30	15	20	25	30
Elongation at Failure (mm)	4000												
	1000												











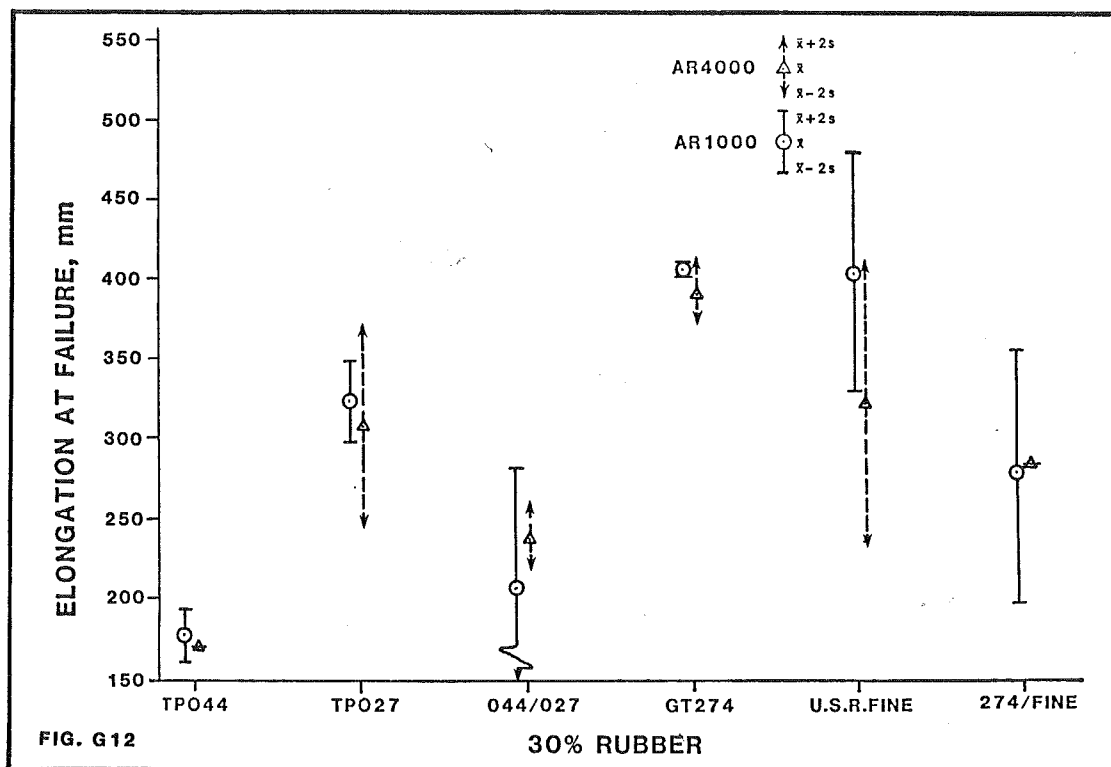
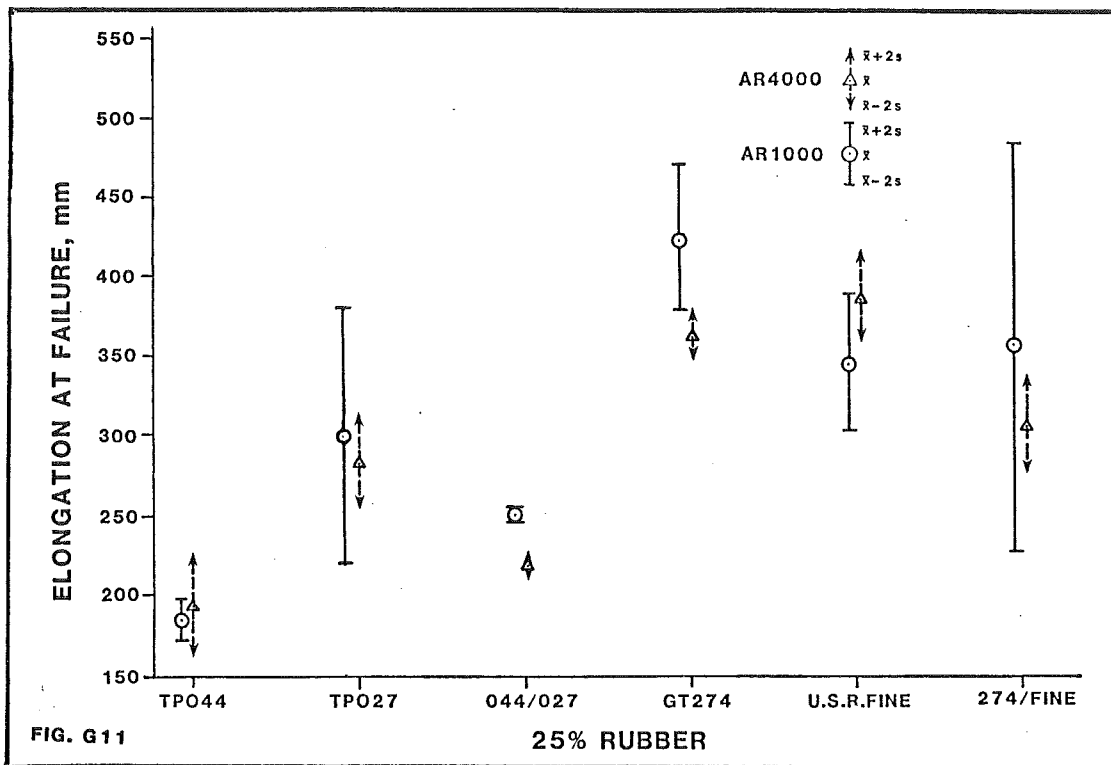


Table G-3 Log Elongation at Failure, mm

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	<u>2.347</u>	<u>2.300</u>	<u>2.268</u>	<u>2.228</u>
	2.322	2.308	2.308	2.230
A R 1 0 0 0	<u>2.489</u>	<u>2.385</u>	<u>2.262</u>	<u>2.262</u>
	2.384	2.385	2.275	2.241

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>2.33</u>	<u>2.30</u>	<u>2.29</u>	<u>2.23</u>
	S	<u>.022</u>	<u>.007</u>	<u>.035</u>	<u>.002</u>
	CV	.95	.31	1.55	.08
A R 1 0 0 0	$\bar{x}$	<u>2.44</u>	<u>2.39</u>	<u>2.27</u>	<u>2.25</u>
	S	<u>.093</u>	<u>0</u>	<u>.012</u>	<u>.002</u>
	CV	3.82	0	.51	.83

		ASPHALT TYPE (A)			PERCENT RUBBER (B)			RUBBER TYPE (C)		
		TP044			TP037			60% TP044 40% TP037		
		15	20	30	15	20	30	15	20	30
LOG ELONGATION	15									
	20									
LOG ELONGATION	25									
	30									
LOG ELONGATION	35									
	40									
LOG ELONGATION	45									
	50									
LOG ELONGATION	55									
	60									
LOG ELONGATION	65									
	70									
LOG ELONGATION	75									
	80									
LOG ELONGATION	85									
	90									
LOG ELONGATION	95									
	100									

Table G-3 Log Elongation at Failure, mm

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	<u>2.570</u>	<u>2.505</u>	<u>2.467</u>	<u>2.515</u>
	2.530	2.497	2.442	2.467
A R 1 0 0 0	<u>2.669</u>	<u>2.645</u>	<u>2.442</u>	<u>2.520</u>
	2.690	2.588	2.504	2.501

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>2.55</u>	<u>2.50</u>	<u>2.45</u>	<u>2.49</u>
	s	<u>.035</u>	<u>.007</u>	<u>.022</u>	<u>.043</u>
	CV	1.39	.28	.90	1.71
A R 1 0 0 0	$\bar{x}$	<u>2.68</u>	<u>2.62</u>	<u>2.47</u>	<u>2.51</u>
	s	<u>.019</u>	<u>.051</u>	<u>.055</u>	<u>.017</u>
	CV	.69	1.93	2.22	.67

Table G-3 Log Elongation at Failure, mm

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	<u>2.388</u>	<u>2.372</u>	<u>2.346</u>	<u>2.370</u>
	2.429	2.352	2.341	2.391
A R 1 0 0 0	<u>2.491</u>	<u>2.458</u>	<u>2.402</u>	<u>2.360</u>
	2.516	2.425	2.397	2.273

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>2.41</u>	<u>2.36</u>	<u>2.34</u>	<u>2.38</u>
	S	<u>.036</u>	<u>.018</u>	<u>.004</u>	<u>.019</u>
	CV	1.51	.75	.19	.78
A R 1 0 0 0	$\bar{x}$	<u>2.50</u>	<u>2.44</u>	<u>2.40</u>	<u>2.32</u>
	S	<u>.022</u>	<u>.029</u>	<u>.004</u>	<u>.077</u>
	CV	.88	1.20	.18	3.33

ASPHALT TYPE (A)

PERCENT RUBBER (B)

RUBBER TYPE (C)

	TP044			TP027			50% TP044 50% TP027			GT274	V.S. Rubber Film			50% GT274 50% V.S. Rubber					
	15	20	25	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Log Elongation																			
Standard Deviation																			
Coefficient of Variation																			

Table G-3 Log Elongation at Failure, mm

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	2.572	2.585	2.588	2.602
	2.604	2.588	2.568	2.590
A R 1 0 0 0	2.703	2.673	2.642	2.612
	2.682	2.625	2.615	2.609

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	2.59	2.59	2.58	2.60
	s	.028	.003	.018	.011
	CV	1.10	.10	.69	.41
A R 1 0 0 0	$\bar{x}$	2.69	2.65	2.63	2.61
	s	.019	.043	.024	.003
	CV	.69	1.61	.91	.10

		ASPHALT TYPE (A)									PERCENT RUBBER (B)									RUBBER TYPE (C)																	
		TP644			TP627			50% TP644 50% TP627			GT274			U.S. Rubber Firm			50% GT274 50% U.S. Firm																				
		15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Log Elongation at Failure, mm	TP644	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TP627	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Log Elongation at Failure, mm	50% TP644 50% TP627	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GT274	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Log Elongation at Failure, mm	U.S. Rubber Firm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	50% GT274 50% U.S. Firm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table G-3 Log Elongation at Failure, mm

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	2.500	2.522	2.567	2.479
	2.559	2.458	2.581	2.545
A R 1 0 0 0	2.620	2.613	2.525	2.585
	2.582	2.582	2.555	2.631

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	2.53	2.49	2.57	2.51
	s	.052	.057	.012	.058
	CV	2.07	2.28	.48	2.33
A R 1 0 0 0	$\bar{x}$	2.60	2.60	2.54	2.61
	s	.034	.027	.027	.041
	CV	1.29	1.06	1.05	1.56

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				SAC 15044 SAC 15047				S1210				U.S. Rubber Fine				SAC 61210 SAC 61210															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30				
Sample No.																																					
	Log Elong																																				

Table G-3 Log Elongation at Failure, mm

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	<u>2.563</u>	<u>2.540</u>	<u>2.503</u>	<u>2.459</u>
	2.568	2.489	2.479	2.457
A R 1 0 0 0	<u>2.660</u>	<u>2.548</u>	<u>2.596</u>	<u>2.482</u>
	2.790	2.603	2.507	2.413

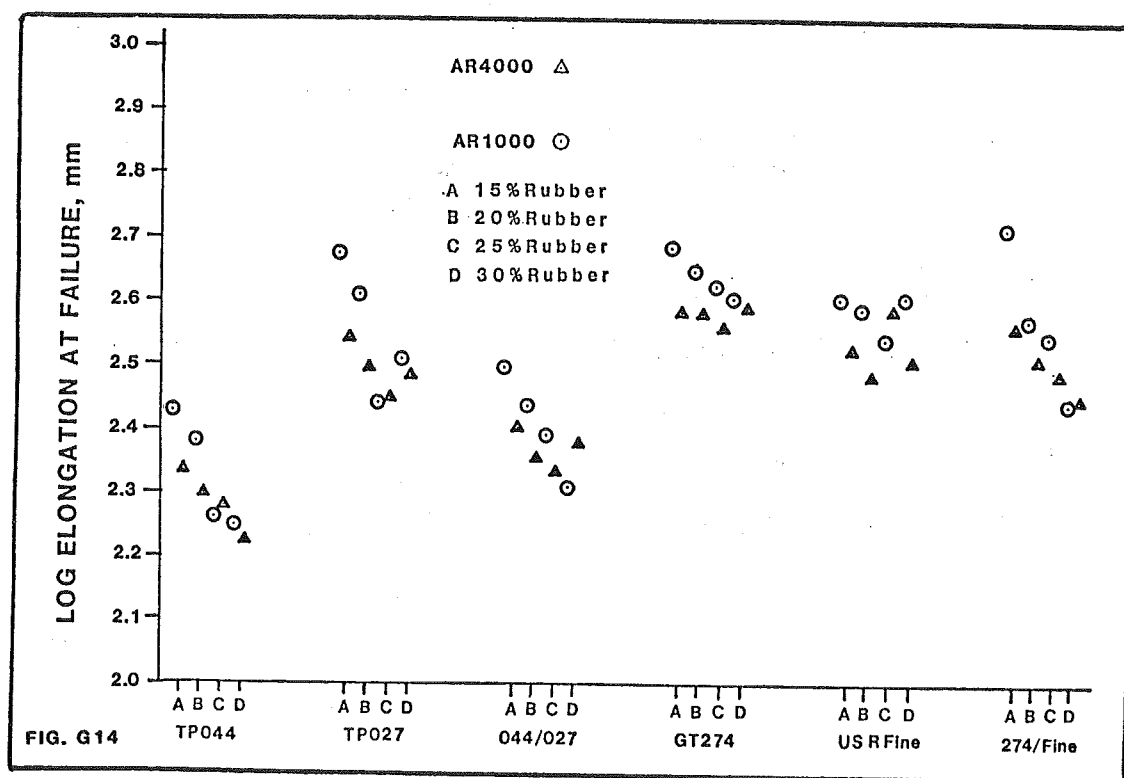
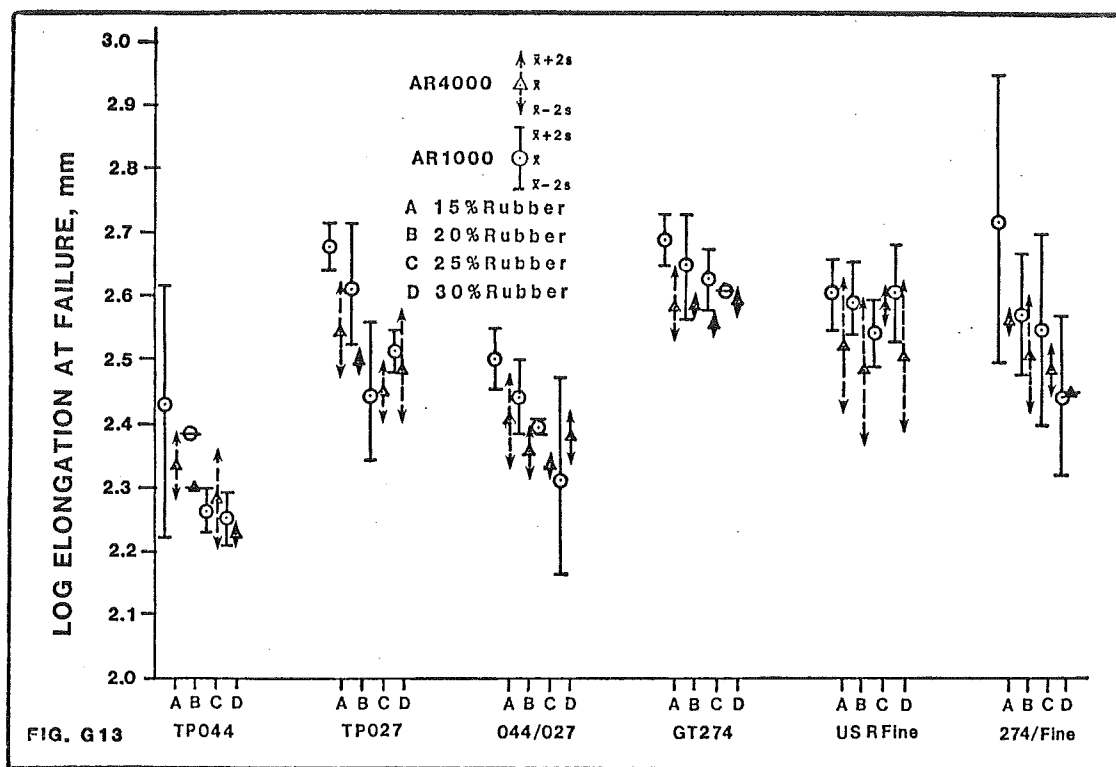
b. Summary

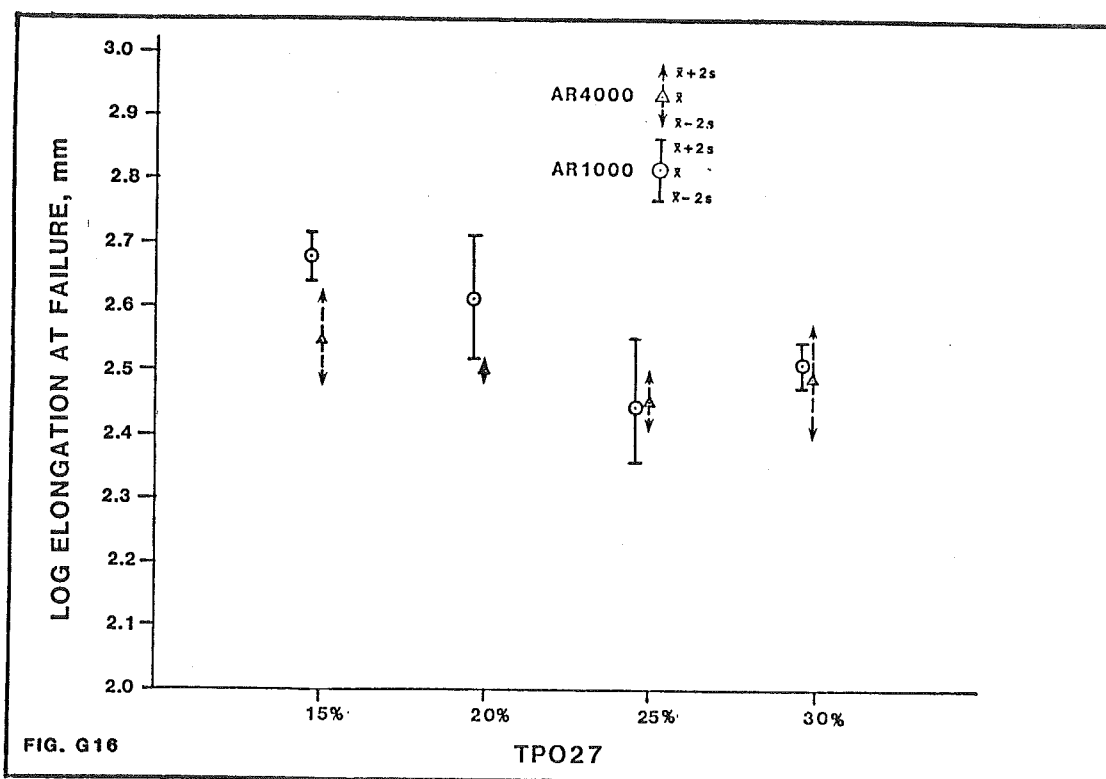
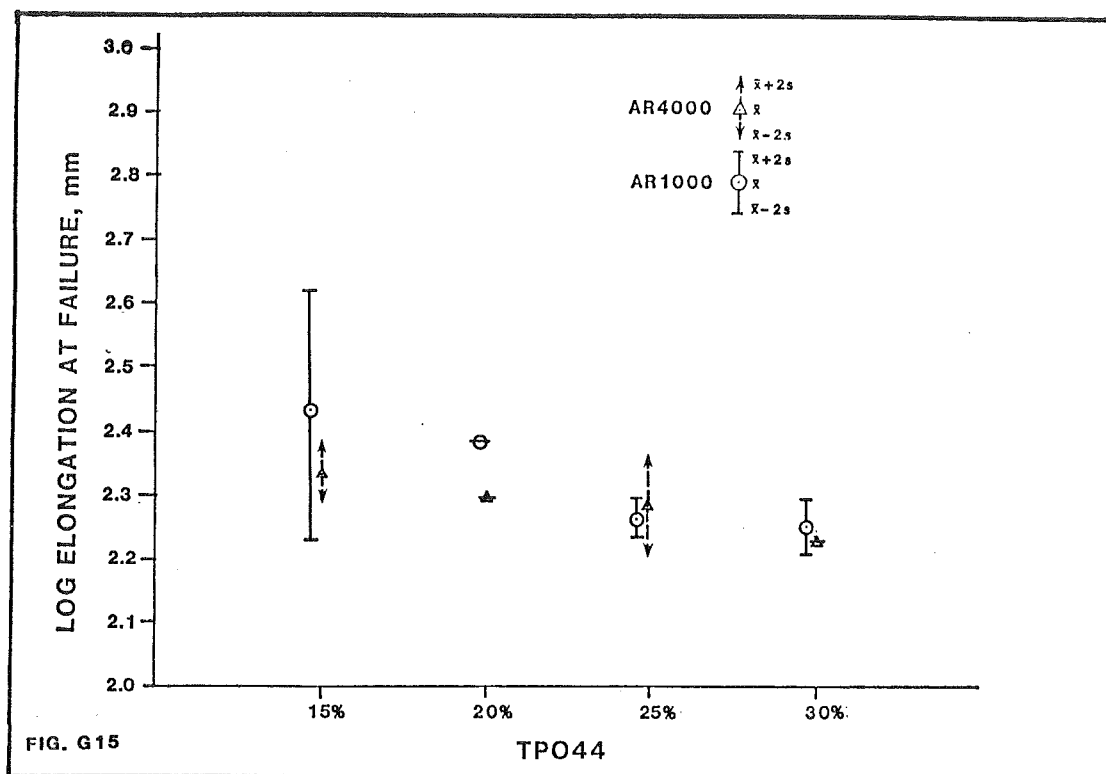
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>2.57</u>	<u>2.51</u>	<u>2.49</u>	<u>2.46</u>
	S	<u>.004</u>	<u>.045</u>	<u>.021</u>	<u>.002</u>
	CV	.17	1.80	.85	.072
A R 1 0 0 0	$\bar{x}$	<u>2.73</u>	<u>2.58</u>	<u>2.55</u>	<u>2.45</u>
	S	<u>.115</u>	<u>.049</u>	<u>.079</u>	<u>.061</u>
	CV	4.23	1.89	3.09	2.50

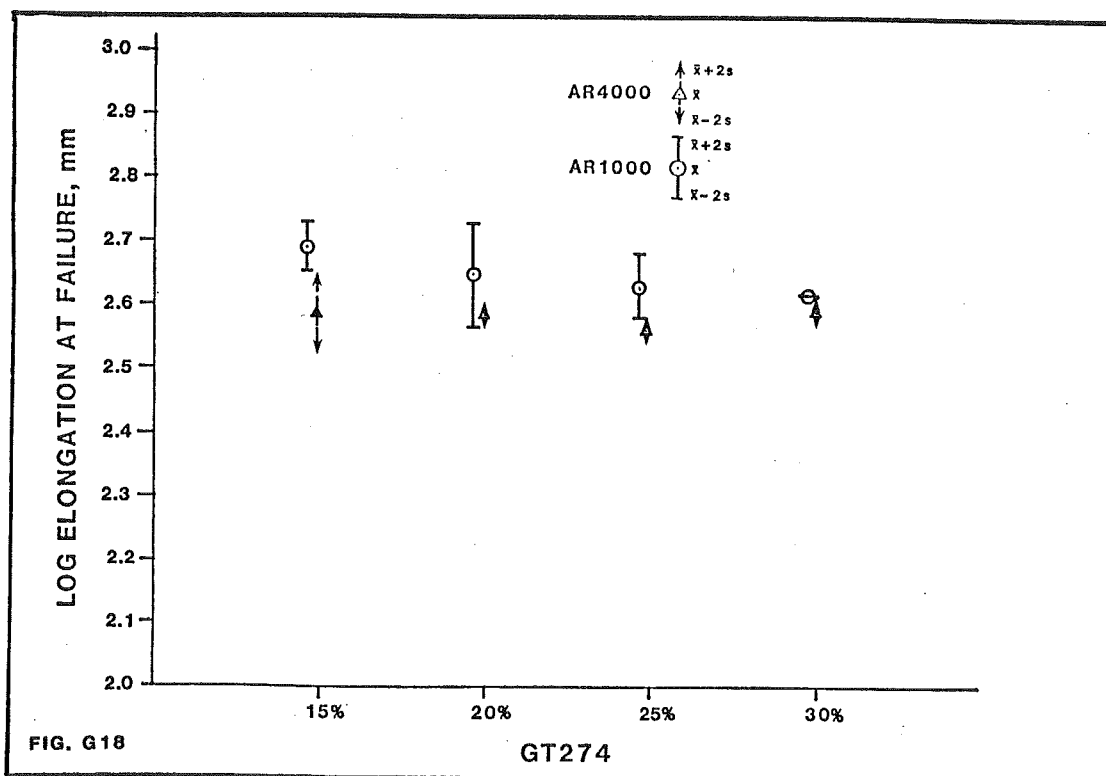
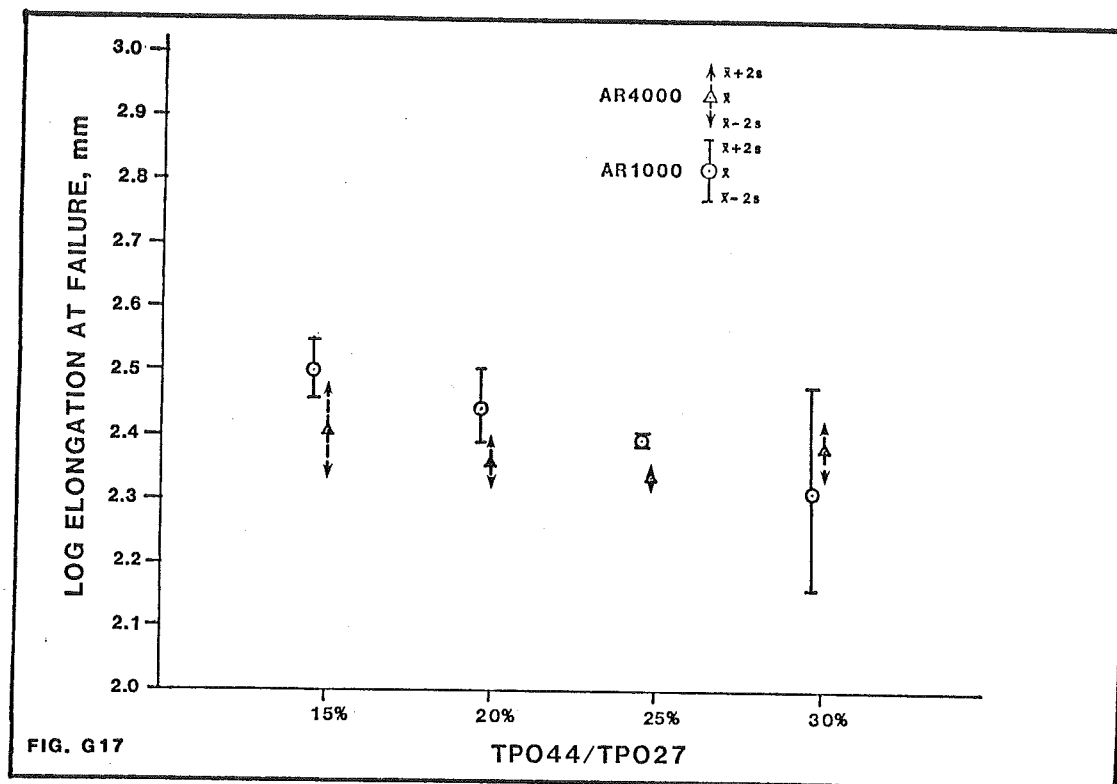
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)											
		TP648				TP627				50% TP648 50% TP627				B1274				U.S. Rubber Fine				50% B1274 50% B774															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Log Elongation at Failure, mm	AR 4000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	AR 1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

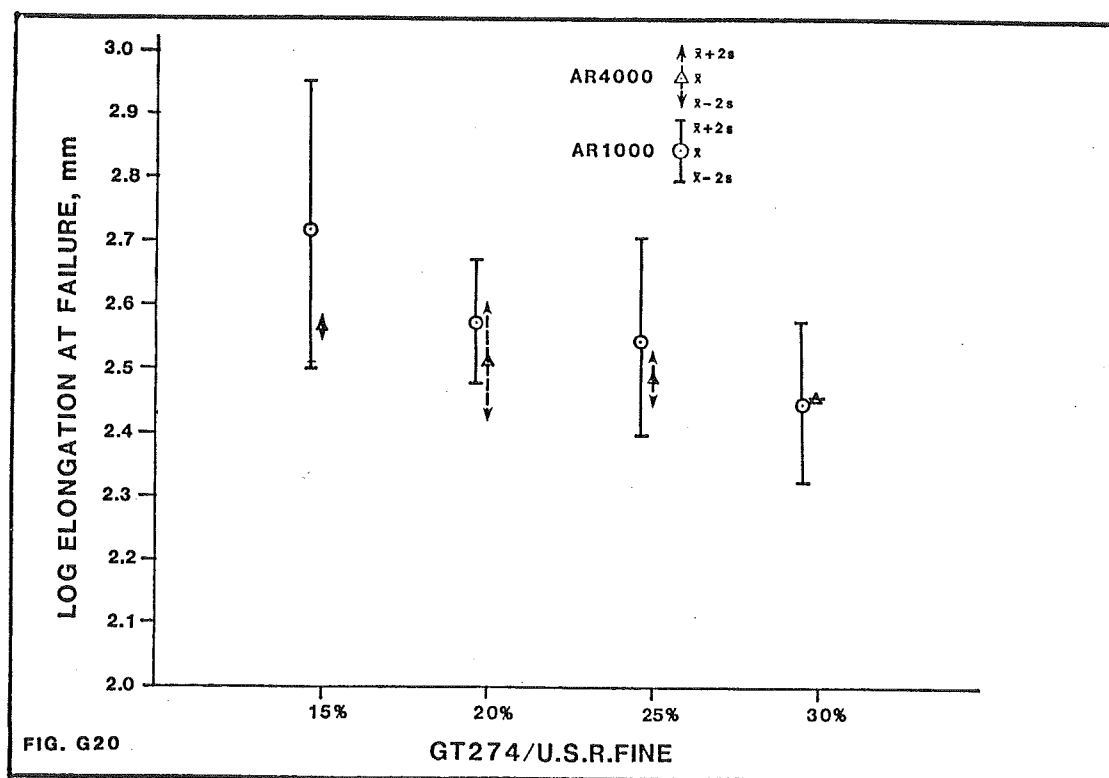
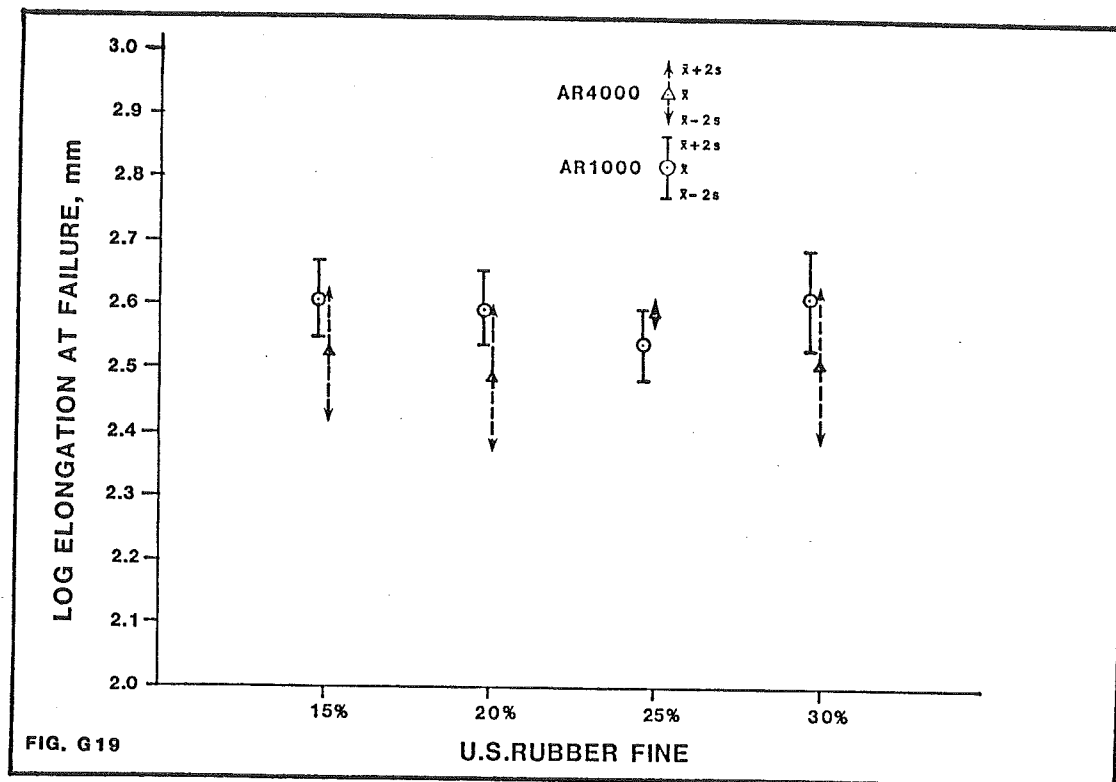
Table G-4 Anova Summary, Log Elongation
at Failure, mm

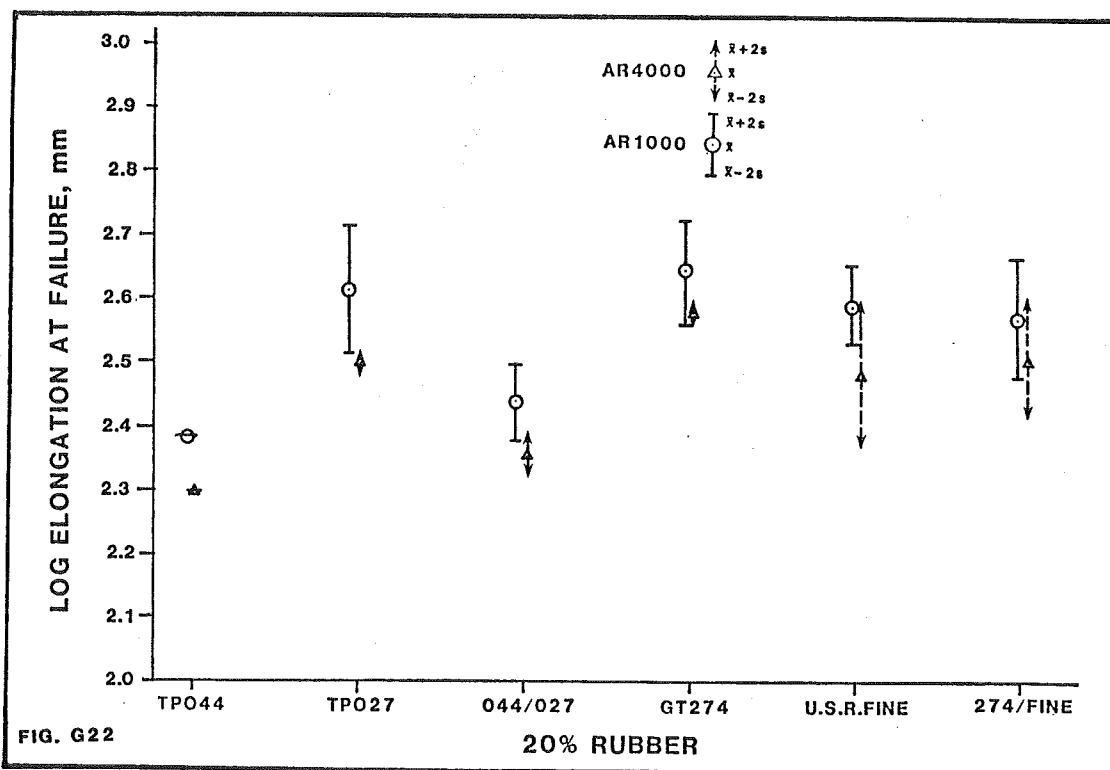
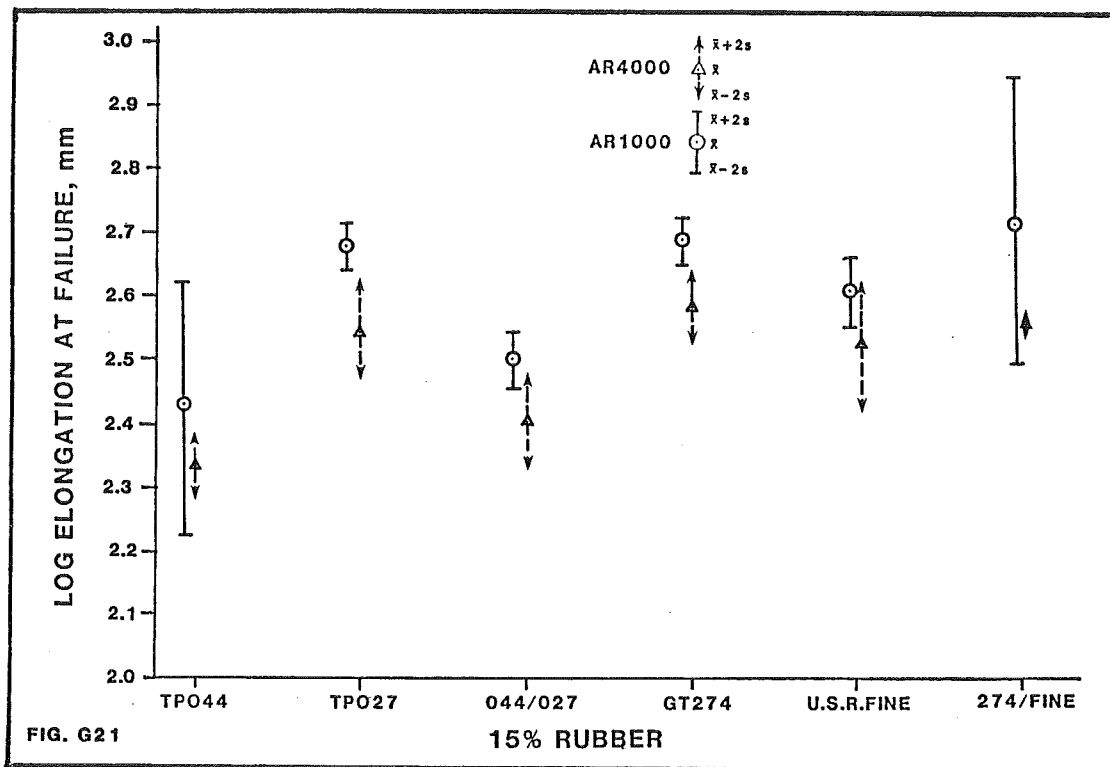
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	1.0501501396	.21003002792	210.36	2.43	3.48
Q	3	.1436355708	.0478785236	47.96	2.82	4.28
A	1	.0802915833	.0802915833	80.42	4.07	7.27
RQ	15	.0674333594	.00449555729	4.50	1.91	2.49
RA	5	.0025956817	.00051913634	.52	2.43	3.48
QA	3	.0413423009	.0137807669	13.80	2.82	4.28
RQA	15	.0291211961	.00194141307	1.94	1.91	2.49
Error	48	.0479234501	.00099840521			
TOTAL	95	1.4624932819				

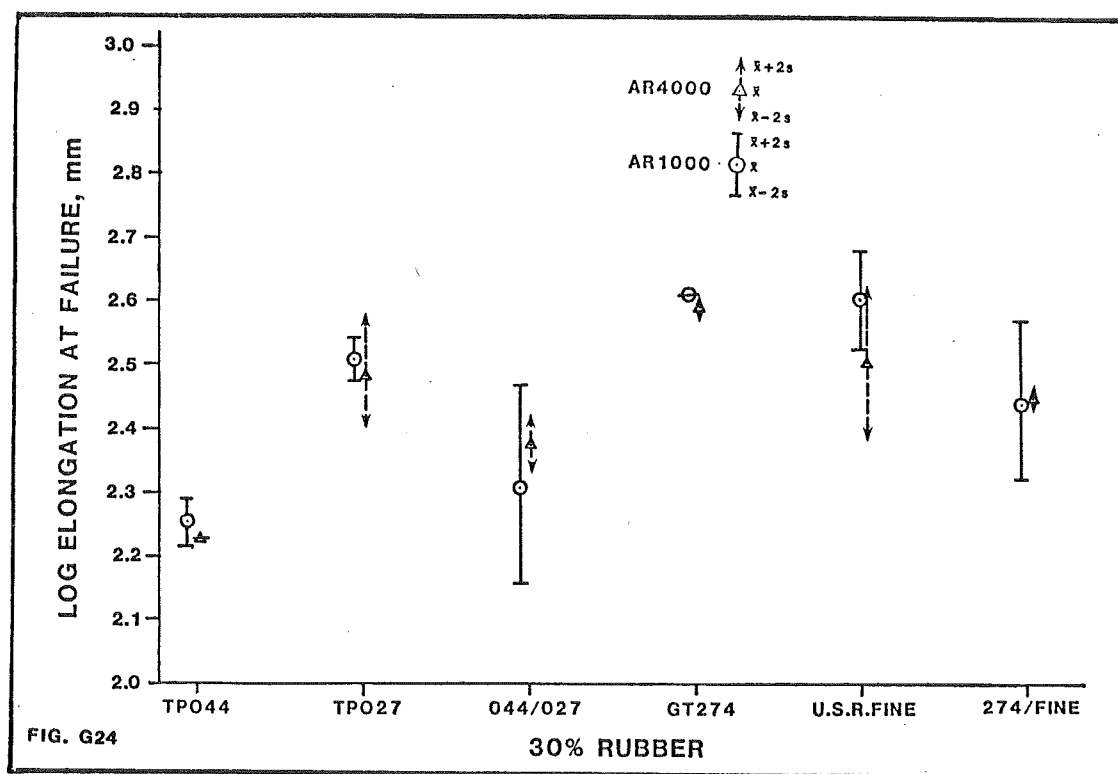
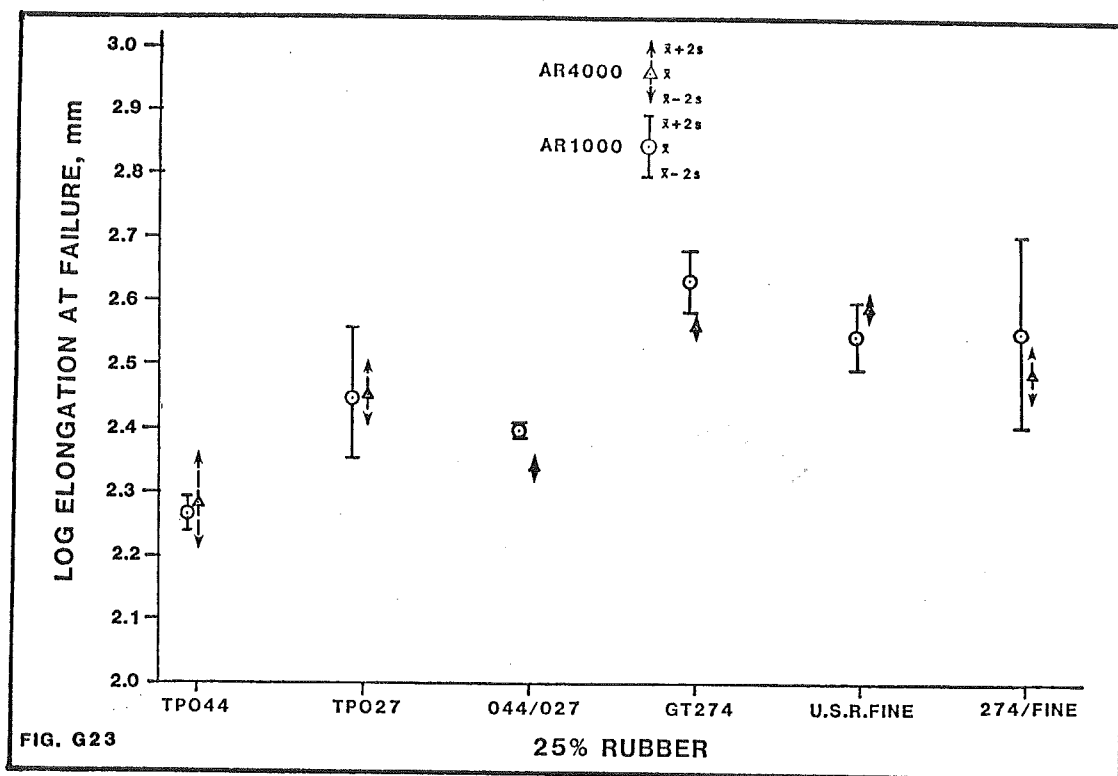












APPENDIX H
FORCE-DUCTILITY ENGINEERING
STRESS AT FAILURE AT 39.2F (4C)

Table H-1 Engineering Stress at Failure, psi

a. Measured Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	120.0	144.0	148.2	144.5
	118.1	135.1	146.7	158.6
	<u>114.6</u>	<u>117.4</u>	<u>133.1</u>	<u>160.3</u>
	97.3	135.3	145.0	155.4
	116.9	130.6	138.3	176.1
	117.6	124.3	118.0	172.6
A R 1 0 0 0	52.1	57.9	107.4	139.0
	45.0	83.0	116.8	129.0
	<u>48.2</u>	<u>63.2</u>	<u>126.5</u>	<u>111.4</u>
	37.9	86.2	101.3	110.4
	50.6	79.6	102.3	106.7
	50.2	75.6	88.7	103.5

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>114.08</u>	<u>131.12</u>	<u>138.22</u>	<u>161.25</u>
	S	<u>8.407</u>	<u>9.319</u>	<u>11.424</u>	<u>11.594</u>
	CV	7.37	7.11	8.27	7.19
A R 1 0 0 0	$\bar{x}$	<u>47.33</u>	<u>74.25</u>	<u>107.17</u>	<u>116.67</u>
	S	<u>5.231</u>	<u>11.307</u>	<u>13.159</u>	<u>14.076</u>
	CV	11.05	15.23	12.28	12.06

ASPHALT TYPE (A)
 PERCENT RUBBER (B)
 RUBBER TYPE (H)

	TP044			TP047			50% TP044 50% TP047			GT074			U.S. Rubber Fms			50% GT074 50% U.S. Fms		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
1000-100																		
1000-200																		
1000-300																		
1000-400																		
1000-500																		
1000-600																		
1000-700																		
1000-800																		
1000-900																		
1000-1000																		

Table H-1 Engineering Stress at Failure, psi

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	95.6	118.5	178.6	146.5
	98.8	118.5	156.4	144.8
	92.1	106.9	193.6	150.4
	134.3	121.6	139.6	136.1
	100.1	119.5	135.6	125.5
	68.4	117.6	120.8	123.8
A R 1 0 0 0	27.9	65.2	82.8	115.6
	31.1	59.6	78.5	108.4
	28.4	57.8	77.8	110.1
	30.7	68.7	127.3	103.2
	30.6	72.4	89.4	104.3
	28.2	63.2	86.5	100.5

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>98.22</u>	<u>117.10</u>	<u>154.10</u>	<u>137.85</u>
	S	<u>21.162</u>	<u>5.181</u>	<u>27.667</u>	<u>11.257</u>
	CV	21.55	4.43	17.95	8.17
A R 1 0 0 0	$\bar{x}$	<u>29.48</u>	<u>64.48</u>	<u>90.37</u>	<u>107.02</u>
	S	<u>1.461</u>	<u>5.498</u>	<u>18.593</u>	<u>5.468</u>
	CV	4.95	8.53	20.58	5.11

ASPHALT TYPE (A)

PERCENT RUBBER (B)

RUBBER TYPE (C)

	TP044				TP027				50% TP044 & 50% TP027				GT274				U.S. Rubber Film				50% GT274 & 50% Rubber Film			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
15																								
20																								
25																								
30																								
35																								
40																								
45																								
50																								
55																								
60																								
65																								
70																								
75																								
80																								
85																								
90																								
95																								
100																								

ASPHALT TYPE (A)

PERCENT RUBBER (B)

RUBBER TYPE (C)

Table H-1 Engineering Stress at Failure, psi

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	145.3	190.1	180.1	216.9
	159.3	179.1	189.6	222.8
	<u>153.1</u>	<u>169.9</u>	<u>187.7</u>	<u>220.1</u>
	141.3	151.6	190.7	236.6
	140.8	158.1	205.0	240.8
	140.0	159.0	212.9	262.2
A R 1 0 0 0	63.2	93.4	133.2	182.2
	65.3	97.3	140.5	190.9
	<u>62.7</u>	<u>97.4</u>	<u>144.2</u>	<u>179.3</u>
	60.5	99.3	144.7	175.4
	61.3	99.5	146.5	184.2
	50.0	106.5	145.3	200.5

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>146.63</u>	<u>167.97</u>	<u>194.33</u>	<u>233.23</u>
	S	<u>7.881</u>	<u>14.582</u>	<u>12.171</u>	<u>17.063</u>
	CV	5.37	8.68	6.26	7.32
A R 1 0 0 0	$\bar{x}$	<u>60.50</u>	<u>98.90</u>	<u>142.40</u>	<u>185.42</u>
	S	<u>5.405</u>	<u>4.321</u>	<u>4.940</u>	<u>9.024</u>
	CV	8.93	4.37	3.47	4.87

		ASPHALT TYPE (A)												PERCENT RUBBER (C)												RUBBER TYPE (B)											
		TP044				TP027				50% TP044 50% TP027				G1274				U.S. Rubber Pm				50% G1274 50% U.S. Pm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
0000-30	1																																				
	2																																				
	3																																				
	4																																				
	5																																				
	6																																				
	7																																				
	8																																				
	9																																				
	10																																				

a. Measured Data

b. Summary

[illegible]

Table H-1 Engineering Stress at Failure, psi

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	112.1	133.7	87.2	111.2
	115.1	137.1	86.5	109.9
	<u>121.1</u>	<u>142.7</u>	<u>91.6</u>	<u>114.3</u>
	122.8	104.5	104.7	115.8
	120.6	108.5	101.1	116.6
	123.8	128.0	100.5	117.8
A R 1 0 0 0	68.5	91.7	116.3	82.7
	71.1	90.4	94.1	87.2
	<u>70.9</u>	<u>95.4</u>	<u>98.5</u>	<u>77.9</u>
	64.8	94.4	100.1	77.4
	65.3	94.8	96.6	76.4
	64.5	96.3	95.8	70.9

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>119.25</u>	<u>125.75</u>	<u>95.27</u>	<u>114.27</u>
	S	<u>4.624</u>	<u>15.707</u>	<u>7.820</u>	<u>3.123</u>
	CV	3.88	12.49	8.21	2.73
A R 1 0 0 0	$\bar{x}$	<u>67.52</u>	<u>93.83</u>	<u>100.23</u>	<u>78.76</u>
	S	<u>3.055</u>	<u>2.286</u>	<u>8.144</u>	<u>5.60</u>
	CV	4.52	2.44	8.13	7.11

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)													
		TP048				TP077				50% TP048 50% TP077				GT374				U.S. Rubber Fine				50% GT374 50% B Fine				50% A Fine 50% C Fine													
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30		
STRESS (PSI)	100-150																																						
	150-200																																						
	200-250																																						
	250-300																																						

Table H-1 Engineering Stress at Failure, psi

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	118.1	145.2	77.6	76.4
	109.9	148.2	93.4	84.2
	<u>110.2</u>	<u>146.0</u>	<u>88.2</u>	<u>88.9</u>
	114.9	118.3	86.5	119.3
	125.2	123.0	96.1	112.6
	116.3	112.9	88.7	103.8
A R 1 0 0 0	56.6	68.2	89.7	75.9
	55.4	62.7	83.3	76.1
	<u>54.1</u>	<u>65.7</u>	<u>88.2</u>	<u>74.4</u>
	38.3	79.8	79.6	77.4
	40.5	78.3	81.6	68.4
	38.5	82.0	79.8	56.3

b. Summary

		50% GT274 & 50% U. S. RUBBER FINE			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>115.77</u>	<u>132.27</u>	<u>88.42</u>	<u>97.53</u>
	S	<u>5.672</u>	<u>15.911</u>	<u>6.398</u>	<u>16.965</u>
	CV	4.90	12.03	7.24	17.39
A R 1 0 0 0	$\bar{x}$	<u>47.23</u>	<u>71.95</u>	<u>83.70</u>	<u>71.42</u>
	S	<u>8.978</u>	<u>7.591</u>	<u>4.309</u>	<u>8.054</u>
	CV	19.01	10.55	5.15	11.28

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
GRADE	TYPE	TPQ44				TPQ47				50% TPQ44 50% TPQ47				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Fine															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30												
100-100																																					
100-100																																					

Table H-2 Engineering Stress at Failure, psi

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	117.57	132.17	142.47	154.47
	110.60	130.07	133.77	168.03
A R 1 0 0 0	48.43	68.03	116.90	126.47
	46.23	80.47	97.43	106.87

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	114.09	131.12	138.12	161.25
	s	6.18	1.86	7.71	12.01
	cv	5.42	1.42	5.58	7.45
A R 1 0 0 0	$\bar{x}$	47.33	74.25	107.17	116.67
	s	1.95	11.02	17.25	17.37
	cv	4.12	14.84	16.10	14.89

ASPHALT TYPE (A)

PERCENT RUBBER (B)

RUBBER TYPE (R)

	TP044				TP047				50% TP044 50% TP047				G1376				U.S. Rubber Firm				GOS G1376 GOS F-100			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
TP044																								
TP047																								
50% TP044 50% TP047																								
G1376																								
U.S. Rubber Firm																								
GOS G1376 GOS F-100																								

Table H-2 Engineering Stress at Failure, psi

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
AR 4000	95.50	114.63	176.20	147.23
	100.93	119.57	132.00	128.47
AR 1000	29.13	60.87	79.70	111.37
	29.83	68.10	101.03	102.67

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>98.22</u>	<u>117.10</u>	<u>154.10</u>	<u>137.85</u>
	S	<u>4.81</u>	<u>4.38</u>	<u>39.16</u>	<u>16.62</u>
	CV	4.90	3.74	25.41	12.06
A R 1 0 0 0	$\bar{x}$	<u>29.48</u>	<u>64.49</u>	<u>90.37</u>	<u>107.02</u>
	S	<u>0.62</u>	<u>6.41</u>	<u>18.50</u>	<u>7.71</u>
	CV	2.10	9.94	20.91	7.20

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)											
		TP044						TP027						50% TP044 50% TP027						G1574						U.S. Rubber Firm						50% G1574 50% U.S. Firm					
		15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40
Condition																																					
	Stress-strain																																				

Table H-2 Engineering Stress at Failure, psi

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	152.57	179.70	185.80	219.93
	140.70	156.23	202.87	246.53
A R 1 0 0 0	63.73	96.03	139.30	184.13
	57.27	101.77	145.50	186.70

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	146.64	167.97	194.34	233.23
	s	10.52	20.79	15.12	23.57
	cv	7.17	12.38	7.78	10.11
A R 1 0 0 0	$\bar{x}$	60.50	98.90	142.40	185.42
	s	5.72	5.09	5.49	2.28
	cv	9.45	5.15	3.86	1.23

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044						TP027						50% TP044 50% TP027						BT274						U.S. Rubber Firm						50% BT274 50% U.S. Firm					
		15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40
STRESS	psi																																				
	ksi																																				
	MPa																																				
	MPa																																				

Table H-2 Engineering Stress at Failure, psi

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	99.47	116.83	117.33	93.97
	86.70	120.03	120.17	86.97
A R 1 0 0 0	48.87	67.63	81.53	64.80
	53.80	64.97	84.13	67.60

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	93.09	118.43	118.75	90.47
	s	11.31	2.84	2.52	6.20
	cv	12.15	2.40	2.12	6.85
A R 1 0 0 0	$\bar{x}$	51.34	66.30	82.83	66.20
	s	4.37	2.36	2.30	2.48
	cv	8.51	3.56	2.78	3.75

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TPG44				TPG27				50% TPG44 50% TPG27				GT274				U.S. Rubber Firm				50% GT274 50% U.S. Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
A R 4 0 0 0	$\bar{x}$																																				
	s																																				
A R 1 0 0 0	$\bar{x}$																																				
	s																																				
	cv																																				

Table H-2 Engineering Stress at Failure, psi

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	116.10	137.83	88.43	111.80
	122.40	113.67	102.10	116.73
A R 1 0 0 0	70.17	92.50	102.97	82.60
	64.87	95.17	97.50	74.90

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	119.25	125.75	95.27	114.27
	S	5.58	21.41	12.11	4.37
	CV	4.68	17.03	12.71	3.82
A R 1 0 0 0	$\bar{x}$	67.52	93.84	100.24	78.75
	S	4.70	2.37	4.85	6.82
	CV	6.96	2.53	4.84	8.66

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				60% TP044 40% TP027				BT274				U.S. Rubber Fine				60% BT274 40% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
6000-30	6000-30																																				
	6000-30																																				
	6000-30																																				
	6000-30																																				
	6000-30																																				
	6000-30																																				
	6000-30																																				
	6000-30																																				
	6000-30																																				
	6000-30																																				

Table H-2 Engineering Stress at Failure, psi

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	112.73	146.47	86.40	83.17
	118.80	118.07	90.43	111.90
A R 1 0 0 0	55.37	65.53	87.07	75.47
	39.10	80.03	80.33	67.37

b. Summary

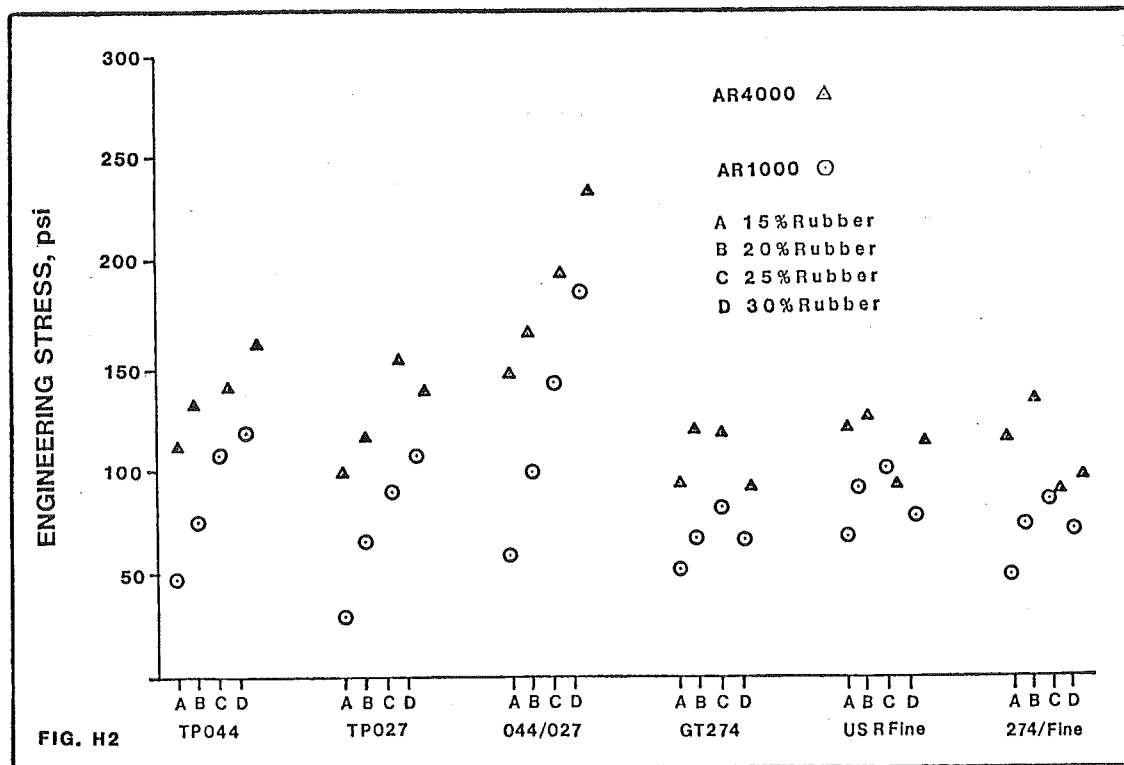
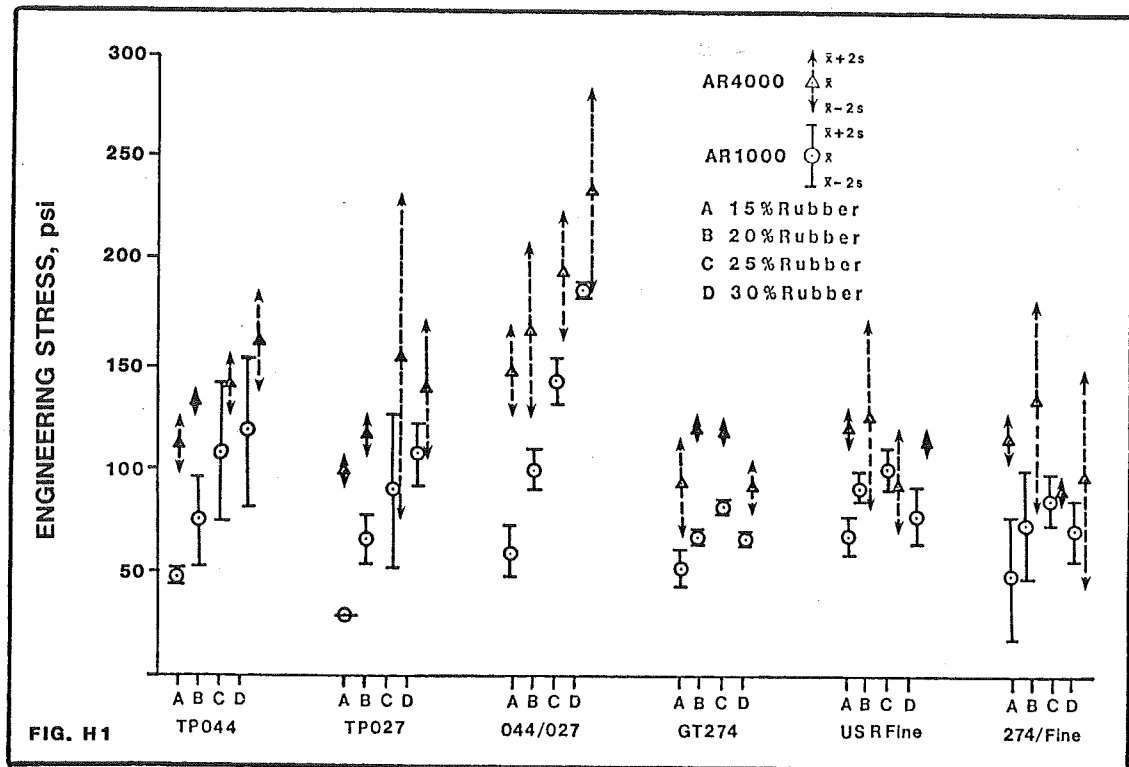
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	115.77	132.27	88.42	97.54
	S	5.38	25.16	3.51	25.45
	CV	4.65	19.02	4.04	26.09
A R 1 0 0 0	$\bar{X}$	47.24	72.78	83.70	71.42
	S	14.42	12.85	5.97	7.18
	CV	30.52	17.66	7.13	10.05

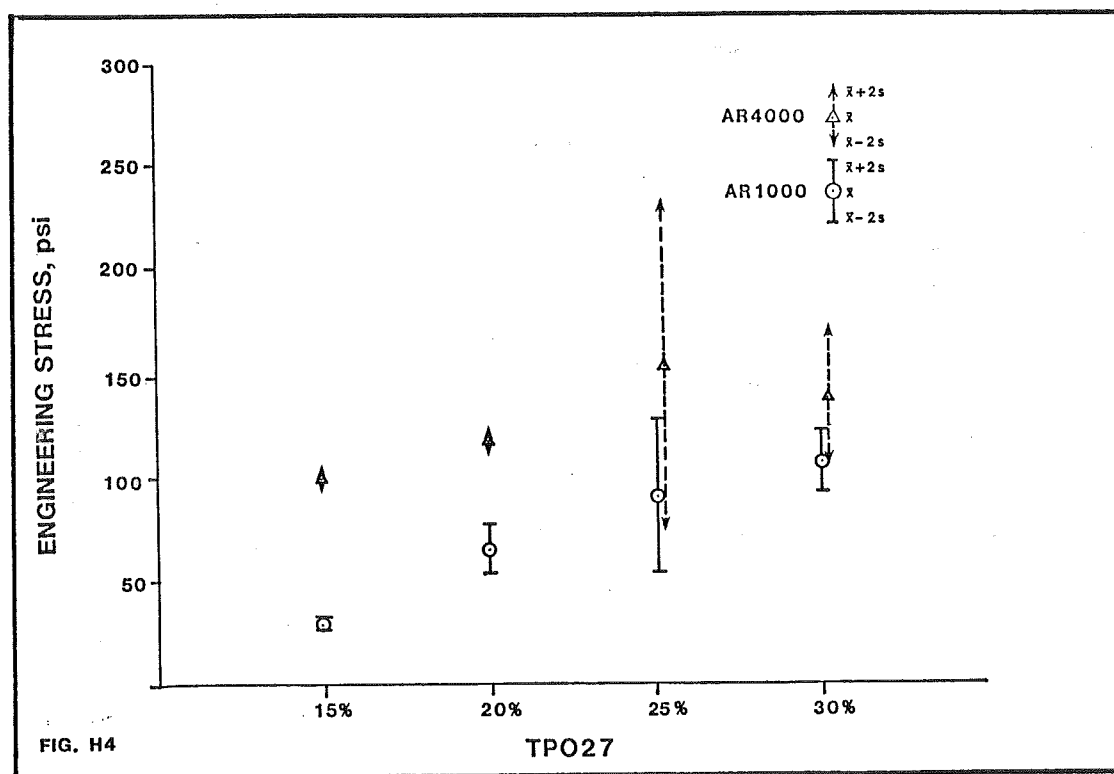
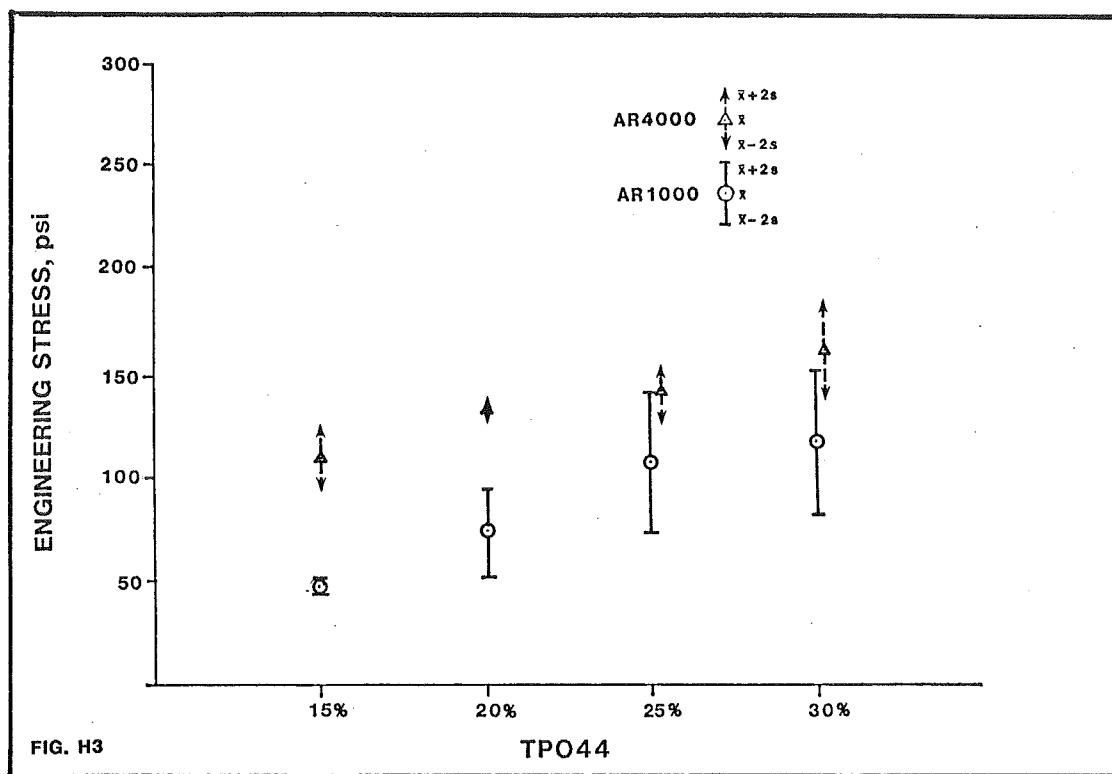
		ASPHALT TYPE (A)									PERCENT RUBBER (B)									RUBBER TYPE (B)																		
		TP044			TP047			50% TP044 50% TP047			GT274			U.S. Rubber Fine			50% GT274 50% U.S. Rubber Fine																					
		15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																																					
GROUP	GROUP																																					
	GROUP																	</																				

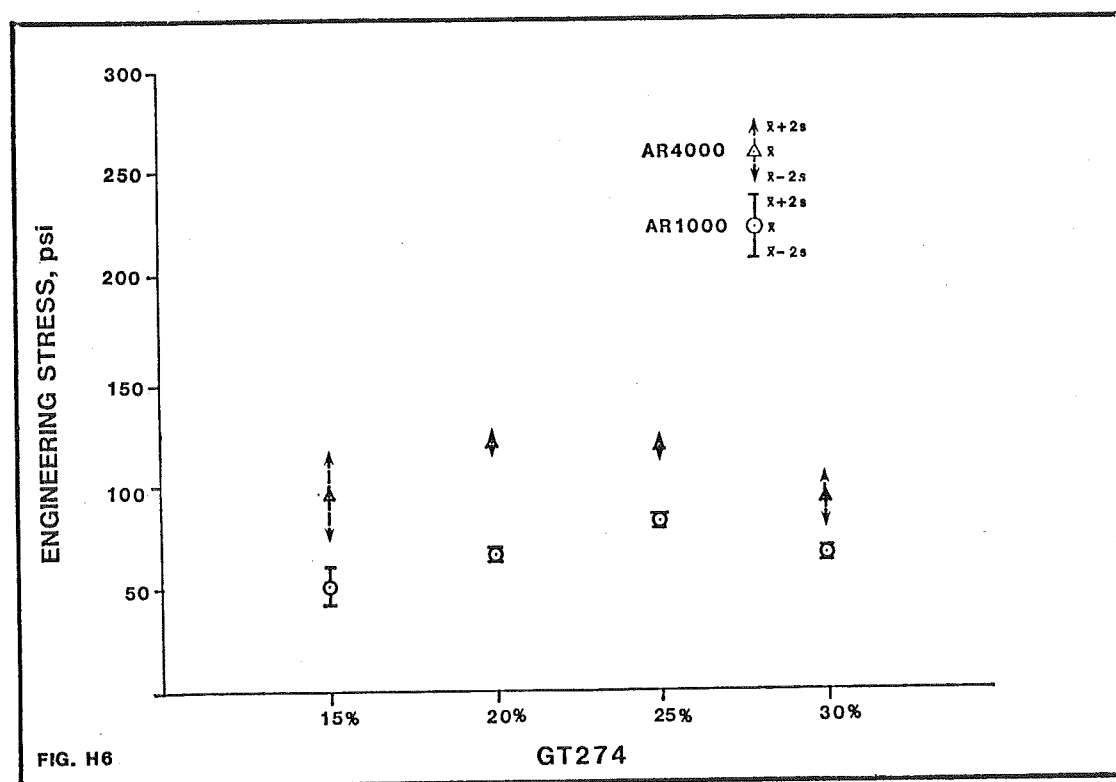
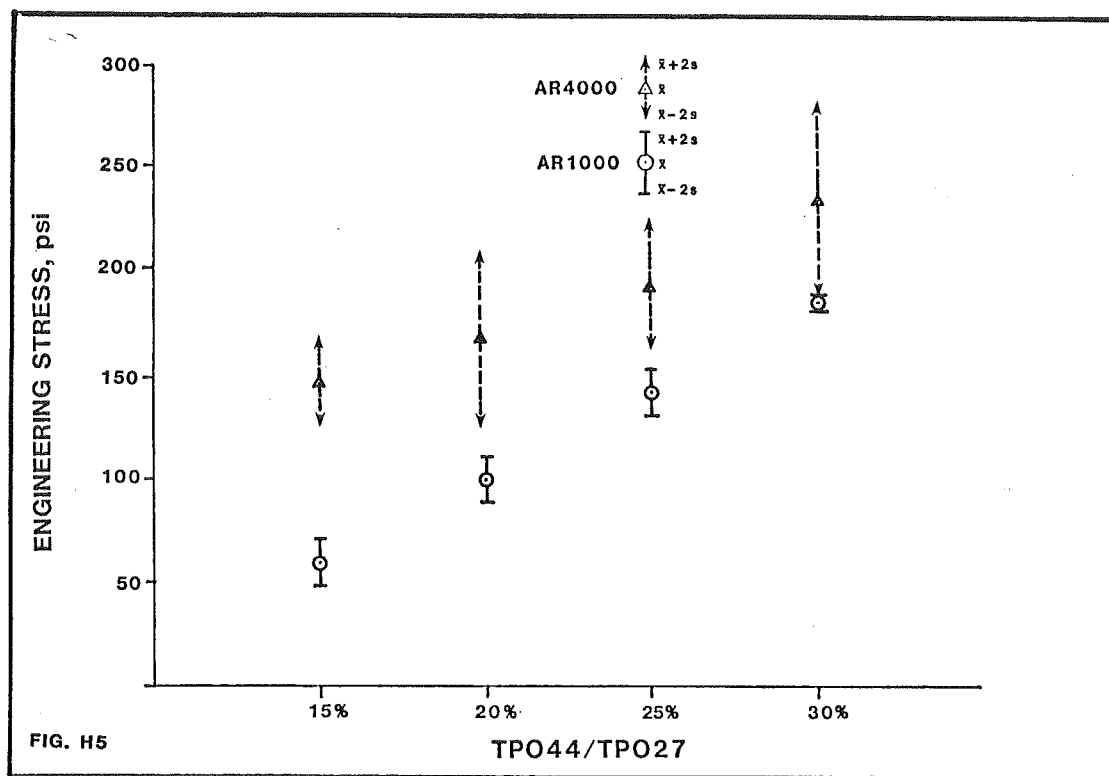
Table H-3 Anova Summary, Engineering Stress
at Failure

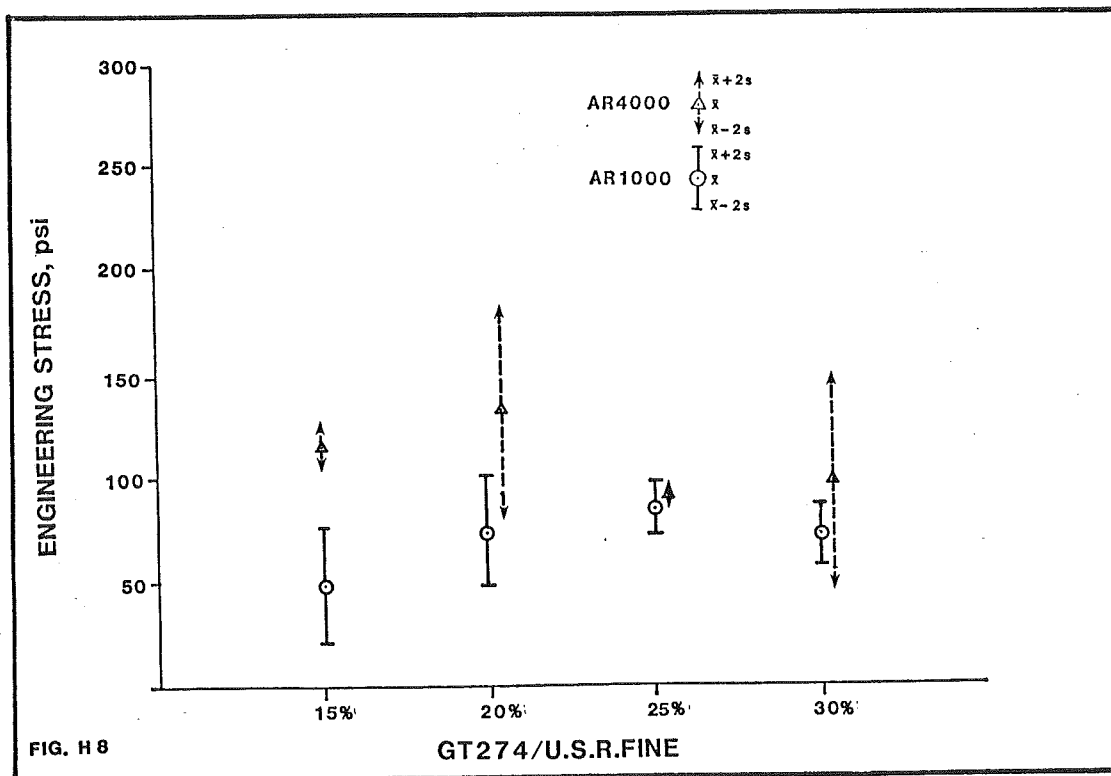
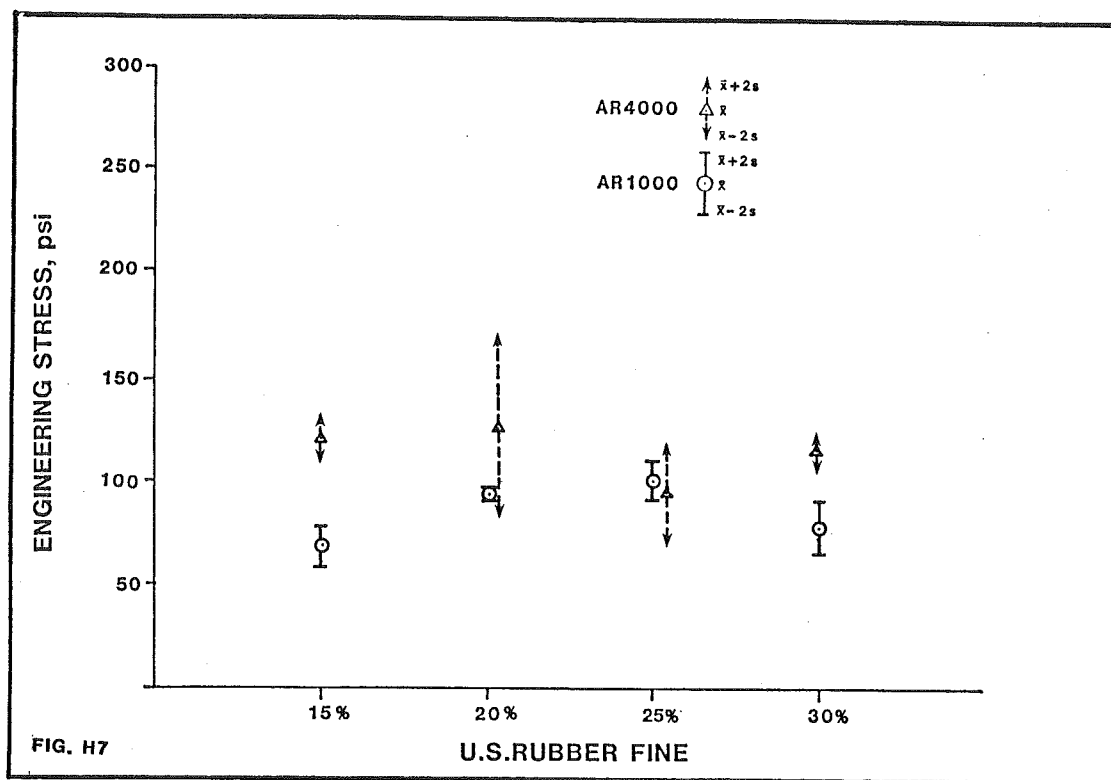
ANOVA

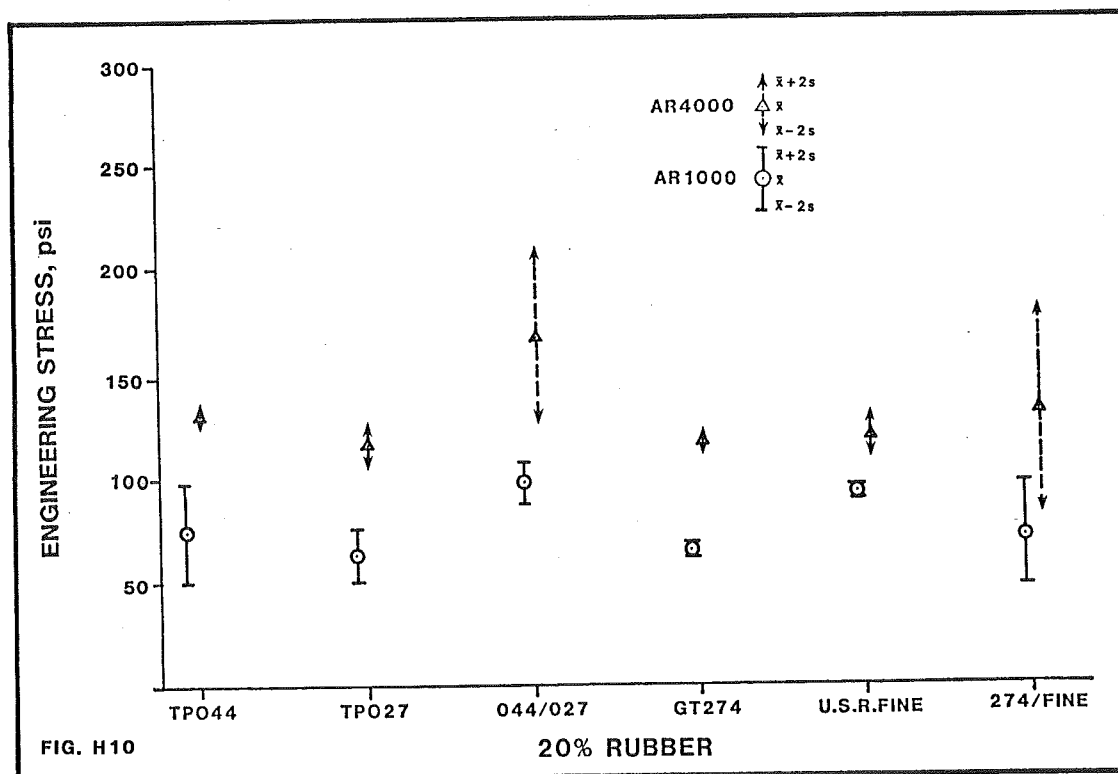
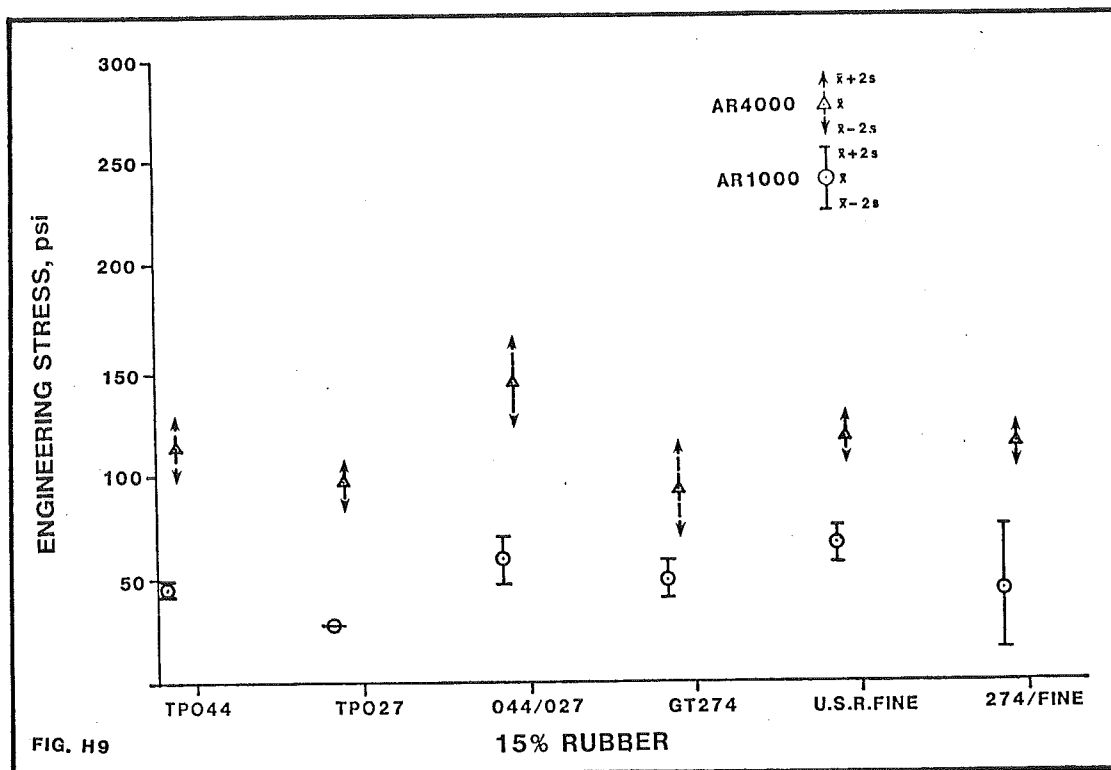
SOURCE	df	SS	MS	F	F.05	F.01
R	5	49369.85	9873.97	99.83	2.43	3.48
Q	3	21651.87	7217.29	72.97	2.82	4.27
A	1	50154.38	50154.38	507.08	4.06	7.27
RQ	15	24177.44	1611.82	16.29	1.90	2.49
RA	5	3169.05	633.81	6.40	2.43	3.48
QA	3	4491.85	1497.28	15.13	2.82	4.27
RQA	15	2759.02	183.93	1.85	1.90	2.49
Error	48	4747.55	98.90			
TOTAL	95	160521.05				

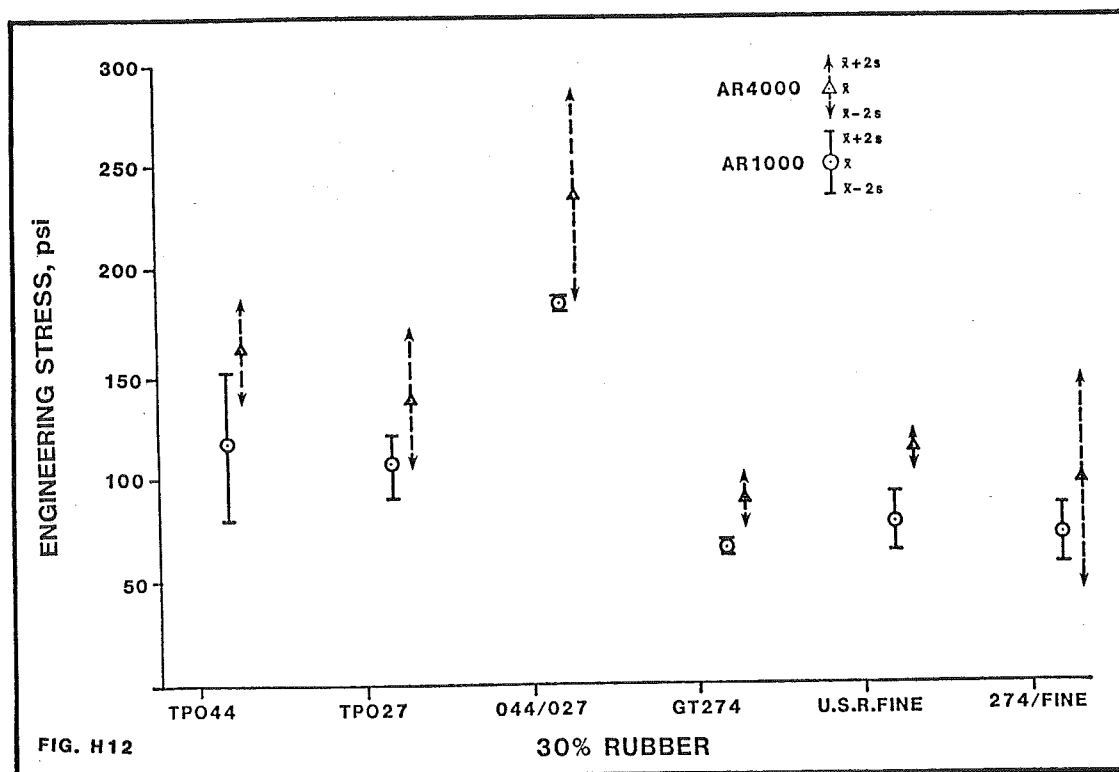
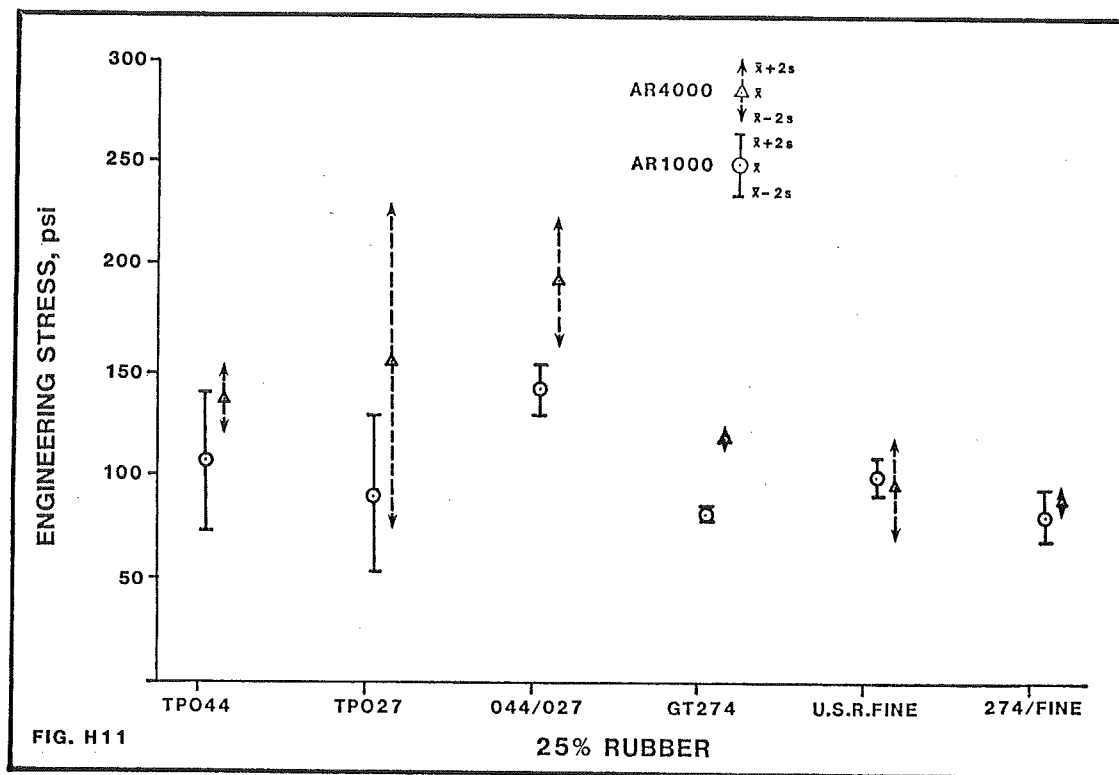












APPENDIX I
FORCE-DUCTILITY ENGINEERING STRAIN
AT FAILURE AT 39.2F (4C)

a. Measured Data

b. Summary

[illegible]

Table I-1 Engineering Strain at Failure, mm/mm

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	7.31	6.13	6.48	5.98
	7.06	6.06	5.78	6.26
	<u>6.92</u>	<u>5.93</u>	<u>5.34</u>	<u>6.77</u>
	7.09	6.02	6.06	5.69
	6.29	5.94	5.23	5.69
A R 1 0 0 0	6.85	6.16	4.56	5.54
	8.39	7.88	4.81	6.25
	9.26	8.58	5.29	6.36
	<u>9.14</u>	<u>8.83</u>	<u>6.90</u>	<u>6.02</u>
	8.70	7.33	5.66	5.67
	10.08	7.19	6.45	5.32
	9.29	7.85	6.56	6.90

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>6.92</u>	<u>6.04</u>	<u>5.58</u>	<u>5.99</u>
	S	<u>.347</u>	<u>9.529</u>	<u>.678</u>	<u>.461</u>
	CV	5.02	1.58	12.17	7.70
A R 1 0 0 0	$\bar{x}$	<u>9.14</u>	<u>7.94</u>	<u>5.95</u>	<u>6.09</u>
	S	<u>.579</u>	<u>.655</u>	<u>.818</u>	<u>.553</u>
	CV	6.33	8.25	13.76	9.08

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP027				80% TP044 & 20% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
STRAIN	AR 4000	-	-	-	-	-	-	-	-	-	-	-	-
	AR 1000	-	-	-	-	-	-	-	-	-	-	-	-
STRAIN	80% TP044 & 20% TP027	-	-	-	-	-	-	-	-	-	-	-	-
	US Rubber Fm	-	-	-	-	-	-	-	-	-	-	-	-
STRAIN	80% TP044 & 20% TP027	-	-	-	-	-	-	-	-	-	-	-	-
	80% TP044 & 20% TP027	-	-	-	-	-	-	-	-	-	-	-	-

Table I-1 Engineering Strain at Failure, mm/mm

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	4.79	4.84	4.06	4.38
	4.98	4.41	4.15	4.37
	5.19	4.48	4.52	4.35
	4.82	4.93	3.83	4.69
	5.13	5.08	3.87	4.51
	5.21	4.35	4.57	4.57
A R 1 0 0 0	6.20	6.11	4.59	4.08
	5.37	6.00	5.17	4.58
	6.56	5.62	5.19	4.47
	5.80	5.47	5.06	3.67
	6.13	6.07	4.65	3.82
	5.88	5.83	5.04	3.81

b. Summary

50% TP044 & 50% TP027				
	15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$ 5.02	4.68	4.17	4.48
	S .185	.307	.316	.136
	CV 3.69	6.55	7.59	3.03
A R 1 0 0 0	$\bar{x}$ 5.99	5.85	4.95	4.07
	S .405	.259	.263	.377
	CV 6.77	4.43	5.31	9.26

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044				TP027				50% TP044 50% TP027				01374				US Rubber Pave				50% 01374 50% 01374			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Source																								
Source																								

Table I-1 Engineering Strain at Failure, mm/mm

a. Measured Data

		GT 274			
		15%	20%	25%	30%
A R 4 0 0 0		7.53	7.76	7.16	7.79
		7.33	7.41	6.75	7.65
		<u>7.82</u>	<u>7.30</u>	<u>7.09</u>	<u>7.63</u>
		8.00	7.29	7.06	7.71
		7.79	7.54	7.49	8.20
		7.68	8.24	6.78	7.14
A R 1 0 0 0		8.92	9.42	8.67	7.59
		10.71	8.86	8.25	8.19
		<u>10.22</u>	<u>9.24</u>	<u>8.24</u>	<u>8.29</u>
		10.49	8.18	8.02	8.13
		9.54	8.38	7.81	8.18
		9.44	9.08	7.96	7.60

b. Summary

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>7.69</u>	<u>7.59</u>	<u>7.055</u>	<u>7.69</u>
	S	<u>.236</u>	<u>.363</u>	<u>.272</u>	<u>.340</u>
	CV	3.07	4.79	3.86	4.42
A R 1 0 0 0	$\bar{x}$	<u>9.89</u>	<u>8.86</u>	<u>8.16</u>	<u>8.00</u>
	S	<u>.694</u>	<u>.490</u>	<u>.302</u>	<u>.315</u>
	CV	7.02	5.53	3.70	3.94

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (R)

	TP044			TP037			50% TP044 & 50% TP037			Q1374			U.S. Rubber Firm			50% Q1374 & 50% U.S. Rubber Firm		
	15	25	30	15	25	30	15	25	30	15	25	30	15	25	30	15	25	30
Asphalt																		
Rubber																		

Table I-1 Engineering Strain at Failure, mm/mm

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	5.46	6.63	8.44	5.67
	5.98	6.70	7.40	6.54
	<u>7.13</u>	<u>6.35</u>	<u>7.49</u>	<u>6.20</u>
	7.02	5.14	7.48	7.29
	6.55	5.81	7.76	6.55
A R 1 0 0 0	6.93	6.13	7.60	6.92
	7.89	7.60	6.61	7.41
	7.94	7.68	6.43	6.75
	<u>7.81</u>	<u>7.52</u>	<u>6.04</u>	<u>6.69</u>
	7.63	7.13	6.88	7.27
	7.27	7.06	6.65	8.00
	7.75	7.64	6.79	8.08

b. Summary

U S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>6.51</u>	<u>6.13</u>	<u>7.70</u>	<u>6.53</u>
	S	<u>.664</u>	<u>.584</u>	<u>.386</u>	<u>.562</u>
	CV	10.20	9.53	5.01	8.61
A R 1 0 0 0	$\bar{x}$	<u>7.72</u>	<u>7.44</u>	<u>6.57</u>	<u>7.37</u>
	S	<u>.244</u>	<u>.272</u>	<u>.301</u>	<u>.593</u>
	CV	3.16	3.66	4.58	8.05

ASPHALT TYPE (A)
PERCENT RUBBER (R)
RUBBER TYPE (R)

	TPQ44			TPQ37			80% TPQ44 & 20% TPQ37			QT274			U.S. Rubber Fine			80% QT274 & 20% U.S. Rubber Fine		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
100-100																		
90-10																		
80-20																		
70-30																		
60-40																		
50-50																		
40-60																		
30-70																		
20-80																		
10-90																		
0-100																		

Table I-1 Engineering Strain at Failure, mm/mm

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	7.10	7.02	7.04	4.94
	7.80	7.04	6.16	5.42
	<u>7.02</u>	<u>6.58</u>	<u>5.92</u>	<u>7.12</u>
	7.73	5.28	5.14	6.35
	6.60	6.60	6.66	5.60
	8.02	6.22	5.92	5.83
A R 1 0 0 0	8.84	7.40	7.35	6.10
	9.20	8.20	7.90	5.18
	<u>9.58</u>	<u>6.16</u>	<u>7.65</u>	<u>6.67</u>
	13.23	8.74	6.12	6.00
	10.96	8.47	5.82	4.65
	12.74	7.16	7.10	5.02

b. Summary

50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>7.38</u>	<u>6.46</u>	<u>6.14</u>	<u>5.88</u>
	s	<u>.552</u>	<u>.653</u>	<u>.660</u>	<u>.766</u>
	cv	7.49	10.12	10.75	13.04
A R 1 0 0 0	$\bar{x}$	<u>10.76</u>	<u>7.69</u>	<u>6.99</u>	<u>5.60</u>
	s	<u>1.88</u>	<u>.967</u>	<u>.840</u>	<u>.771</u>
	cv	17.43	12.58	12.02	13.76

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TPQ44				TPQ47				50% TPQ44 50% TPQ47				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30												
Date	Test No.																																				
	Operator																																				
Date	Test No.																																				
	Operator																																				

a. Reduced Data

b. Summary

[illegible]

Table I-2 Engineering Strain at Failure, mm/mm

a. Reduced Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	7.097	6.040	5.867	6.337
	6.743	6.040	5.283	5.640
A R 1 0 0 0	8.930	8.430	5.667	6.210
	9.357	7.457	6.223	5.963

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	6.92	6.04	5.58	5.99
	s	.31	0	.52	.62
	CV	4.53	0	9.28	10.31
A R 1 0 0 0	$\bar{x}$	9.14	7.94	5.95	6.09
	s	.378	.86	.49	.22
	CV	4.14	10.85	8.29	3.60

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (R)

	TP044			TP027			50% TP044 50% TP027			Q1214			U.S. Rubber Type			50% Q1214 50% U.S. Rubber		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Engineering Strain at Failure (mm/mm)																		
Standard Deviation (mm/mm)																		
Coefficient of Variation (%)																		

Table I-2 Engineering Strain at Failure, mm/mm

a. Reduced Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	4.987	4.577	4.243	4.367
	5.053	4.787	4.090	4.590
A R 1 0 0 0	6.043	5.910	4.983	4.377
	5.937	5.790	4.917	3.767

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	5.02	4.68	4.17	4.48
	S	.06	.19	.14	.20
	CV	1.16	3.97	3.25	4.41
A R 1 0 0 0	$\bar{X}$	5.99	5.85	4.95	4.07
	S	.09	.11	.06	.54
	CV	1.57	1.82	1.18	13.27

ASPHALT TYPE (A)
PERCENT RUBBER (C)
RUBBER TYPE (B)

	TP044			TP027			50% TP044 & 50% TP027			GT216			U.S. Rubber Fm.			50% GT216 & 50% Fm. 8		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
Asphalt																		
Rubber																		
Strain																		

Table I-2 Engineering Strain at Failure mm/mm

a. Reduced Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	7.560	7.490	7.000	7.690
	7.823	7.690	7.110	7.683
A R 1 0 0 0	9.950	9.173	8.387	8.023
	9.823	8.547	7.930	7.970

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>7.69</u>	<u>7.59</u>	<u>7.06</u>	<u>7.69</u>
	s	<u>.23</u>	<u>.18</u>	<u>.10</u>	<u>.06</u>
	CV	3.03	2.33	1.38	.08
A R 1 0 0 0	$\bar{x}$	<u>9.89</u>	<u>8.86</u>	<u>8.16</u>	<u>8.00</u>
	s	<u>.11</u>	<u>.55</u>	<u>.40</u>	<u>.05</u>
	CV	1.14	6.26	4.96	.59

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP644				TP627				50% TP644 50% TP627				G1714				U.S. Rubber Fm				50% G1714 50% U.S. Fm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Sample No.	1																																				
	2																																				
Sample No.	3																																				
	4																																				

a. Reduced Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	<u>6.190</u>	<u>6.560</u>	<u>7.777</u>	<u>6.137</u>
	6.833	5.693	7.613	6.920
A R 1 0 0 0	<u>7.880</u>	<u>7.600</u>	<u>6.360</u>	<u>6.950</u>
	7.550	7.277	6.773	7.783

b. Summary

		U. S. RUBBER FINE			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>6.51</u>	<u>6.13</u>	<u>7.70</u>	<u>6.53</u>
	s	<u>.57</u>	<u>.77</u>	<u>.15</u>	<u>.69</u>
	cv	8.75	12.54	1.89	10.63
A R 1 0 0 0	$\bar{x}$	<u>7.72</u>	<u>7.44</u>	<u>6.57</u>	<u>7.37</u>
	s	<u>.29</u>	<u>.29</u>	<u>.37</u>	<u>.74</u>
	cv	3.79	3.85	5.57	10.02

[illegible]

Table I-2 Engineering Strain at Failure, mm/mm

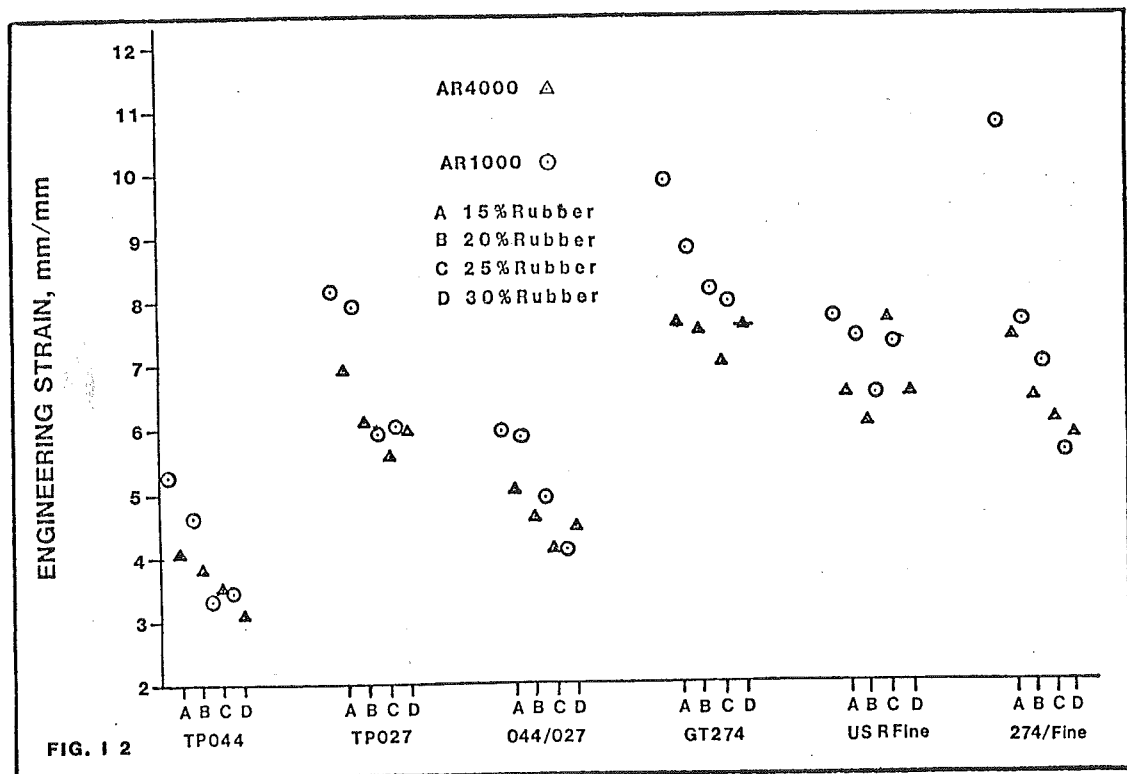
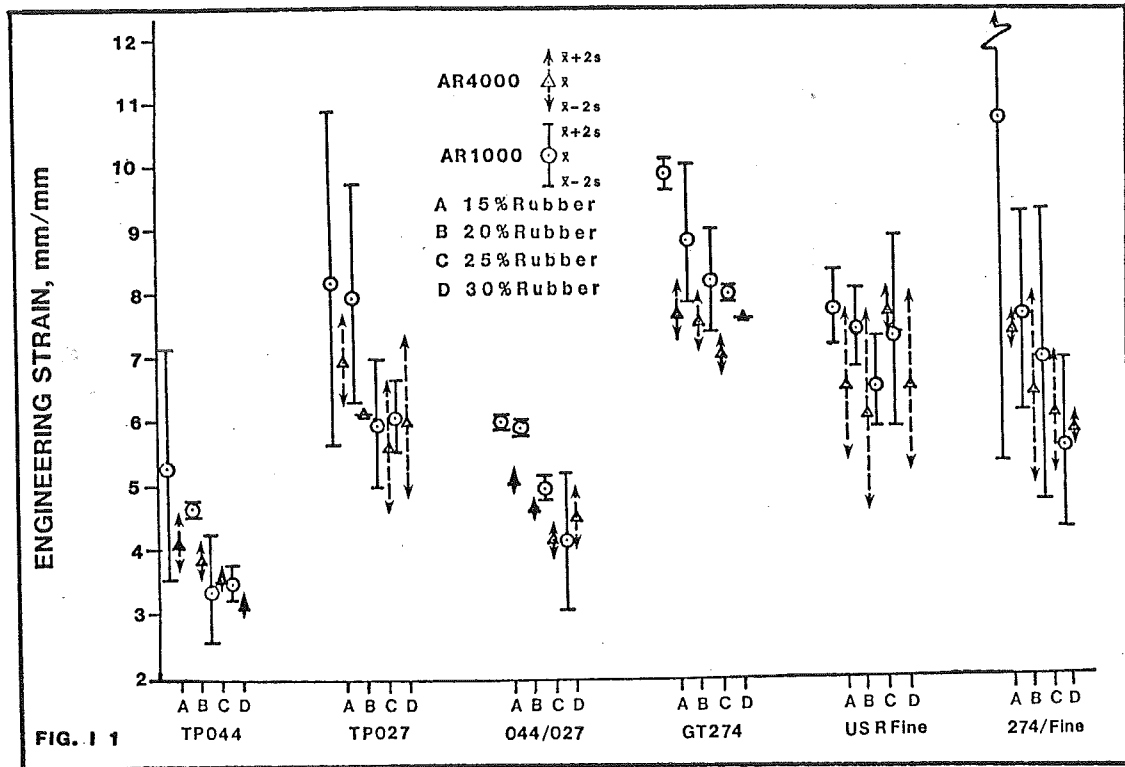
a. Reduced Data

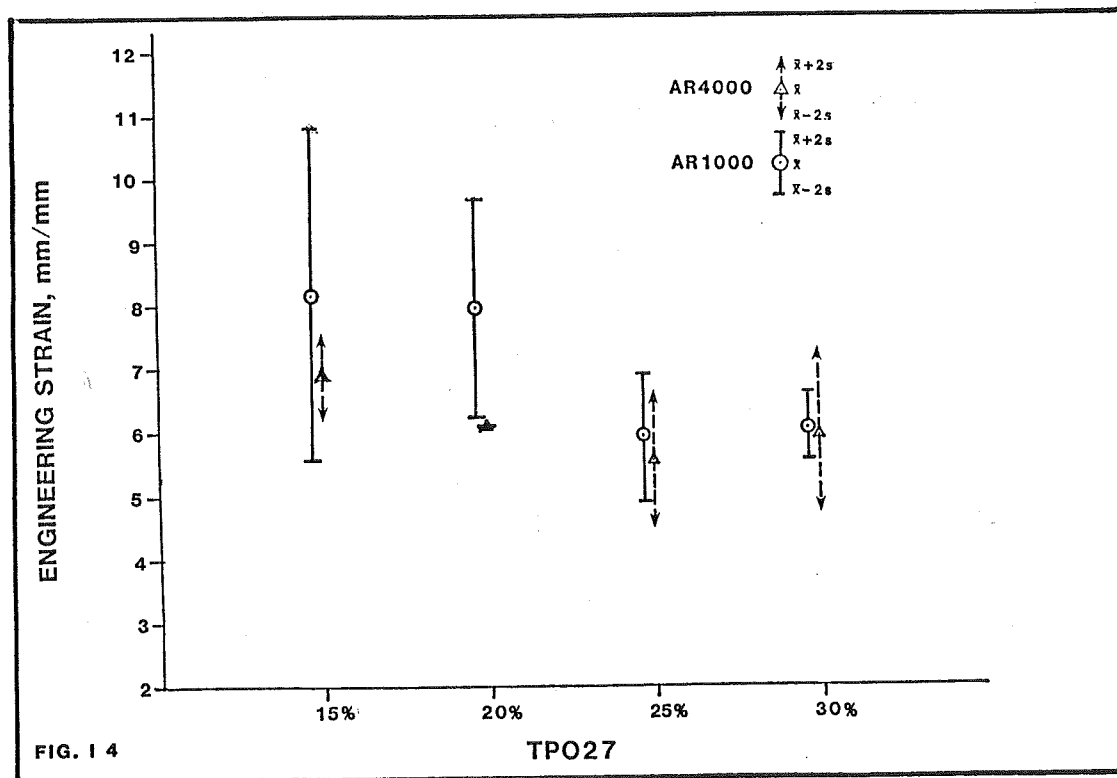
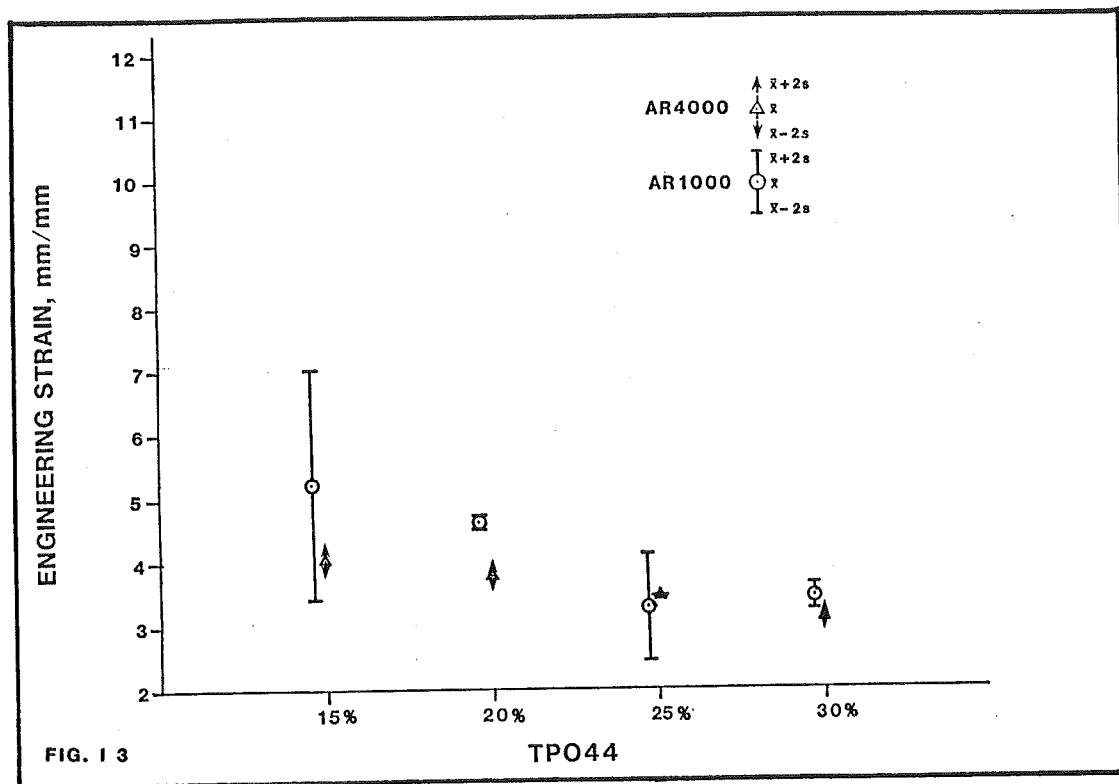
50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	7.307	6.880	6.373	5.827
	7.450	6.033	5.907	5.927
A R 1 0 0 0	9.207	7.253	7.633	5.983
	12.310	8.123	6.347	5.223

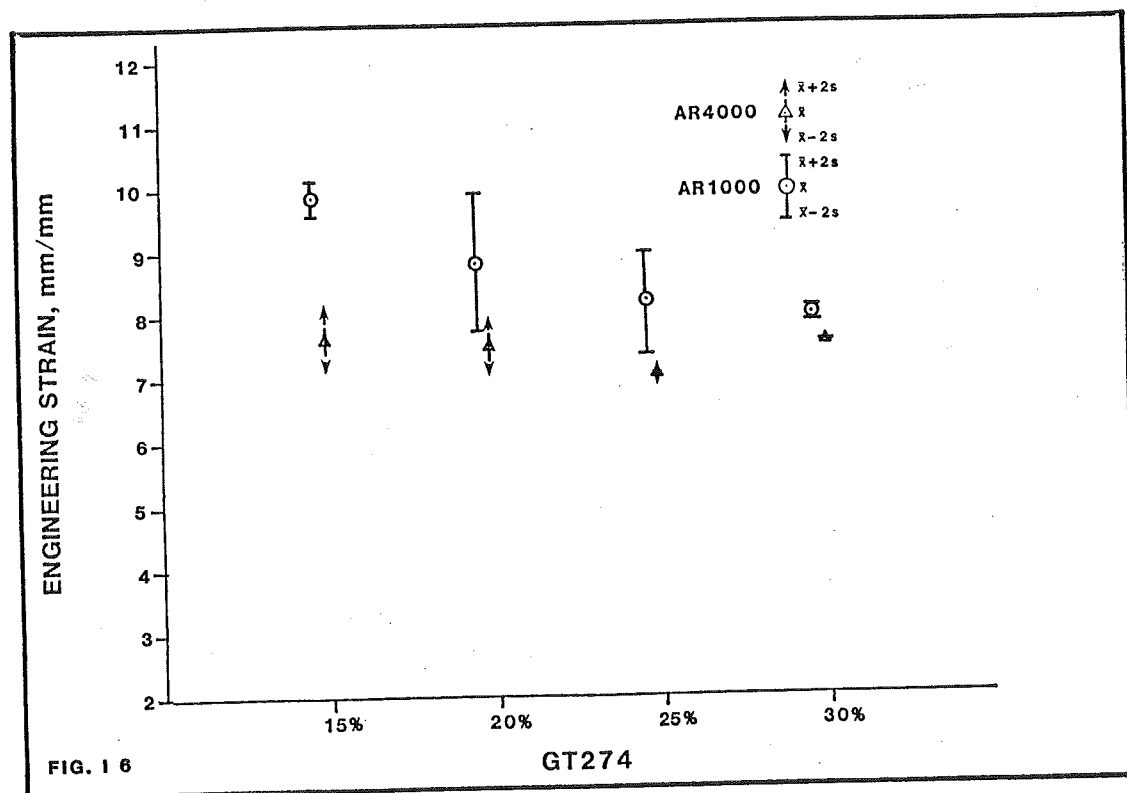
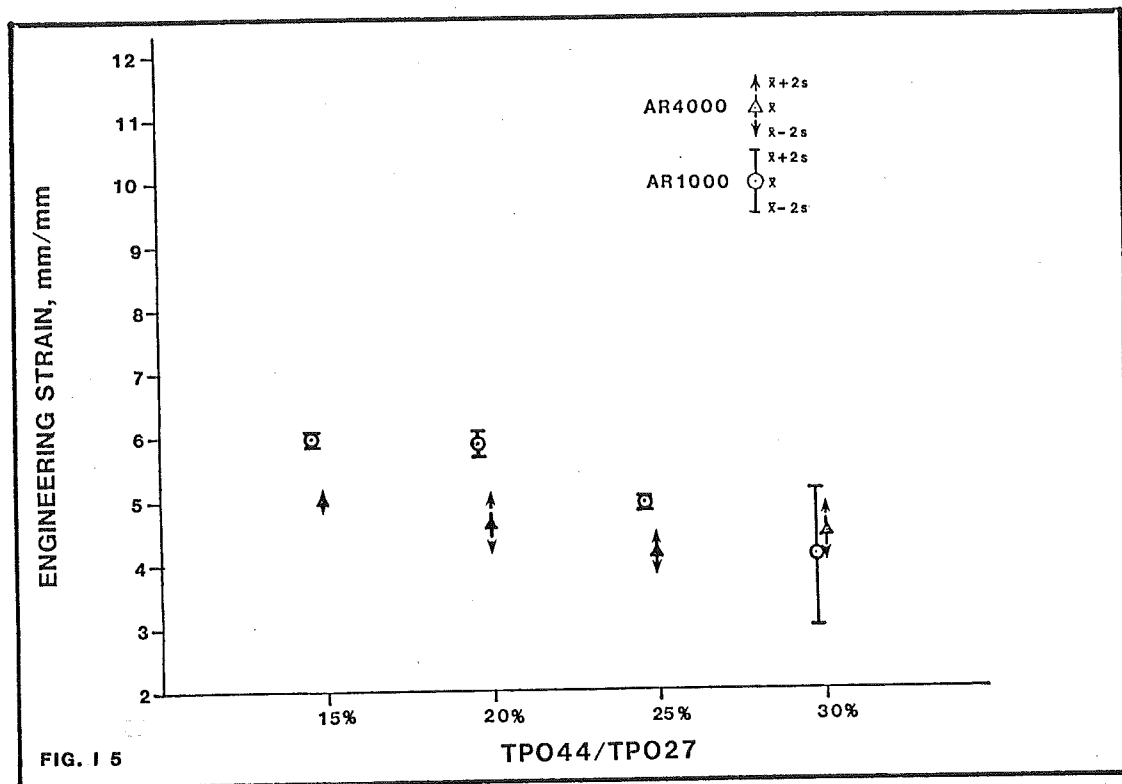
b. Summary

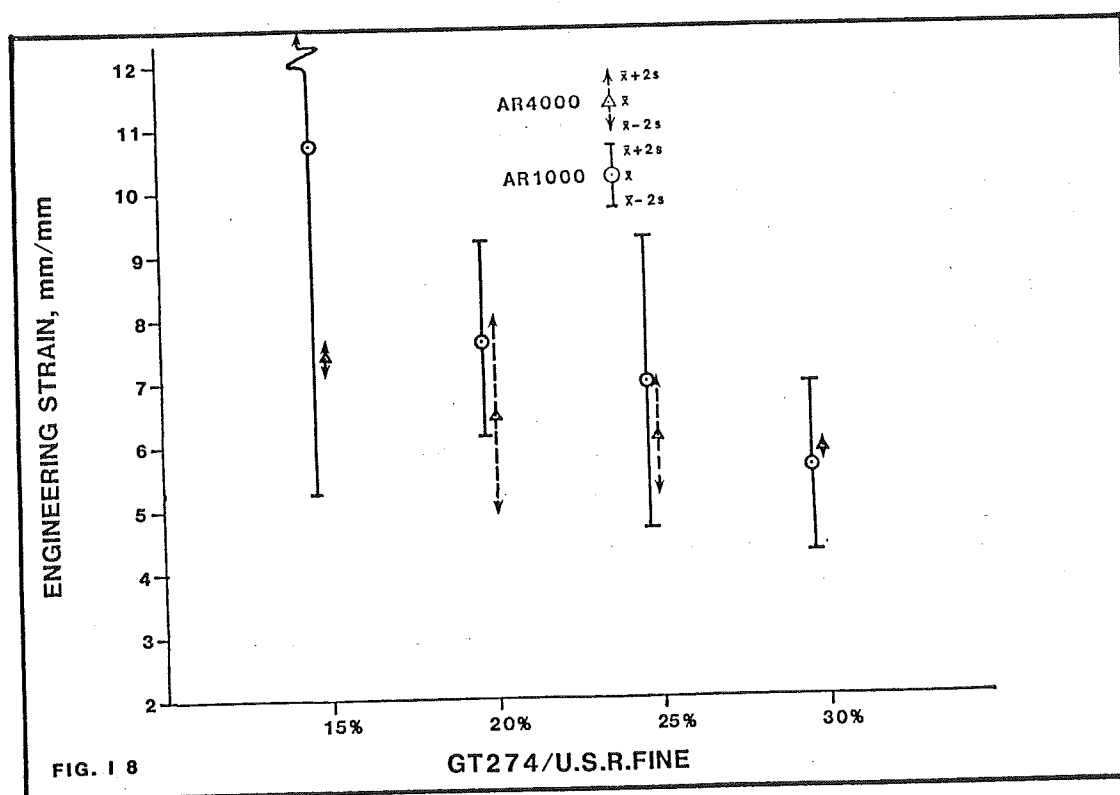
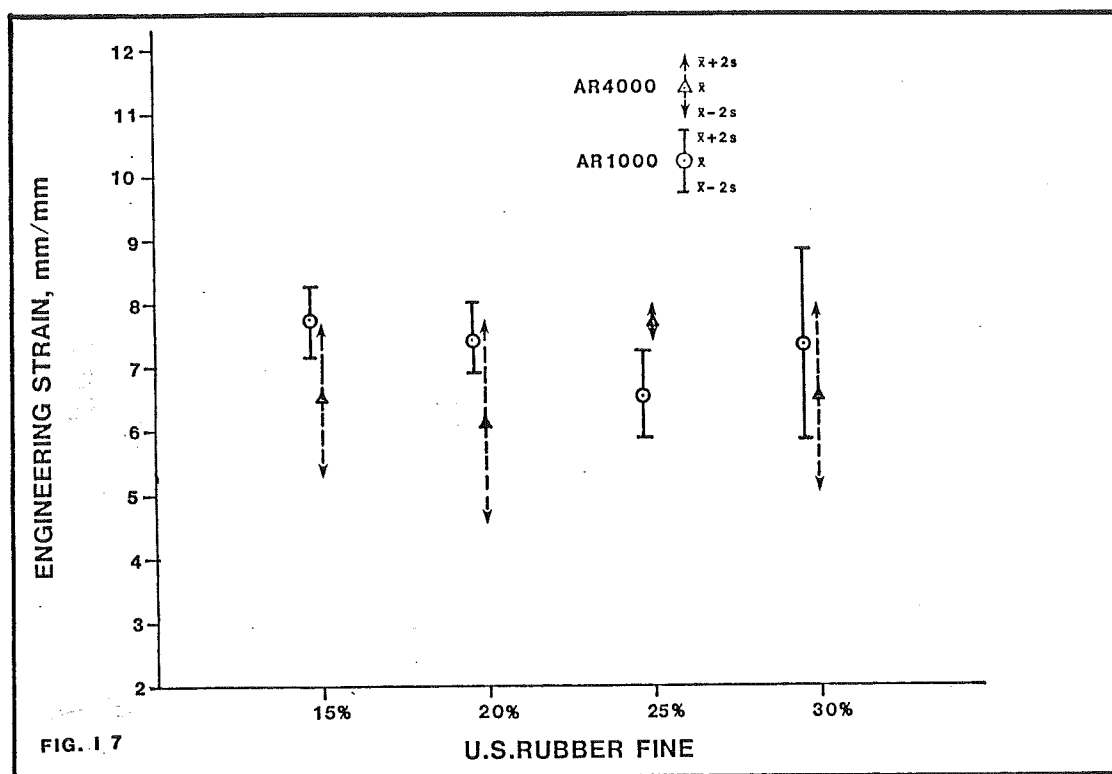
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>7.38</u>	<u>6.46</u>	<u>6.14</u>	<u>5.88</u>
	S	<u>.13</u>	<u>.75</u>	<u>.41</u>	<u>.09</u>
	CV	1.72	11.62	6.72	1.51
A R 1 0 0 0	$\bar{x}$	<u>10.76</u>	<u>7.69</u>	<u>6.99</u>	<u>5.60</u>
	S	<u>2.75</u>	<u>.77</u>	<u>1.14</u>	<u>.67</u>
	CV	25.55	10.03	16.30	12.02

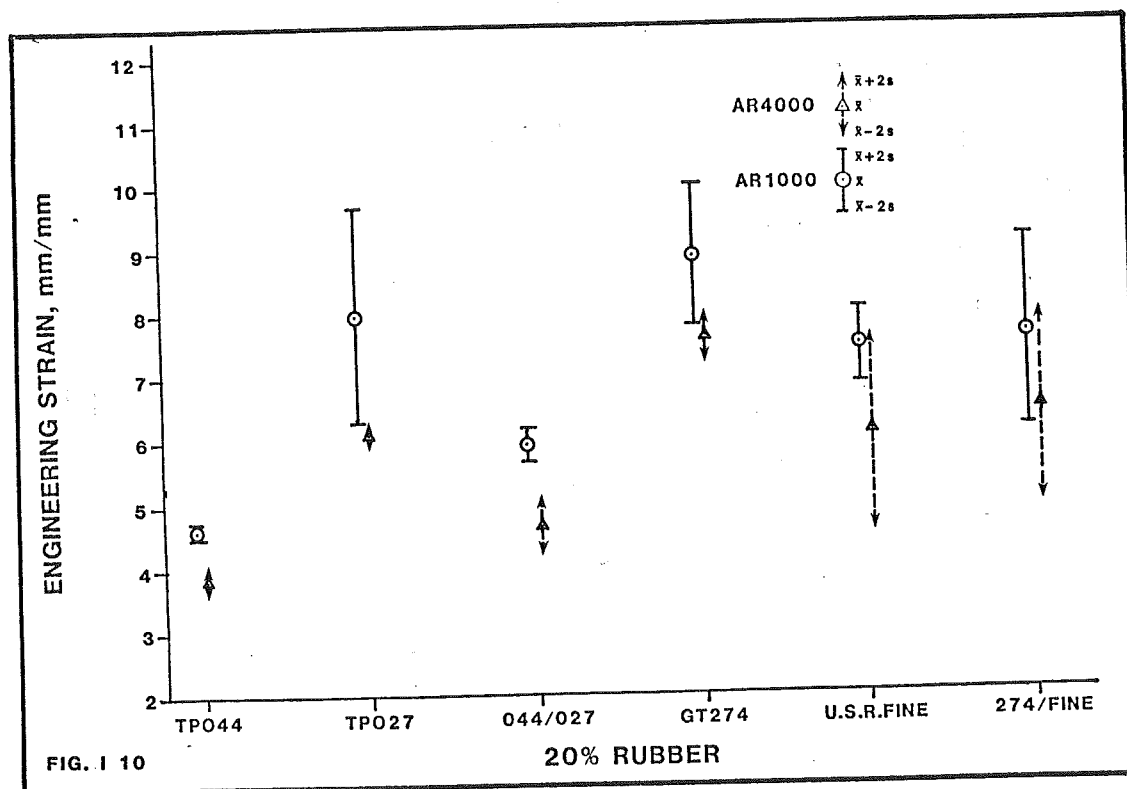
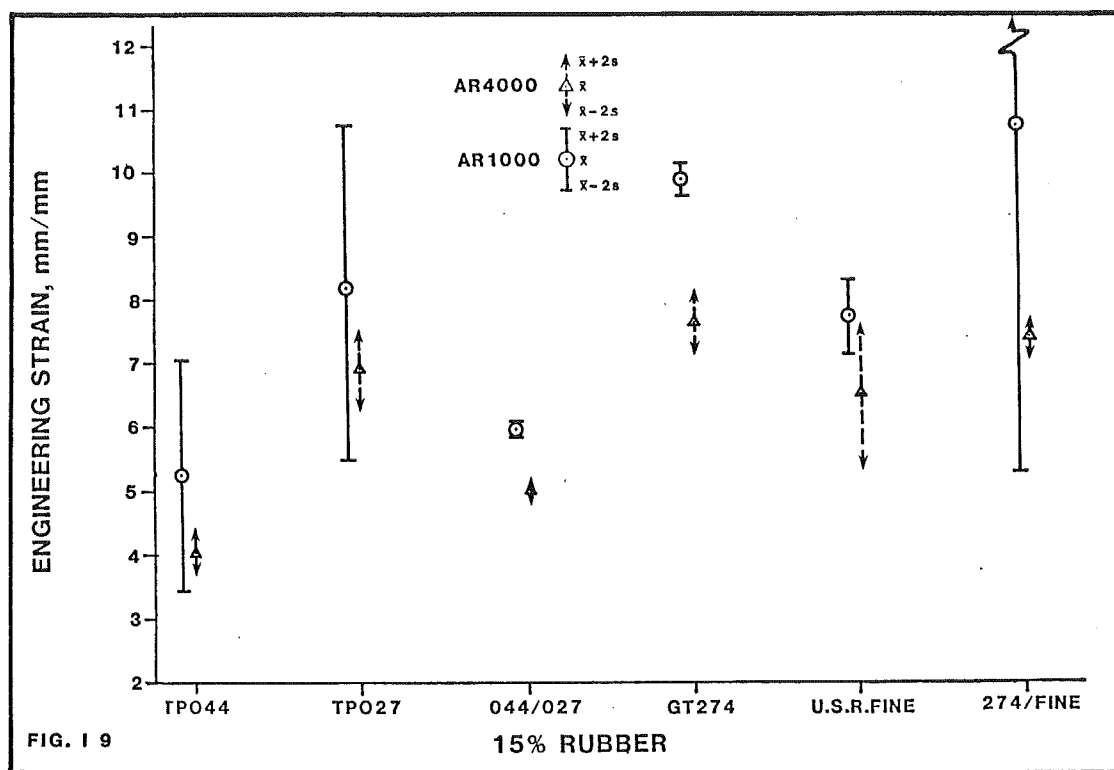
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP646				TP687				50% TP646 50% TP687				B1276				U.S. Rubber Fine				50% B1276 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
A	4000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B	4000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C	4000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-











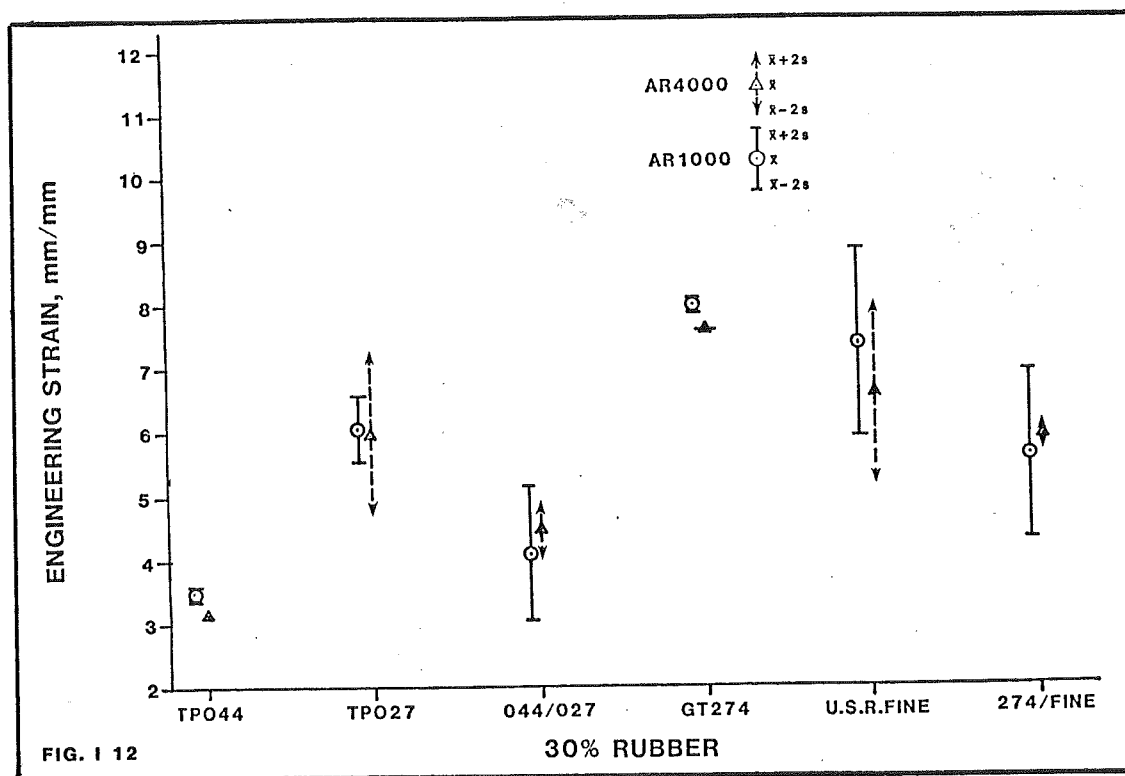
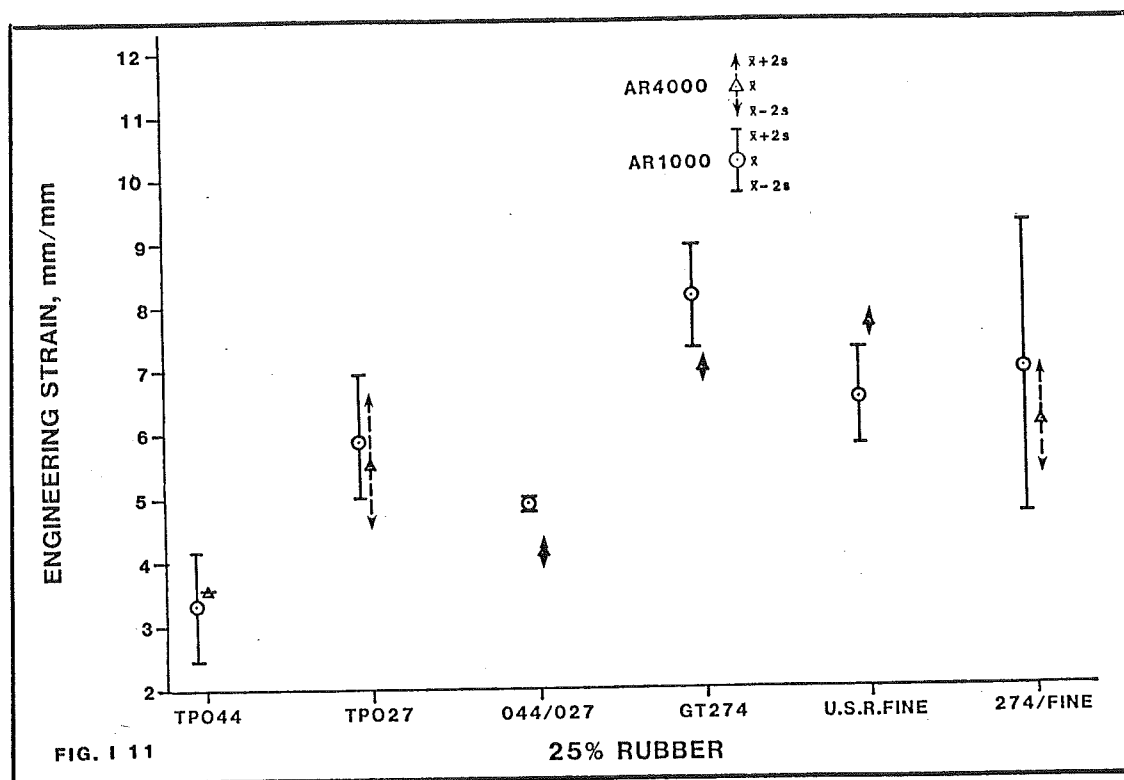


Table I-3 Log Engineering Strain at Failure, mm/mm

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	.62562	.59251	.54654	.50147
	.60885	.057484	.54654	.49094
A R 1 0 0 0	.76170	.66370	.48671	.54370
	.66761	.67182	.55060	.53058

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	0.61723	0.58368	0.54759	0.49621
	S	.01486	.01565	.00185	.00933
	CV	2.41	2.68	0.34	1.88
A R 1 0 0 0	$\bar{x}$	0.71965	0.66776	0.51865	0.53392
	S	.07451	.07194	.05660	.01733
	CV	10.35	10.77	10.91	3.25

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP037				80% TP044 20% TP037			
		15	20	25	30	15	20	25	30	15	20	25	30
Log Engineering Strain at Failure	mm/mm	---	---	---	---	---	---	---	---	---	---	---	---
	in/in	---	---	---	---	---	---	---	---	---	---	---	---
	mm/mm	---	---	---	---	---	---	---	---	---	---	---	---
	in/in	---	---	---	---	---	---	---	---	---	---	---	---

a. Analyzed Data

b. Summary

[illegible]

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
AR 4 0 0 0	.69784 	.66058 	.62767 	.64018
	.70355	.68006	.61172	.66181
AR 1 0 0 0	.78125 	.77159 	.69749 	.64118
	.77357	.76268	.69170	.57600

b. Summary

		50% TP044 & 50% TP027			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	<u>0.70069</u>	<u>0.67032</u>	<u>0.61970</u>	<u>0.65100</u>
	S	<u>.00506</u>	<u>.01726</u>	<u>.01413</u>	<u>.01916</u>
	CV	0.72	2.57	2.28	2.94
A R 1 0 0 0	$\bar{X}$	<u>0.77741</u>	<u>0.76713</u>	<u>0.69460</u>	<u>0.60859</u>
	S	<u>.00681</u>	<u>.00789</u>	<u>.00513</u>	<u>.05775</u>
	CV	0.88	1.03	0.74	9.49

ADDRESS TYPE (A) PERCENT NUMBER (B) NUMBER TYPE (N)																													
TP044					TP037					50% TP044 50% TP037					GT27Q					U.S. Rubber Film					50% GT27Q 50% R. Film				
15	30	25	30	15	15	30	25	30	15	30	25	30	15	30	25	30	15	30	25	30	15	30	25	30	15	30	25	30	
1000-200																													
200-500																													
500-750																													
750-1000																													
1000-1250																													
1250-1500																													
1500-1750																													
1750-2000																													
2000-2250																													
2250-2500																													
2500-2750																													
2750-3000																													
3000-3250																													
3250-3500																													
3500-3750																													
3750-4000																													
4000-4250																													
4250-4500																													
4500-4750																													
4750-5000																													
5000-5250																													
5250-5500																													
5500-5750																													
5750-6000																													
6000-6250																													
6250-6500																													
6500-6750																													
6750-7000																													
7000-7250																													
7250-7500																													
7500-7750																													
7750-8000																													
8000-8250																													
8250-8500																													
8500-8750																													
8750-9000																													
9000-9250																													
9250-9500																													
9500-9750																													
9750-10000																													

Table I-3 Log Engineering Strain at Failure, mm/mm

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	.87852	.87448	.84510	.88593
	.89337	.88593	.85187	.88553
A R 1 0 0 0	.99782	.96251	.92361	.90434
	.99224	.93181	.89927	.90146

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	0.88595	0.88020	0.84848	0.88573
	s	.01316	.01014	.00600	.00035
	CV	1.49	1.15	0.71	0.04
A R 1 0 0 0	$\bar{x}$	0.99503	0.94716	0.911440	0.90290
	s	.04943	.02720	.02156	.00255
	CV	4.97	2.87	2.37	0.28

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP644				TP637				50% TP644 50% TP637				Q1710				U.S. Rubber Fms				50% Q1710 50% U.S. Rubber Fms															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Log Strain	mm/mm																																				
	mm/mm																																				
Log Strain	mm/mm																																				
	mm/mm																																				

Table I-3 Log Engineering Strain at Failure, mm/mm

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.79169	.81690	.89081	.78796
	.83778	7.5534	.88156	.84011
A R 1 0 0 0	.89653	.88081	.80346	.84198
	.87795	.86195	.83078	.89115

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	0.81315	0.78612	0.88618	0.81403
	S	.03803	.05454	.00820	.04620
	CV	4.68	6.94	0.93	5.68
A R 1 0 0 0	$\bar{x}$	0.88724	0.87138	0.81712	0.86657
	S	.01646	.01671	.02421	.04356
	CV	1.86	1.92	2.96	5.03

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP606			TP627			SS 17044 50% TP627			61976			U.S. Rubber Fine			SS 61976 50% U.S. Rubber		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
1000																		
2000																		
3000																		
4000																		
5000																		
6000																		
7000																		
8000																		
9000																		
10000																		

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
AR 4 0 0 0	.86374 	.83759 	.80434 	.76545
	.87216	.78053	.77137	.77283
AR 1 0 0 0	.96412 	.86052 	.88270 	.77692
	1.09026	.90972	.80257	.71792

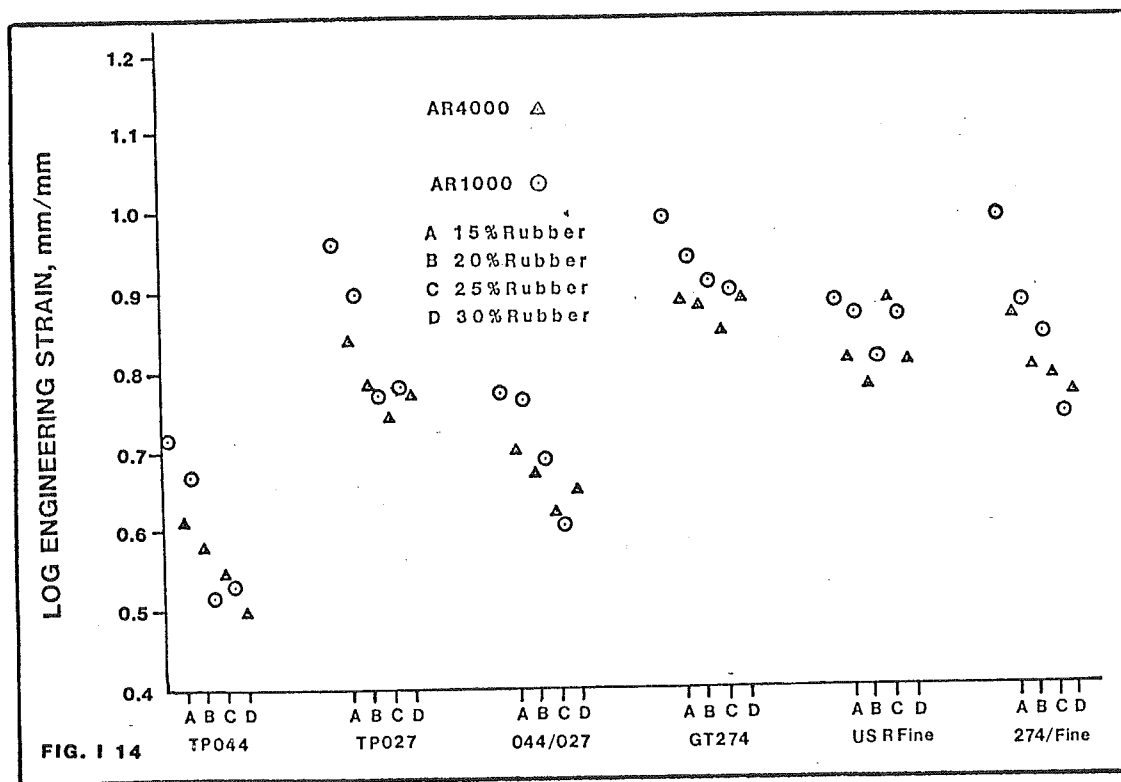
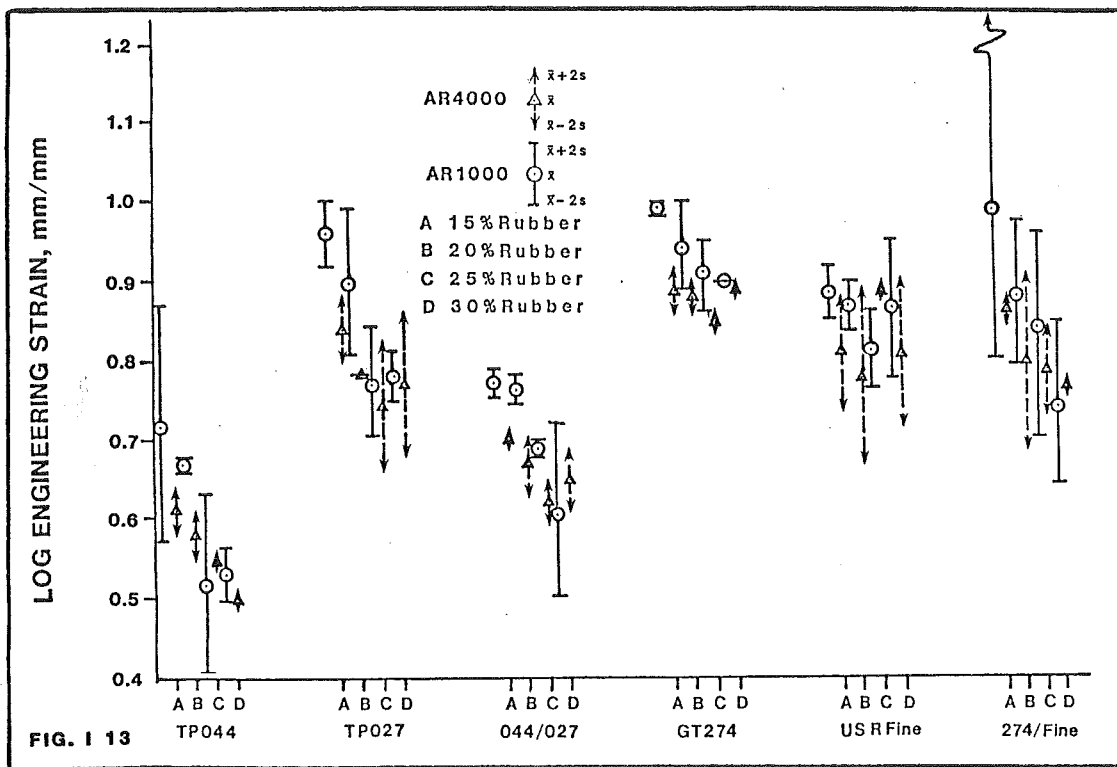
b. Summary

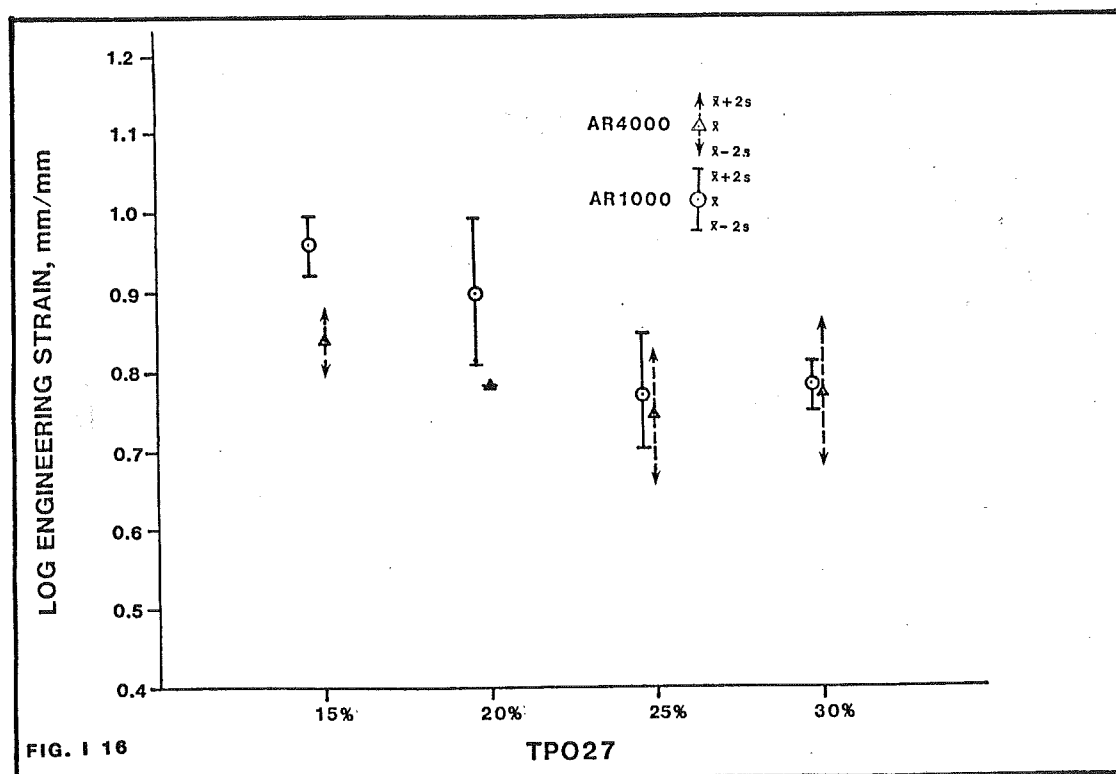
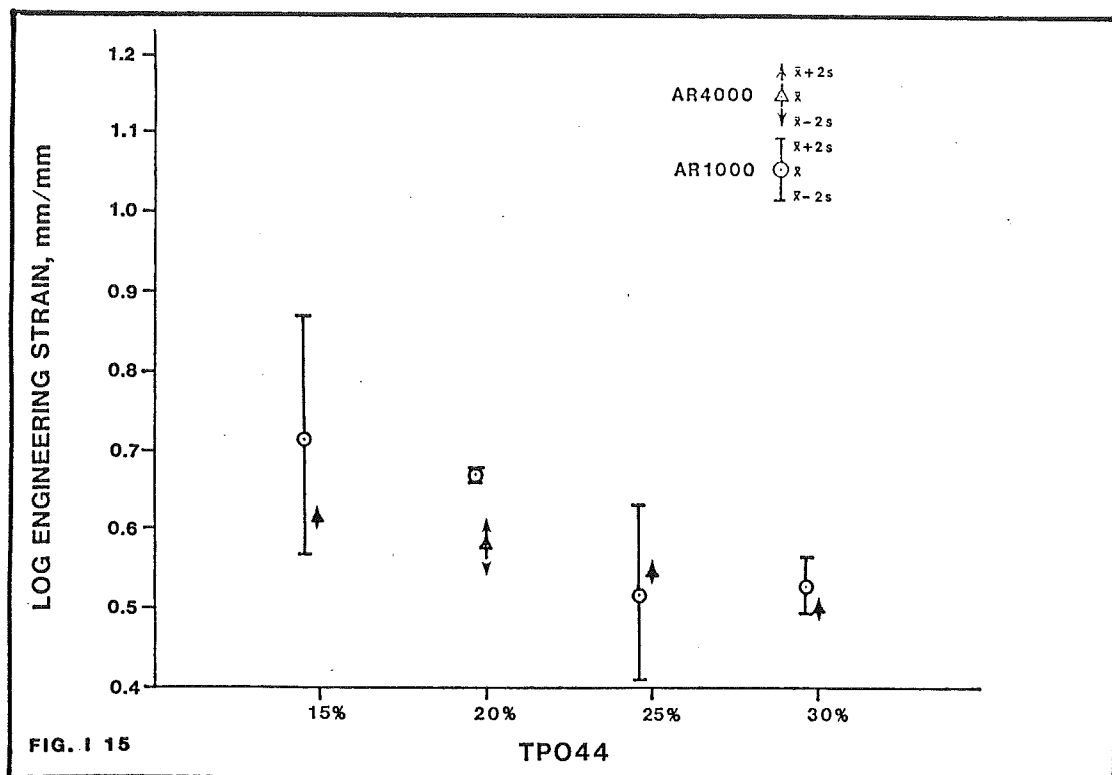
		50% GT274 & 50% U. S. RUBBER FINE			
		15%	20%	25%	30%
A R 4 0 0 0	X	<u>0.86795</u>	<u>0.80906</u>	<u>0.78786</u>	<u>0.76914</u>
	S	<u>.00746</u>	<u>.05055</u>	<u>.02922</u>	<u>.00654</u>
	CV	.01	0.05	0.03	.01
A R 1 0 0 0	X	<u>1.02719</u>	<u>0.88512</u>	<u>0.84263</u>	<u>0.74742</u>
	S	<u>.11176</u>	<u>.04359</u>	<u>.07099</u>	<u>.05227</u>
	CV	1.08	0.04	.07	.05

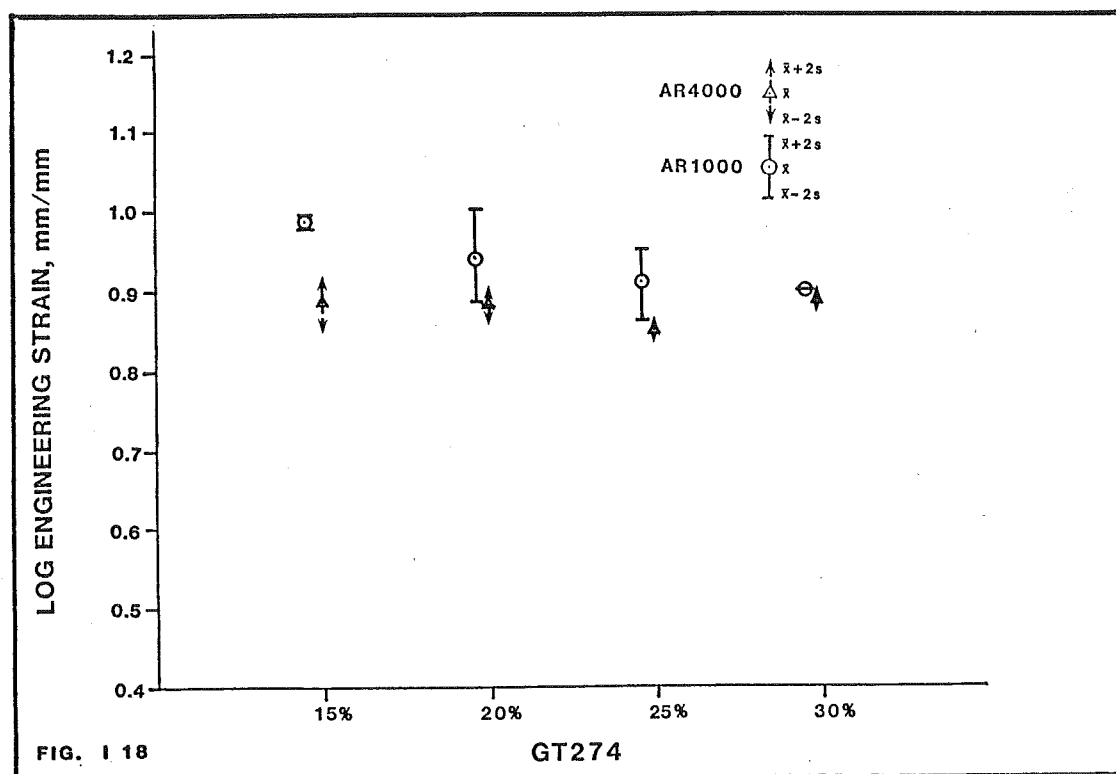
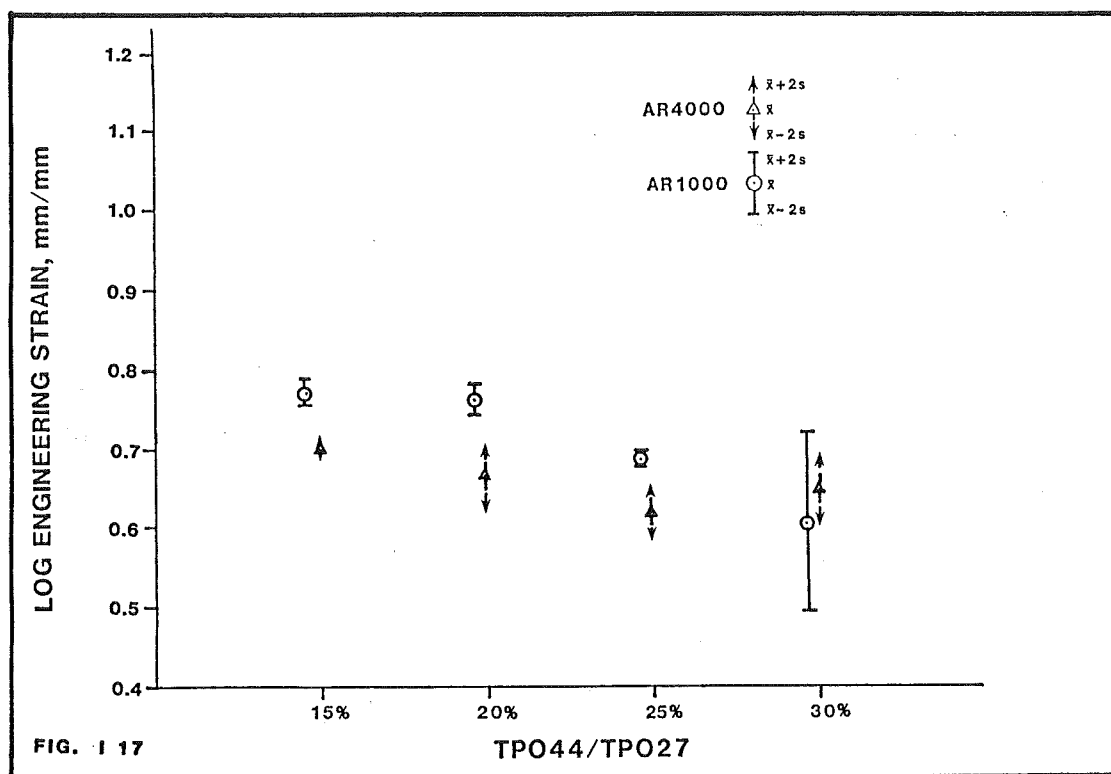
[illegible]

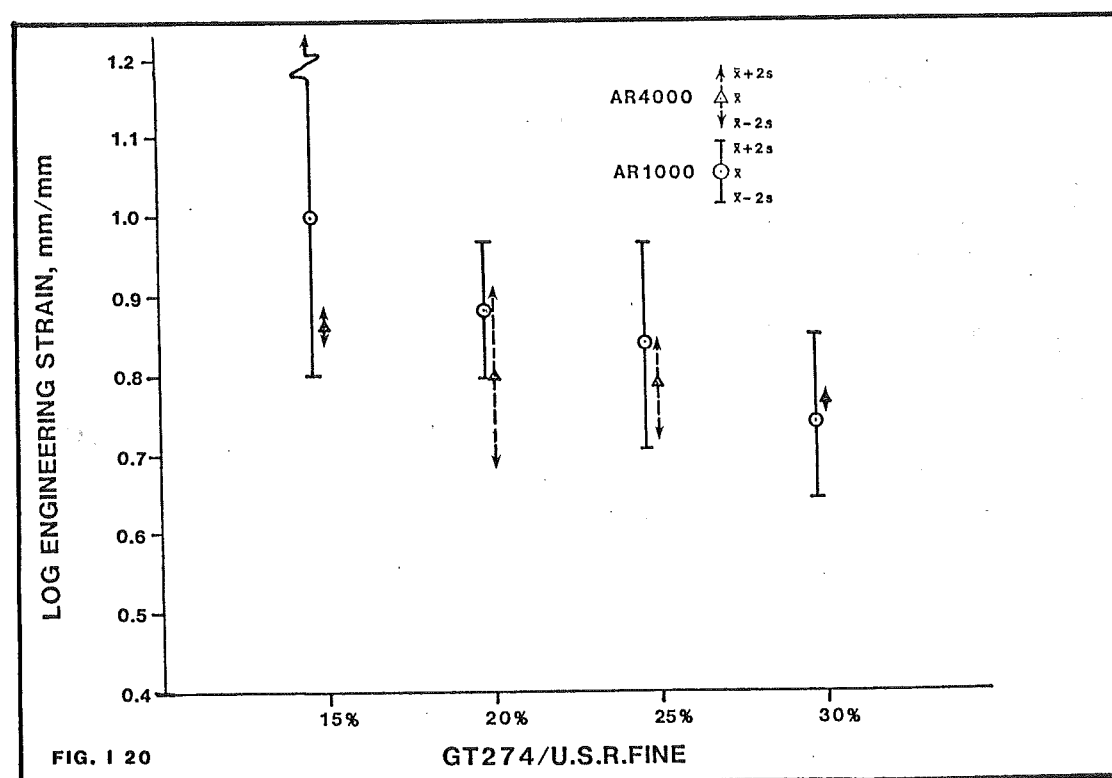
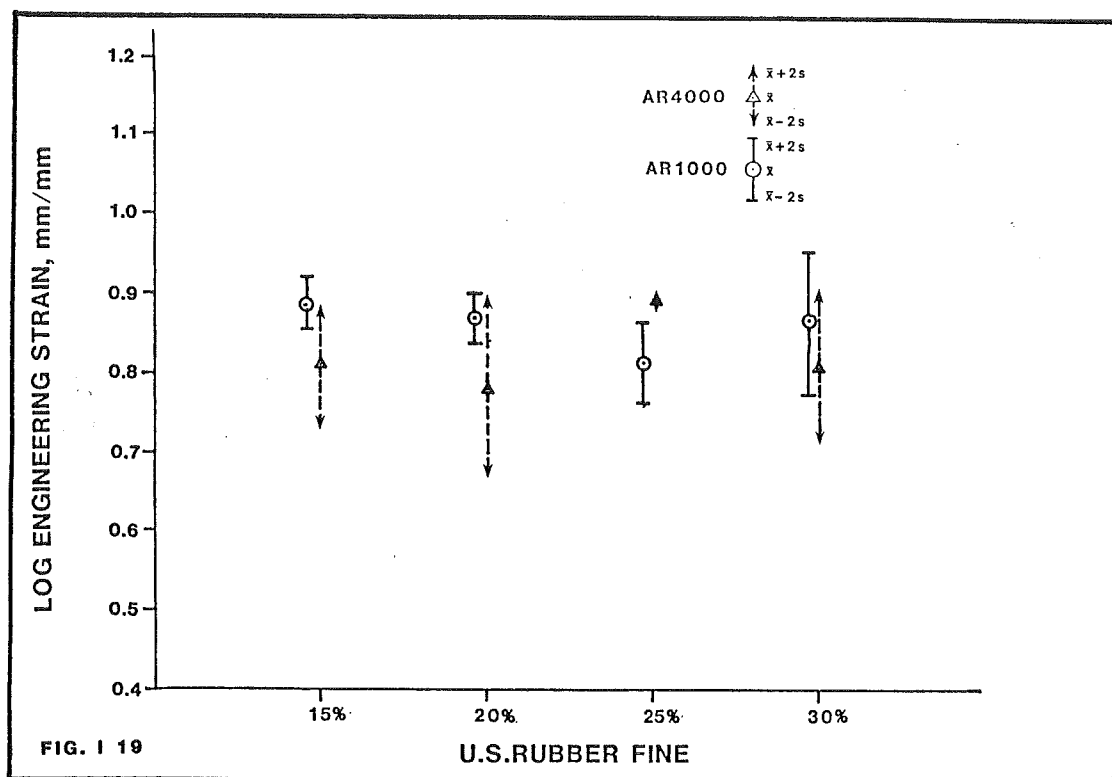
Table I-4 Anova Summary, Log Engineering Strain at Failure

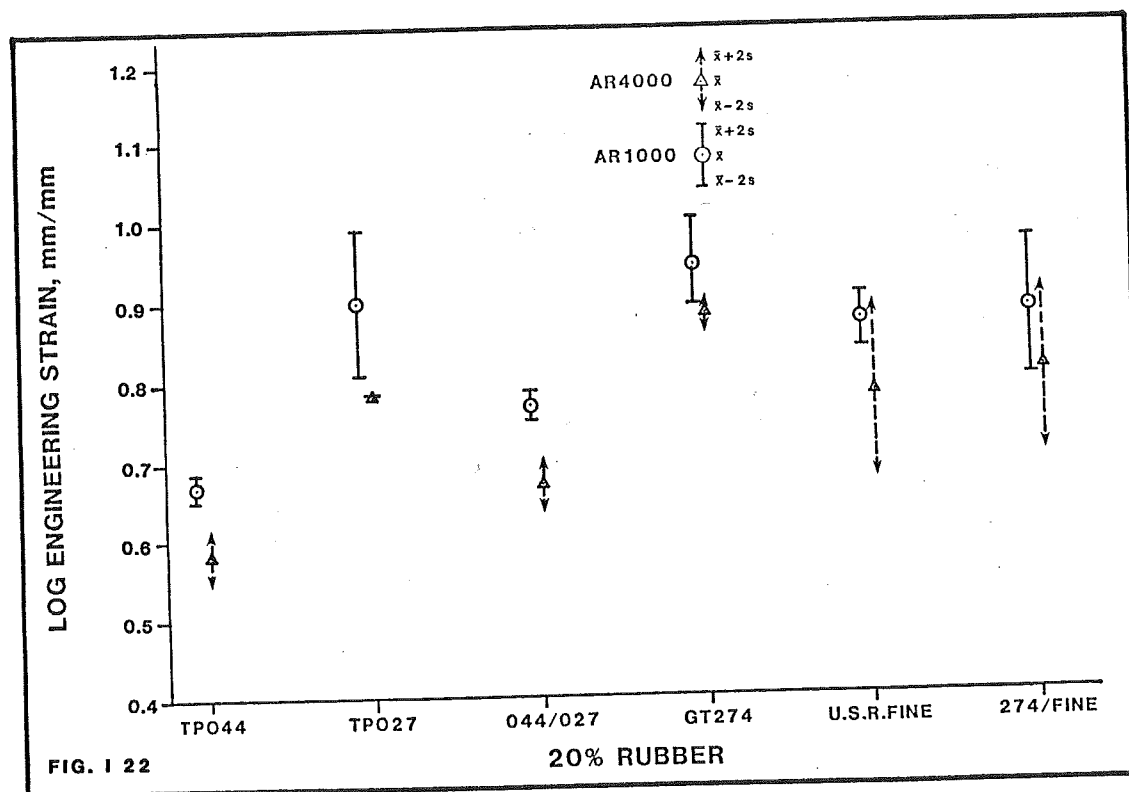
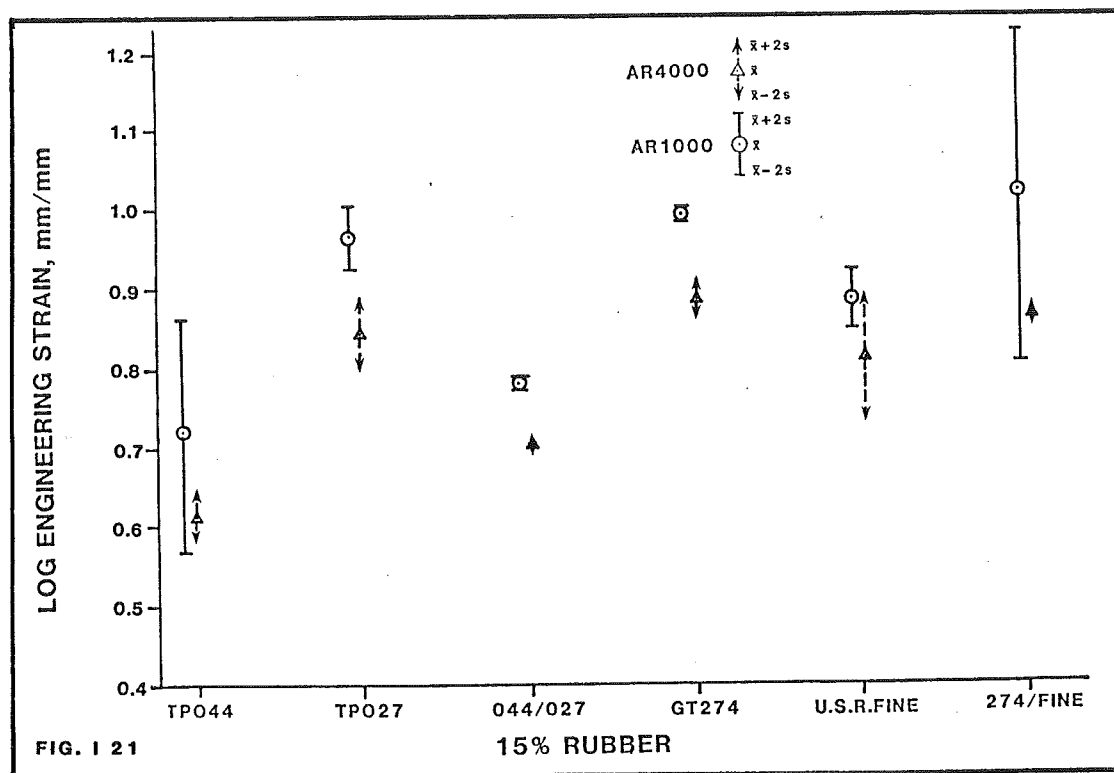
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	1.1523090	0.230461800	293.99	2.43	3.48
Q	3	.1631693	0.054389767	69.38	2.82	4.27
A	1	.0753979	0.00753979	96.18	4.06	7.27
RQ	15	.0658106	0.004387373	5.59	1.90	2.49
RA	5	.0033545	0.000670900	0.85	2.43	3.48
QA	3	.0424257	0.014141900	18.04	2.82	4.27
RQA	15	.0263276	0.001755173	2.23	1.90	2.49
Error	48	.0376266	0.000783888			
TOTAL	95	1.5664211				

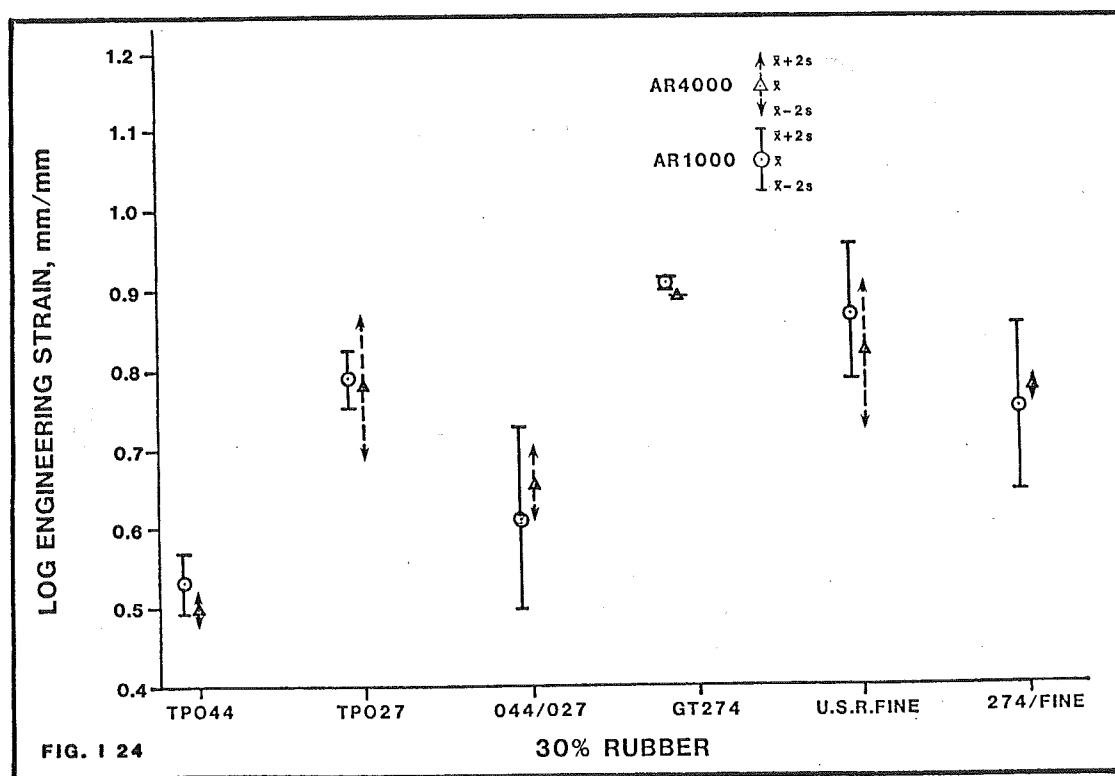
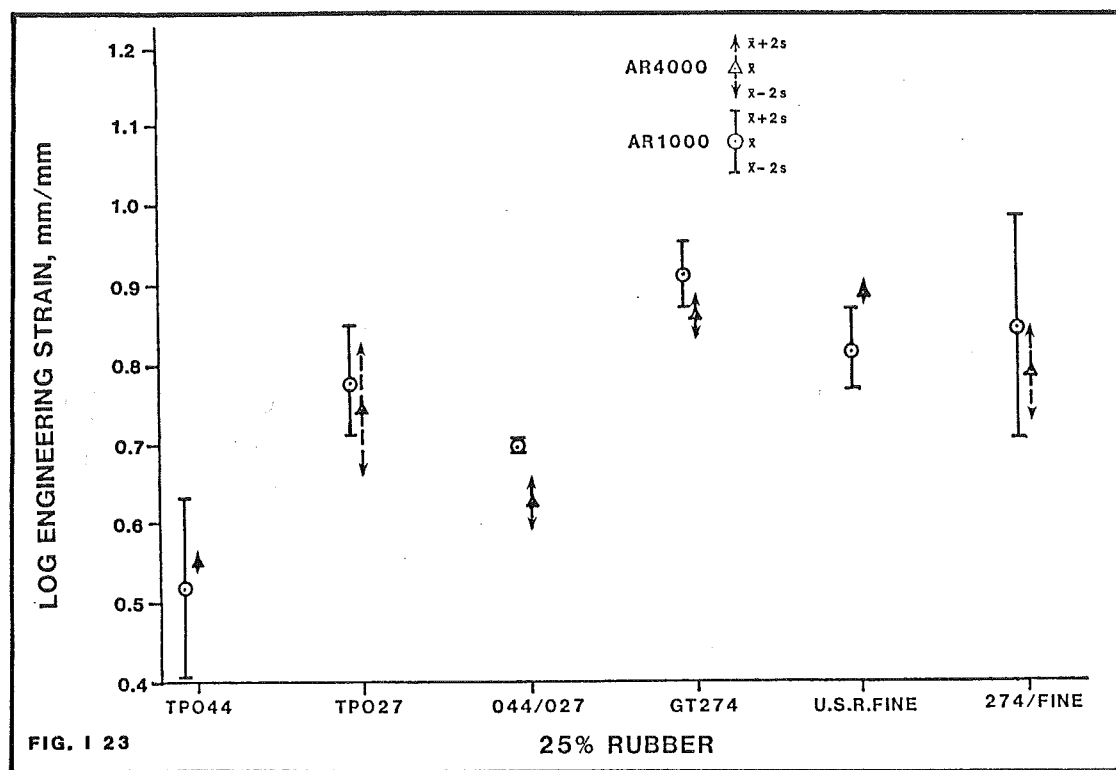












APPENDIX J
FORCE-DUCTILITY TRUE STRESS AT
FAILURE AT 39.2F (4C)

a. Measured Data

b. Summary[illegible]

Table J-1 True Stress at Failure, psi

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	794.2	845.1	1336.1	1022.8
	795.9	835.9	1060.7	1051.6
	729.5	740.1	1227.3	1169.1
	1085.7	853.8	985.3	910.8
	729.8	829.3	844.9	840.0
A R 1 0 0 0	536.6	841.7	671.4	809.7
	278.9	579.1	481.3	837.5
	318.6	571.5	493.1	797.4
	287.6	567.8	551.9	772.4
	297.9	572.1	847.2	688.4
	338.4	593.1	665.9	659.0
	290.3	558.7	654.1	793.9

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	778.6	824.3	1021.0	967.33
	S	177.88	42.08	244.10	137.95
	CV	22.85	5.11	23.91	14.26
A R 1 0 0 0	$\bar{x}$	302.0	573.7	615.6	758.1
	S	22.34	11.60	137.66	69.30
	CV	7.40	2.02	22.36	9.14

		ASPHALT TYPE (A)												PERCENT NUMBER (B)												RUBBER TYPE (C)												
		TP046				TP027				50% TP046 & 50% TP027				G1374				U.S. Rubber Firm				50% G1374 50% U.S. Firm																
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	
Specimen	1																																					
	2																																					

Table J-1 True Stress at Failure, psi

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	841.2	1109.2	911.1	1166.1
	952.7	969.2	976.4	1196.7
	947.2	931.1	1036.0	1178.4
	822.9	899.3	921.2	1346.9
	863.8	961.9	999.0	1326.7
A R 1 0 0 0	869.8	851.1	1185.1	1460.6
	454.7	663.8	744.6	925.1
	415.9	680.9	866.2	1065.0
	473.5	645.1	892.2	980.6
	411.2	642.1	876.2	820.0
	437.1	702.7	828.3	887.4
	344.2	727.5	877.9	964.8

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	882.93	953.63	1004.80	1279.23
	S	54.556	87.732	100.090	117.902
	CV	6.18	9.20	9.96	9.22
A R 1 0 0 0	$\bar{x}$	422.77	677.02	847.57	940.48
	S	45.062	33.573	54.868	83.995
	CV	10.66	4.96	6.47	8.93

		ASPHALT TYPE (A)									PERCENT RUBBER (R)									RUBBER TYPE (R)																		
		TP044			TP027			50% TP044 50% TP027			B1274			U.S. Rubber Fms			95% B1274 50% R Fms																					
		15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	
Failure Mode	Failure Mode																																					
	Failure Mode																																					

Table J-1 True Stress at Failure, psi

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	798.3	993.5	926.8	858.3
	805.0	997.8	916.7	728.4
	<u>954.7</u>	<u>983.4</u>	<u>972.4</u>	<u>863.9</u>
	762.0	1033.0	972.1	615.3
	770.7	1035.8	1030.6	615.0
A R 1 0 0 0	761.2	1054.1	923.4	588.0
	516.5	720.8	765.4	551.3
	570.4	652.7	727.6	574.4
	<u>514.4</u>	<u>691.7</u>	<u>802.6</u>	<u>628.8</u>
	650.3	573.6	774.2	838.6
	545.2	602.1	770.9	762.0
	554.1	689.0	709.0	666.0

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>808.65</u>	<u>1016.27</u>	<u>957.00</u>	<u>711.48</u>
	S	<u>73.918</u>	<u>28.399</u>	<u>43.697</u>	<u>125.603</u>
	CV	9.14	2.79	4.57	17.65
A R 1 0 0 0	$\bar{x}$	<u>558.48</u>	<u>654.98</u>	<u>758.28</u>	<u>670.18</u>
	S	<u>49.948</u>	<u>57.030</u>	<u>34.051</u>	<u>111.205</u>
	CV	8.94	8.71	4.49	16.59

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (A)																
		TP644				TP657				50% TP644 50% TP657				Q1376				U.S. Rubber Firm				50% Q1376 50% U.S. Firm																				
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	
STRESS	psi																																									
	ksi																																									
STRAIN	in/in																																									
	mm/mm																																									

Table J-1 True Stress at Failure, psi

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	724.1	1020.2	823.1	741.5
	803.3	1055.8	726.4	828.5
	<u>985.5</u>	<u>1048.9</u>	<u>777.4</u>	<u>823.1</u>
	985.0	641.7	887.6	959.5
	910.5	739.4	886.0	880.5
	981.5	913.2	864.0	933.0
A R 1 0 0 0	609.2	789.2	884.9	695.1
	635.5	784.5	699.4	675.3
	<u>624.4</u>	<u>812.8</u>	<u>693.0</u>	<u>599.5</u>
	559.9	767.8	789.5	640.4
	540.7	763.4	738.8	687.9
	564.1	831.4	746.2	643.4

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>898.32</u>	<u>903.20</u>	<u>827.42</u>	<u>861.02</u>
	S	<u>110.96</u>	<u>175.224</u>	<u>64.988</u>	<u>80.049</u>
	CV	12.35	19.40	7.85	9.30
A R 1 0 0 0	$\bar{x}$	<u>588.97</u>	<u>791.52</u>	<u>758.63</u>	<u>656.93</u>
	S	<u>39.047</u>	<u>26.273</u>	<u>71.078</u>	<u>36.078</u>
	CV	6.63	3.32	9.37	5.49

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP064				TP027				50% TP064 50% TP027				GT076				U.S. Rubber Fine				50% GT076 50% U.S. Rubber			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
0000-000																								
0000-001																								
0000-002																								
0000-003																								
0000-004																								
0000-005																								
0000-006																								
0000-007																								
0000-008																								
0000-009																								
0000-010																								
0000-011																								
0000-012																								
0000-013																								
0000-014																								
0000-015																								
0000-016																								
0000-017																								
0000-018																								
0000-019																								
0000-020																								
0000-021																								
0000-022																								
0000-023																								
0000-024																								
0000-025																								
0000-026																								
0000-027																								
0000-028																								
0000-029																								
0000-030																								
0000-031																								
0000-032																								
0000-033																								
0000-034																								
0000-035																								
0000-036																								
0000-037																								
0000-038																								
0000-039																								
0000-040																								
0000-041																								
0000-042																								
0000-043																								
0000-044																								
0000-045																								
0000-046																								
0000-047																								
0000-048																								
0000-049																								
0000-050																								

Table J-1 True Stress at Failure, psi

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	956.8	1107.3	624.1	454.0
	967.0	1191.4	668.8	540.1
	884.0	1164.2	610.5	721.6
	1003.2	804.4	531.0	876.5
	951.3	934.7	736.1	743.4
	1048.7	815.2	614.1	709.5
A R 1 0 0 0	557.0	573.2	749.3	538.8
	565.6	576.4	741.9	470.6
	572.2	470.5	763.2	570.5
	544.6	777.2	566.8	542.1
	484.0	741.3	556.8	386.1
	528.5	669.2	646.2	338.7

b. Summary

50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>968.50</u>	<u>1002.37</u>	<u>630.77</u>	<u>674.18</u>
	S	<u>55.157</u>	<u>174.890</u>	<u>68.159</u>	<u>152.104</u>
	CV	5.70	17.45	10.81	22.56
A R 1 0 0 0	$\bar{x}$	<u>541.98</u>	<u>634.63</u>	<u>670.70</u>	<u>474.47</u>
	S	<u>32.395</u>	<u>115.761</u>	<u>93.992</u>	<u>94.012</u>
	CV	5.98	18.24	14.01	19.81

— ASPHALT TYPE (A)
 — PERCENT RUBBER (B)
 — RUBBER TYPE (R)

	TP044			TP07			50% TP044 50% TP07			GT274			U.S. Rubber Fine			50% GT274 50% Rubber F		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
1000-100																		
1000-200																		
1000-300																		
1000-400																		
1000-500																		
1000-600																		
1000-700																		
1000-800																		
1000-900																		
1000-1000																		

Table J-2 True Stress at Failure, psi

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	613.63	649.53	646.37	645.83
	560.70	618.27	606.67	687.40
A R 1 0 0 0	327.50	380.03	575.53	569.40
	263.83	459.23	444.57	469.57

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	587.17	633.90	626.52	666.62
	S	46.90	27.70	35.17	36.83
	CV	7.99	4.31	5.61	5.52
A R 1 0 0 0	$\bar{x}$	295.67	419.63	510.05	519.49
	S	56.41	70.17	116.03	88.45
	CV	19.08	16.72	22.75	17.03

ASPHALT TYPE (A)
 PERCENT RUBBER (B)
 RUBBER TYPE (H)

	TP044				TP047				50% TP044 50% TP047				BT274				U.S. Rubber Fms				50% BT274 50% U.S. Rubber			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
1000-20																								
1000-25																								
1000-30																								
1000-35																								
1000-40																								
1000-45																								
1000-50																								
1000-55																								
1000-60																								
1000-65																								
1000-70																								
1000-75																								
1000-80																								
1000-85																								
1000-90																								
1000-95																								
1000-100																								

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
AR 4 0 0 0	773.20	807.03	1208.03	1081.17
	784.03	841.60	833.87	853.50
AR 1 0 0 0	295.03	572.80	508.77	802.43
	308.87	574.63	722.40	713.77

b. Summary

		TP027			
		15%	20%	25%	30%
A R	$\bar{x}$	778.62	824.32	1020.95	967.34
4 0 0 0	S	9.60	30.63	331.51	201.72
	CV	1.23	3.72	32.47	20.85
A R	$\bar{x}$	301.95	573.72	615.59	758.10
1 0 0 0	S	12.26	1.62	189.28	78.55
	CV	4.06	0.28	30.75	10.36

[illegible]

Table J-2 True Stress at Failure, psi
a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	913.70	1003.17	974.50	1180.40
	852.17	904.10	1035.10	1378.07
A R 1 0 0 0	448.03	663.27	834.33	990.23
	397.50	690.77	860.80	890.73

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	882.94	953.64	1004.80	1297.24
	S	54.52	87.78	53.69	175.14
	CV	6.17	9.20	5.34	13.50
A R 1 0 0 0	$\bar{x}$	422.77	677.02	847.57	940.48
	S	44.77	24.37	23.45	88.16
	CV	10.59	3.60	2.77	9.37

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)											
		TPO44				TPO27				50% TPO44 & 50% TPO27				G1274				U.S. Rubber Fms				50% G1274 50% R Fms															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30								
TPO44	15																																				
	20																																				
TPO27	15																																				
	20																																				
50% TPO44 50% TPO27	15																																				
	20																																				
G1274	15																																				
	20																																				
U.S. Rubber Fms	15																																				
	20																																				
50% G1274 50% R Fms	15																																				
	20																																				

Table J-2 True Stress at Failure, psi

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	852.67	991.57	938.63	816.87
	764.63	1040.97	975.37	606.10
A R 1 0 0 0	533.77	688.40	765.20	584.83
	583.20	621.57	751.37	755.53

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	808.65	1016.27	957.00	711.49
	s	78.00	43.77	32.55	186.74
	cv	1.65	4.31	3.40	26.25
A R 1 0 0 0	$\bar{x}$	558.49	654.99	758.29	670.18
	s	43.79	59.21	12.25	151.24
	cv	7.84	9.04	1.63	22.57

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)											
		TP644				TP627				50% TP644 50% TP627				GT274				U.S. Rubber Firm				50% GT274 50% U.S. Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30				
STRESS	1000-250																																				

a. Analyzed Data

	U. S. Rubber Fine			
	15%	20%	25%	30%
A R 4 0 0 0	837.63 	1041.63 	775.63 	797.70
	959.00	764.77	879.20	924.33
A R 1 0 0 0	623.03 	795.50 	759.10 	656.63
	554.90	787.53	758.17	657.23

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	898.32	903.20	827.42	861.01
	s	107.53	245.30	91.76	112.19
	cv	11.97	27.16	11.09	13.03
A R 1 0 0 0	$\bar{x}$	588.97	791.52	758.64	656.93
	s	60.36	7.06	0.82	0.53
	cv	10.25	0.89	0.11	0.08

[illegible]

Table J-2 True Stress at Failure, psi

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	935.93	1154.30	634.47	571.90
	1001.07	850.43	627.07	776.47
A R 1 0 0 0	564.93	547.03	751.47	526.63
	519.03	729.23	589.93	422.30

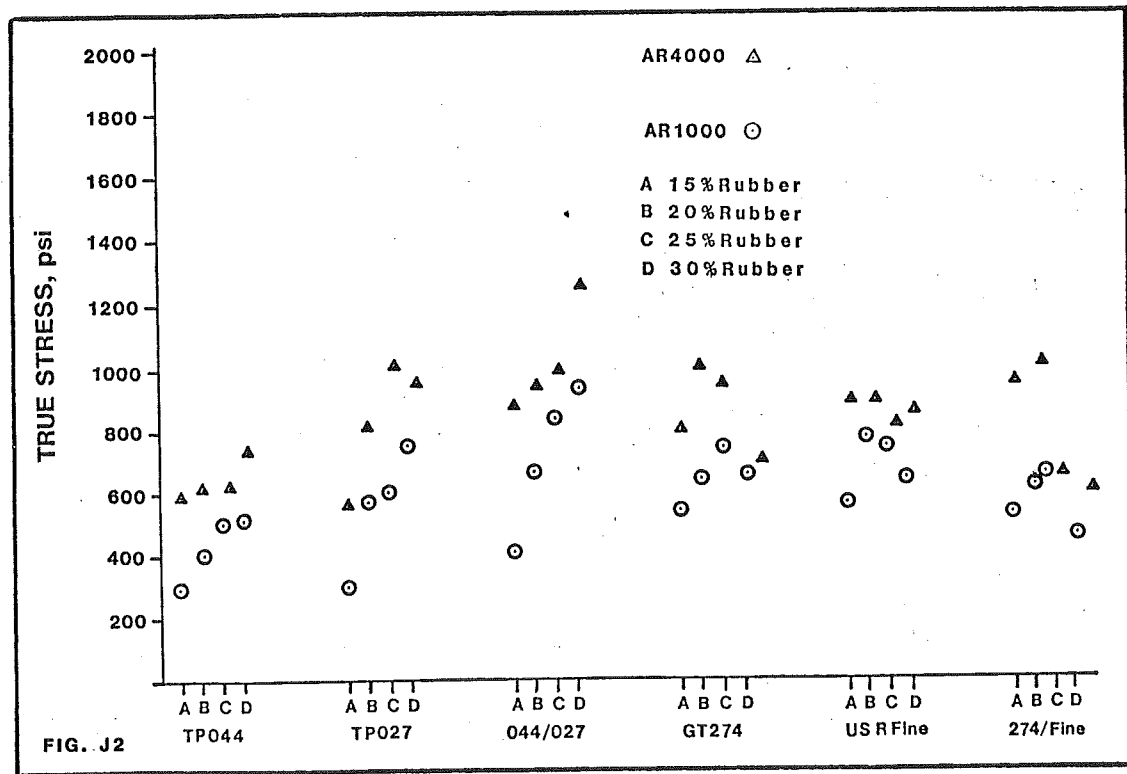
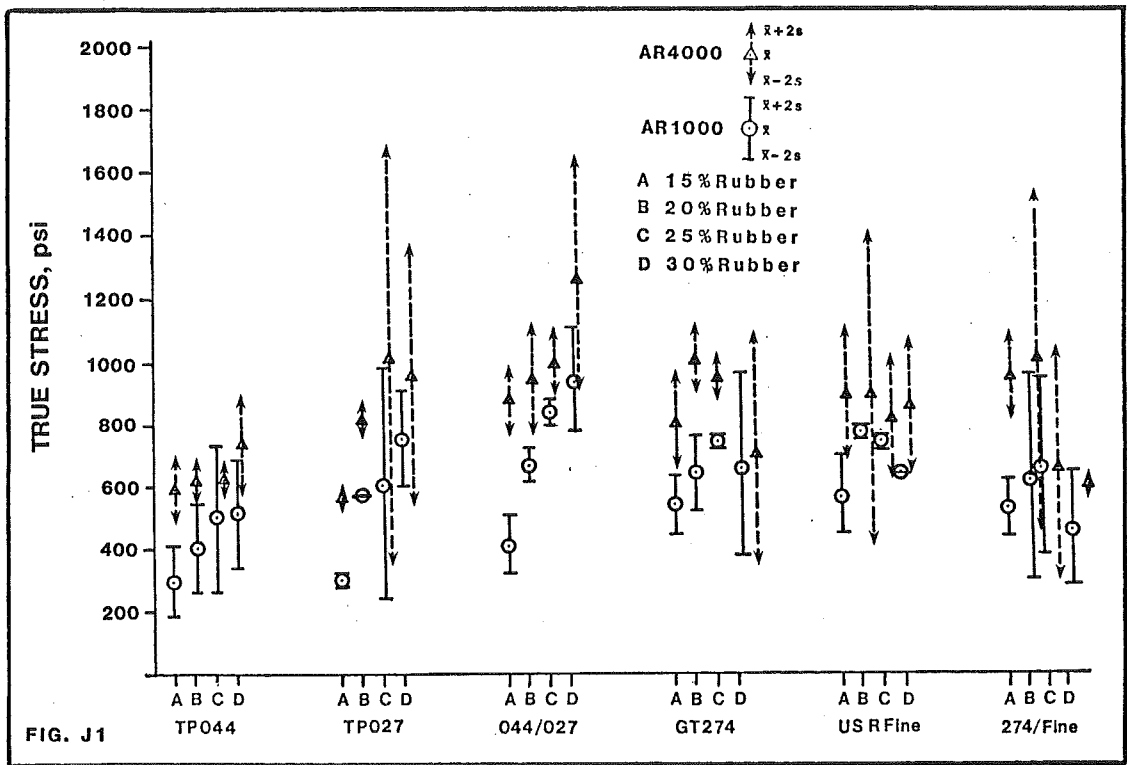
b. Summary

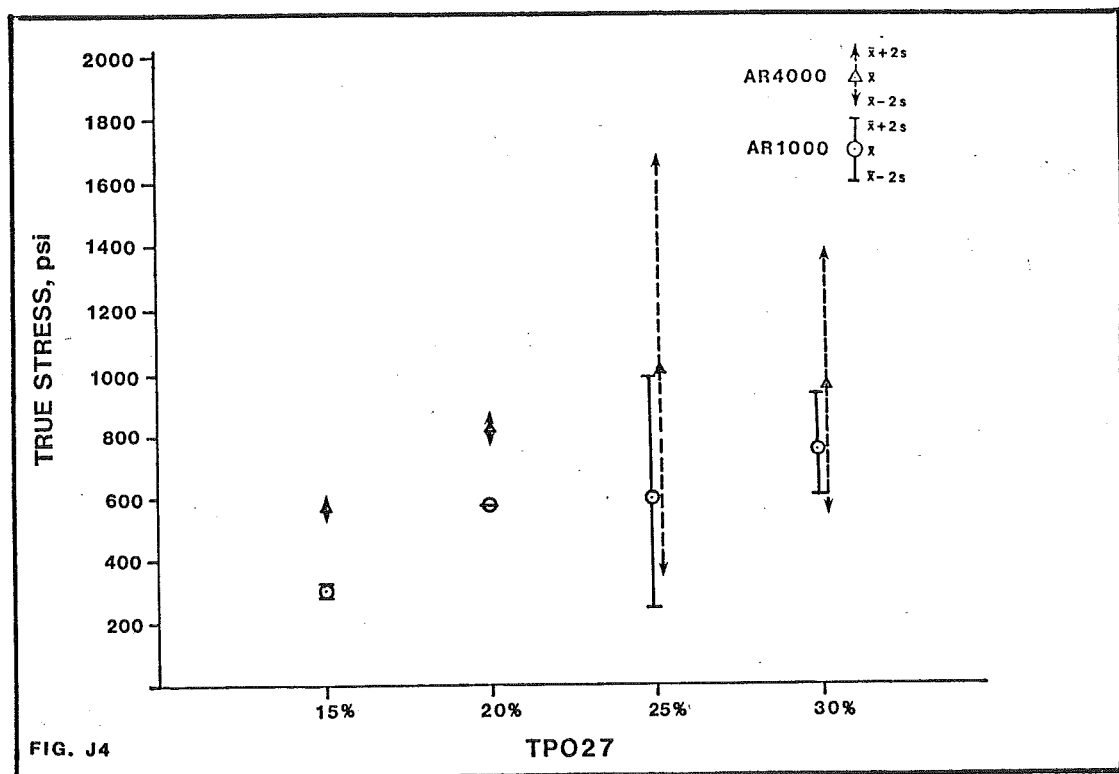
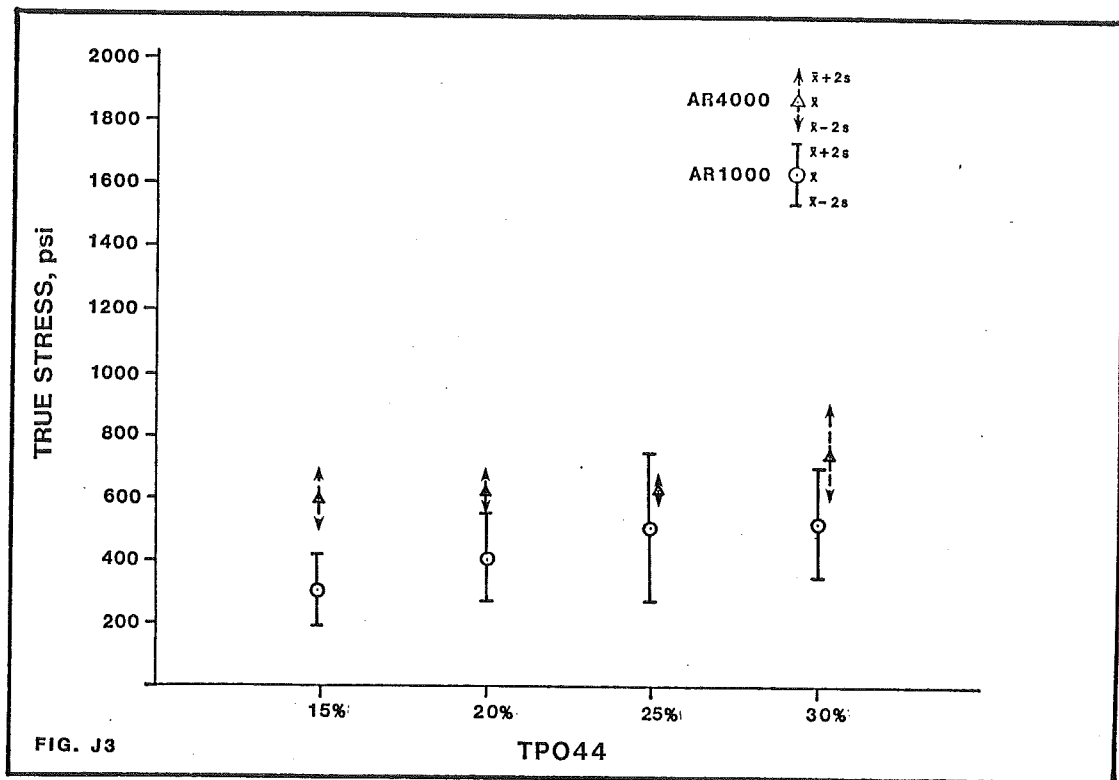
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	968.50	1002.37	630.77	674.19
	S	57.71	269.23	6.56	181.25
	CV	5.96	26.86	1.04	26.88
A R 1 0 0 0	$\bar{x}$	541.98	634.63	670.70	474.47
	S	40.67	167.63	143.12	92.44
	CV	7.50	26.41	21.34	19.88

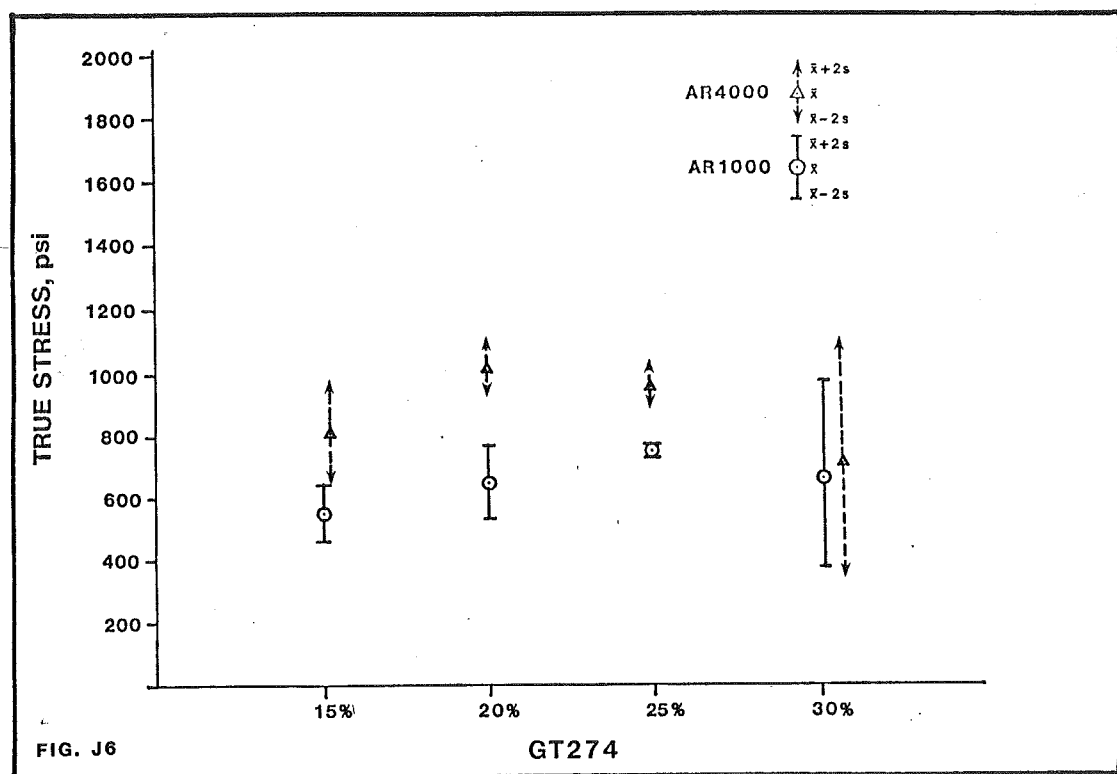
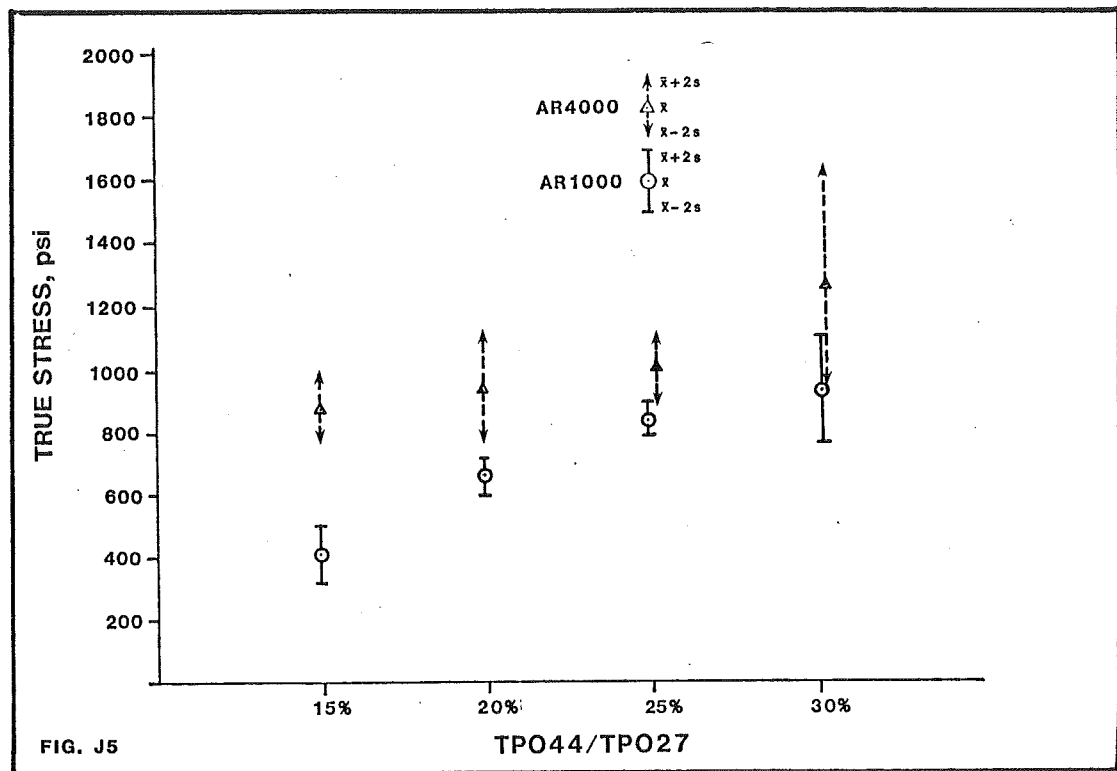
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (H)											
		TP044				TP047				50% TP044 & 50% TP047				Q1774				U.S. Rubber Fine				50% Q1774 & 50% U.S. Rubber Fine															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30				
SOLUBLE	600-200																																				
	600-200																																				
	600-200																																				
	600-200																																				

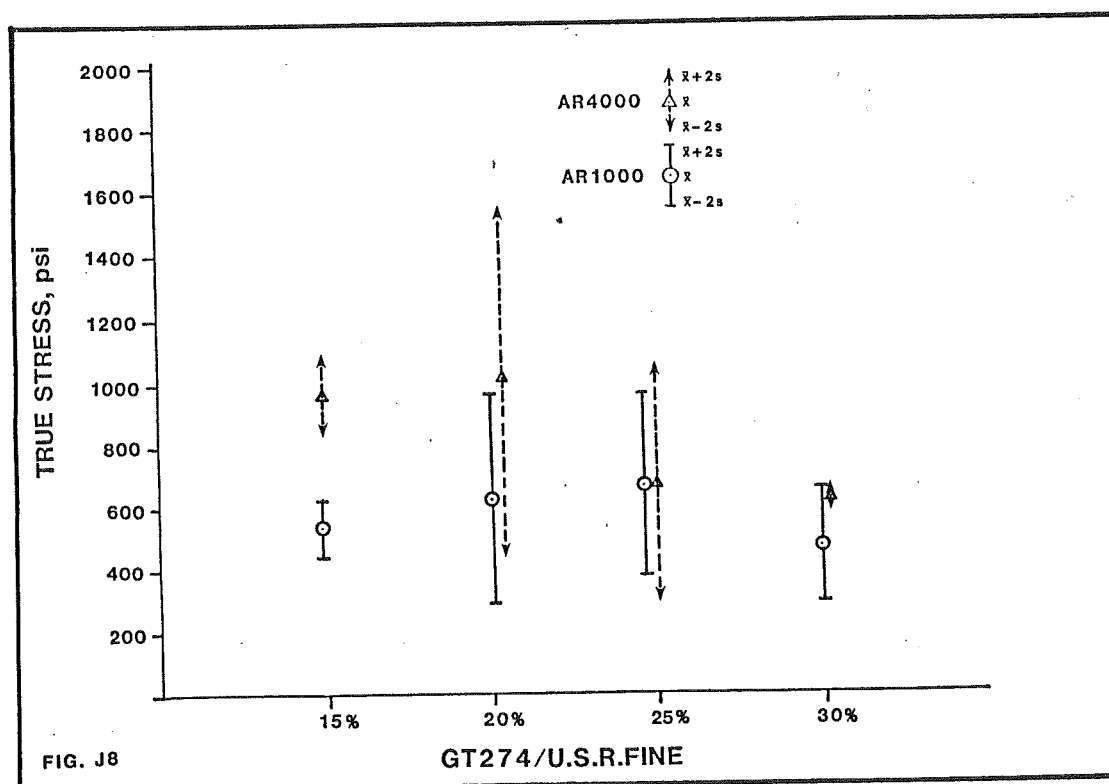
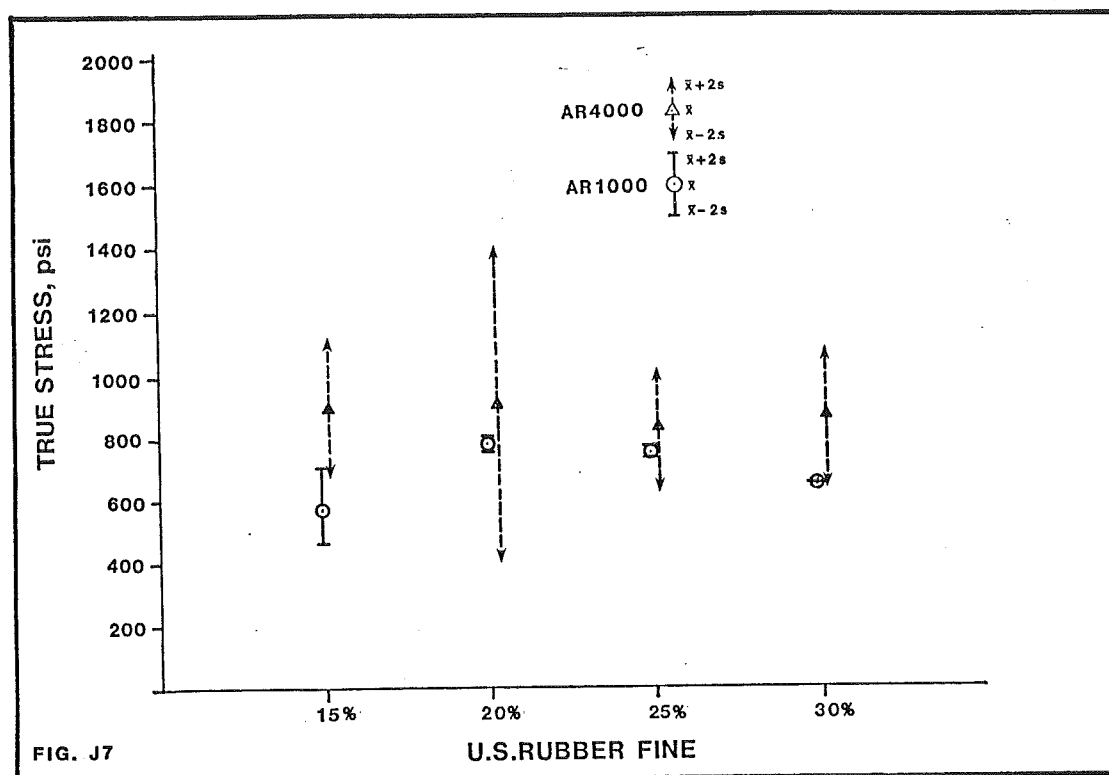
Table J-3 Anova Summary, True Stress at Failure

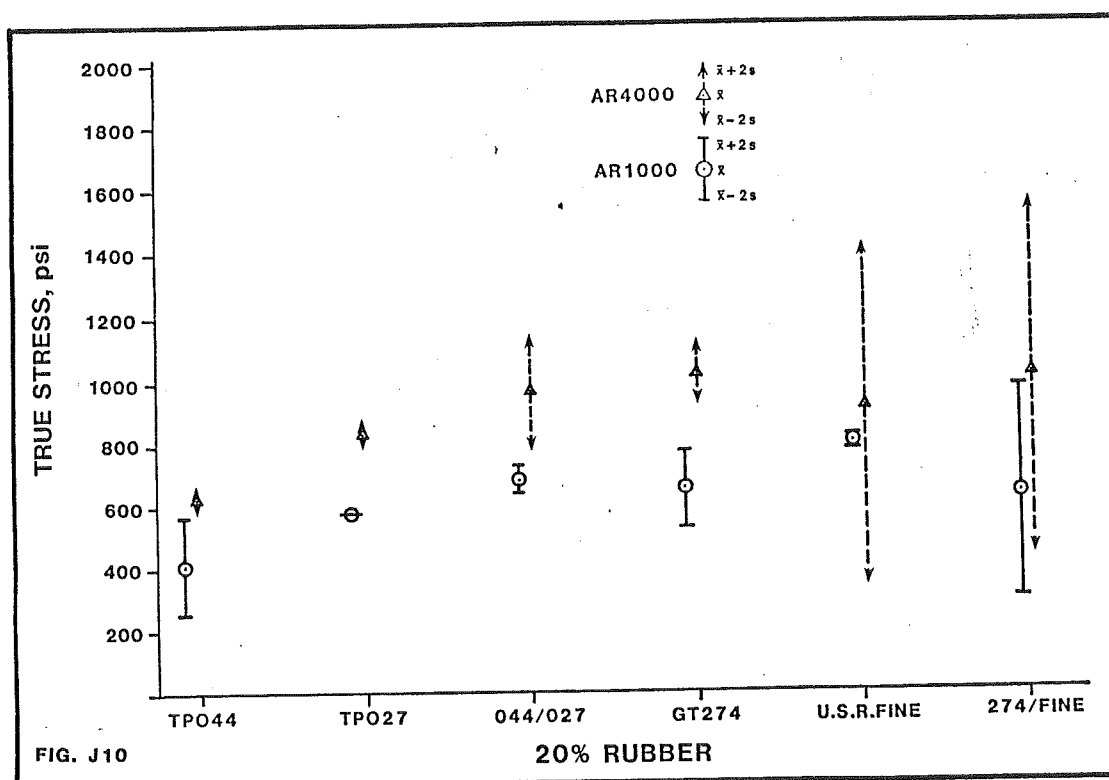
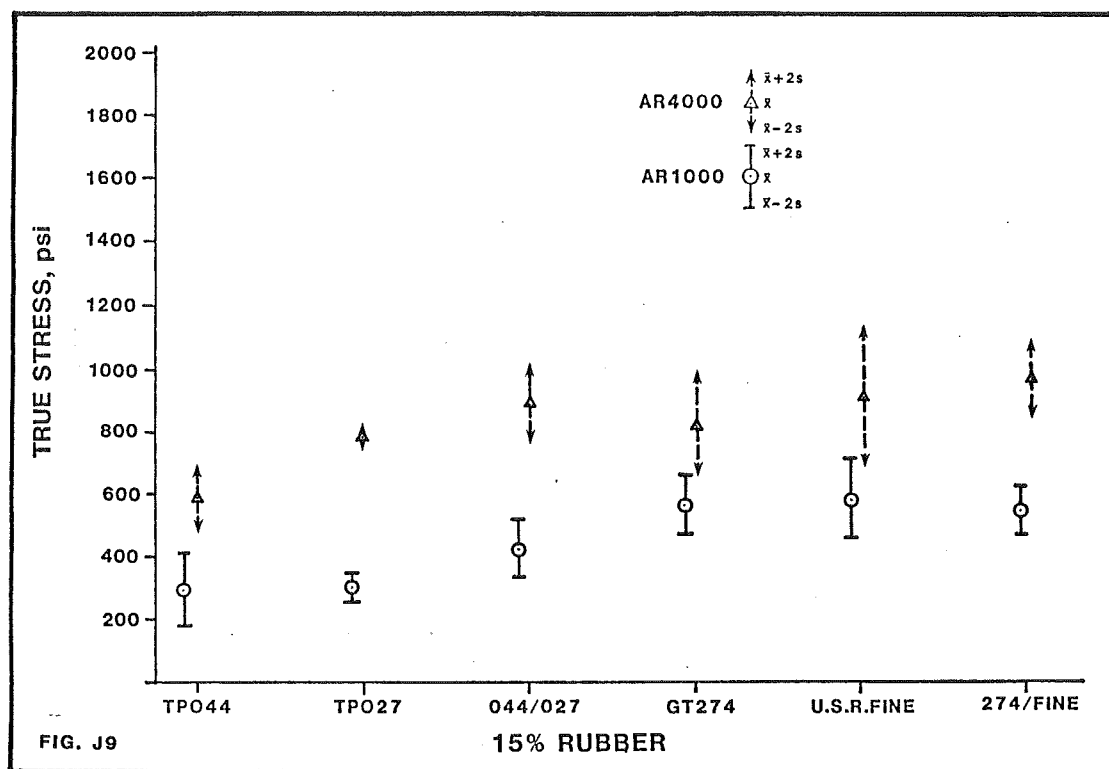
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	1052084.89	210416.97	25.56	2.43	3.48
Q	3	294503.39	98167.79	11.92	2.82	4.27
A	1	1422733.98	1422733.98	172.88	4.06	7.27
RQ	15	720135.22	48009.01	5.83	1.90	2.49
RA	5	84507.58	16901.51	2.05	2.43	3.48
QA	3	165411.20	55137.06	6.69	2.82	4.27
RQA	15	166789.92	11119.32	1.35	1.90	2.49
Error	48	395020.12	8229.58			
TOTAL	95	4301186.35				

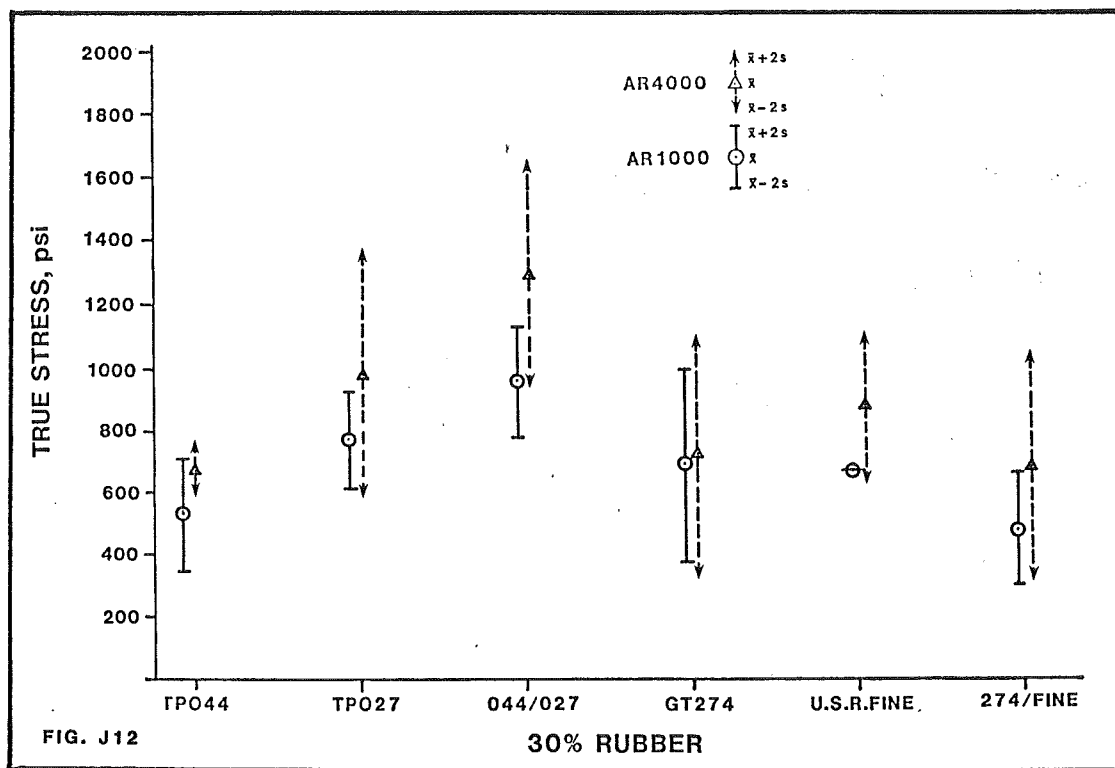
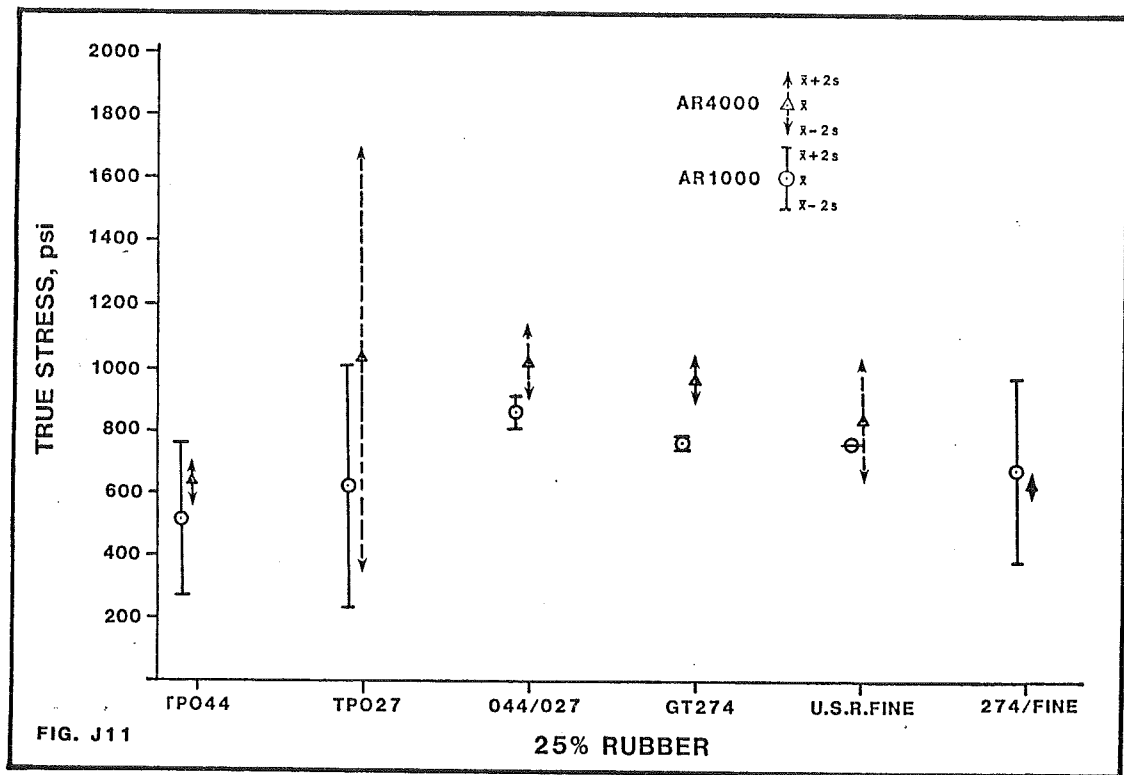












APPENDIX K
FORCE-DUCTILITY TRUE STRAIN
AT FAILURE AT 39.2F (4C)

Table K-1 True Strain at Failure, mm/mm

a. Measured Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	1.66	1.60	1.49	1.35
	1.62	1.58	1.59	1.44
	1.68	1.60	1.44	1.49
	1.60	1.57	1.51	1.21
	1.66	1.52	1.51	1.42
	1.68	1.59	1.51	1.55
A R 1 0 0 0	1.92	1.77	1.47	1.52
	2.00	1.69	1.53	1.51
	1.81	1.71	1.74	1.48
	1.87	1.79	1.50	1.45
	1.63	1.75	1.57	1.51
	1.74	1.68	1.47	1.48

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>1.65</u>	<u>1.58</u>	<u>1.51</u>	<u>1.41</u>
	S	<u>.033</u>	<u>.030</u>	<u>.048</u>	<u>.119</u>
	CV	1.99	1.91	3.20	8.43
A R 1 0 0 0	$\bar{x}$	<u>1.83</u>	<u>1.73</u>	<u>1.55</u>	<u>1.49</u>
	S	<u>.132</u>	<u>.045</u>	<u>.102</u>	<u>.026</u>
	CV	7.22	2.59	6.60	1.77

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (R)

	TP044			TP007			50% TP044 50% TP007			61376			U.S. Rubber Fms			50% 61376 50% Fms		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
15																		
20																		
30																		
40																		
50																		
60																		
70																		
80																		
90																		

Table K-1 True Strain at Failure, mm/mm

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	2.12	1.96	2.01	1.94
	2.09	1.95	1.91	1.98
	<u>2.07</u>	<u>1.94</u>	<u>1.85</u>	<u>2.05</u>
	2.09	1.95	1.95	1.90
	1.99	1.94	1.83	1.90
	2.06	1.97	1.72	1.88
A R 1 0 0 0	2.24	2.18	1.76	1.98
	2.33	2.26	1.84	2.00
	<u>2.32</u>	<u>2.29</u>	<u>1.96</u>	<u>1.95</u>
	2.27	2.12	1.90	1.90
	2.40	2.10	2.01	1.84
	2.33	2.18	2.02	2.07

b. Summary

		TP027			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>2.07</u>	<u>1.95</u>	<u>1.88</u>	<u>1.94</u>
	S	<u>.044</u>	<u>.012</u>	<u>.102</u>	<u>.064</u>
	CV	2.14	.60	5.41	3.30
A R 1 0 0 0	$\bar{x}$	<u>2.32</u>	<u>2.19</u>	<u>1.92</u>	<u>1.96</u>
	S	<u>.055</u>	<u>.075</u>	<u>.102</u>	<u>.080</u>
	CV	2.39	3.43	5.32	4.10

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (H)											
		TP044				TP027				50% TP044 & 50% TP027				GT074				U.S. Rubber Pave				50% GT074 & 50% U.S. Pave															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Condition																																					
Remarks																																					

Table K-1 True Strain at Failure, mm/mm

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	2.14	2.17	2.10	2.17
	2.12	2.13	2.05	2.16
	<u>2.18</u>	<u>2.12</u>	<u>2.09</u>	<u>2.15</u>
	2.20	2.11	2.09	2.16
	2.17	2.14	2.14	2.22
	2.16	2.22	2.05	2.10
A R 1 0 0 0	2.29	2.34	2.27	2.15
	2.46	2.39	2.23	2.22
	<u>2.42</u>	<u>2.33</u>	<u>2.22</u>	<u>2.23</u>
	2.22	2.22	2.20	2.21
	2.36	2.24	2.18	2.22
	2.35	2.31	2.19	2.15

b. Summary

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>2.16</u>	<u>2.15</u>	<u>2.09</u>	<u>2.16</u>
	S	<u>.029</u>	<u>.034</u>	<u>.034</u>	<u>.039</u>
	CV	1.32	1.58	1.62	1.78
A R 1 0 0 0	$\bar{x}$	<u>2.35</u>	<u>2.31</u>	<u>2.22</u>	<u>2.20</u>
	S	<u>.087</u>	<u>.064</u>	<u>.033</u>	<u>.037</u>
	CV	3.69	2.78	1.48	1.67

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP057				50% TP044 50% TP057				DT174				U.S. Rubber Flu				50% DT174 50% U.S. Flu															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				
	2000																																				
S	1000																																				

Table K-1 True Strain at Failure, mm/mm

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	1.87	2.03	2.24	1.90
	1.94	2.04	2.13	2.02
	<u>2.10</u>	<u>2.00</u>	<u>2.14</u>	<u>1.97</u>
	2.08	1.84	2.14	2.11
	2.02	1.92	2.17	2.02
	2.07	1.96	2.15	2.07
A R 1 0 0 0	2.18	2.15	2.03	2.13
	2.19	2.16	2.01	2.05
	<u>2.18</u>	<u>2.14</u>	<u>1.95</u>	<u>2.04</u>
	2.16	2.10	2.06	2.11
	2.11	2.09	2.03	2.20
	2.17	2.16	2.05	2.21

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>2.01</u>	<u>1.96</u>	<u>2.16</u>	<u>2.02</u>
	S	<u>.091</u>	<u>.086</u>	<u>.041</u>	<u>.074</u>
	CV	4.51	4.39	1.88	3.67
A R 1 0 0 0	$\bar{x}$	<u>2.17</u>	<u>2.13</u>	<u>2.03</u>	<u>2.12</u>
	S	<u>.029</u>	<u>.031</u>	<u>.032</u>	<u>.072</u>
	CV	1.33	1.44	1.59	3.39

— ASPHALT TYPE (A)
 — PERCENT RUBBER (B)
 — RUBBER TYPE (R)

	TP004				TP007				50% TP004 & 50% TP007				OT074				U.S. Rubber Fine				50% OT074 & 50% U.S. Rubber Fine			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Asphalt																								
Rubber																								

Table K-1 True Strain at Failure, mm/mm

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	2.09	2.08	2.08	1.78
	2.17	2.08	1.97	1.86
	2.08	2.03	1.93	2.09
	2.17	1.91	1.81	1.99
	2.03	2.03	2.04	1.89
	2.20	1.98	1.93	1.92
A R 1 0 0 0	2.29	2.13	2.12	1.96
	2.32	2.22	2.19	1.82
	2.36	1.97	2.16	2.04
	2.66	2.28	1.96	1.95
	2.48	2.25	1.92	1.73
	2.62	2.10	2.09	1.80

b. Summary

50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	<u>2.12</u>	<u>2.02</u>	<u>1.96</u>	<u>1.92</u>
	S	<u>.066</u>	<u>.065</u>	<u>.095</u>	<u>.108</u>
	CV	3.12	3.21	4.85	5.60
A R 1 0 0 0	$\bar{X}$	<u>2.46</u>	<u>2.16</u>	<u>2.07</u>	<u>1.88</u>
	S	<u>.158</u>	<u>.116</u>	<u>.110</u>	<u>.118</u>
	CV	6.42	5.35	5.28	6.25

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP644				TP607				50% TP644 50% TP607			
		15	20	25	30	15	20	25	30	15	20	25	30
Sample	TP644												
	TP607												
Sample	50% TP644 50% TP607												
	U.S. Rubber Fine												
Sample	50% GT274 50% U.S. Rubber Fine												

Table K-2 True Strain at Failure, mm/mm

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	1.653	1.593	1.507	1.427
	1.647	1.560	1.510	1.393
A R 1 0 0 0	1.910	1.723	1.580	1.580
	1.747	1.740	1.513	1.480

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	1.65	1.58	1.51	1.41
	s	.06532	.0292	.00266	.0301
	cv	0.32	1.84	0.18	2.13
A R 1 0 0 0	$\bar{x}$	1.83	1.73	1.55	1.49
	s	0.14	.0151	.0594	.0204
	cv	7.65	0.87	3.83	1.37

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP047			SON TP044 & SON TP047			GT076			U.S. Rubber Firm			SON GT076		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
Asphalt																		
Rubber																		

Table K-2 True Strain at Failure, mm/mm

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	2.093	1.950	1.923	1.990
	2.047	.1953	.1833	1.893
A R 1 0 0 0	2.297	2.243	1.853	1.977
	2.333	2.133	1.977	1.937

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	2.07	1.95	1.88	1.94
	S	.0408	.0266	.0797	.0859
	CV	1.97	1.36	4.24	4.43
A R 1 0 0 0	$\bar{x}$	2.32	2.19	1.92	1.96
	S	.0319	.0975	0.11	.0354
	CV	1.38	4.45	5.73	1.81

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)												
		TP044				TP027				50% TP044 50% TP027				GT274				U.S. Rubber Fms				50% GT274 50% U.S. Fms																
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	
SECTIONS	1																																					
	2																																					
6040-150	3																																					
	4																																					
5	5																																					
	6																																					
6	7																																					
	8																																					
7	9																																					
	10																																					
8	11																																					
	12																																					
9	13																																					
	14																																					
10	15																																					
	16																																					
11	17																																					
	18																																					
12	19																																					
	20																																					
13	21																																					
	22																																					
14	23																																					
	24																																					
15	25																																					
	26																																					
16	27																																					
	28																																					
17	29																																					
	30																																					
18	31																																					
	32																																					
19	33																																					
	34																																					
20	35																																					
	36																																					
21	37																																					
	38																																					
22	39																																					
	40																																					
23	41																																					
	42																																					
24	43																																					
	44																																					
25	45																																					
	46																																					
26	47																																					
	48																																					
27	49																																					
	50																																					
28	51																																					
	52																																					
29	53																																					
	54																																					
30	55																																					
	56																																					
31	57																																					
	58																																					
32	59																																					
	60																																					
33	61																																					
	62																																					
34	63																																					
	64																																					
35	65																																					
	66																																					
36	67																																					
	68																																					
37	69																																					
	70																																					
38	71																																					
	72																																					
39	73																																					

Table K-2 True Strain at Failure, mm/mm

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	1.790	1.717	1.657	1.680
	1.800	1.757	1.623	1.723
A R 1 0 0 0	1.947	1.933	1.787	1.683
	1.937	1.917	1.777	1.560

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	1.80	1.74	1.64	1.70
	S	.00886	.0354	.0301	.0381
	CV	0.49	2.03	1.84	2.24
A R 1 0 0 0	$\bar{x}$	1.94	1.93	1.78	1.62
	S	.00886	.0142	.00886	0.11
	CV	0.46	0.74	0.50	6.79

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044				TP027				50% TP044 50% TP027				G1876				U.S. Rubber Pave				50% G1876 50% Rubber P			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
1000-100																								
1000-200																								
1000-300																								
1000-400																								
1000-500																								
1000-600																								
1000-700																								
1000-800																								
1000-900																								
1000-1000																								

Table K-2 True Strain at Failure, mm/mm

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	2.147	2.140	2.080	2.160
	2.177	2.157	2.093	2.160
A R 1 0 0 0	2.390	2.353	2.240	2.200
	2.310	2.257	2.190	2.193

b. Summary

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>2.16</u>	<u>2.15</u>	<u>2.09</u>	<u>2.16</u>
	S	<u>.0266</u>	<u>.0151</u>	<u>.0115</u>	<u>0</u>
	CV	1.23	0.70	0.55	0
A R 1 0 0 0	$\bar{x}$	<u>2.35</u>	<u>2.31</u>	<u>2.22</u>	<u>2.20</u>
	S	<u>.0709</u>	<u>.0851</u>	<u>.0443</u>	<u>.00620</u>
	CV	3.02	3.68	2.00	0.28

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP067				50% TP044 50% TP067				Q1314				U.S. Rubber Plant				50% Q1314 50% U.S. Plant															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
RUBBER TYPE	BR-1																																				
	BR-2																																				

Table K-2 True Strain at Failure, mm/mm

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	1.970	2.023	2.170	1.963
	2.057	1.897	2.153	2.067
A R 1 0 0 0	2.183	2.150	1.997	2.073
	2.147	2.117	2.047	2.173

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	2.01	1.96	2.16	2.02
	s	.0771	0.11	.0151	.0921
	cv	0.35	5.61	0.70	4.56
A R 1 0 0 0	$\bar{x}$	2.17	2.13	2.02	2.12
	s	.0319	.0292	.0443	.0886
	cv	1.47	1.37	2.19	4.18

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP046				TP027				SOS TP027 & SOS TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
SOS TP027 & SOS TP027	15												
	20												
U.S. Rubber Fine	15												
	20												
SOS TP027 & SOS TP027	15												
	20												

Table K-2 True Strain at Failure, mm/mm

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	2.113	2.063	1.993	1.910
	2.133	1.973	1.927	1.933
A R 1 0 0 0	2.323	2.107	2.157	1.940
	2.587	2.210	1.990	1.827

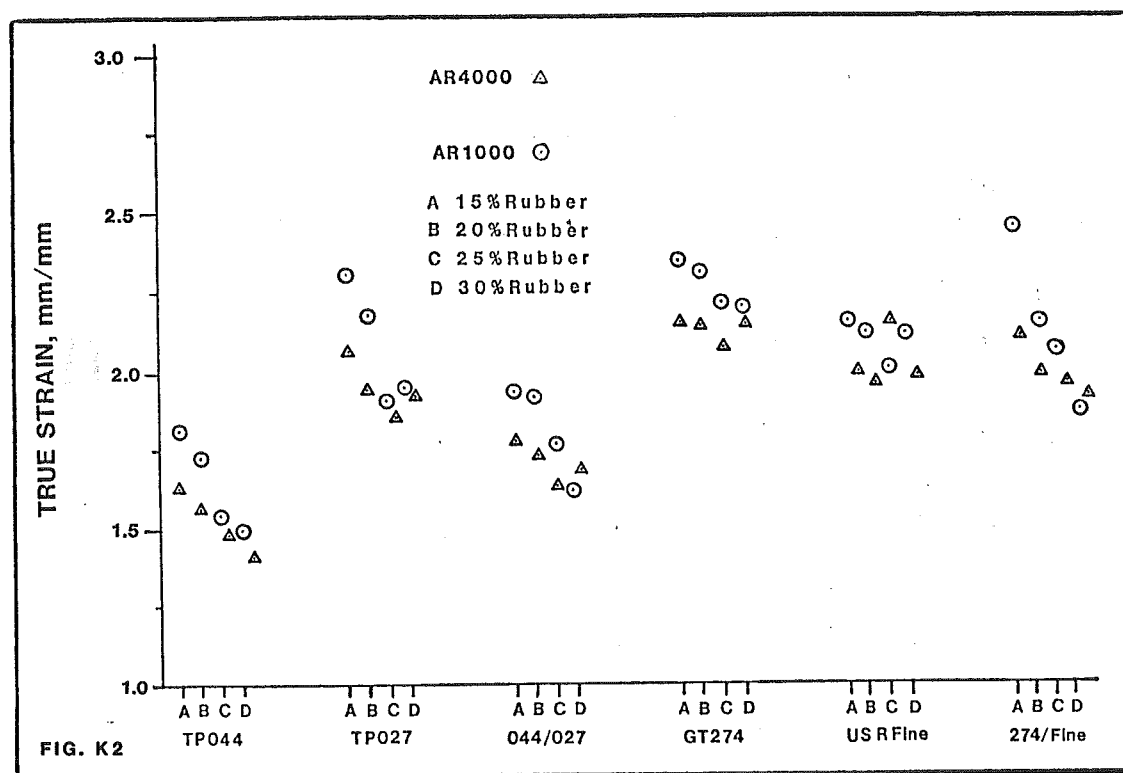
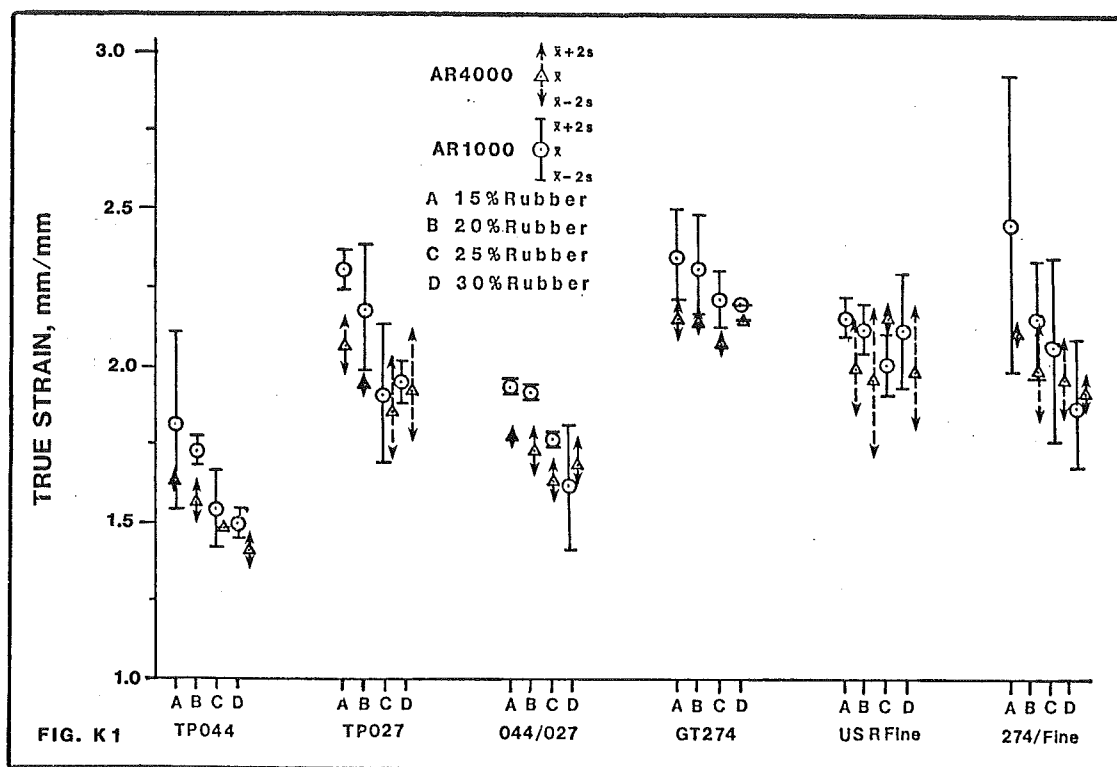
b. Summary

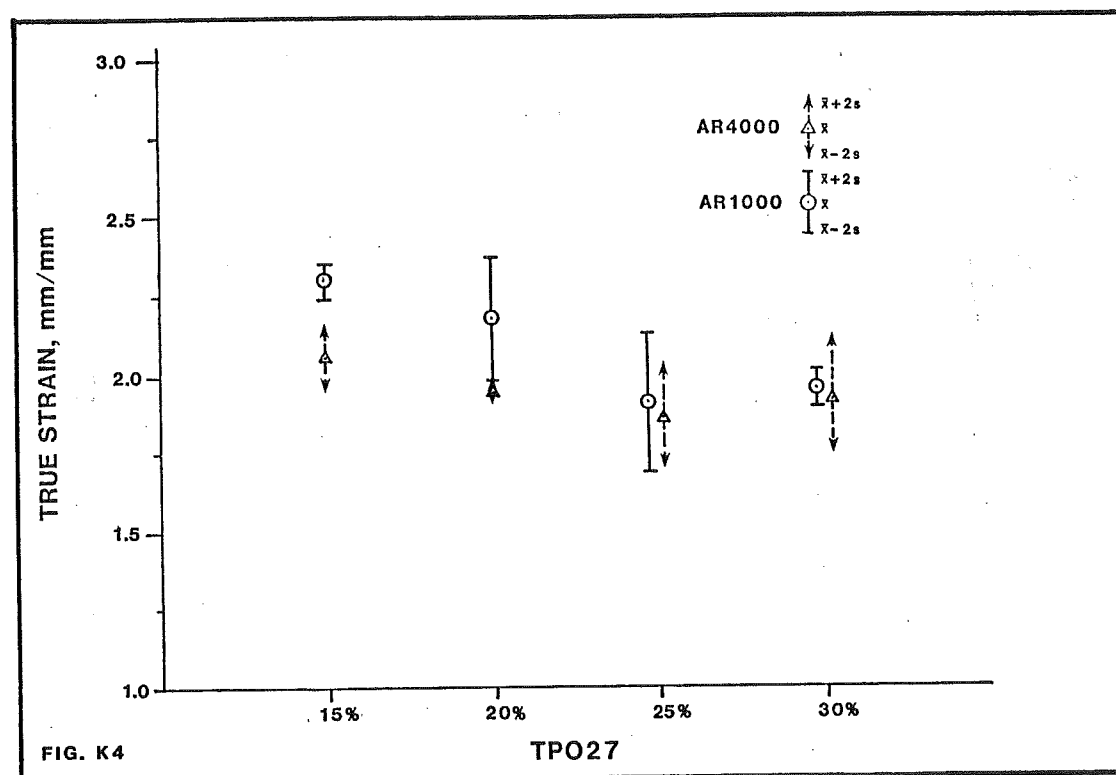
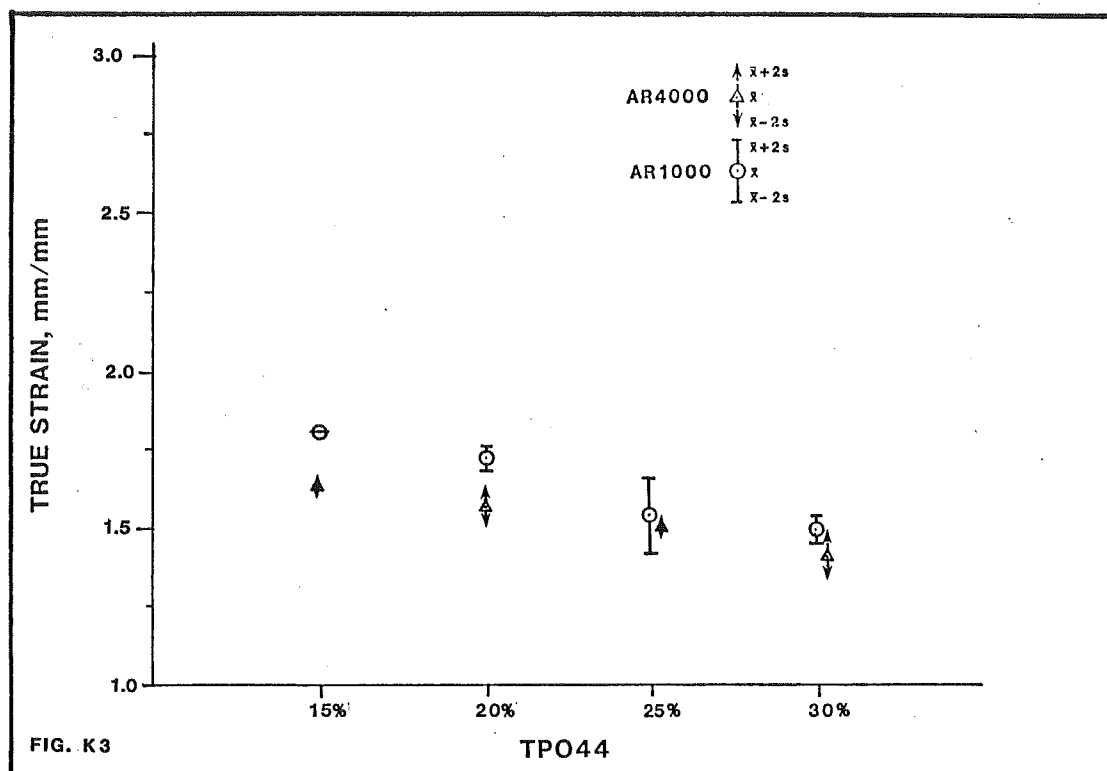
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	2.12	2.02	1.96	1.92
	S	.0177	.0797	.0585	.0204
	CV	0.83	3.95	2.98	1.06
A R 1 0 0 0	$\bar{x}$	2.46	2.16	2.07	1.88
	S	0.23	.0913	0.15	0.10
	CV	9.35	4.23	7.25	5.32

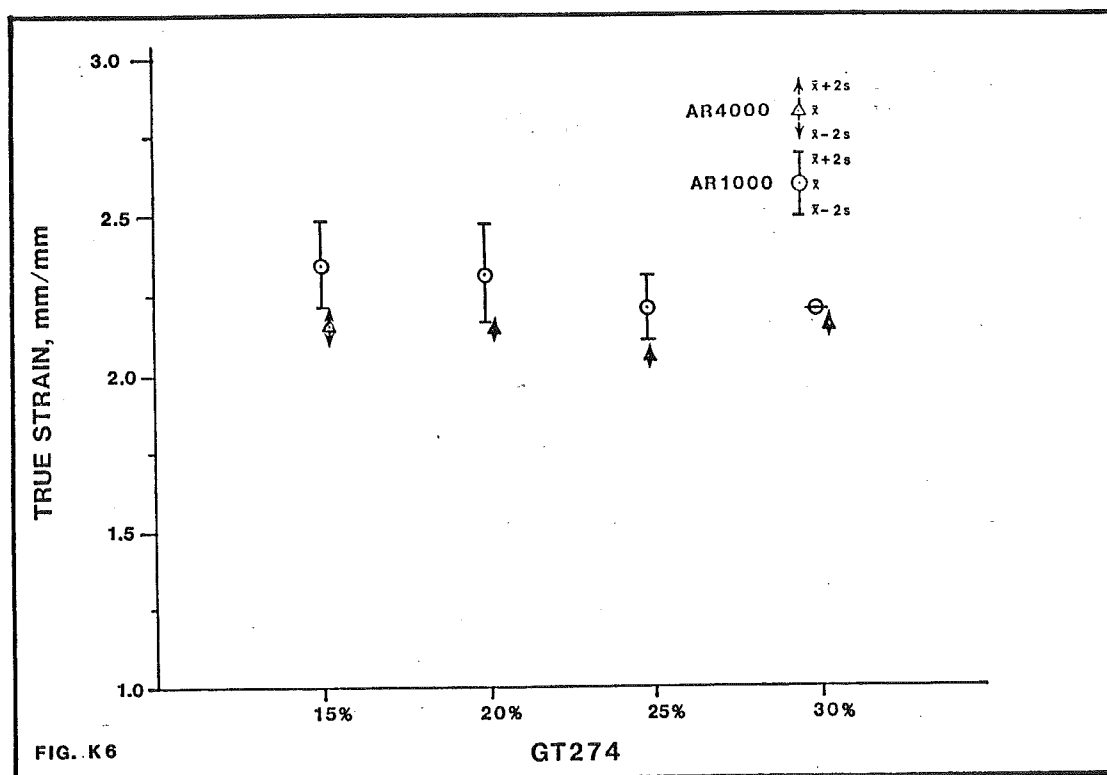
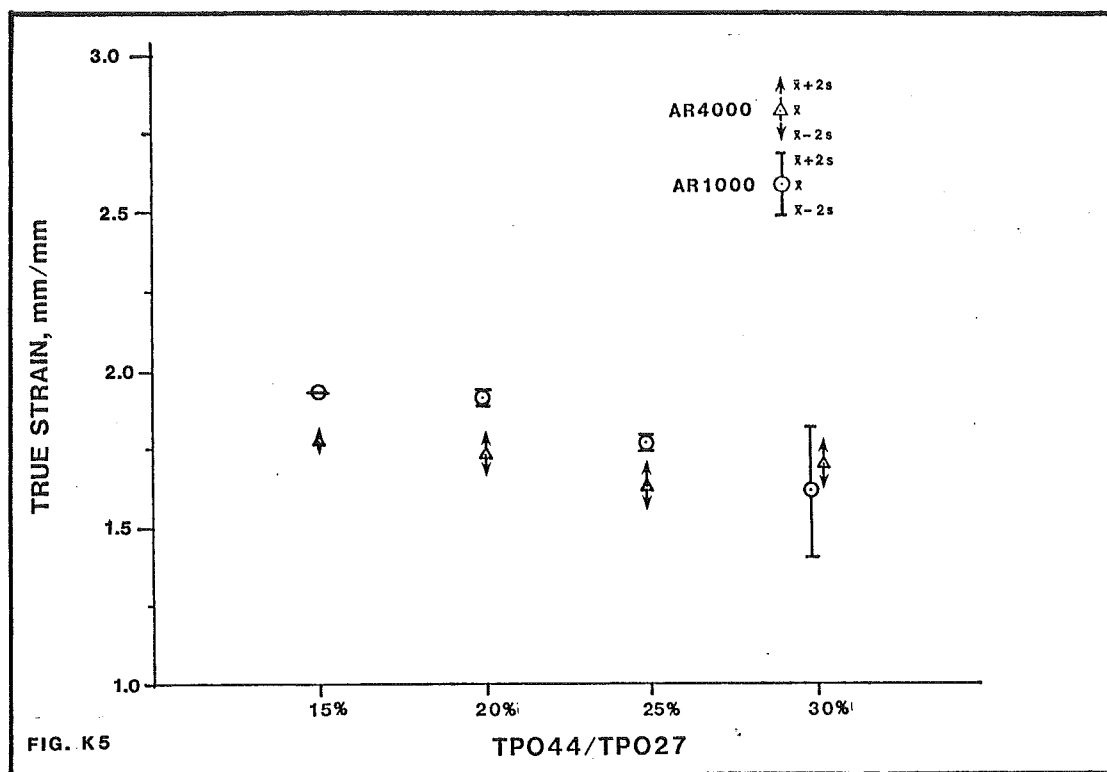
		ASPHALT TYPE (A)			PERCENT RUBBER (B)			RUBBER TYPE (C)		
RUBBER TYPE (C)	PERCENT RUBBER (B)	TPD44			TPD07			SOS TPO44 & SOS TPO17		
		15	20	25	15	20	25	15	20	25
TPD44	15	---	---	---	---	---	---	---	---	---
TPD44	20	---	---	---	---	---	---	---	---	---
TPD44	25	---	---	---	---	---	---	---	---	---
TPD07	15	---	---	---	---	---	---	---	---	---
TPD07	20	---	---	---	---	---	---	---	---	---
TPD07	25	---	---	---	---	---	---	---	---	---
SOS TPO44 & SOS TPO17	15	---	---	---	---	---	---	---	---	---
SOS TPO44 & SOS TPO17	20	---	---	---	---	---	---	---	---	---
SOS TPO44 & SOS TPO17	25	---	---	---	---	---	---	---	---	---
U.S. Rubber Fine	15	---	---	---	---	---	---	---	---	---
U.S. Rubber Fine	20	---	---	---	---	---	---	---	---	---
U.S. Rubber Fine	25	---	---	---	---	---	---	---	---	---
SOS GT274 & SOS GT274	15	---	---	---	---	---	---	---	---	---
SOS GT274 & SOS GT274	20	---	---	---	---	---	---	---	---	---
SOS GT274 & SOS GT274	25	---	---	---	---	---	---	---	---	---

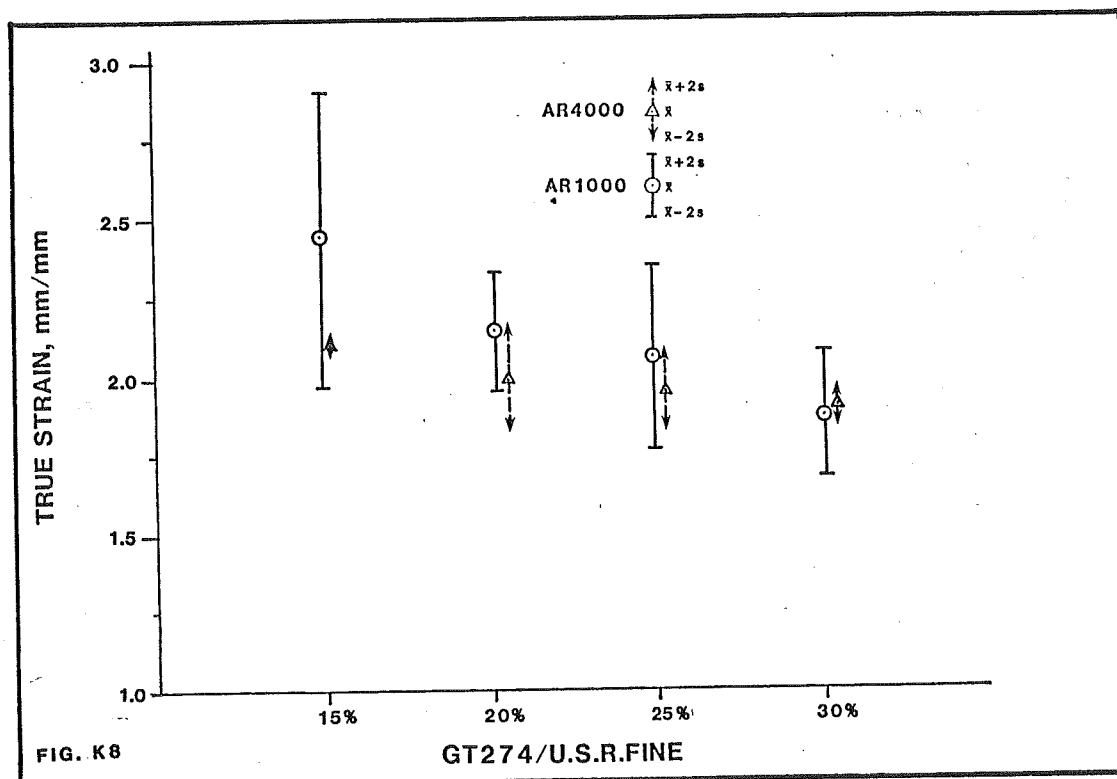
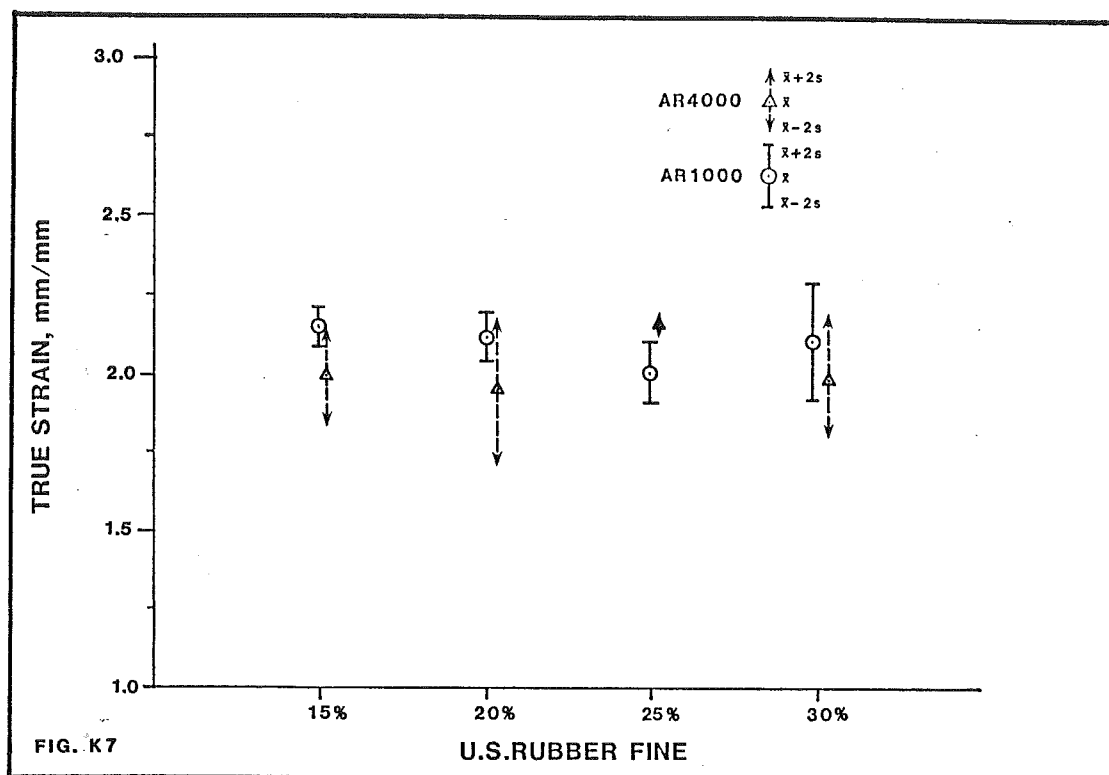
Table K-3 Anova Summary, True Strain at Failure

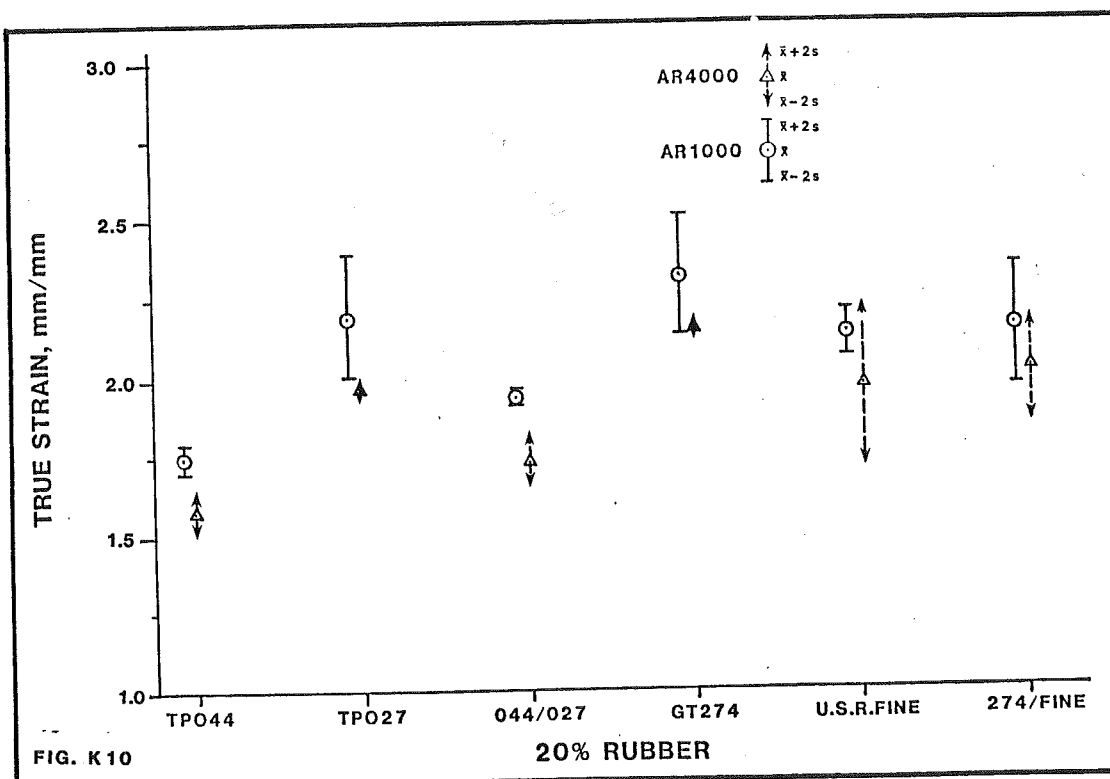
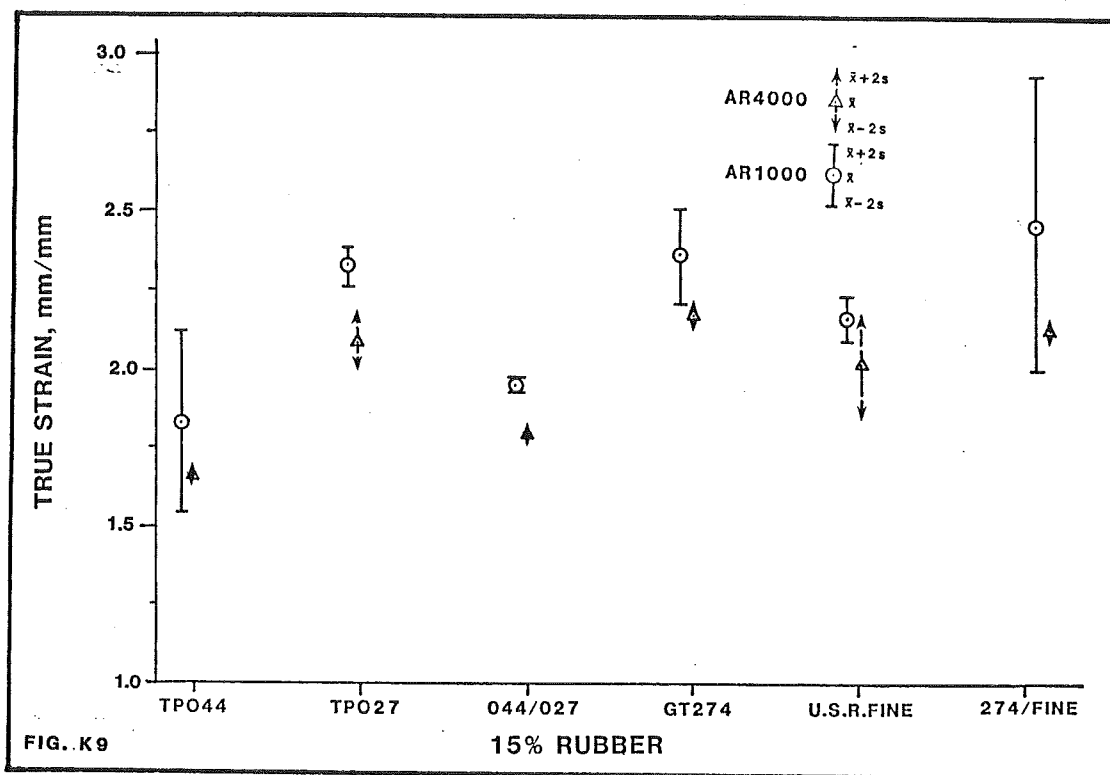
<u>ANOVA</u>						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	4.1782891	.835657820	260.66	2.43	3.48
Q	3	.6083994	.202799800	63.25	2.82	4.27
A	1	.3116760	.3116760	97.21	4.06	7.27
RQ	15	.2625505	.017503367	5.45	1.90	2.49
RA	5	.0118266	.002365320	0.73	2.43	3.48
QA	3	.1487234	.049574467	15.46	2.82	4.27
RQA	15	.0989810	.006598733	2.05	1.90	2.49
Error	48	.1538840	.03205917			
TOTAL	95	5.7743300				

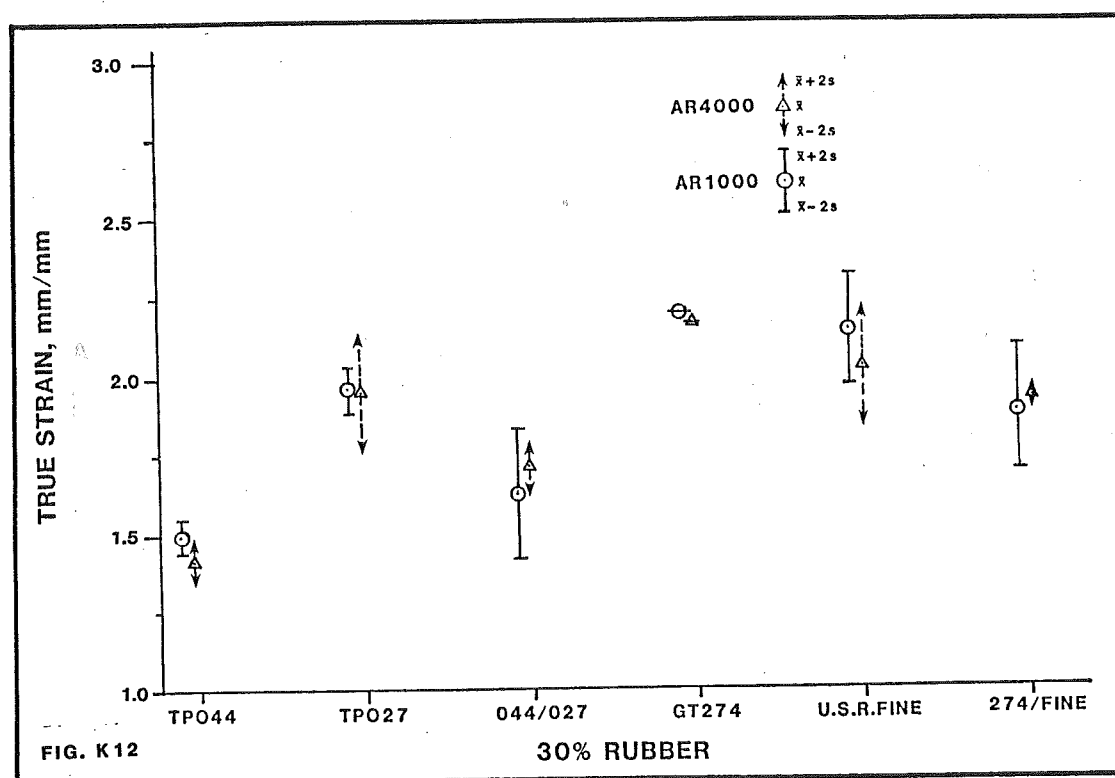
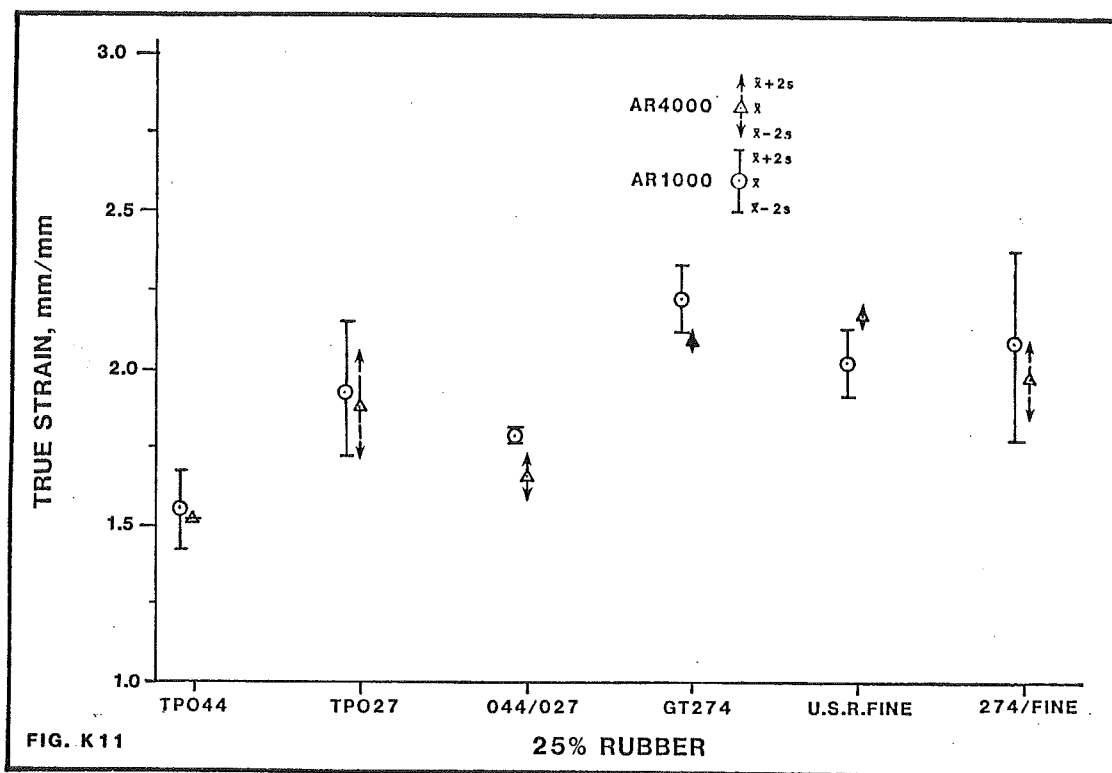












APPENDIX L
FORCE-DUCTILITY ENGINEERING
CREEP COMPLIANCE AT 39.2F (4C)

Table L-1 Engineering Creep Compliance
at Failure, psi^{-1}

a. Measured Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	.0345	.0274	.0231	.0199
	.0345	.0286	.0266	.0203
	<u>.0379</u>	<u>.0336</u>	<u>.0244</u>	<u>.0213</u>
	.0411	.0282	.0245	.0152
	.0364	.0273	.0254	.0179
	<u>.0335</u>	<u>.0313</u>	<u>.0300</u>	<u>.0214</u>
A R 1 0 0 0	.111	.0840	.0312	.0256
	.143	.0534	.0310	.0273
	<u>.106</u>	<u>.0717</u>	<u>.0371</u>	<u>.0306</u>
	.145	.0576	.0346	.0279
	.0811	.0596	.0373	.0329
	<u>.0933</u>	<u>.0579</u>	<u>.0377</u>	<u>.0329</u>

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.0363</u>	<u>.0294</u>	<u>.0257</u>	<u>.0193</u>
	S	<u>.00283</u>	<u>.00252</u>	<u>.00242</u>	<u>.00239</u>
	CV	7.78	8.57	9.43	12.36
A R 1 0 0 0	$\bar{x}$	<u>.1132</u>	<u>.0641</u>	<u>.0348</u>	<u>.0295</u>
	S	<u>.0260</u>	<u>.01171</u>	<u>.00308</u>	<u>.00306</u>
	CV	22.98	18.26	8.84	10.37

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP047				80% TP044 20% TP047				G1576				U.S. Rubber Firm				80% G1576 20% U.S. Firm															
RESEARCHER	TEST NO.	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4								

Table L-1 Engineering Creep Compliance
at Failure, psi^{-1}

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.0764	.0518	.0363	.0408
	.0714	.0511	.0369	.0432
	<u>.0752</u>	<u>.0555</u>	<u>.0276</u>	<u>.0450</u>
	.0528	.0495	.0434	.0418
	.0628	.0497	.0386	.0454
	.1000	.0524	.0377	.0447
A R 1 0 0 0	.282	.12098	.0581	.0540
	.398	.14397	.0674	.0587
	<u>.322</u>	<u>.153</u>	<u>.0784</u>	<u>.0547</u>
	.283	.1070	.0445	.0550
	.330	.0993	.0772	.0510
	.330	.1240	.0758	.0687

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.0731</u>	<u>.0517</u>	<u>.0368</u>	<u>.0435</u>
	S	<u>.0159</u>	<u>.00220</u>	<u>.00515</u>	<u>.00187</u>
	CV	21.72	4.25	14.01	4.31
A R 1 0 0 0	$\bar{x}$	<u>.3075</u>	<u>.1247</u>	<u>.0661</u>	<u>.0570</u>
	S	<u>.02264</u>	<u>.02071</u>	<u>.01277</u>	<u>.00623</u>
	CV	7.36	16.61	19.32	10.93

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				60% TP044 40% TP027				01276				U.S. Rubber #100				60% 01276 40% #100															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
ASPHALT TYPE (A)	TP044																																				
	TP027																																				
	60% TP044 40% TP027																																				
	01276																																				
PERCENT RUBBER (B)	U.S. Rubber #100																																				
	60% 01276 40% #100																																				
RUBBER TYPE (C)																																					

Table L-1 Engineering Creep Compliance
at Failure, psi^{-1}

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.0329	.0255	.0224	.0202
	.0313	.0246	.0219	.0196
	<u>.0339</u>	<u>.0264</u>	<u>.0241</u>	<u>.0198</u>
	.0341	.0326	.0201	.0198
	.0365	.0322	.0189	.0187
	.0373	.0274	.0215	.0174
A R 1 0 0 0	.0982	.0654	.0344	.0224
	.0821	.0617	.0368	.0240
	<u>.105</u>	<u>.0577</u>	<u>.0360</u>	<u>.0249</u>
	.0959	.0551	.0350	.0209
	.100	.0600	.0318	.0207
	.117	.0547	.0347	.0190

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	X	<u>.0343</u>	<u>.0281</u>	<u>.0215</u>	<u>.0193</u>
	S	<u>.00223</u>	<u>.00345</u>	<u>.00182</u>	<u>.00103</u>
	CV	6.51	12.26	8.49	5.38
A R 1 0 0 0	X	<u>.0997</u>	<u>.0591</u>	<u>.0348</u>	<u>.0220</u>
	S	<u>.01144</u>	<u>.004113</u>	<u>.00171</u>	<u>.00221</u>
	CV	11.47	6.96	4.92	10.06

ASPHALT TYPE (A)
PERCENT RUBBER (C)
RUBBER TYPE (B)

	TP044				TP027				50% TP044 & 50% TP027				Q1974				U.S. Rubber Firm				50% Q1974			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Creep																								
Compliance																								

a. Measured Data

b. Summary

[illegible]

Table L-1 Engineering Creep Compliance
at Failure, psi^{-1}

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.0487	.0496	.0968	.0510
	.0520	.0489	.0850	.0595
	<u>.0589</u>	<u>.0445</u>	<u>.0818</u>	<u>.0543</u>
	.0572	.0492	.0715	.0630
	.0543	.0536	.0767	.0562
	.0559	.0479	.0756	.0588
A R 1 0 0 0	.115	.0829	.0569	.0897
	.112	.0850	.0684	.0774
	<u>.110</u>	<u>.0788</u>	<u>.0613</u>	<u>.0858</u>
	.118	.0755	.0688	.0939
	.111	.0745	.0688	.105
	.120	.0793	.0709	.114

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.05450</u>	<u>.04895</u>	<u>.0813</u>	<u>.0571</u>
	S	<u>.00370</u>	<u>.00293</u>	<u>.00903</u>	<u>.00423</u>
	CV	6.79	5.99	11.10	7.40
A R 1 0 0 0	$\bar{x}$	<u>.1143</u>	<u>.0793</u>	<u>.0659</u>	<u>.0943</u>
	S	<u>.00403</u>	<u>.00408</u>	<u>.00548</u>	<u>.01328</u>
	CV	3.53	5.14	8.32	14.08

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP046				TP027				50% TP046 50% TP027				BT274				U.S. Rubber Fine				50% BT274 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Creep Time	1000																																				
	2000																																				
	3000																																				
	4000																																				
Shrinkage	1000																																				
	2000																																				
	3000																																				
	4000																																				

Table L-1 Engineering Creep Compliance
at Failure, psi^{-1}

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.0601	.0451	.0907	.0646
	.0710	.0475	.0660	.0644
	<u>.0637</u>	<u>.0483</u>	<u>.0671</u>	<u>.0801</u>
	.0673	.0488	.0594	.0532
	.0527	.0537	.0693	.0498
	.0690	.0551	.0668	.0562
A R 1 0 0 0	.156	.109	.0820	.0803
	.166	.131	.0949	.0681
	<u>.177</u>	<u>.0938</u>	<u>.0868</u>	<u>.0900</u>
	.346	.110	.0768	.0775
	.271	.108	.0713	.0680
	.332	.0874	.0890	.0892

b. Summary

		50% GT274 & 50% U. S. RUBBER FINE			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.0640</u>	<u>.0498</u>	<u>.0699</u>	<u>.0614</u>
	S	<u>.00675</u>	<u>.00384</u>	<u>.01073</u>	<u>.01093</u>
	CV	10.55	7.73	15.36	17.81
A R 1 0 0 0	$\bar{x}$	<u>.2413</u>	<u>.1065</u>	<u>.0835</u>	<u>.0789</u>
	S	<u>.08620</u>	<u>.01515</u>	<u>.00857</u>	<u>.00968</u>
	CV	35.72	14.22	10.27	12.28

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (B)														
RUBBER TYPE (A)	PERCENT RUBBER (B)	TP044				TP047				50% TP044 & 50% TP047				GT 274				U.S. Rubber Fine				50% GT 274 & 50% U.S. Rubber Fine				50% GT 274 & 50% U.S. Rubber Fine				50% GT 274 & 50% U.S. Rubber Fine				50% GT 274 & 50% U.S. Rubber Fine						
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30			
TP044	15																																							
TP044	20																																							
TP044	25																																							
TP044	30																																							
TP047	15																																							
TP047	20																																							
TP047	25																																							
TP047	30																																							
50% TP044 & 50% TP047	15																																							
50% TP044 & 50% TP047	20																																							
50% TP044 & 50% TP047	25																																							
50% TP044 & 50% TP047	30																																							
GT 274	15																																							
GT 274	20																																							
GT 274	25																																							
GT 274	30																																							
U.S. Rubber Fine	15																																							
U.S. Rubber Fine	20																																							
U.S. Rubber Fine	25																																							
U.S. Rubber Fine	30																																							
50% GT 274 & 50% U.S. Rubber Fine	15																																							
50% GT 274 & 50% U.S. Rubber Fine	20																																							
50% GT 274 & 50% U.S. Rubber Fine	25																																							
50% GT 274 & 50% U.S. Rubber Fine	30																																							

Table L-2 Engineering Creep Compliance
at Failure, psi^{-1}

a. Reduced Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	.03563	.02987	.02470	.02050
	.03700	.02893	.02663	.01817
A R 1 0 0 0	.12000	.06970	.03310	.02783
	.10647	.05837	.03653	.03123

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.0363	.0294	.0257	.0193
	S	.0012	.0008	.0017	.0021
	CV	3.3425	2.8328	6.6627	10.6769
A R 1 0 0 0	$\bar{x}$	.1132	.0640	.0348	.0295
	S	.0120	.0100	.0030	.0030
	CV	10.5865	15.6764	8.7289	10.2012

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP087				50% TP044 & 50% TP087			
		15	20	25	30	15	20	25	30	15	20	25	30
PERCENT RUBBER	15												
	20												
	25												
	30												

Table L-2 Engineering Creep Compliance
at Failure, psi^{-1}

a. Reduced Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.07433	.05280	.03360	.04300
	.07187	.05053	.03990	.04397
A R 1 0 0 0	.30067	.13932	.06797	.05580
	.31433	.11010	.06417	.05823

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.0731	.0517	.0368	.0435
	S	.0022	.0020	.0056	.0009
	CV	2.9816	3.8928	15.1886	1.9764
A R 1 0 0 0	$\bar{x}$	.3075	.1247	.0661	.0570
	S	.0121	.0259	.0034	.0022
	CV	3.9359	20.7593	5.0958	3.7762

ASPHALT TYPE (A)
PERCENT RUBBER (R)
RUBBER TYPE (R)

	TP044			TP037			50% TP044 50% TP037			ST274			U.S. Rubber Firm			50% ST274 50% R Firm		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
1000-15																		
1000-20																		
1000-30																		
1000-40																		
1000-50																		
1000-60																		
1000-70																		
1000-80																		
1000-90																		
1000-100																		

Table L-2 Engineering Creep Compliance
at Failure, psi^{-1}

a. Reduced Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	<u>.03270</u>	<u>.02550</u>	<u>.02283</u>	<u>.01987</u>
	.03597	.03073	.02017	.01863
A R 1 0 0 0	<u>.09510</u>	<u>.06160</u>	<u>.03573</u>	<u>.02377</u>
	.10430	.05660	.03383	.02020

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	<u>.0343</u>	<u>.0281</u>	<u>.0215</u>	<u>.0193</u>
	S	<u>.0029</u>	<u>.0046</u>	<u>.0024</u>	<u>.0011</u>
	CV	8.4381	16.4815	10.9617	5.7072
A R 1 0 0 0	$\bar{X}$	<u>.0997</u>	<u>.0591</u>	<u>.0348</u>	<u>.0220</u>
	S	<u>.0082</u>	<u>.0044</u>	<u>.0017</u>	<u>.0031</u>
	CV	8.1757	7.4958	4.8401	14.3842

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP027			50% TP044 50% TP027			G1574			V.S. Rubber Fms.			50% G1574 50% V.S. Fms.		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Creep																		
Modulus																		

Table L-2 Engineering Creep Compliance
at Failure, psi^{-1}

a. Reduced Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	.07623	.06433	.05973	.08230
	.09030	.06423	.05917	.08880
A R 1 0 0 0	.20467	.13567	.10330	.12367
	.17100	.13167	.00433	.11800

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.0833	.0643	.0595	.0856
	S	.0125	.0001	.0005	.0058
	CV	14.9715	.1378	.8346	6.7317
A R 1 0 0 0	$\bar{x}$	.1878	.1337	.0988	.1208
	S	.0298	.0035	.0079	.0050
	CV	15.8818	2.6513	8.0427	4.1574

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP648		TP627		50% TP648 50% TP627		D1174		U.S. Rubber Firm		50% D1174 50% U.S. Firm	
		15	20	25	30	15	20	25	30	15	20	25	30
Specimen	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-
Specimen	3	-	-	-	-	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-	-	-	-	-

Table L-2 Engineering Creep Compliance
at Failure, psi^{-1}

a. Reduced Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	<u>.05320</u>	<u>.04767</u>	<u>.08803</u>	<u>.05493</u>
	.05580	.05023	.07460	.05933
A R 1 0 0 0	<u>.11233</u>	<u>.08223</u>	<u>.06220</u>	<u>.08430</u>
	.11633	.07643	.06950	.10430

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.0545</u>	<u>.0490</u>	<u>.0813</u>	<u>.0571</u>
	s	<u>.0023</u>	<u>.0023</u>	<u>.0119</u>	<u>.0039</u>
	CV	4.2267	4.6336	14.6332	6.8237
A R 1 0 0 0	$\bar{x}$	<u>.1143</u>	<u>.0793</u>	<u>.0659</u>	<u>.0943</u>
	s	<u>.0035</u>	<u>.0051</u>	<u>.0065</u>	<u>.0177</u>
	CV	3.0998	6.4778	9.8220	18.7911

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				50% TP044 50% TP027				01374				U.S. Rubber Fine				50% 01374 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Creep	1000-10																																				
	1000-10																																				

Table L-2 Engineering Creep Compliance
at Failure, psi^{-1}

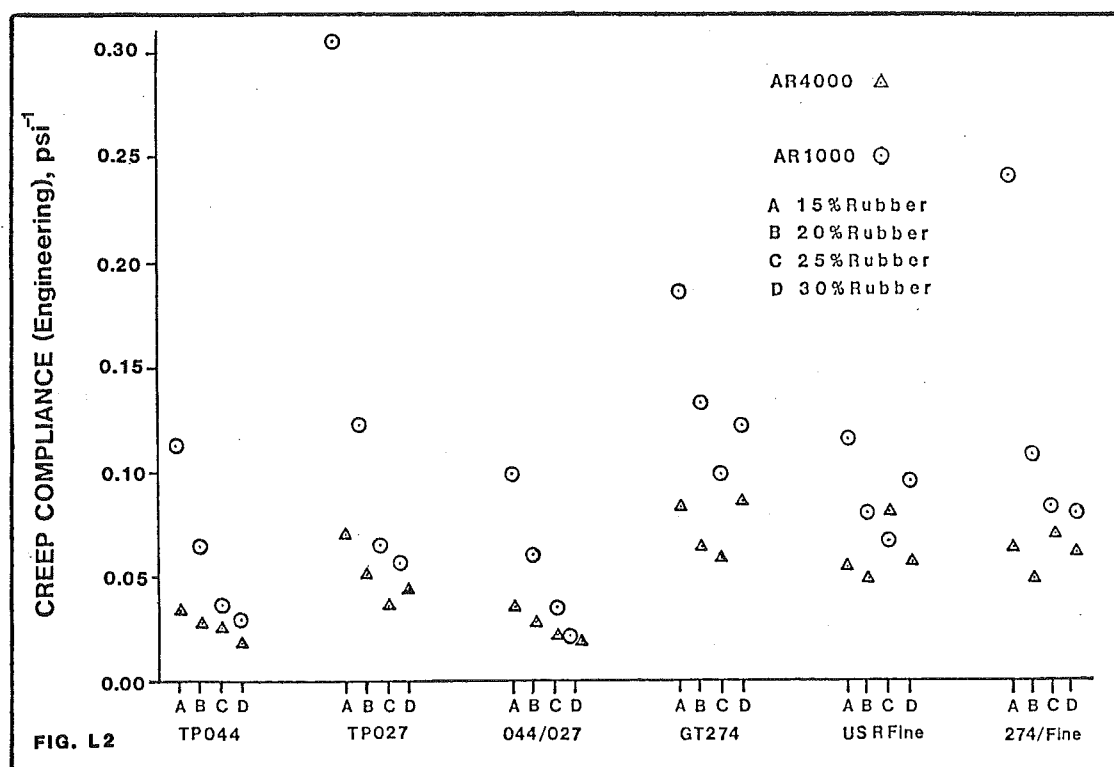
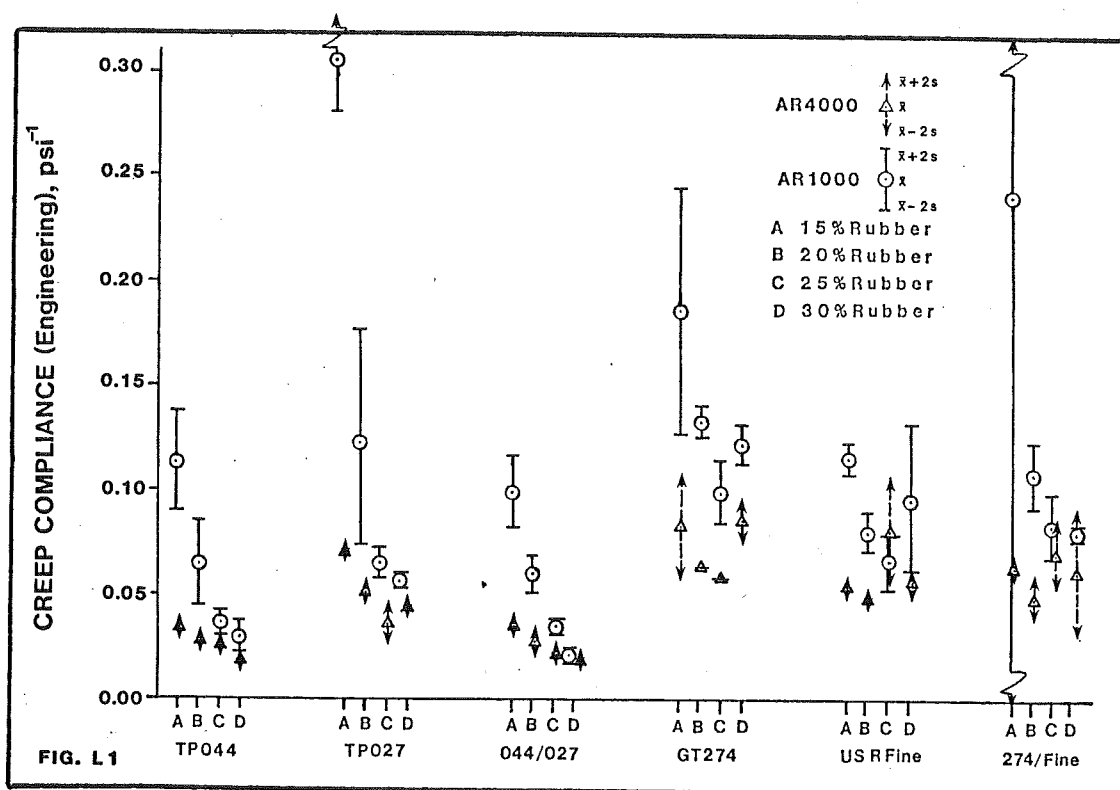
a. Reduced Data

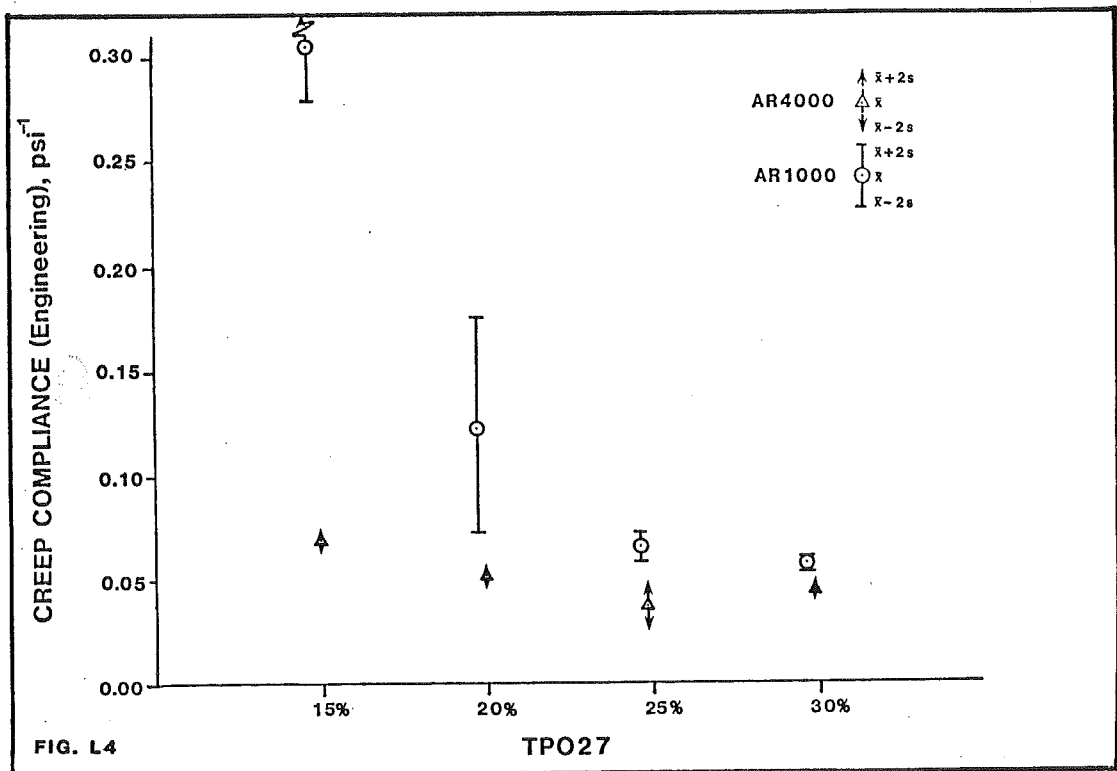
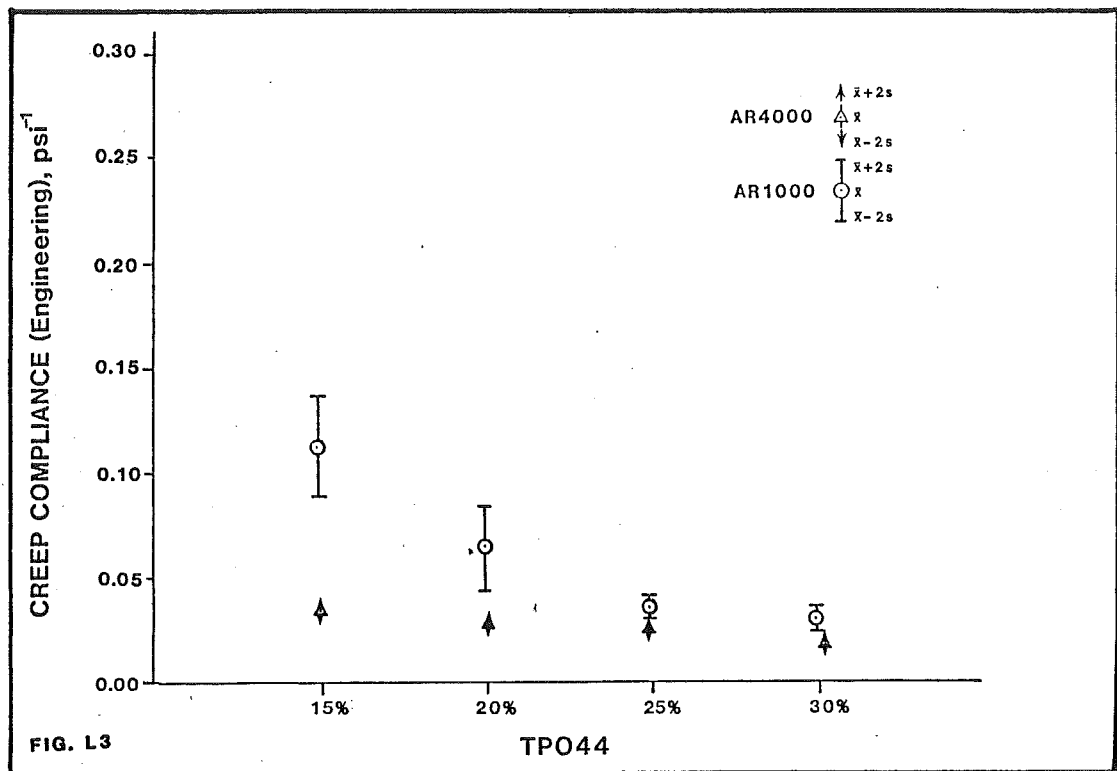
50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	<u>.06493</u>	<u>.04697</u>	<u>.07460</u>	<u>.06970</u>
	.06300	.05253	.06517	.05307
A R 1 0 0 0	<u>.16633</u>	<u>.11127</u>	<u>.08790</u>	<u>.07947</u>
	.31633	.10180	.07903	.07823

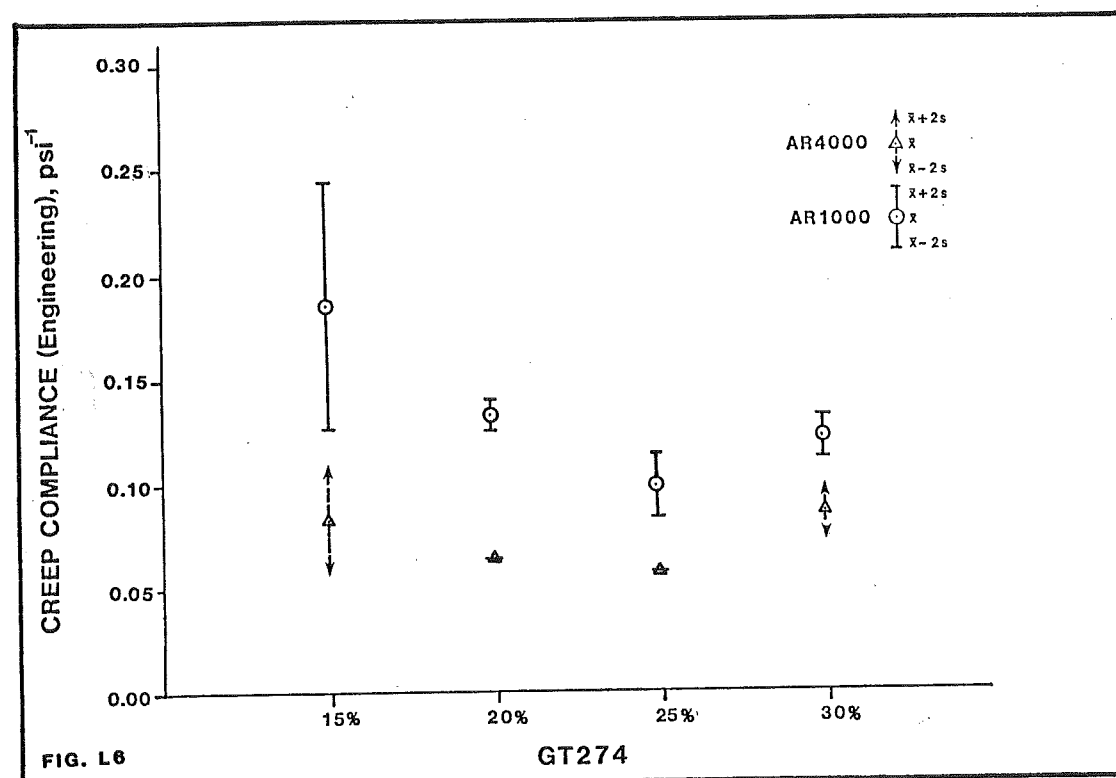
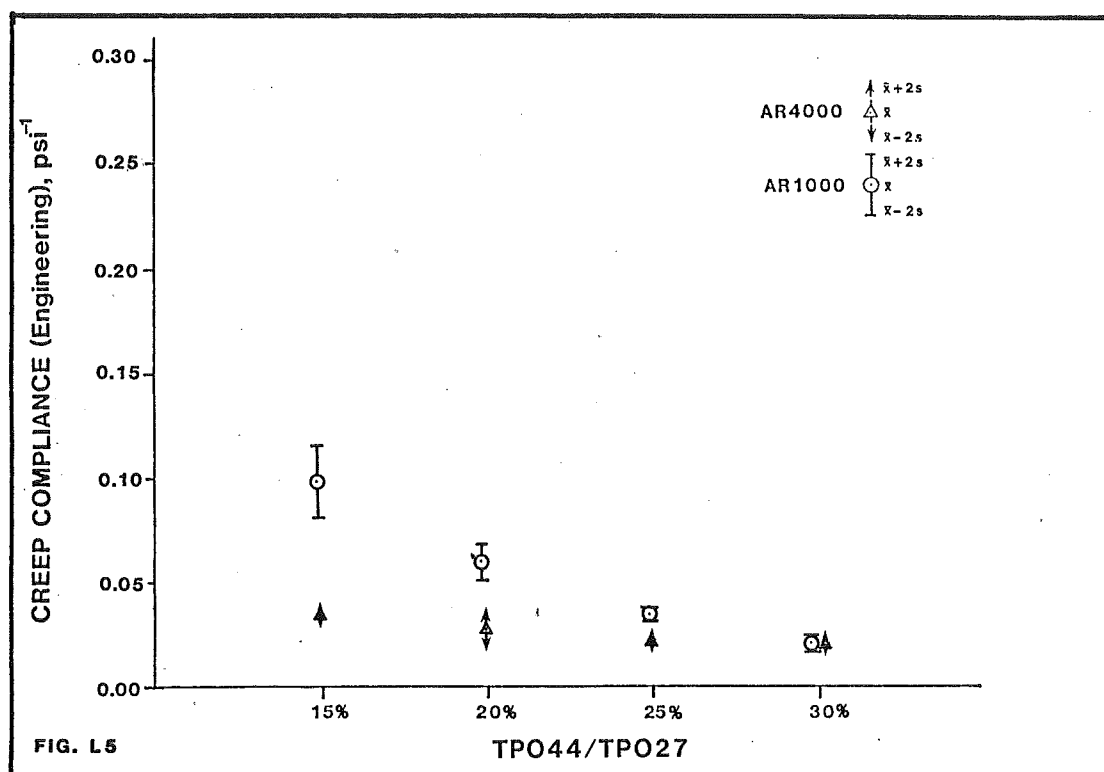
b. Summary

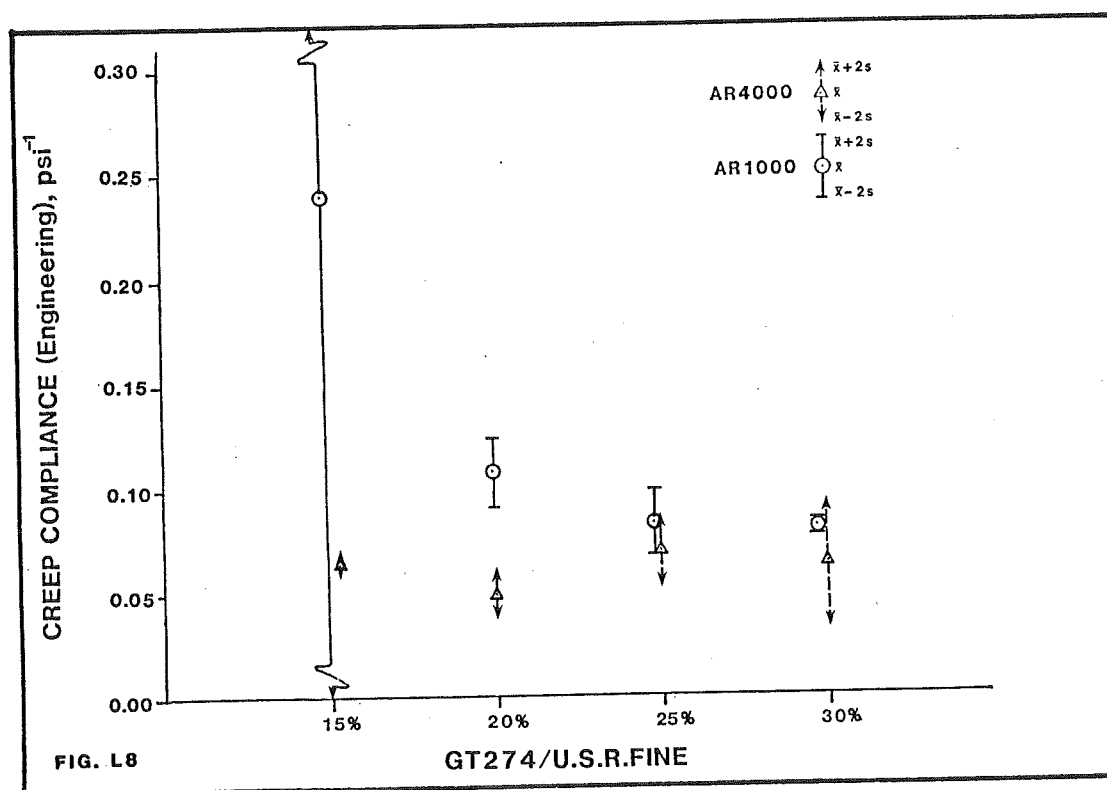
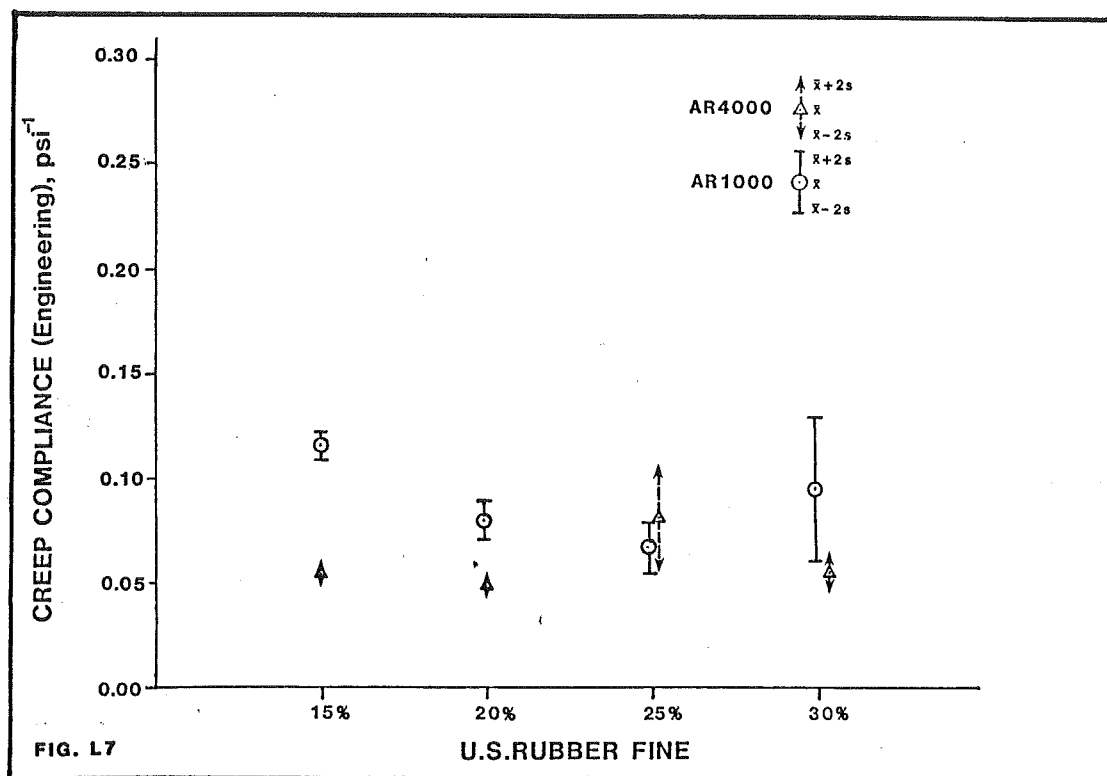
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.0640</u>	<u>.0498</u>	<u>.0699</u>	<u>.06139</u>
	S	<u>.0017</u>	<u>.0049</u>	<u>.0084</u>	<u>.0147</u>
	CV	2.6733	9.9018	11.9553	24.0029
A R 1 0 0 0	$\bar{x}$	<u>.2413</u>	<u>.1065</u>	<u>.0835</u>	<u>.0789</u>
	S	<u>.1329</u>	<u>.0083</u>	<u>.0079</u>	<u>.0011</u>
	CV	55.0698	7.8751	9.4157	1.3933

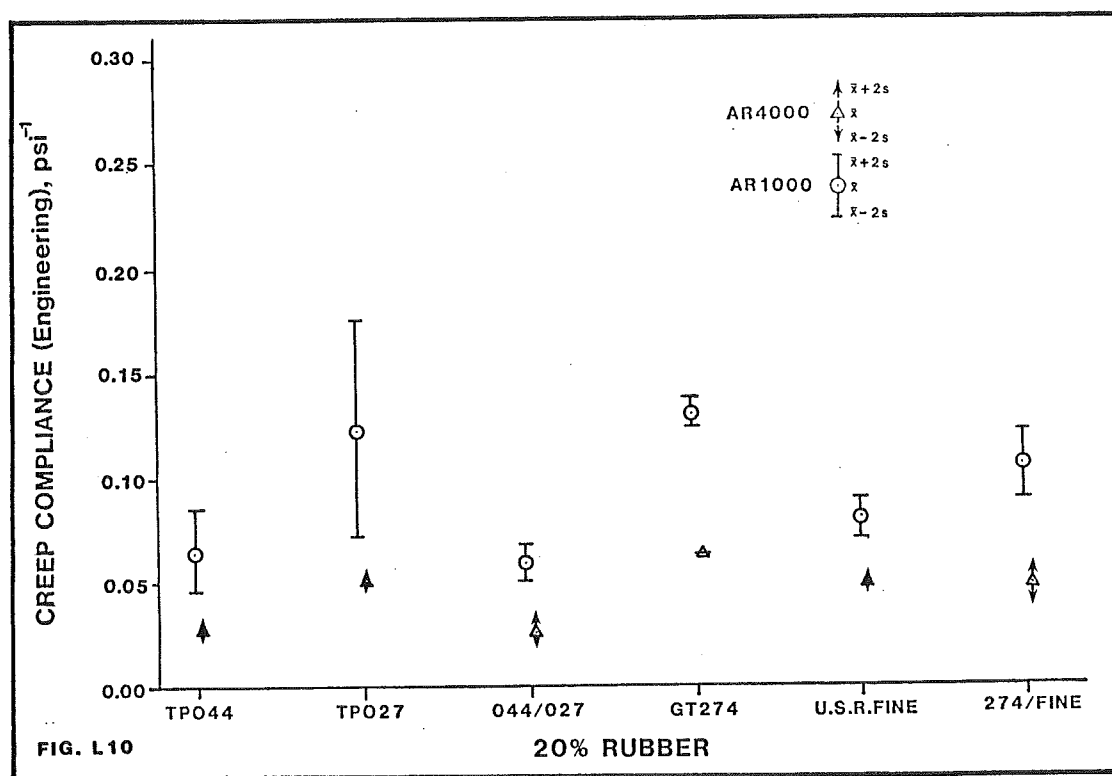
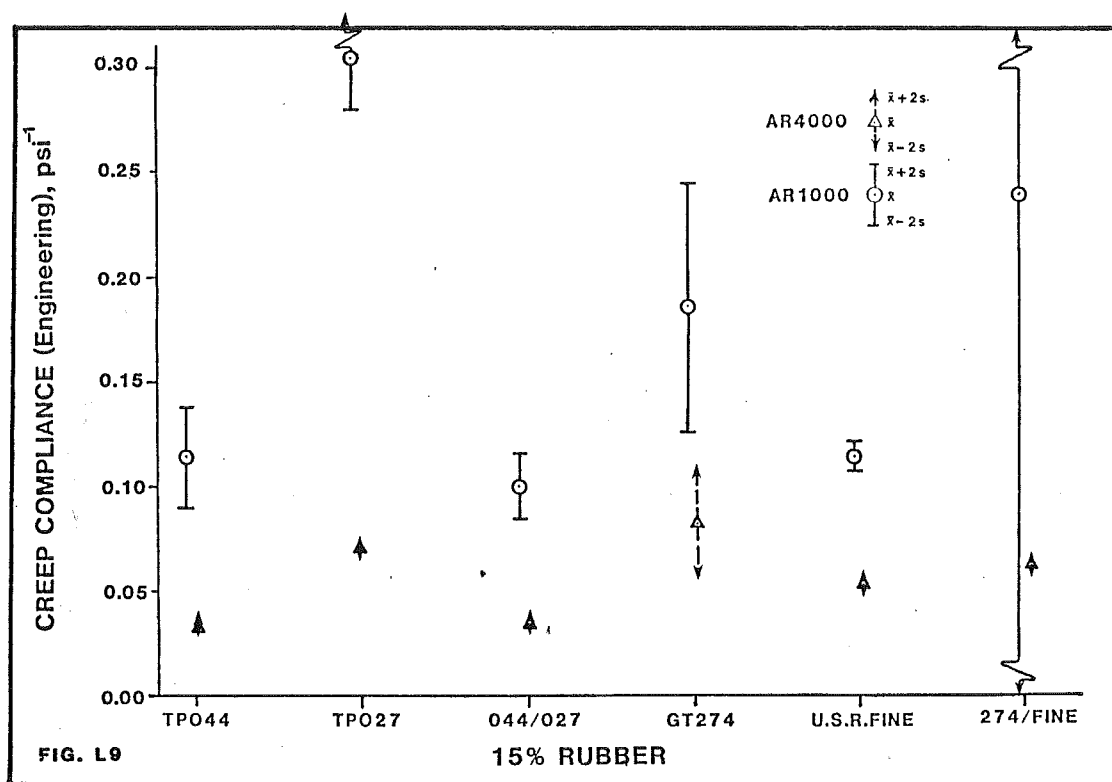
		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP646				TP687				50% TP646 50% TP687			
		15	20	25	30	15	20	25	30	15	20	25	30
RUBBER	15	-	-	-	-	-	-	-	-	-	-	-	-
	20	-	-	-	-	-	-	-	-	-	-	-	-
50% GT274	15	-	-	-	-	-	-	-	-	-	-	-	-
	20	-	-	-	-	-	-	-	-	-	-	-	-
50% U.S. Rubber Fine	15	-	-	-	-	-	-	-	-	-	-	-	-
	20	-	-	-	-	-	-	-	-	-	-	-	-
50% GT274 50% U.S. Rubber Fine	15	-	-	-	-	-	-	-	-	-	-	-	-
	20	-	-	-	-	-	-	-	-	-	-	-	-











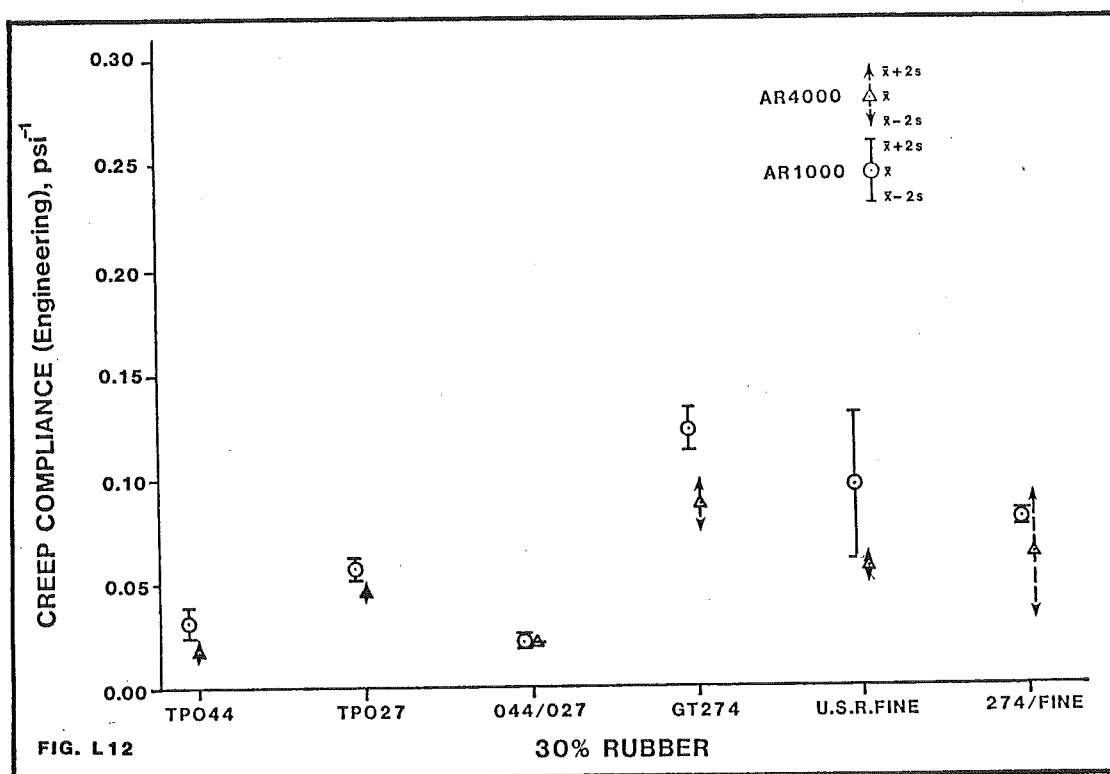
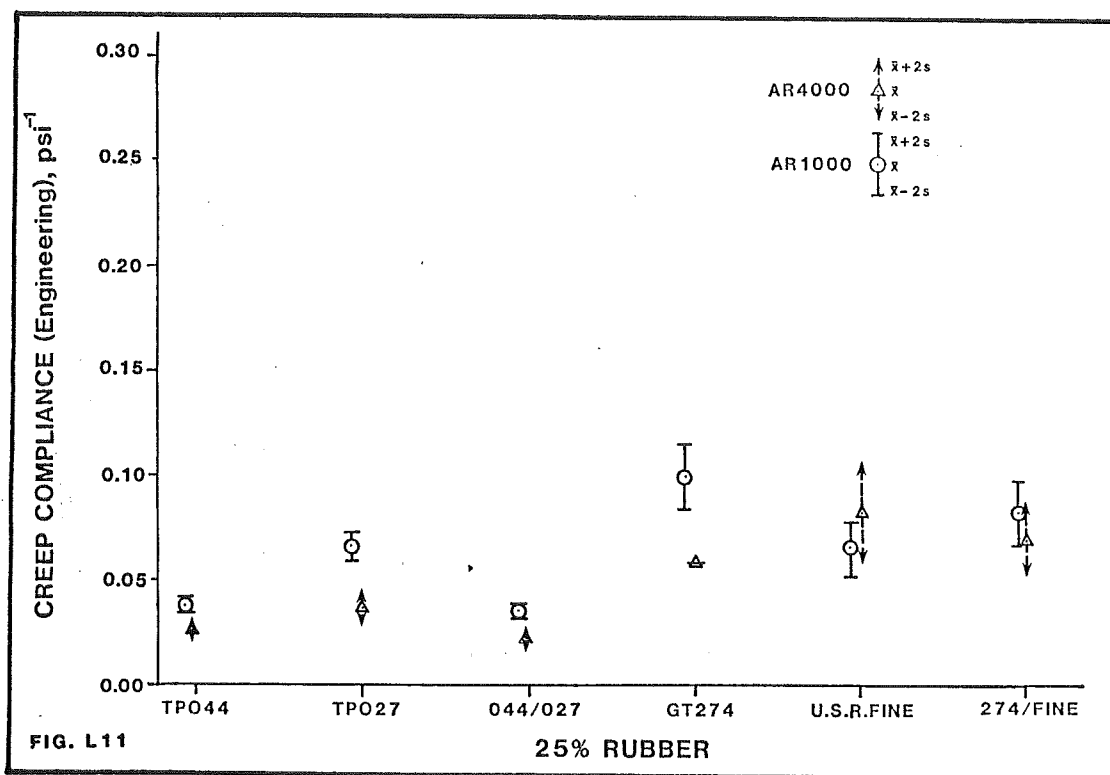


Table L-3 Log Log Arctan $\sqrt{\text{Engineering Creep Compliance at Failure, psi}^{-1}}$

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	.01240	-.00372	-.02185	-.04045
	.01575	-.00671	-.01457	-.05296
A R 1 0 0 0	.10761	.06817	.00574	-.01038
	.09933	.05422	.01462	.00041

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	X	.01408	-.00522	-.01821	-.04671
	S	.00298	.00265	.00645	.01108
	CV	21.16	-50.77	-35.42	-23.72
A R 1 0 0 0	X	.10347	.06119	.01018	-.00498
	S	.00734	.01235	.00787	.00955
	CV	7.09	20.18	77.31	-191.77

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP007			SOS TP044 & TP007			GT174			U.S. Rubber Firm			SOS GT174 & U.S. Rubber Firm		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		
27																		
28																		
29																		
30																		

Table L-3 Log Log Arctan $\sqrt{\text{Engineering Creep Compliance at Failure, psi}^{-1}}$

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.07309	.04609	.00710	.02887
	.07052	.04247	.02240	.03078
A R 1 0 0 0	1.6389	.11763	.06622	.05059
	1.6629	.10167	.06174	.05403

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.07180	.04428	.01475	.02983
	S	.00227	.00321	.01355	.00169
	CV	3.16	7.25	91.86	5.67
A R 1 0 0 0	$\bar{x}$	.16509	.10965	.06398	.05231
	S	.00213	.01414	.00398	.00303
	CV	1.29	12.90	6.22	5.79

ASPHALT TYPE (A)
 PERCENT RUBBER (R)
 RUBBER TYPE (R)

	TP044			TP037			50% TP044 50% TP037			GT076			U.S. Rubber Firm			50% GT076 50% U.S. Rubber Firm		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
15																		
20																		
25																		
30																		
40																		
50																		
60																		
70																		
80																		
90																		
100																		

Table L-3 Log Log Arctan $\sqrt{\text{Engineering Creep Compliance at Failure, psi}^{-1}}$

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.00463	-.01875	-.02960	-.04366
	.01325	-.00108	-.04212	-.05034
A R 1 0 0 0	.09131	.05851	.01264	-.02561
	.09789	.05174	.00773	-.04196

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.00894	-.00992	-.03586	-.04700
	S	.00763	.01566	.01108	.00592
	CV	85.35	-157.86	-30.90	-12.60
A R 1 0 0 0	$\bar{x}$	.09460	.05513	.01018	-.03379
	S	.00583	.00600	.00436	.01449
	CV	6.16	10.88	42.79	-42.88

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP027				50% TP044 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
AR 4000	CV	-	-	-	-	-	-	-	-	-	-	-	-
	S	-	-	-	-	-	-	-	-	-	-	-	-
AR 1000	CV	-	-	-	-	-	-	-	-	-	-	-	-
	S	-	-	-	-	-	-	-	-	-	-	-	-

Table L-3 Log Log Arctan $\sqrt{\text{Engineering Creep Compliance at Failure, psi}^{-1}}$

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
AR 4000	.07500	.06193	.05606	.08074
	.08756	.06181	.05531	.08634
AR 1000	.14187	.11587	.09720	.10966
	.13082	.11388	.09072	.10646

b. Summary

GT274					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	.08128	.06187	.05569	.08354
	S	.01113	.00011	.00067	.00496
	CV	13.69	.18	1.20	5.94
AR 1000	$\bar{x}$	.13635	.11488	.09397	.10806
	S	.00979	.00177	.00574	.00283
	CV	7.18	1.54	6.11	2.62

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP046				TP037				80% TP046, 20% TP037			
		15	20	25	30	15	20	25	30	15	20	25	30
AR	4000												
AR	1000												
AR	4000												
AR	1000												

Table L-3 Log Log Arctan $\sqrt{\text{Engineering Creep Compliance at Failure, psi}^{-1}}$

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.04531	.03762	.08570	.04932
	.05059	.04198	.07336	.05553
A R 1 0 0 0	.10307	.08068	.05928	.08252
	.10548	.07520	.06794	.09789

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.04795	.03980	.07953	.05242
	S	.00468	.00386	.01093	.00550
	CV	9.76	9.70	13.74	10.49
A R 1 0 0 0	$\bar{x}$	.10428	.07799	.06361	.09020
	S	.00214	.00493	.00768	.01361
	CV	2.05	6.32	12.07	15.09

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (R)			
		TP044				TP027				50% TP044 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
TP044	15												
	20												
	25												
	30												
TP027	15												
	20												
	25												
	30												
50% TP044 50% TP027	15												
	20												
	25												
	30												
U.S. Rubber Fine	15												
	20												
	25												
	30												
50% U.S. Rubber 50% U.S. Rubber	15												
	20												
	25												
	30												

Table L-3 Log Log Arctan $\sqrt{\text{Engineering Creep Compliance at Failure, psi}^{-1}}$

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.06265	.03638	.07336	.06817
	.06029	.04567	.06294	.04651
A R 1 0 0 0	.12908	.10241	.08559	.07813
	.16663	.09617	.07771	.07695

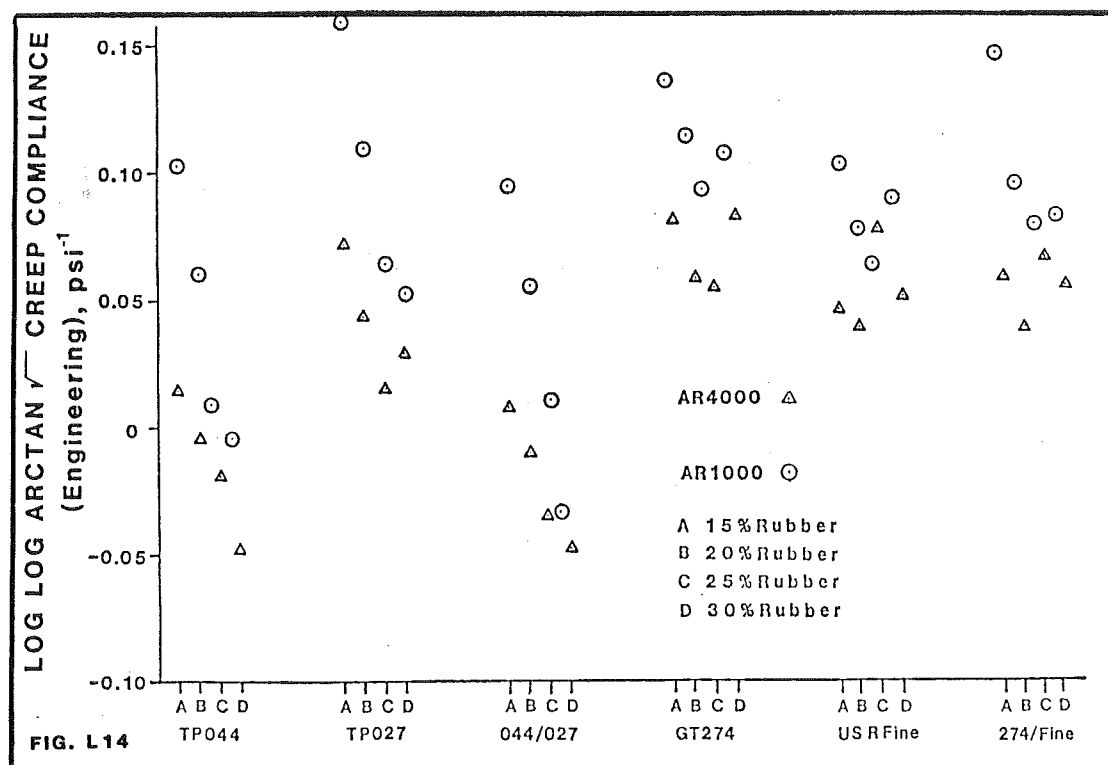
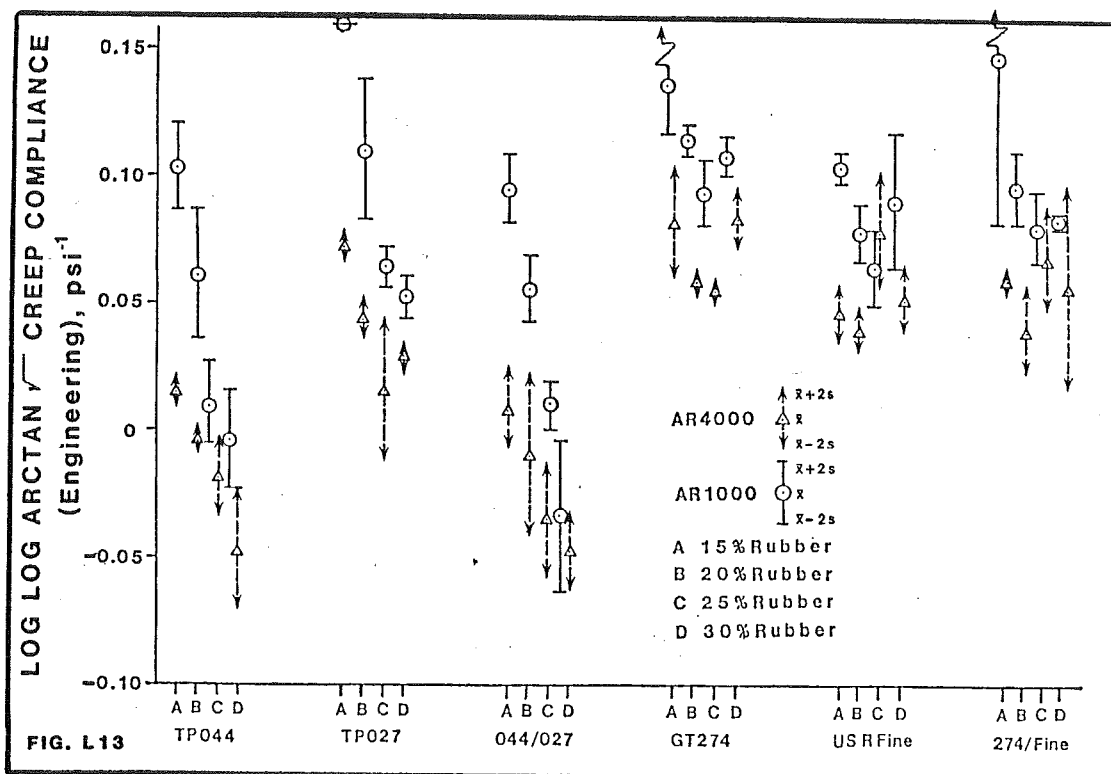
b. Summary

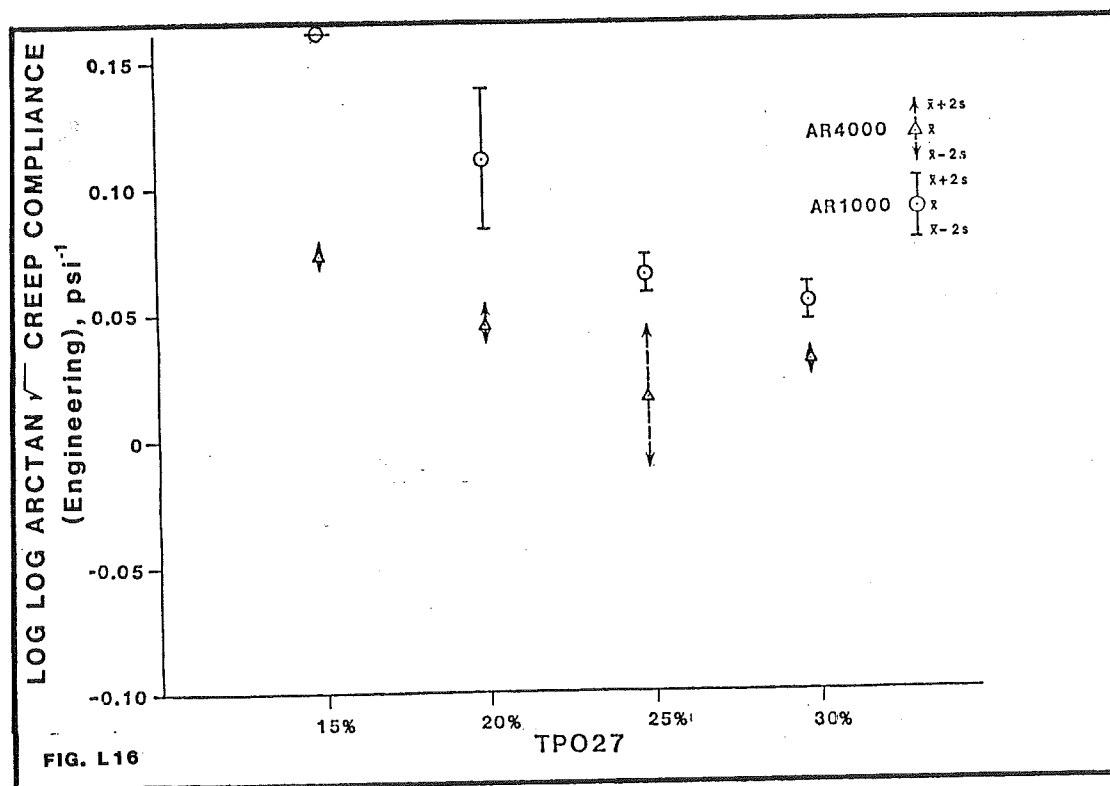
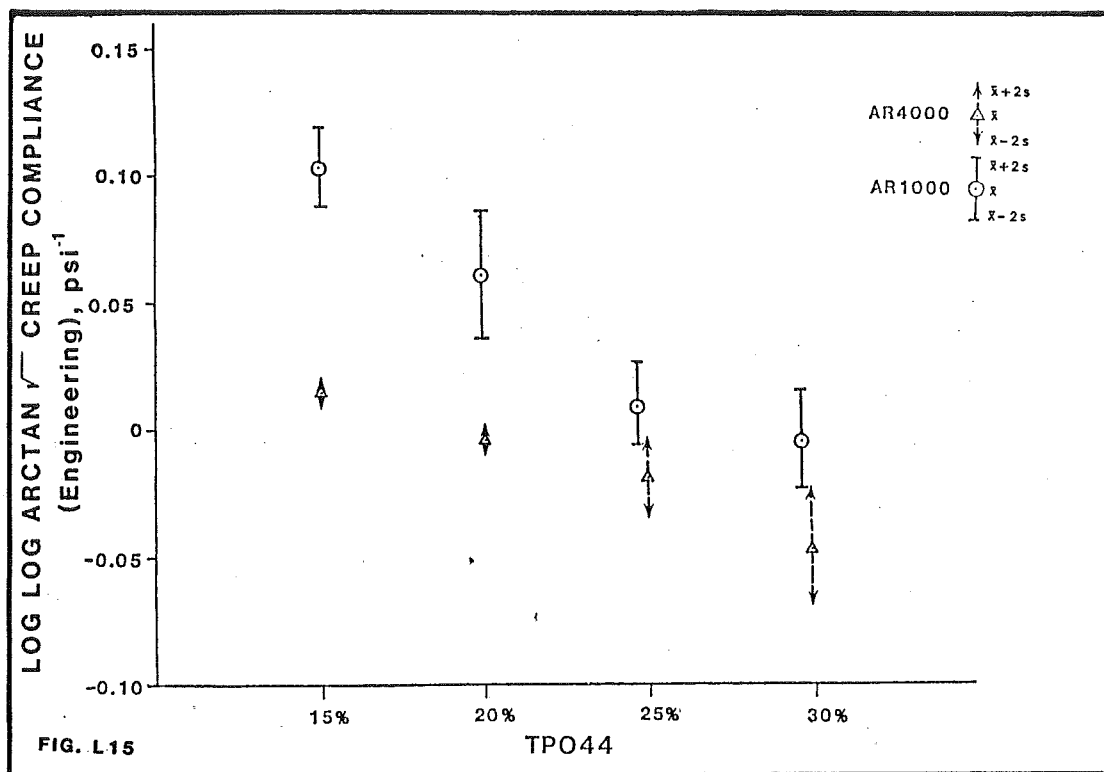
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	.06147	.04102	.06815	.05734
	S	.00210	.00823	.00923	.01919
	CV	3.42	20.06	13.54	33.47
A R 1 0 0 0	$\bar{X}$	.14786	.09929	.08165	.07754
	S	.03327	.00533	.00698	.00105
	CV	22.50	5.37	8.55	1.35

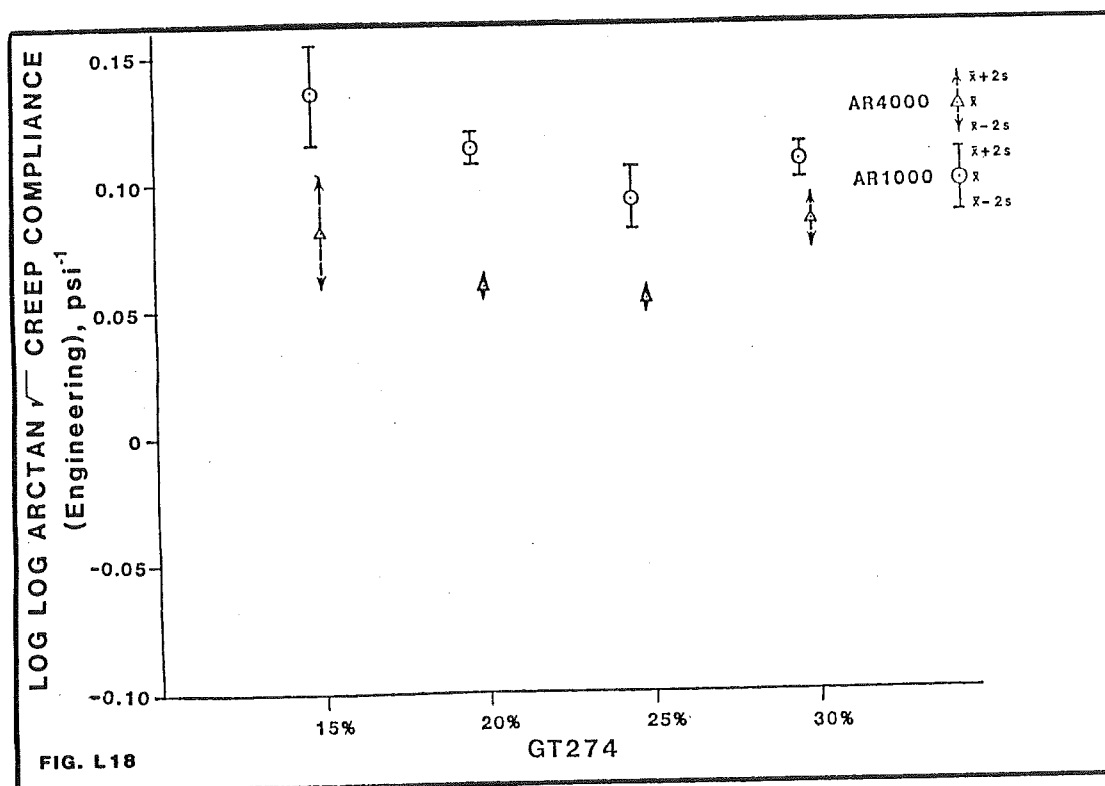
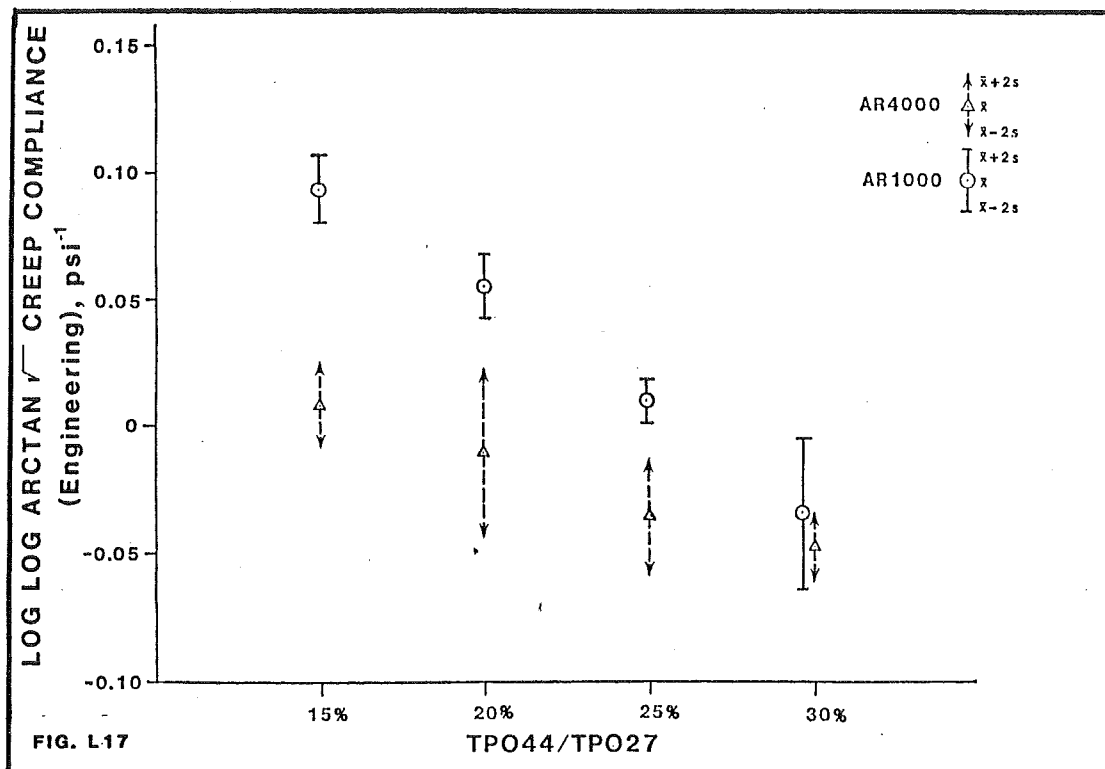
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TYPE 6				TYPE 7				50% TYPE 6 50% TYPE 7				TYPE 8				U.S. Rubber Fine				50% TYPE 6 50% U.S. Rubber				TYPE 9				TYPE 10				TYPE 11			
		10	20	30	40	10	20	30	40	10	20	30	40	10	20	30	40	10	20	30	40	10	20	30	40	10	20	30	40	10	20	30	40	10	20	30	40
Sample																																					
Analysis																																					

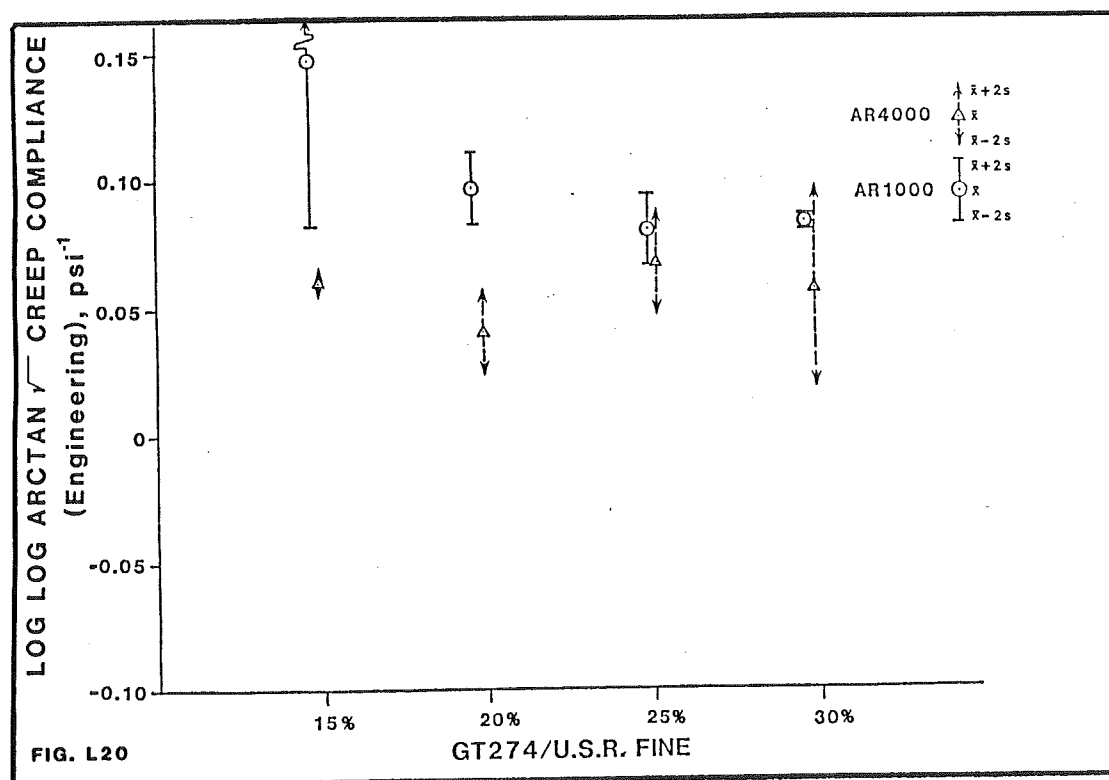
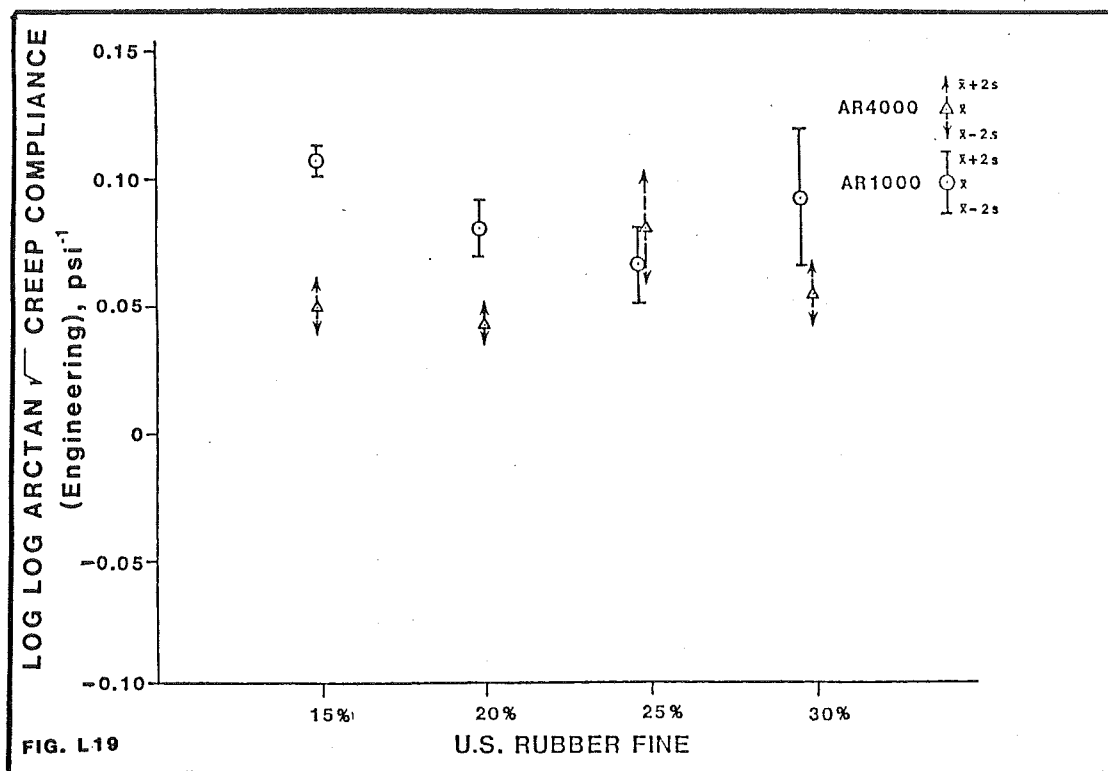
Table L-4 Anova Summary, Log Log Arctan $\sqrt{\cdot}$
Engineering Creep Compliance at
at Failure, psi^{-1}

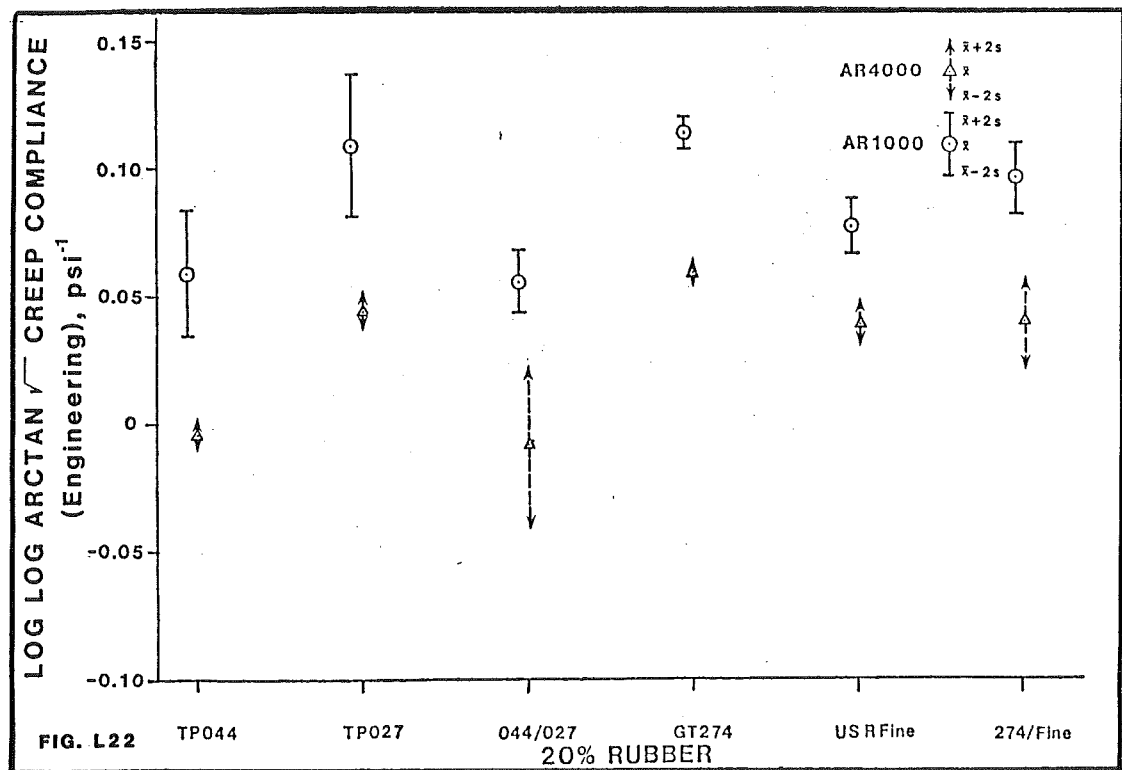
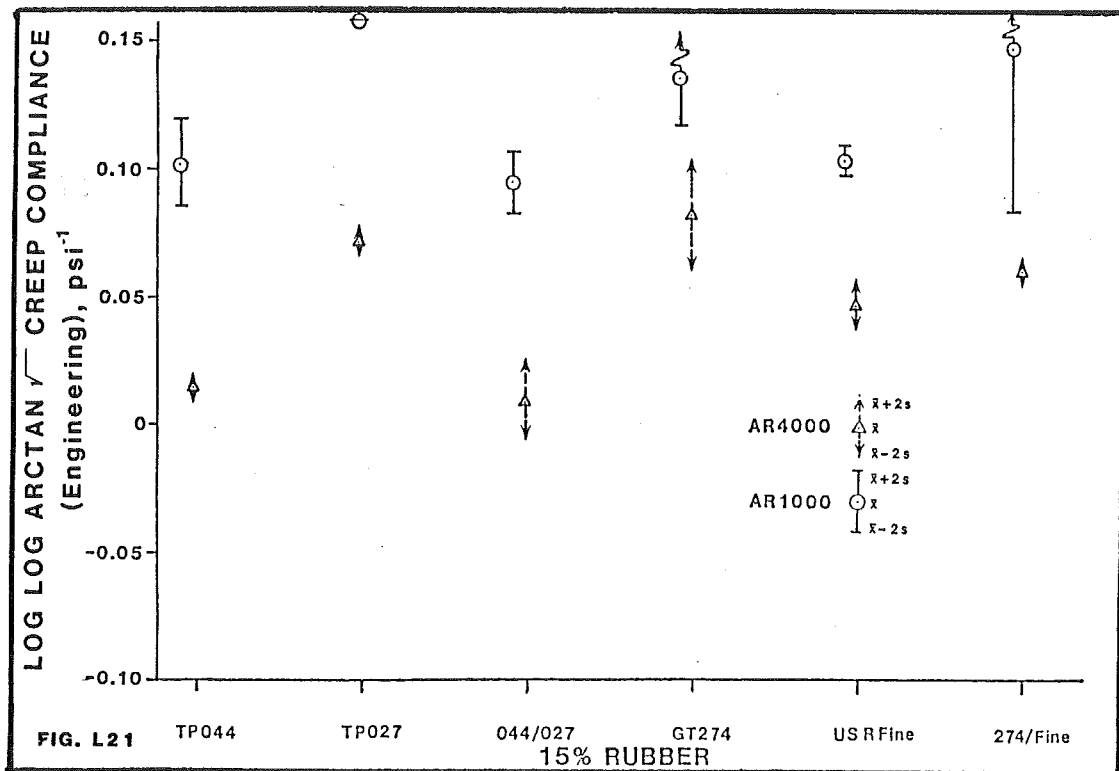
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	.1038968	.0207793	373.47	2.43	3.48
Q	3	.0385068	.0128356	230.70	2.82	4.28
A	1	.0533724	.0533724	959.28	4.07	7.27
RQ	15	.0207387	.0013825	24.84	1.91	2.49
RA	5	.0023092	.0004618	8.30	2.43	3.48
QA	3	.0113209	.0037736	67.82	2.82	4.28
RQA	15	.0033763	.0002250	4.04	1.91	2.49
Error	48	.0026706	.0000556			
TOTAL	95	.2361916				

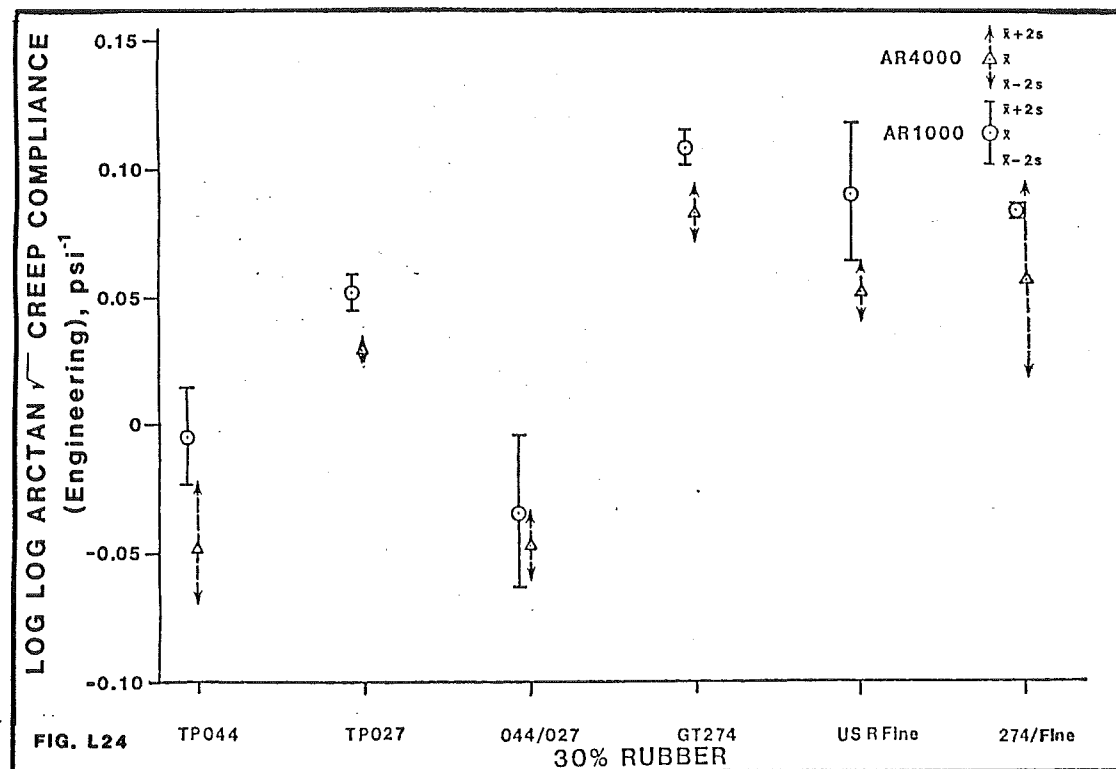
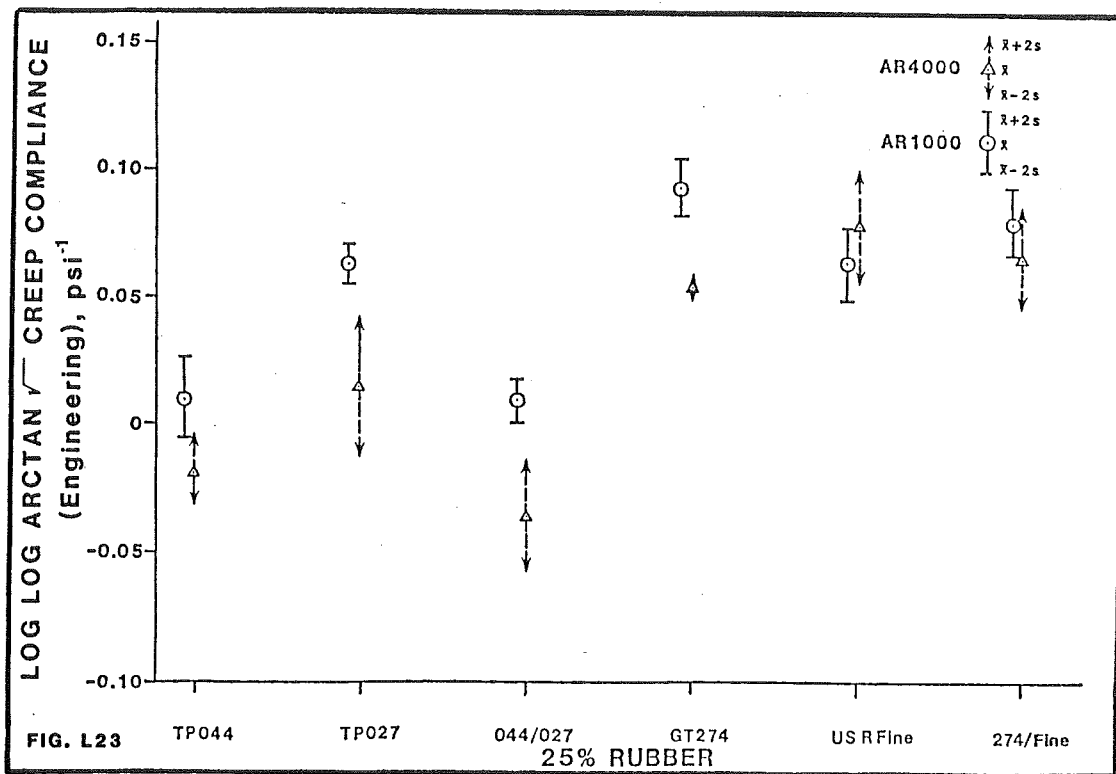












APPENDIX M
FORCE-DUCTILITY TRUE CREEP
COMPLIANCE AT FAILURE AT 39.2F (4C)

a. Measured Data

b. Summary

[illegible]

Table M-1 True Creep Compliance at Failure, psi^{-1}

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.00267	.00233	.00151	.00190
	.00262	.00234	.00151	.00189
	.00284	.00261	.00150	.00175
	<u>.00193</u>	<u>.00234</u>	<u>.00198</u>	<u>.00209</u>
	.00272	.00228	.00217	.00226
	.00384	.00234	.00255	.00232
A R 1 0 0 0	.00803	.00377	.00366	.00236
	.00731	.00395	.00373	.00250
	.00805	.00402	.00355	.00252
	<u>.00763</u>	<u>.00370</u>	<u>.00224</u>	<u>.00276</u>
	.00711	.00355	.00302	.00280
	.00803	.00390	.00309	.00260

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.003</u>	<u>.002</u>	<u>.002</u>	<u>.002</u>
	S	<u>.0006</u>	<u>.0001</u>	<u>.0004</u>	<u>.0002</u>
	CV	22.20	4.98	19.97	11.11
A R 1 0 0 0	$\bar{x}$	<u>.008</u>	<u>.004</u>	<u>.003</u>	<u>.003</u>
	S	<u>.0004</u>	<u>.0001</u>	<u>.0006</u>	<u>.0002</u>
	CV	5.34	4.59	17.48	6.44

ASPHALT TYPE (A)
PERCENT RUBBER (R)
RUBBER TYPE (R)

	TP044			TP027			50% TP044 & 50% TP027			ST274			U.S. Rubber Prod			50% ST274 & 50% U.S. Rubber Prod		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Creep (in/in)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Modulus (psi)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Table M-1 True Creep Compliance at Failure, psi^{-1}

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.00209	.00159	.00178	.00144
	.00188	.00174	.00168	.00140
	.00192	.00183	.00165	.00142
	.00214	.00198	.00171	.00129
	.00210	.00188	.00159	.00129
	.00210	.00197	.00145	.00118
A R 1 0 0 0	.00434	.00295	.00231	.00176
	.00445	.00286	.00210	.00161
	.00427	.00293	.00204	.00173
	.00466	.00291	.00206	.00188
	.00278	.00209	.00177	.00177
	.00560	.00264	.00205	.00163

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.002	.002	.002	.001
	S	.0001	.0002	.0001	.0001
	CV	5.36	8.11	6.92	7.52
A R 1 0 0 0	$\bar{x}$	.005	.003	.002	.002
	S	.0005	.0001	.0001	.0001
	CV	10.60	4.13	4.81	5.75

		ASPHALT TYPE (A)												PERCENT RUBBER (R)												RUBBER TYPE (R)											
		TP044				TP027				50% TP044 50% TP027				G1876				U.S. Rubber Fms				90% B7274 90% B Fms				90% B7274 90% B Fms											
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
COMPLIANCE	1000-2000																																				
	2000-3000																																				
COMPLIANCE	3000-4000																																				
	4000-5000																																				
COMPLIANCE	5000-6000																																				
	6000-7000																																				
COMPLIANCE	7000-8000																																				
	8000-9000																																				
COMPLIANCE	9000-10000																																				
	10000-11000																																				
COMPLIANCE	11000-12000																																				
	12000-13000																																				
COMPLIANCE	13000-14000																																				
	14000-15000																																				
COMPLIANCE	15000-16000																																				
	16000-17000																																				
COMPLIANCE	17000-18000																																				
	18000-19000																																				
COMPLIANCE	19000-20000																																				
	20000-21000																																				
COMPLIANCE	21000-22000																																				
	22000-23000																																				
COMPLIANCE	23000-24000																																				
	24000-25000																																				
COMPLIANCE	25000-26000																																				
	26000-27000																																				
COMPLIANCE	27000-28000																																				
	28000-29000																																				
COMPLIANCE	29000-30000																																				
	30000-31000																																				
COMPLIANCE	31000-32000																																				
	32000-33000																																				
COMPLIANCE	33000-34000																																				
	34000-35000																																				
COMPLIANCE	35000-36000																																				
	36000-37000																																				
COMPLIANCE	37000-38000																																				
	38000-39000																																				
COMPLIANCE	39000-40000																																				
	40000-41000																																				
COMPLIANCE	41000-42000																																				
	42000-43000																																				
COMPLIANCE	43000-44000																																				
	44000-45000																																				
COMPLIANCE	45000-46000																																				
	46000-47000																																				
COMPLIANCE	47000-48000																																				
	48000-49000																																				
COMPLIANCE	49000-50000																																				
	50000-51000																																				
COMPLIANCE	51000-52000																																				
	52000-53000																																				
COMPLIANCE	53000-54000																																				
	54000-55000																																				
COMPLIANCE	55000-56000																																				
	56000-57000																																				
COMPLIANCE	57000-58000																																				
	58000-59000																																				
COMPLIANCE	59000-60000																																				
	60000-61000																																				
COMPLIANCE	61000-62000																																				
	62000-63000																																				
COMPLIANCE	63000-64000																																				
	64000-65000																																				
COMPLIANCE	65000-66000																																				
	66000-67000																																				
COMPLIANCE	67000-68000																																				
	68000-69000																																				
COMPLIANCE	69000-70000																																				
	70000-71000																																				
COMPLIANCE	71000-72000																																				

Table M-1 True Creep Compliance at Failure, psi^{-1}

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	.00269	.00218	.00227	.00253
	.00263	.00213	.00223	.00296
	<u>.00228</u>	<u>.00215</u>	<u>.00215</u>	<u>.00249</u>
	.00288	.00205	.00215	.00258
	.00282	.00207	.00208	.00291
	.00284	.00311	.00222	.00315
A R 1 0 0 0	.00444	.00325	.00296	.00390
	.00431	.00351	.00306	.00386
	<u>.00470</u>	<u>.00336</u>	<u>.00277</u>	<u>.00354</u>
	.00458	.00387	.00284	.00360
	.00432	.00372	.00282	.00360
	.00423	.00325	.00309	.00366

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.003</u>	<u>.002</u>	<u>.002</u>	<u>.003</u>
	S	<u>.0002</u>	<u>.00005</u>	<u>.00007</u>	<u>.0003</u>
	CV	8.24	2.31	3.17	9.85
A R 1 0 0 0	$\bar{x}$	<u>.004</u>	<u>.004</u>	<u>.003</u>	<u>.004</u>
	S	<u>.0002</u>	<u>.0002</u>	<u>.0001</u>	<u>.0002</u>
	CV	4.06	6.85	4.56	4.06

ASPHALT TYPE (A)
PERCENT RUBBER (R)
RUBBER TYPE (R)

	TP044				TP037				50% TP044 50% TP037				GT274				U.S. Rubber Plant				50% GT274 50% U.S. Plant			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
TP044																								
TP037																								
50% TP044 50% TP037																								
GT274																								
U.S. Rubber Plant																								
50% GT274 50% U.S. Plant																								

Table M-1 True Creep Compliance at Failure, psi^{-1}

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.00258	.00199	.00273	.00256
	.00242	.00193	.00293	.00244
	.00213	.00190	.00275	.00240
	.00211	.00283	.00241	.00220
	.00222	.00259	.00245	.00230
	.00211	.00215	.00249	.00222
A R 1 0 0 0	.00359	.00273	.00229	.00306
	.00345	.00275	.00287	.00303
	.00348	.00264	.00282	.00340
	.00385	.00273	.00262	.00330
	.00891	.00273	.00275	.00319
	.00384	.00259	.00275	.00343

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.00226</u>	<u>.00223</u>	<u>.00263</u>	<u>.00235</u>
	S	<u>.0002</u>	<u>.0004</u>	<u>.0002</u>	<u>.0001</u>
	CV	8.65	17.38	7.89	5.90
A R 1 0 0 0	$\bar{x}$	<u>.00369</u>	<u>.00270</u>	<u>.00268</u>	<u>.00324</u>
	S	<u>.0002</u>	<u>.00006</u>	<u>.0002</u>	<u>.0002</u>
	CV	5.53	2.39	7.84	5.25

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)																
		TP046				TP027				50% TP046 50% TP027				G1276				U.S. Rubber Fine				NBR G1276 50% U.S. Rubber																				
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	
Creep at Failure	TP046																																									
	TP027																																									
	50% TP046 50% TP027																																									
	G1276																																									
Creep at Failure	U.S. Rubber Fine																																									
	NBR G1276 50% U.S. Rubber																																									

Table M-1 True Creep Compliance at Failure, psi^{-1}

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.00219	.00179	.00334	.00392
	.00225	.00175	.00294	.00344
	<u>.00236</u>	<u>.00183</u>	<u>.00317</u>	<u>.00290</u>
	.00216	.00239	.00342	.00228
	.00213	.00217	.00277	.00254
	.00210	.00243	.00315	.00271
A R 1 0 0 0	.00411	.00371	.00283	.00364
	.00411	.00385	.00295	.00387
	<u>.00412</u>	<u>.00419</u>	<u>.00283</u>	<u>.00357</u>
	.00488	.00293	.00346	.00359
	.00513	.00303	.00345	.00448
	.00496	.00314	.00324	.00530

b. Summary

50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	<u>.00220</u>	<u>.00206</u>	<u>.00313</u>	<u>.00297</u>
	S	<u>.00001</u>	<u>.0003</u>	<u>.0002</u>	<u>.0006</u>
	CV	4.30	15.04	7.77	20.55
A R 1 0 0 0	$\bar{X}$	<u>.00455</u>	<u>.00348</u>	<u>.00313</u>	<u>.00408</u>
	S	<u>.0005</u>	<u>.0005</u>	<u>.0003</u>	<u>.0007</u>
	CV	10.70	14.75	9.44	16.95

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)													
TP044	TP047	50% TP044						50% TP047						50% TP044						50% TP047						50% TP044						50% TP047							
		15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40	15	20	25	30	35	40		

a. Analyzed Data

b. Summary

[illegible]

Table M-2 True Creep Compliance at Failure, psi^{-1}

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
AR 4000	.00271	.00243	.00160	.00185
	.00283	.00232	.00223	.00222
AR 1000	.00780	.00391	.00365	.00246
	.00759	.00372	.00278	.00276

b. Summary

TP027					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	.00277	.00238	.00192	.00204
	S	.00011	.00010	.00056	.00033
	CV	3.97	4.20	29.17	16.18
AR 1000	$\bar{x}$	.00770	.00382	.00322	.00261
	S	.00019	.00017	.00077	.00027
	CV	7.04	4.45	23.91	10.34

		TP046				TP027				50% TP046 & 50% TP027				BT576				U.S. Rubber Fine				50% BT576 & 50% Rubber A			
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Asphalt Type (A)	TP046																								
	TP027																								
Percent Rubber (B)	TP046																								
	TP027																								
Rubber Type (C)	TP046																								
	TP027																								

Table M-2 True Creep Compliance at Failure, psi^{-1}

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.00196	.00172	.00170	.00142
	.00211	.00194	.00158	.00125
A R 1 0 0 0	.00435	.00291	.00215	.00170
	.00492	.00278	.00207	.00176

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.00204	.00183	.00164	.00134
	s	.00013	.00019	.00011	.00015
	CV	6.37	10.38	6.71	11.19
A R 1 0 0 0	$\bar{x}$	.00464	.00285	.00211	.00173
	s	.00051	.00012	.00007	.00005
	CV	10.49	4.21	3.32	2.89

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044		TP027		50% TP044 50% TP027		G1274		V.E. Rubber Free		50% G1274 50% V.E. Free	
		15	20	25	30	15	20	25	30	15	20	25	30
Creep	15												
	20												
Failure	15												
	20												

Table M-2 True Creep Compliance at Failure, psi^{-1}

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	.00253	.00215	.00222	.00266
	.00285	.00208	.00215	.00288
A R 1 0 0 0	.00448	.00337	.00293	.00377
	.00438	.00365	.00292	.00362

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.00269	.00212	.00219	.00277
	S	.00028	.00006	.00006	.00019
	CV	10.41	2.83	2.74	6.86
A R 1 0 0 0	$\bar{x}$	.00443	.00351	.00293	.00370
	S	.00009	.00025	.00001	.00013
	CV	2.03	7.13	0.34	3.51

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (R)

	TP044			TP047			50% TP044 50% TP047			GT274			U.S. Rubber Fm			50% GT274 50% U.S. Fm		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
TP044																		
TP047																		
50% TP044 50% TP047																		
GT274																		
U.S. Rubber Fm																		
50% GT274 50% U.S. Fm																		

Table M-2 True Creep Compliance at Failure, psi^{-1}

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.00258	.00199	.00273	.00256
	.00242	.00193	.00293	.00244
	.00213	.00190	.00275	.00240
	<u>.00211</u>	<u>.00283</u>	<u>.00241</u>	<u>.00220</u>
	.00222	.00259	.00245	.00230
	.00211	.00215	.00249	.00222
A R 1 0 0 0	.00359	.00273	.00229	.00306
	.00345	.00275	.00287	.00303
	.00348	.00264	.00282	.00340
	<u>.00385</u>	<u>.00273</u>	<u>.00262</u>	<u>.00330</u>
	.00891	.00273	.00275	.00319
	.00384	.00259	.00275	.00343

b. Summary

		U. S. RUBBER FINE			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.00226</u>	<u>.00223</u>	<u>.00263</u>	<u>.00235</u>
	S	<u>.0002</u>	<u>.0004</u>	<u>.0002</u>	<u>.0001</u>
	CV	8.65	17.38	7.89	5.90
A R 1 0 0 0	$\bar{x}$	<u>.00369</u>	<u>.00270</u>	<u>.00268</u>	<u>.00324</u>
	S	<u>.0002</u>	<u>.00006</u>	<u>.0002</u>	<u>.0002</u>
	CV	5.53	2.39	7.84	5.25

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TPQ24				TPQ27				50% TPQ24 50% TPQ27			
		15	20	25	30	15	20	25	30	15	20	25	30
Creep Compliance	Failure												
	Initial												

Table M-2 True Creep Compliance at Failure, psi^{-1}

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.00219	.00179	.00334	.00392
	.00225	.00175	.00294	.00344
	<u>.00236</u>	<u>.00183</u>	<u>.00317</u>	<u>.00290</u>
	.00216	.00239	.00342	.00228
	.00213	.00217	.00277	.00254
	.00210	.00243	.00315	.00271
A R 1 0 0 0	.00411	.00371	.00283	.00364
	.00411	.00385	.00295	.00387
	<u>.00412</u>	<u>.00419</u>	<u>.00283</u>	<u>.00357</u>
	.00488	.00293	.00346	.00359
	.00513	.00303	.00345	.00448
	.00496	.00314	.00324	.00530

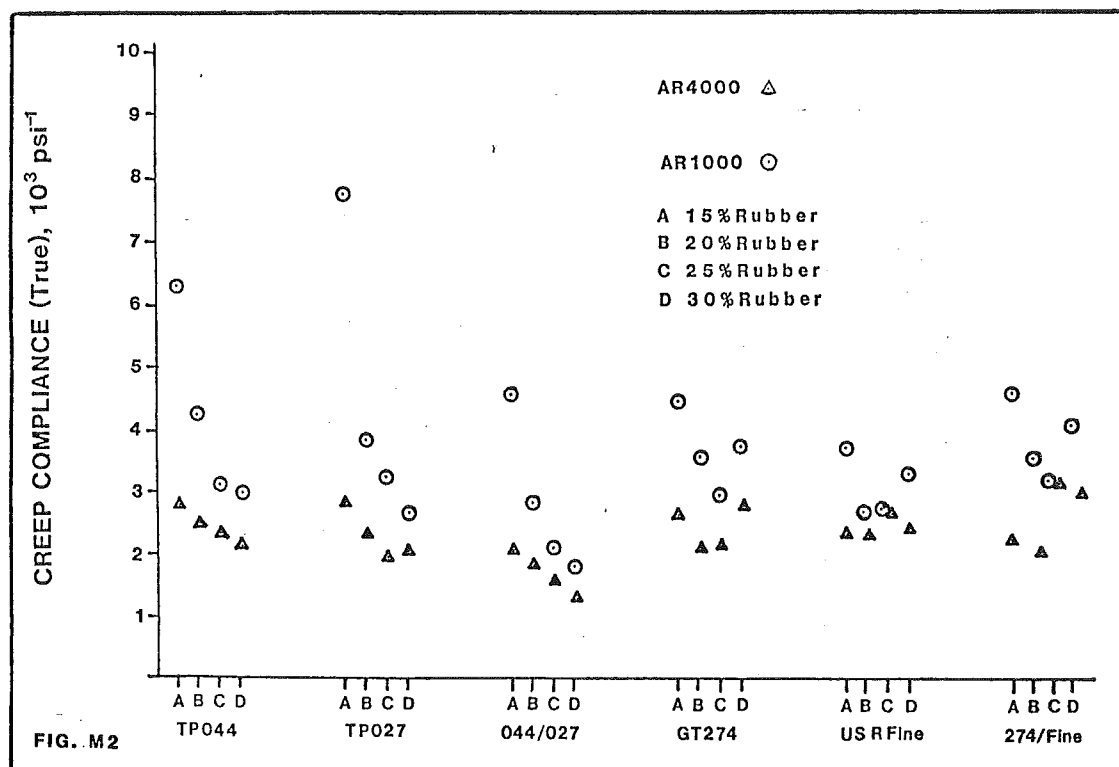
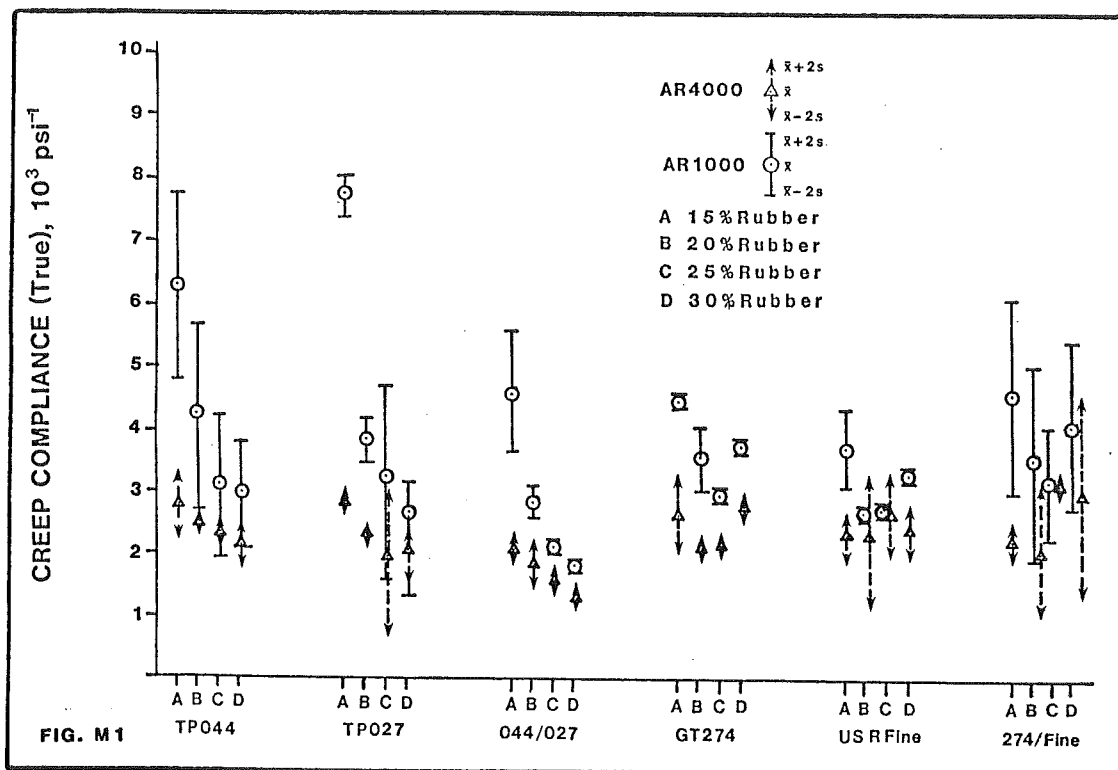
b. Summary

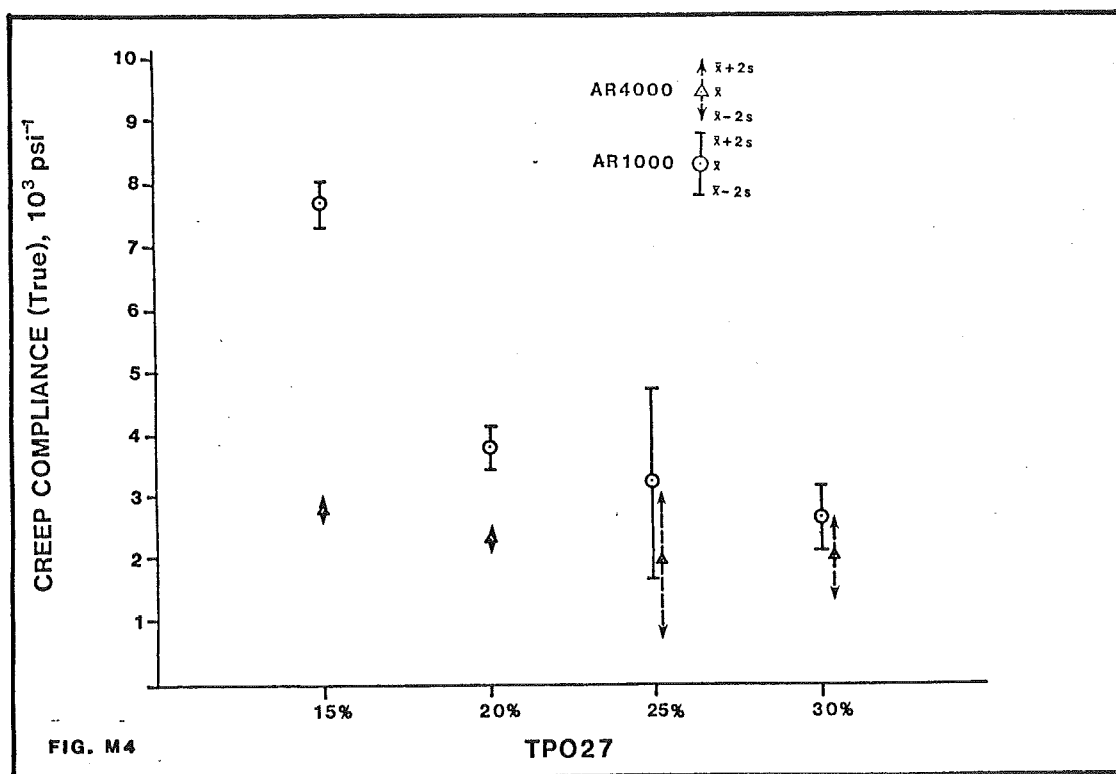
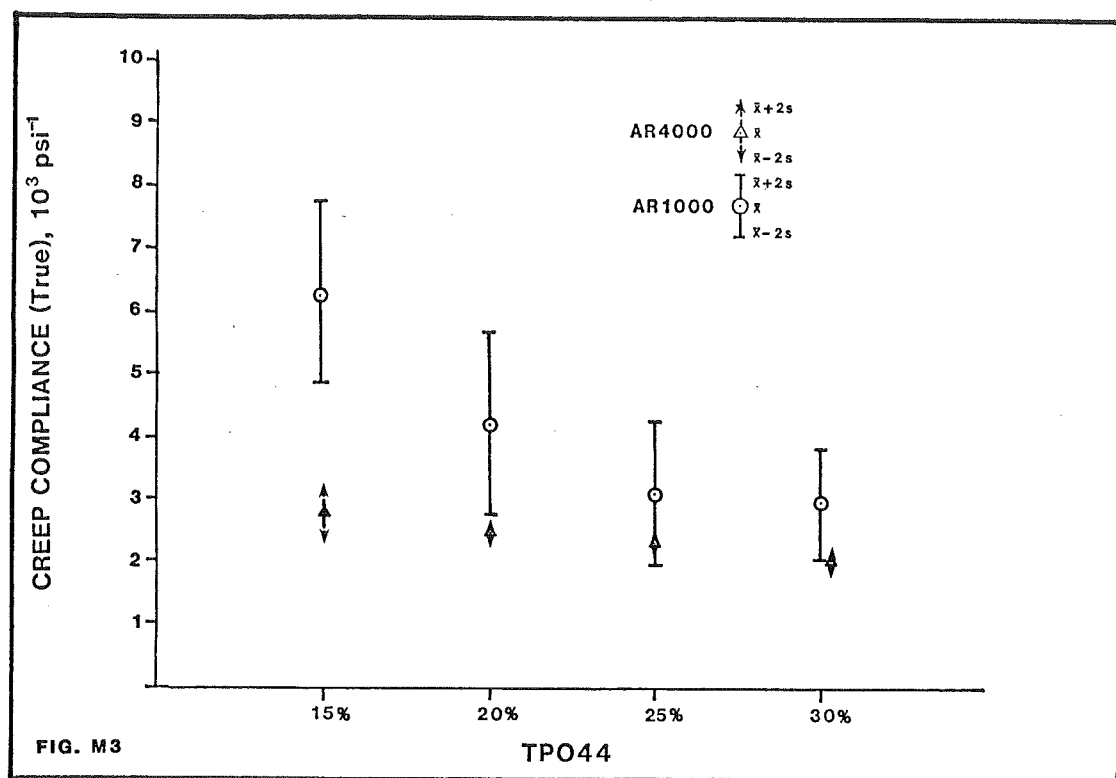
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	<u>.00220</u>	<u>.00206</u>	<u>.00313</u>	<u>.00297</u>
	S	<u>.00001</u>	<u>.00003</u>	<u>.00002</u>	<u>.00006</u>
	CV	4.30	15.04	7.77	20.55
A R 1 0 0 0	$\bar{X}$	<u>.00455</u>	<u>.00348</u>	<u>.00313</u>	<u>.00408</u>
	S	<u>.00005</u>	<u>.00005</u>	<u>.00003</u>	<u>.00007</u>
	CV	10.70	14.75	9.44	16.95

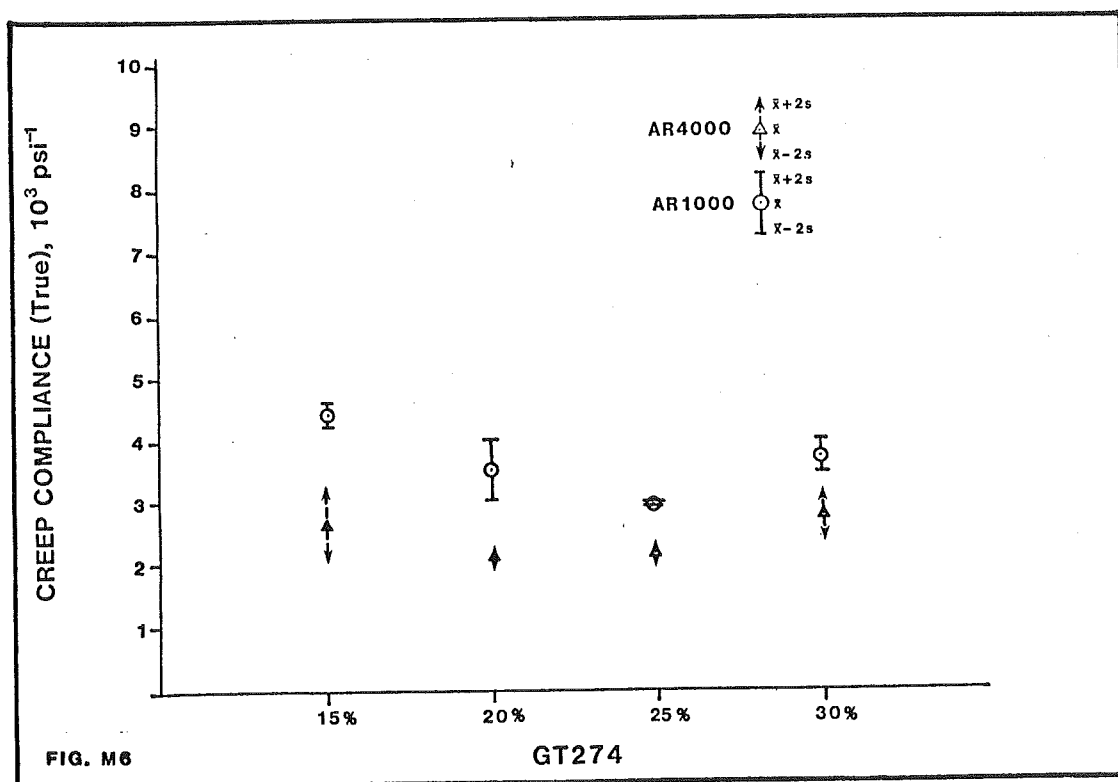
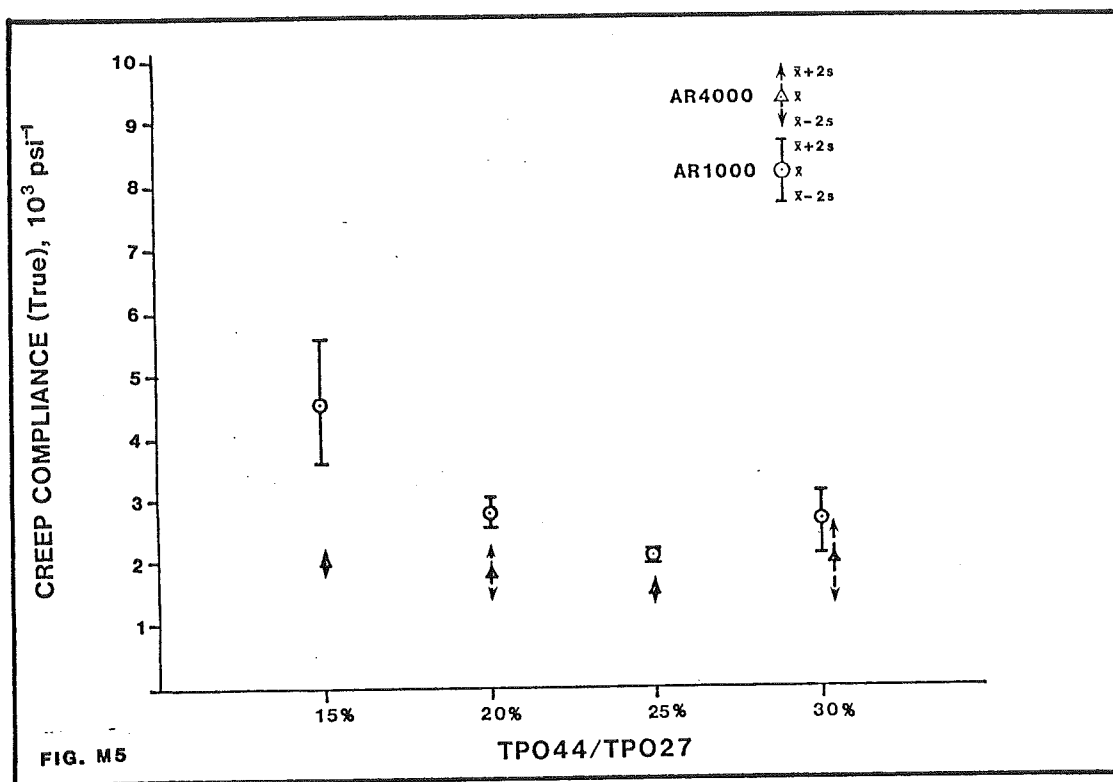
		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (R)			
		TP046				TP047				50% TP046 & 50% TP047			
		15	20	25	30	15	20	25	30	15	20	25	30
Sample	Number												
	Value												

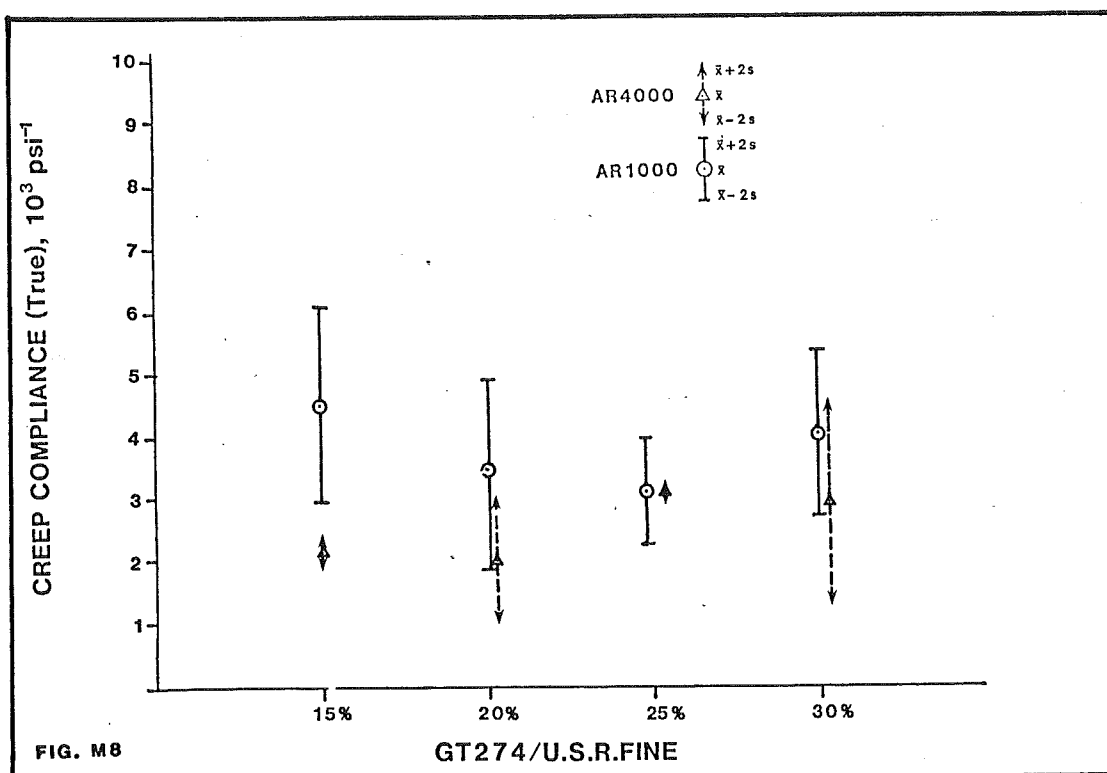
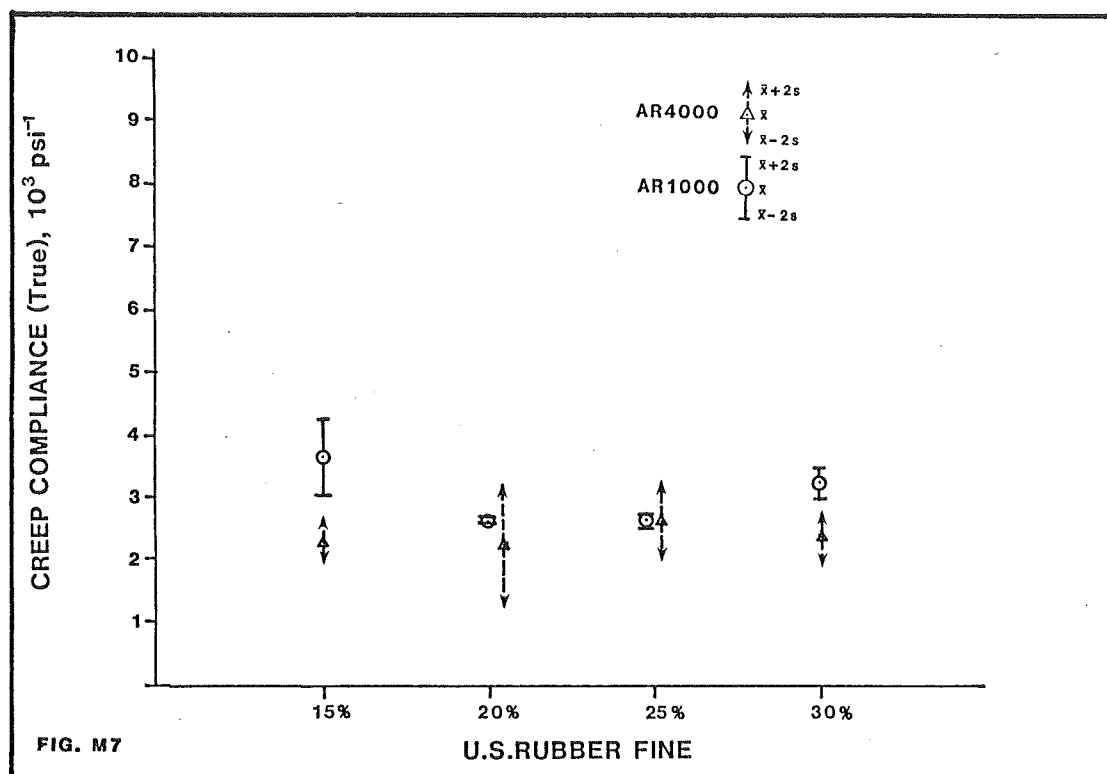
Table M-3 Anova Summary, True Creep
Compliance at Failure

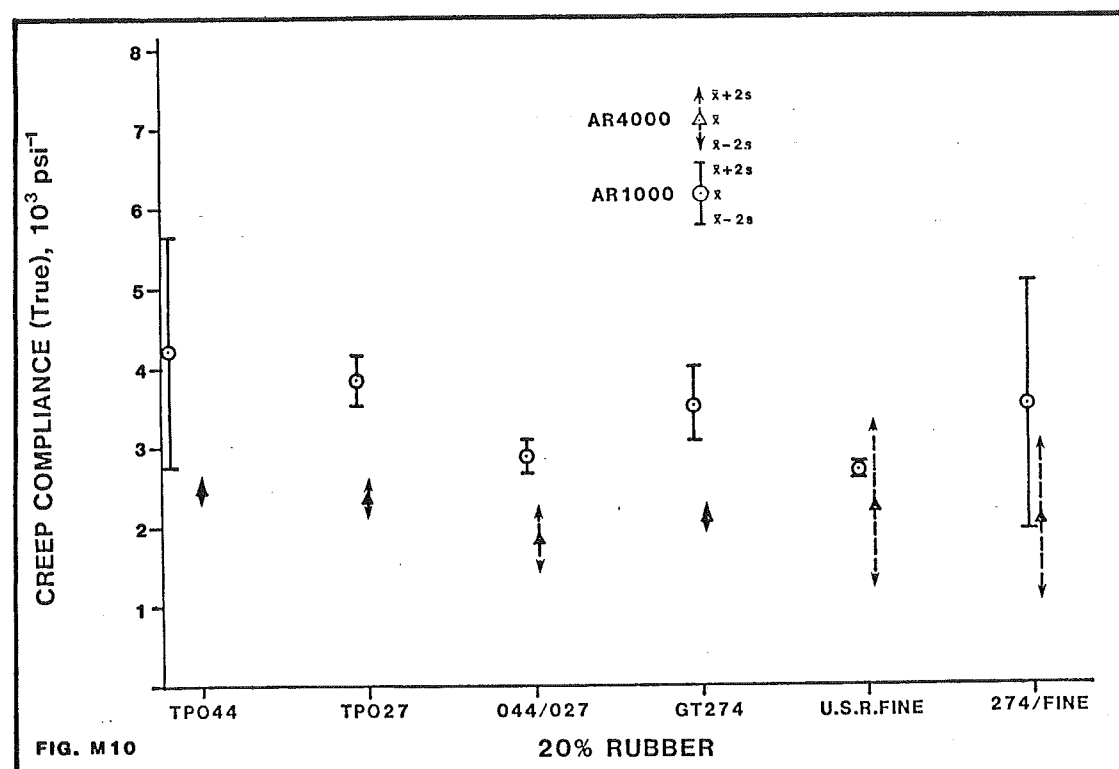
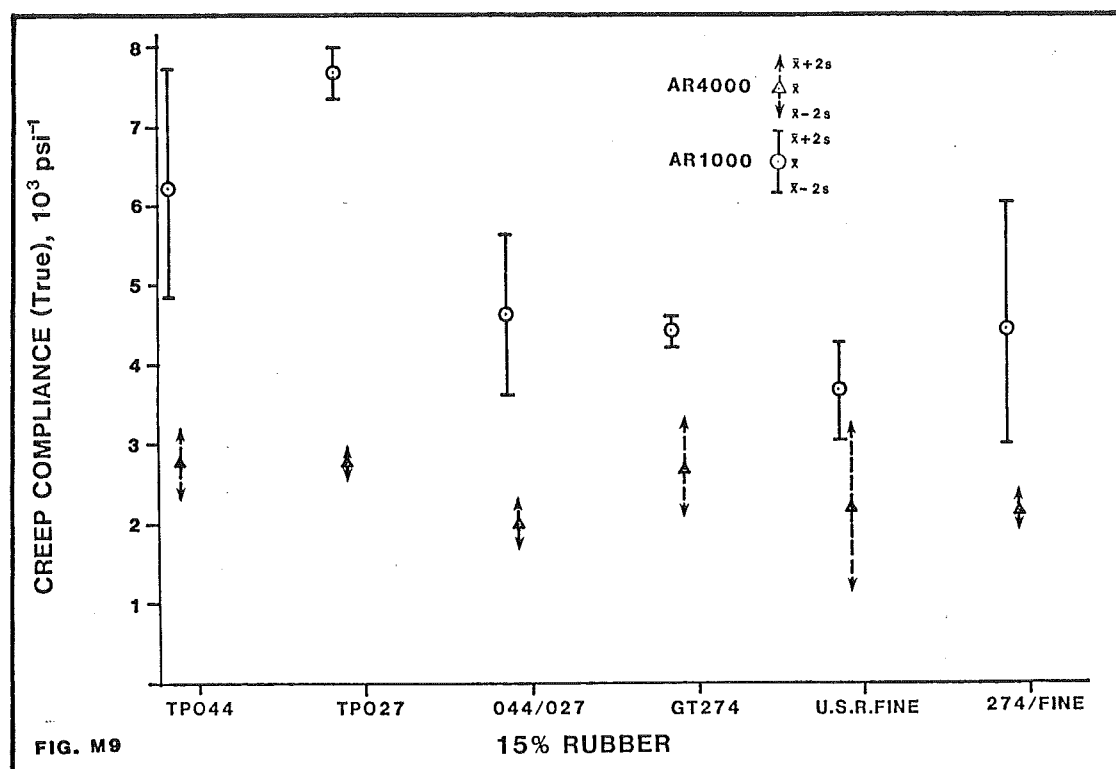
<u>ANOVA</u>						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	.0000132	.000002640	29.47	2.43	3.48
Q	3	.0000244	.000008133	90.79	2.82	4.28
A	1	.0000424	.0000424	473.30	4.07	7.27
RQ	15	.0000178	.000001187	13.25	1.91	2.49
RA	5	.0000044	.000000880	9.82	2.43	3.48
QA	3	.0000177	.000005900	65.86	2.82	4.30
RQA	15	.0000063	.000000420	4.69	1.91	2.49
Error	48	.0000043	.000000090			
TOTAL	95	.0001305				

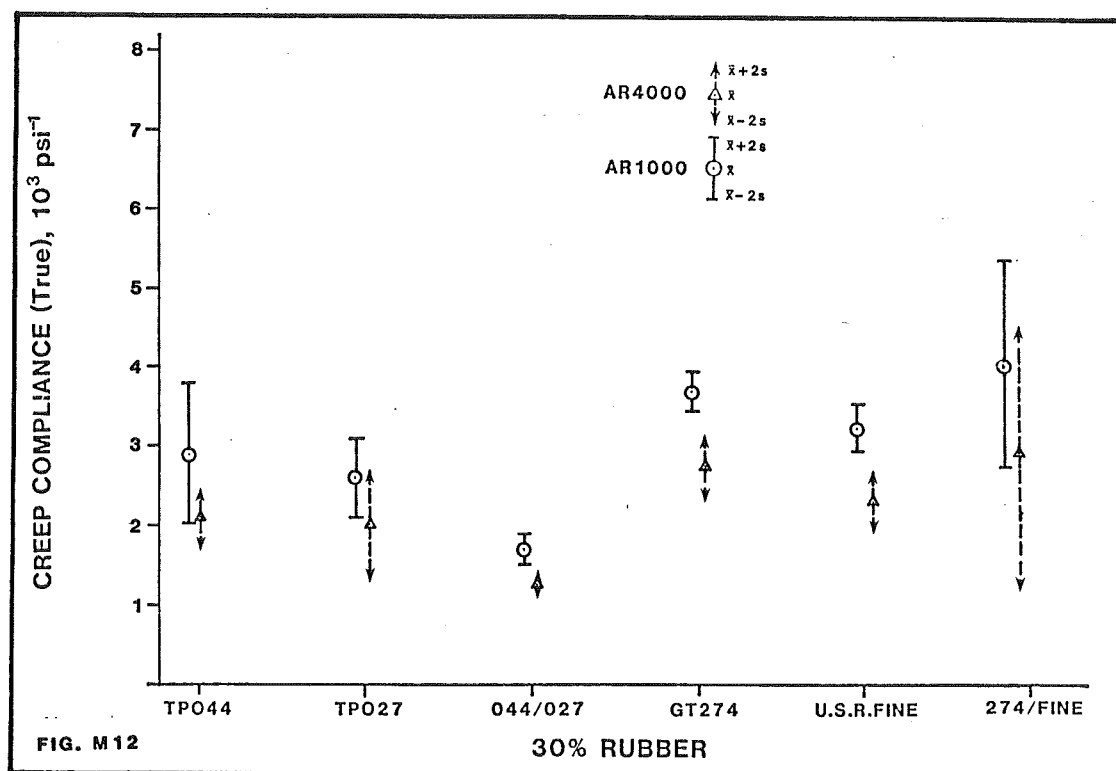
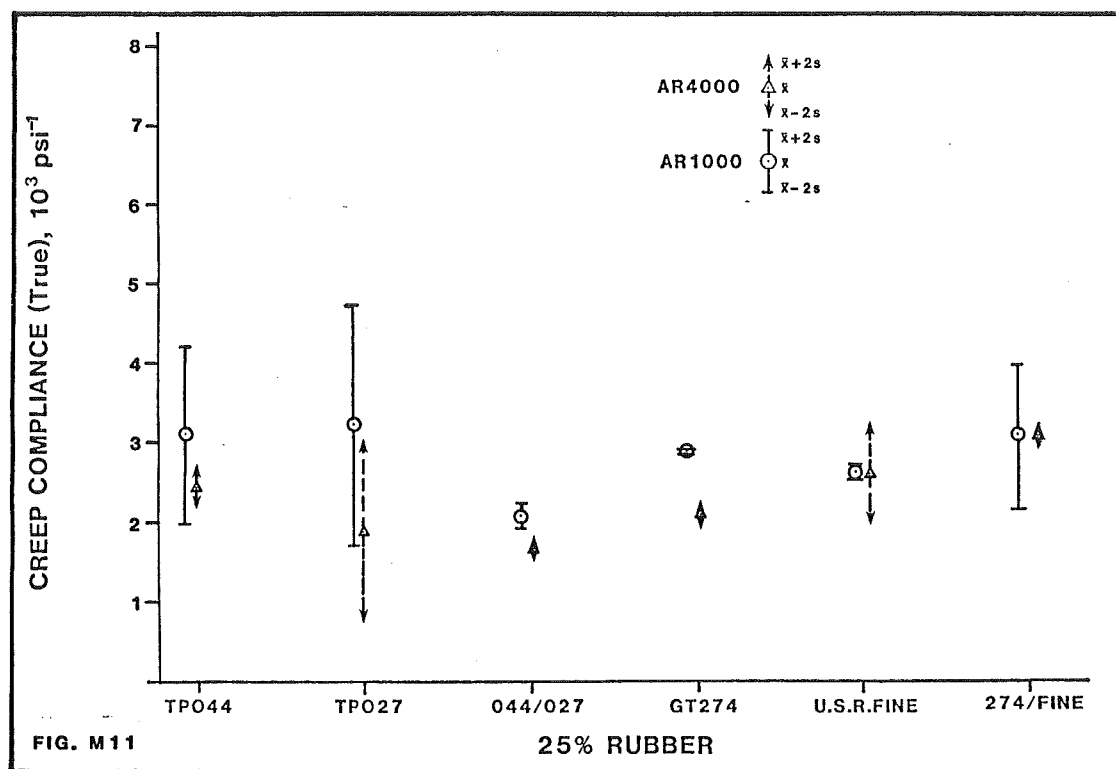












APPENDIX N
FORCE-DUCTILITY MAXIMUM TRUE CREEP
COMPLIANCE AT 39.2F (4C)

Table N-1 Maximum True Creep Compliance, psi^{-1}

a. Measured Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	.00350	.0033	.00336	.00378
	.0034	.0034	.00348	.00373
	<u>.0035</u>	<u>.0037</u>	<u>.00376</u>	<u>.00382</u>
	.0045	.00343	.0037	.0031
	.0037	.00338	.0035	.0032
	.0037	.00346	.0043	.0034
A R 1 0 0 0	.00691	.00744	.00621	.00539
	.00802	.00562	.00538	.00566
	<u>.00769</u>	<u>.00678</u>	<u>.00496</u>	<u>.00627</u>
	.0071	.00565	.00604	.0063
	.0079	.00583	.00598	.0065
	.0076	.00615	.00642	.0064

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.0037</u>	<u>.0034</u>	<u>.0037</u>	<u>.0035</u>
	S	<u>.00040</u>	<u>.00014</u>	<u>.00034</u>	<u>.00031</u>
	CV	10.82	3.95	9.13	8.96
A R 1 0 0 0	$\bar{x}$	<u>.0078</u>	<u>.0062</u>	<u>.0058</u>	<u>.0061</u>
	S	<u>.00071</u>	<u>.00073</u>	<u>.00055</u>	<u>.00045</u>
	CV	9.10	11.64	9.45	7.40

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP007			60% TP044 40% TP007			GT076			U.S. Rubber Firm			60% GT076 40% U.S. Rubber		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
15																		
20																		
25																		
30																		
35																		
40																		
45																		
50																		
55																		
60																		
65																		
70																		
75																		
80																		
85																		
90																		
95																		
100																		

Table N-1 Maximum True Creep Compliance, psi^{-1}

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.00477	.00469	.00469	.00607
	.00442	.00458	.00423	.00640
	<u>.00452</u>	<u>.00512</u>	<u>.00371</u>	<u>.00605</u>
	.00314	.00465	.00493	.00625
	.00421	.00454	.00513	.00672
	.00698	.00458	.00527	.00674
A R 1 0 0 0	.0106	.00762	.00736	.00772
	.0100	.00767	.00776	.00801
	<u>.0109</u>	<u>.00819</u>	<u>.00747</u>	<u>.00787</u>
	.0108	.00738	.00696	.00886
	.0103	.00718	.00707	.00838
	.0119	.00768	.00527	.00527

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	-X	<u>.0047</u>	<u>.0047</u>	<u>.0047</u>	<u>.0064</u>
	S	<u>.00126</u>	<u>.00022</u>	<u>.00059</u>	<u>.00031</u>
	CV	27.04	4.60	12.71	4.80
A R 1 0 0 0	-X	<u>.0108</u>	<u>.0076</u>	<u>.0070</u>	<u>.00825</u>
	S	<u>.00065</u>	<u>.00034</u>	<u>.00089</u>	<u>.00046</u>
	CV	6.08	4.47	12.69	5.55

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP046				TP027				50% TP046 & 50% TP027				G1374				U.S. Rubber Firm				50% G1374 & 50% U.S. Rubber Firm				G1374				G1374				G1374			
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Creep Compliance	15%																																				
	20%																																				
	25%																																				
	30%																																				

Table N-1 Maximum True Creep Compliance, psi^{-1}

a. Measured Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.00273	.00282	.00322	.00361
	.00248	.00289	.00322	.00366
	.00251	.00304	.00328	.00364
	.00277	.00337	.00321	.00379
	.00283	.00327	.00290	.00365
	.00285	.00327	.00298	.00332
A R 1 0 0 0	.00662	.00579	.00507	.00415
	.00648	.00545	.00520	.00409
	.00655	.00549	.00492	.00467
	.00679	.00549	.00455	.00391
	.00686	.00530	.00461	.00380
	.00717	.00507	.00462	.00379

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.0027	.0031	.0031	.0036
	S	.00016	.00023	.00016	.00016
	CV	5.97	7.28	4.95	4.32
A R 1 0 0 0	$\bar{x}$	.0067	.0054	.0048	.0041
	S	.00025	.00024	.00027	.00033
	CV	3.75	4.39	5.69	8.11

ASPHALT TYPE (A)
PERCENT RUBBER (R)
RUBBER TYPE (R)

	TP044			TP027			50% TP044 & 50% TP027			G1276			U.S. Rubber Firm			50% G1276		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Creep (in)																		
Creep (in)																		

Table N-1 Maximum True Creep Compliance, psi^{-1}

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	.00420	.00512	.00694	.00868
	.00409	.00509	.00659	.01030
	<u>.00364</u>	<u>.00493</u>	<u>.00649</u>	<u>.00880</u>
	.00485	.00435	.00688	.00866
	.00455	.00452	.00657	.01070
	.00461	.00501	.00680	.01050
A R 1 0 0 0	.00911	.00931	.00938	.01204
	.00892	.00981	.00977	.01303
	<u>.01010</u>	<u>.00939</u>	<u>.00838</u>	<u>.01187</u>
	.00816	.00990	.00948	.0116
	.00909	.00993	.00875	.0126
	.00926	.00924	.00968	.0115

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.0043</u>	<u>.0048</u>	<u>.0067</u>	<u>.0096</u>
	S	<u>.00044</u>	<u>.00033</u>	<u>.00019</u>	<u>.00099</u>
	CV	10.07	6.83	2.77	10.28
A R 1 0 0 0	$\bar{x}$	<u>.0091</u>	<u>.0096</u>	<u>.0092</u>	<u>.0121</u>
	S	<u>.00062</u>	<u>.00032</u>	<u>.00055</u>	<u>.00060</u>
	CV	6.84	3.30	5.99	4.93

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (R)			
		TP644		TP627		50% TP644 50% TP627		BT274		U.S. Rubber Firm		50% BT274 50% U.S. Firm	
		15	20	25	30	15	20	25	30	15	20	25	30
Sample	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-
Date	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-

Table N-1 Maximum True Creep Compliance, psi^{-1}

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.00371	.00459	.00924	.00744
	.00357	.00451	.00936	.00760
	<u>.00392</u>	<u>.00442</u>	<u>.00852</u>	<u>.00748</u>
	.00370	.00515	.00782	.00742
	.00382	.00535	.00831	.00735
	.00365	.00443	.00820	.00732
A R 1 0 0 0	.00802	.00773	.00743	.00934
	.00774	.00809	.00786	.00938
	<u>.00737</u>	<u>.00785</u>	<u>.00754</u>	<u>.01080</u>
	.00793	.00768	.00794	.0105
	.00825	.00762	.00802	.0115
	.00767	.00750	.00812	.0117

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	<u>.0037</u>	<u>.0047</u>	<u>.0086</u>	<u>.0074</u>
	S	<u>.00012</u>	<u>.00040</u>	<u>.00061</u>	<u>.00010</u>
	CV	3.34	8.51	7.08	1.34
A R 1 0 0 0	$\bar{X}$	<u>.0078</u>	<u>.0077</u>	<u>.0078</u>	<u>.0105</u>
	S	<u>.00031</u>	<u>.00021</u>	<u>.00027</u>	<u>.00101</u>
	CV	3.91	2.65	3.51	9.61

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP644				TP627				50% TP644 50% TP627				61274				U.S. Rubber Fine				50% 61274 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Creep	1000																																				
	10000																																				

Table N-1 Maximum True Creep Compliance, psi^{-1}

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.00372	.00423	.00881	.00882
	.00385	.00409	.00925	.00911
	<u>.00386</u>	<u>.00404</u>	<u>.00966</u>	<u>.00901</u>
	.00377	.00518	.00791	.00720
	.00351	.00526	.00787	.00694
	.00363	.00541	.00825	.00784
A R 1 0 0 0	.00924	.01077	.00856	.01028
	.00924	.01217	.00969	.00998
	<u>.00977</u>	<u>.01046</u>	<u>.00927</u>	<u>.01049</u>
	<u>.01067</u>	<u>.00858</u>	<u>.00914</u>	<u>.0107</u>
	.01073	.00886	.00928	.01038
	.01023	.00844	.00981	.01214

b. Summary

50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.0037</u>	<u>.0047</u>	<u>.0088</u>	<u>.0082</u>
	S	<u>.0001</u>	<u>.0006</u>	<u>.0009</u>	<u>.0010</u>
	CV	3.63	13.71	10.32	11.73
A R 1 0 0 0	$\bar{x}$	<u>.0100</u>	<u>.0099</u>	<u>.0093</u>	<u>.0107</u>
	S	<u>.0007</u>	<u>.0015</u>	<u>.0004</u>	<u>.0008</u>
	CV	6.71	15.13	4.78	7.15

		ASPHALT TYPE (A)									PERCENT RUBBER (B)									RUBBER TYPE (C)																		
		TPQ44			TPQ47			50% TPQ44 50% TPQ47			Q1376			U.S. Rubber Fine			50% Q1376 50% U.S. Rubber Fine																					
		15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	
Sample	1																																					
	2																																					
Sample	3																																					
	4																																					

Table N-2 Maximum True Creep Compliance, psi^{-1}

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	.00347	.00347	.00353	.00378
	.00397	.00342	.00383	.00323
A R 1 0 0 0	.00754	.00661	.00552	.00577
	.00820	.00588	.00615	.00640

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	-x	.00372	.00345	.00368	.00351
	S	.00044	.00004	.00027	.00049
	CV	11.83	1.16	7.34	13.96
A R 1 0 0 0	-x	.00787	.00625	.00584	.00609
	S	.00058	.00065	.00056	.00056
	CV	7.37	10.40	9.59	9.20

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

TP044	TP007	80% TP044 20% TP007	GT276	U.S. Rubber Firm	80% GT276 20% U.S. Rubber Firm
15	15	15	15	15	15
20	20	20	20	20	20
25	25	25	25	25	25
30	30	30	30	30	30
35	35	35	35	35	35
40	40	40	40	40	40
45	45	45	45	45	45
50	50	50	50	50	50
55	55	55	55	55	55
60	60	60	60	60	60
65	65	65	65	65	65
70	70	70	70	70	70
75	75	75	75	75	75
80	80	80	80	80	80
85	85	85	85	85	85
90	90	90	90	90	90
95	95	95	95	95	95
100	100	100	100	100	100

Table N-2 Maximum True Creep Compliance, psi^{-1}

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.00457	.00480	.00421	.00617
	.00478	.00459	.00511	.00657
A R 1 0 0 0	.01050	.00783	.00753	.00787
	.01100	.00741	.00643	.00864

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.00468	.00470	.00460	.00637
	S	.00019	.00019	.00080	.00035
	CV	4.06	4.04	17.39	5.49
A R 1 0 0 0	$\bar{x}$	.01075	.00762	.00698	.00826
	S	.00044	.00037	.00097	.00068
	CV	4.09	4.86	13.90	8.23

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

PERCENT RUBBER (B)	TP044				TP017				50% TP044 50% TP017				07276				U.S. Rubber Firm				50% 07276 50% U.S. Rubber Firm			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
ASPHALT TYPE (A)																								
RUBBER TYPE (C)																								

Table N-2 Maximum True Creep Compliance, psi^{-1}

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	.00257	.00292	.00324	.00364
	.00282	.00330	.00303	.00359
A R 1 0 0 0	.00655	.00558	.00506	.00430
	.00694	.00529	.00459	.00383

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	-x	.00270	.00311	.00314	.00362
	S	.00022	.00034	.00019	.00004
	CV	8.15	10.93	6.05	1.10
A R 1 0 0 0	-x	.00675	.00544	.00483	.00407
	S	.00035	.00026	.00042	.00042
	CV	5.19	4.78	8.70	10.32

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044		TP027		50% TP044 50% TP027		G1376		U.S. Rubber Firm		50% G1376 50% R.F. 6	
		15	20	25	30	15	20	25	30	15	20	25	30
Compliance	1000-150	-	-	-	-	-	-	-	-	-	-	-	-
	1000-200	-	-	-	-	-	-	-	-	-	-	-	-

Table N-2 Maximum True Creep Compliance, psi^{-1}

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	.00398	.00505	.00667	.00926
	_____	_____	_____	_____
	.00467	.00465	.00675	.00995
A R 1 0 0 0	.00938	.00950	.00918	.01231
	_____	_____	_____	_____
	.00884	.00969	.00930	.01190

b. Summary

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.00433	.00485	.00671	.00961
	S	.00061	.00035	.00007	.00061
	CV	14.09	7.22	1.04	6.35
A R 1 0 0 0	$\bar{x}$	.00911	.00945	.00924	.01211
	S	.00048	.00010	.00011	.00036
	CV	5.27	1.06	1.19	2.97

[illegible]

Table N-2 Maximum True Creep Compliance, psi^{-1}

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.00373	.00451	.00904	.00751
	.00372	.00498	.00811	.00736
A R 1 0 0 0	.00771	.00789	.00761	.00984
	.00795	.00760	.00803	.01123

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.00373	.00475	.00858	.00744
	S	.00001	.00042	.00082	.00013
	CV	0.27	8.84	9.56	1.75
A R 1 0 0 0	$\bar{x}$	.00783	.00775	.00782	.01054
	S	.00021	.00026	.00037	.00123
	CV	7.68	3.35	4.73	11.67

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP024			TP027			50% TP024 & 50% TP027			B1276			U.S. Rubber Fine			50% B1276 & 50% U.S. Rubber Fine		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Creep Compliance																		
Standard Deviation																		
Coefficient of Variation																		

Table N-2 Maximum True Creep Compliance, psi^{-1}

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.00381	.00412	.00961	.00898
	.00364	.00528	.00801	.00733
A R 1 0 0 0	.00942	.01113	.00917	.01025
	.01054	.00863	.00941	.01107

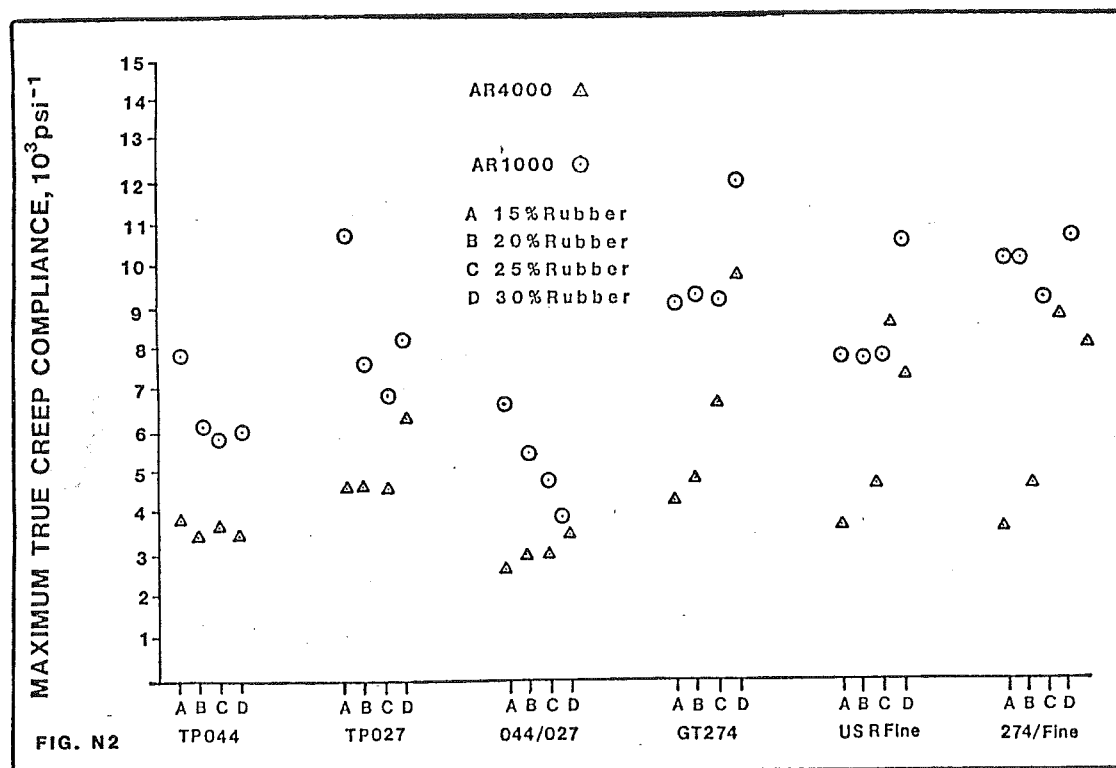
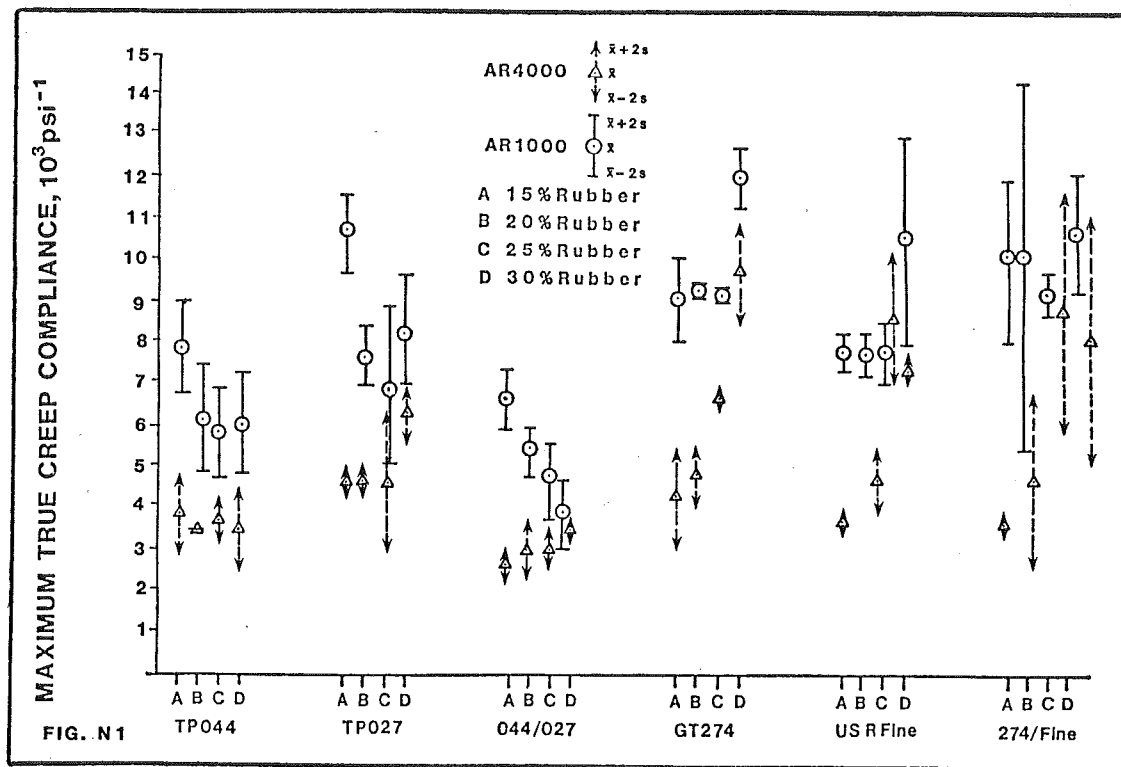
b. Summary

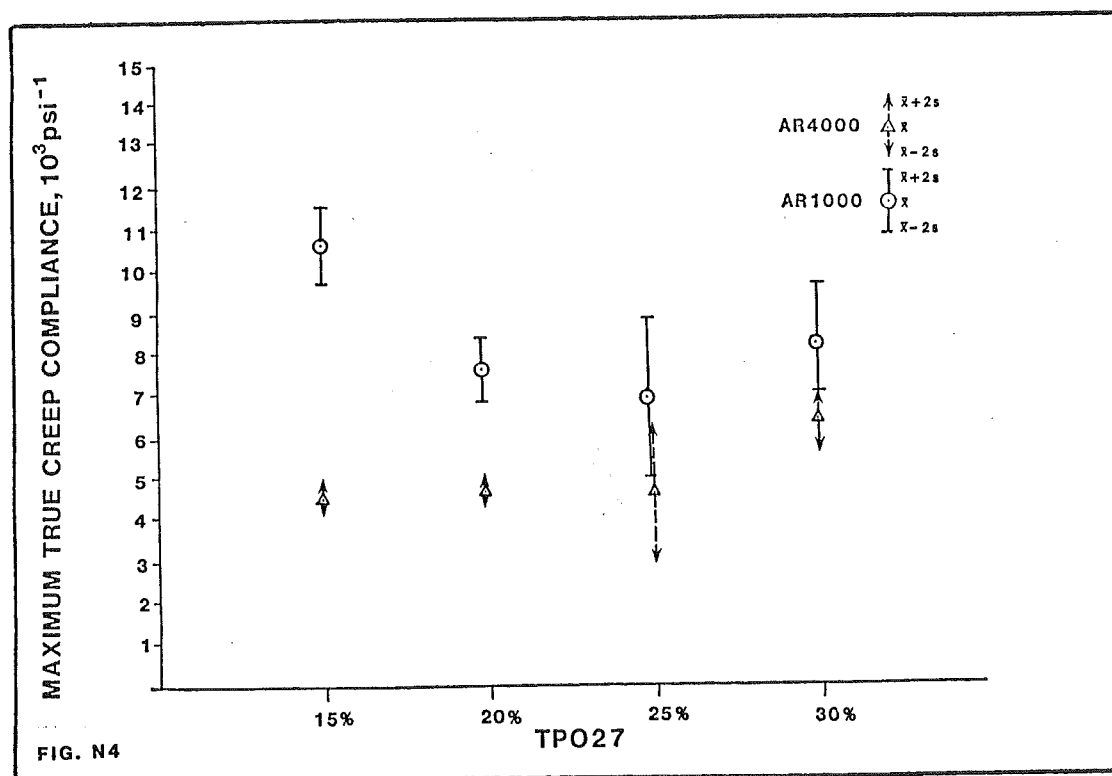
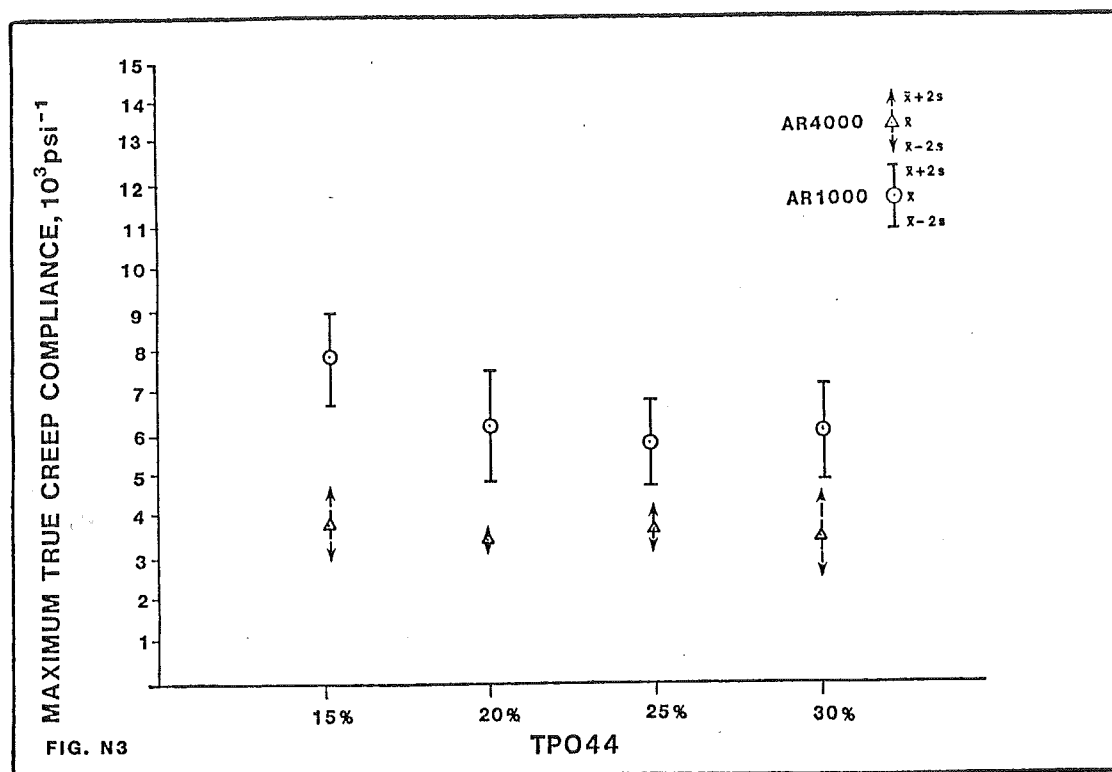
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	.00373	.00470	.00881	.00816
	S	.00015	.00103	.00140	.00146
	CV	4.02	21.91	15.89	17.89
A R 1 0 0 0	$\bar{X}$	.00998	.00980	.00929	.01066
	S	.00099	.00222	.00021	.00073
	CV	9.92	22.65	2.26	6.85

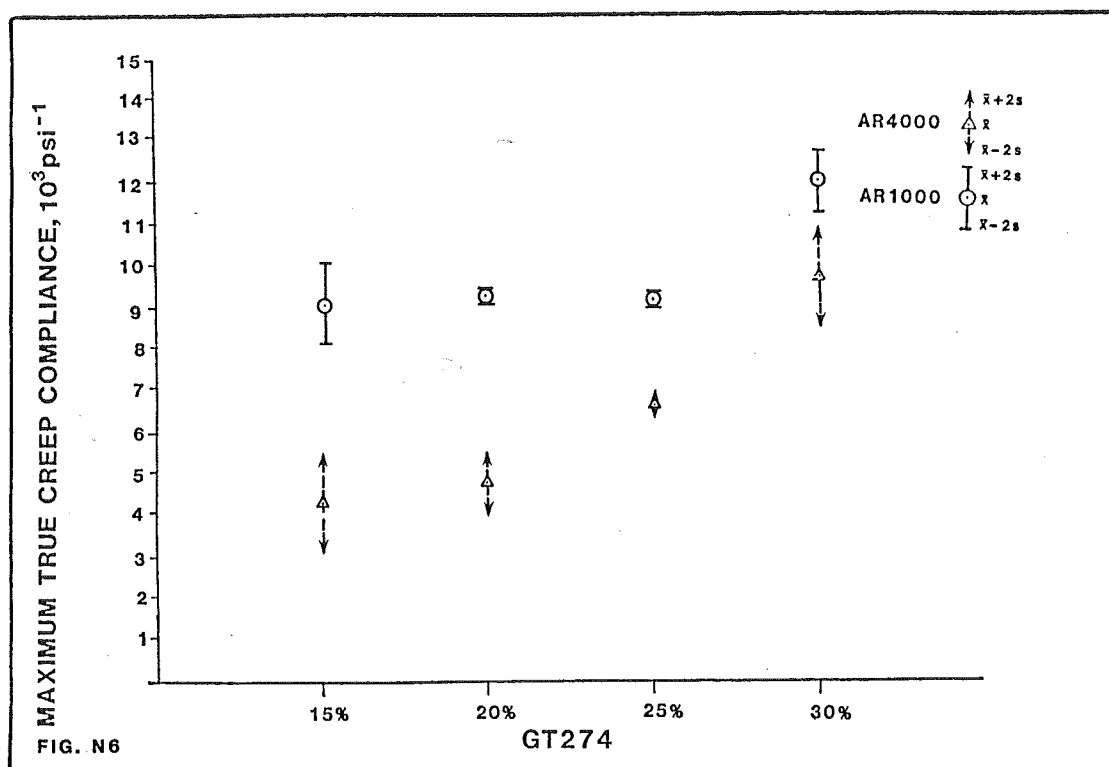
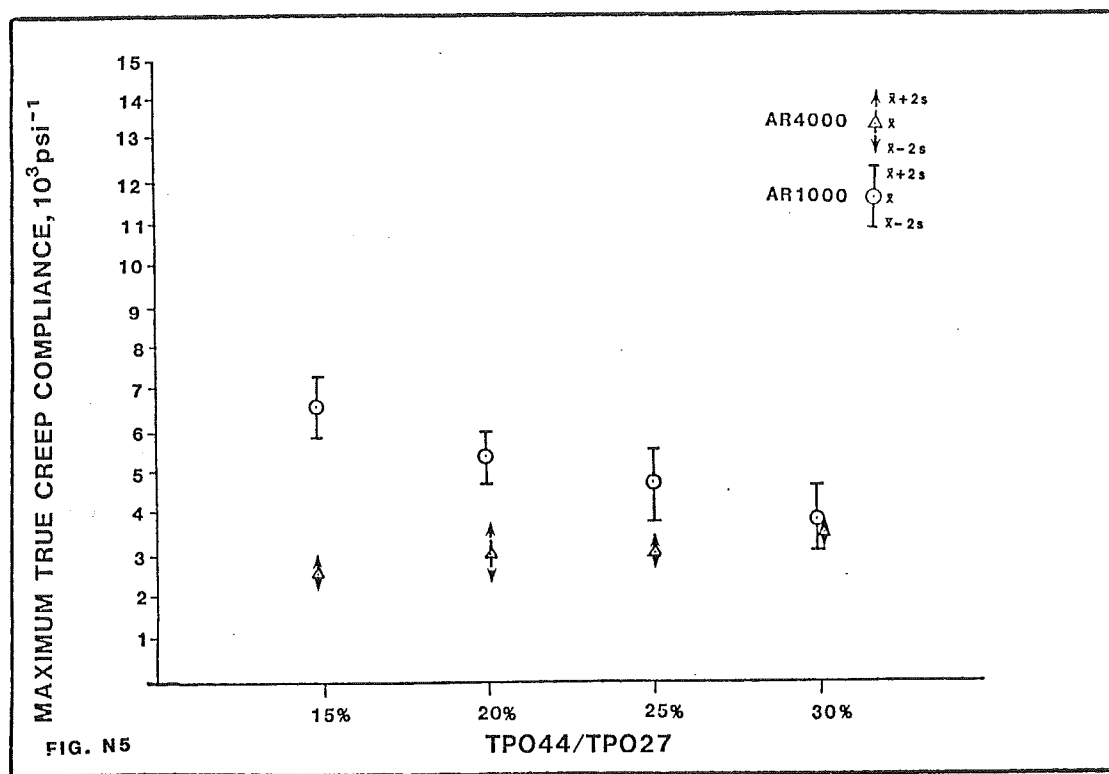
		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TPG40				TPG47				50% TPG40 & 50% TPG47			
		15	20	25	30	15	20	25	30	15	20	25	30
Rubber Type	TPG40												
	TPG47												
	50% TPG40 & 50% TPG47												
	U.S. Rubber Fine												
Asphalt Type	TPG40												
	TPG47												
	50% TPG40 & 50% TPG47												
	U.S. Rubber Fine												

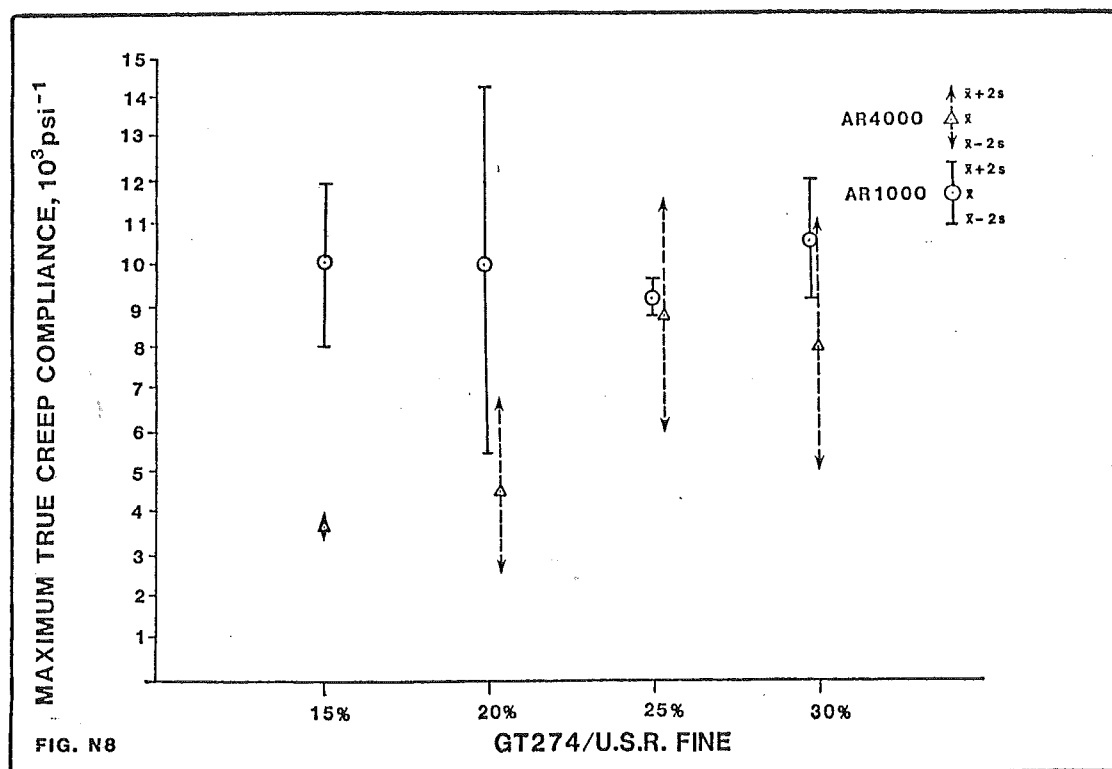
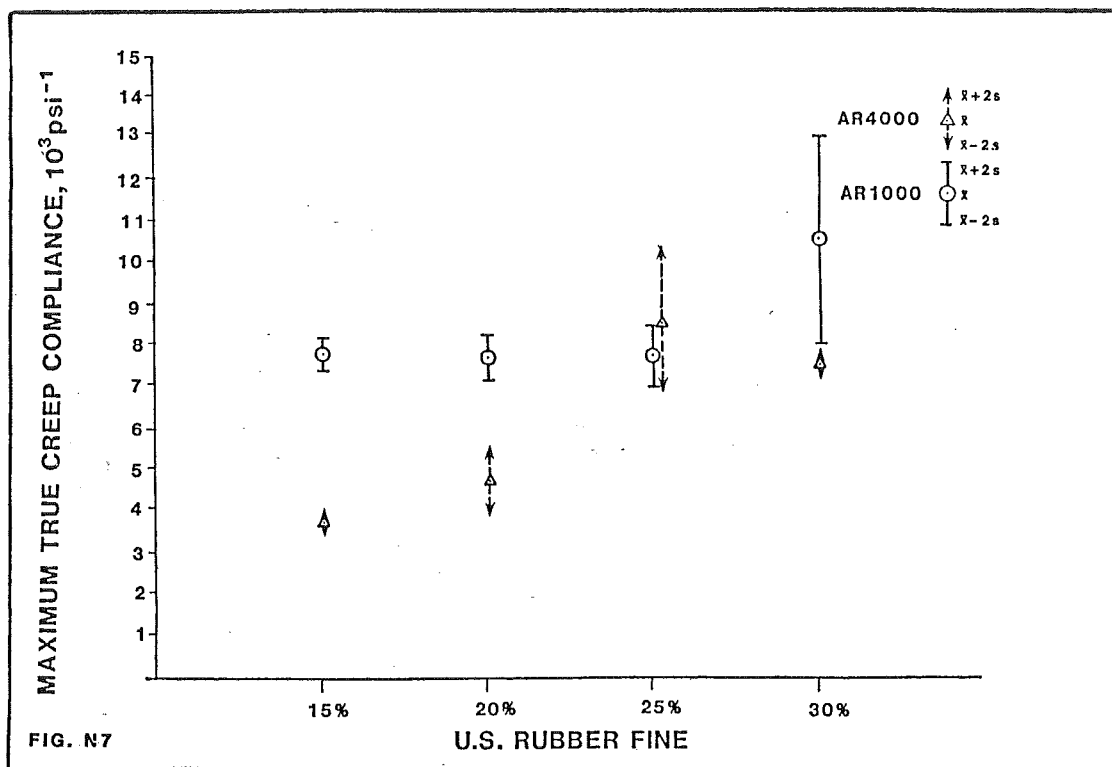
Table N-3 Anova Summary, Maximum True Creep Compliance

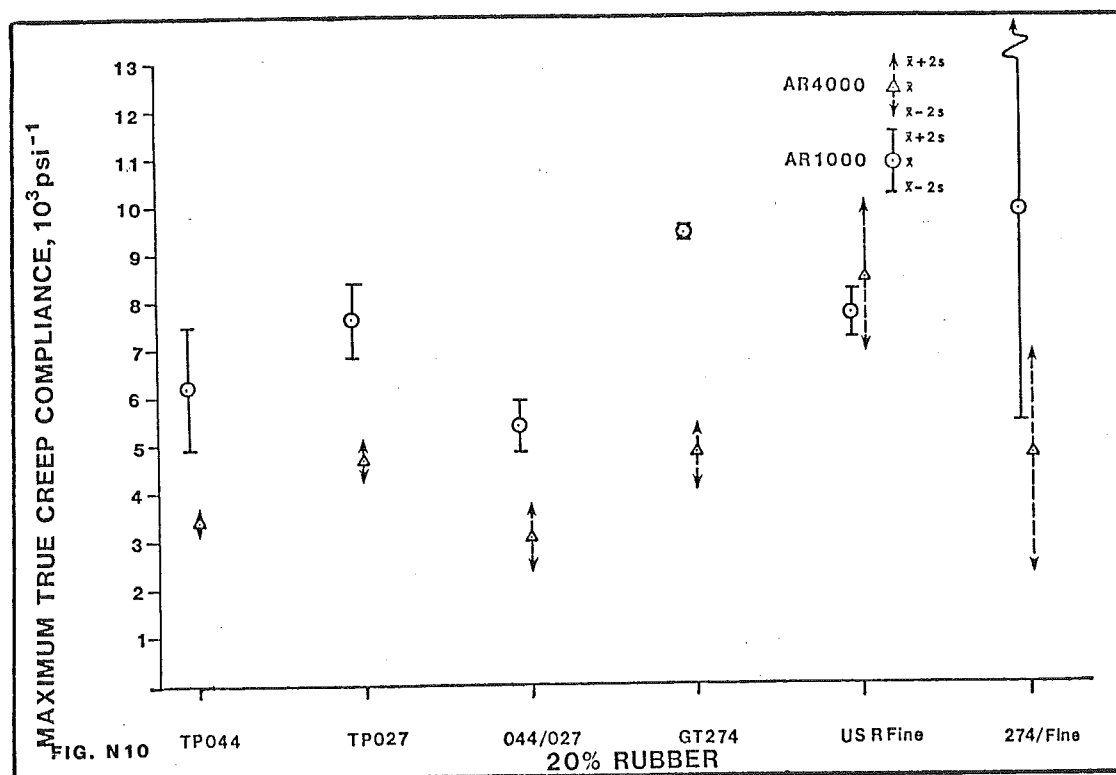
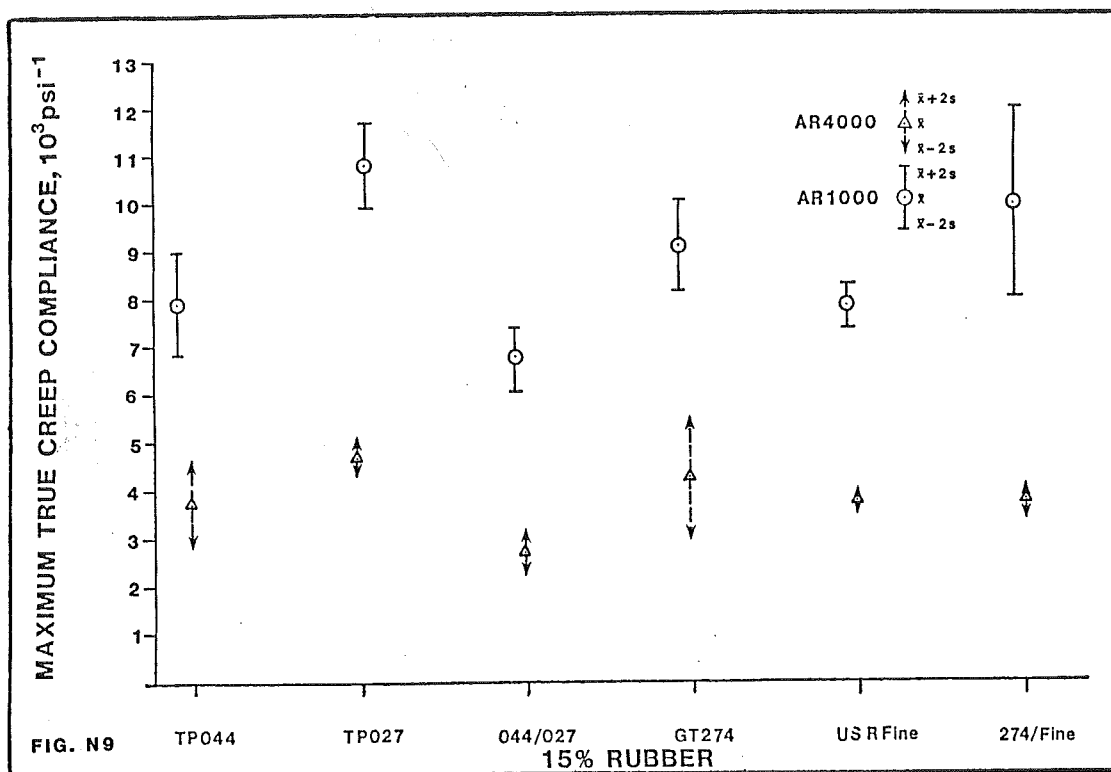
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	.0002167	.000043340	157.60	2.43	3.48
Q	3	.0000325	.000010833	39.39	3.82	4.27
A	1	.0002141	.0002141	778.54	4.06	7.27
RQ	15	.0000713	.000004753	17.28	1.90	2.49
RA	5	.0000080	.000001600	5.81	2.43	3.48
QA	3	.0000425	.000014167	51.51	2.82	4.27
RQA	15	.0000162	.000001080	3.92	1.90	2.49
Error	48	.0000132	.000000275			
TOTAL	95	.0006146				

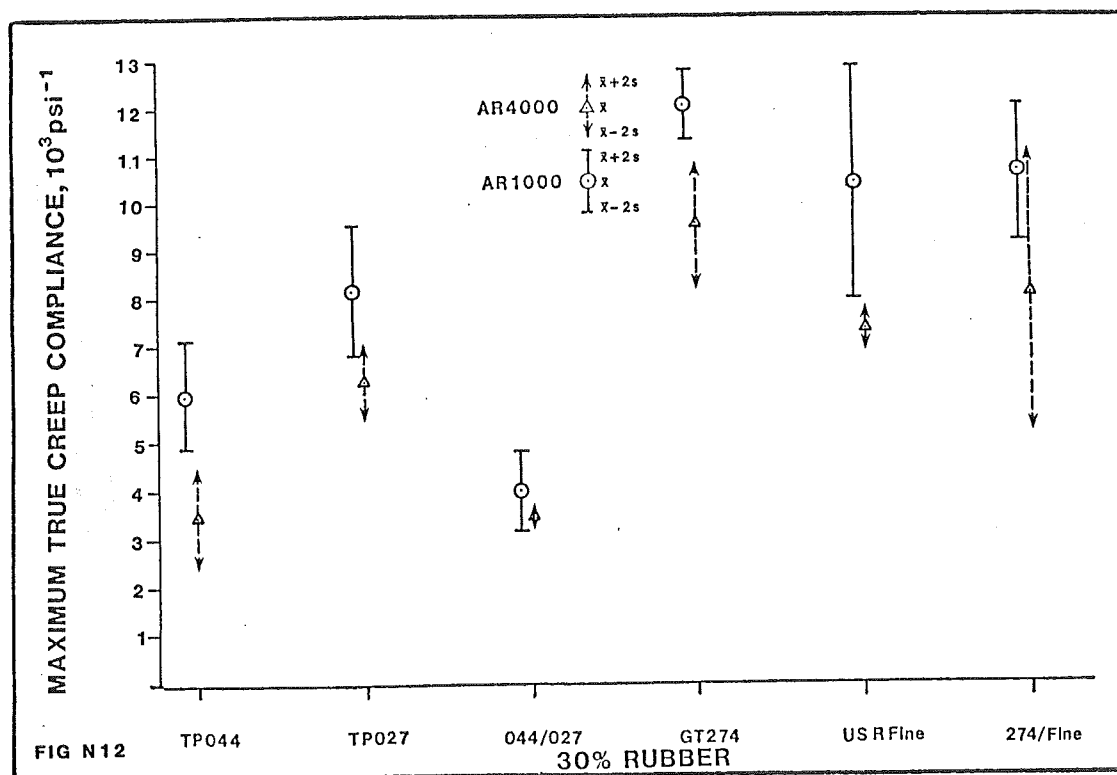
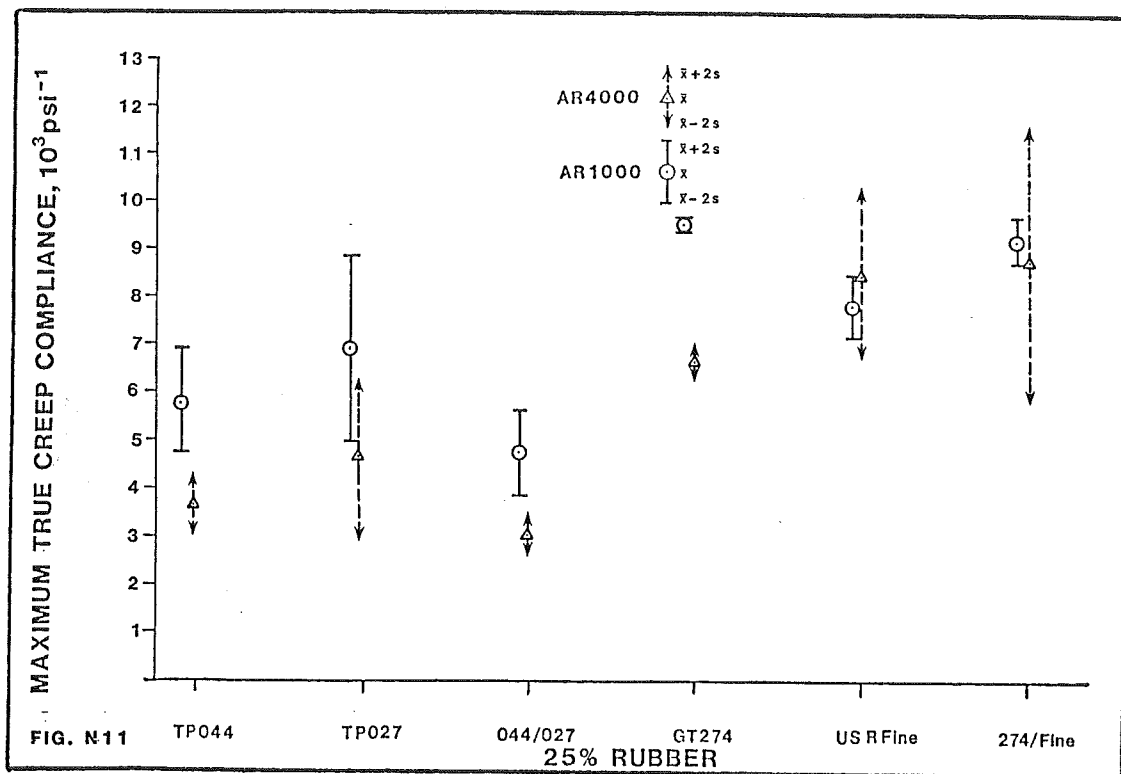












APPENDIX O

FORCE DUCTILITY TIME TO MAXIMUM
TRUE CREEP COMPLIANCE AT 39.2F(4C)

Table O-1 Time to Maximum True Creep Compliance

a. Measured Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	13	10	9	7
	14	10	9	7
	13	11	9	7
	12	11	9	7
	12	11	9	8
A R 1 0 0 0	13	11	10	8
	11	9	7	6
	11	9	8	7
	12	9	7	6
	14	9	7	6
	11	10	7	6
	12	9	7	6

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>12.83</u>	<u>10.67</u>	<u>9.17</u>	<u>7.33</u>
	S	<u>.75</u>	<u>.52</u>	<u>.41</u>	<u>.52</u>
	CV	5.85	4.81	4.47	7.09
A R 1 0 0 0	$\bar{x}$	<u>11.83</u>	<u>9.17</u>	<u>7.17</u>	<u>6.17</u>
	S	<u>1.17</u>	<u>.41</u>	<u>.41</u>	<u>.41</u>
	CV	9.89	4.47	5.72	6.65

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP047			50% TP044 & 50% TP047			GT374			U.S. Rubber Fine			50% GT374 & 50% U.S. Rubber Fine		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
TP044																		
TP047																		
50% TP044 & 50% TP047																		
GT374																		
U.S. Rubber Fine																		
50% GT374 & 50% U.S. Rubber Fine																		

Table O-1 Time to Maximum True Creep Compliance

a. Measured Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	13	11	9	8
	13	11	9	7
	13	11	9	7
	13	11	9	7
	13	11	9	8
	13	11	9	8
A R 1 0 0 0	14	10	8	7
	13	10	8	7
	14	9	8	7
	14	10	8	7
	13	10	8	7
	14	11	8	7

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>13.00</u>	<u>11.00</u>	<u>9.00</u>	<u>7.50</u>
	s	<u>0</u>	<u>0</u>	<u>0</u>	<u>.55</u>
	cv	<u>0</u>	<u>0</u>	<u>0</u>	<u>7.33</u>
A R 1 0 0 0	$\bar{x}$	<u>13.67</u>	<u>10.00</u>	<u>8.00</u>	<u>7.00</u>
	s	<u>.52</u>	<u>.63</u>	<u>0</u>	<u>0</u>
	cv	<u>3.80</u>	<u>6.30</u>	<u>0</u>	<u>0</u>

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP027			50% TP044 50% TP027			51374			U.S. Rubber Type			50% 51374 50% 51374		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
Compliance																		
Time to Max. True Creep Compliance																		

a. Measured Data

b. Summary

[illegible]

Table O-1 Time to Maximum True Creep Compliance

a. Measured Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	14	12	11	10
	14	13	11	10
	14	13	11	9
	14	13	11	10
	14	13	11	9
	14	13	11	9
A R 1 0 0 0	14	12	10	9
	14	12	9	10
	13	12	9	9
	14	11	10	9
	14	12	11	8
	14	11	10	9

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>14.0</u>	<u>12.83</u>	<u>11.00</u>	<u>9.50</u>
	s	<u>0</u>	<u>.41</u>	<u>0</u>	<u>.55</u>
	cv	0	3.20	0	5.79
A R 1 0 0 0	$\bar{x}$	<u>13.83</u>	<u>11.67</u>	<u>9.83</u>	<u>9.00</u>
	s	<u>.41</u>	<u>.52</u>	<u>.75</u>	<u>.63</u>
	cv	2.96	4.46	7.63	7.00

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				50% TP044 50% TP027				G1316				U.S. Rubber Fm				50% G1316 50% Rubber Fm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Time to Max True Creep Compliance (min)	15																																				
	20																																				
	25																																				
	30																																				
Time to Max True Creep Compliance (min)	15																																				
	20																																				
	25																																				
	30																																				

Table O-1 Time to Maximum True Creep Compliance

a. Measured Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	14	12	11	10
	12	12	11	10
	14	12	12	10
	14	13	12	9
	14	13	10	9
	13	13	11	10
A R 1 0 0 0	14	11	9	7
	13	11	9	8
	13	10	10	8
	13	12	10	9
	13	10	10	9
	13	11	10	8

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	13.33	12.50	11.17	9.67
	S	.82	.55	.75	.52
	CV	6.15	4.40	6.71	5.38
A R 1 0 0 0	$\bar{x}$	13.17	10.83	9.67	8.17
	S	.41	.75	.52	.75
	CV	3.11	6.93	5.38	9.18

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (B)																	
		TP044				TP077				50% TP044 50% TP077				B1274				U.S. Rubber Fine				50% B1274 50% U.S. Rubber																					
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30		
CREEP	100-150																																										
	150-200																																										

Table O-1 Time to Maximum True Creep Compliance

a. Measured Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	14	13	9	11
	14	13	9	11
	14	13	9	10
	14	12	11	9
	14	12	12	10
	14	13	11	9
A R 1 0 0 0	13	11	11	9
	14	10	10	9
	13	10	9	9
	14	12	10	9
	14	12	10	9
	14	11	10	8

b. Summary

50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>14.00</u>	<u>12.67</u>	<u>10.17</u>	<u>10.00</u>
	S	<u>0</u>	<u>.52</u>	<u>1.33</u>	<u>.89</u>
	CV	<u>0</u>	<u>4.10</u>	<u>13.08</u>	<u>8.90</u>
A R 1 0 0 0	$\bar{x}$	<u>13.67</u>	<u>11.00</u>	<u>10.00</u>	<u>8.83</u>
	S	<u>.52</u>	<u>.89</u>	<u>.63</u>	<u>.41</u>
	CV	<u>3.80</u>	<u>8.09</u>	<u>6.30</u>	<u>4.64</u>

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP046			TP047			50% TP046 & 50% TP047			GT274			U.S. Rubber Fine			50% GT274 & 50% U.S. Rubber Fine		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Time to Max. True Creep Compliance (min)	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Standard Deviation (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coefficient of Variation (CV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table O-2 Time to Maximum True Creep Compliance

a. Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	13.3	10.3	9.0	7.0
	12.3	11.0	9.3	7.7
A R 1 0 0 0	11.3	9.0	7.3	6.7
	12.3	9.3	7.0	6.0

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	12.8	10.7	9.2	7.4
	S	.89	.62	.27	.62
	CV	6.92	5.82	2.90	8.44
A R 1 0 0 0	$\bar{x}$	11.8	9.2	7.2	6.4
	S	.89	.27	.27	.62
	CV	7.51	2.90	3.72	9.77

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP007				50% TP044 50% TP007			
		15	20	25	30	15	20	25	30	15	20	25	30
S T R E T	15												
	20												
	25												
	30												

Table O-2 Time to Maximum True Creep Compliance

a. Analyzed Data

TPO 27				
	15%	20%	25%	30%
AR 4000	13.0	11.0	9.0	7.3
	13.0	11.0	9.0	7.7
AR 1000	13.7	9.7	8.0	7.0
	13.7	10.3	8.0	7.0

b. Summary

TP027					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	13.0	11.0	9.0	7.5
	S	0	0	0	.35
	CV	0	0	0	4.73
AR 1000	$\bar{x}$	13.7	10.0	8.0	7.0
	S	0	.53	0	0
	CV	0	5.32	0	0

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

GRADE	TP044				TP027				50% TP044 & 50% TP027				01274				U.S. Rubber Fm				50% 01274 & 50% Fm 5			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
1000																								
2000																								
3000																								
4000																								
5000																								
6000																								
7000																								
8000																								
9000																								
10000																								

Table O-2 Time to Maximum True Creep Compliance

a. Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	13.7	11.0	8.7	7.3
	13.0	10.0	9.0	7.3
A R 1 0 0 0	12.0	9.0	7.3	6.7
	12.3	9.0	7.7	6.7

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	13.4	10.5	8.9	7.3
	S	.62	.89	.27	0
	CV	4.65	8.44	3.00	0
A R 1 0 0 0	$\bar{x}$	12.2	9.0	7.5	6.7
	S	.27	0	.35	0
	CV	2.19	0	4.73	0

		ASPHALT TYPE (A)									PERCENT RUBBER (B)									RUBBER TYPE (C)																	
		TP044			TP027			50% TP044 + 50% TP027			G1504			U.S. Rubber Firm			50% G1504 50% U.S. Rubber																				
		15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
AR 4000	Time to Max. True Creep Compliance (min)																																				
	Standard Deviation (S)																																				
AR 1000	Time to Max. True Creep Compliance (min)																																				
	Standard Deviation (S)																																				

Table O-2 Time to Maximum True Creep Compliance

a. Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	14.0	12.7	11.0	9.7
	14.0	13.0	11.0	9.3
A R 1 0 0 0	13.7	12.0	9.3	9.3
	14.0	11.3	10.3	8.7

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	14.0	12.9	11.0	9.5
	S	0	.27	0	.35
	CV	0	2.07	0	3.73
A R 1 0 0 0	$\bar{x}$	13.9	11.7	9.8	9.0
	S	.27	.62	.89	.53
	CV	1.92	5.32	9.04	5.91

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (B)											
		TP004				TP007				60% TP004 40% TP007				GT274				U.S. Rubber Type				60% GT274 40% U.S. Type				60% GT274 40% U.S. Type				60% GT274 40% U.S. Type							
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Time to Max. True Creep Compliance (min)	15																																				
	20																																				
	25																																				
	30																																				
Time to Max. True Creep Compliance (min)	15																																				
	20																																				
	25																																				
	30																																				

Table O-2 Time to Maximum True Creep Compliance

a. Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	13.3	12.0	11.3	10.0
	13.3	13.0	11.0	9.3
A R 1 0 0 0	13.3	10.7	9.3	7.7
	13.0	11.0	10.0	8.7

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>13.3</u>	<u>12.5</u>	<u>11.2</u>	<u>9.7</u>
	S	<u>0</u>	<u>.89</u>	<u>.27</u>	<u>.62</u>
	CV	0	7.09	2.38	6.43
A R 1 0 0 0	$\bar{x}$	<u>13.2</u>	<u>10.9</u>	<u>9.7</u>	<u>8.2</u>
	S	<u>.27</u>	<u>.27</u>	<u>.62</u>	<u>.89</u>
	CV	2.02	2.45	6.43	10.80

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)												
		TP644				TP627				50% TP644 50% TP627				61374				U.S. Rubber Fine				50% 61374 50% U.S. Rubber																
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	
GRADE	100-100																																					
	400-50																																					

Table O-2 Time to Maximum True Creep Compliance

a. Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	14.0	13.0	9.0	10.7
	14.0	12.3	11.3	9.3
A R 1 0 0 0	13.3	10.3	10.0	9.0
	14.0	11.7	10.0	8.7

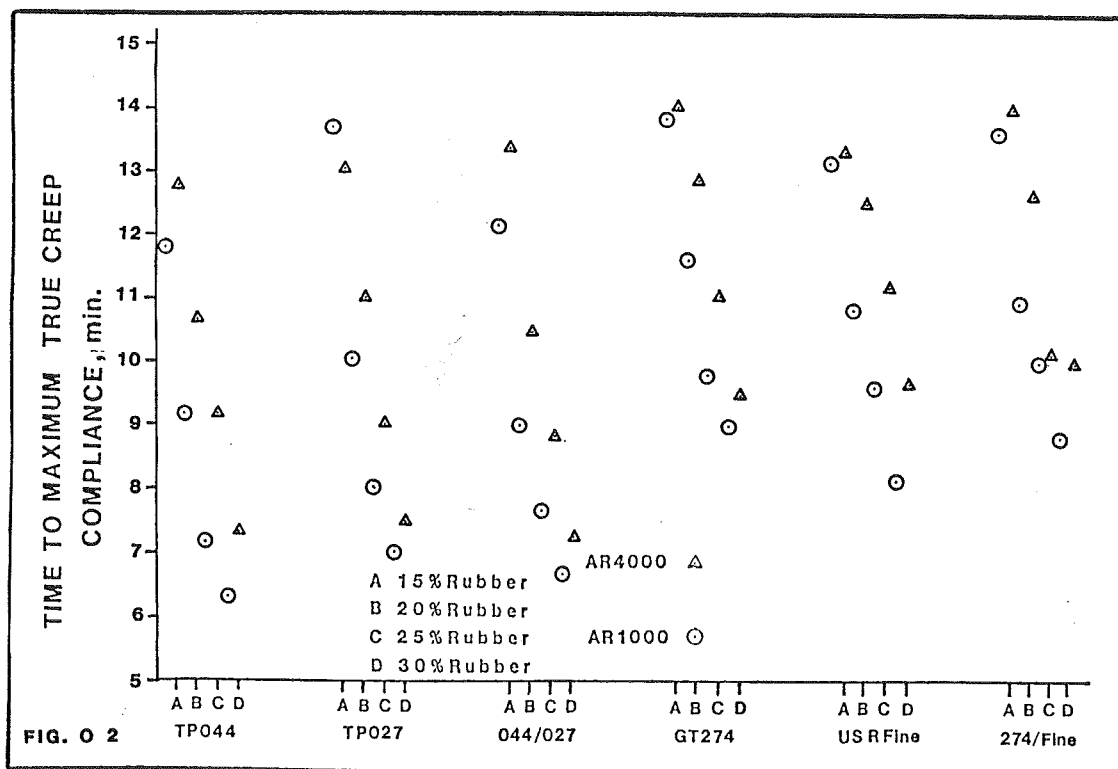
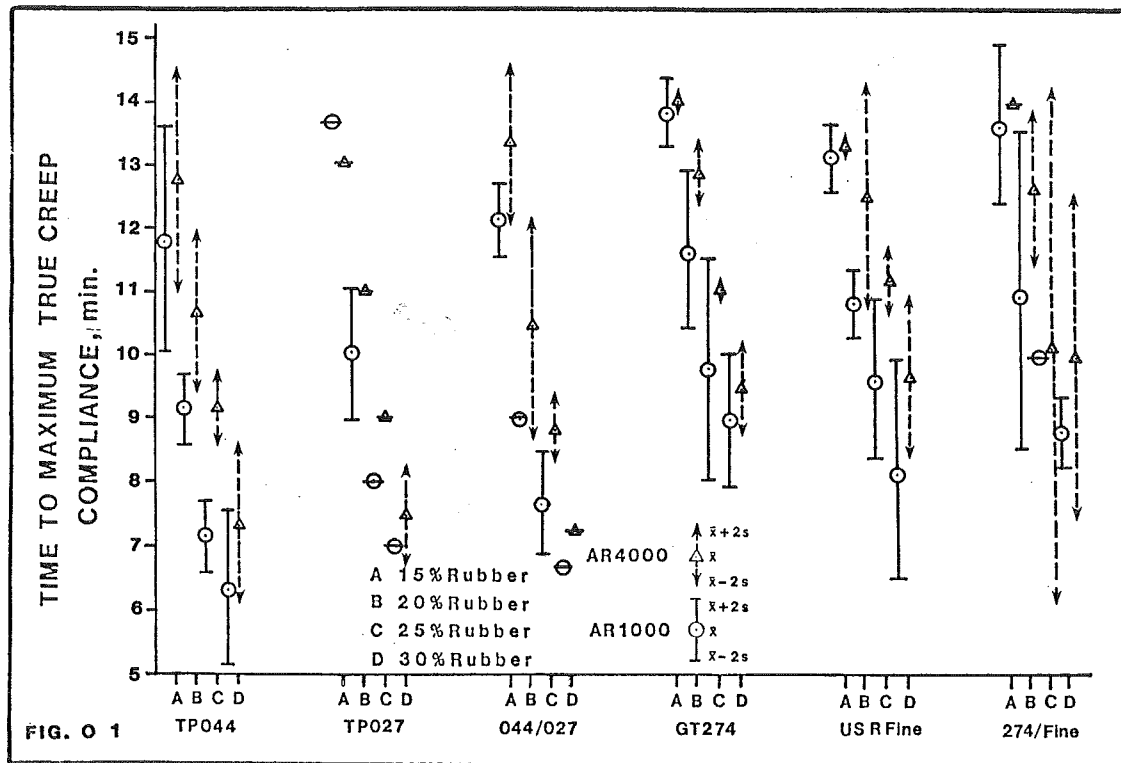
b. Summary

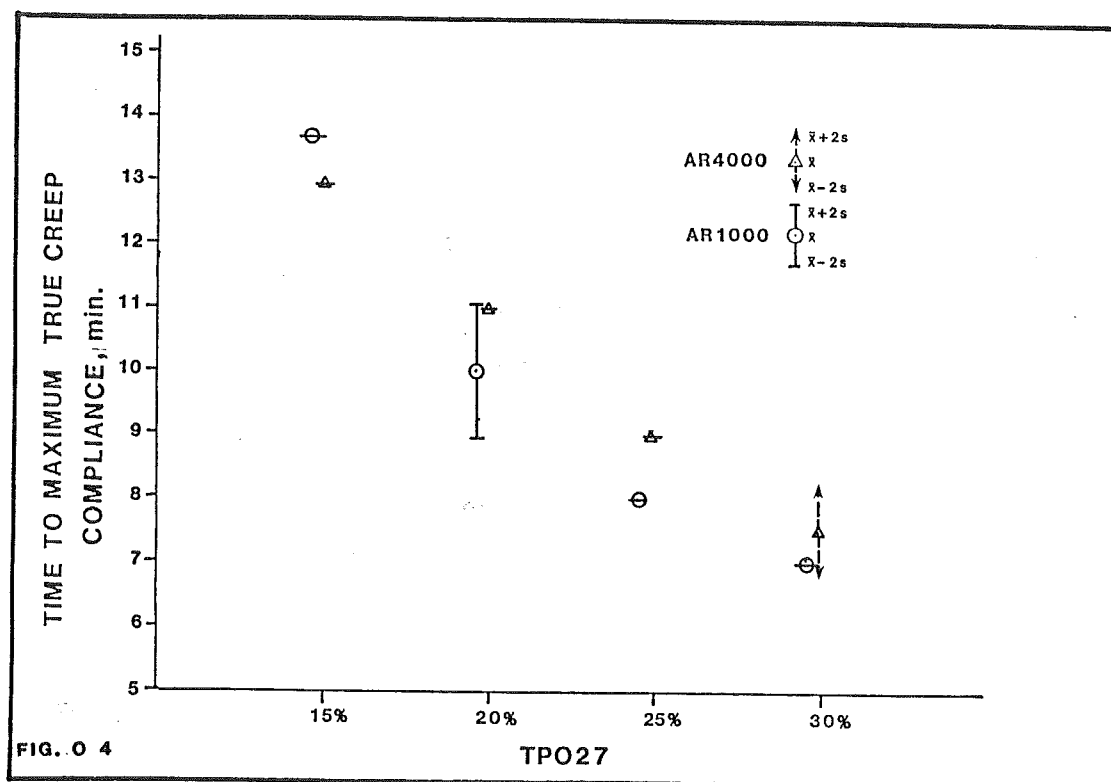
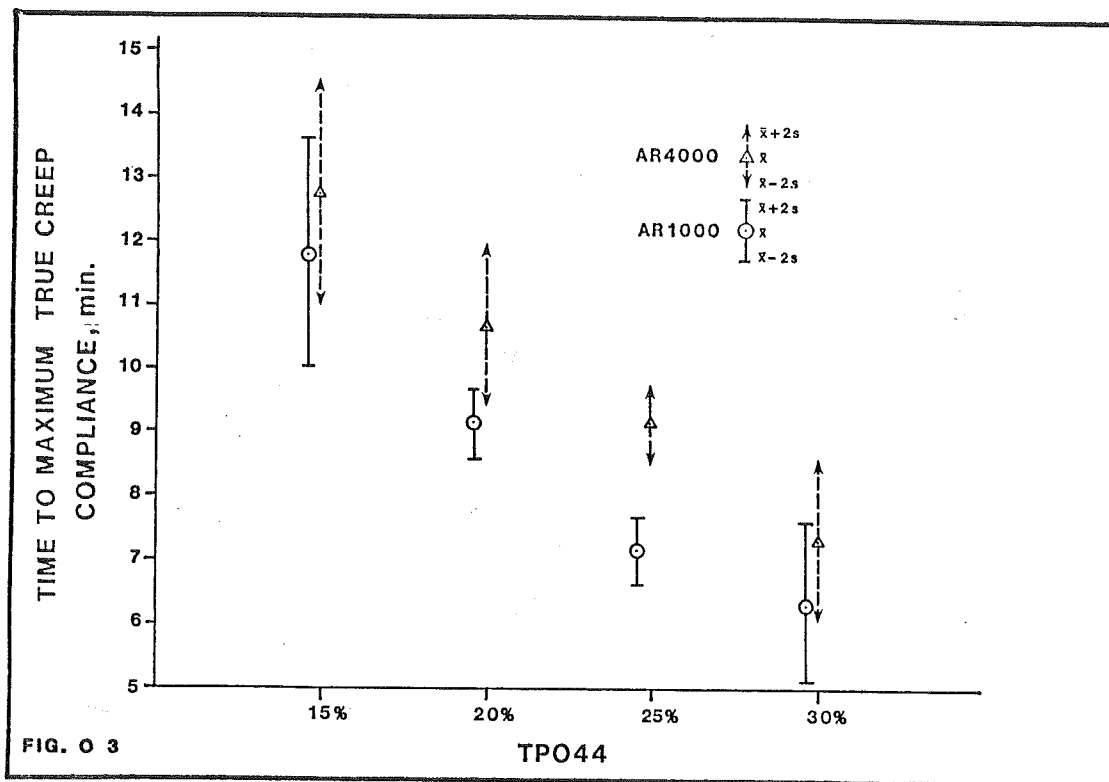
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	14.0	12.7	10.2	10.0
	S	0	.62	2.04	1.24
	CV	0	4.90	20.08	12.40
A R 1 0 0 0	$\bar{x}$	13.7	11.0	10.0	8.9
	S	.62	1.24	0	.27
	CV	4.54	11.28	0	3.00

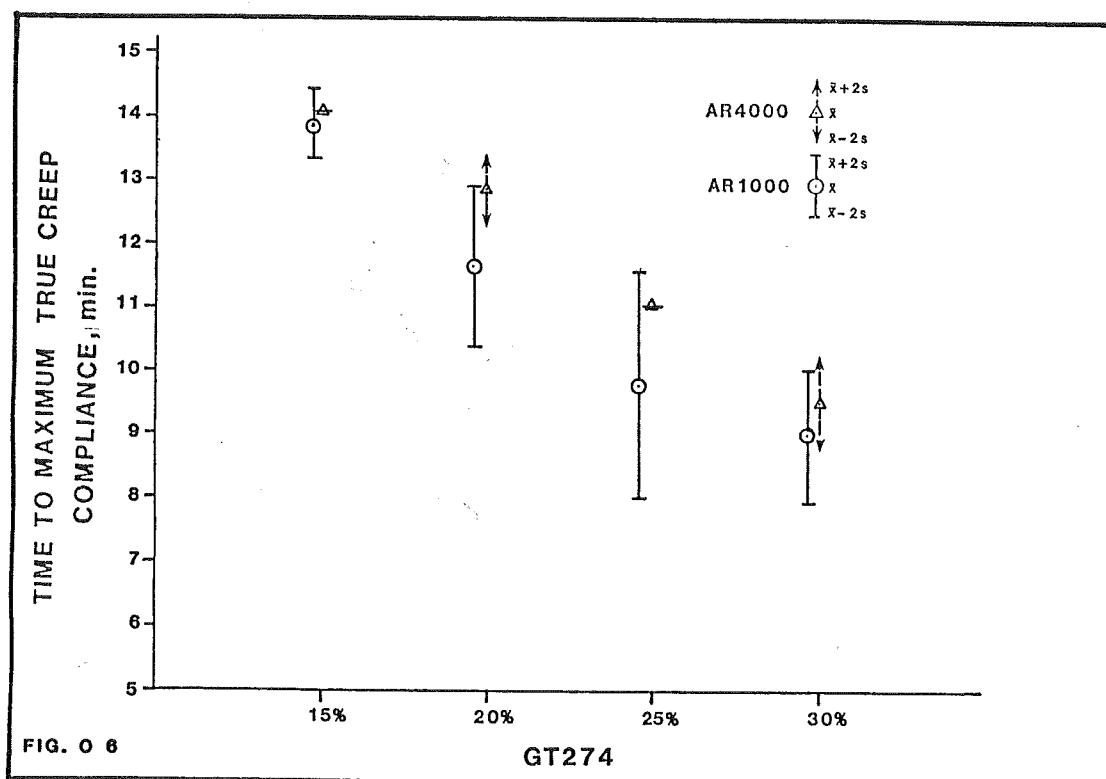
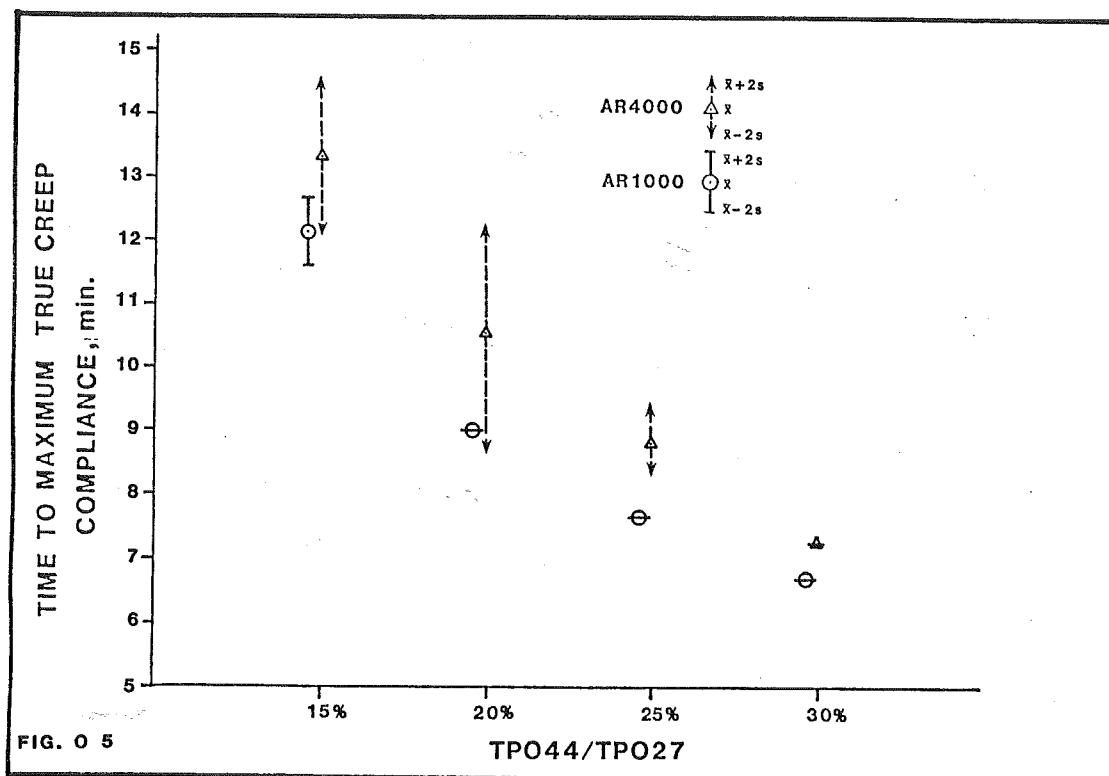
		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TPQ46				TPQ47				TPQ48			
		15	20	25	30	15	20	25	30	15	20	25	30
Subgrade	1												
	2												
	3												
	4												

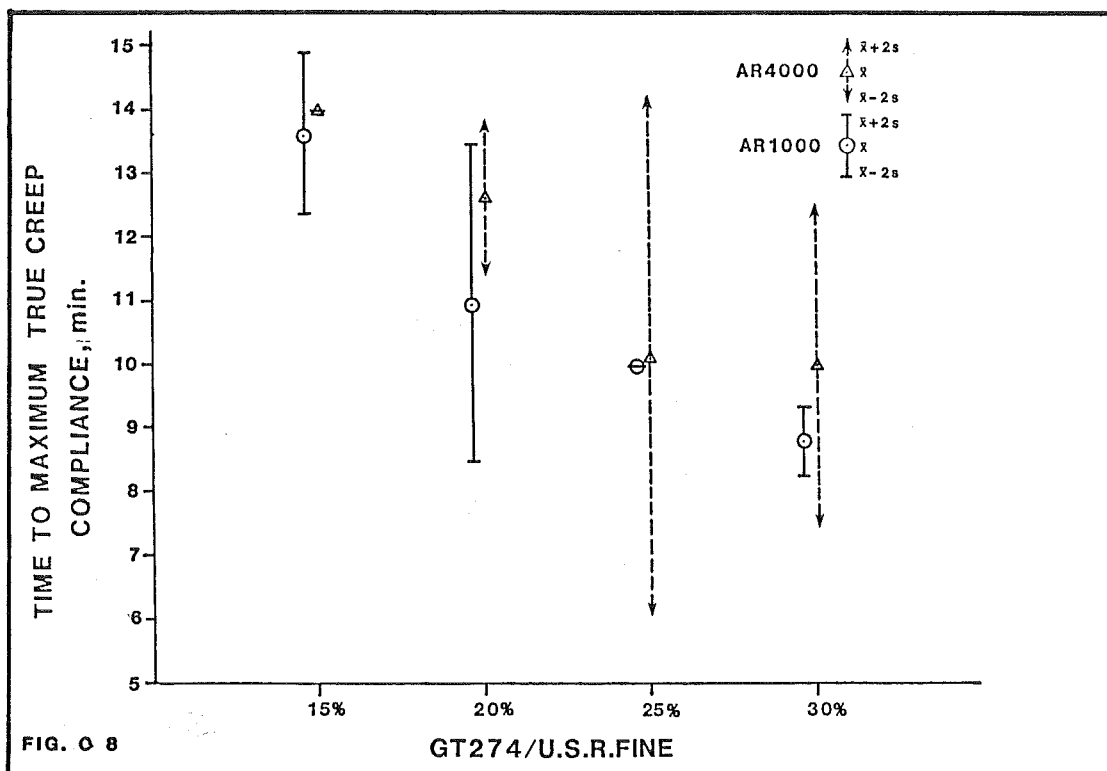
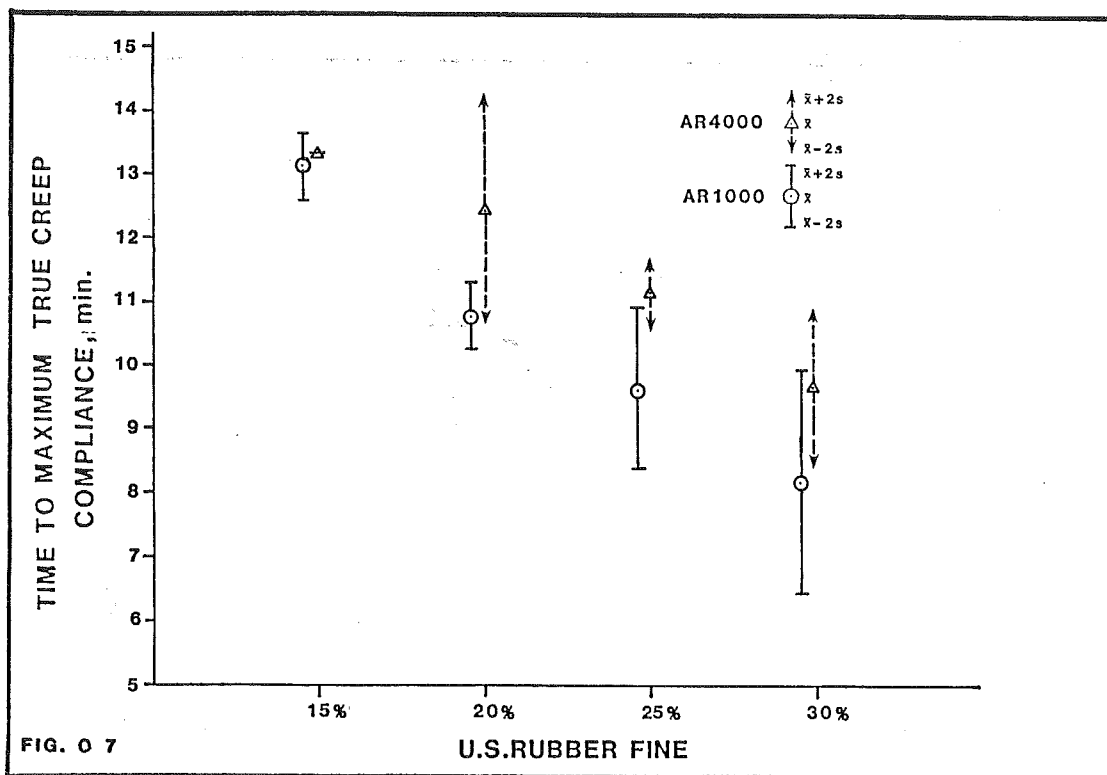
Table O-3 Anova Summary, Time to Maximum
True Creep Compliance

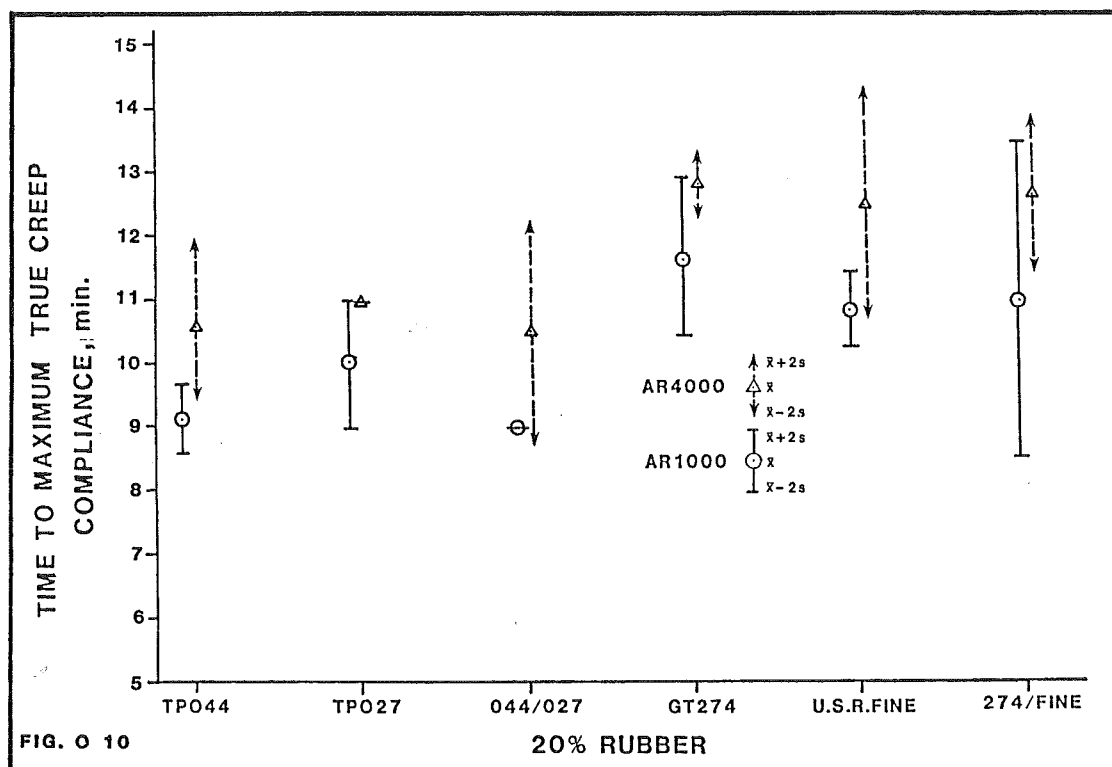
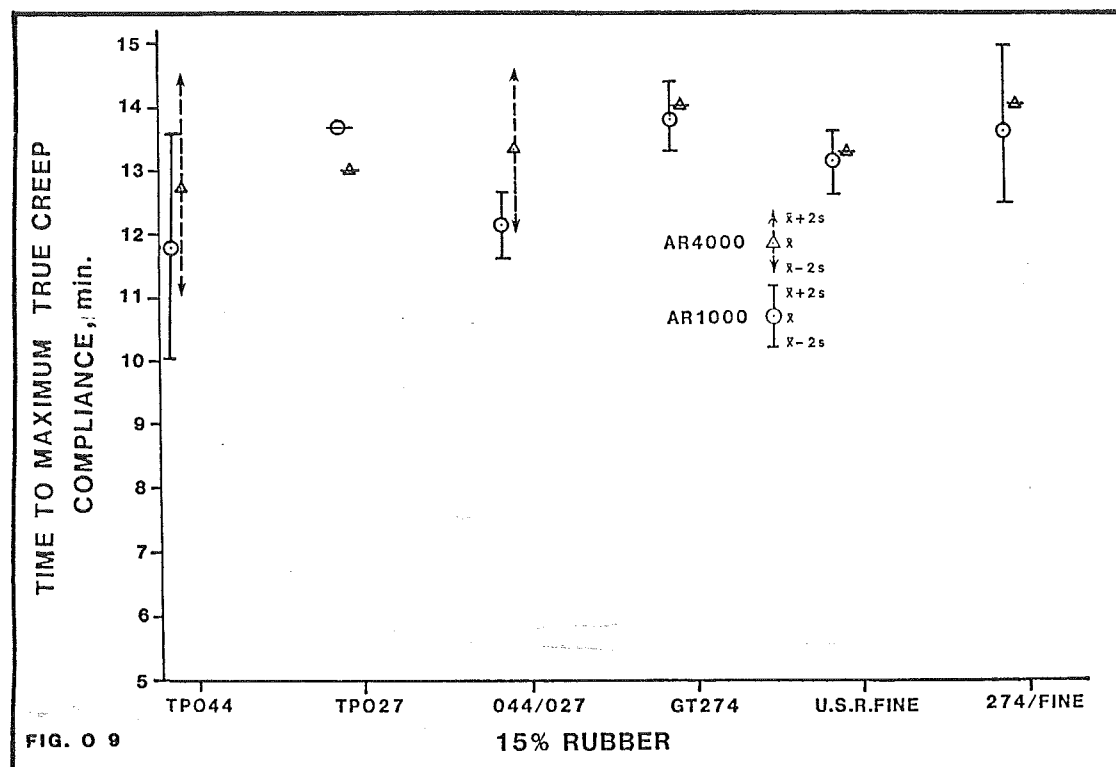
<u>ANOVA</u>						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	76.1084375	15.2216875	67.00	2.43	3.48
Q	3	355.3194792	118.4398264	521.33	2.82	4.28
A	1	22.1376042	22.1376042	97.44	4.07	7.27
RQ	15	8.5536458	.5702431	2.51	1.91	2.49
RA	5	2.3292708	.4658542	2.05	2.43	3.48
QA	3	3.8211458	1.2737153	5.61	2.82	4.28
RQA	15	3.0144792	.2009653	.88	1.91	2.49
Error	48	10.905	.2271875			
TOTAL	95	482.1890625				

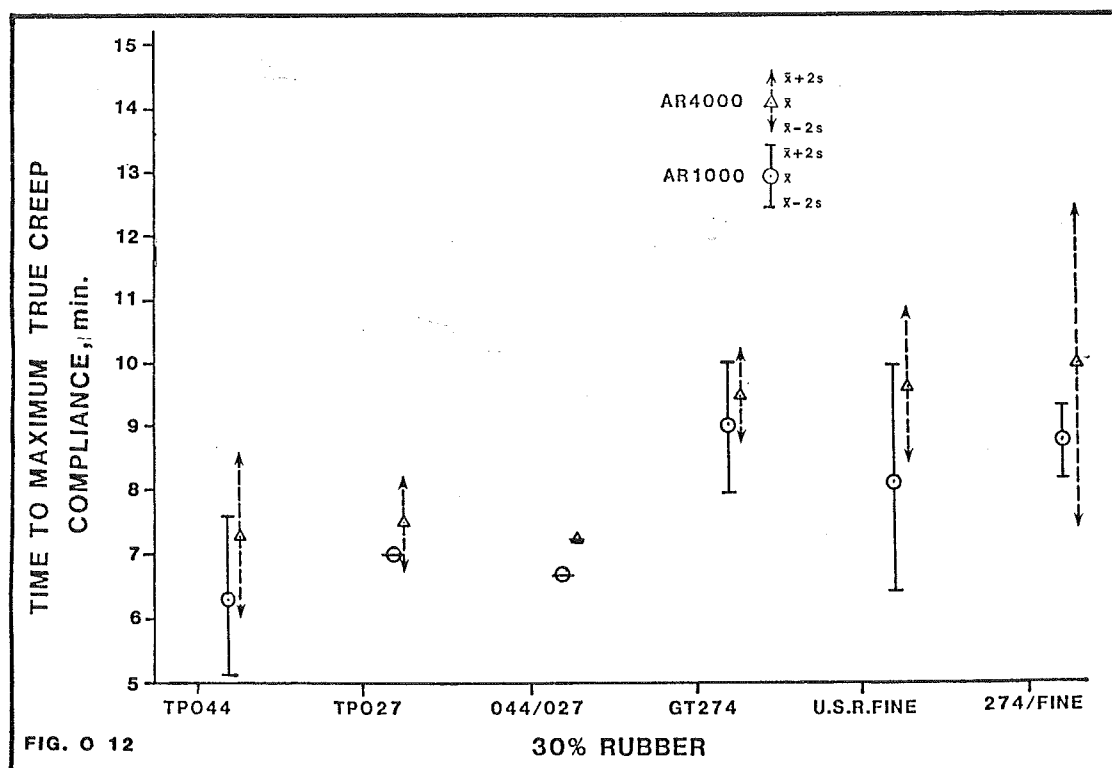
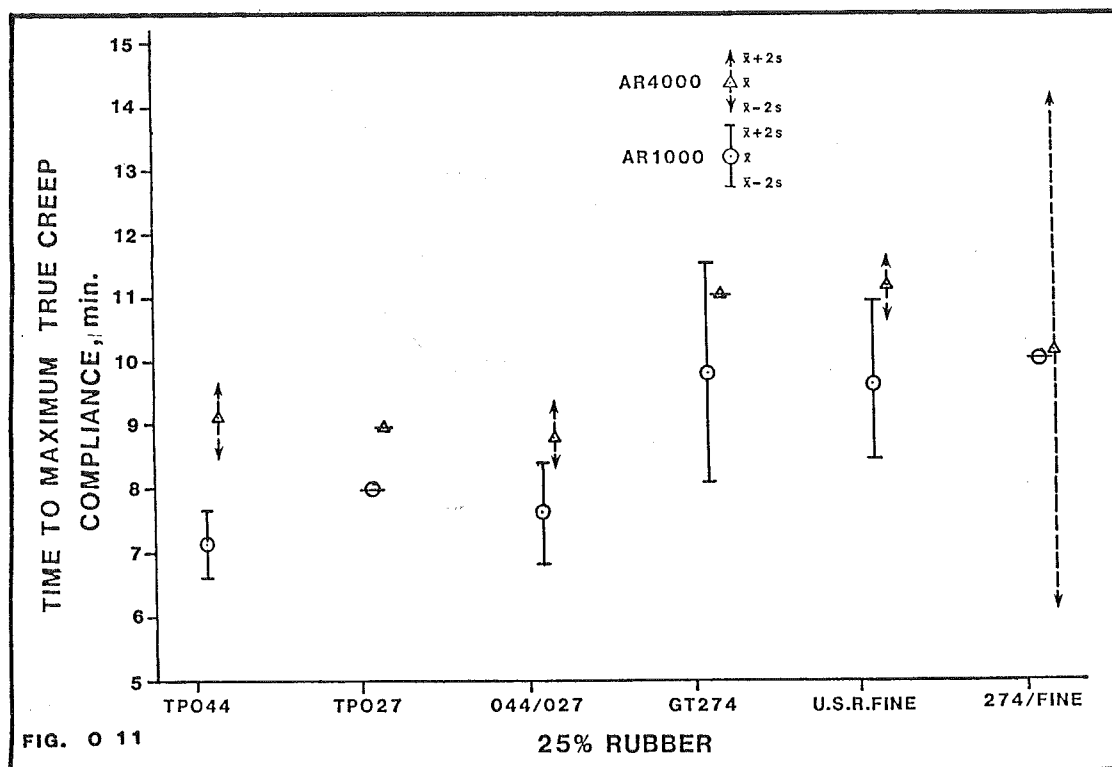












APPENDIX P
APPARENT VISCOSITY AT 32.0F (0C)
BY SLIDING PLATE MICROVISCOMETER

Table P-1 Sliding Plate Apparent Viscosity,
32.0F, 10^9 Poise

a. Measured and Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	4.98	7.60	No Movement	8.50
	4.41	5.28	No Movement	13.04
A R 1 0 0 0	2.06	4.36	13.75	2.81
	2.18	2.76	7.66	5.34

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	4.70	6.44	—	10.77
	s	.505	2.056	—	4.022
	cv	10.76	31.92	—	37.35
A R 1 0 0 0	$\bar{x}$	2.12	3.56	10.71	4.08
	s	.106	1.418	5.396	2.242
	cv	5.02	39.82	50.40	55.01

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP007				SBS TP044 S SBS TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
Sliding Plate	Apparent Viscosity	—	—	—	—	—	—	—	—	—	—	—	—
	Standard Deviation	—	—	—	—	—	—	—	—	—	—	—	—
	Coefficient of Variation	—	—	—	—	—	—	—	—	—	—	—	—
	U.S. Rubber Firm	—	—	—	—	—	—	—	—	—	—	—	—

Table P-1 Sliding Plate Apparent Viscosity,
32.0F, 10⁹ Poise

a. Measured and Analyzed Data

TPO 27				
	15%	20%	25%	30%
AR 40000	4.3	4.5	4.0	3.4
	3.5	7.0	4.2	2.4
AR 10000	1.6	2.2	2.6	3.7
	1.9	1.8	3.5	3.3

b. Summary

TP027					
		15%	20%	25%	30%
AR 40000	$\bar{x}$	3.90	5.75	4.10	2.90
	S	.709	2.215	.177	.886
	CV	18.17	38.52	4.32	30.55
AR 10000	$\bar{x}$	1.75	2.00	3.05	3.50
	S	.266	.354	.797	.354
	CV	15.19	17.72	26.14	10.13

		ASPHALT TYPE (A)				PERCENT HUMIDITY (B)				HUMIDITY TYPE (C)			
		TP027				TP027				TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
ASPHALT TYPE (A)	TP027												
	TP027												
	TP027												
	TP027												
PERCENT HUMIDITY (B)	TP027												
	TP027												
	TP027												
	TP027												
HUMIDITY TYPE (C)	TP027												
	TP027												
	TP027												
	TP027												

Table P-1 Sliding Plate Apparent Viscosity,
32.0F 10^9 Poise

a. Measured and Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	7.8	4.6	4.7	14.8
	9.5	6.9	4.4	12.1
A R 1 0 0 0	2.1	3.6	2.2	3.1
	2.5	3.0	3.3	6.6

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	8.65	5.75	4.55	13.45
	s	1.506	2.038	.266	2.392
	cv	17.41	35.44	5.84	17.79
A R 1 0 0 0	$\bar{x}$	2.30	3.30	2.75	4.85
	s	.354	.532	.975	3.101
	cv	15.41	16.11	35.44	63.94

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				50% TP044 50% TP027				G1216				U.S. Rubber Pmc				50% G1216 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
ASPHALT TYPE (A)	TP044																																				
	TP027																																				
PERCENT RUBBER (B)	50% TP044 50% TP027																																				
	G1216																																				
RUBBER TYPE (C)	U.S. Rubber Pmc																																				
	50% G1216 50% U.S. Rubber																																				

Table P-1 Sliding Plate Apparent Viscosity,
32.0F, 10^9 Poise

a. Measured and Analyzed Data

GT 274				
	15%	20%	25%	30%
AR 4000	3.0	2.3	3.9	1.9
	2.2	2.9	3.2	2.9
AR 1000	2.1	1.3	2.6	1.5
	2.1	1.3	2.1	1.3

b. Summary

GT274					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	2.60	2.60	3.55	2.40
	s	.709	.532	.620	.886
	cv	27.26	20.45	17.47	36.92
AR 1000	$\bar{x}$	2.10	1.30	2.35	1.40
	s	0	0	.443	.177
	cv	0	0	18.85	12.66

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (R)			
		TP644		TP627		90% TP644 10% TP627		GT274		U.S. Rubber Firm		90% GT274 10% U.S. Firm	
		15	20	25	30	15	20	25	30	15	20	25	30
Sample No.	1	---	---	---	---	---	---	---	---	---	---	---	---
	2	---	---	---	---	---	---	---	---	---	---	---	---
Viscosity	32.0F	---	---	---	---	---	---	---	---	---	---	---	---
	100F	---	---	---	---	---	---	---	---	---	---	---	---

Table P-1 Sliding Plate Apparent Viscosity,
32.0F, 10^9 Poise

a. Measured and Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	3.4	2.8	2.5	2.9
	4.4	1.7	2.8	1.8
A R 1 0 0 0	3.0	3.1	2.3	2.3
	2.0	1.6	3.3	2.2

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	3.90	2.25	2.65	2.35
	s	.886	.975	.266	.975
	CV	22.71	43.32	10.03	41.47
A R 1 0 0 0	$\bar{x}$	2.50	2.35	2.80	2.25
	s	.886	1.329	.886	.089
	CV	35.44	56.55	31.64	3.94

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				50% TP024 50% TP027				61274				U.S. Rubber Fine				50% 61274 50% U.S. Fine															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Observed	15																																				
	20																																				
Calculated	15																																				
	20																																				

Table P-1 Sliding Plate Apparent Viscosity,
32.0F/ 10^9 Poise

a. Measured and Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	3.5	3.1	2.1	1.5
	2.5	4.9	1.7	1.2
A R 1 0 0 0	1.4	2.5	1.8	2.7
	1.5	1.8	1.4	1.9

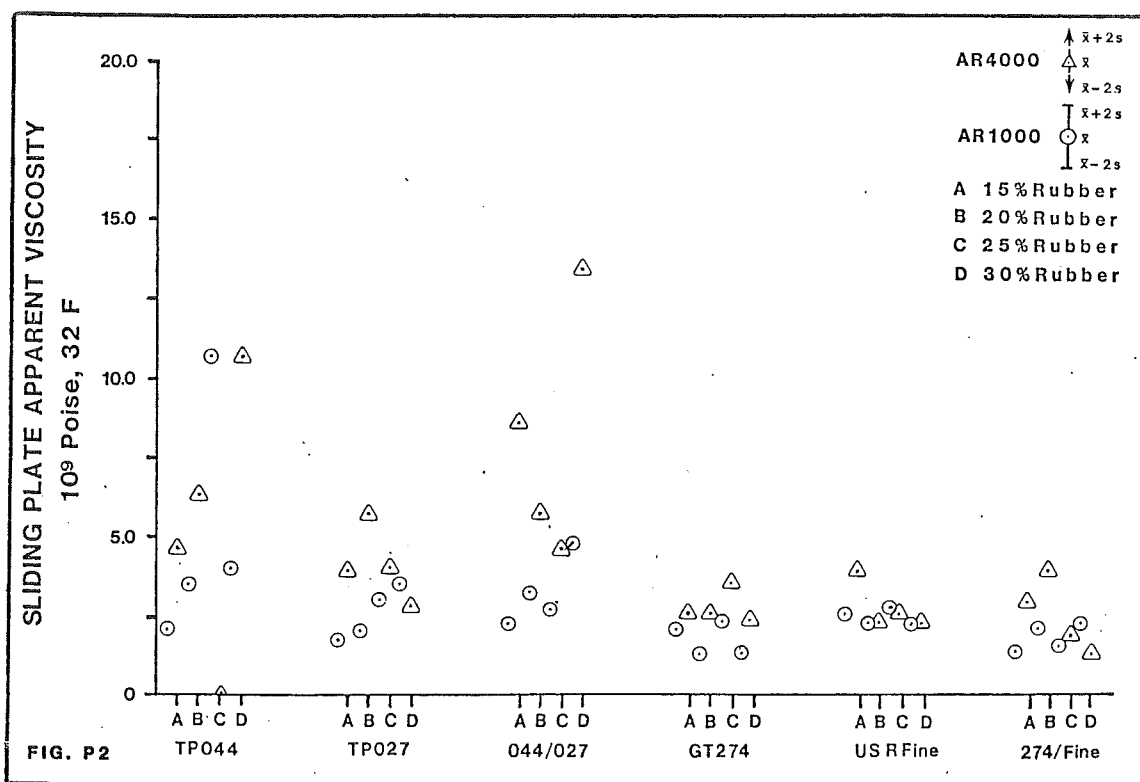
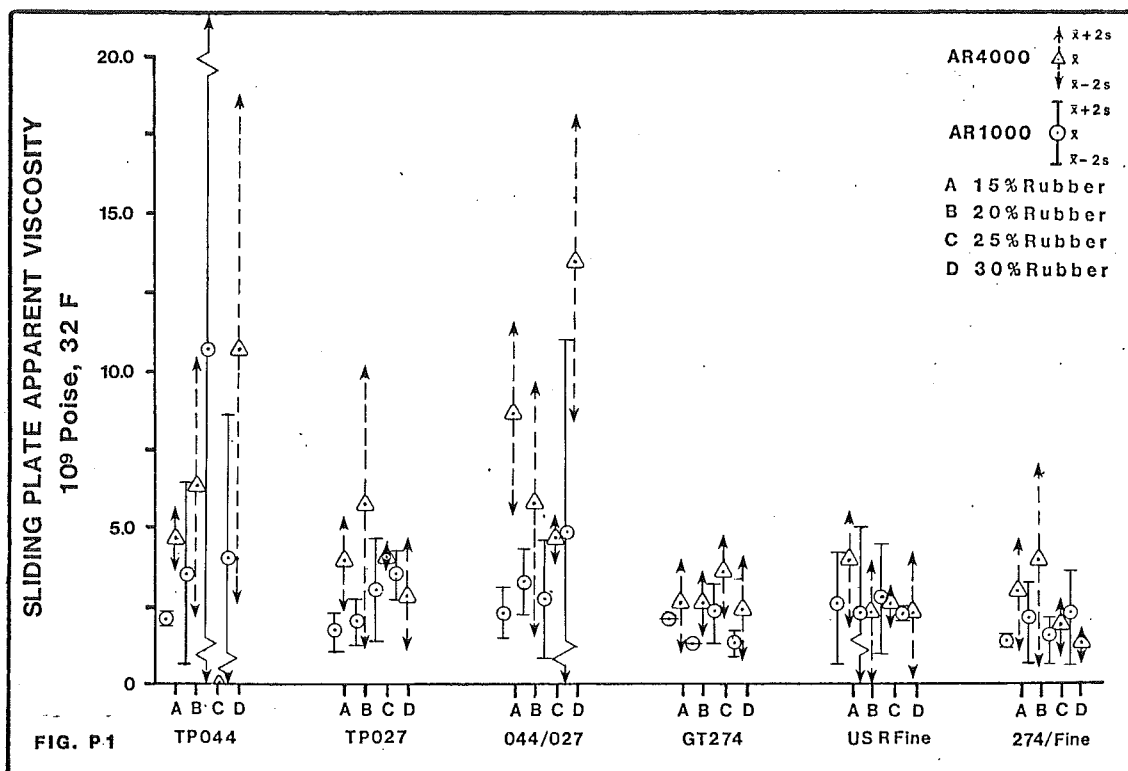
b. Summary

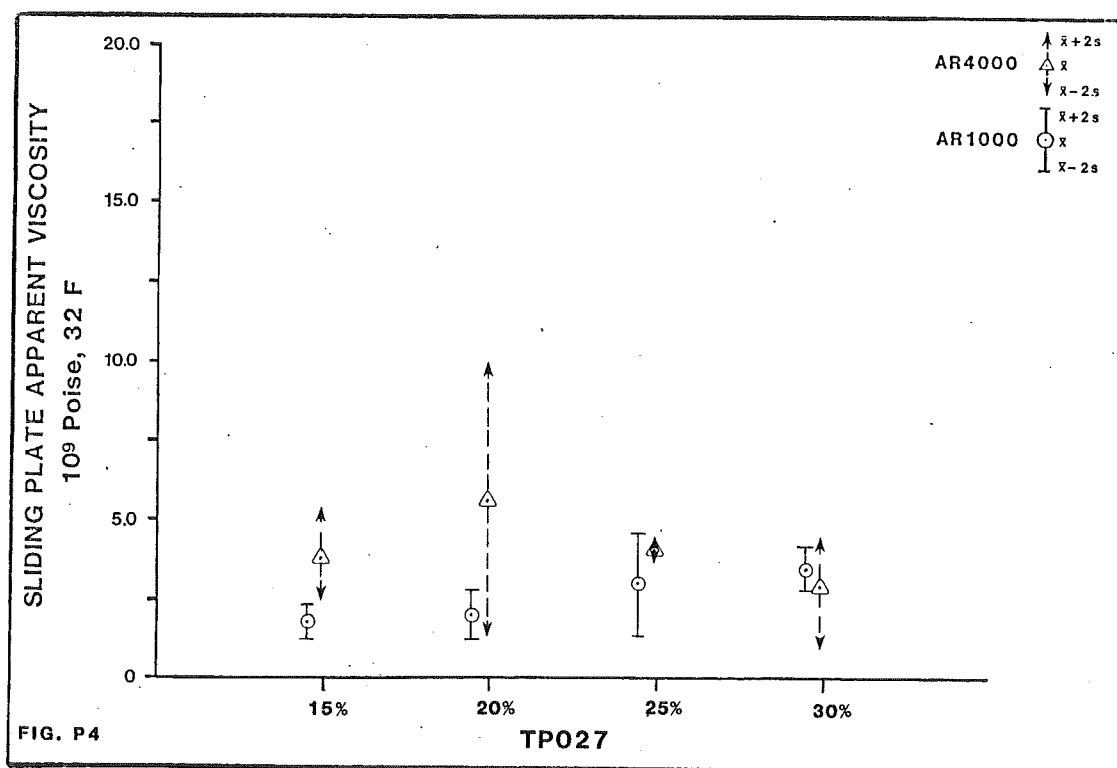
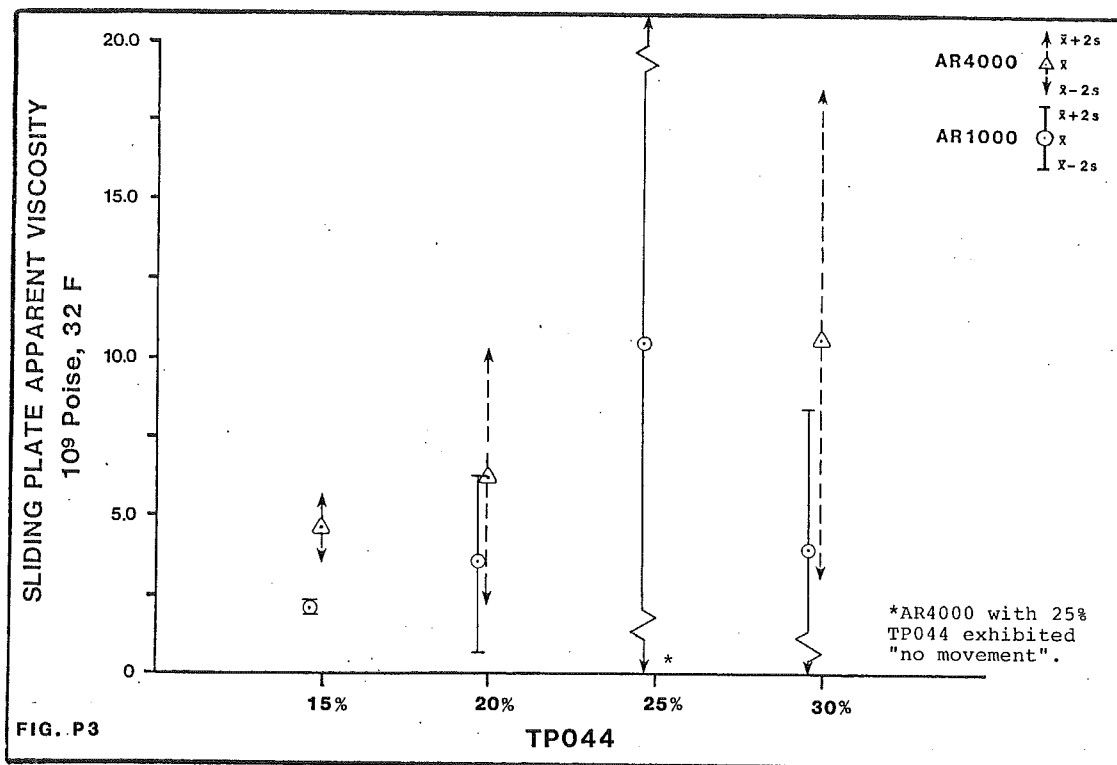
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	-X	3.00	4.00	1.90	1.35
	S	.886	1.595	.354	.266
	CV	29.53	39.87	18.65	19.68
A R 1 0 0 0	-X	1.45	2.15	1.60	2.30
	S	.089	.620	.354	.709
	CV	6.11	28.85	22.15	30.82

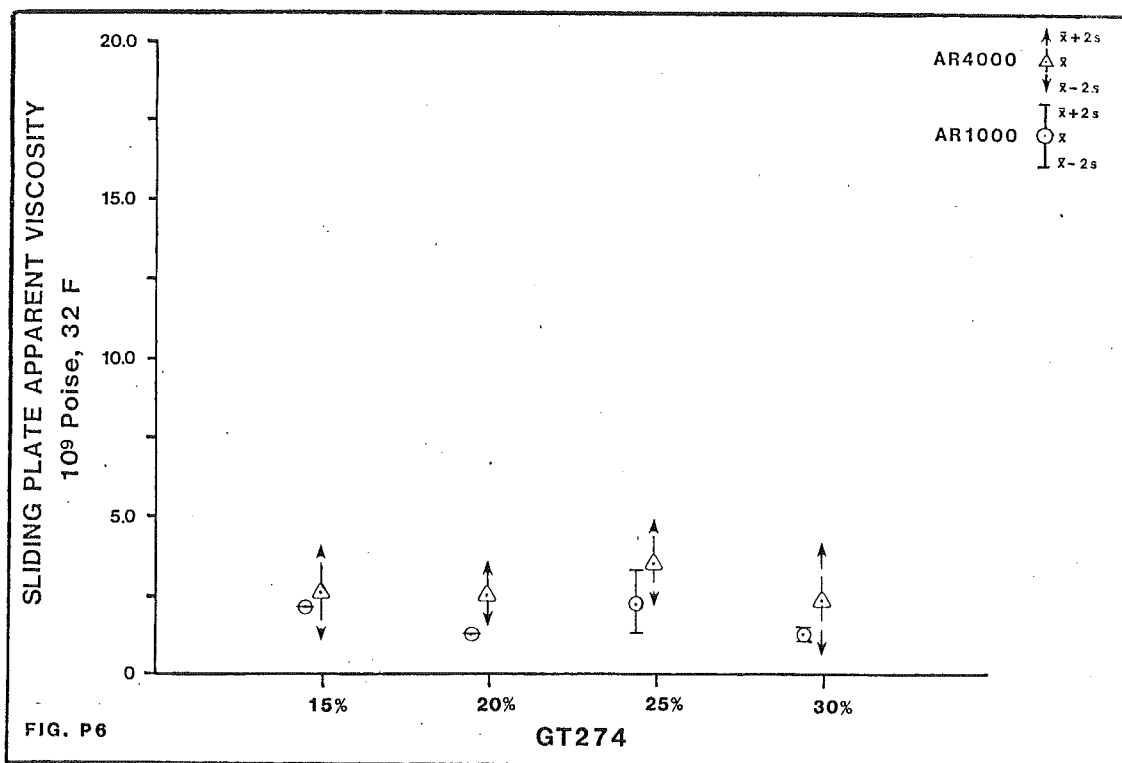
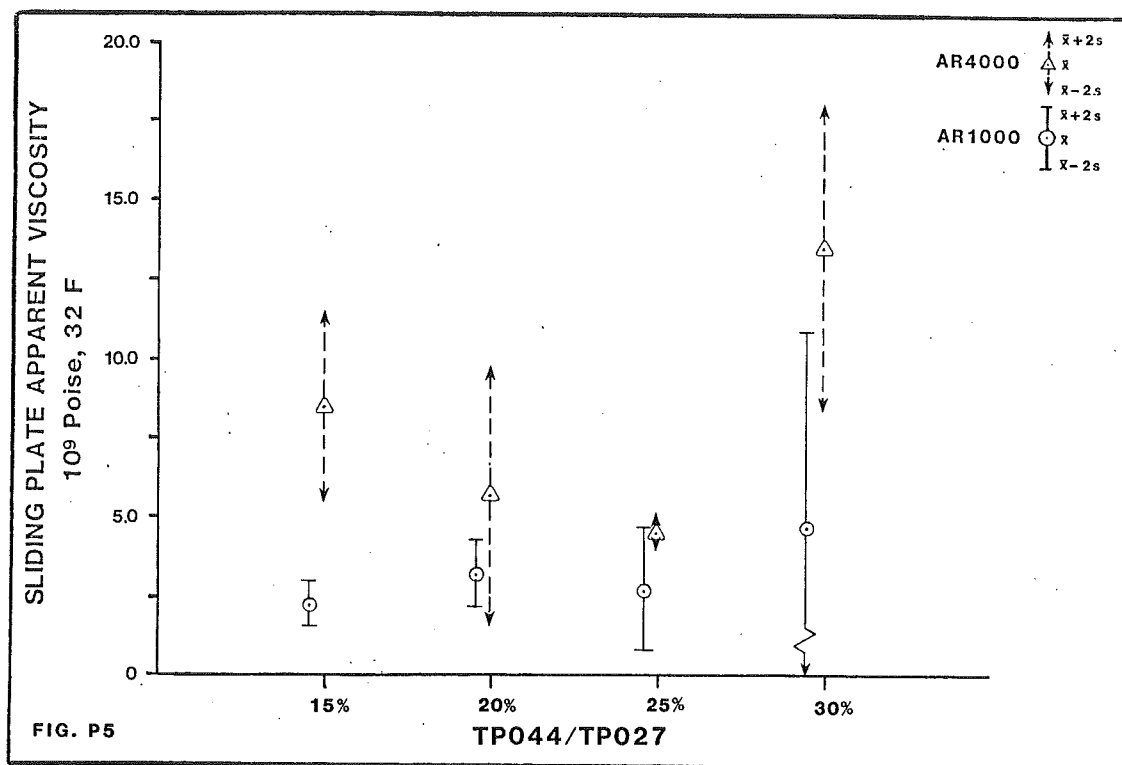
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP046				TP047				50% TP046 50% TP047				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Asphalt	AR 4000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	AR 1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

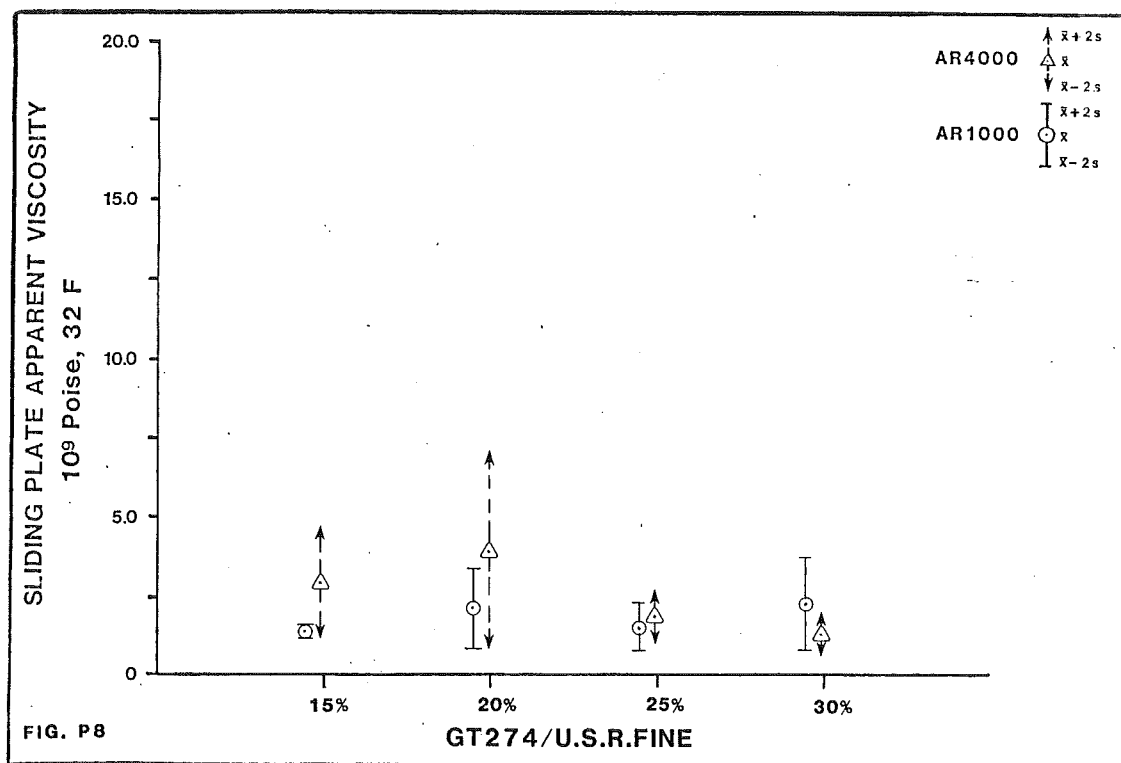
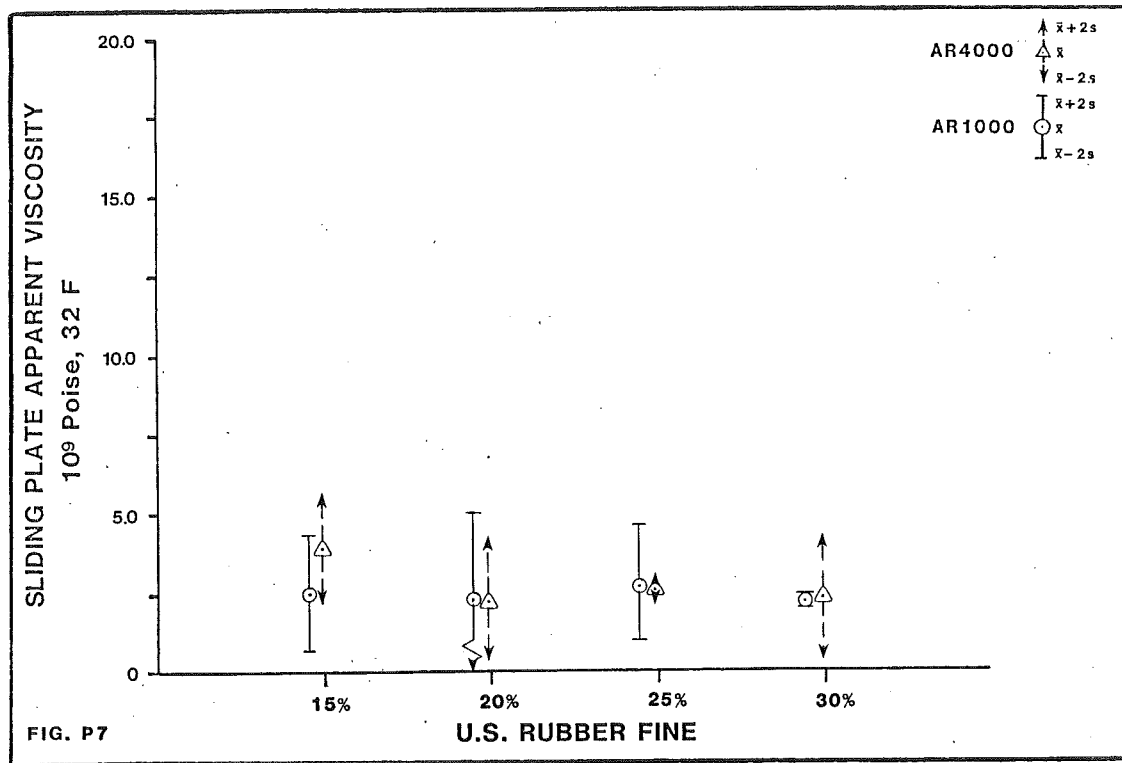
Table P-2 Anova Summary, Sliding Plate
Apparent Viscosity

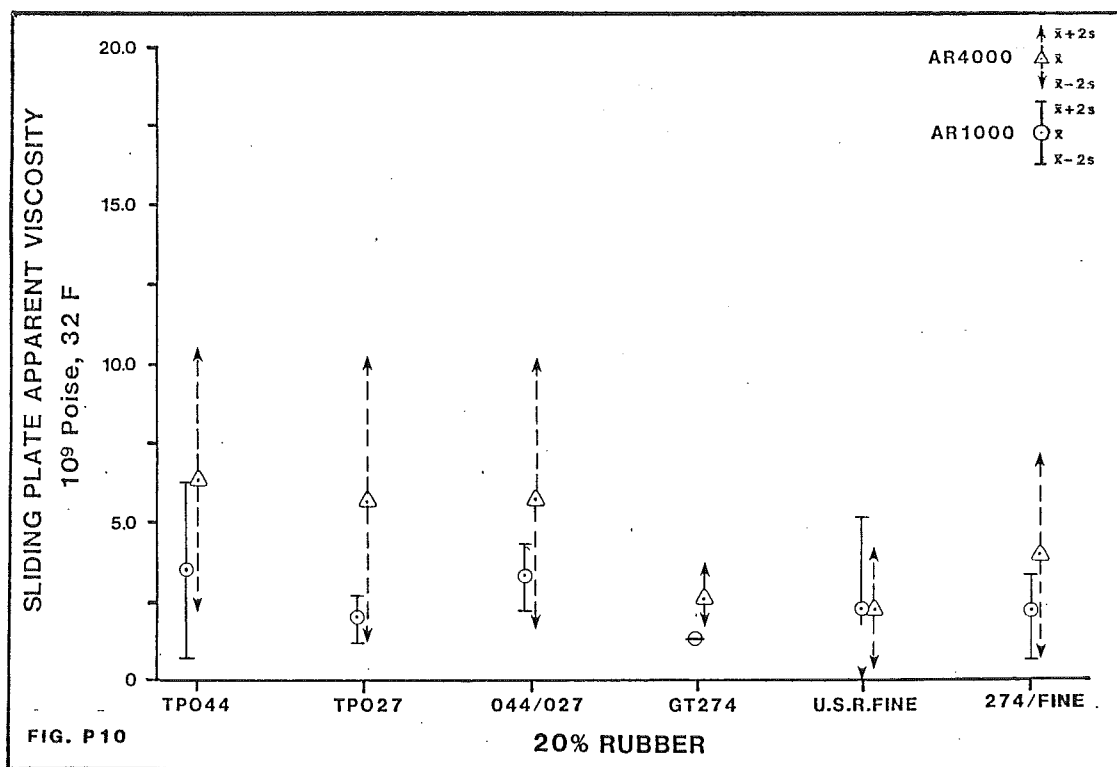
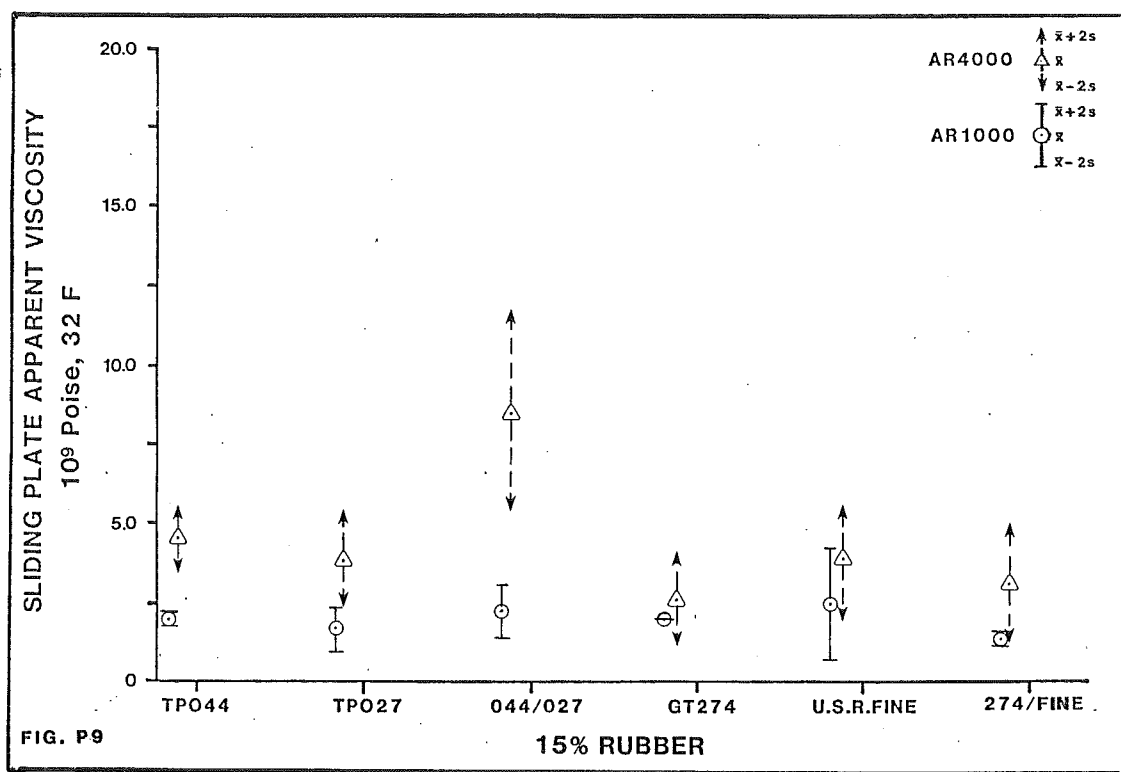
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	190.50	38.10	28.71	2.43	3.48
Q	3	16.92	5.64	4.25	2.82	4.28
A	1	51.03	51.03	38.45	4.07	7.27
RQ	15	97.90	6.53	4.92	1.91	2.49
RA	5	58.02	11.60	8.74	2.43	3.48
QA	3	52.44	17.48	13.17	2.82	4.28
RQA	15	169.73	11.32	8.53	1.91	2.49
Error	48	63.71	1.33			
TOTAL	95	700.24				

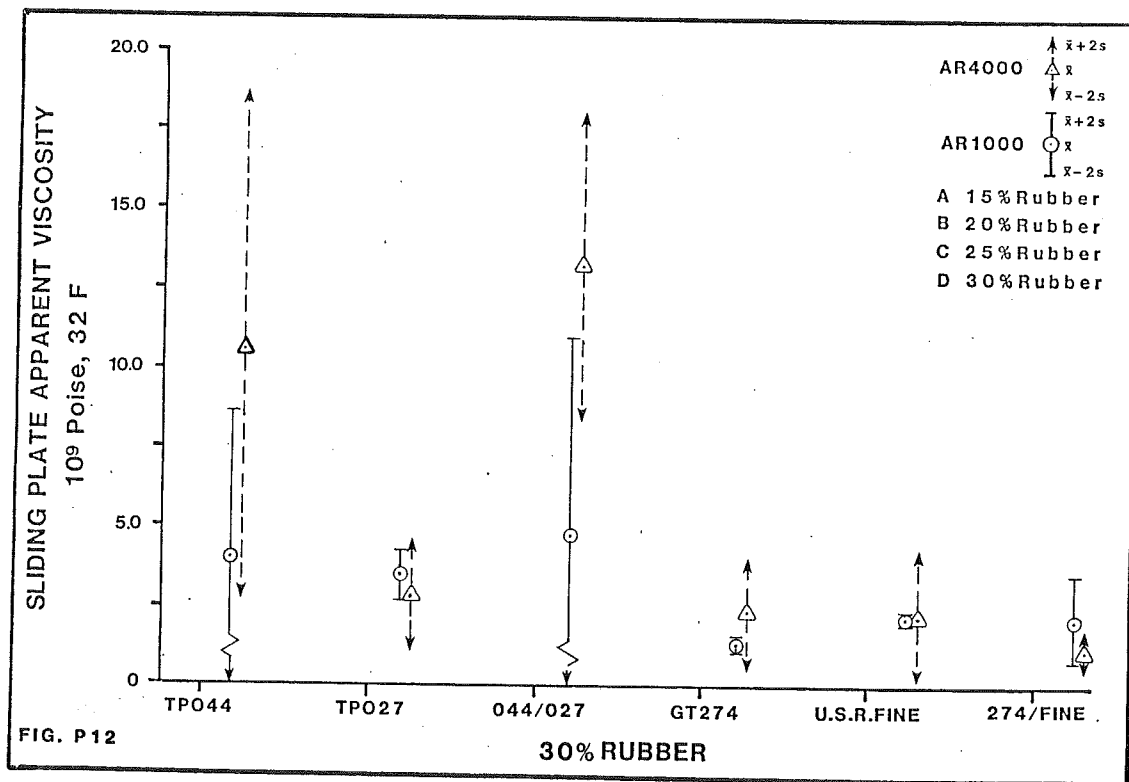
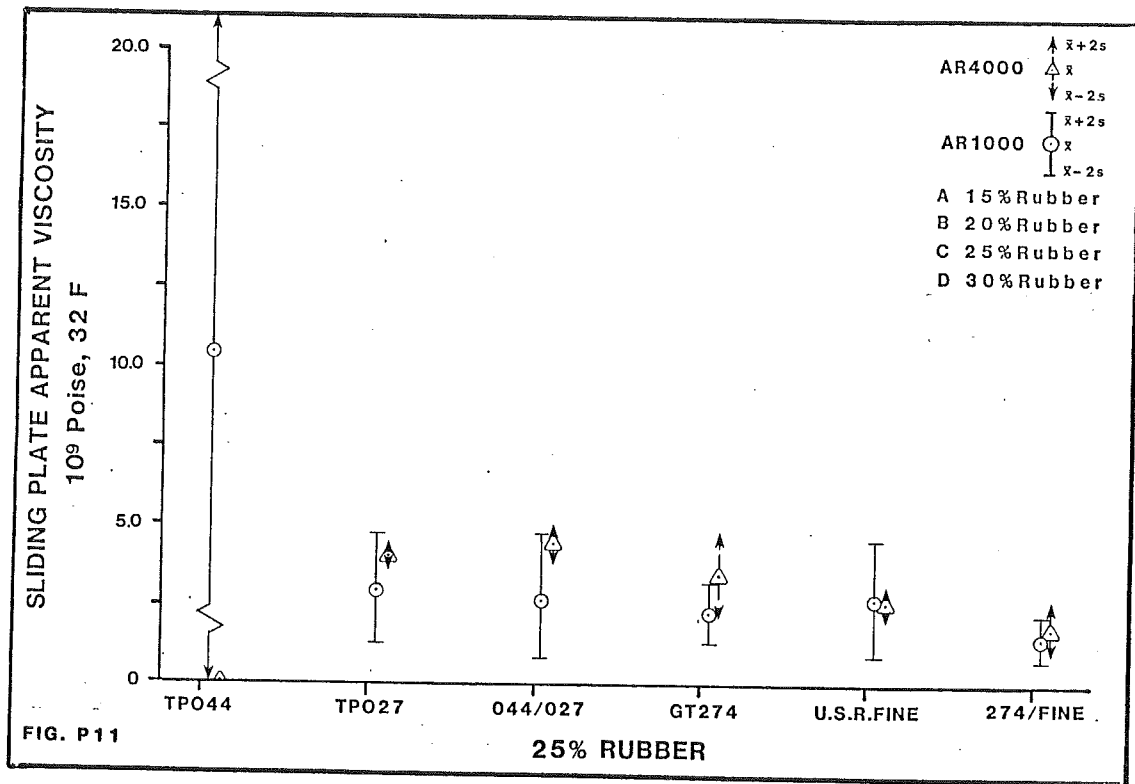












APPENDIX Q

FIRST CYCLE CREEP (30 MIN) AT 32.0F
(0C) BY SLIDING PLATE MICROVISCOMETER

Table Q-1 Sliding Plate First Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	252	229	193	225
	190	190	203	207
A R 1 0 0 0	466	458	323	444
	415	400	308	377

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>221.00</u>	<u>209.50</u>	<u>198.00</u>	<u>216.00</u>
	s	<u>54.932</u>	<u>34.554</u>	<u>8.860</u>	<u>15.948</u>
	cv	24.86	16.49	4.47	7.38
A R 1 0 0 0	$\bar{x}$	<u>440.50</u>	<u>429.00</u>	<u>315.50</u>	<u>410.50</u>
	s	<u>45.186</u>	<u>51.388</u>	<u>13.290</u>	<u>59.362</u>
	cv	10.26	11.98	4.21	14.46

		ADPHALY TYPE (A)			PERCENT RUBBER (B)			RUBBER TYPE (C)		
		TP044			TP087			80% TP044 & 20% TP087		
		15	20	30	15	20	30	15	20	30
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.	</								

Table Q-1 Sliding Plate First Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	270	284	314	384
	242	230	351	511
A R 1 0 0 0	564	619	472	547
	435	533	403	541

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	256.00	257.00	332.50	447.50
	s	24.808	47.844	32.782	112.522
	cv	9.69	18.62	9.86	25.14
A R 1 0 0 0	$\bar{x}$	499.50	576.00	437.50	544.00
	s	114.294	76.196	61.134	5.316
	cv	22.88	13.23	13.97	.98

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP027			50% TP044 50% TP027			50% TP044 50% TP027			50% TP044 50% TP027			50% TP044 50% TP027			50% TP044 50% TP027		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
Creep																					
Standard Deviation																					
Coefficient of Variation																					

Table Q-1 Sliding Plate First Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	163	211	231	322
	117	197	317	290
A R 1 0 0 0	433	364	512	520
	405	365	608	437

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	140.00	204.00	274.00	306.00
	s	40.756	12.404	76.196	28.352
	cv	29.11	6.08	27.81	9.27
A R 1 0 0 0	$\bar{x}$	419.00	364.50	560.00	478.50
	s	24.808	.886	85.056	73.538
	cv	5.92	.24	15.19	15.37

		ASPHALT TYPE (A)									PERCENT RUBBER (B)									RUBBER TYPE (C)																		
		TP044			TP027			50% TP044 50% TP027			G1274			U.S. Rubber Firm			50% G1274 50% B.F. Goodrich																					
		15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	
Sliding Plate	Creep																																					
	Creep																																					

Table Q-1 Sliding Plate First Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	288	454	414	718
	297	391	412	592
A R 1 0 0 0	513	651	663	739
	642	929	772	812

b. Summary

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>292.50</u>	<u>422.50</u>	<u>413.00</u>	<u>655.00</u>
	s	<u>7.974</u>	<u>55.818</u>	<u>1.772</u>	<u>111.636</u>
	cv	2.73	13.21	.43	17.04
A R 1 0 0 0	$\bar{x}$	<u>577.50</u>	<u>790.00</u>	<u>717.50</u>	<u>775.50</u>
	s	<u>114.294</u>	<u>246.308</u>	<u>96.574</u>	<u>64.678</u>
	cv	19.79	31.18	13.46	8.34

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP037			60% TP044 50% TP037			GT274			U.S. Rubber Firm			60% GT274 50% U.S. Firm		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
TP044																		
TP037																		
60% TP044 50% TP037																		
GT274																		
U.S. Rubber Firm																		
60% GT274 50% U.S. Firm																		

Table Q-1 Sliding Plate First Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	242	380	575	920
	319	549	623	600
A R 1 0 0 0	523	717	825	872
	727	742	465	944

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	280.50	464.50	599.00	760.00
	S	68.222	149.734	42.528	283.520
	CV	24.32	32.24	7.10	37.31
A R 1 0 0 0	$\bar{x}$	625.00	729.50	645.00	908.00
	S	180.744	22.150	318.960	63.792
	CV	28.92	3.04	49.45	7.03

		ASPHALT TYPE (A)			PERCENT RUBBER (B)			RUBBER TYPE (C)		
		TP044			TP037			80% TP044 20% TP037		
		15	20	25	15	20	25	15	20	25
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									
Sliding Plate	Creep									
	First Cycle									

Table Q-1 Sliding Plate First Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	276	355	566	879
	303	380	689	965
A R 1 0 0 0	587	648	818	793
	600	667	957	880

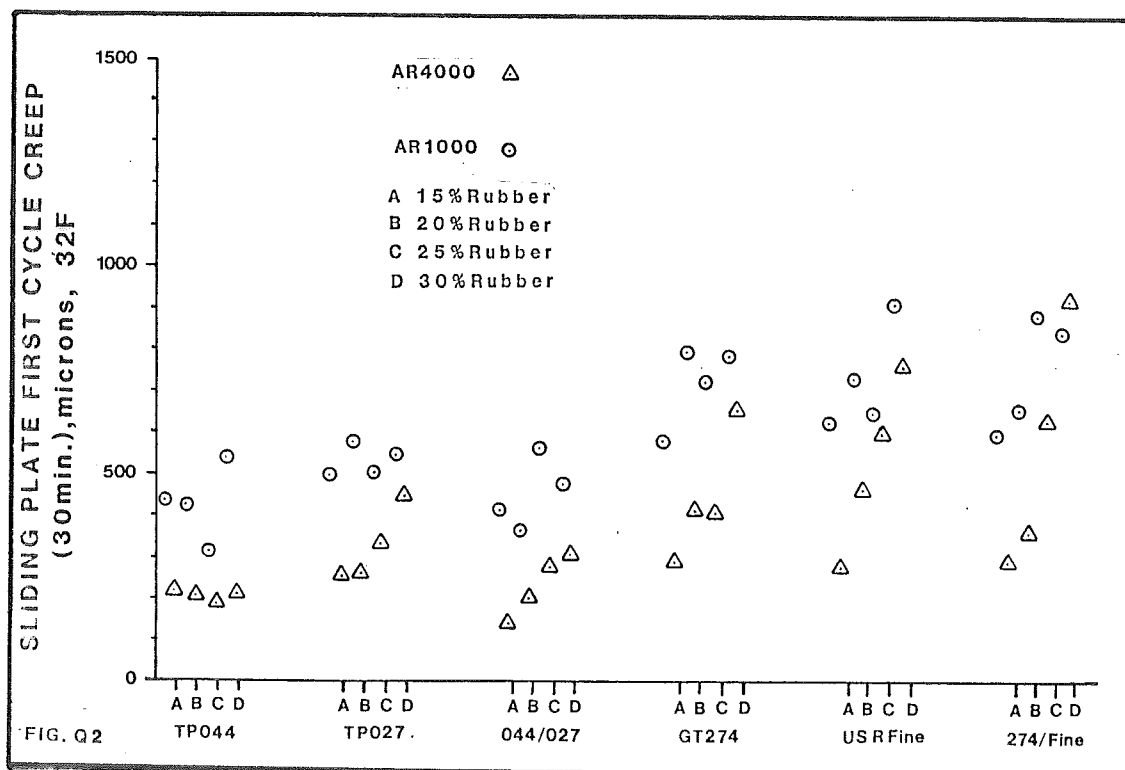
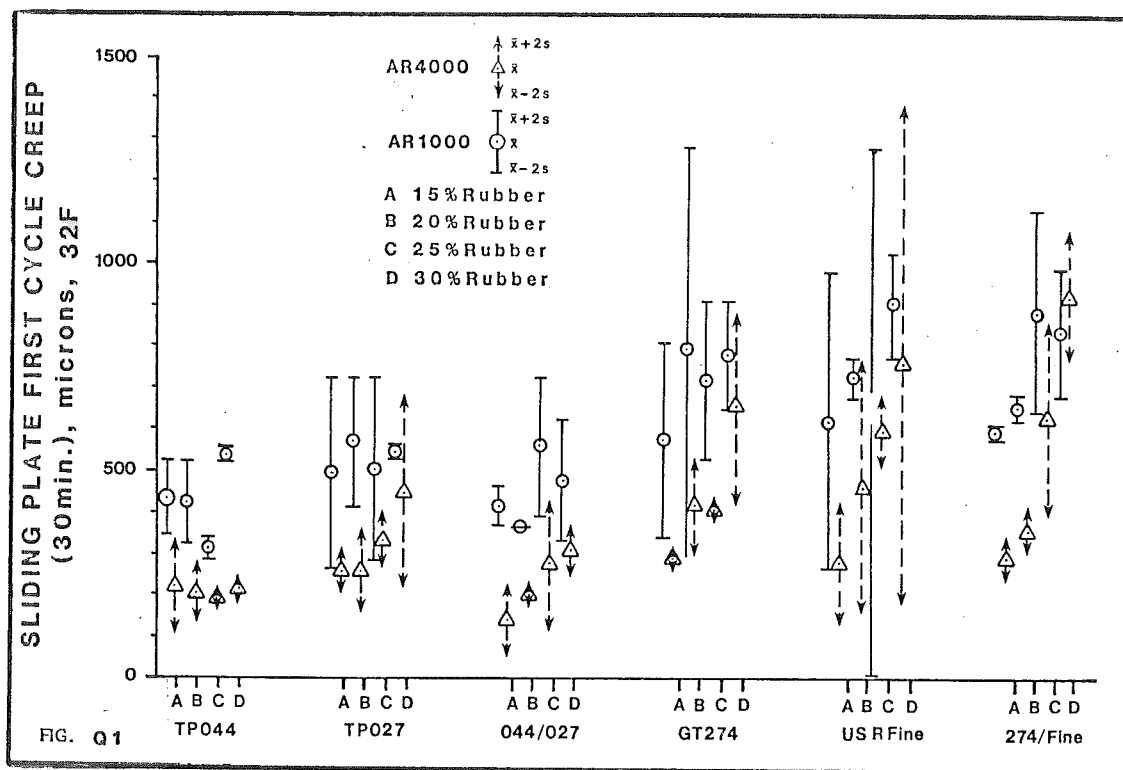
b. Summary

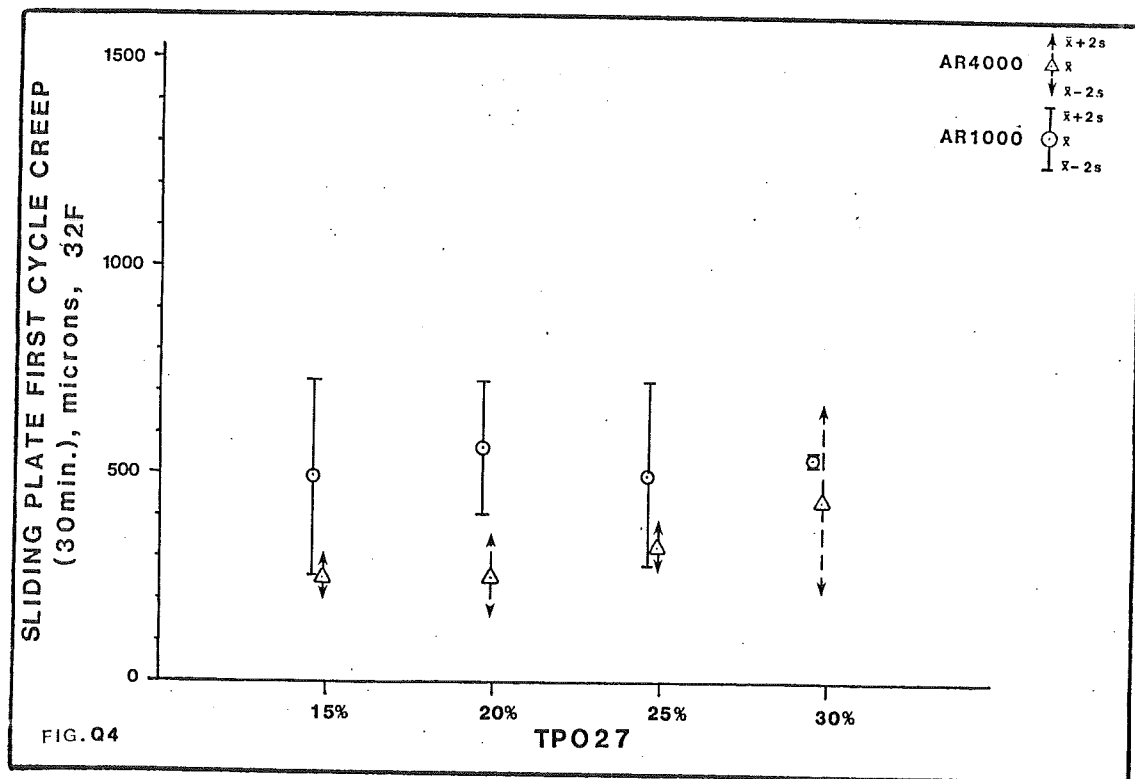
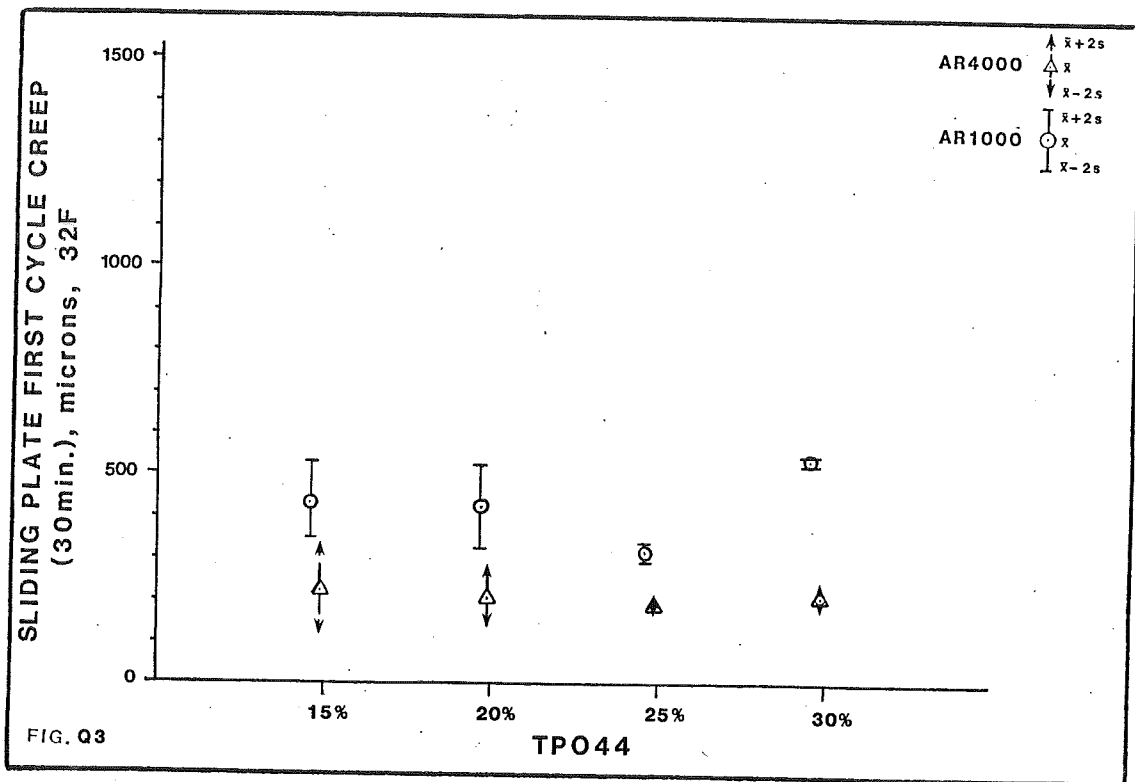
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>289.50</u>	<u>367.50</u>	<u>627.50</u>	<u>922.50</u>
	S	<u>23.922</u>	<u>22.150</u>	<u>108.978</u>	<u>76.196</u>
	CV	8.26	6.03	17.37	8.26
A R 1 0 0 0	$\bar{x}$	<u>593.50</u>	<u>657.50</u>	<u>887.50</u>	<u>836.50</u>
	S	<u>11.518</u>	<u>16.834</u>	<u>123.154</u>	<u>77.082</u>
	CV	1.94	2.56	13.88	9.21

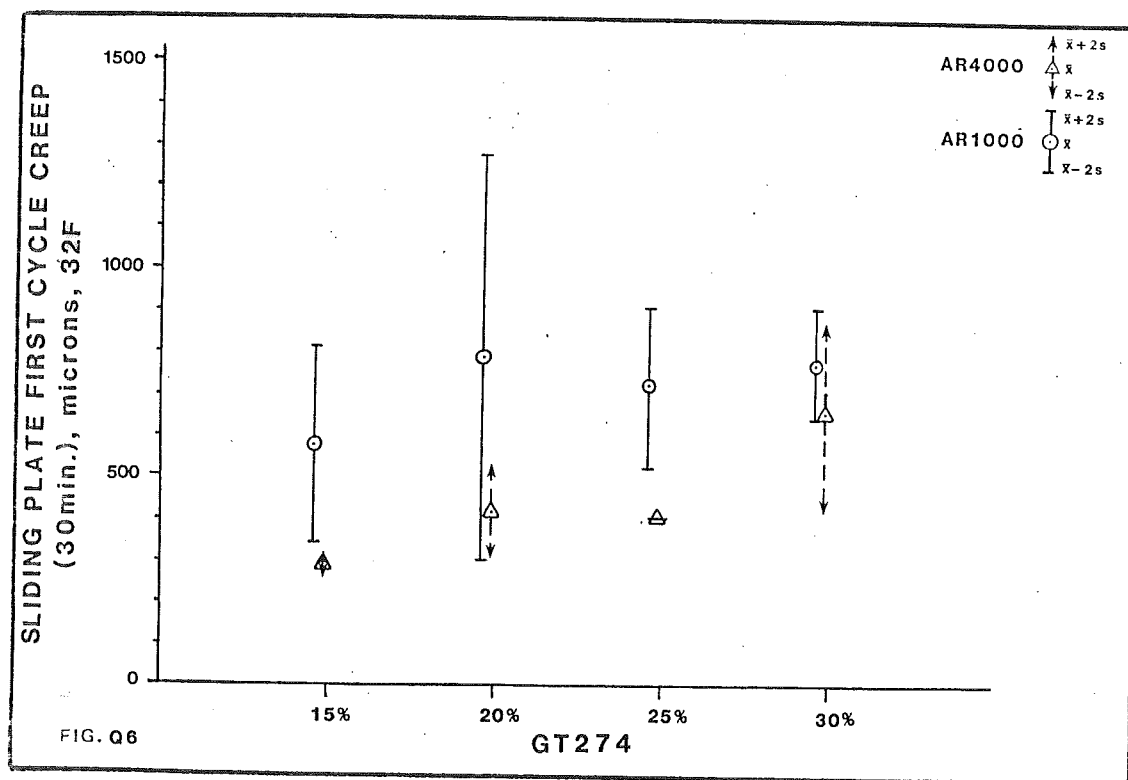
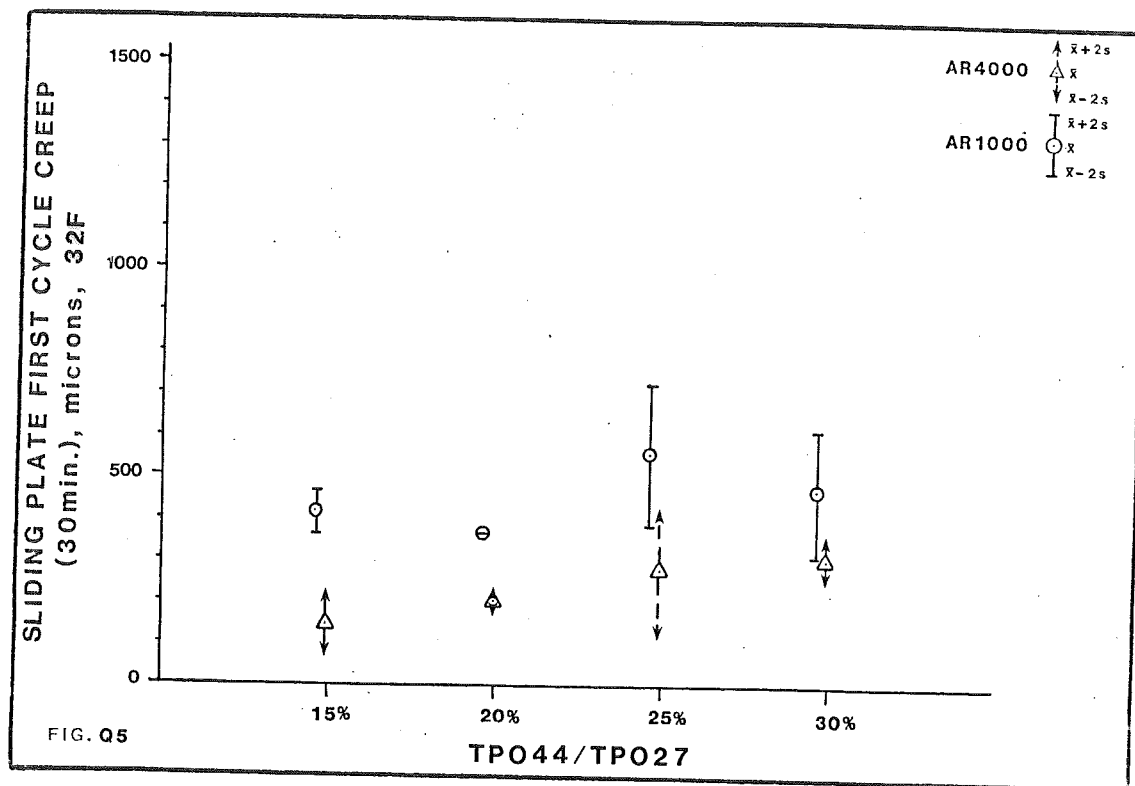
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP644				TP627				50% TP644 50% TP627				B1376				U.S. Rubber Fine				50% GT274 50% B.Fine															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30								
Sliding Plate	Creep																																				
	First Cycle																																				
Sliding Plate	Creep																																				
	First Cycle																																				

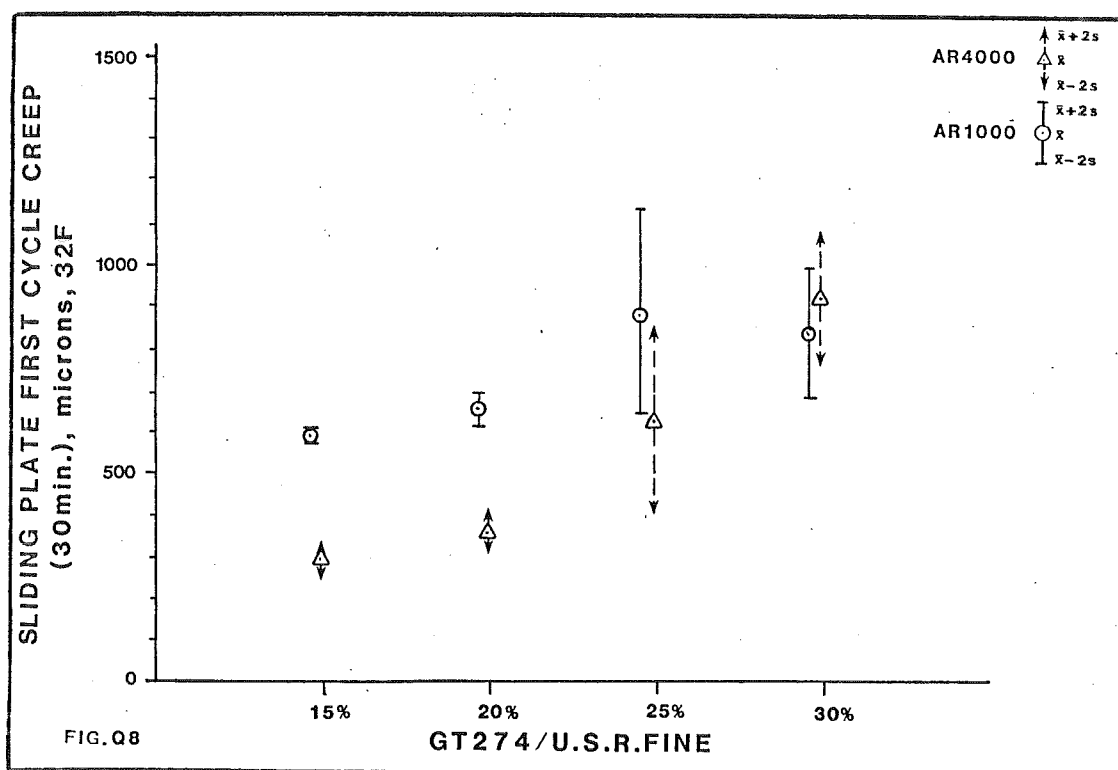
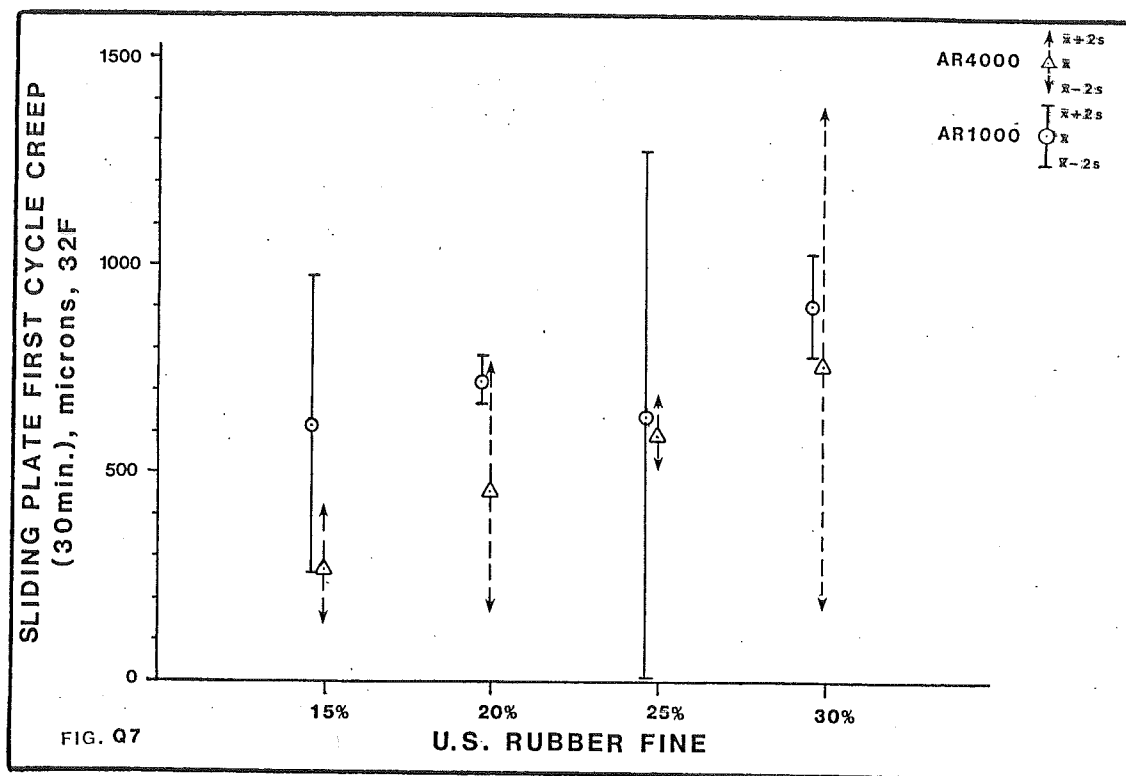
Table Q-2 Anova Summary, Sliding Plate First
Cycle Creep (30 min.)

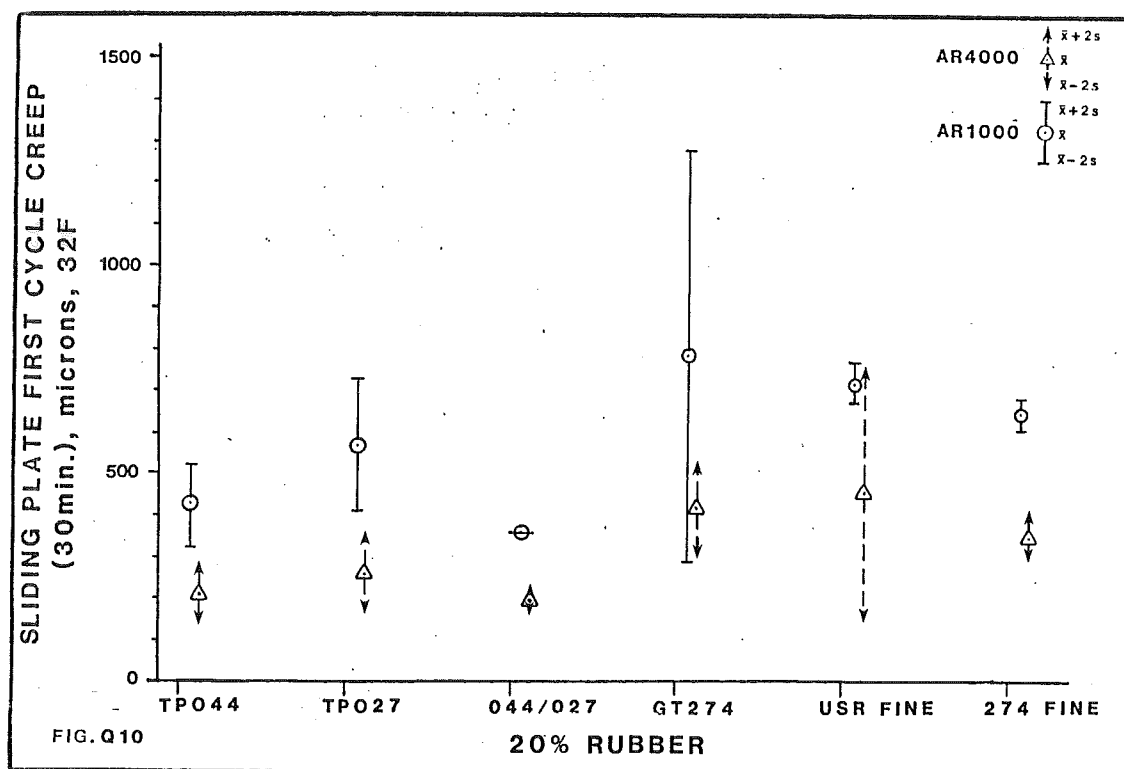
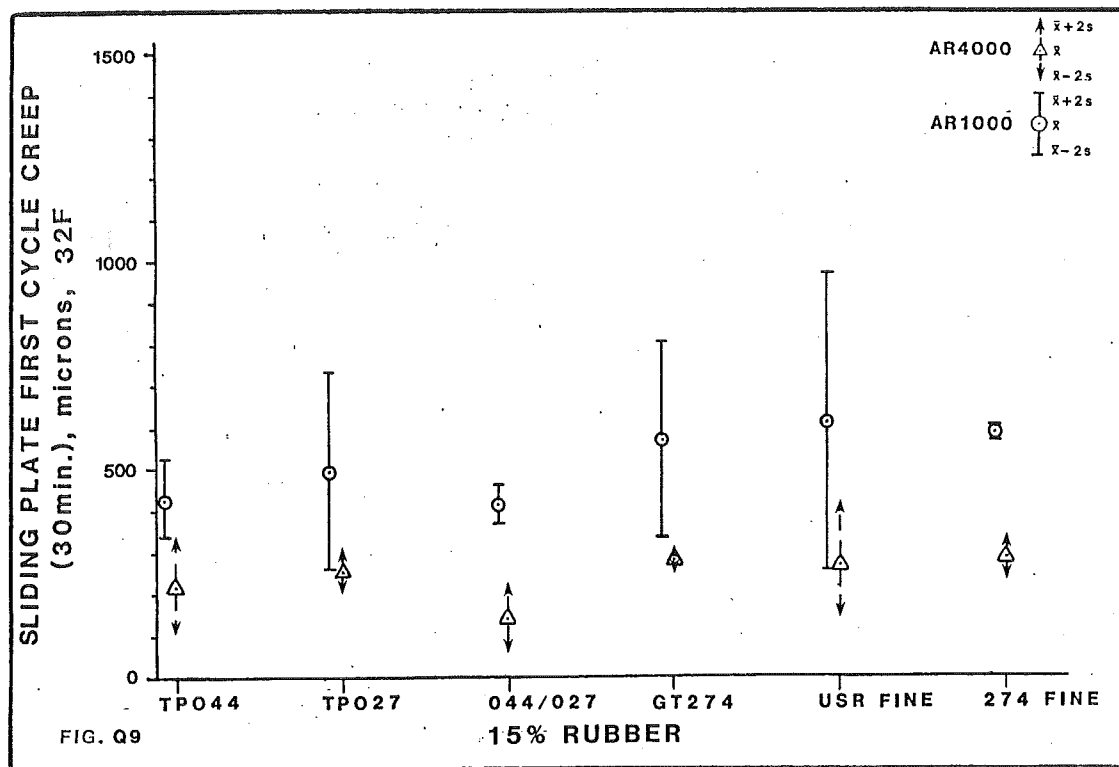
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	1799039.18	359807.84	58.28	2.43	3.48
Q	3	605308.78	201769.59	32.68	2.82	4.28
A	1	1067871.09	1067871.09	172.96	4.07	7.27
RQ	15	467609.78	31173.99	5.05	1.91	2.49
RA	5	19956.84	3991.37	.65	2.43	3.48
QA	3	116576.53	38858.84	6.29	2.82	4.28
RQA	15	128009.78	8533.99	1.38	1.91	2.49
Error	48	296352.50	6174.01			
TOTAL	95	4500724.49				

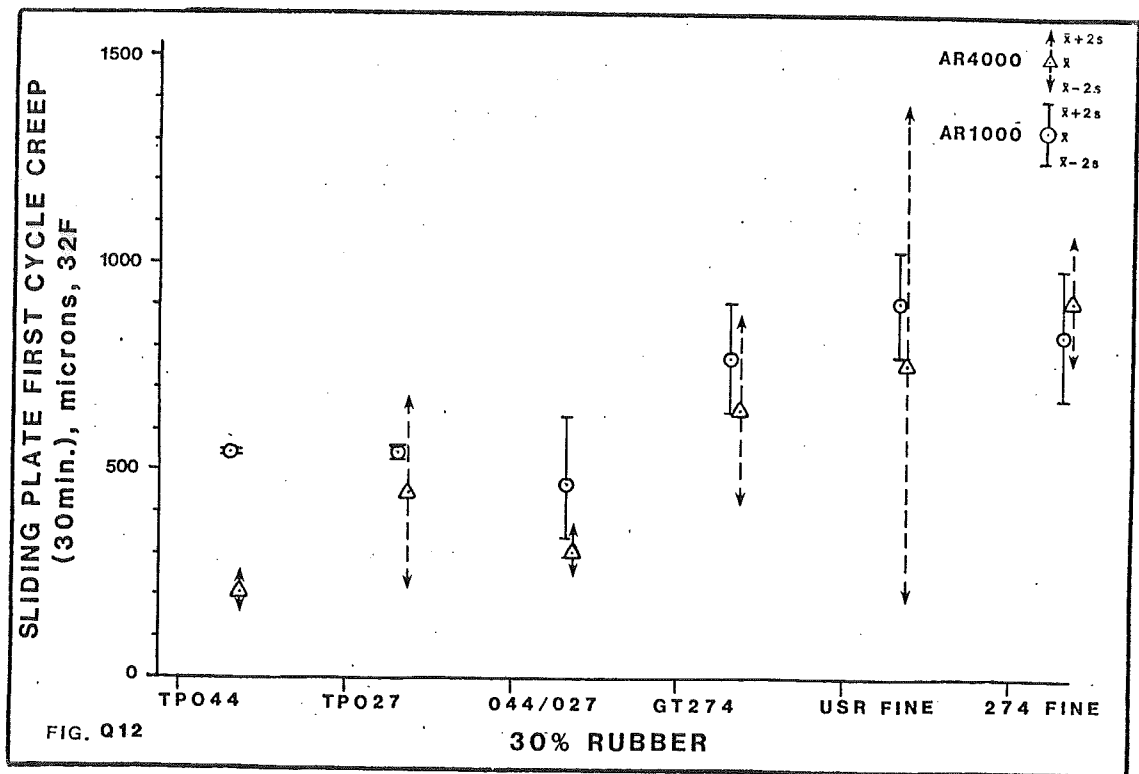
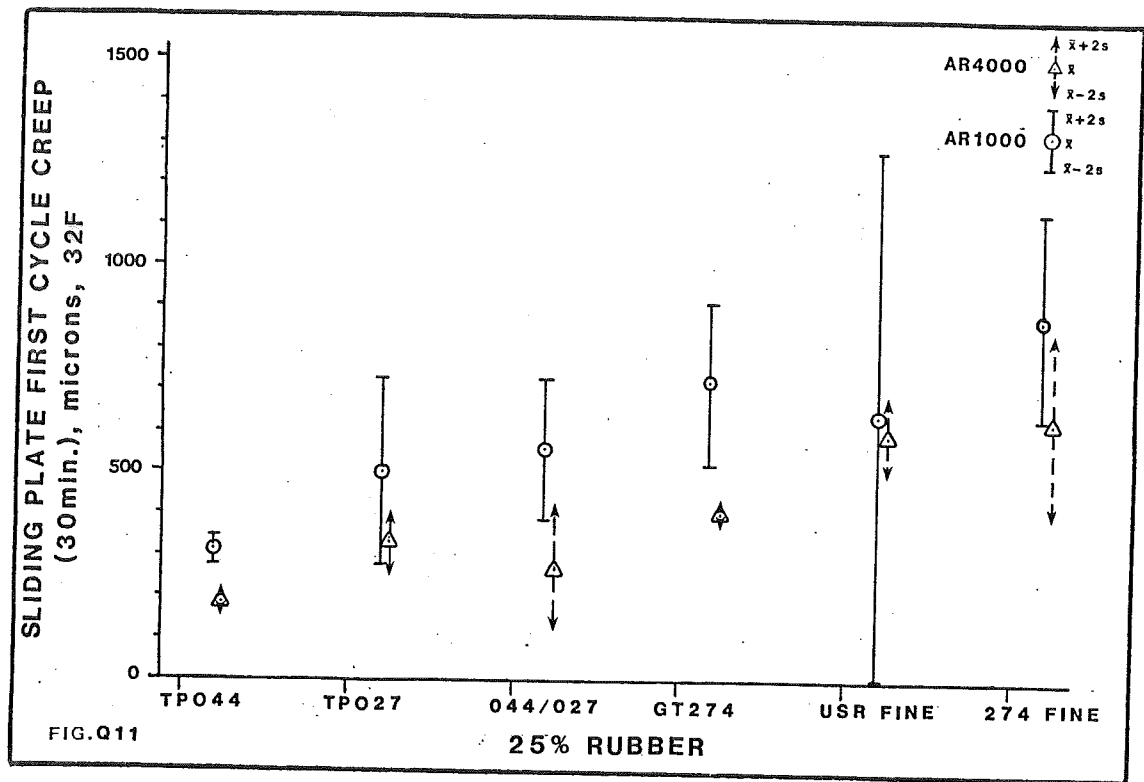












APPENDIX R

FIRST CYCLE RECOVERY (30 MIN) AT 32.0F
(0C) BY SLIDING PLATE MICROVISCOMETER

Table R-1 Sliding Plate First Cycle Recovery
(30 min.), microns

a. Measured and Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	97	93	99	124
	65	77	107	116
A R 1 0 0 0	182	172	196	236
	148	178	191	238

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>81.00</u>	<u>85.00</u>	<u>103.00</u>	<u>120.00</u>
	s	<u>28.352</u>	<u>14.176</u>	<u>7.088</u>	<u>7.088</u>
	cv	35.00	16.68	6.88	5.91
A R 1 0 0 0	$\bar{x}$	<u>165.00</u>	<u>175.00</u>	<u>193.50</u>	<u>237.00</u>
	s	<u>30.124</u>	<u>5.316</u>	<u>4.430</u>	<u>1.772</u>
	cv	18.26	3.04	2.29	.75

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP047				90% TP044 & 10% TP047				G1776				U.S. Rubber Firm				90% G1776 10% U.S. Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
RUBBER TYPE	100-151	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	100-152	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

Table R-1 Sliding Plate First Cycle Recovery
(30 min.), microns

a. Measured and Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	81	100	127	161
	67	115	159	216
A R 1 0 0 0	167	203	240	293
	149	177	227	228

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	74.00	107.50	143.00	188.50
	s	12.404	13.290	28.352	48.730
	cv	16.76	12.36	19.83	25.85
A R 1 0 0 0	$\bar{x}$	158.00	190.00	233.50	260.50
	s	15.948	23.036	11.518	57.590
	cv	10.09	12.12	4.93	22.11

		ASTM TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (A)			
		TP044				TP027				50% TP044 & 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
A	4000												
	1000												
B	4000												
	1000												

Table R-1 Sliding Plate First Cycle Recovery
(30 min.), microns

a. Measured and Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	75	97	102	155
	44	113	126	157
A R 1 0 0 0	164	166	217	264
	179	151	279	257

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>59.50</u>	<u>105.00</u>	<u>114.00</u>	<u>156.00</u>
	S	<u>27.466</u>	<u>14.176</u>	<u>21.264</u>	<u>1.772</u>
	CV	46.16	13.50	18.65	1.14
A R 1 0 0 0	$\bar{x}$	<u>171.50</u>	<u>158.50</u>	<u>248.00</u>	<u>260.50</u>
	S	<u>13.290</u>	<u>13.290</u>	<u>54.932</u>	<u>6.202</u>
	CV	7.75	8.38	22.15	2.38

ASPHALT TYPE (A)																				
PERCENT RUBBER (B)																				
RUBBER TYPE (C)																				

Table R-1 Sliding Plate First Cycle Recovery
(30 min.), microns

a. Measured and Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	54	112	160	279
	46	130	141	296
A R 1 0 0 0	181	195	297	385
	193	393	334	352

b. Summary

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>50.00</u>	<u>121.00</u>	<u>150.50</u>	<u>287.50</u>
	S	<u>7.088</u>	<u>15.948</u>	<u>16.834</u>	<u>15.062</u>
	CV	14.18	13.18	11.19	5.24
A R 1 0 0 0	$\bar{x}$	<u>187.00</u>	<u>294.00</u>	<u>315.50</u>	<u>368.50</u>
	S	<u>10.632</u>	<u>175.428</u>	<u>32.782</u>	<u>29.238</u>
	CV	5.69	59.67	10.39	7.93

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP644				TP637				50% TP644 50% TP637				G1714				U.S. Rubber Fms				50% G1714 50% U.S. Fms															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Recovery																																					
Recovery																																					

Table R-1 Sliding Plate First Cycle Recovery
(30 min.), microns

a. Measured and Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	54	96	212	357
	68	98	230	285
A R 1 0 0 0	286	283	375	425
	214	247	230	469

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	61.00	97.00	221.00	321.00
	s	12.404	1.772	15.948	63.792
	cv	20.33	1.83	7.22	19.87
A R 1 0 0 0	$\bar{x}$	250.00	265.00	302.50	447.00
	s	63.792	31.896	128.470	38.984
	cv	25.52	12.04	42.47	8.72

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (R)			
		TP044				TP027				80% TP044 20% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
Sliding Plate	Recovery	---	---	---	---	---	---	---	---	---	---	---	---
	Loss	---	---	---	---	---	---	---	---	---	---	---	---
		BT076				U.S. Rubber Fine				80% BT076 20% U.S. Rubber Fine			
		15	20	25	30	15	20	25	30	15	20	25	30
Sliding Plate	Recovery	---	---	---	---	---	---	---	---	---	---	---	---
	Loss	---	---	---	---	---	---	---	---	---	---	---	---

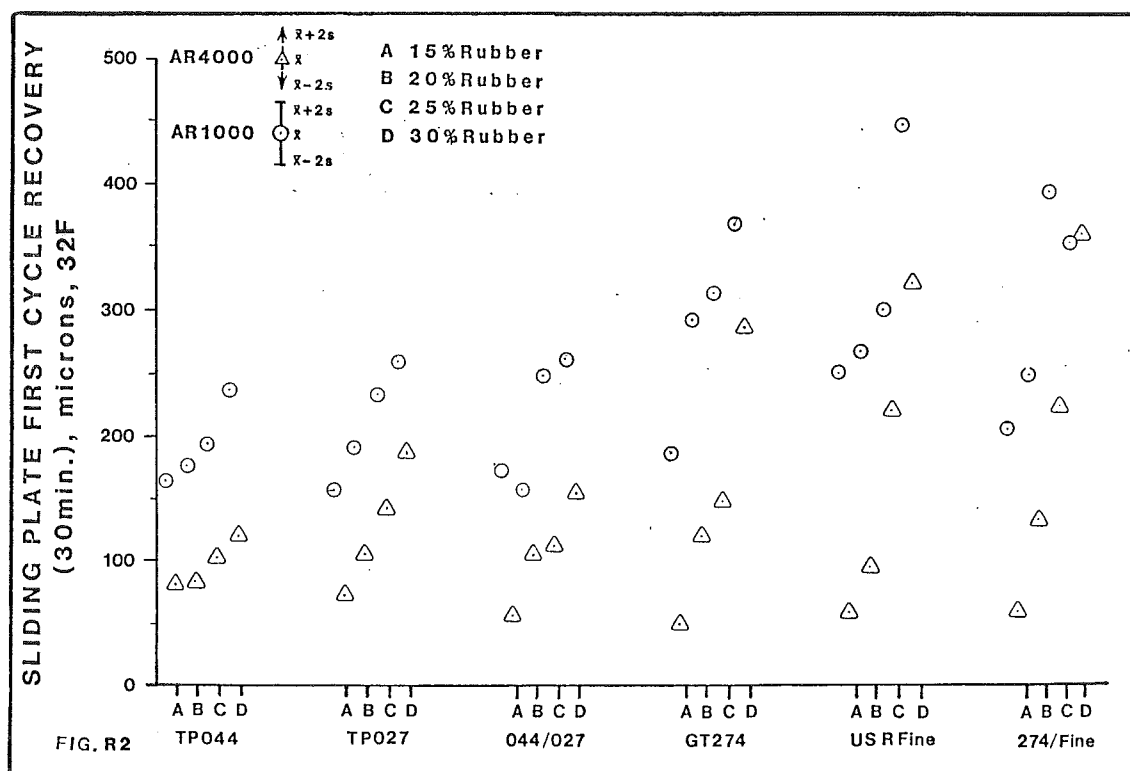
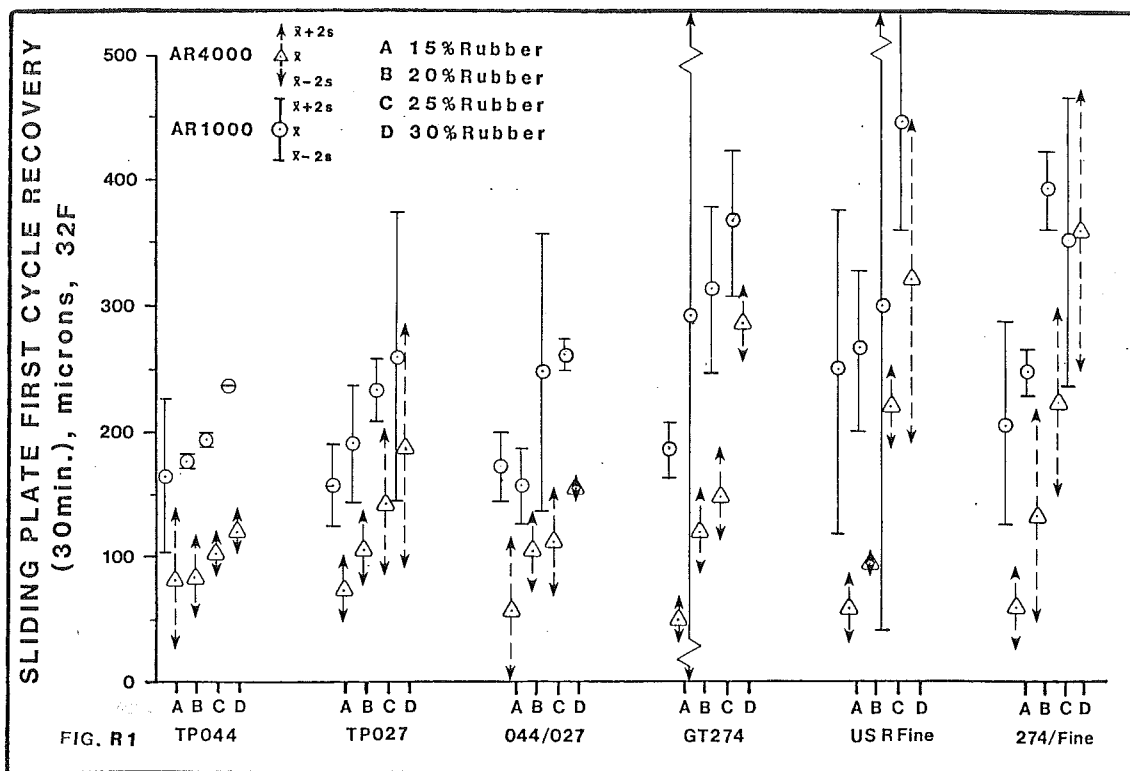
a. Measured and Analyzed Data

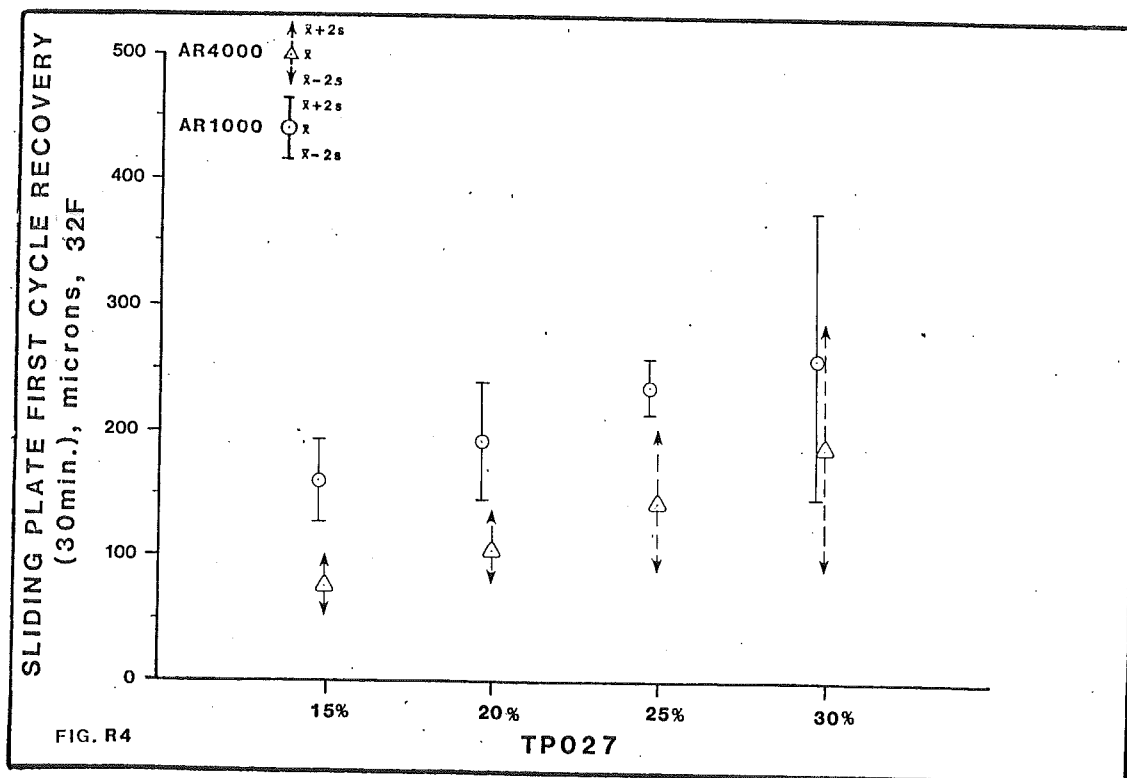
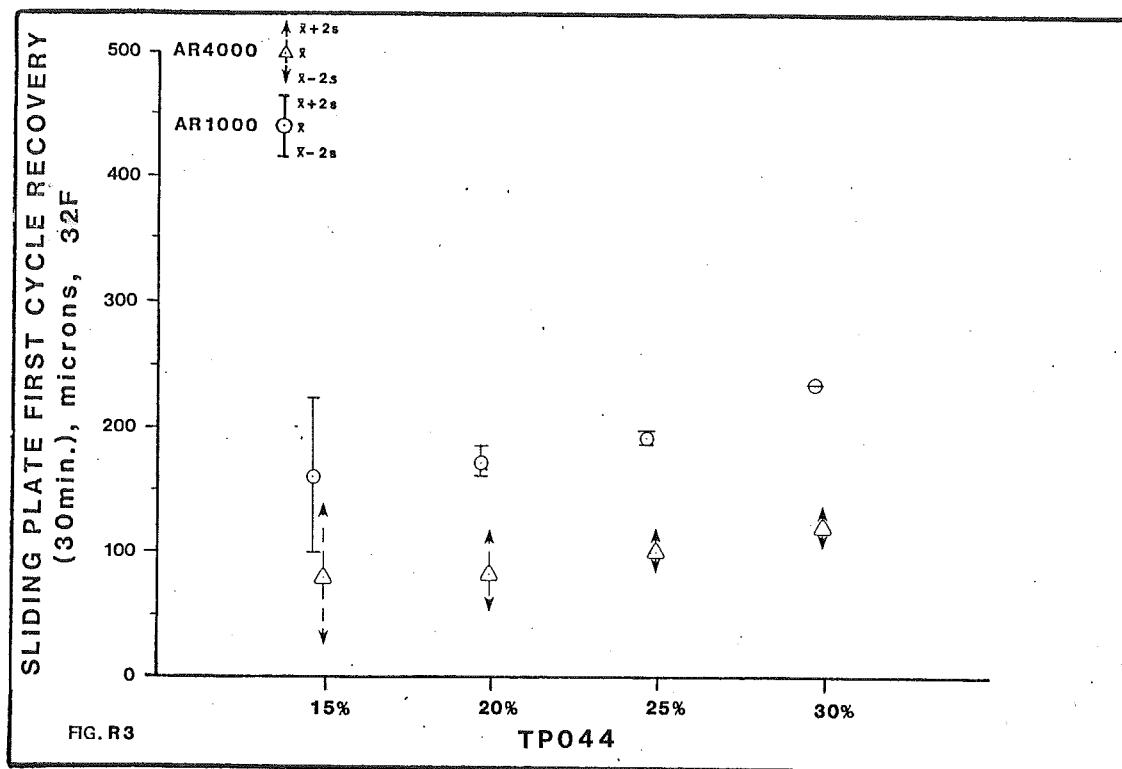
b. Summary

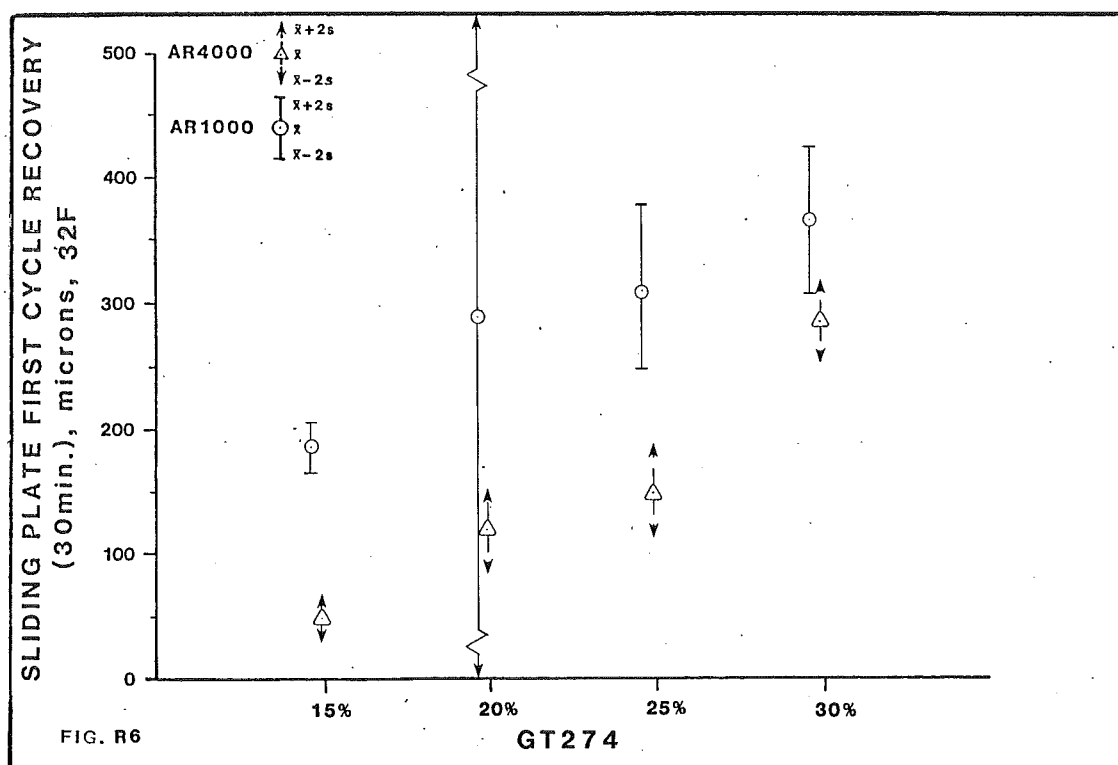
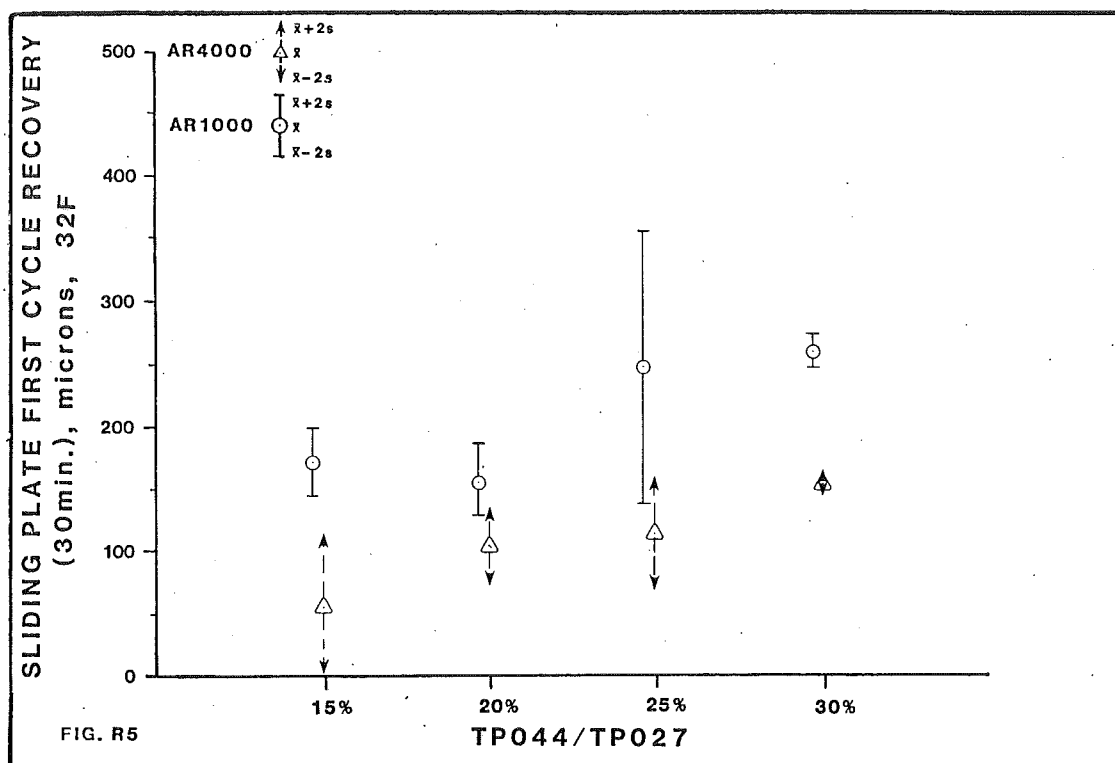
[illegible]

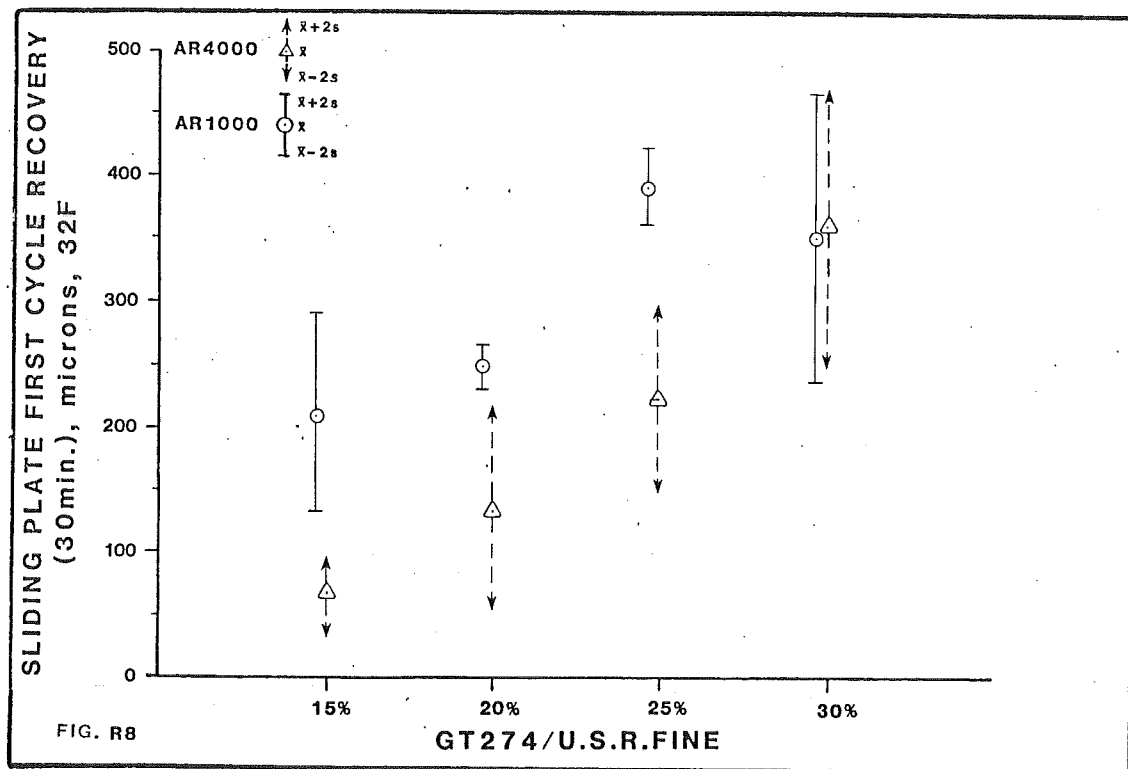
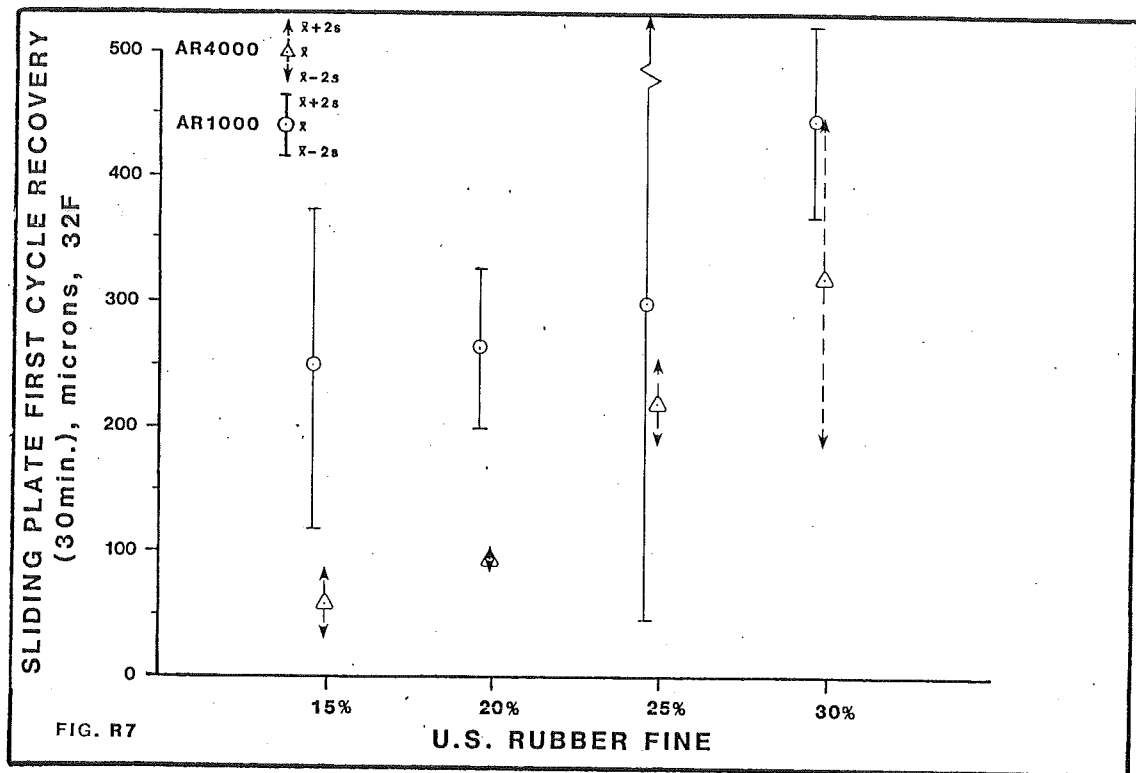
Table R-2 Anova Summary, Sliding Plate
First Cycle Recovery (30 min.)

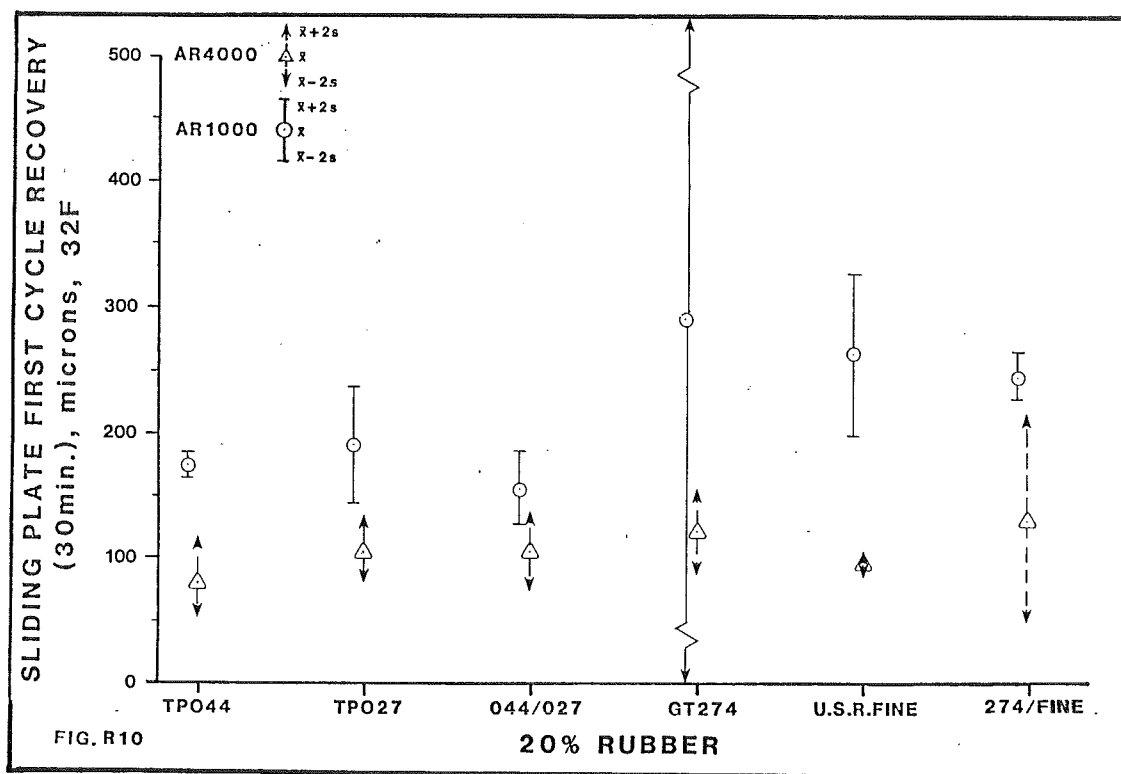
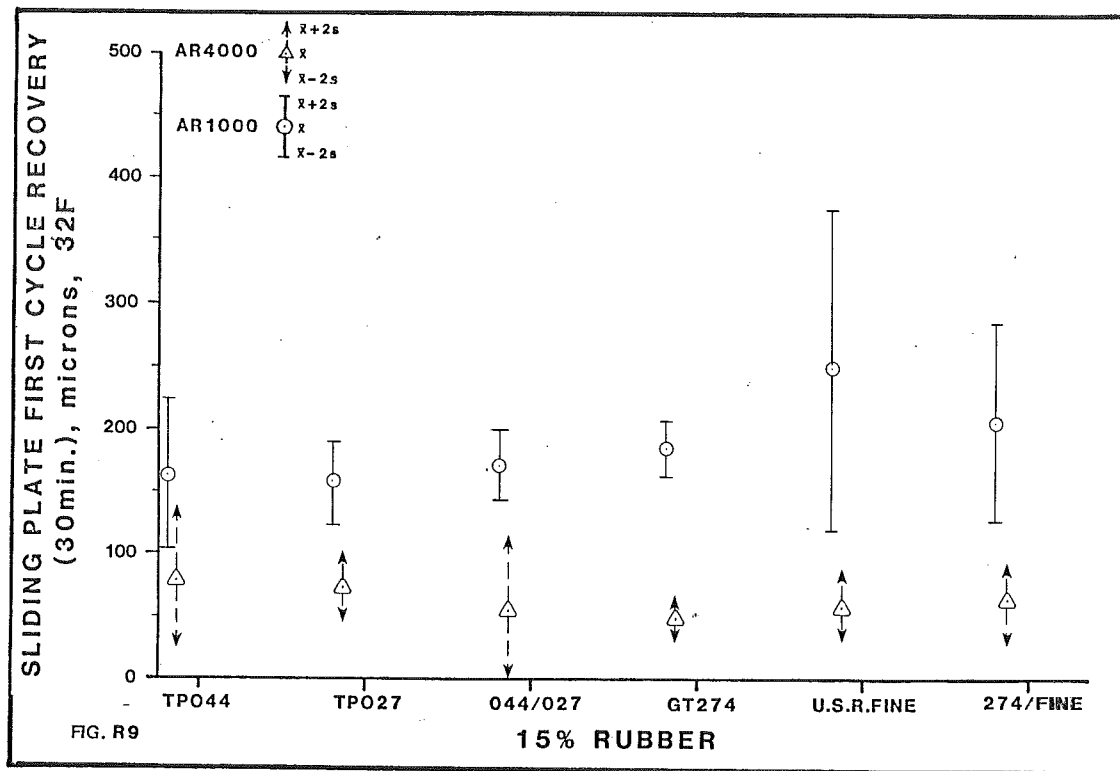
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	169473.18	33894.64	29.23	2.43	3.48
Q	3	319821.95	106607.32	91.93	2.82	4.28
A	1	294041.34	294041.34	253.57	4.07	7.27
RQ	15	79174.11	5278.27	4.55	1.91	2.49
RA	5	11573.09	2314.62	2.00	2.43	3.48
QA	3	6993.61	2331.20	2.01	2.82	4.28
RQA	15	27882.20	1858.81	1.60	1.91	2.49
Error	48	55661.50	1159.61			
TOTAL	95	964620.99				

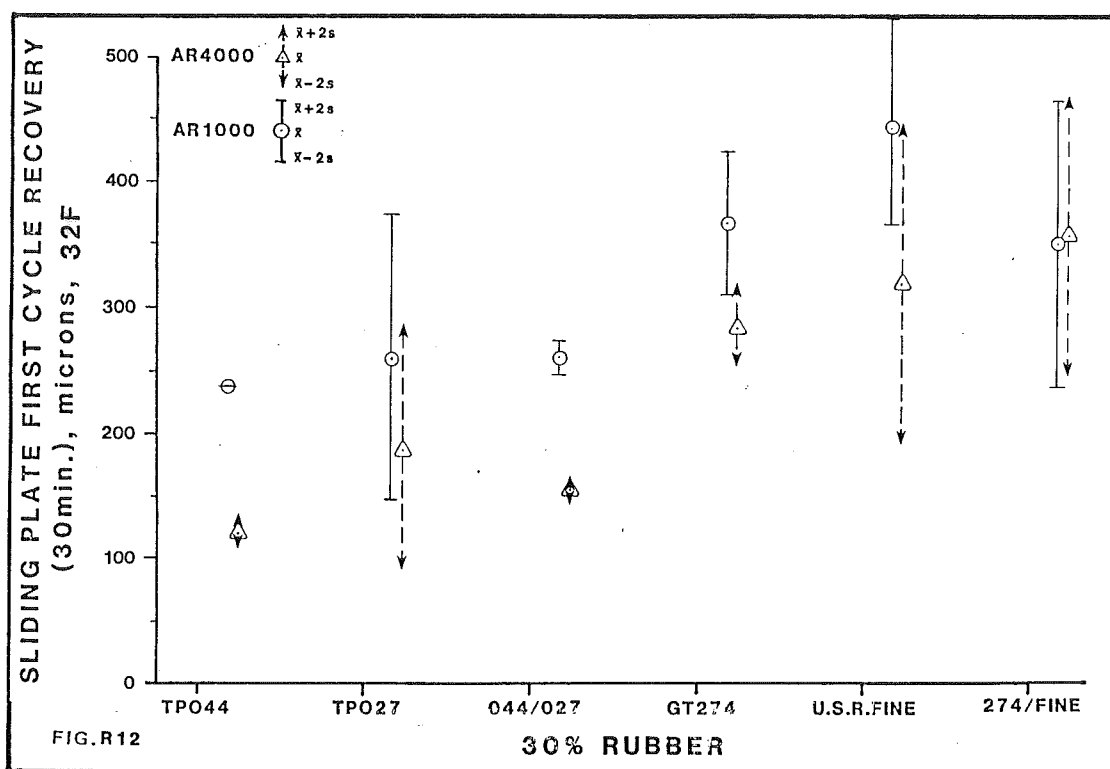
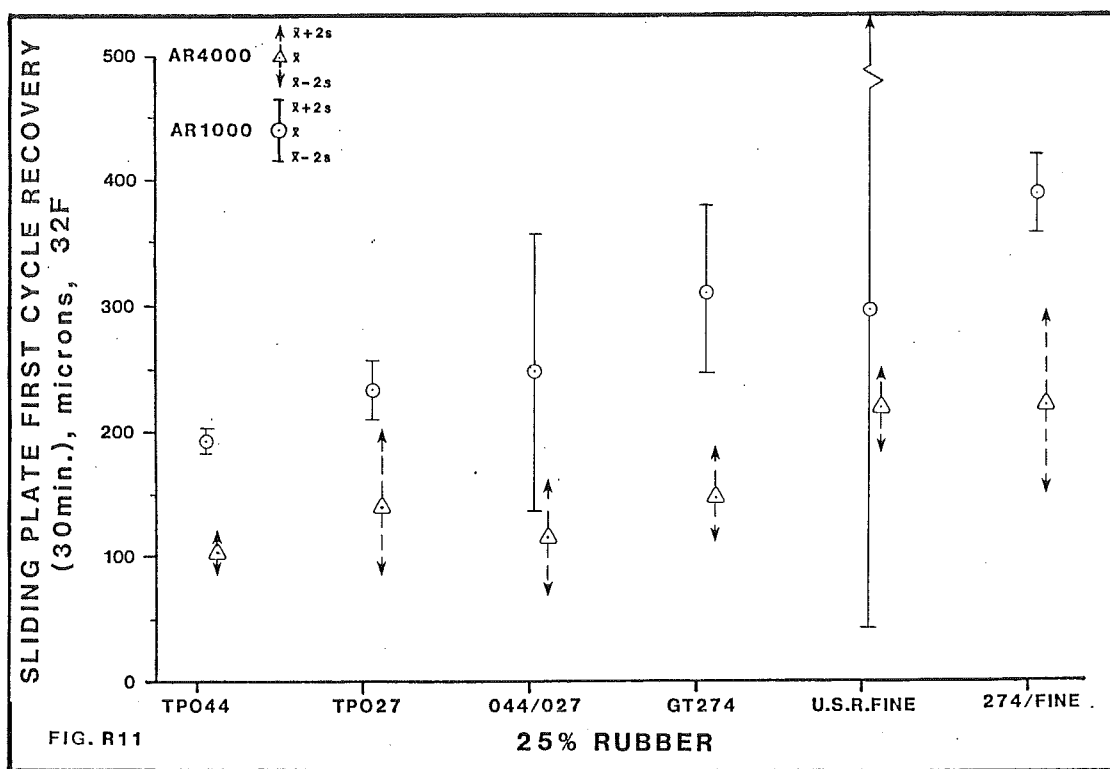












APPENDIX S
SECOND CYCLE CREEP (30 MIN) AT 32.0F
(0C) BY SLIDING PLATE MICROVISCOMETER

Table S-1 Sliding Plate Second Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	125	163	146	173
	129	130	156	168
A R 1 0 0 0	385	311	238	330
	335	285	295	317

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	127.00	146.50	151.00	170.50
	S	3.544	29.238	8.860	4.430
	CV	2.79	19.96	5.87	2.60
A R 1 0 0 0	$\bar{x}$	360.00	298.00	266.50	323.50
	S	44.300	23.036	50.502	11.518
	CV	12.31	7.73	18.95	3.56

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP027				50% TP044 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
S L I D I N G P L A T E C R E E P	15												
	20												
	25												
	30												

a. Measured and Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	148	169	196	286
	152	188	220	332
A R 1 0 0 0	397	381	377	453
	353	334	357	451

b. Summary

		TP027			
		15%	20%	25%	30%
A	X	150.00	178.50	208.00	309.00
R	S	3.544	16.834	21.264	40.756
4	CV	2.36	9.43	10.22	13.19
0					
0					
0					
A	X	375.00	357.50	367.00	452.00
R	S	38.984	41.642	11.720	1.772
1	CV	10.40	11.65	4.83	.39
0					
0					
0					

[illegible]

Table S-1 Sliding Plate Second Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	123	160	169	219
	100	132	178	209
A R 1 0 0 0	333	269	325	361
	322	300	400	329

b. Summary

		50% TP044 & 50% TP027			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>111.50</u>	<u>146.00</u>	<u>173.50</u>	<u>214.00</u>
	S	<u>20.378</u>	<u>24.808</u>	<u>7.974</u>	<u>8.860</u>
	CV	18.28	16.99	4.60	4.14
A R 1 0 0 0	$\bar{x}$	<u>327.50</u>	<u>284.50</u>	<u>362.50</u>	<u>345.00</u>
	S	<u>9.746</u>	<u>27.466</u>	<u>66.450</u>	<u>28.352</u>
	CV	2.98	9.65	18.33	8.22

		ASPHALT TYPE (A)			PERCENT RUBBER (B)			RUBBER TYPE (C)		
		TP044			TP027			50% TP044 50% TP027		
		15	20	25	15	20	25	15	20	25
Sliding Plate	Creep									
	30 min.									
Sliding Plate	Creep									
	30 min.									

Table S-1 Sliding Plate Second Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	163	278	294	483
	188	249	263	476
A R 1 0 0 0	426	505	514	676
	473	658	604	666

b. Summary

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>175.50</u>	<u>263.50</u>	<u>278.50</u>	<u>479.50</u>
	s	<u>22.150</u>	<u>25.694</u>	<u>27.466</u>	<u>6.202</u>
	cv	12.62	9.75	9.86	1.29
A R 1 0 0 0	$\bar{x}$	<u>449.50</u>	<u>581.50</u>	<u>559.00</u>	<u>671.00</u>
	s	<u>41.642</u>	<u>135.558</u>	<u>79.740</u>	<u>8.860</u>
	cv	9.26	23.31	14.26	1.32

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP044				TP037				50% TP044 50% TP037			
		15	20	25	30	15	20	25	30	15	20	25	30
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												
	20												
Sliding Plate	15												

Table S-1 Sliding Plate Second Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	180	274	396	595
	211	377	404	655
A R 1 0 0 0	422	542	568	706
	464	512	427	736

b. Summary

		U. S. RUBBER FINE			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>195.50</u>	<u>325.50</u>	<u>400.00</u>	<u>625.00</u>
	S	<u>27.466</u>	<u>91.258</u>	<u>7.088</u>	<u>53.160</u>
	CV	14.05	28.04	1.77	8.51
A R 1 0 0 0	$\bar{x}$	<u>443.00</u>	<u>527.00</u>	<u>497.50</u>	<u>721.00</u>
	S	<u>37.212</u>	<u>26.580</u>	<u>124.926</u>	<u>26.580</u>
	CV	8.40	5.04	25.11	3.69

		ASPHALT TYPE (A)			PERCENT RUBBER (B)			RUBBER TYPE (B)		
C	D	TP044			TP027			80% TP044 & 20% TP027		
		15	20	25	15	20	25	15	20	25
E	F	G1274			U.S. Rubber Fine			80% G1274 & 20% U.S. Rubber Fine		
		15	20	25	15	20	25	15	20	25
1	1									
2	2									
3	3									
4	4									
5	5									
6	6									
7	7									
8	8									
9	9									
10	10									
11	11									
12	12									
13	13									
14	14									
15	15									
16	16									
17	17									
18	18									
19	19									
20	20									
21	21									
22	22									
23	23									
24	24									
25	25									
26	26									
27	27									
28	28									
29	29									
30	30									
31	31									
32	32									
33	33									
34	34									
35	35									
36	36									
37	37									
38	38									
39	39									
40	40									
41	41									
42	42									
43	43									
44	44									
45	45									
46	46									
47	47									
48	48									
49	49									
50	50									

Table S-1 Sliding Plate Second Cycle Creep
(30 min.), microns

a. Measured and Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	183	226	435	648
	200	258	531	589
A R 1 0 0 0	454	483	667	570
	474	523	769	658

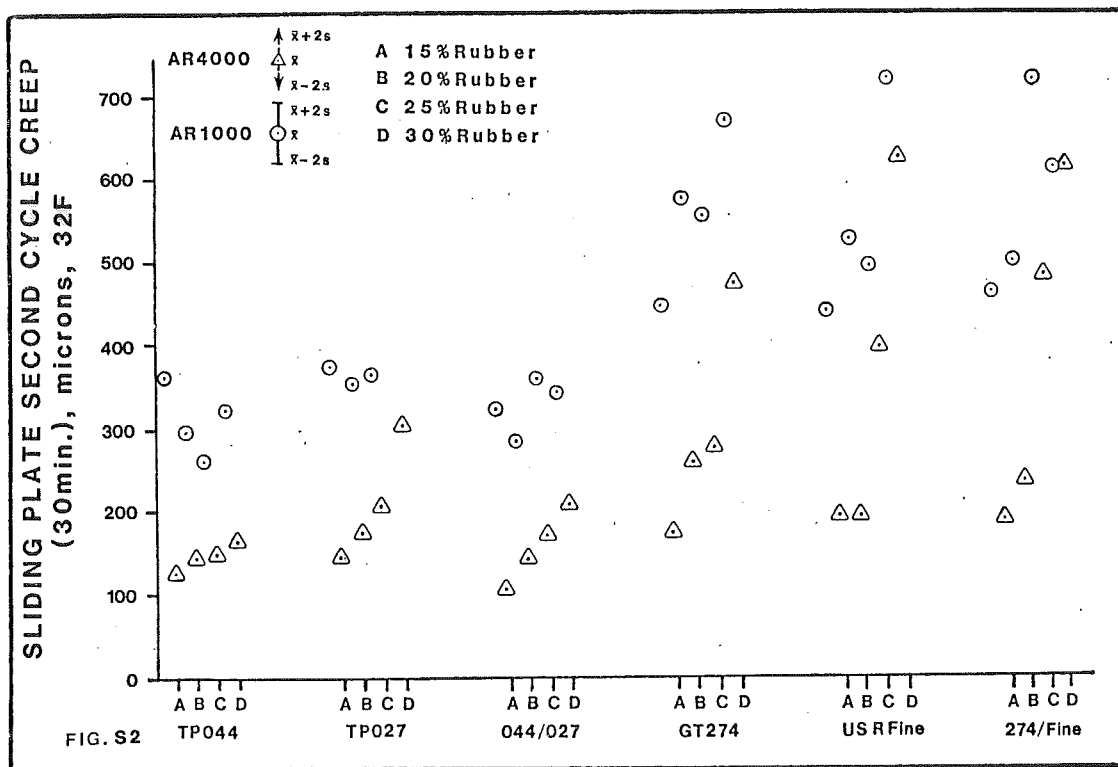
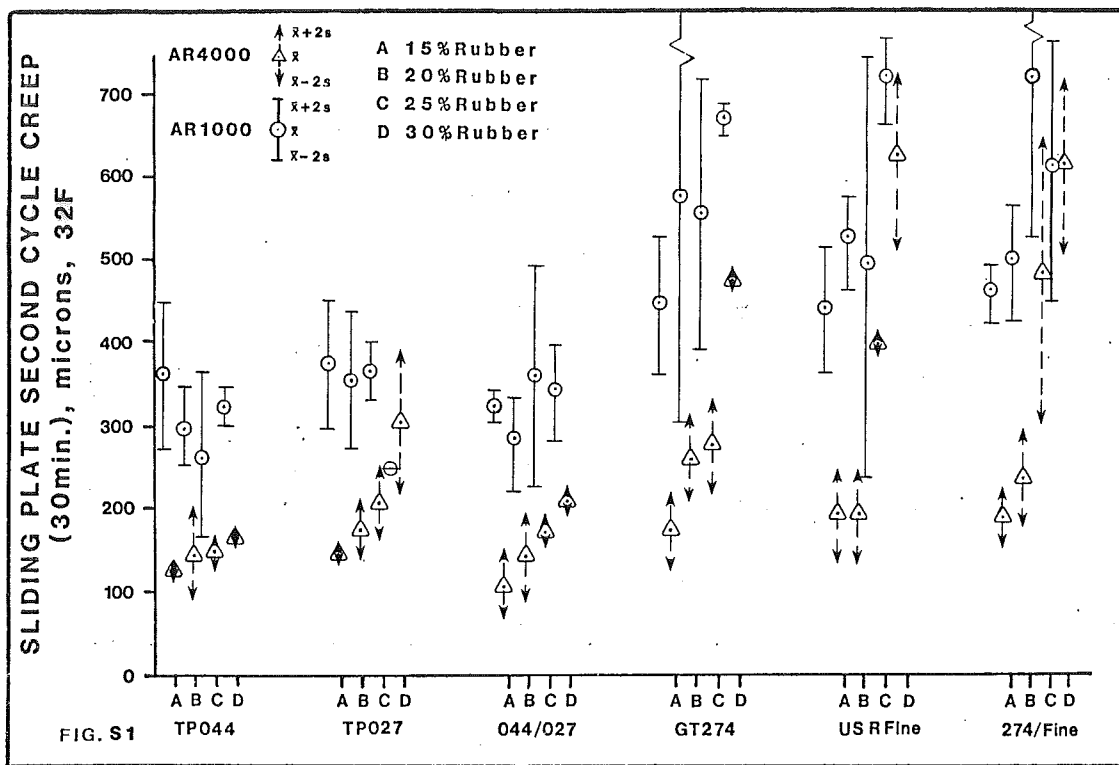
b. Summary

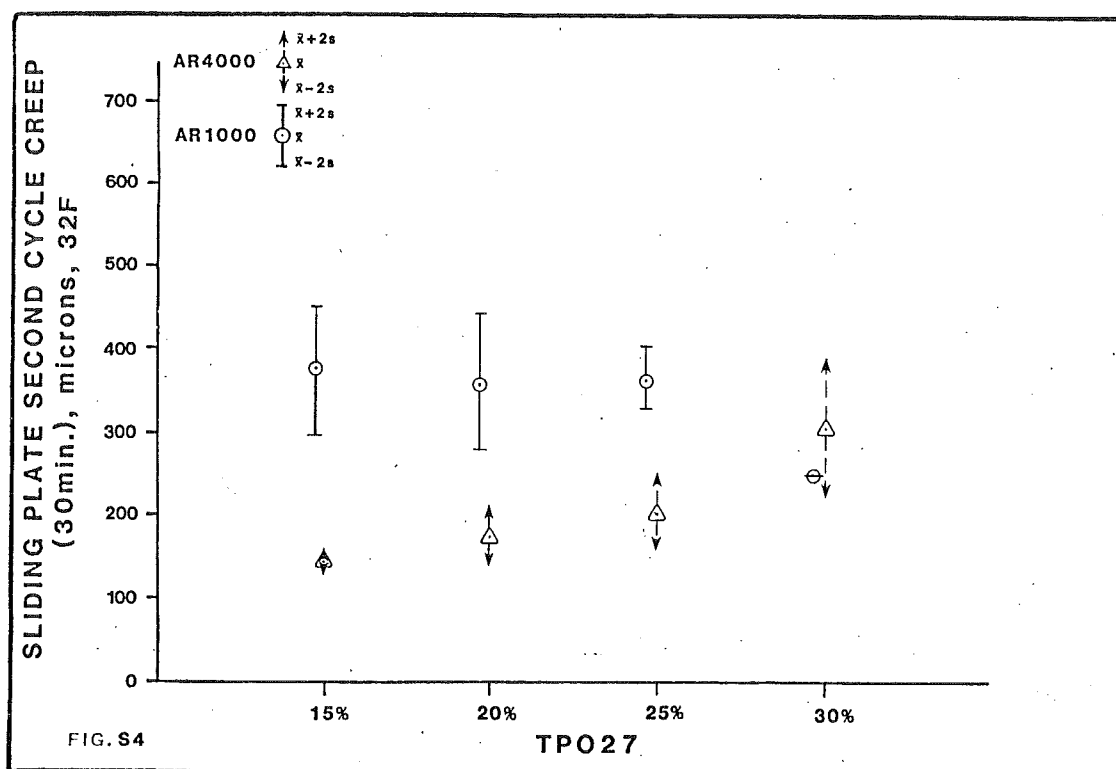
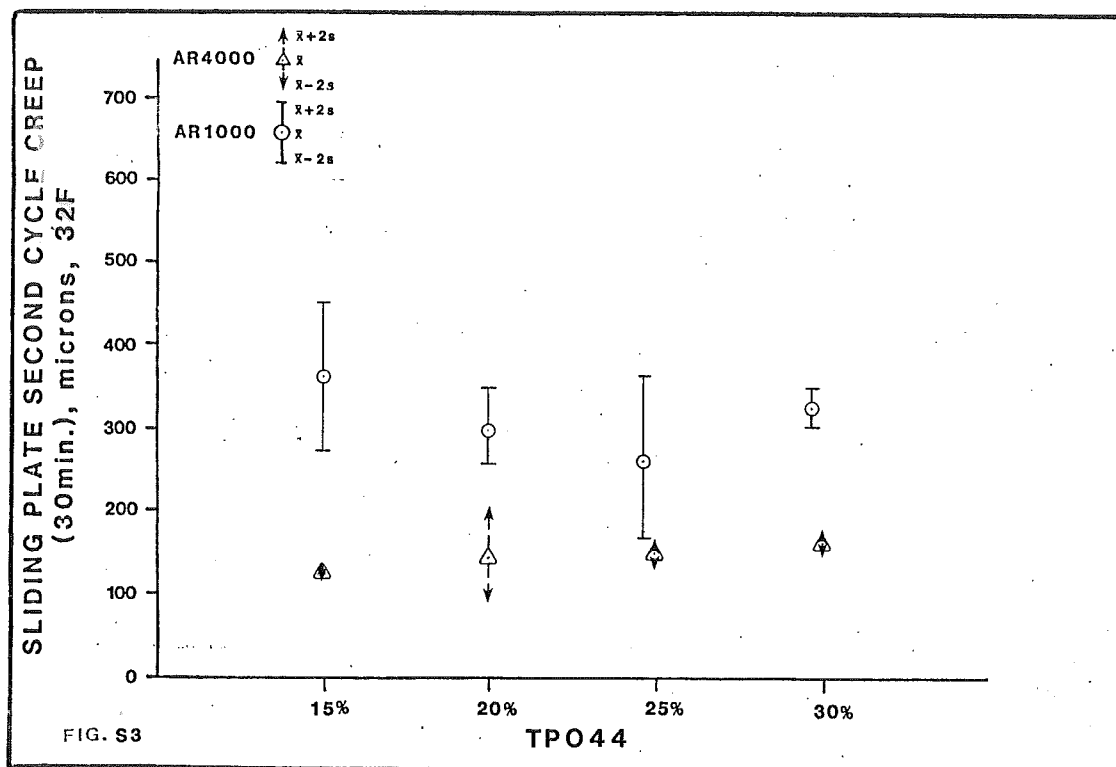
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	191.50	242.00	483.00	618.50
	s	15.062	28.352	85.056	52.274
	cv	7.87	11.72	17.61	8.45
A R 1 0 0 0	$\bar{x}$	464.00	503.00	718.00	614.00
	s	17.720	35.440	90.372	77.968
	cv	3.82	7.05	12.59	12.70

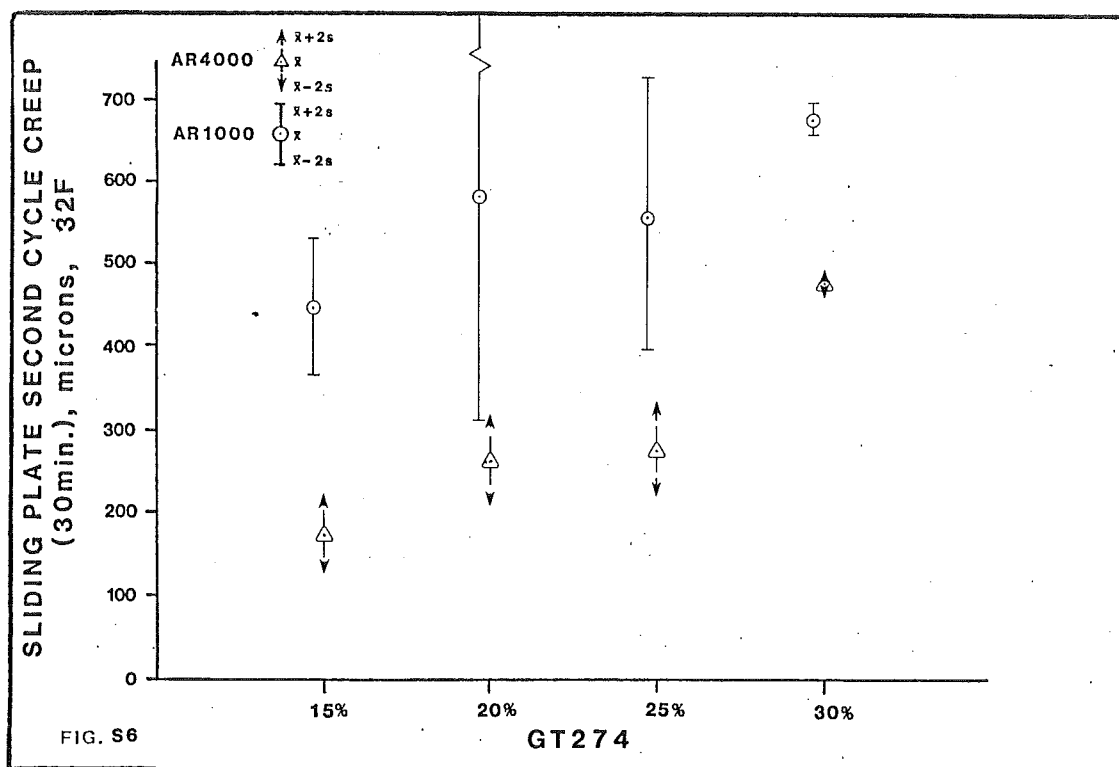
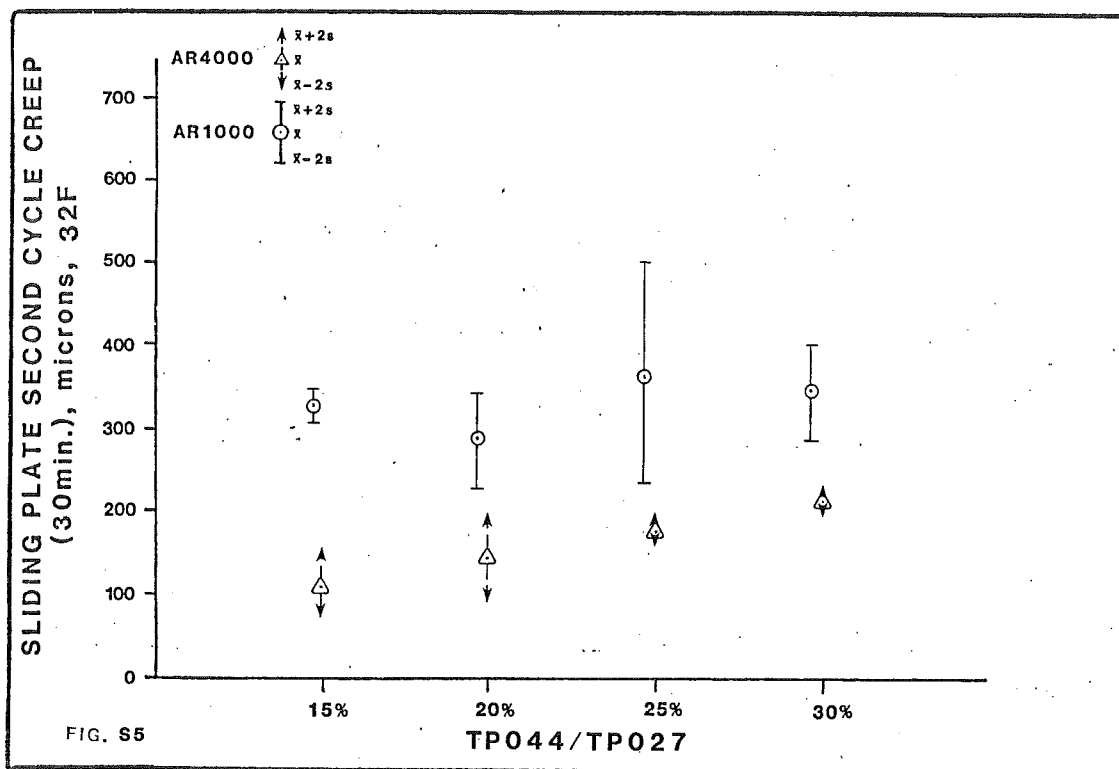
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)												
		TP048				TP027				50% TP048 50% TP027				GT 274				U.S. Rubber Fine				50% GT 274 50% S.F. 6																
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	
RUBBER	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																																					
	100-100																				</																	

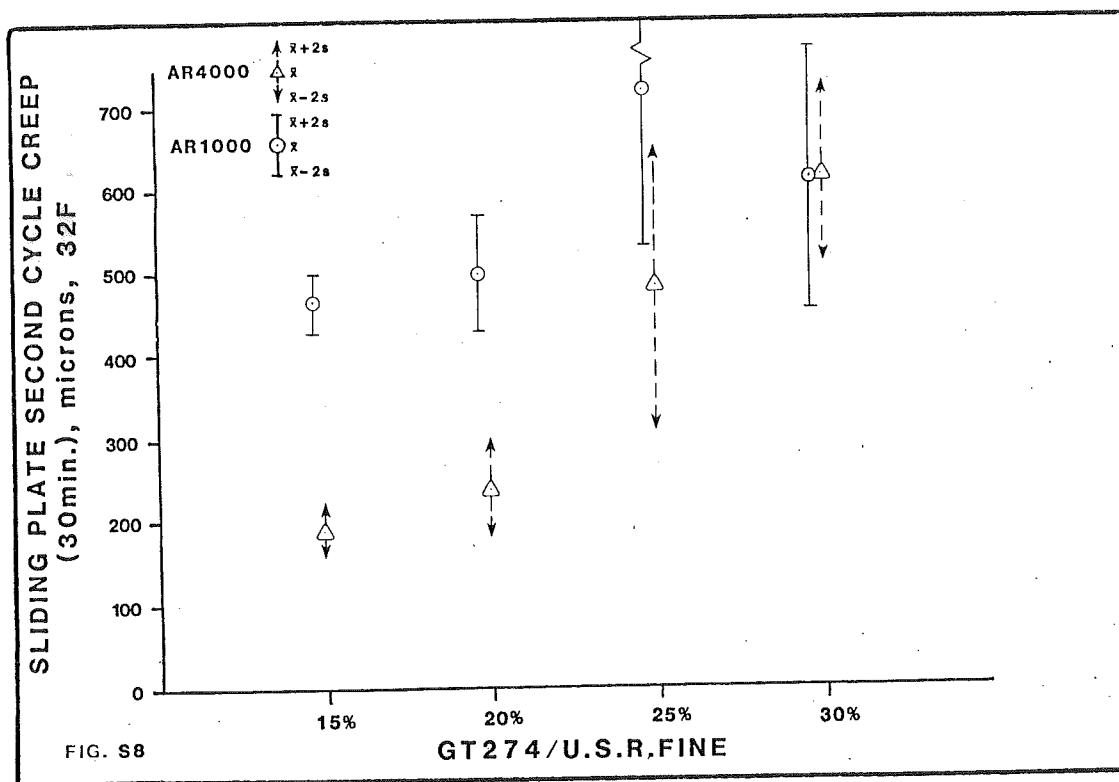
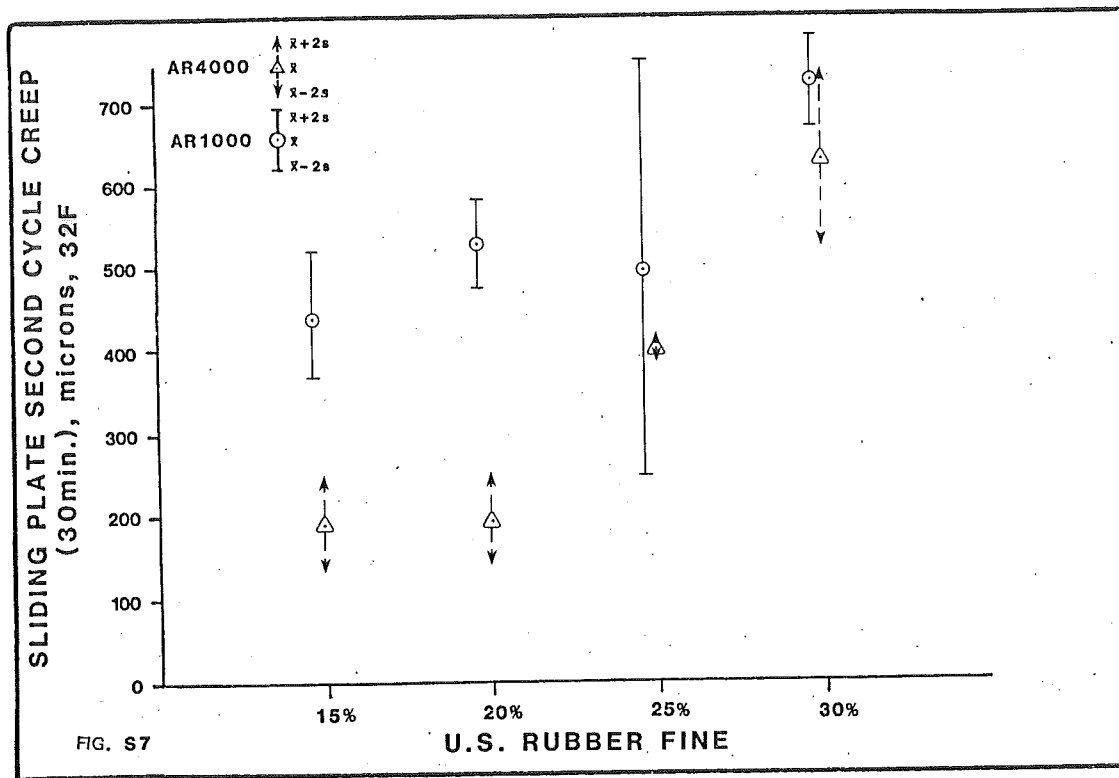
Table S-2 Anova Summary, Sliding Plate Second Cycle Creep (30 min.)

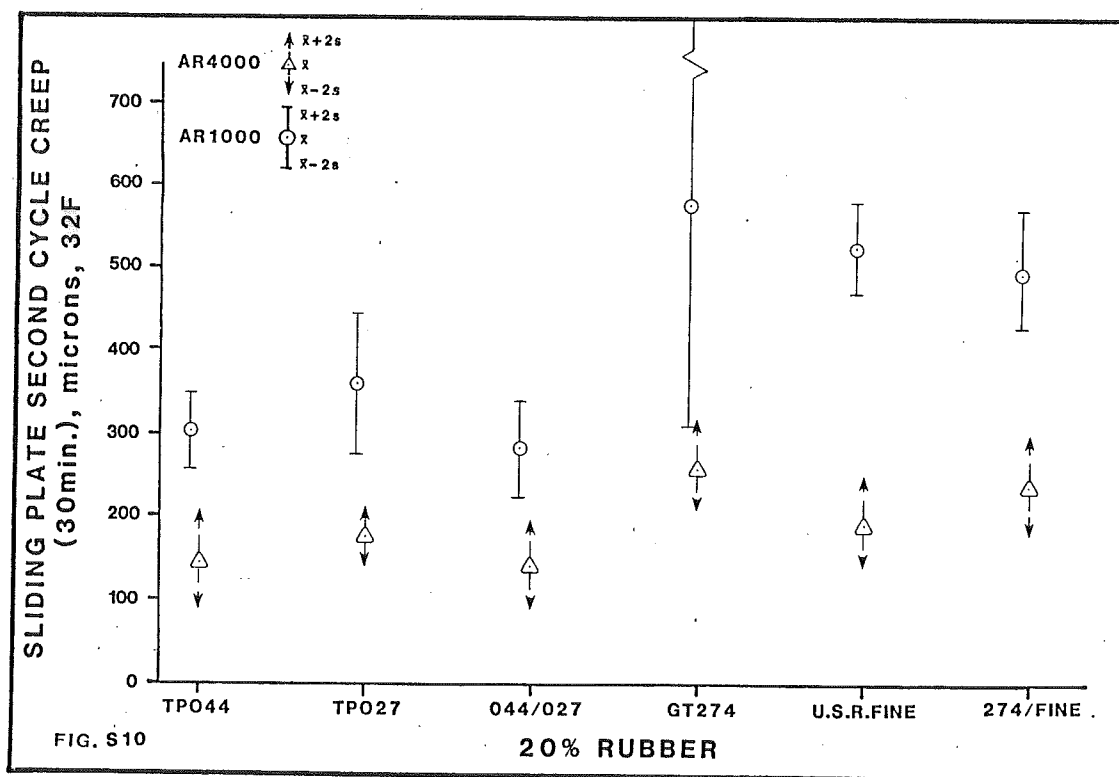
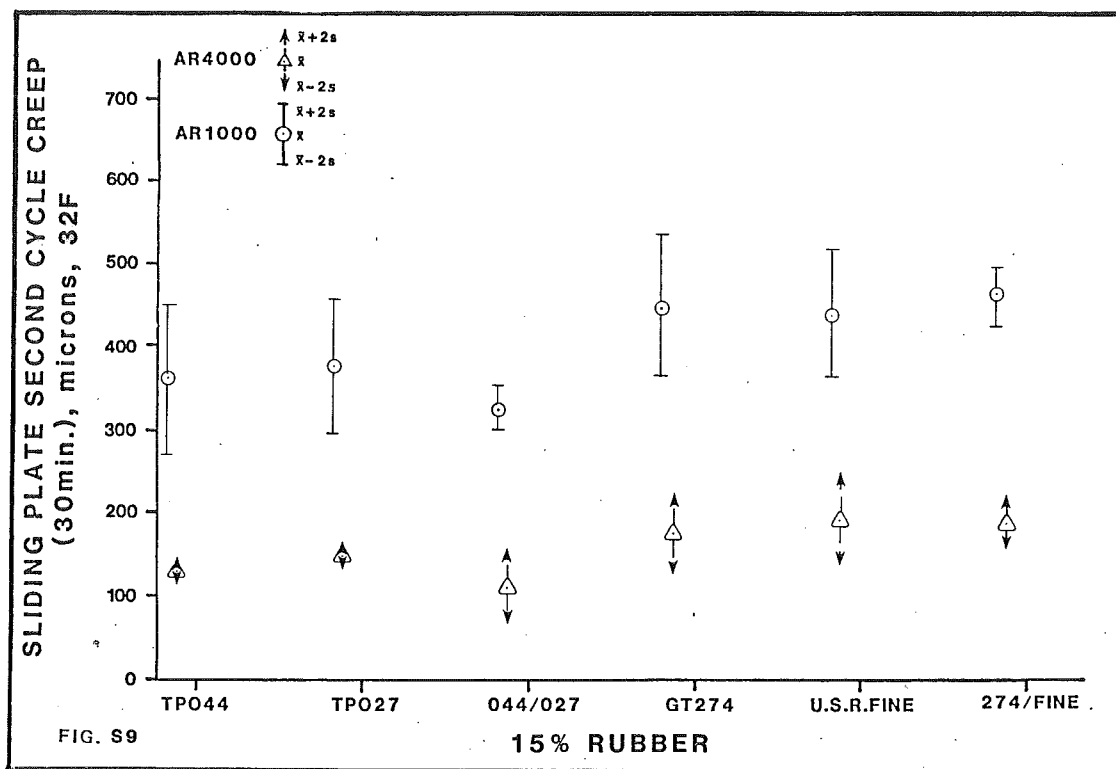
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	1030192.08	206038.42	147.83	2.43	3.48
Q	3	439355.21	146451.74	105.08	2.82	4.28
A	1	845250.67	845250.67	606.47	4.07	7.27
RQ	15	290429.17	19361.94	13.89	1.91	2.49
RA	5	31847.71	6369.54	4.57	2.43	3.48
QA	3	51287.08	17095.69	12.27	2.82	4.28
RQA	15	42477.04	2831.80	2.03	1.91	2.49
Error	48	66899.00	1393.73			
TOTAL	95	2797737.96				

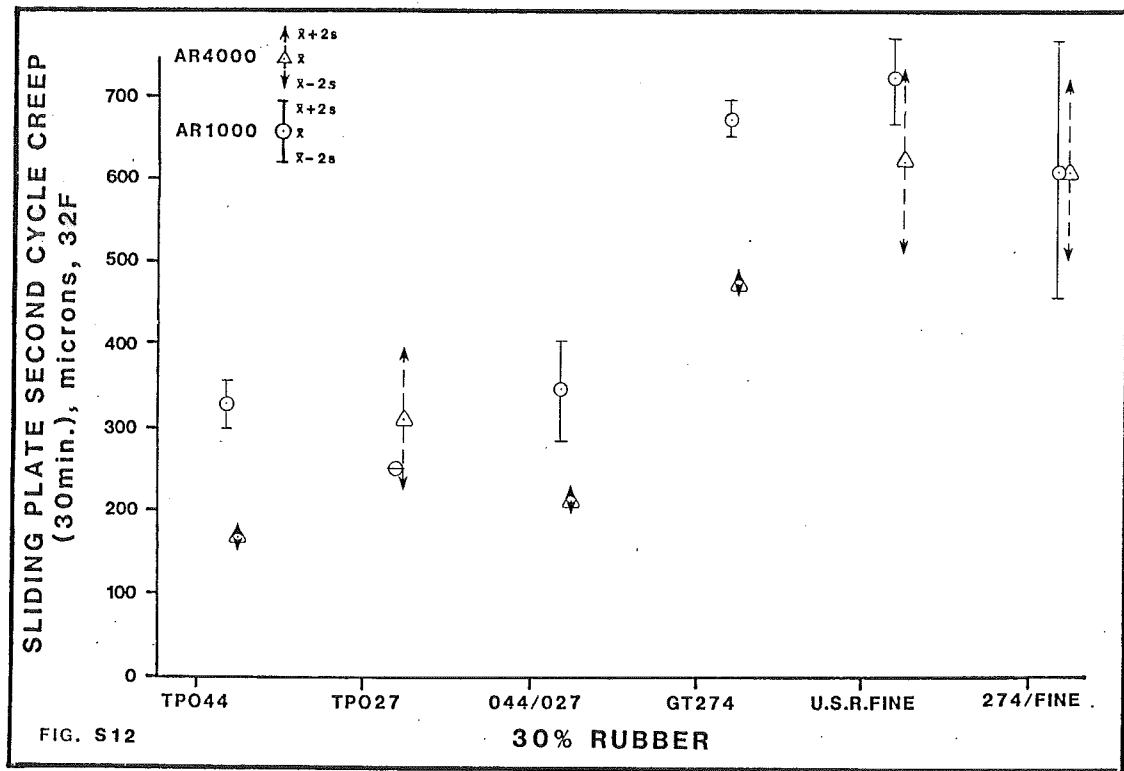
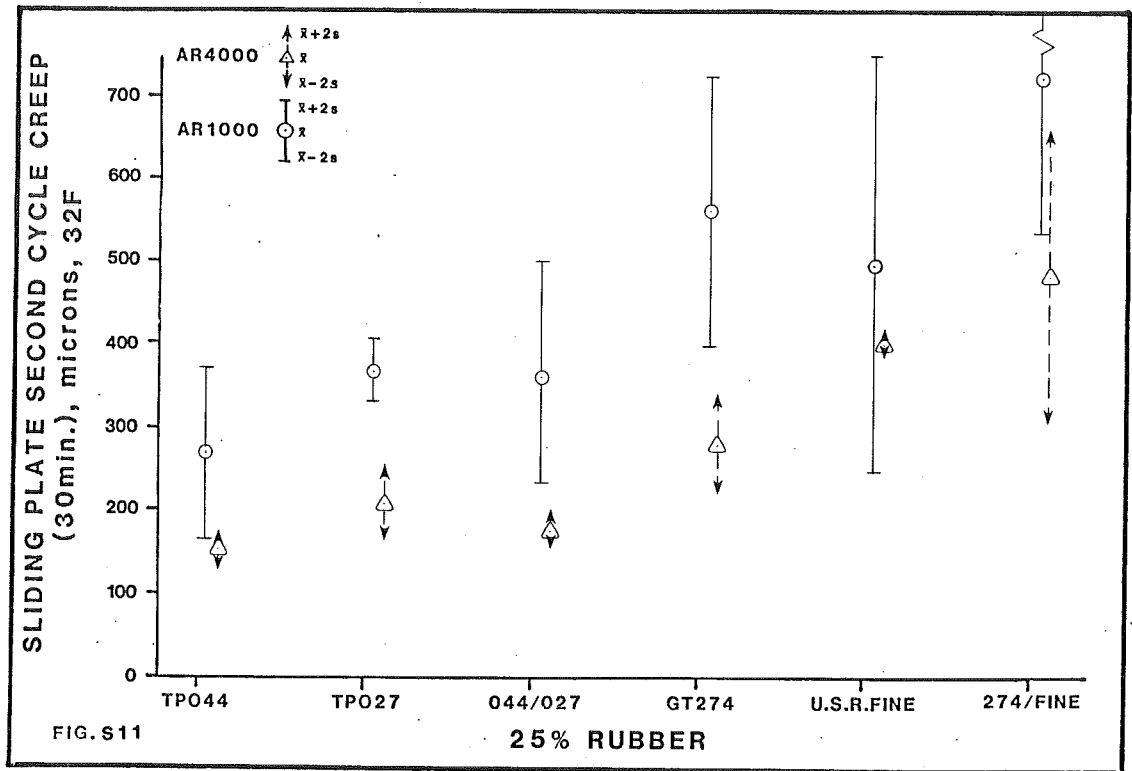












APPENDIX T
SECOND CYCLE RECOVERY (30 MIN) AT 32.0F
(0C) BY SLIDING PLATE MICROVISCOMETER

a. Measured and Analyzed Data

	TPO 44			
	15%	20%	25%	30%
AR 4 0 0 0	68 	84 	72 	114
	62	75	108	114
AR 1 0 0 0	180 	200 	177 	228
	153	197	182	246

b. Summary

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	65.00	79.50	90.00	114.00
	s	5.316	7.974	31.896	0
	cv	8.18	10.03	35.44	0
A R 1 0 0 0	$\bar{x}$	166.50	198.50	179.50	237.00
	s	23.922	2.658	4.430	15.948
	cv	14.37	1.34	2.47	6.73

[illegible]

Table T-1 Sliding Plate Second Cycle Recovery
(30 min.), microns

a. Measured and Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	77	84	166	186
	64	89	145	194
A R 1 0 0 0	173	206	213	303
	159	185	235	252

b. Summary

		TP027			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>70.50</u>	<u>86.50</u>	<u>155.50</u>	<u>190.00</u>
	S	<u>11.518</u>	<u>4.430</u>	<u>18.606</u>	<u>7.088</u>
	CV	16.34	5.12	11.97	3.73
A R 1 0 0 0	$\bar{x}$	<u>166.00</u>	<u>195.50</u>	<u>224.00</u>	<u>277.50</u>
	S	<u>12.404</u>	<u>18.606</u>	<u>19.492</u>	<u>45.186</u>
	CV	7.47	9.52	8.70	16.28

		TP024				TP027				50% TP024 50% TP027				50% TP024 50% TP027				50% TP024 50% TP027				50% TP024 50% TP027				50% TP024 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
ASPHALT TYPE (A)	ASPHALT TYPE (A)																												
	PERCENT RUBBER (B)																												
	RUBBER TYPE (C)																												
RUBBER TYPE (C)	RUBBER TYPE (C)																												

Table T-1 Sliding Plate Second Cycle Recovery
(30 min.), microns

a. Measured and Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	65	87	86	172
	39	84	115	152
A R 1 0 0 0	185	162	219	255
	176	173	248	258

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	52.00	85.50	100.50	162.00
	S	23.036	2.658	25.694	17.720
	CV	44.30	3.11	25.57	10.94
A R 1 0 0 0	$\bar{x}$	180.50	167.50	233.50	256.50
	S	7.974	9.746	25.694	2.658
	CV	4.42	5.82	11.00	1.04

		ASPHALT TYPE (A)									PERCENT RUBBER (B)									RUBBER TYPE (C)																		
		TP044			TP027			50% TP044 50% TP027			STP76			U.S. Rubber Firm			50% STP76 50% U.S. Rubber																					
		15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	
Recovery	30 min.																																					
	60 min.																																					
Recovery	30 min.																																					
	60 min.																																					

Table T-1 Sliding Plate Second Cycle Recovery
(30 min.), microns

a. Measured and Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	52	131	151	314
	57	126	159	347
A R 1 0 0 0	187	273	305	406
	232	328	377	348

b. Summary

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>54.50</u>	<u>128.50</u>	<u>155.00</u>	<u>330.50</u>
	s	<u>4.430</u>	<u>4.430</u>	<u>7.088</u>	<u>29.238</u>
	cv	8.13	3.45	4.57	8.85
A R 1 0 0 0	$\bar{x}$	<u>209.50</u>	<u>300.50</u>	<u>341.00</u>	<u>377.00</u>
	s	<u>39.870</u>	<u>48.730</u>	<u>63.792</u>	<u>51.388</u>
	cv	19.03	16.22	18.71	13.63

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP646				TP627				50% TP646 50% TP627				GT274				U.S. Rubber Firm				50% GT274 50% U.S. Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Asphalt 25																																					

Table T-1 Sliding Plate Second Cycle Recovery
(30 min.), microns

a. Measured and Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	60	115	210	353
	72	98	254	293
A R 1 0 0 0	267	310	320	471
	223	293	239	468

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	66.00	106.50	232.00	323.00
	s	10.632	15.062	38.984	53.160
	cv	16.11	14.14	16.80	16.46
A R 1 0 0 0	$\bar{x}$	245.00	301.50	279.50	469.50
	s	38.984	15.062	71.766	2.658
	cv	15.91	5.00	25.68	.57

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP600				TP607				50% TP600				50% TP607				50% TP600				50% TP607				U.S. Rubber Fine				50% U.S. Rubber Fine				50% U.S. Rubber Fine			
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30				
CONCRETE	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
SAND-SP	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				
	100-100																																				

Table T-1 Sliding Plate Second Cycle Recovery
(30 min.), microns

a. Measured and Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	58	106	238	339
	75	216	289	329
A R 1 0 0 0	249	272	397	401
	221	235	431	540

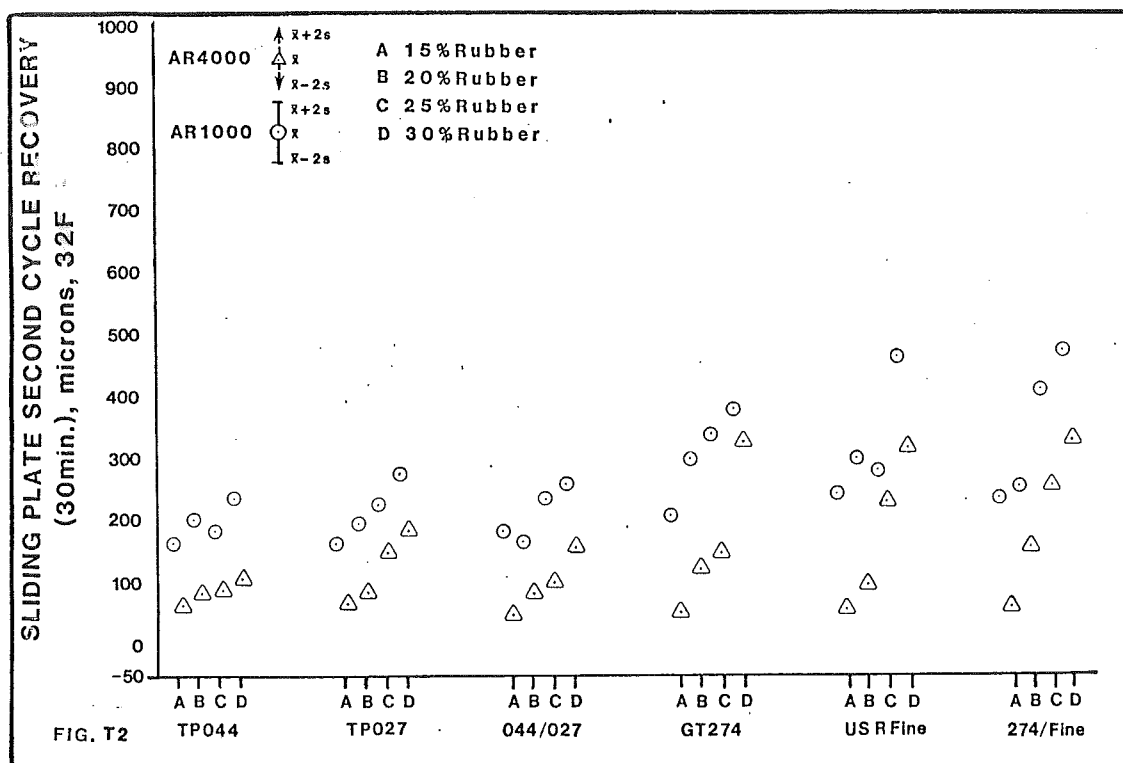
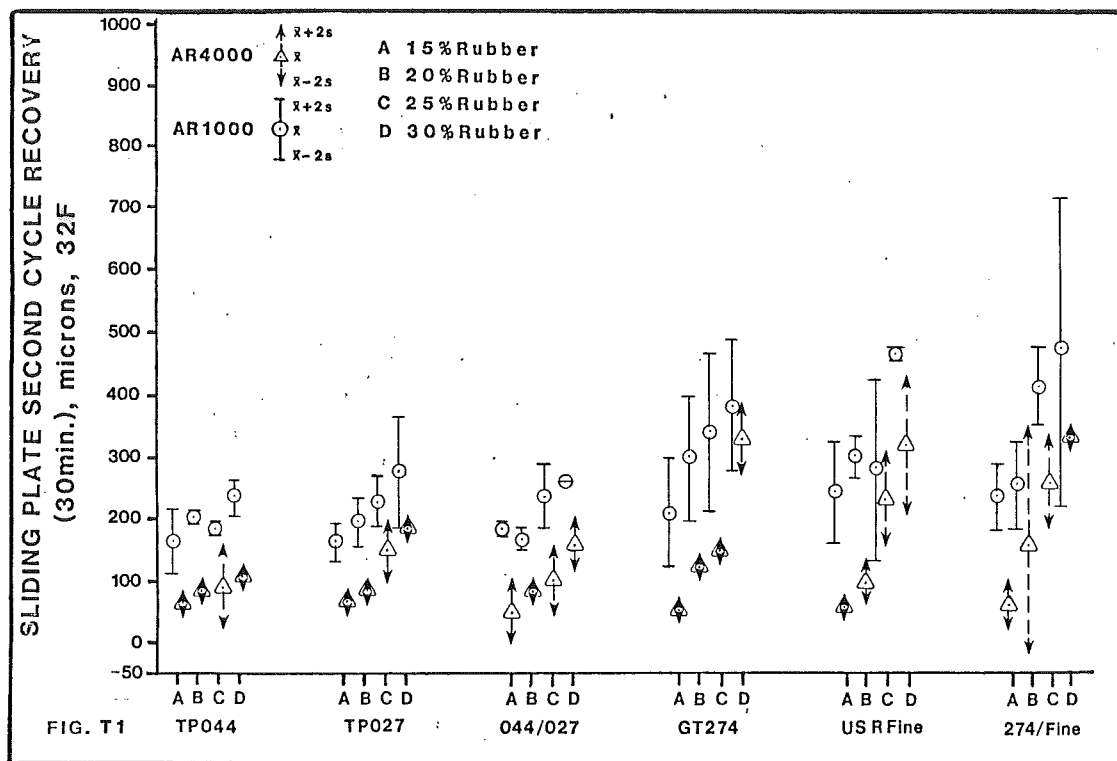
b. Summary

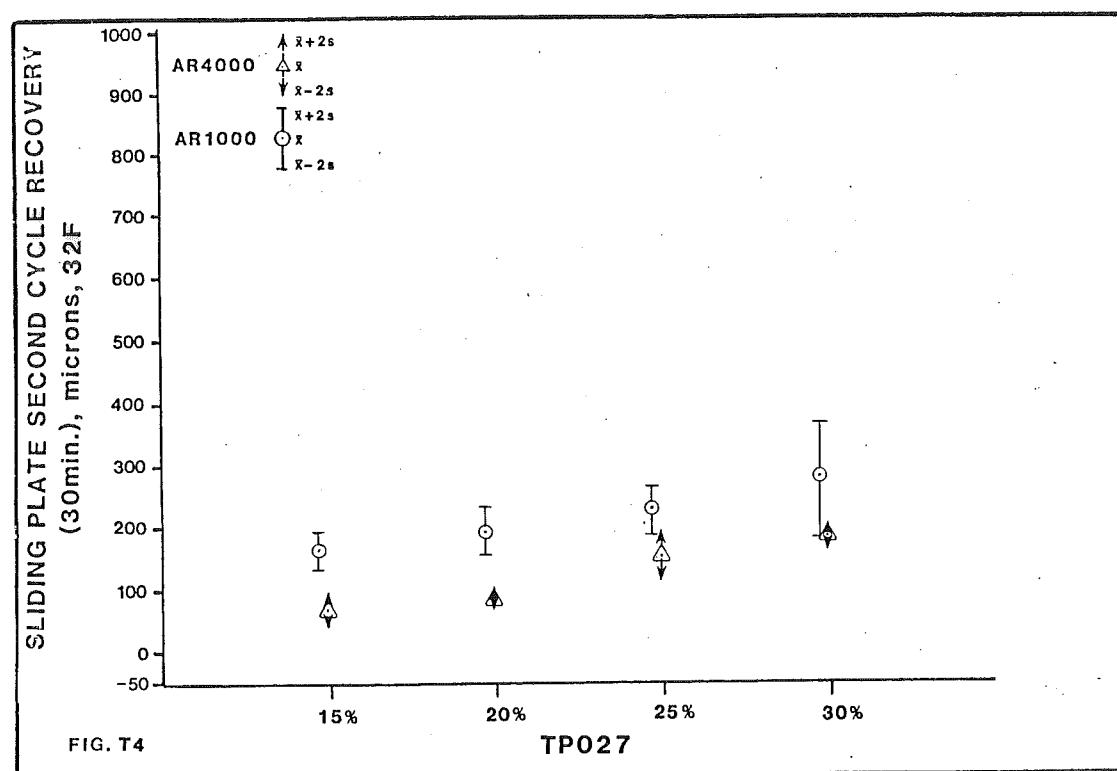
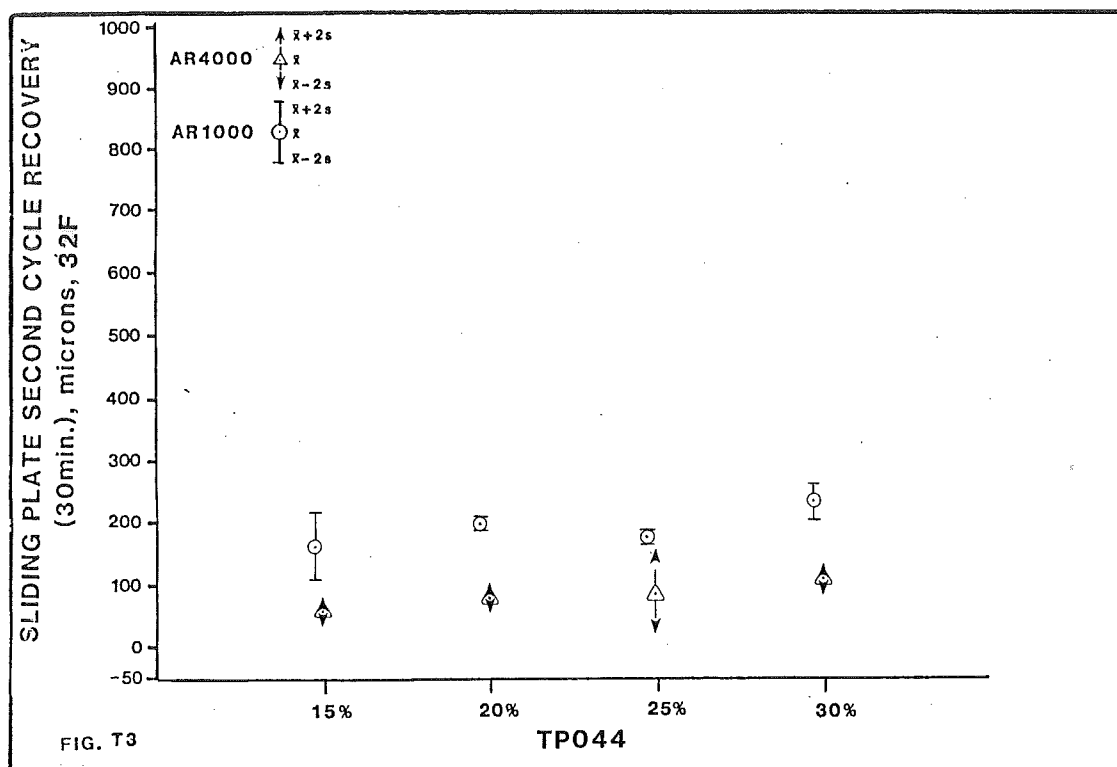
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>66.50</u>	<u>161.00</u>	<u>263.50</u>	<u>334.00</u>
	s	<u>15.062</u>	<u>97.460</u>	<u>45.186</u>	<u>8.860</u>
	CV	<u>22.65</u>	<u>60.53</u>	<u>17.15</u>	<u>2.65</u>
A R 1 0 0 0	$\bar{x}$	<u>235.00</u>	<u>253.50</u>	<u>414.00</u>	<u>470.50</u>
	s	<u>24.808</u>	<u>32.782</u>	<u>30.124</u>	<u>123.154</u>
	CV	<u>10.56</u>	<u>12.93</u>	<u>7.28</u>	<u>26.18</u>

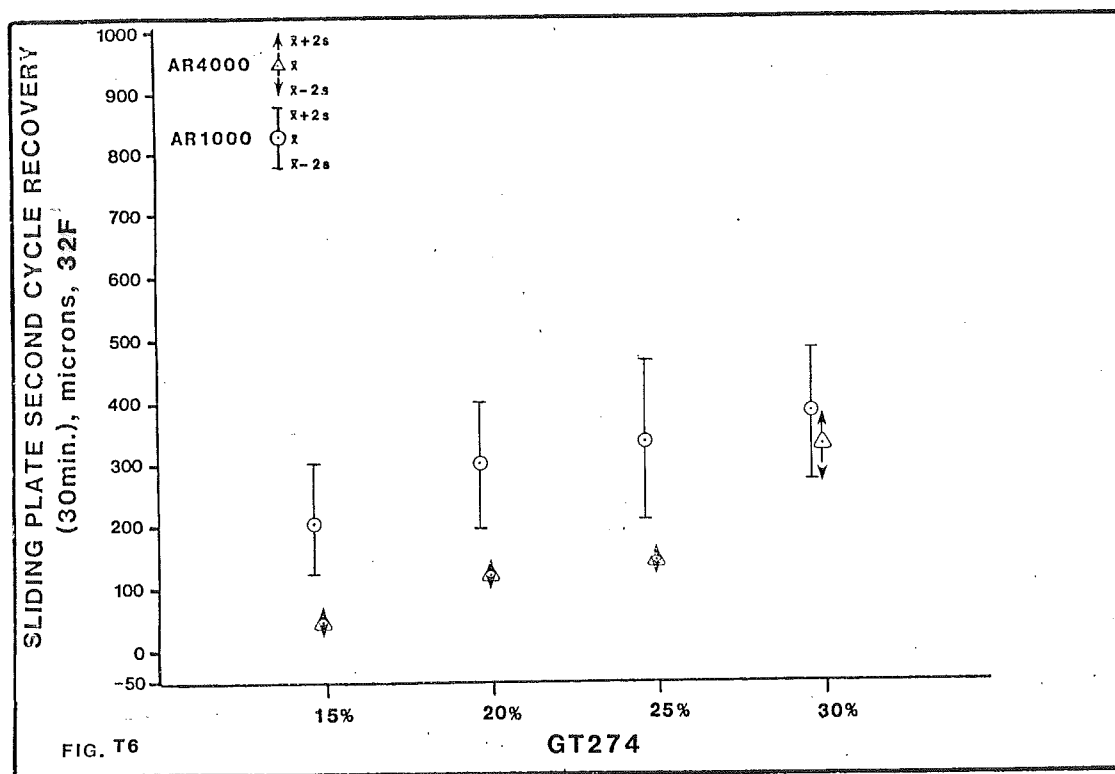
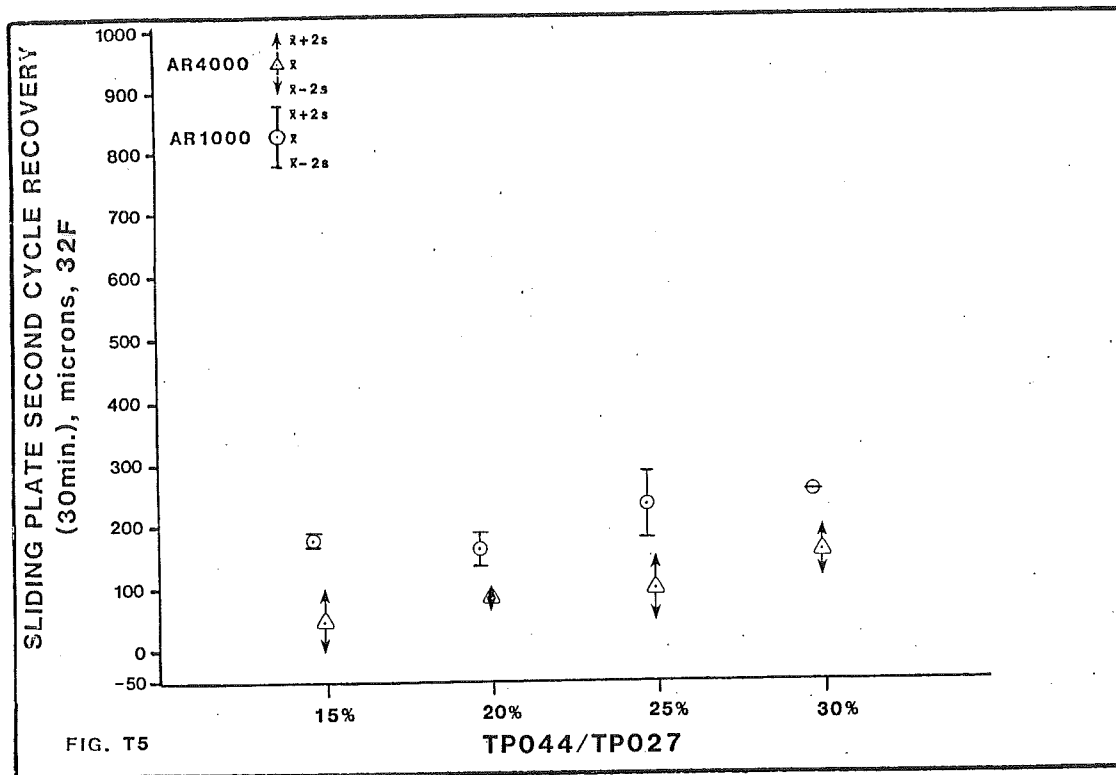
		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)																							
		TPQ48				TPQ57				50% TPQ48 50% TPQ57				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber																											
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30								
Recovery		58	75	106	161	238	289	329	339	221	235	272	401	431	470	540	580	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550	1600	1650	1700	1750	1800							
Standard Deviation		15.062	22.65	97.460	60.53	45.186	17.15	8.860	2.65	24.808	10.56	32.782	12.93	30.124	7.28	123.154	26.18	24.808	10.56	32.782	12.93	30.124	7.28	123.154	26.18	24.808	10.56	32.782	12.93	30.124	7.28	123.154	26.18	24.808	10.56	32.782	12.93	30.124	7.28	123.154	26.18	24.808	10.56	32.782	12.93	30.124	7.28	123.154	26.18

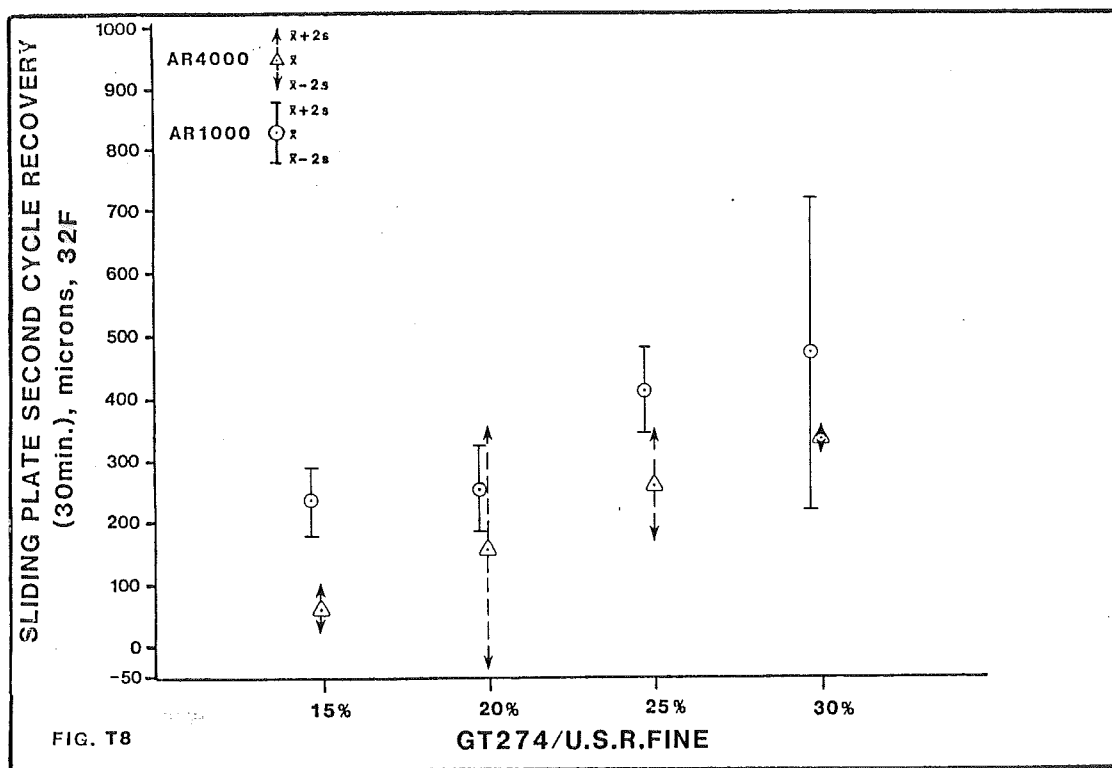
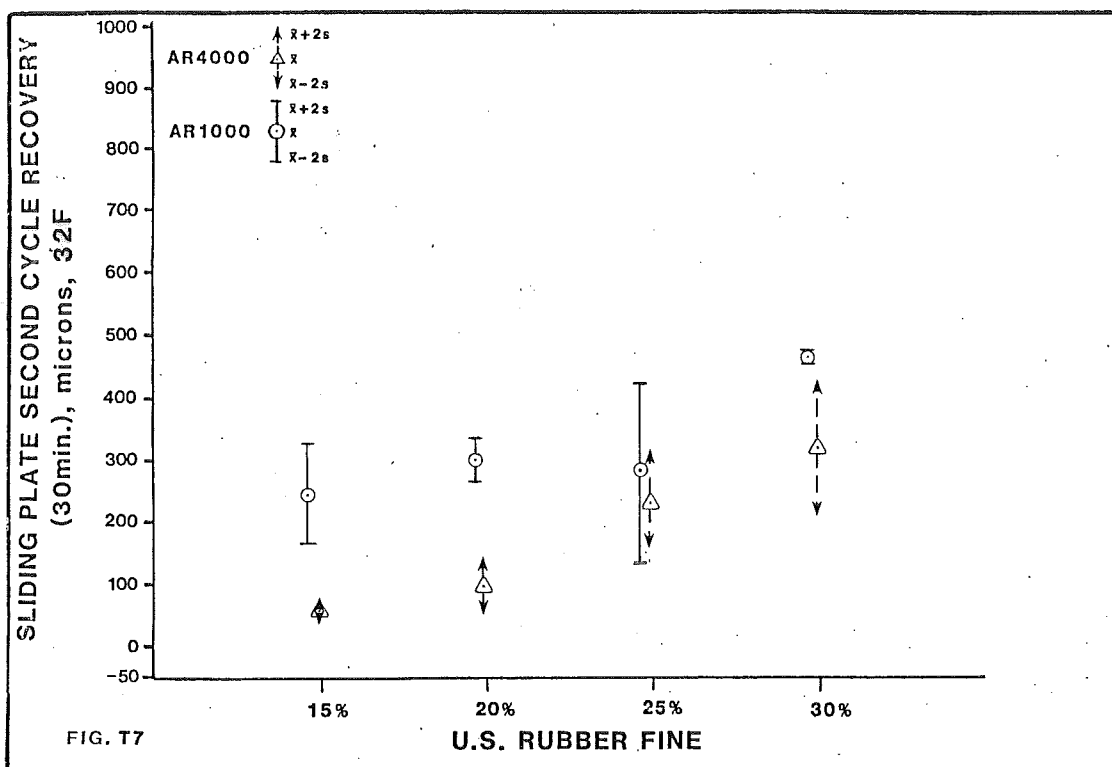
Table T-2 Anova Summary, Sliding Plate Second Cycle Recovery (30 min.)

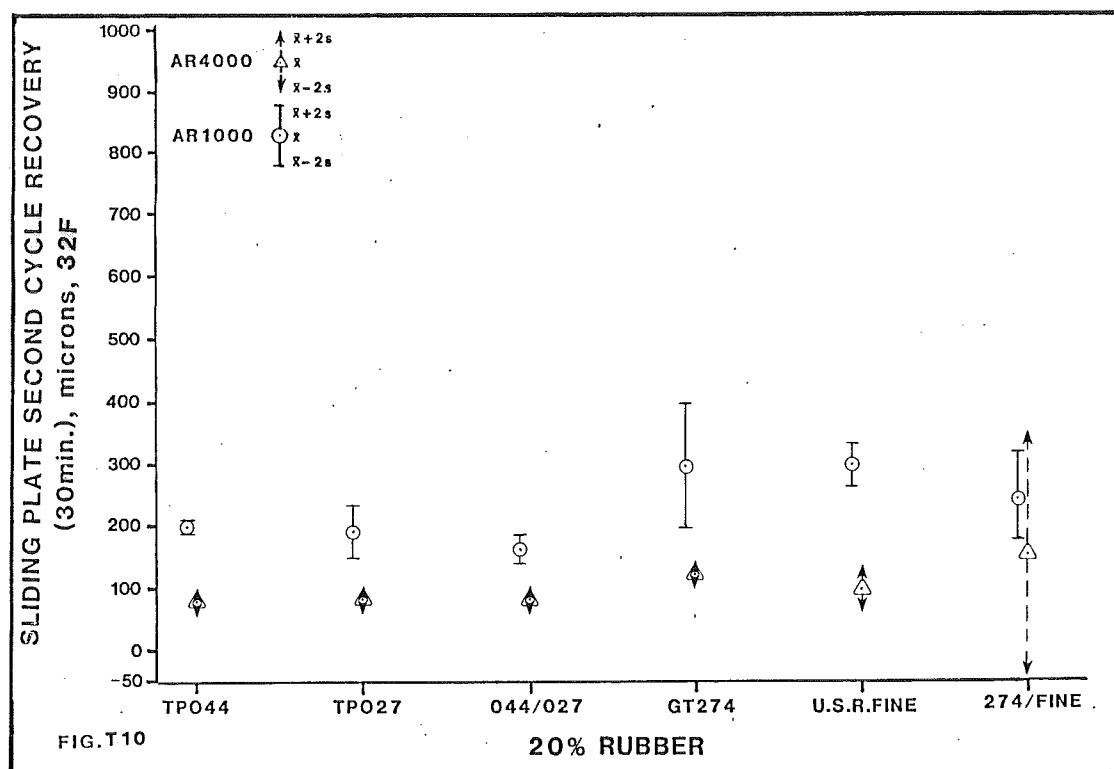
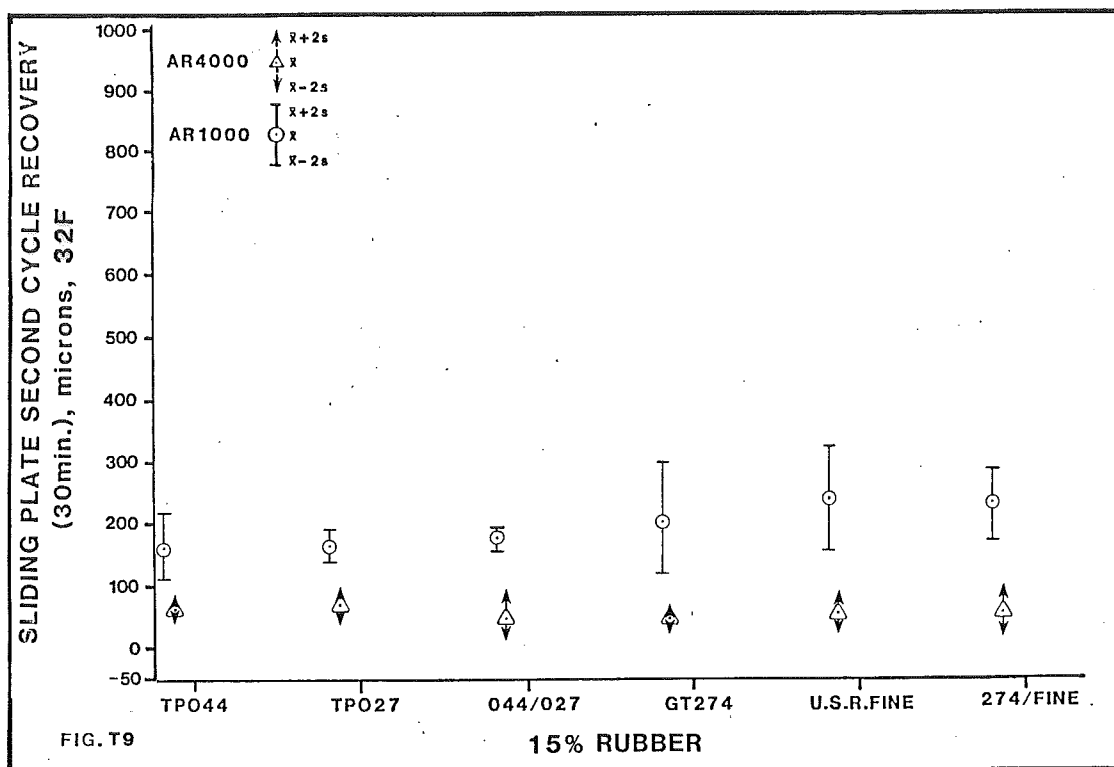
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	255219.83	51043.97	63.49	2.43	3.48
Q	3	358164.21	119388.07	148.49	2.82	4.28
A	1	352110.38	352110.38	437.95	4.07	7.27
RQ	15	94816.42	6321.09	7.86	1.91	2.49
RA	5	9205.00	1841.00	2.29	2.43	3.48
QA	3	3877.88	1292.63	1.61	2.82	4.28
RQA	15	27997.25	1866.48	2.32	1.91	2.49
Error	48	38592.00	804.00			
TOTAL	95	1139982.96				

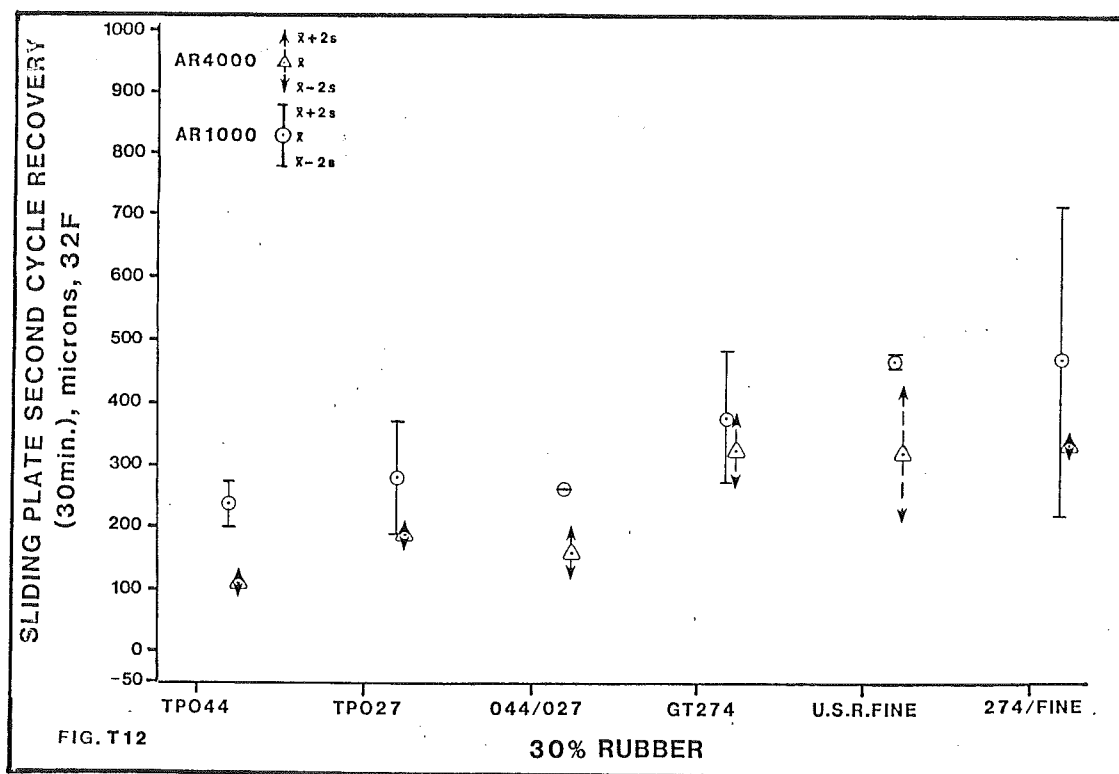
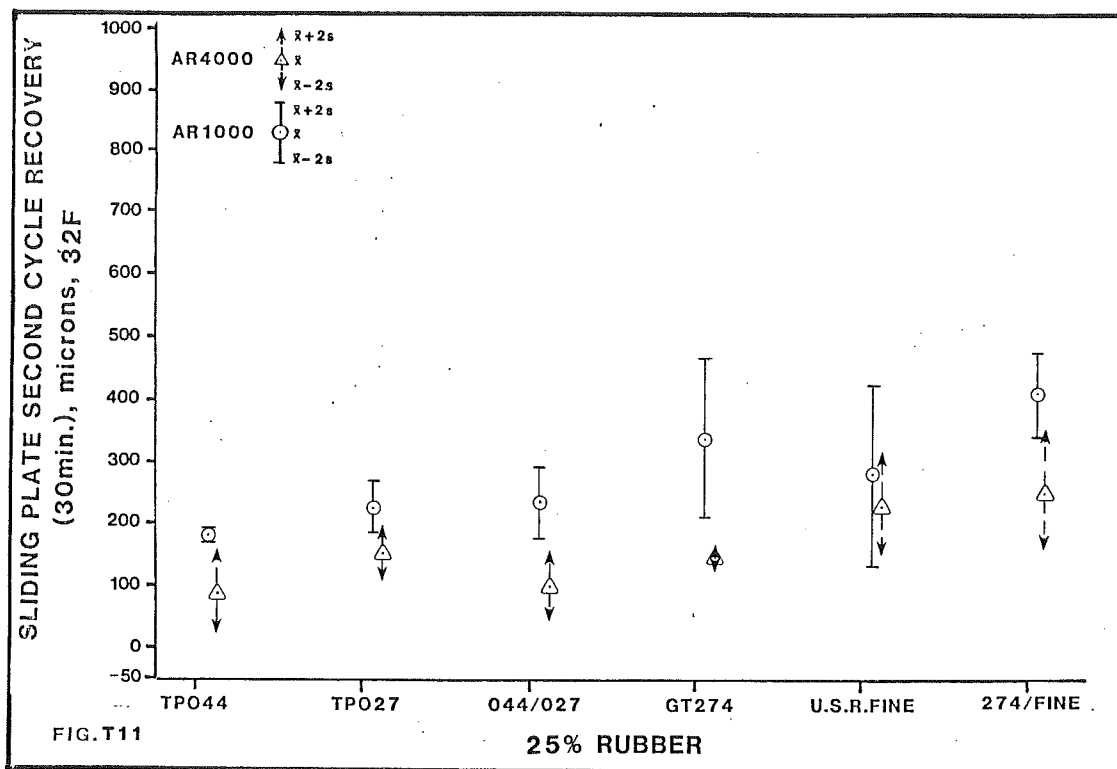












APPENDIX U
SECOND CYCLE RECOVERY (20 HOUR) AT 32.0F
(0C) BY SLIDING PLATE MICROVISCOMETER

a. Measured and Analyzed Data

b. Summary[illegible]

Table U-1 Sliding Plate Second Cycle Recovery
(20 hour), microns

a. Measured and Analyzed Data

TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	150	158	166	251
	81	174	204	261
A R 1 0 0 0	280	412	285	474
	204	276	288	501

b. Summary

TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	115.50	166.00	185.00	256.00
	S	61.134	14.176	33.668	8.860
	CV	52.93	8.54	18.20	3.46
A R 1 0 0 0	$\bar{x}$	242.00	344.00	286.50	487.50
	S	67.336	120.496	2.658	23.922
	CV	27.82	35.03	.93	4.91

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP046				TP031				50% TP046 & 50% TP031			
		15	20	25	30	15	20	25	30	15	20	25	30
Sample	Recovery	---	---	---	---	---	---	---	---	---	---	---	---
	microns	---	---	---	---	---	---	---	---	---	---	---	---

Table U-1 Sliding Plate Second Cycle Recovery
(20 hour), microns

a. Measured and Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	101	87	107	326
	85	84	176	273
A R 1 0 0 0	205	182	248	322
	215	272	439	380

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>93.00</u>	<u>85.50</u>	<u>141.50</u>	<u>299.50</u>
	S	<u>14.176</u>	<u>2.658</u>	<u>61.134</u>	<u>46.958</u>
	CV	15.24	3.11	43.20	15.68
A R 1 0 0 0	$\bar{x}$	<u>210.00</u>	<u>227.00</u>	<u>343.50</u>	<u>351.00</u>
	S	<u>8.860</u>	<u>79.740</u>	<u>169.226</u>	<u>51.388</u>
	CV	4.22	35.13	49.27	14.64

		ASPHALT TYPE (A)				PERCENT NUMBER (B)				RUBBER TYPE (C)			
		TP044				TP027				50% TP044 50% TP027			
		15	20	25	30	15	20	25	30	15	20	25	30
Sliding Plate	Recovery												
	20 hr												

Table U-1 Sliding Plate Second Cycle Recovery
(20 hour), microns

a. Measured and Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	149	254	327	474
	66	203	256	475
A R 1 0 0 0	362	363	555	461
	518	513	565	491

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	107.50	228.50	291.50	474.50
	s	73.538	45.186	62.906	.886
	cv	68.41	19.78	21.58	.19
A R 1 0 0 0	$\bar{x}$	440.00	438.00	560.00	476.00
	s	138.216	132.900	8.860	26.580
	cv	31.41	30.34	1.58	5.58

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP664				TP667				50% TP664 & 50% TP667			
		15	20	25	30	15	20	25	30	15	20	25	30
Sliding Plate	Recovery												
	20 hr												
Sliding Plate	Recovery												
	20 hr												

Table U-1 Sliding Plate Second Cycle Recovery
(20 hour), microns

a. Measured and Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	126	270	428	863
	288	99	506	506
A R 1 0 0 0	377	703	647	783
	565	492	405	832

b. Summary

U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	207.00	184.50	467.00	684.50
	S	143.532	151.506	69.108	316.302
	CV	69.34	82.12	14.80	46.21
A R 1 0 0 0	$\bar{x}$	471.00	597.50	526.00	807.50
	S	166.568	186.946	214.412	43.414
	CV	35.36	31.29	40.76	5.38

		ASPHALT TYPE (A)									PERCENT RUBBER (B)									RUBBER TYPE (C)								
		TP044			TP037			90% TP044 90% TP037			ST074			U.S. Rubber Fine			90% ST074 90% S Fine											
		15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25									
C	1																											
	2																											
D	1																											
	2																											

Table U-1 Sliding Plate Second Cycle Recovery
(20 hour), microns

a. Measured and Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	178	197	410	641
	107	313	479	438
A R 1 0 0 0	249	530	618	648
	343	471	737	729

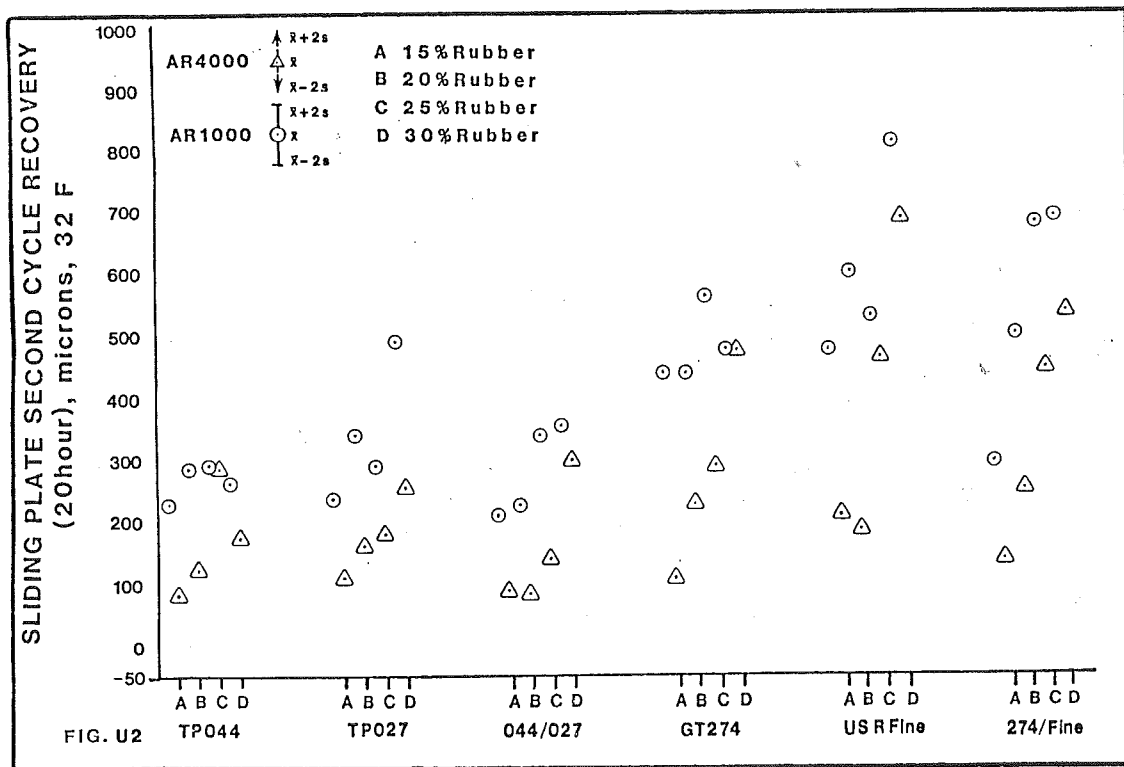
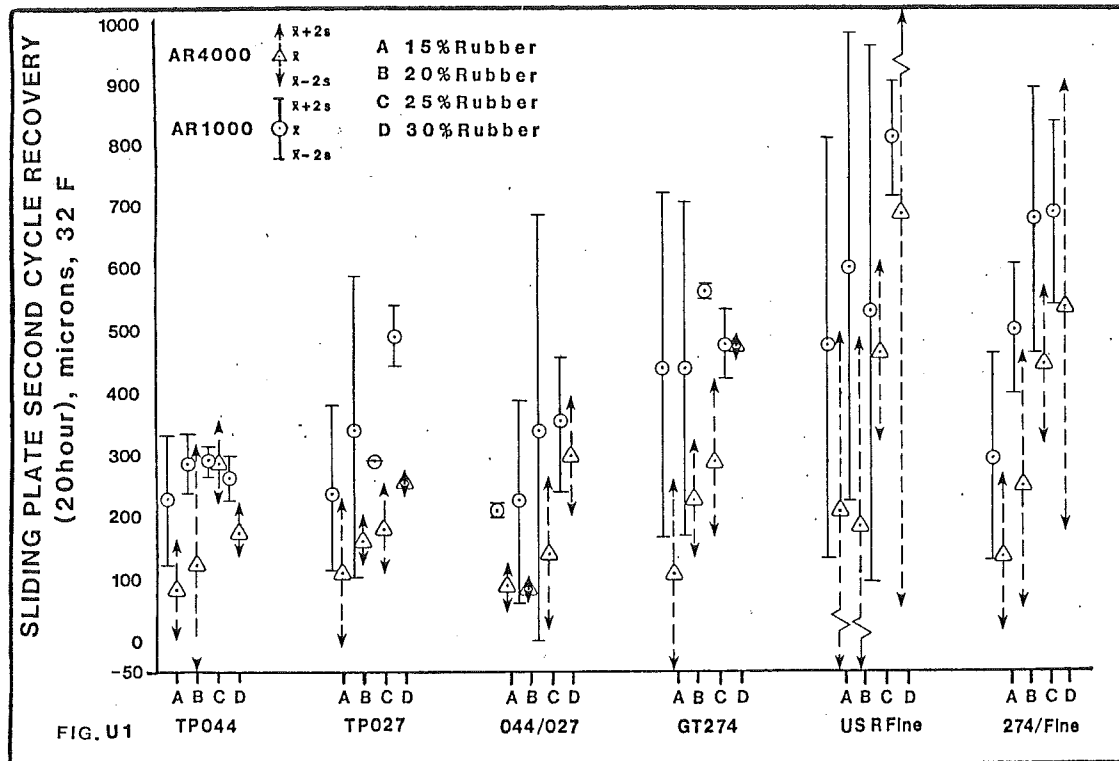
b. Summary

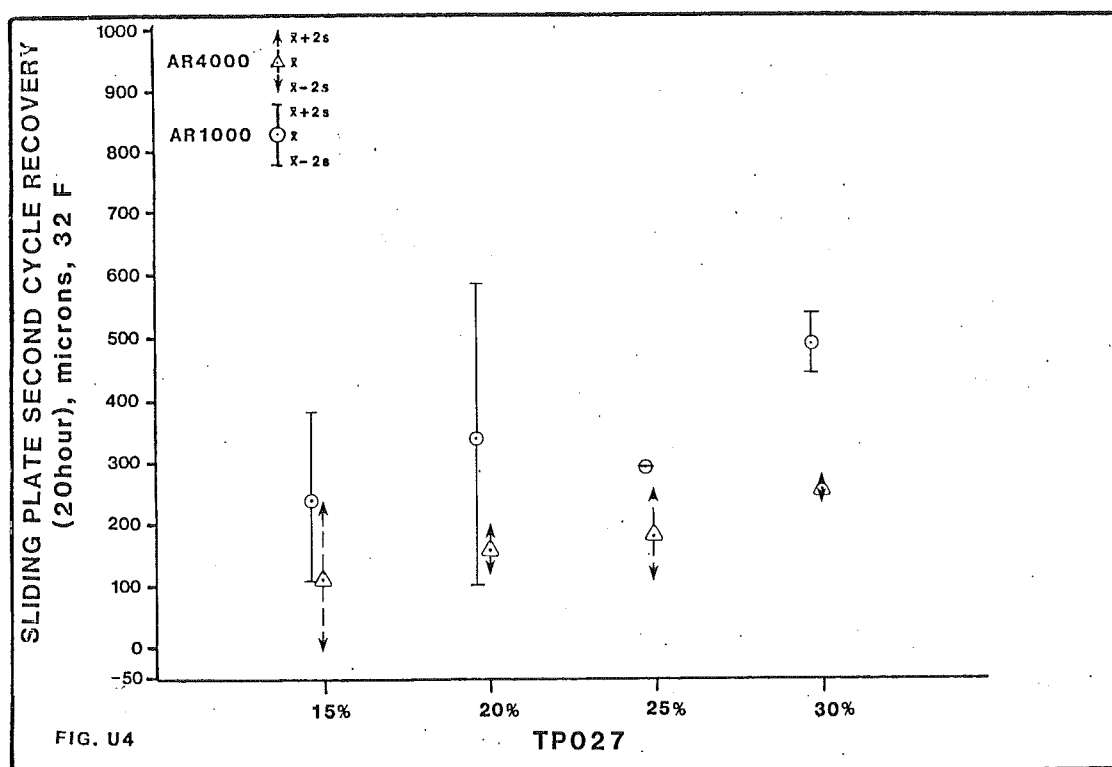
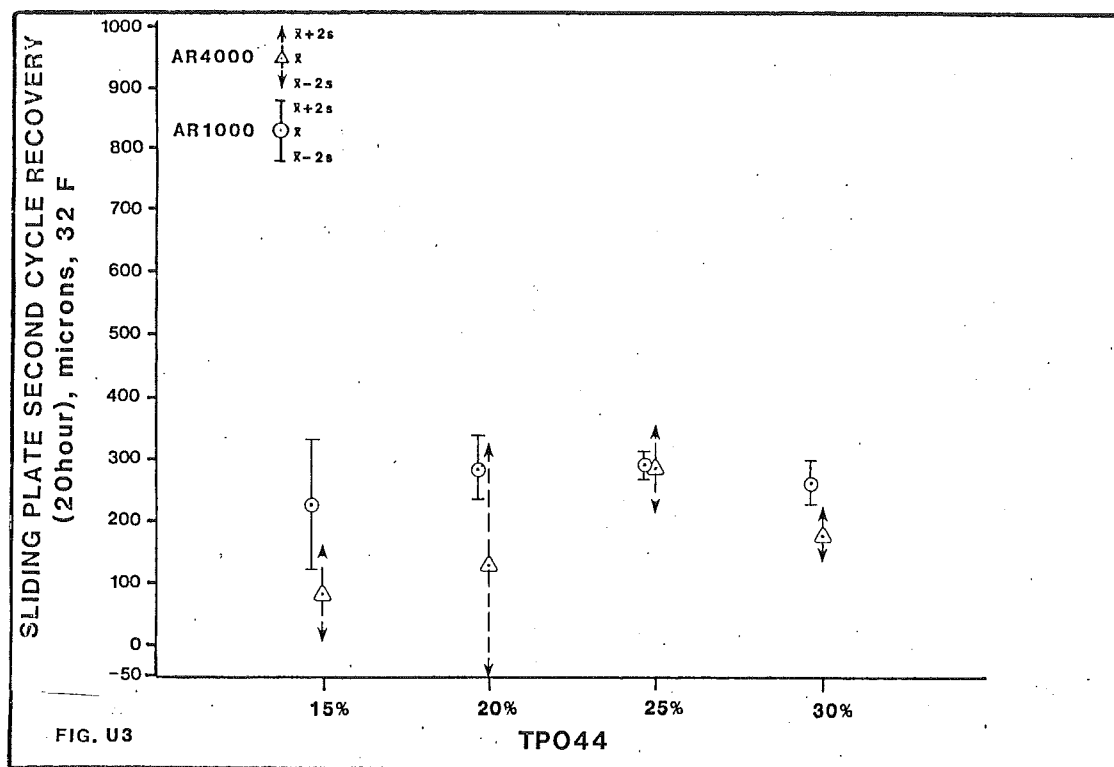
		50% GT274 & 50% U. S. RUBBER FINE			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>142.50</u>	<u>255.00</u>	<u>444.50</u>	<u>539.50</u>
	s	<u>62.906</u>	<u>102.776</u>	<u>61.134</u>	<u>179.858</u>
	cv	<u>44.14</u>	<u>40.30</u>	<u>13.75</u>	<u>33.34</u>
A R 1 0 0 0	$\bar{x}$	<u>296.00</u>	<u>500.50</u>	<u>677.50</u>	<u>688.50</u>
	s	<u>83.284</u>	<u>52.274</u>	<u>105.434</u>	<u>71.766</u>
	cv	<u>28.14</u>	<u>10.44</u>	<u>15.56</u>	<u>10.42</u>

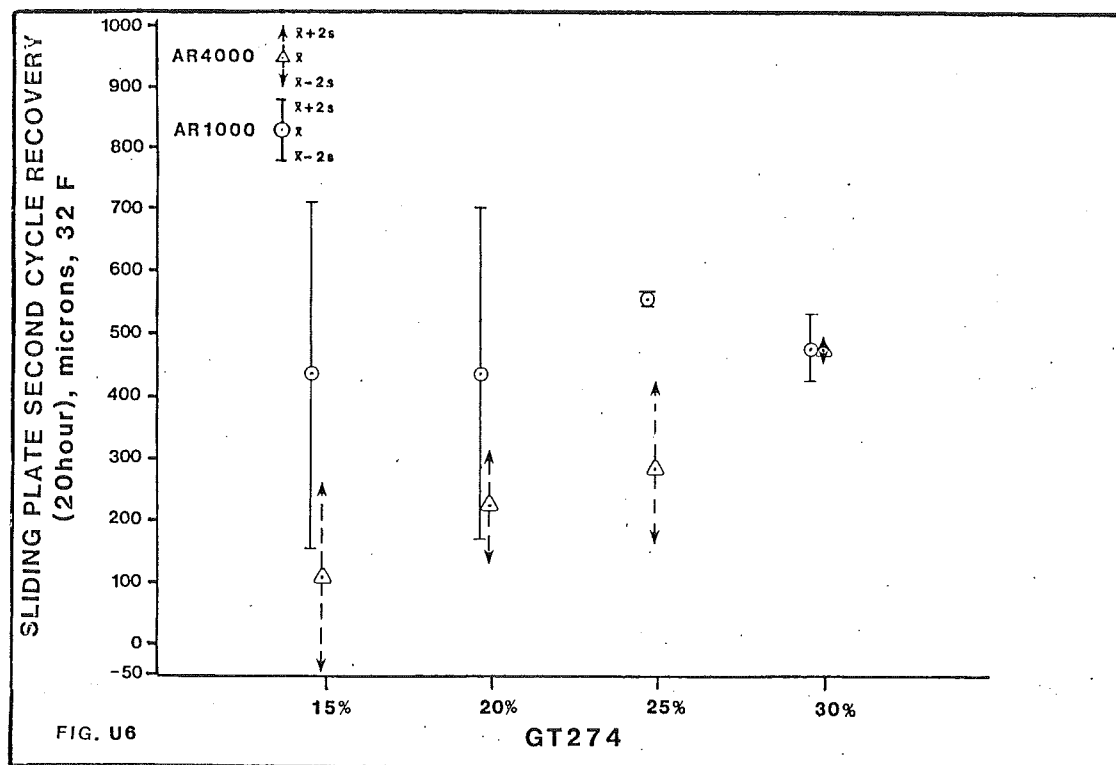
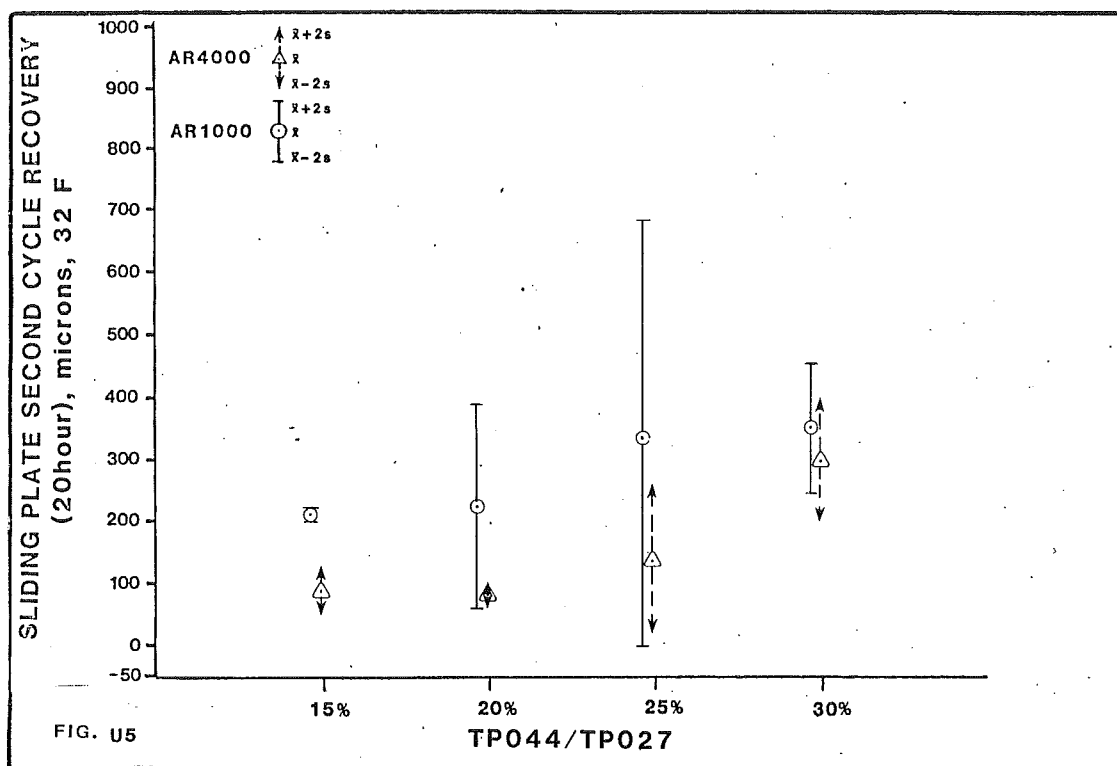
		ASPHALT TYPE (A)										PERCENT RUBBER (B)										RUBBER TYPE (C)									
TEST NO.	TEST TYPE	TP046					TP067					50% TP046 & 50% TP067					GT274					U.S. Rubber Fine					50% GT274 & 50% U.S. Rubber Fine				
		15	20	25	30	35	15	20	25	30	35	15	20	25	30	35	15	20	25	30	35	15	20	25	30	35	15	20	25	30	35
1	1																														
2	1																														
3	1																														
4	1																														
5	1																														
6	1																														
7	1																														
8	1																														
9	1																														
10	1																														
11	1																														
12	1																														
13	1																														
14	1																														
15	1																														
16	1																														
17	1																														
18	1																														
19	1																														
20	1																														
21	1																														
22	1																														
23	1																														
24	1																														
25	1																														
26	1																														
27	1																														
28	1																														
29	1																														
30	1																														
31	1																														
32	1																														
33	1																														
34	1																														
35	1																														
36	1																														
37	1																														
38	1																														
39	1																														
40	1																														
41	1																														
42	1																														
43	1																														
44	1																														
45	1																														
46	1																														
47	1																														
48	1																														
49	1																														
50	1																														

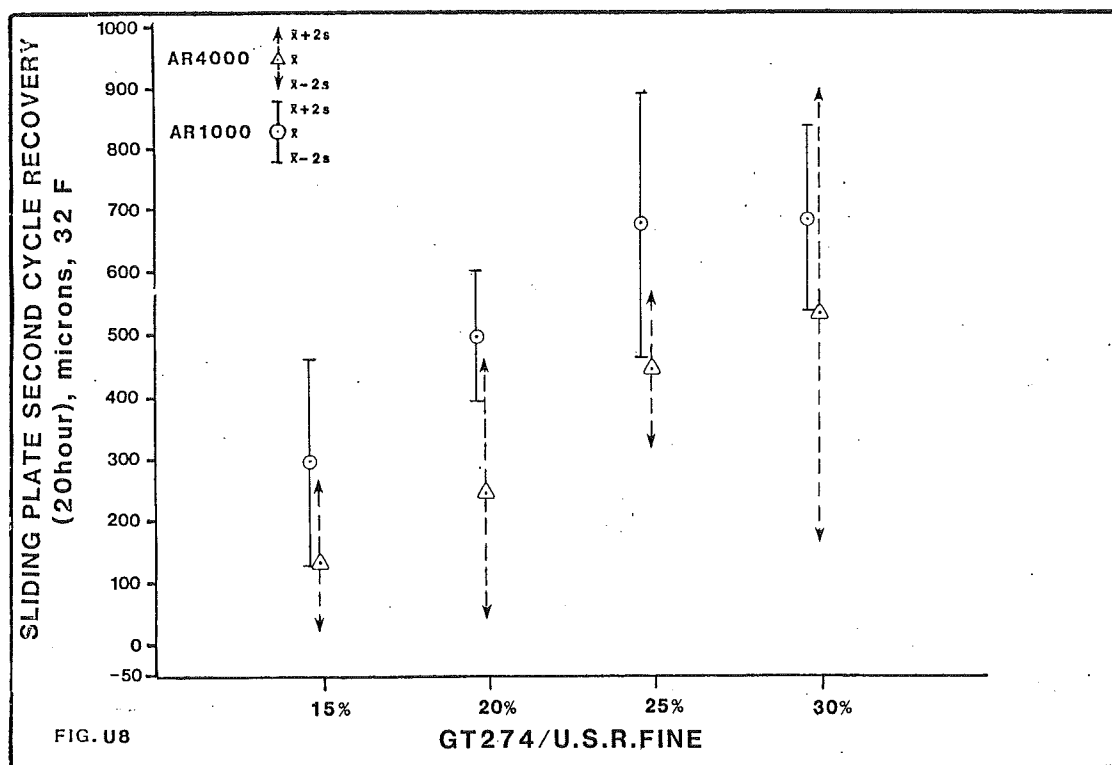
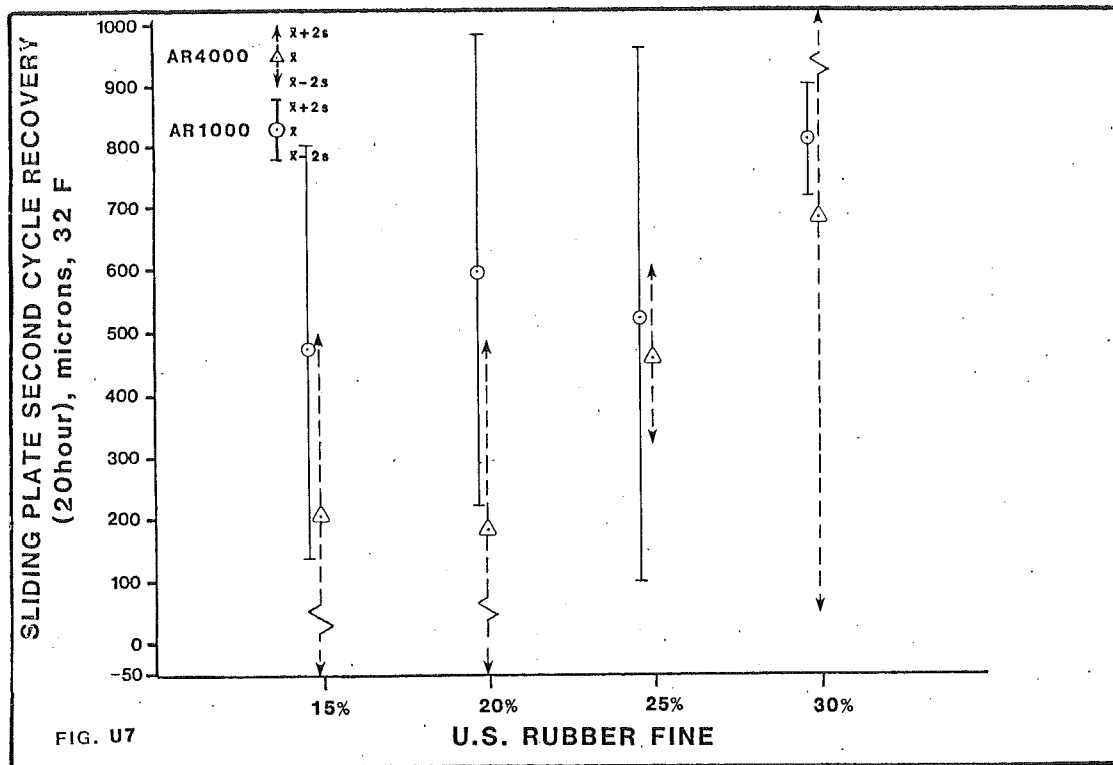
Table U-2 Anova Summary, Sliding Plate Second
Cycle Recovery (20 hour)

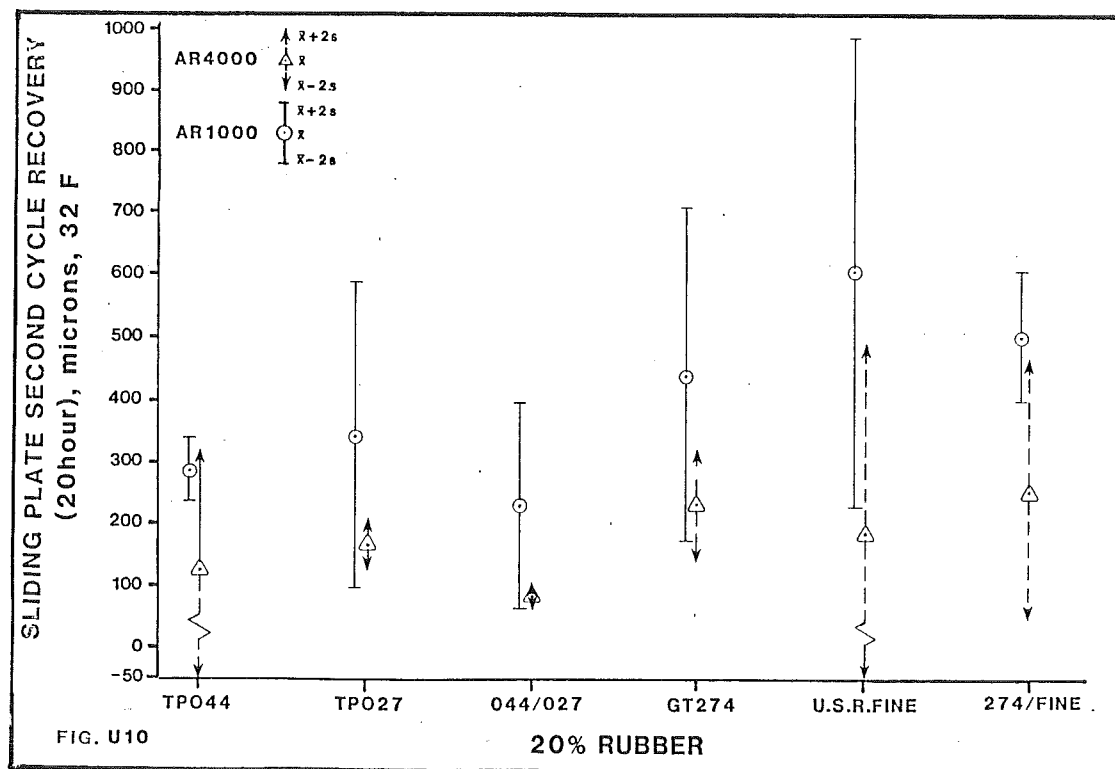
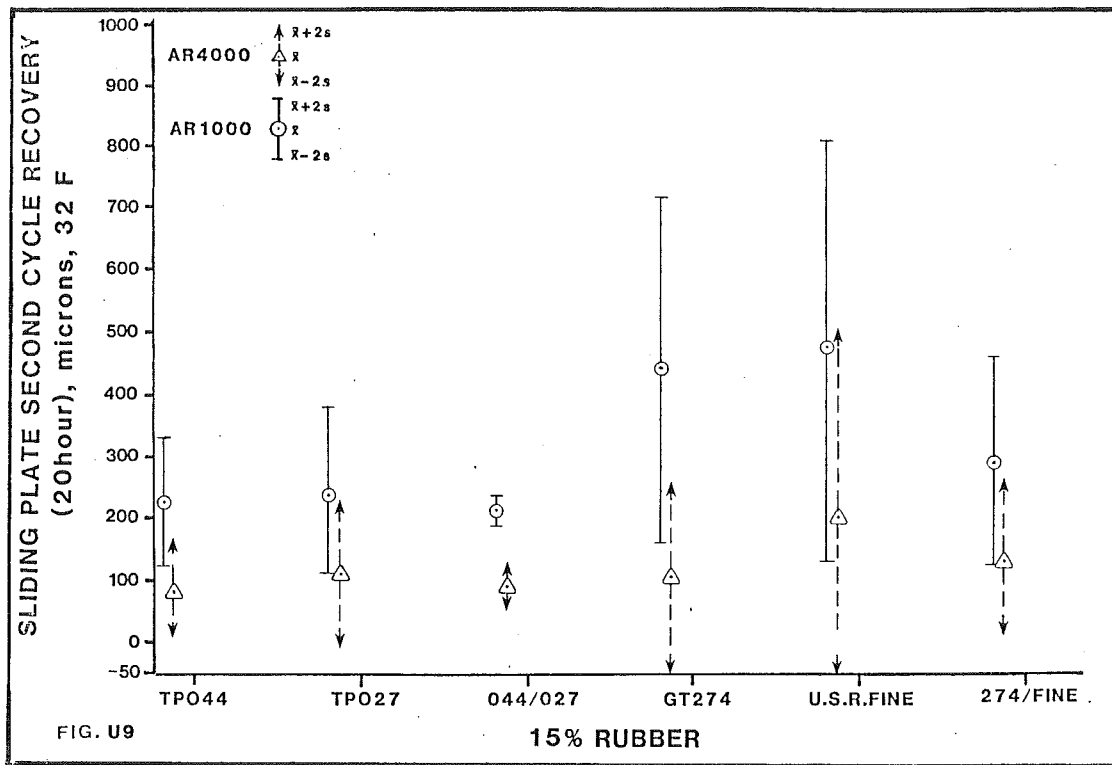
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	1135207.47	227041.49	36.54	2.43	3.48
Q	3	785594.53	261864.84	42.14	2.82	4.28
A	1	661510.01	661510.01	106.46	4.07	7.27
RQ	15	294557.16	19637.14	3.16	1.91	2.49
RA	5	44096.30	8819.26	1.42	2.43	3.48
QA	3	47613.28	15871.09	2.55	2.82	4.28
RQA	15	133452.16	8896.81	1.43	1.91	2.49
Error	48	298269.50	6213.95			
TOTAL	95	3400300.41				

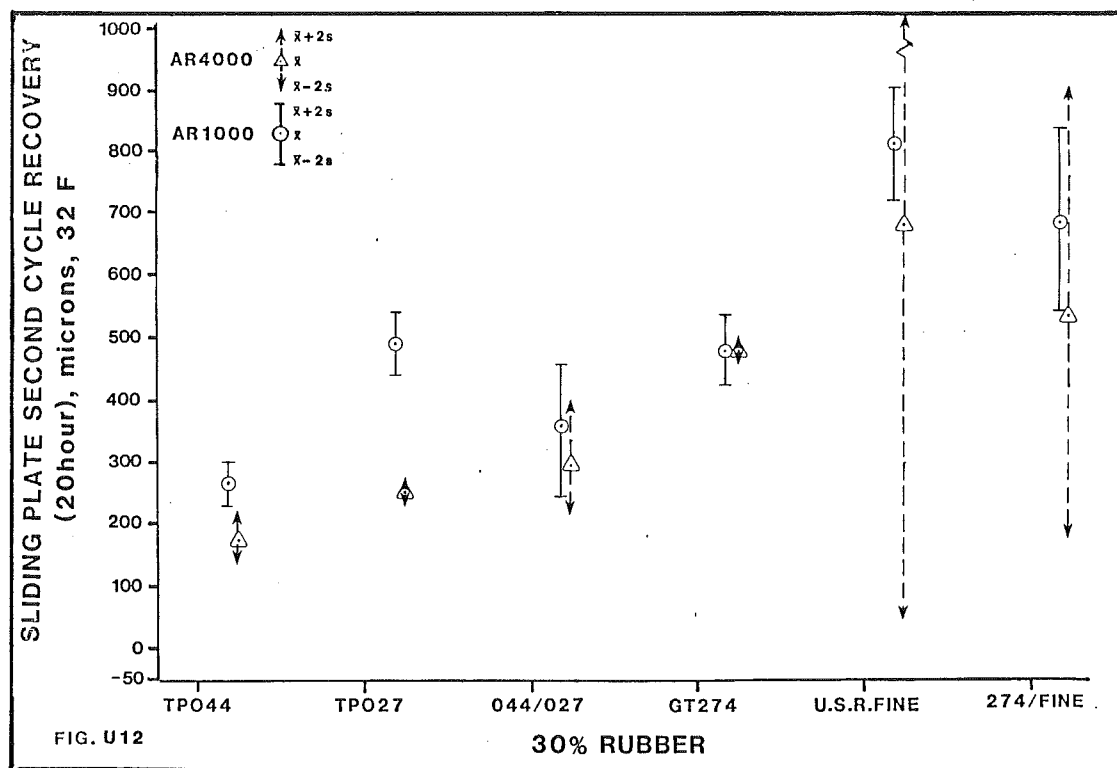
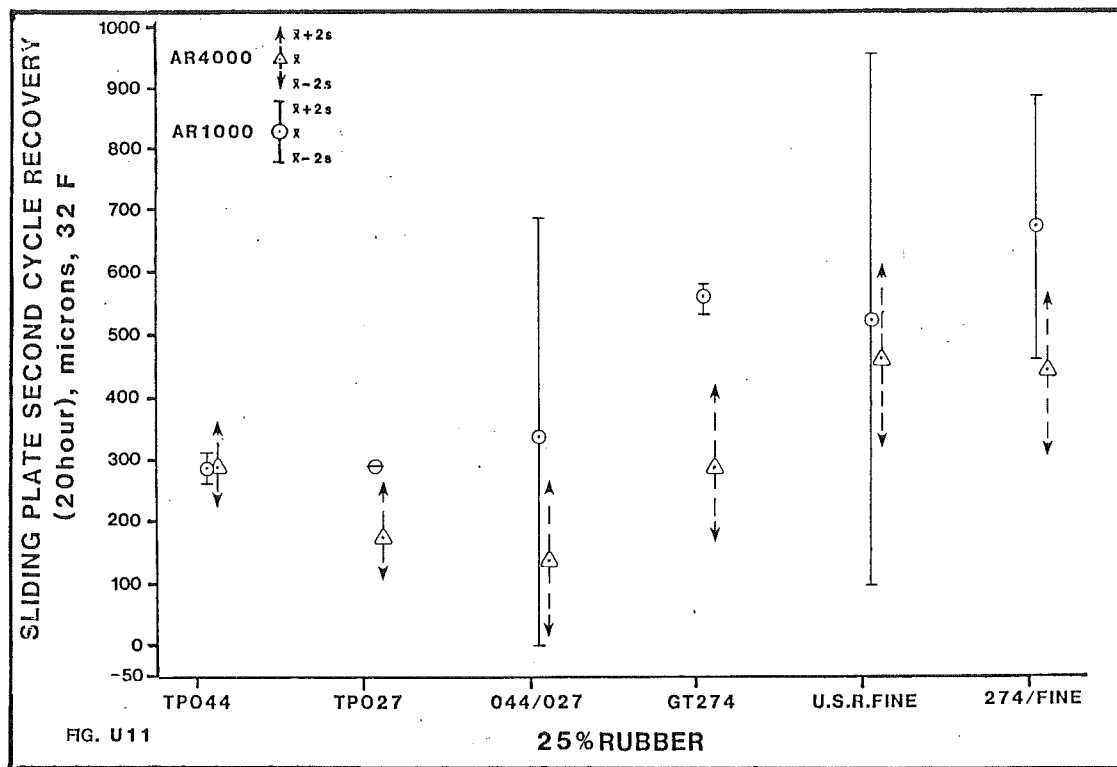












APPENDIX V

SECOND CYCLE RECOVERY (20 HOUR MINUS 30 MIN)
AT 32.0F (0C) BY SLIDING PLATE MICROVISCOMETER

Table V-1 Sliding Plate Second Cycle Recovery
(20 hr. minus 30 min.), microns

a. Measured and Analyzed Data

TPO 44				
	15%	20%	25%	30%
A R 4 0 0 0	36	98	273	56
	0	0	203	76
A R 1 0 0 0	74	74	121	27
	43	102	104	27

b. Summary

TP044					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	18.00	49.00	238.00	66.00
	S	31.895	86.828	62.020	17.720
	CV	177.20	177.20	26.06	26.85
A R 1 0 0 0	$\bar{x}$	58.50	88.00	112.50	27.00
	S	27.466	24.808	15.062	0
	CV	46.95	28.19	13.39	0

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044			TP007			SOL TP044 & SOL TP007			GT274			U.S. Rubber Film			SOL GT274 & SOL U.S. Film		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
TP044																		
TP007																		
SOL TP044 & SOL TP007																		
GT274																		
U.S. Rubber Film																		
SOL GT274 & SOL U.S. Film																		

a. Measured and Analyzed Data

b. Summary

[illegible]

Table V-1 Sliding Plate Second Cycle Recovery
(20 hr. minus 30 min.), microns

a. Measured and Analyzed Data

50% TPO 44 & 50% TPO 27				
	15%	20%	25%	30%
A R 4 0 0 0	36	0	21	154
	46	0	61	121
A R 1 0 0 0	20	20	29	67
	39	99	191	122

b. Summary

50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	41.00	0	41.00	137.50
	S	8.860	0	35.440	29.238
	CV	21.61	0	86.44	21.26
A R 1 0 0 0	$\bar{x}$	29.50	59.50	110.00	94.50
	S	16.834	69.994	143.532	48.730
	CV	57.06	117.64	130.48	51.57

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP044				TP027				50% TP044 50% TP027				G1876				U.S. Rubber Firm				50% G1876 50% U.S. Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				
RUBBER TYPE	BR																																				
	BR																																				

Table V-1 Sliding Plate Second Cycle Recovery
(20 hr. minus 30 min.), microns

a. Measured and Analyzed Data

GT 274				
	15%	20%	25%	30%
A R 4 0 0 0	97	123	176	160
	9	77	97	128
A R 1 0 0 0	175	90	250	55
	286	185	188	143

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	53.00	100.00	136.50	144.00
	s	77.968	40.756	69.994	28.352
	cv	147.11	40.76	51.28	19.69
A R 1 0 0 0	$\bar{x}$	230.50	137.50	219.00	99.00
	s	98.346	84.170	54.932	77.968
	cv	42.67	61.21	25.08	78.76

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP644				TP647				50% TP644 50% TP647				Q1314				U.S. Rubber Fm.				GEN. Q1314 GEN. Fm. 4															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					
RECOVERED																																					

a. Measured and Analyzed Data

	U. S. Rubber Fine			
	15%	20%	25%	30%
AR 4 0 0 0	66 	155 	218 	510
	216	1	252	213
AR 1 0 0 0	110 	393 	327 	312
	342	199	166	364

b. Summary

		U. S. RUBBER FINE			
		15%	20%	25%	30%
A R	$\bar{x}$	141.00	78.00	235.00	361.50
4 0 0 0	S	132.900	136.444	30.124	263.142
	CV	94.26	174.93	12.82	72.79
A R	$\bar{x}$	226.00	296.00	246.50	338.00
1 0 0 0	S	205.552	171.884	142.646	46.072
	CV	90.95	58.07	57.87	13.63

[illegible]

Table V-1 Sliding Plate Second Cycle Recovery
(20 hr. minus 30 min.), microns

a. Measured and Analyzed Data

50% GT 274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	120	91	172	302
	32	97	190	109
A R 1 0 0 0	0	258	221	247
	122	236	306	189

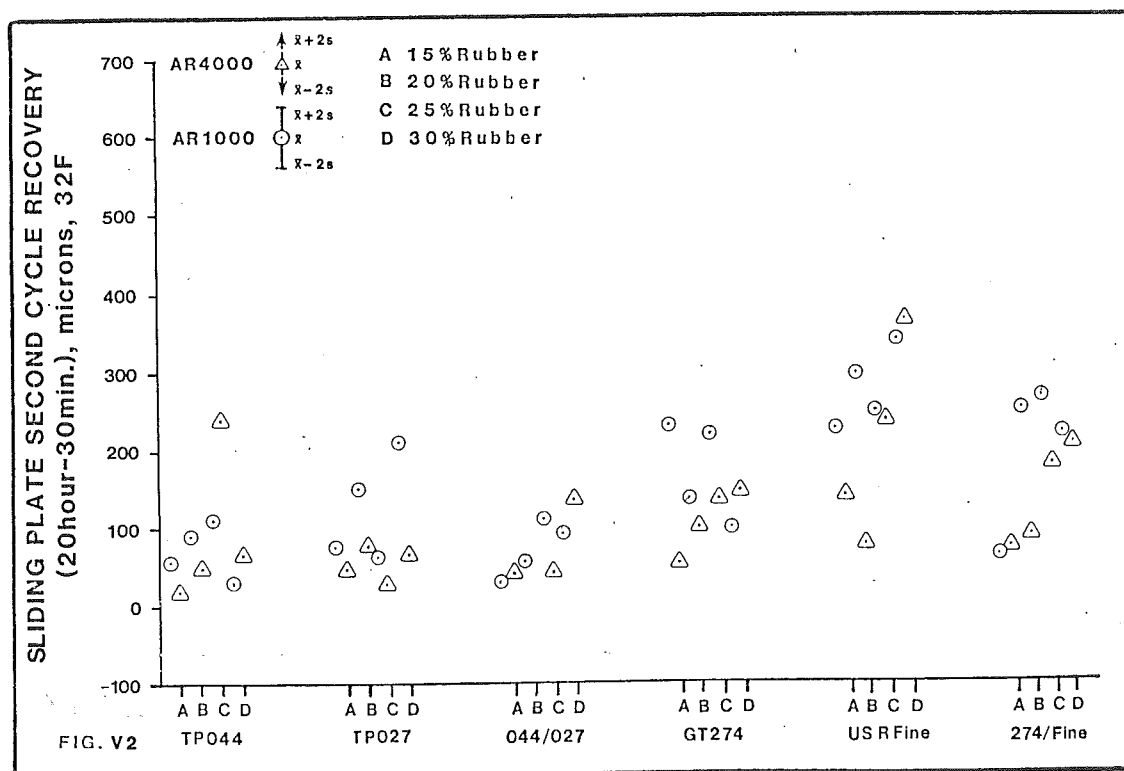
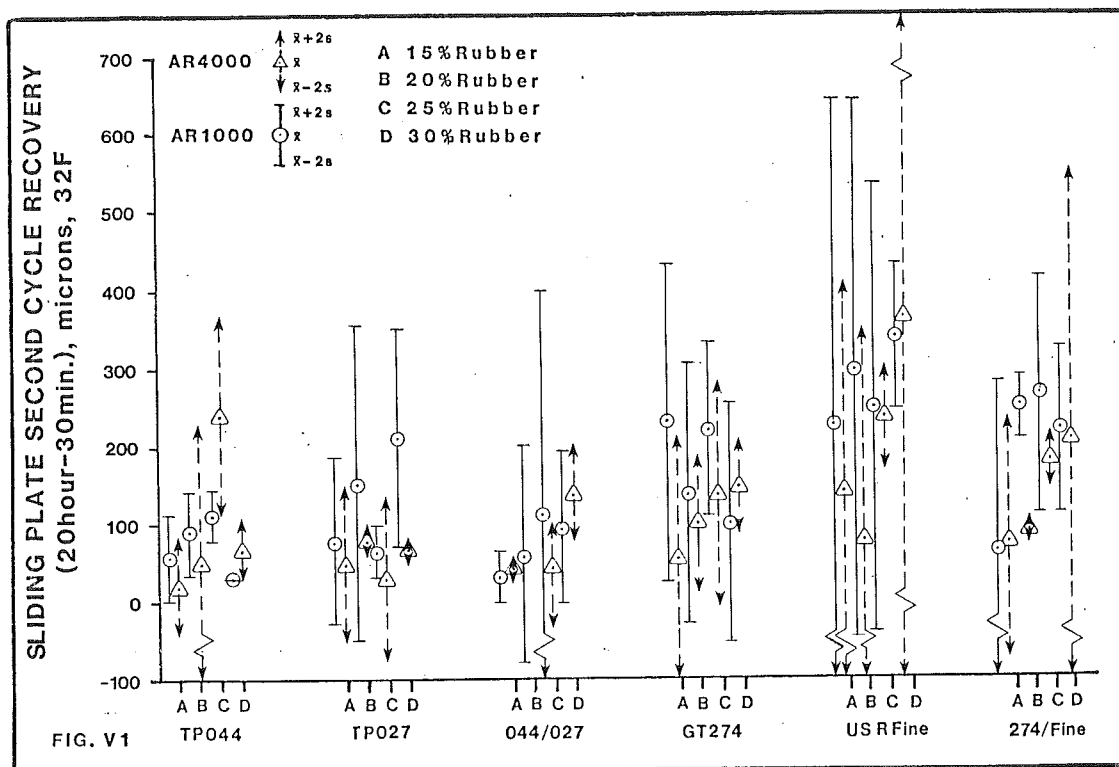
b. Summary

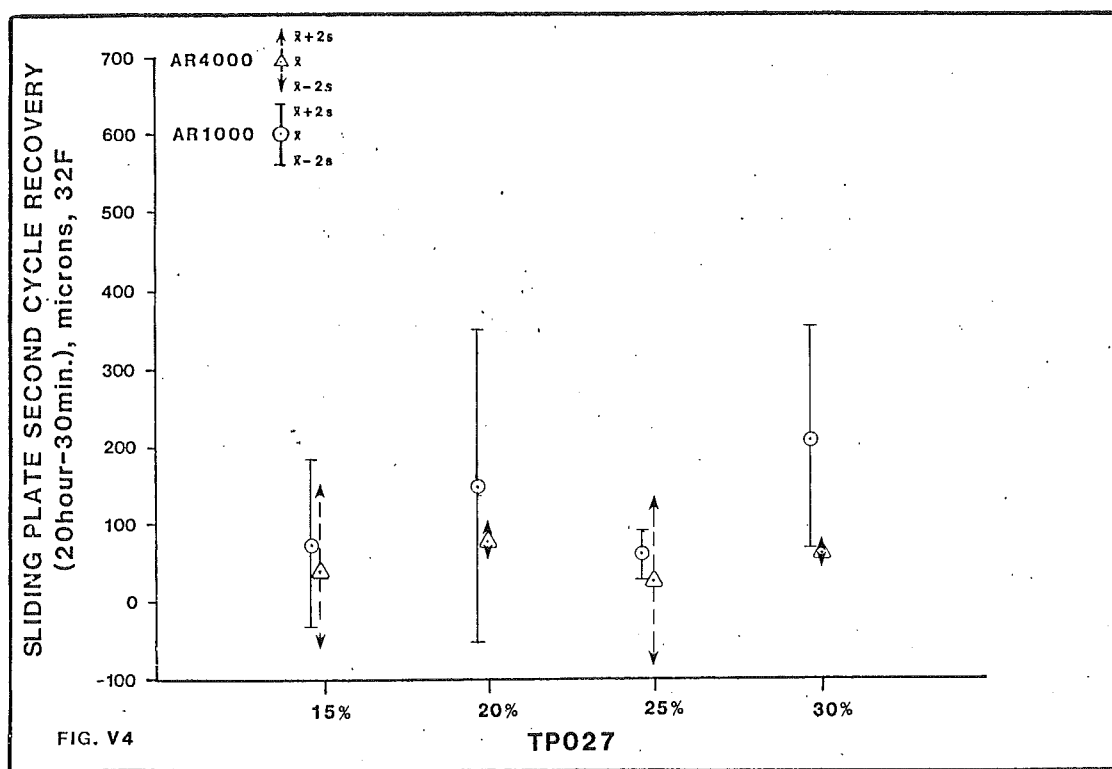
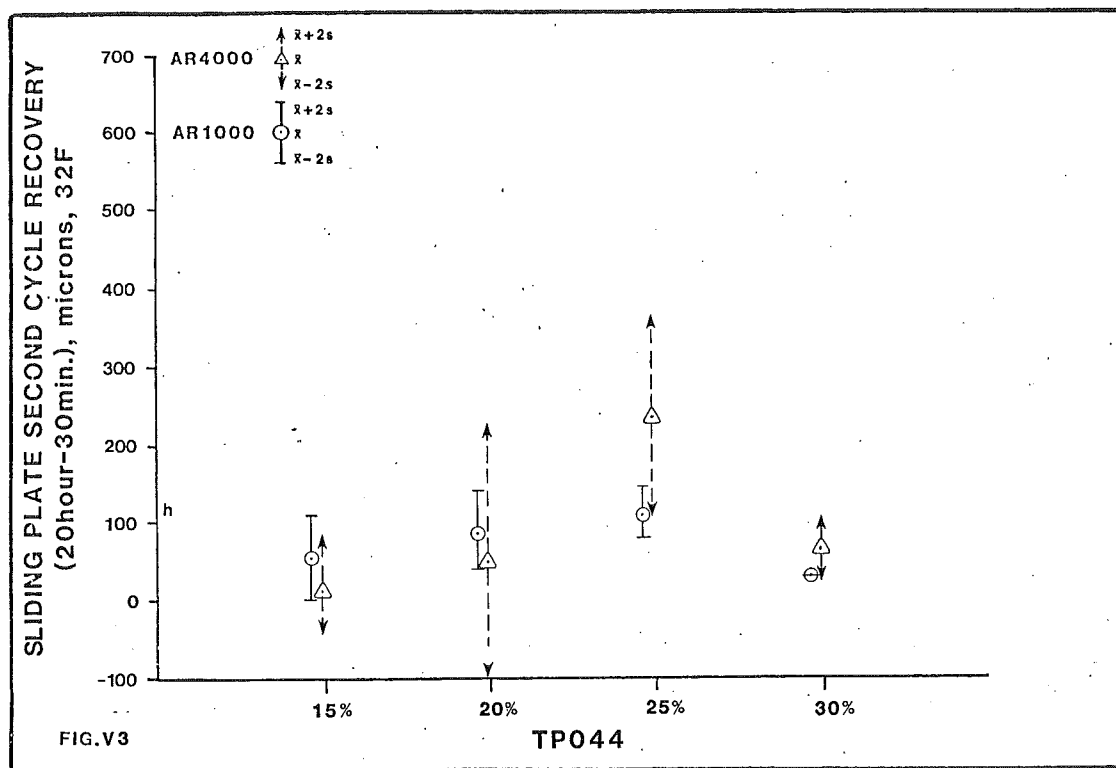
50% GT274 & 50% U. S. RUBBER FINE					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	76.00	94.00	181.00	205.50
	s	77.968	5.316	15.948	170.998
	cv	102.59	5.66	8.81	83.21
A R 1 0 0 0	$\bar{x}$	61.00	247.00	263.50	218.00
	s	108.092	19.492	75.310	51.388
	cv	177.20	7.89	28.58	23.57

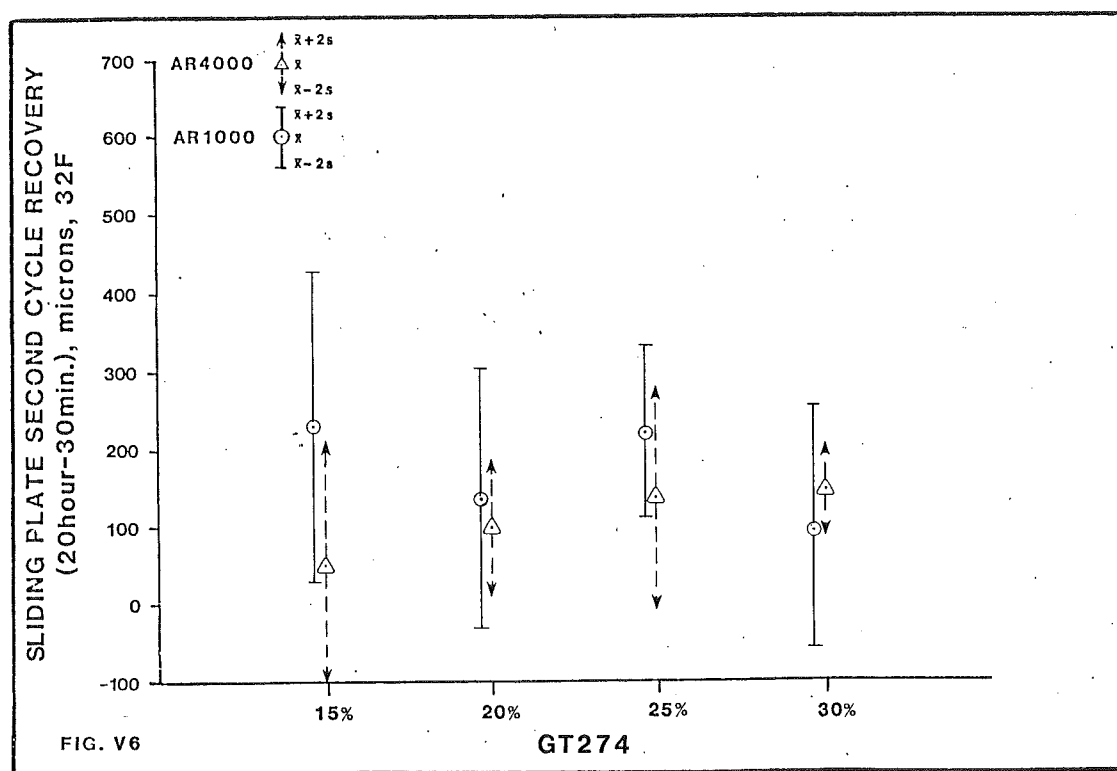
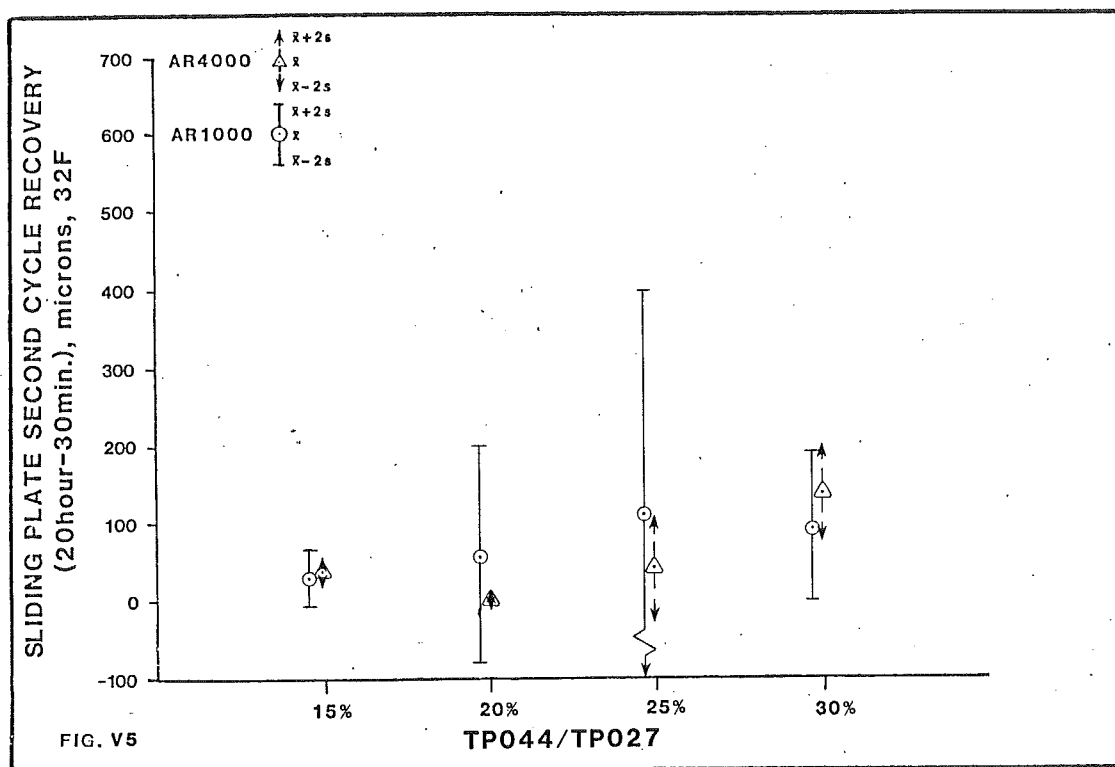
		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP046				TP087				50% TP046 & 50% TP087			
		15	20	25	30	15	20	25	30	15	20	25	30
Sliding Plate	Recovery												
	microns												

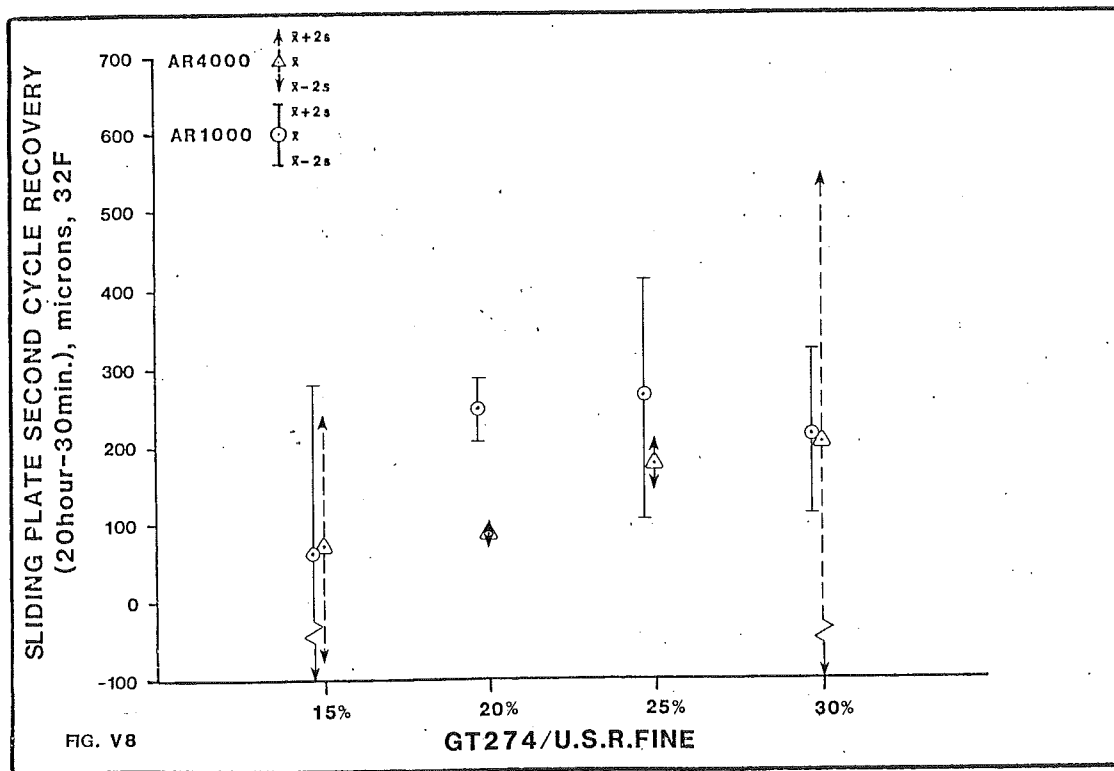
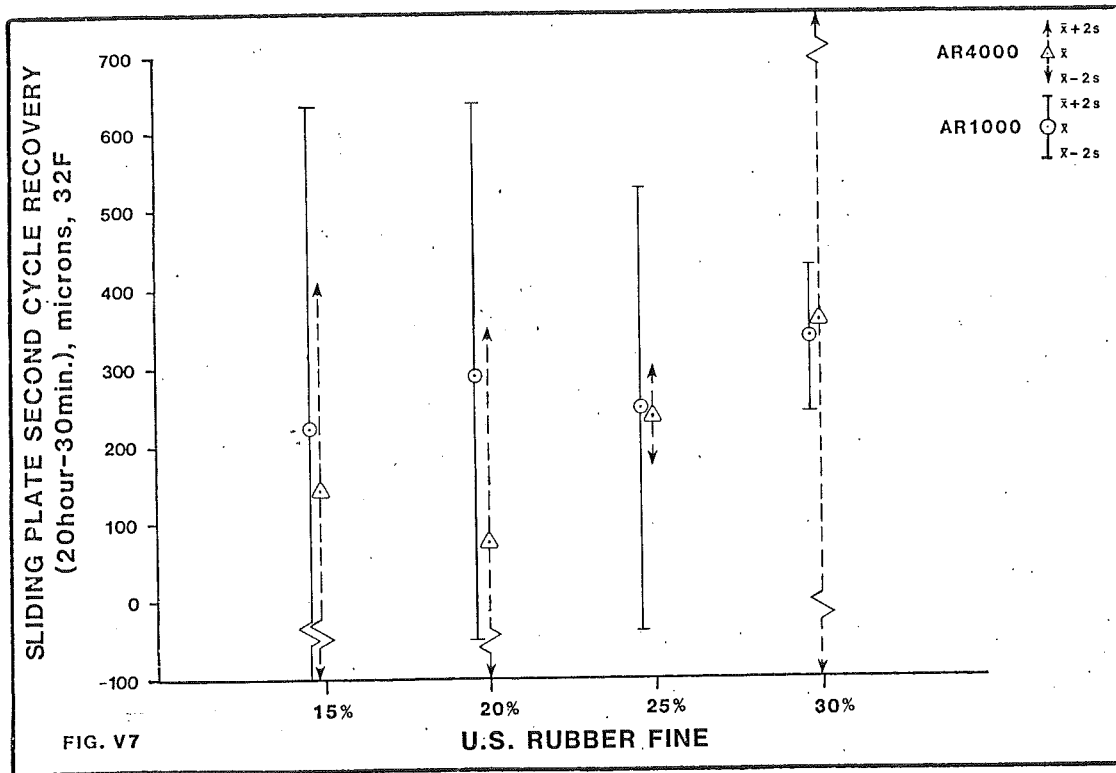
Table V-2 Anova Summary, Sliding Plate Second
Cycle Recovery (20 hr minus 30 min)

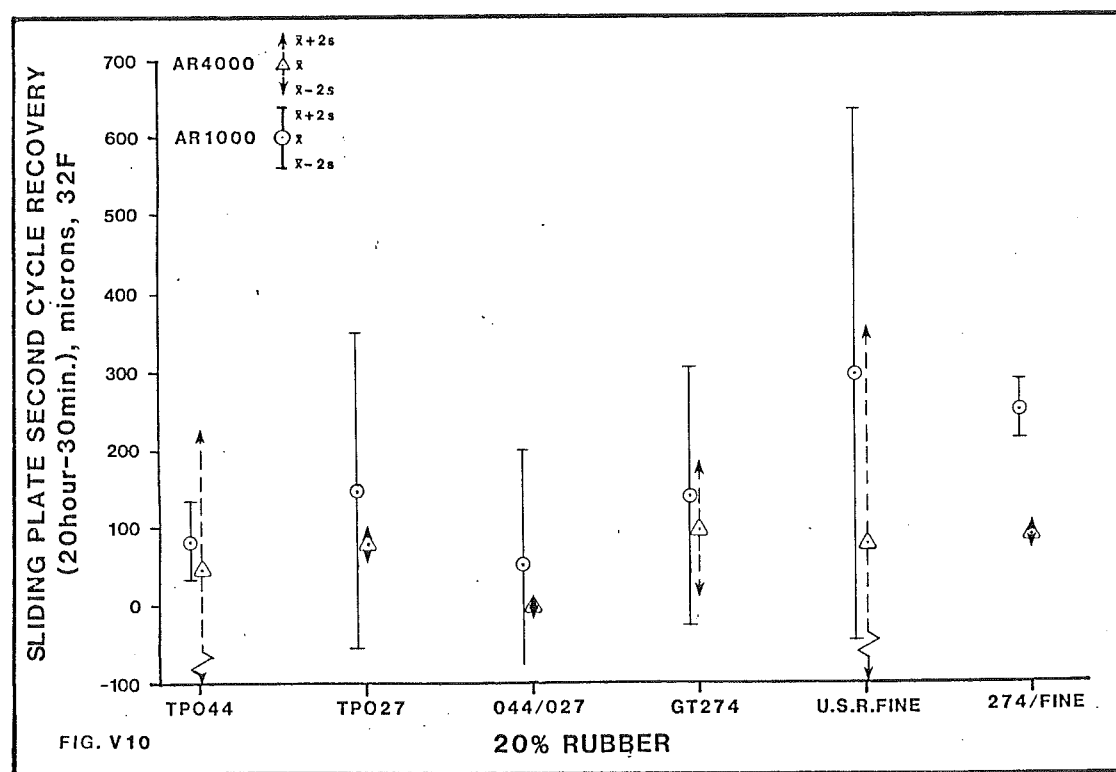
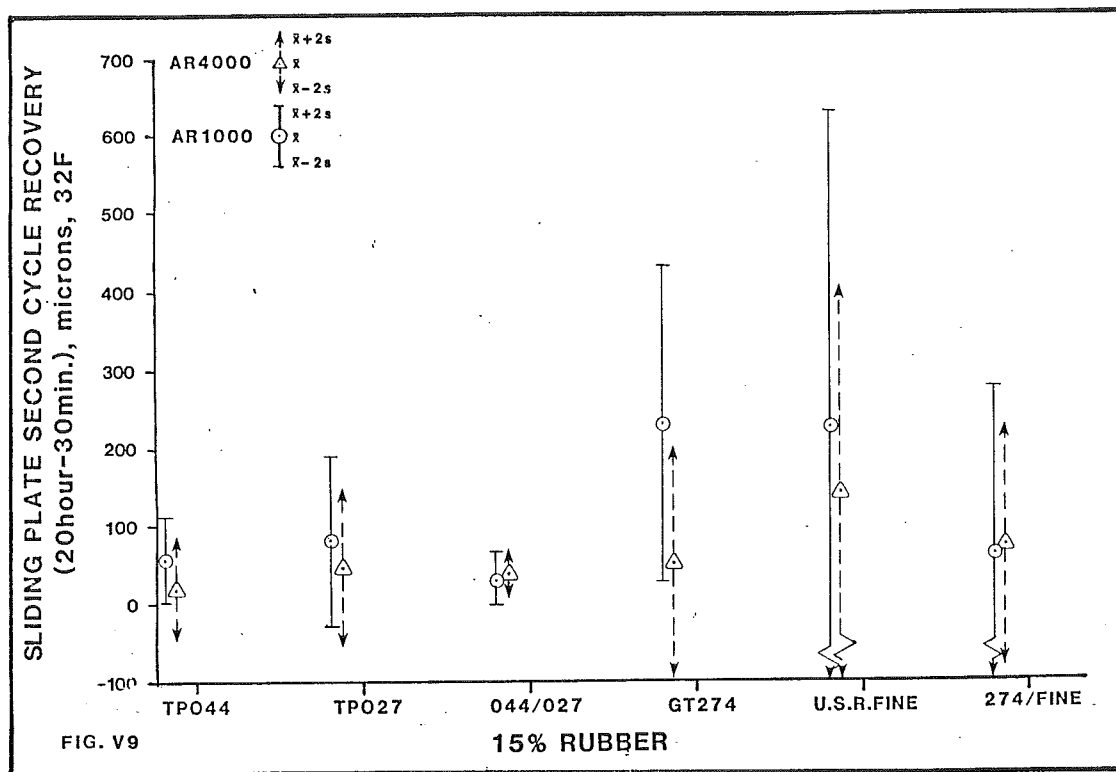
ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	351607.21	70321.44	14.54	2.43	3.48
Q	3	92097.61	30699.20	6.35	2.82	4.28
A	1	45283.59	45283.59	9.37	4.07	7.27
RQ	15	138324.32	9221.62	1.91	1.91	2.49
RA	5	27755.47	5551.09	1.15	2.43	3.48
QA	3	29679.28	9893.10	2.05	2.82	4.28
RQA	15	83317.41	5554.49	1.15	1.91	2.49
Error	48	232092.50	4835.26			
TOTAL	95	1000157.39				

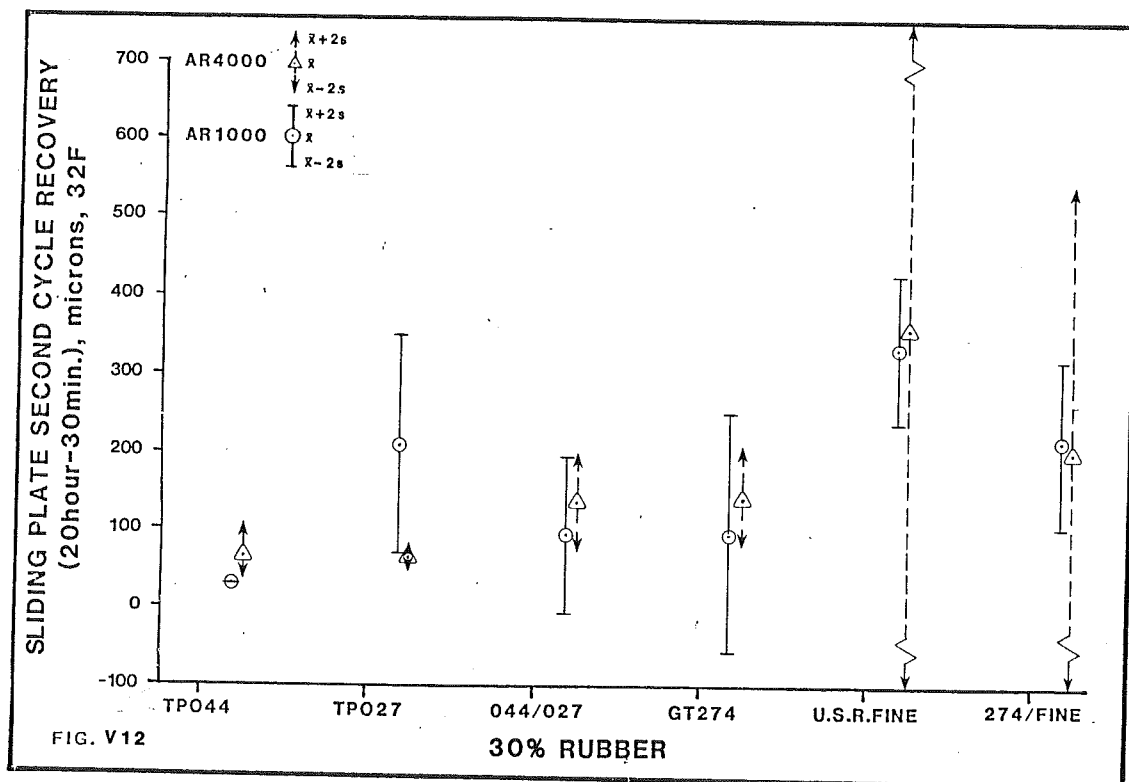
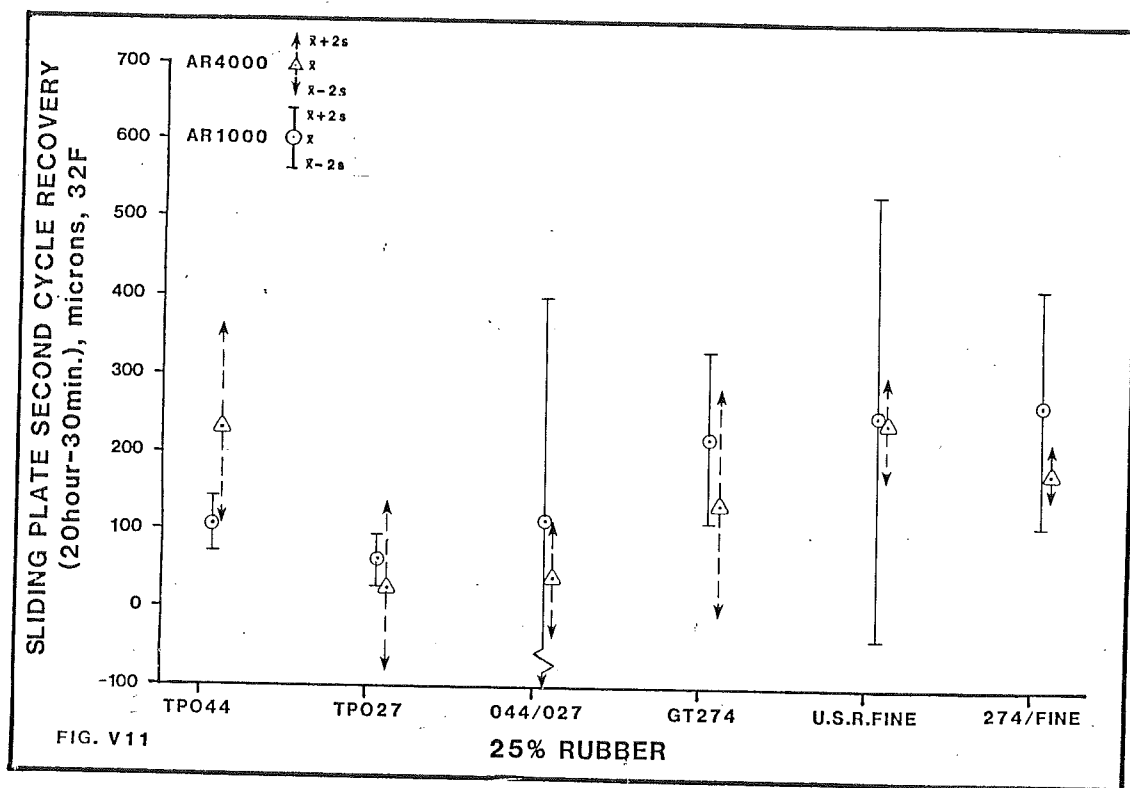












APPENDIX W

FIRST CYCLE PERCENT REBOUND AT 32.0F (0C)

BY SLIDING PLATE MICROVISCOMETER

Table W-1 Sliding Plate First Cycle Rebound, %

a. Measured and Analyzed Data

TPO44				
	15%	20%	25%	30%
A R 4 0 0 0	38.5	40.6	51.3	55.1
	34.2	40.5	52.7	56.0
A R 1 0 0 0	39.1	37.6	60.7	53.2
	35.7	44.5	62.0	63.1

b. Summary

TPO44					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	36.35	40.55	52.00	55.55
	s	3.81	.11	1.24	.80
	cv	10.48	.28	2.38	1.44
A R 1 0 0 0	$\bar{x}$	37.40	41.05	61.35	58.15
	s	3.01	6.11	1.15	8.77
	cv	8.05	14.89	1.88	15.08

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TPO44			TPO27			SBS TPO44 SBS TPO27			SBS			U.S. Rubber Firm			SBS SBR		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
Rebound																		
Standard Dev.																		
CV																		

a. Measured and Analyzed Data

TPO27				
	15%	20%	25%	30%
A R 4 0 0 0	30.0	35.2	40.4	41.9
	27.7	50.0	45.3	42.3
A R 1 0 0 0	29.6	32.8	50.8	53.6
	34.2	33.2	56.3	42.1

b. Summary

		TPO27			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	28.85	42.60	42.85	42.10
	s	2.04	13.11	4.34	.35
	cv	7.06	30.78	10.13	.84
A R 1 0 0 0	$\bar{x}$	31.90	33.00	53.55	47.85
	s	4.08	.35	4.87	10.19
	cv	12.78	1.07	9.10	21.29

ADHESIVE TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
TP044						TP027						50% TP044 & 50% TP027						G1374						U.S. Rubber Firm						50% G1374 50% R F 100					
18	20	25	30	35	40	18	20	25	30	35	40	18	20	25	30	35	40	18	20	25	30	35	40	18	20	25	30	35	40	18	20	25	30	35	40
[Empty grid area]																																			

Table W-1 Sliding Plate First Cycle Rebound, %

a. Measured and Analyzed Data

50% TPO44 & 50% TPO27				
	15%	20%	25%	30%
A R 4 0 0 0	46.0	46.0	44.2	48.1
	37.6	57.4	39.7	54.1
A R 1 0 0 0	37.9	45.6	42.4	50.8
	44.2	41.4	45.9	58.8

b. Summary

50% TPO44 & 50% TPO27					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>41.80</u>	<u>51.70</u>	<u>41.95</u>	<u>51.10</u>
	s	<u>7.44</u>	<u>10.10</u>	<u>4.08</u>	<u>5.32</u>
	cv	17.80	19.54	9.72	10.40
A R 1 0 0 0	$\bar{x}$	<u>41.05</u>	<u>43.50</u>	<u>44.15</u>	<u>54.80</u>
	s	<u>5.58</u>	<u>3.72</u>	<u>3.10</u>	<u>7.09</u>
	cv	13.60	8.55	7.02	12.93

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TPO44			TPO27			50% TPO44 + 50% TPO27			G1274			U.S. Rubber Firm			50% G1274 + 50% A F 100		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
Rebound	46.0	46.0	44.2	46.0	46.0	44.2	46.0	46.0	44.2	46.0	46.0	44.2	46.0	46.0	44.2	46.0	46.0	44.2
Standard Deviation	7.44	10.10	4.08	7.44	10.10	4.08	7.44	10.10	4.08	7.44	10.10	4.08	7.44	10.10	4.08	7.44	10.10	4.08
Coefficient of Variation	17.80	19.54	9.72	17.80	19.54	9.72	17.80	19.54	9.72	17.80	19.54	9.72	17.80	19.54	9.72	17.80	19.54	9.72

Table W-1 Sliding Plate First Cycle Rebound, %

a. Measured and Analyzed Data

GT274				
	15%	20%	25%	30%
A R 4 0 0 0	18.7	24.7	38.6	39.0
	15.5	33.2	34.2	50.0
A R 1 0 0 0	35.3	30.0	44.8	52.1
	30.1	42.3	43.3	43.3

b. Summary

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	17.10	28.95	36.40	44.50
	s	2.84	7.53	3.90	9.75
	CV	16.58	26.01	10.71	21.90
A R 1 0 0 0	$\bar{x}$	32.70	36.15	44.05	47.70
	s	4.61	10.90	1.33	8.80
	CV	14.09	30.15	3.02	18.45

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP644				TP627				60% TP644 + 40% TP627			
		15	20	25	30	15	20	25	30	15	20	25	30
Sliding Plate	Rebound	18	20	25	30	18	20	25	30	18	20	25	30
	First Cycle	18	20	25	30	18	20	25	30	18	20	25	30
Sliding Plate	Rebound	18	20	25	30	18	20	25	30	18	20	25	30
	First Cycle	18	20	25	30	18	20	25	30	18	20	25	30

Table W-1 Sliding Plate First Cycle Rebound, %

a. Measured and Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	22.3	25.3	36.9	38.8
	21.3	17.8	36.9	47.5
A R 1 0 0 0	54.7	39.5	45.5	48.7
	29.4	33.3	49.5	49.7

b. Summary

U. S. Rubber Fine					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	21.80	21.55	36.90	43.15
	s	.89	6.64	—	7.71
	cv	4.06	30.84	—	18.29
A R 1 0 0 0	$\bar{x}$	42.05	36.40	47.50	49.20
	s	22.42	5.49	3.54	.89
	cv	53.31	15.09	7.46	1.81

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP044				TP027				50% TP044 50% TP027				51374				U.S. Rubber Fine				50% 51374 50% 51374			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
1000-100																								
1000-200																								
1000-300																								
1000-400																								
1000-500																								
1000-600																								
1000-700																								
1000-800																								
1000-900																								
1000-1000																								

Table W-1 Sliding Plate First Cycle Rebound, %

a. Measured and Analyzed Data

50% GT274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	19.2	31.5	36.4	37.7
	23.4	41.8	35.8	40.7
A R 1 0 0 0	39.7	39.0	49.3	48.8
	31.3	36.4	40.3	36.6

b. Summary

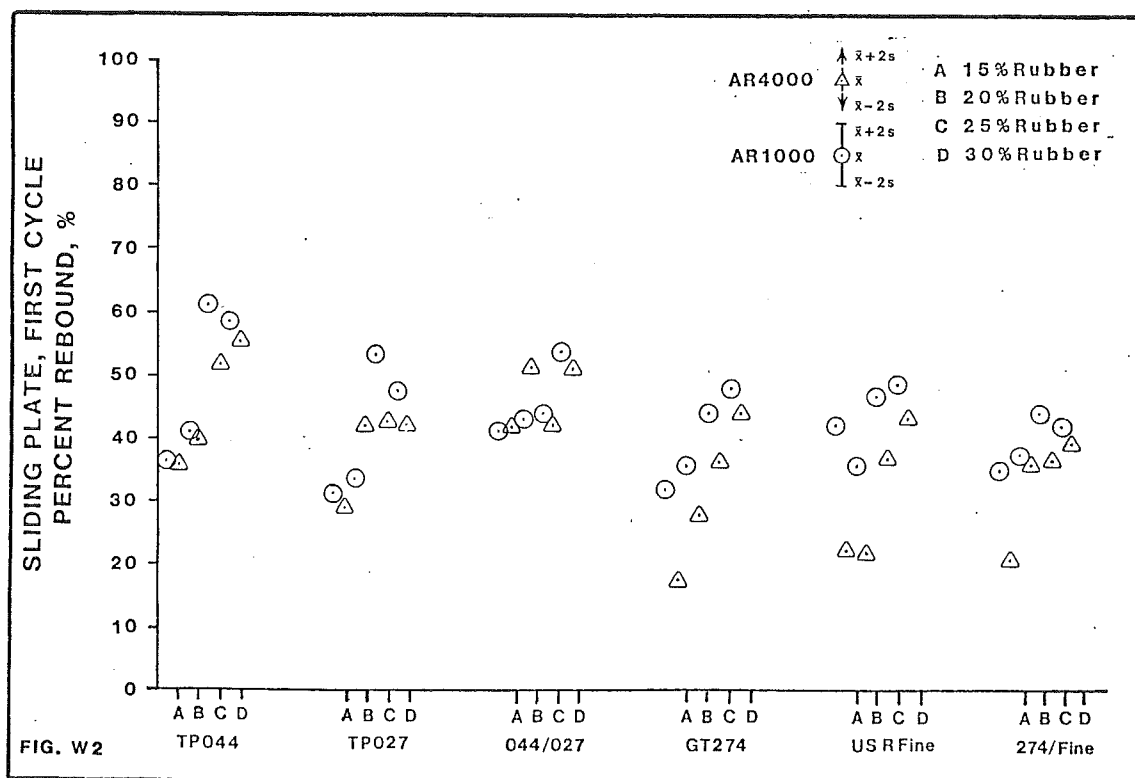
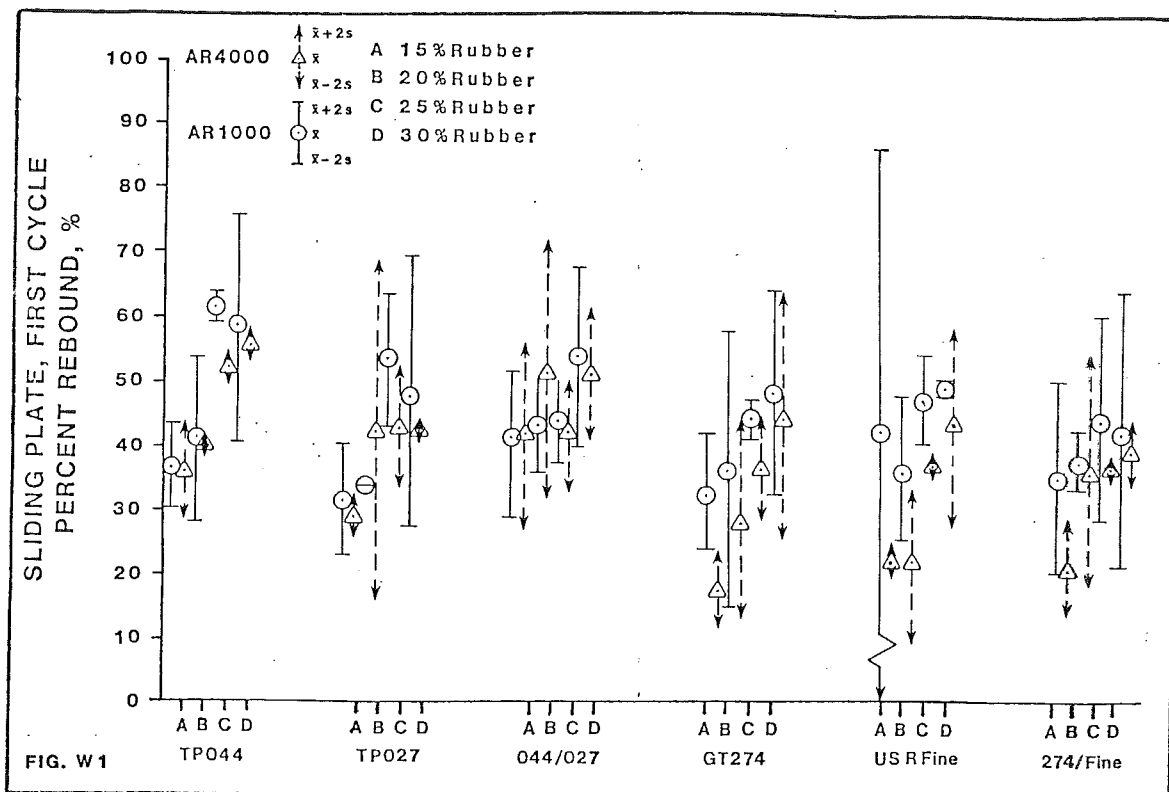
50% GT274 & 50% U. S. Rubber Fine					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	21.30	36.65	36.10	39.20
	s	3.72	9.13	0.53	2.66
	CV	17.47	24.90	1.47	6.78
A R 1 0 0 0	$\bar{x}$	35.50	37.70	44.80	42.70
	s	7.44	2.30	7.97	10.81
	CV	20.96	6.11	17.80	25.31

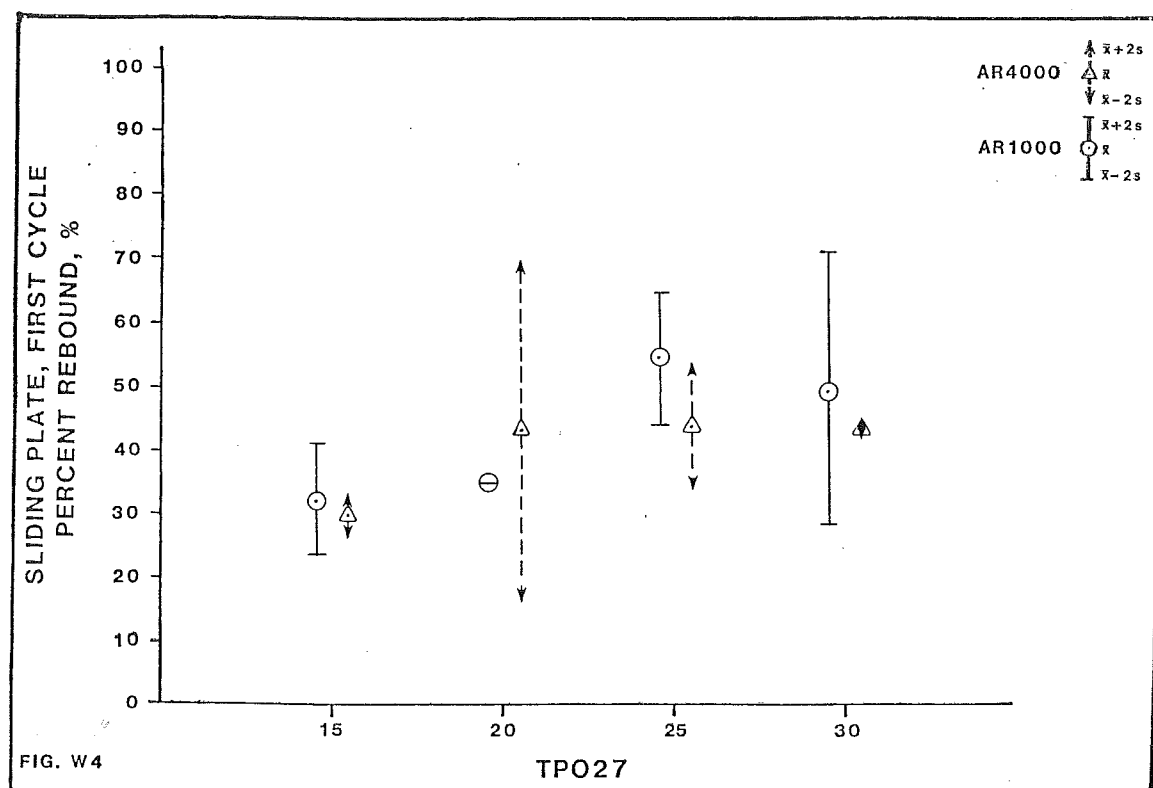
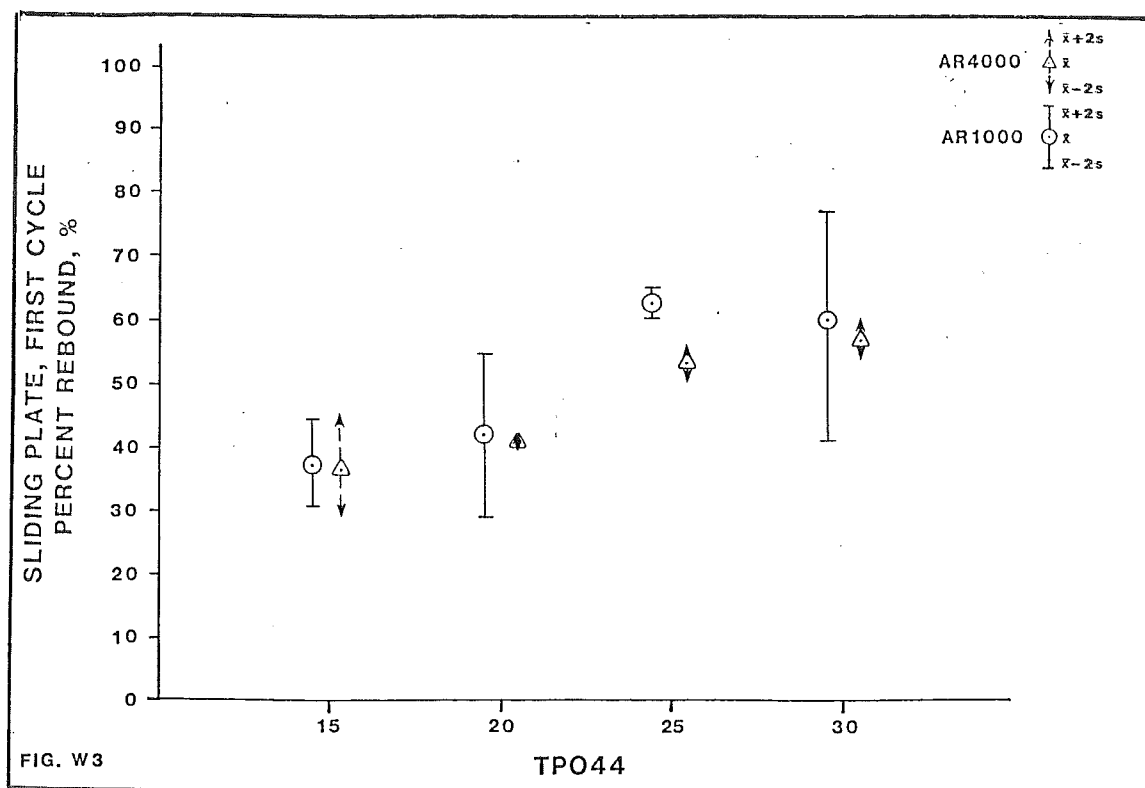
ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

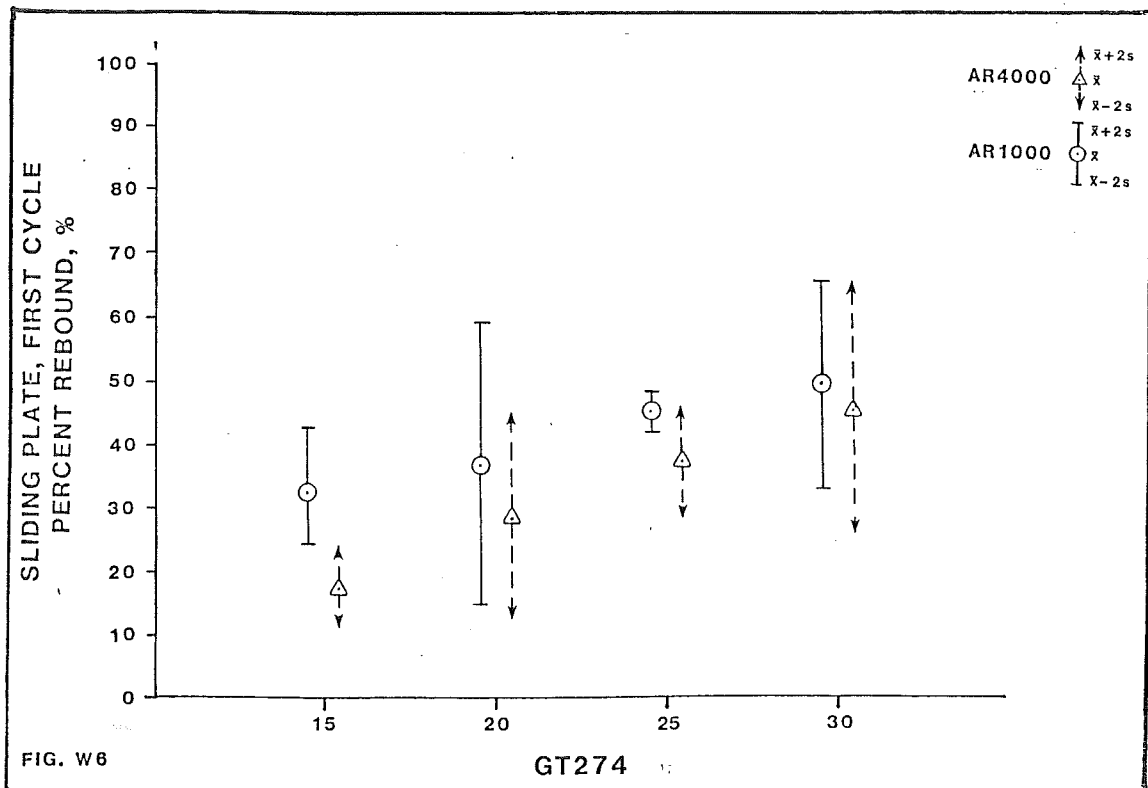
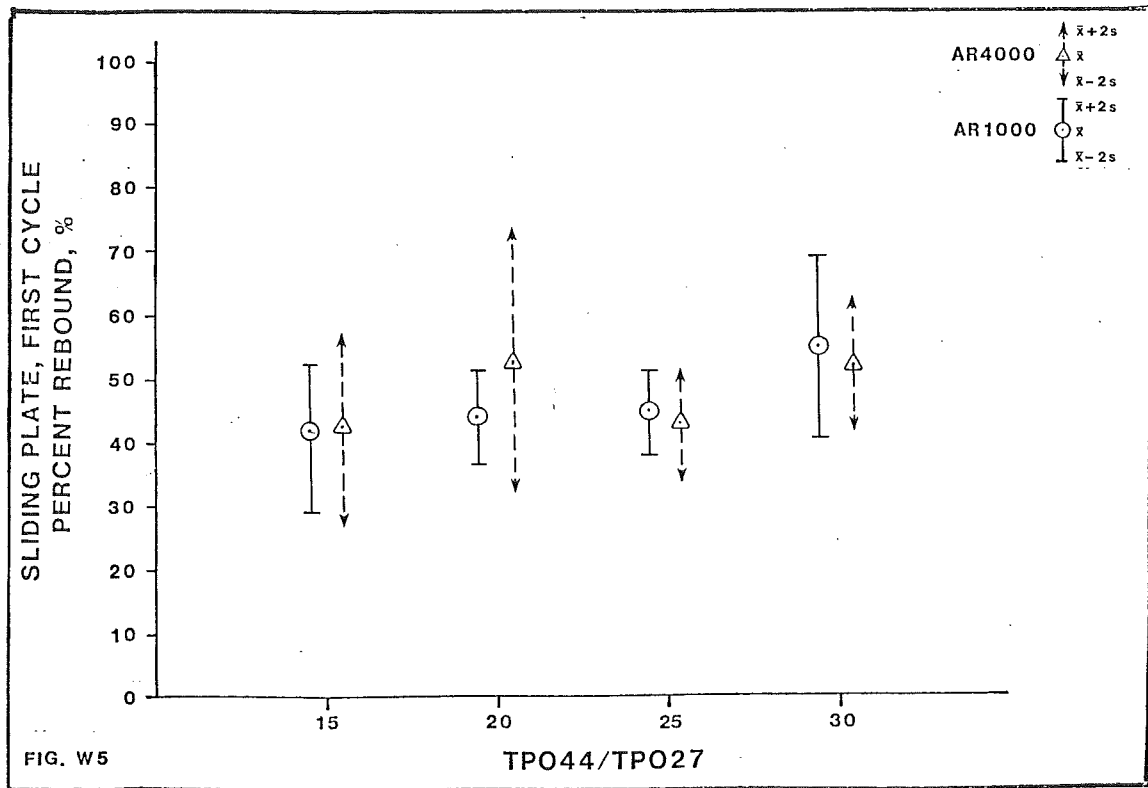
	TP662				TP667				50% TP662 & 50% TP667				GT274				U.S. Rubber Fine				50% GT274 & 50% U.S. Rubber Fine			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Rebound																								
Standard Deviation																								
Coefficient of Variation																								

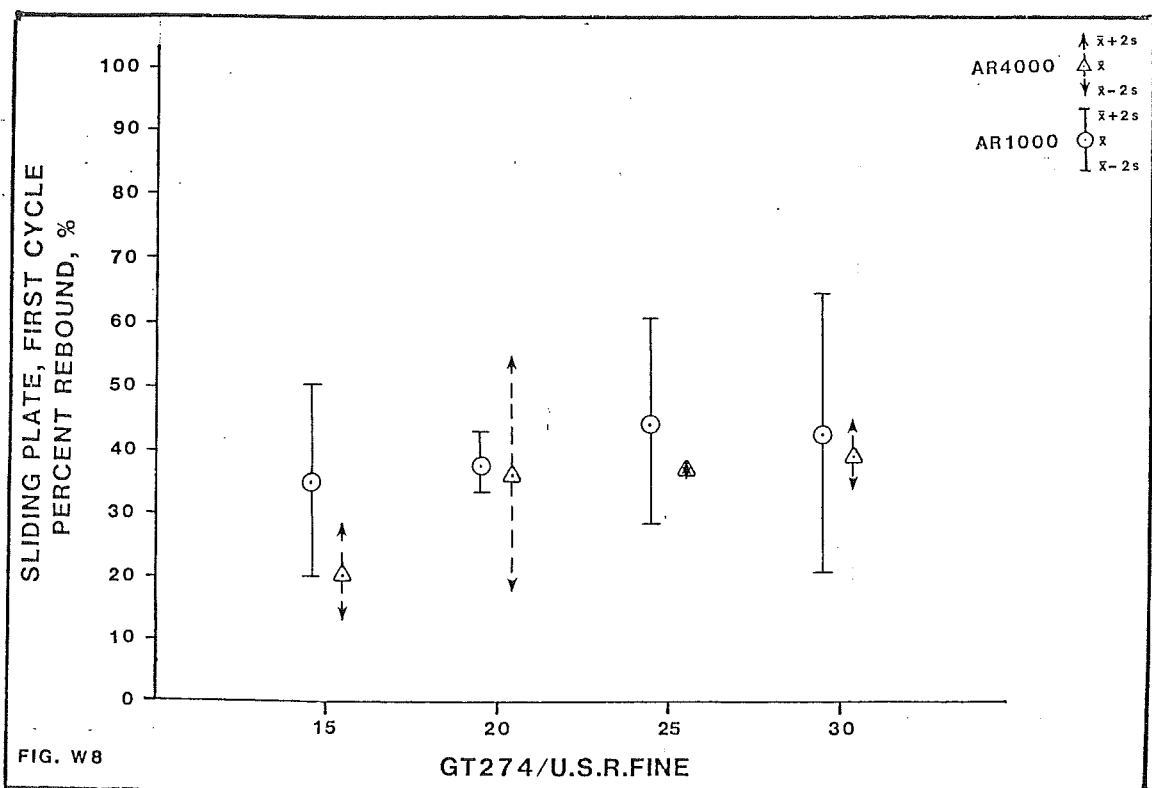
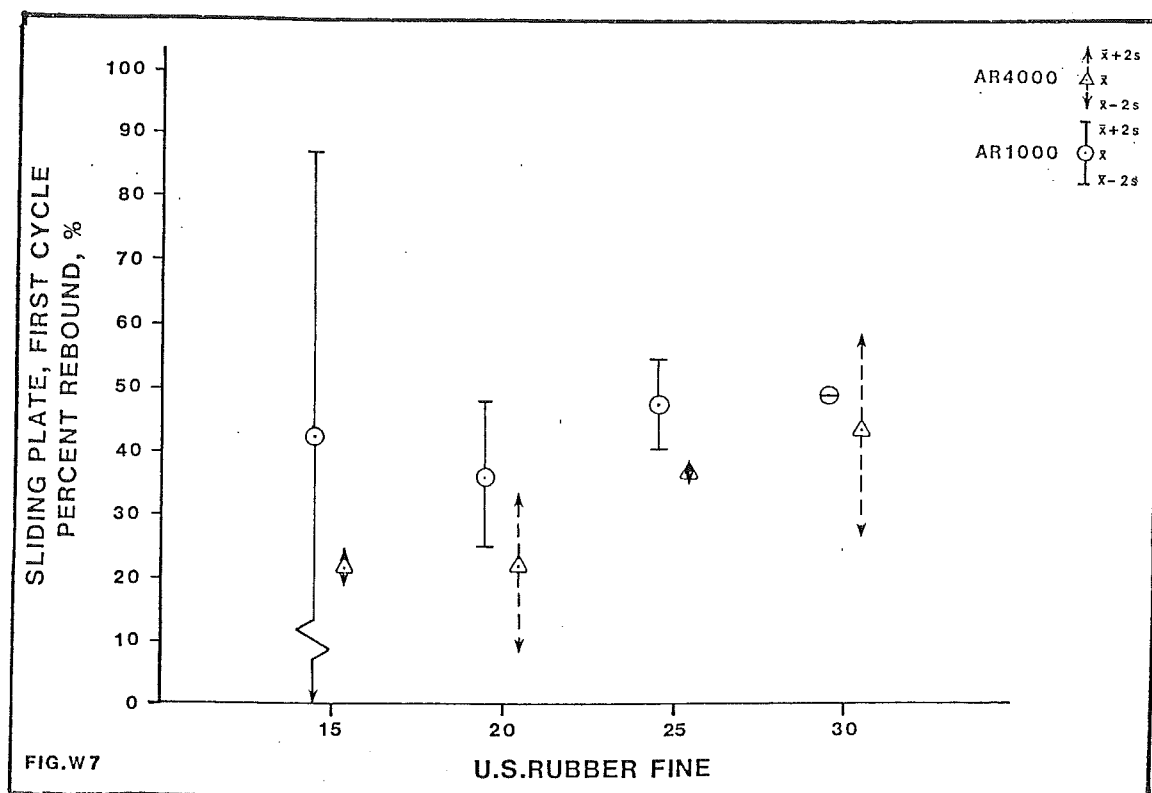
Table W-2 ANOVA Summary, Sliding Plate
Percent Rebound

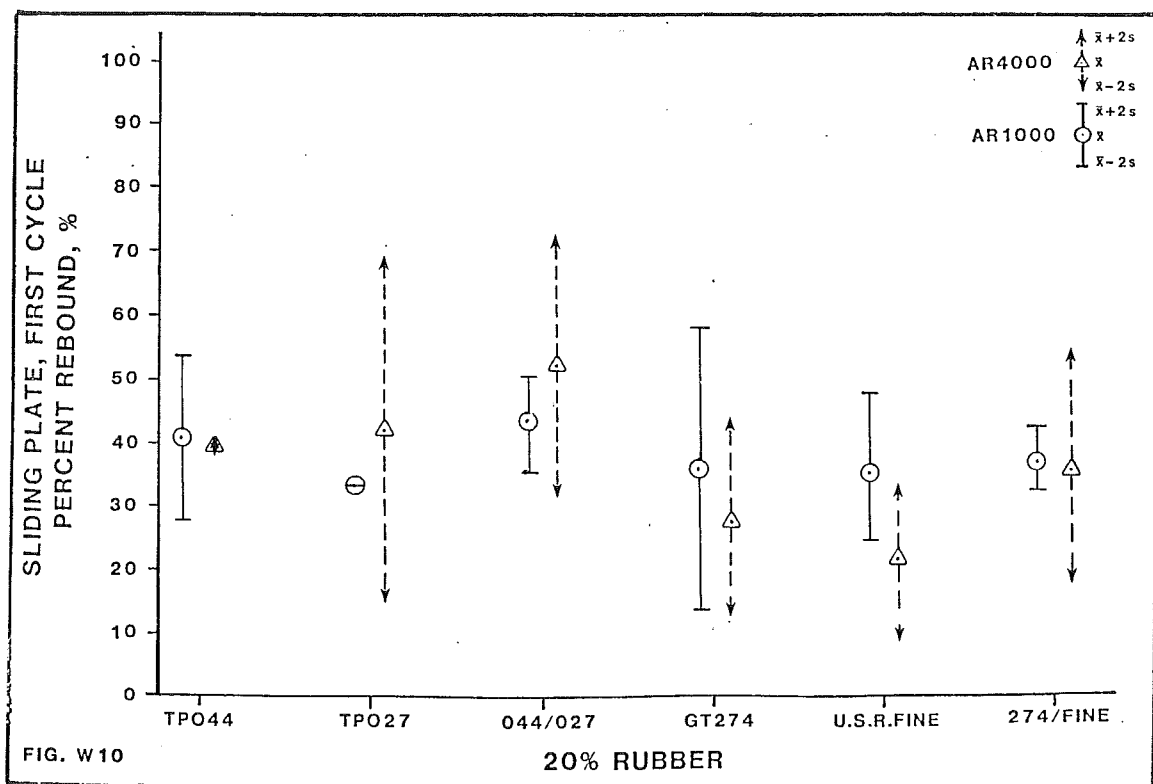
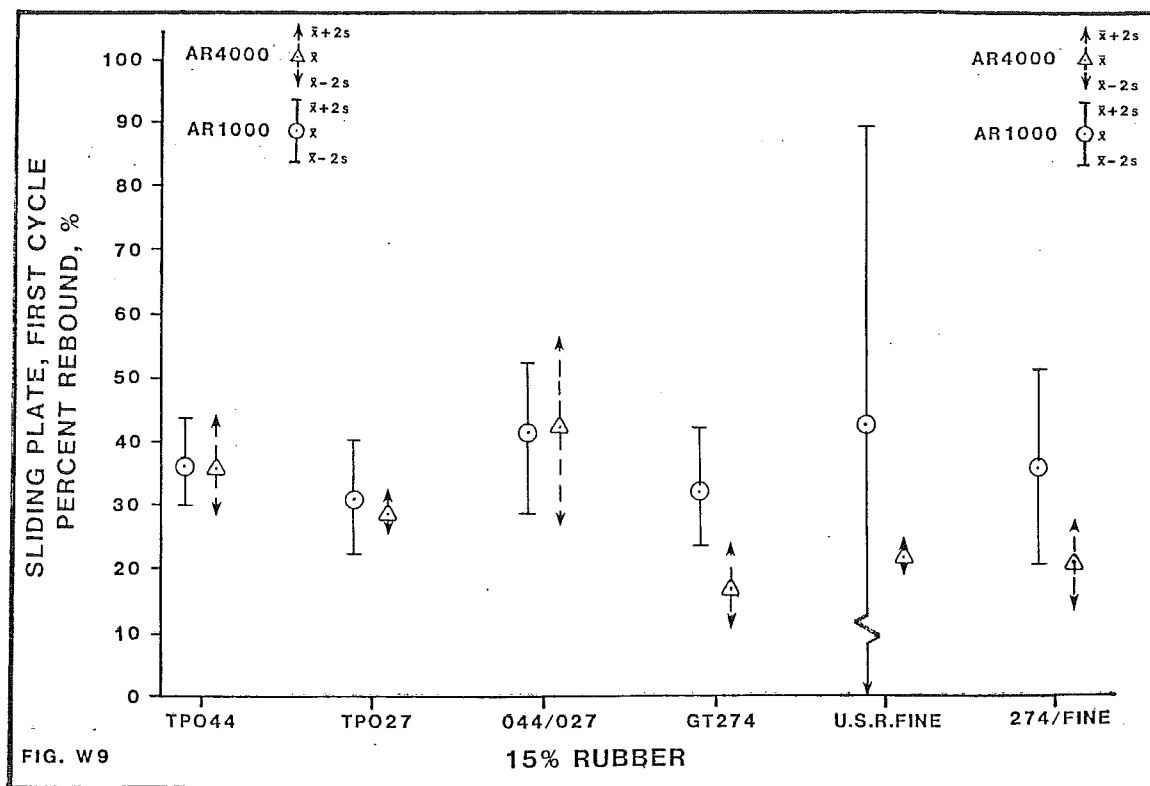
<u>ANOVA</u>						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	2097.81	419.56	14.63	2.43	3.48
Q	3	3865.61	1228.54	42.85	2.82	4.28
A	1	739.26	739.26	25.78	4.07	7.27
RQ	15	936.13	62.41	2.18	1.91	2.49
RA	5	474.10	94.82	3.31	2.43	3.48
QA	3	247.55	82.52	2.88	2.82	4.28
RQA	15	404.16	26.94	.94	1.91	2.49
Error	48	1376.20	28.67			
TOTAL	95	9960.83				

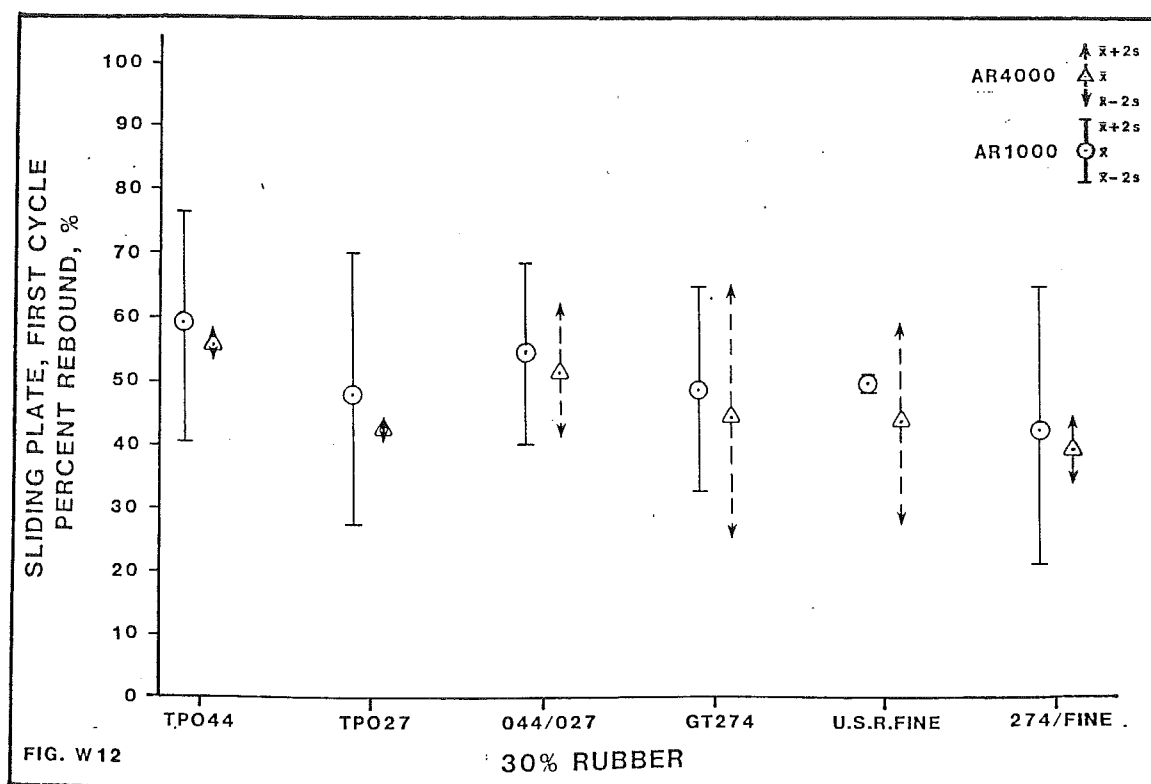
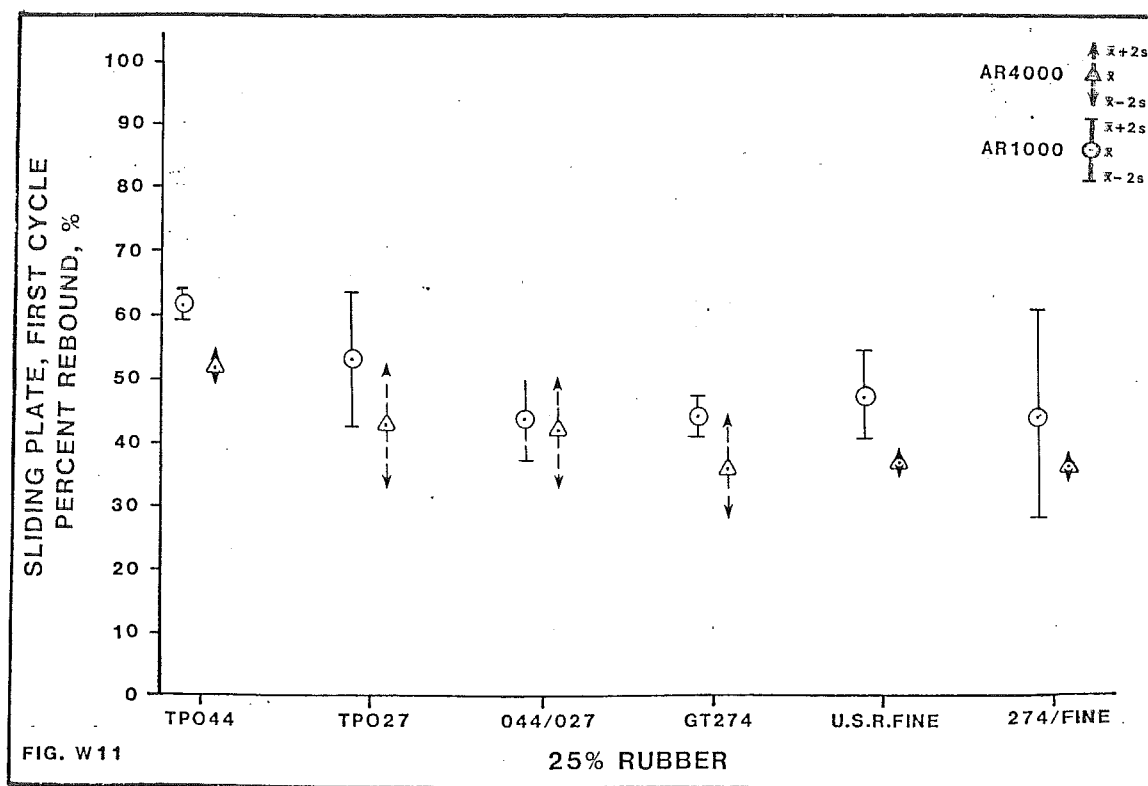












APPENDIX X

FIRST CYCLE CREEP RHEOLOGICAL COEFFICIENT S_m
AT 32.0F (0C) BY SLIDING PLATE MICROVISCOMETER

Table X-1 First Cycle Creep Coefficient S_m

a. Calculated Data

TPO44				
	15%	20%	25%	30%
A R 4 0 0 0	.068	.080	.136	.080
	.045	.044	.103	.673
A R 1 0 0 0	.124	.117	.126	.144
	.089	.117	.102	.112

b. Summary

TPO44					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.0565</u>	<u>.0620</u>	<u>.120</u>	<u>.377</u>
	s	<u>.0204</u>	<u>.0319</u>	<u>.029</u>	<u>.525</u>
	cv	36.1	51.4	24.5	139.5
A R 1 0 0 0	$\bar{x}$	<u>.107</u>	<u>.117</u>	<u>.114</u>	<u>.128</u>
	s	<u>.031</u>	<u>.0</u>	<u>.021</u>	<u>.028</u>
	cv	29.1	.0	18.7	22.2

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TPO44			TPO27			50% TPO44 50% TPO27			S1E76			U.S. Rubber Firm			50% S1E76 50% U.S. Firm		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
ASPHALT TYPE (A)																		
PERCENT RUBBER (B)																		
RUBBER TYPE (C)																		

Table X-1 First Cycle Creep Coefficient S_m

a. Calculated Data

TPO27				
	15%	20%	25%	30%
A R 4 0 0 0	.082	.077	.088	.118
	.056	.088	—	.139
A R 1 0 0 0	.141	.202	.143	.213
	.107	.160	.126	.198

b. Summary

		TPO27			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.069</u>	<u>.083</u>	<u>.088</u>	<u>.129</u>
	s	<u>.023</u>	<u>.010</u>	<u>-</u>	<u>.019</u>
	CV	33.4	11.8	-	14.5
A R 1 0 0 0	$\bar{x}$	<u>.124</u>	<u>.181</u>	<u>.135</u>	<u>.206</u>
	s	<u>.030</u>	<u>.037</u>	<u>.015</u>	<u>.013</u>
	CV	24.3	20.6	11.2	6.5

ASPHALT TYPE (A)
 PERCENT RUBBER (B)
 RUBBER TYPE (R)

	TPO44			TPO27			50% TPO44 50% TPO27			S1374			U.S. Rubber Firm			50% S1374 50% U.S. Rubber Firm		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
15																		
20																		
25																		
30																		
35																		
40																		
45																		
50																		
55																		
60																		
65																		
70																		
75																		
80																		
85																		
90																		
95																		
100																		

Table X-1 First Cycle Creep Coefficient S_m

a. Calculated Data

50% TPO44 & 50% TPO27				
	15%	20%	25%	30%
AR 4000	.057	.054	.057	.119
	.029	—	.094	.119
AR 1000	.113	.107	.160	.154
	.278	.096	.174	.166

b. Summary

50% TPO44 & 50% TPO27					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	.043	—	.076	.119
	s	.025	—	.033	0.00
	cv	57.7	.054	43.4	0.00
AR 1000	$\bar{x}$	.196	—	.167	.160
	s	.146	—	.012	.011
	cv	74.8	9.6	7.4	6.7

— ASPHALT TYPE (A)
 — PERCENT RUBBER (B)
 — RUBBER TYPE (C)

	TPO44			TPO27			50% TPO44 50% TPO27			G1274			U.S. Rubber Firm			50% G1274 50% S.F. 6		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
ASPHALT	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RUBBER	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table X-1 First Cycle Creep Coefficient S_m

a. Calculated Data

GT274				
	15%	20%	25%	30%
A R 4 0 0 0	.083	.144	.178	.232
	.058	.105	.114	.212
A R 1 0 0 0	.345	.161	.241	.245
	.360	.232	.257	.222

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.071</u>	<u>.125</u>	<u>.146</u>	<u>.222</u>
	s	<u>.022</u>	<u>.035</u>	<u>.057</u>	<u>.018</u>
	cv	31.4	27.8	38.8	8.0
A R 1 0 0 0	$\bar{x}$	<u>.353</u>	<u>.197</u>	<u>.249</u>	<u>.234</u>
	s	<u>.013</u>	<u>.063</u>	<u>.014</u>	<u>.020</u>
	cv	3.8	32.0	5.7	8.7

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP600			TP607			50% TP604 50% TP607			G1276			U.S. Rubber Firm 50% B Type S			50% GT274 50% B Type S		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		
27																		
28																		
29																		
30																		
31																		
32																		
33																		
34																		
35																		
36																		
37																		
38																		
39																		
40																		
41																		
42																		
43																		
44																		
45																		
46																		
47																		
48																		
49																		
50																		

Table X-1 First Cycle Creep Coefficient S_m

a. Calculated Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.088	.118	.198	.374
	1.067	.172	.260	.159
A R 1 0 0 0	.234	.291	.289	.331
	.255	.137	.149	.388

b. Summary

U. S. Rubber Fine					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.578	.145	.229	.267
	s	.867	.048	.055	.190
	cv	150.2	33.0	24.0	71.5
A R 1 0 0 0	$\bar{x}$	.245	.214	.219	.210
	s	.019	.136	.124	.215
	cv	7.6	63.8	56.6	102.8

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TPQ44				TPQ27				60% TPQ44 60% TPQ27				B174				U.S. Rubber Fine				60% B174 60% Rubber F			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Creep Coefficient																								
First Cycle Creep Coefficient																								
Second Cycle Creep Coefficient																								
Third Cycle Creep Coefficient																								
Fourth Cycle Creep Coefficient																								
Fifth Cycle Creep Coefficient																								
Sixth Cycle Creep Coefficient																								
Seventh Cycle Creep Coefficient																								
Eighth Cycle Creep Coefficient																								
Ninth Cycle Creep Coefficient																								
Tenth Cycle Creep Coefficient																								

Table X-1 First Cycle Creep Coefficient S_m

a. Calculated Data

50% GT274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
AR 4000	.082	.102	.197	.336
	.070	.162	.213	.262
AR 1000	.135	.236	.328	.286
	.170	.222	.364	.283

b. Summary

50% GT274 & 50% U. S. Rubber Fine					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	.076	.132	.205	.299
	s	.011	.053	.014	.066
	CV	14.0	40.3	6.9	21.9
AR 1000	$\bar{x}$	.153	.229	.346	.285
	s	.031	.012	.032	.003
	CV	20.3	5.4	9.2	0.9

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)												
		TPQ46				TPQ67				50% TPQ46 50% TPQ67				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber Fine																
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	
Depth, in.	0.125																																					
	0.25																																					
Depth, in.	0.375																																					
	0.5																																					
Depth, in.	0.625																																					
	0.75																																					
Depth, in.	0.875																																					
	1.0																																					
Depth, in.	1.125																																					
	1.25																																					
Depth, in.	1.375																																					
	1.5																																					
Depth, in.	1.625																																					
	1.75																																					
Depth, in.	1.875																																					
	2.0																																					
Depth, in.	2.125																																					
	2.25																																					
Depth, in.	2.375																																					
	2.5																																					
Depth, in.	2.625																																					
	2.75																																					
Depth, in.	2.875																																					
	3.0																																					

APPENDIX Y

FIRST CYCLE CREEP RHEOLOGICAL COEFFICIENT b
AT 32.0F(0C) BY SLIDING PLATE MICROVISCOMETER

Table Y-1 First Cycle Creep Coefficient b

a. Calculated and Analyzed Data

TPO44				
	15%	20%	25%	30%
A R 4 0 0 0	.272	.236	.104	.210
	.344	.270	.125	.237
A R 1 0 0 0	.161	.130	.174	.281
	.127	.173	.156	.272

b. Summary

TPO44					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.308	.253	.115	.224
	s	.064	.030	.019	.024
	cv	20.7	11.9	16.3	10.7
A R 1 0 0 0	$\bar{x}$	.144	.152	.165	.277
	s	.030	.038	.016	.008
	cv	20.9	25.2	9.7	2.9

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TPO44				TPO27				50% TPO44 50% TPO27				GT270				U.S. Rubber Firm				50% GT270 50% U.S. Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
REMARKS																																					

Table Y-1 First Cycle Creep Coefficient b

a. Calculated and Analyzed Data

TPO27				
	15%	20%	25%	30%
A R 4 0 0 0	.208	.275	.271	.252
	.213	.098	—	.346
A R 1 0 0 0	.133	.245	.271	.221
	.114	.173	.181	.170

b. Summary

TPO27					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.211	.187	—	.299
	s	.004	.157	—	.083
	cv	2.1	84.1	.271	27.9
A R 1 0 0 0	$\bar{x}$	.124	.209	—	.196
	s	.017	.064	—	.045
	cv	13.6	30.5	35.3	23.1

ASPHALT TYPE (A)
 PERCENT RUBBER (B)
 RUBBER TYPE (R)

	TPO46			TPO27			90% TPO46 90% TPO27			ST276			U.S. Rubber Fine			90% ST276 90% U.S. Rubber		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
Creep Coefficient	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table Y-1 First Cycle Creep Coefficient b

a. Calculated and Analyzed Data

50% TPO44 & 50% TPO27				
	15%	20%	25%	30%
A R 4 0 0 0	.201	.140	.247	.206
	.188	—	.379	.190
A R 1 0 0 0	.281	.223	.635	.428
	.091	.223	.339	.323

b. Summary

50% TPO44 & 50% TPO27					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.195	—	.313	.198
	s	.012	—	.117	.014
	CV	5.9	.140	37.4	7.2
A R 1 0 0 0	$\bar{x}$	.186	—	.487	.376
	s	.168	—	.262	.093
	CV	90.5	0	53.9	24.8

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TPO44				TPO27				50% TPO44 & 50% TPO27				Q1574				U.S. Rubber Firm				50% Q1574 & 50% U.S. Firm															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
RUBBER TYPE	STYRENE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	BUTADIENE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

Table Y-1 First Cycle Creep Coefficient b

a. Calculated and Analyzed Data

GT274				
	15%	20%	25%	30%
A R 4 0 0 0	.113	.072	.096	.188
	.153	.191	.223	.186
A R 1 0 0 0	.047	.211	.119	.183
	.094	.186	.130	.310

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.133</u>	<u>.132</u>	<u>.160</u>	<u>.187</u>
	s	<u>.035</u>	<u>.105</u>	<u>.113</u>	<u>.002</u>
	cv	26.7	80.2	70.6	1.0
A R 1 0 0 0	$\bar{x}$	<u>.071</u>	<u>.199</u>	<u>.125</u>	<u>.247</u>
	s	<u>.042</u>	<u>.022</u>	<u>.010</u>	<u>.113</u>
	cv	59.1	11.2	7.8	45.7

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)			
		TP004				TP017				50% TP004 50% TP017			
		15	20	25	30	15	20	25	30	15	20	25	30
A	4000	-	-	-	-	-	-	-	-	-	-	-	-
	1000	-	-	-	-	-	-	-	-	-	-	-	-
A	4000	-	-	-	-	-	-	-	-	-	-	-	-
	1000	-	-	-	-	-	-	-	-	-	-	-	-

a. Calculated and Analyzed Data

b. Summary

ASPHALT TYPE (A)																															
PERCENT RUBBER (B)																															
RUBBER TYPE (C)																															
SOURCE	TPQ44				TPQ27				80% TPQ44 20% TPQ27				ST974				U.S. Rubber Firm				Adm ST974 Mfg. n Firm										
	15	30	35	40	15	30	35	40	15	30	35	40	15	30	35	40	15	30	35	40	15	30	35	40							

Table Y-1 First Cycle Creep Coefficient b

a. Calculated and Analyzed Data

50% GT274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
AR 4000	.134	.167	.183	.162
	.169	.150	.171	.317
AR 1000	.350	.128	.129	.223
	.124	.113	.114	.183

b. Summary

		50% GT274 & 50% U. S. Rubber Fine			
		15%	20%	25%	30%
AR 4000	$\bar{x}$	.152	.159	.177	.240
	s	.031	.015	.011	.137
	cv	20.5	9.5	6.0	57.3
AR 1000	$\bar{x}$	.237	.121	.122	.203
	s	.200	.013	.013	.035
	cv	84.5	11.0	10.9	17.5

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)											
		TP044				TP047				50% TP044 50% TP047				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber Fine															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30												
Sample No.	1																																				
	2																																				
Sample No.	3																																				
	4																																				
Sample No.	5																																				
	6																																				
Sample No.	7																																				
	8																																				
Sample No.	9																																				
	10																																				
Sample No.	11																																				
	12																																				
Sample No.	13																																				
	14																																				
Sample No.	15																																				
	16																																				
Sample No.	17																																				
	18																																				
Sample No.	19																																				
	20																																				
Sample No.	21																																				
	22																																				
Sample No.	23																																				
	24																																				
Sample No.	25																																				
	26																																				
Sample No.	27																																				
	28																																				
Sample No.	29																																				
	30																																				

Table Y-2 Anova Summary, First Cycle Creep
Coefficient b

ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	.11735	.02347	5.398	2.43	3.48
Q	3	.09015	.03005	6.911	2.82	4.28
A	1	.00253	.00253	.582	4.07	7.27
RQ	15	.15624	.01042	2.396	1.91	2.49
RA	5	.07258	.01451	3.339	2.43	3.48
QA	3	.01115	.00372	.855	2.82	4.28
RQA	15	.10079	.00672	1.545	1.91	2.49
Error	48	.20869	.00435			
TOTAL	95	.75947				

APPENDIX Z

FIRST CYCLE CREEP RHEOLOGICAL COEFFICIENT n
AT 32.0F (0C) BY SLIDING PLATE MICROVISCOMETER

Table Z-1 First Cycle Creep Coefficient n

a. Calculated and Analyzed Data

TPO44				
	15%	20%	25%	30%
A R 4 0 0 0	.748	.622	.590	.675
	.568	.698	.695	.684
A R 1 0 0 0	.743	.934	.726	.659
	.963	.957	.752	.692

b. Summary

TPO44					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.658	.795	.643	.680
	s	.159	.307	.093	.008
	cv	24.2	38.6	14.5	1.2
A R 1 0 0 0	$\bar{x}$	.853	.946	.739	.676
	s	.195	.020	.023	.029
	cv	22.9	2.2	3.1	4.3

— ASPHALT TYPE (A)
 — PERCENT RUBBER (B)
 — RUBBER TYPE (C)

	TPO44			TPO27			50% TPO44 50% TPO27			67876			U.S. Rubber Firm			50% 67876 50% 67876		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
15																		
20																		
30																		
40																		
50																		
60																		
70																		
80																		
90																		
100																		

Table Z-1 First Cycle Creep Coefficient n

a. Calculated and Analyzed Data

TPO27				
	15%	20%	25%	30%
AR 4000	.731	.735	.682	.624
	.652	.765	-	.692
AR 1000	.856	.631	.657	.588
	.833	.823	.738	.676

b. Summary

		TPO27			
		15%	20%	25%	30%
AR4000	$\bar{x}$	.692	.750	-	.658
	s	.070	.027	-	.060
	cv	10.1	3.5	.682	9.2
AR1000	$\bar{x}$	.845	.727	-	.632
	s	.020	.170	-	.078
	cv	2.4	23.4	10.3	12.3

[illegible]

Table Z-1 First Cycle Creep Coefficient n

a. Calculated and Analyzed Data

50% TPO44 & 50% TPO27				
	15%	20%	25%	30%
A R 4 0 0 0	.604	.854	.723	.787
	.918	—	.782	.713
A R 1 0 0 0	.563	.698	.390	.584
	.530	.793	.766	.591

b. Summary

50% TPO44 & 50% TPO27					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.761	.854	.753	.750
	s	.278	—	.052	.066
	cv	36.6	—	7.0	8.7
A R 1 0 0 0	$\bar{x}$	.547	.746	.578	.588
	s	.092	.084	.333	.006
	cv	5.3	11.3	57.6	1.1

		ASPHALT TYPE (A)												PERCENT RUBBER (R)												RUBBER TYPE (R)											
		TPO44				TPO27				50% TPO44 50% TPO27				B1316				U.S. Rubber Fine				50% B1316 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
Creep	in/in	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	in/in	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	in/in	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	in/in	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

Table Z-1 First Cycle Creep Coefficient n

a. Calculated and Analyzed Data

	GT274			
	15%	20%	25%	30%
A R 4 0 0 0	.903	1.154	.734	.724
	.771	.718	.759	.713
A R 1 0 0 0	.703	.778	.808	.637
	.594	.694	.710	.642

b. Summary

		GT274			
		15%	20%	25%	30%
AR 40000	$\bar{x}$	<u>.837</u>	<u>.936</u>	<u>.747</u>	<u>.719</u>
	s	<u>.117</u>	<u>.386</u>	<u>.022</u>	<u>.010</u>
	cv	14.0	41.3	3.0	1.4
AR 10000	$\bar{x}$	<u>.649</u>	<u>.736</u>	<u>.759</u>	<u>.640</u>
	s	<u>.097</u>	<u>.074</u>	<u>.087</u>	<u>.004</u>
	cv	14.9	10.1	11.4	0.7

[illegible]

a. Calculated and Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
AR 4 0 0 0	.812	.722	.787	.632
	.551	.857	.645	.731
AR 1 0 0 0	.792	.746	.570	.688
	.604	.744	.717	.636

b. Summary

		U. S. Rubber Fine			
		15%	20%	25%	30%
AR 40000	$\bar{x}$	.682	.790	.716	.682
	s	.231	.120	.126	.088
	cv	33.9	15.2	17.6	12.9
AR 10000	$\bar{x}$	.698	.745	.644	.662
	s	.167	.002	.130	.046
	cv	23.9	0.2	20.2	7.0

[illegible]

Table Z-1 First Cycle Creep Coefficient n

a. Calculated and Analyzed Data

50% GT274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.790	.773	.668	.647
	.748	.738	.739	.787
A R 1 0 0 0	.656	.766	.694	.662
	.770	.776	.738	.695

b. Summary

50% GT274 & 50% U. S. Rubber Fine					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.769</u>	<u>.756</u>	<u>.704</u>	<u>.717</u>
	s	<u>.037</u>	<u>.031</u>	<u>.063</u>	<u>.124</u>
	cv	4.8	4.1	8.9	17.3
A R 1 0 0 0	$\bar{x}$	<u>.713</u>	<u>.771</u>	<u>.716</u>	<u>.679</u>
	s	<u>.101</u>	<u>.009</u>	<u>.039</u>	<u>.029</u>
	cv	14.2	1.2	5.5	4.3

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TYPE A				TYPE B				50% TYPE A & 50% TYPE B				GT274				U.S. Rubber Fine				50% GT274 & 50% U.S. Rubber Fine			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
1000																								
2000																								
3000																								
4000																								
5000																								
6000																								
7000																								
8000																								
9000																								
10000																								

Table Z-2 Anova Summary, First Cycle
Creep Coefficient n

<u>ANOVA</u>						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	.03536	.00707	.772	2.43	3.48
Q	3	.16470	.05490	5.995	2.82	4.28
A	1	.01545	.01545	1.688	4.07	7.27
RQ	15	.05218	.00348	.380	1.91	2.49
RA	5	.23556	.04711	5.145	2.43	3.48
QA	3	.00708	.00236	.258	2.82	4.28
RQA	15	.10510	.00701	.765	1.91	2.49
Error	48	.43954				
TOTAL	95	1.05498				

APPENDIX AA

FIRST CYCLE RECOVERY RHEOLOGICAL COEFFICIENT S_m
AT 32.0F (0C) BY SLIDING PLATE MICROVISCOMETER

Table AA-1 First Cycle Recovery Coefficient S_m

a. Calculated Data

TPO44				
	15%	20%	25%	30%
AR 4000	.052	.040	.039	.063
	.292	.034	.043	.052
AR 1000	.104	.079	.083	.105
	.061	.075	.078	.086

b. Summary

TPO44					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	.172	.037	.041	.058
	s	.213	.005	.004	.010
	CV	123.6	14.4	8.6	17.0
AR 1000	$\bar{x}$	.083	.077	.081	.096
	s	.038	.004	.004	.017
	CV	46.2	4.6	5.5	17.6

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

ASPHALT TYPE (A)	TPO44			TPO21			SOL TPO44 & SOL TPO21			STPA			U.S. Rubber Firm			SOL STPA		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
AR 4000																		
AR 1000																		

Table AA-1 First Cycle Recovery Coefficient S_m

a. Calculated Data

TPO27				
	15%	20%	25%	30%
AR 4000	.037	.048	.055	.068
	.039	.091	—	.092
AR 1000	.079	.098	.103	.136
	.083	.087	.104	.096

b. Summary

TPO27					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	.038	.070	—	.080
	s	.002	.038	—	.021
	cv	4.6	54.8	—	26.6
AR 1000	$\bar{x}$	.081	.093	.104	.116
	s	.004	.010	.001	.035
	cv	4.4	10.5	.856	3.6

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TPO44			TPO27			SBS TPO44 NON TPO27 A			S1374			U.S. Rubber Type			SBS S1374 NON S1374 A		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
1000-10																		
1000-20																		
1000-30																		
1000-40																		
1000-50																		
1000-60																		
1000-70																		
1000-80																		
1000-90																		
1000-100																		

Table AA-1 First Cycle Recovery Coefficient S_m

a. Calculated Data

	50% TPO44 & 50% TPO27			
	15%	20%	25%	30%
A R 4 0 0 0	.037	.042	.045	.065
	.020	—	—	.082
A R 1 0 0 0	.094	.065	.108	.112
	.097	.077	.121	.128

b. Summary

		50% TPO44 & 50% TPO27			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.029	—	—	.074
	s	.015	—	—	.015
	CV	52.9	—	—	20.5
A R 1 0 0 0	$\bar{x}$	.096	.071	.115	.120
	s	.003	.011	.012	.014
	CV	2,8	15.0	10.1	11.8

[illegible]

Table AA-1 First Cycle Recovery Coefficient S_m

a. Calculated Data

GT274				
	15%	20%	25%	30%
AR 4000	.026	.051	.071	.139
	.020	.086	.102	.145
AR 1000	.097	.091	.146	.176
	.095	.187	.141	.167

b. Summary

GT274					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	.023	.069	.087	.142
	s	.005	.031	.027	.005
	CV	23.1	45.3	31.8	3.7
AR 1000	$\bar{x}$	.096	.139	.144	.172
	s	.002	.085	.004	.008
	CV	1.9	61.2	3.1	4.7

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TP464			TP337			80% TP464 & 20% TP337			G1274			U.S. Rubber Firm			80% G1274 & 20% U.S. Firm		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
80% TP464																		
80% TP337																		

Table AA-1 First Cycle Recovery Coefficient S_m

a. Calculated Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.024	.053	.109	.171
	.037	.055	.106	.133
A R 1 0 0 0	.213	.137	.184	.211
	.129	.201	.107	.264

b. Summary

		U. S. Rubber Fine			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.031</u>	<u>.054</u>	<u>.108</u>	<u>.152</u>
	s	<u>.012</u>	<u>.002</u>	<u>.003</u>	<u>.034</u>
	cv	37.8	3.3	2.5	22.2
A R 1 0 0 0	$\bar{x}$	<u>.171</u>	<u>.169</u>	<u>.146</u>	<u>.238</u>
	s	<u>.074</u>	<u>.057</u>	<u>.068</u>	<u>.047</u>
	cv	43.5	33.6	46.9	19.8

[illegible]

Table AA-1 First Cycle Recovery Coefficient S_m

a. Calculated Data

50% GT274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
AR 4000	.034	.073	.120	.186
	.049	.146	.109	.198
AR 1000	.348	.120	.193	.190
	.091	.120	.192	.190

b. Summary

50% GT274 & 50% U. S. Rubber Fine					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	.042	.110	.115	.192
	s	.013	.065	.010	.011
	cv	32.0	59.1	8.5	5.5
AR 1000	$\bar{x}$	.220	.120	.193	.190
	s	.228	0	.001	0
	cv	103.7	0	.460	0

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (R)																	
		TPQ46				TPQ87				50% TPQ46 50% TPQ87				BT274				U.S. Rubber Fine				50% GT274 50% U. S. Rubber Fine																					
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30		
RECOVERY	100%																																										
	80%																																										

APPENDIX BB

FIRST CYCLE RECOVERY COEFFICIENT b AT 32.0F (0C)

BY SLIDING PLATE MICROVISCOMETER

Table BB-1 First Cycle Recovery Coefficient b

a. Calculated and Analyzed Data

TPO44				
	15%	20%	25%	30%
A R 4 0 0 0	.094	.129	.158	.220
	.183	.105	.169	.166
A R 1 0 0 0	.222	.230	.172	.135
	.171	.218	.188	.092

b. Summary

TPO44					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.139	.117	.164	.193
	s	.079	.021	.010	.048
	cv	56.9	18.2	6.0	24.8
A R 1 0 0 0	$\bar{x}$	.197	.224	.180	.114
	s	.045	.011	.014	.038
	cv	23.9	4.8	7.9	33.6

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TPO44			TPO27			50% TPO44 50% TPO27			G1876			U.S. Rubber Type			50% G1876 50% U.S. Type		
	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30	15	20	30
1000-1200																		
1200-1400																		
1400-1600																		
1600-1800																		
1800-2000																		
2000-2200																		
2200-2400																		
2400-2600																		
2600-2800																		
2800-3000																		
3000-3200																		
3200-3400																		
3400-3600																		
3600-3800																		
3800-4000																		
4000-4200																		
4200-4400																		
4400-4600																		
4600-4800																		
4800-5000																		

Table BB-1 First Cycle Recovery Coefficient b

a. Calculated and Analyzed Data

TPO27				
	15%	20%	25%	30%
AR 40000	.095	.106	.117	.151
	.114	.114	—	.235
AR 10000	.149	.183	.094	.147
	.133	.170	.199	.238

b. Summary

TPO27					
		15%	20%	25%	30%
AR 40000	$\bar{x}$	.105	.110	—	.193
	s	.017	.007	—	.074
	cv	16.1	6.4	—	38.7
AR 10000	$\bar{x}$	.141	.177	.147	.193
	s	.014	.012	.093	.081
	cv	10.1	6.5	63.5	41.9

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (R)			
		TPO44				TPO27				S04 TPO44 S04 TPO27			
		15	20	25	30	15	20	25	30	15	20	25	30
GROUP	GROUP 1A	—	—	—	—	—	—	—	—	—	—	—	—
	GROUP 1B	—	—	—	—	—	—	—	—	—	—	—	—

Table BB-1 First Cycle Recovery Coefficient b

a. Calculated and Analyzed Data

50% TPO44 & 50% TPO27				
	15%	20%	25%	30%
A R 4 0 0 0	.122	.188	.183	.154
	.116	—	—	.175
A R 1 0 0 0	.247	.247	.202	.185
	.153	.154	.183	.232

b. Summary

50% TPO44 & 50% TPO27					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.119	—	—	.165
	S	.005	—	—	.019
	CV	4.5	—	—	11.3
A R 1 0 0 0	$\bar{x}$	.200	.201	.193	.209
	S	.083	.082	.017	.042
	CV	41.6	41.1	8.8	20.0

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (R)

	TPO44				TPO27				50% TPO44 50% TPO27				G1774				U.S. Rubber Plant				50% G1774 50% U.S. Plant			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
100-100																								
100-50																								
100-25																								
100-10																								
100-5																								
100-0																								

Table BB-1 First Cycle Recovery Coefficient b

a. Calculated and Analyzed Data

GT274				
	15%	20%	25%	30%
A R 4 0 0 0	.055	.150	.100	.156
	.102	.128	.092	.134
A R 1 0 0 0	.112	.125	.154	.165
	.111	.071	.165	.170

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.079</u>	<u>.139</u>	<u>.096</u>	<u>.145</u>
	s	<u>.042</u>	<u>.019</u>	<u>.007</u>	<u>.019</u>
	cv	53.1	14.0	7.4	13.4
A R 1 0 0 0	$\bar{x}$	<u>.112</u>	<u>.098</u>	<u>.160</u>	<u>.168</u>
	s	<u>.001</u>	<u>.048</u>	<u>.010</u>	<u>.004</u>
	cv	0.8	48.8	6.1	2.7

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
		TP004				TP007				50% TP004 50% TP007				GT274				U.S. Rubber Fm.				50% GT274 50% R Fm.															
		15	20	25	30	15	30	35	40	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30				
SAMPLE NO.	1																																				
	2																																				

Table BB-1 First Cycle Recovery Coefficient b

a. Calculated and Analyzed Data

U. S. Rubber Fine				
	15%	20%	25%	30%
AR 4000	.055	.113	.140	.156
	.127	.129	.138	.150
AR 1000	.039	.150	.151	.183
	.091	.074	.186	.192

b. Summary

U. S. Rubber Fine					
		15%	20%	25%	30%
AR 4000	$\bar{x}$	.091	.121	.139	.153
	s	.064	.014	.002	.005
	cv	70.1	11.7	1.3	3.5
AR 1000	$\bar{x}$	.065	.112	.169	.188
	s	.046	.067	.031	.008
	cv	70.9	60.1	18.4	4.3

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (B)															
		TP006				TP027				60% TP006 60% TP027				BT074				U. S. Rubber Fine				60% BT074 60% U. S. Fine			
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
RUBBER TYPE (B)	TP006																								
	TP027																								
	TP006																								
	TP027																								
U. S. Rubber Fine	TP006																								
	TP027																								
	TP006																								
	TP027																								
60% BT074 60% U. S. Fine	TP006																								
	TP027																								
	TP006																								
	TP027																								

Table BB-1 First Cycle Recovery Coefficient b

a. Calculated and Analyzed Data

50% GT274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.091	.093	.150	.141
	.075	.086	.208	.133
A R 1 0 0 0	.041	.133	.165	.202
	.153	.149	.165	.185

b. Summary

50% GT274 & 50% U. S. Rubber Fine					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.083	.090	.179	.137
	s	.014	.006	.051	.007
	cv	17.1	6.9	28.7	5.2
A R 1 0 0 0	$\bar{x}$	.097	.141	.165	.194
	s	.099	.014	—	.015
	cv	102.3	10.1	—	7.8

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (R)

	TPQ44				TPQ47				50% TPQ44 & 50% TPQ47				GT274				U.S. Rubber Fine				50% GT274 & 50% U.S. Rubber Fine			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
100-100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
90-10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80-20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
70-30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60-40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50-50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
40-60	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30-70	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20-80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10-90	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0-100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table BB-2 Anova Summary, First Cycle
Recovery Coefficient b

ANOVA						
SOURCE	df	SS	MS	F	F.05	F.01
R	5	.04030	.00859	7.547	2.43	3.48
Q	3	.03556	.01185	11.101	2.82	4.28
A	1	.01480	.01480	13.859	4.07	7.27
RQ	15	.02662	.00177	1.662	1.91	2.49
RA	5	.00221	.00044	.413	2.43	3.48
QA	3	.00151	.00050	.471	2.82	4.28
RQA	15	.03462	.00231	2.161	1.91	2.49
Error	48	.05126	.00107			
TOTAL	95	.20688				

APPENDIX CC

FIRST CYCLE RECOVERY COEFFICIENT n AT 32.0F (0C)
BY SLIDING PLATE MICROVISCOMETER

Table CC-1 First Cycle Recovery Coefficient n

a. Calculated Data

TPO44				
	15%	20%	25%	30%
AR 4 0 0 0	.786	.850	.871	.577
	.734	.887	.831	.772
AR 1 0 0 0	.494	.647	.762	.964
	.809	.677	.717	1.138

b. Summary

		TPO44			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.760</u>	<u>.869</u>	<u>.851</u>	<u>.675</u>
	s	<u>.046</u>	<u>.033</u>	<u>.035</u>	<u>.173</u>
	cv	6.1	3.8	4.2	25.6
A R 1 0 0 0	$\bar{x}$	<u>.652</u>	<u>.662</u>	<u>.740</u>	<u>1.051</u>
	s	<u>.279</u>	<u>.027</u>	<u>.040</u>	<u>.154</u>
	cv	42.8	4.0	5.4	14.7

[illegible]

Table CC-1 First Cycle Recovery Coefficient n

a. Calculated Data

TPO27				
	15%	20%	25%	30%
A R 4 0 0 0	.979	.818	.851	.889
	.707	.429	—	.763
A R 1 0 0 0	.726	.704	1.055	.746
	.684	.801	.704	.752

b. Summary

TPO27					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.843	.624	—	.826
	s	.241	.345	—	.112
	CV	28.6	55.3	—	13.5
A R 1 0 0 0	$\bar{x}$	.705	.753	.880	.749
	s	.037	.086	.311	.005
	CV	5.3	11.4	35.4	.710

ASPHALT TYPE (A)
PERCENT RUBBER (B)
RUBBER TYPE (C)

	TPO44			TPO37			SOL TPO44 & SBR TPO37			SBR78			U.S. Rubber Fint			SOL SBR78 & SBR Fint		
	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25	15	20	25
100% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
90% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
70% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
40% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0% SBR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table CC-1 First Cycle Recovery Coefficient n

a. Calculated Data

50% TPO44 & 50% TPO27				
	15%	20%	25%	30%
AR 4 0 0 0 0	.837	.765	.748	.841
	.912	—	—	.658
AR 1 0 0 0 0	.622	.693	.663	.748
	.693	.803	.700	.608

b. Summary

50% TPO44 & 50% TPO27					
		15%	20%	25%	30%
AR 4 0 0 0 0	$\bar{x}$	.875	—	—	.750
	s	.066	—	—	.162
	cv	7.6	—	—	21.6
AR 1 0 0 0 0	$\bar{x}$	.658	.748	.682	.678
	s	.063	.097	.033	.124
	cv	9.6	13.0	4.8	18.3

		ASPHALT TYPE (A)				PERCENT RUBBER (B)				RUBBER TYPE (C)																				
		TPO44				TPO27				50% TPO44 / 50% TPO27				G2374				U.S. Weather Film				90% G2374 10% A.P. film								
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	
GROUP 1B	GROUP 1A																													
																						</								

Table CC-1 First Cycle Recovery Coefficient n

a. Calculated Data

GT274				
	15%	20%	25%	30%
A R 4 0 0 0	.171	.777	.903	.724
	.932	.881	.610	.756
A R 1 0 0 0	.779	.890	.726	.829
	.817	.944	.786	.737

b. Summary

GT274					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{X}$	.552	.829	.757	.740
	S	.674	.092	.260	.028
	CV	122.3	11.1	34.3	3.8
A R 1 0 0 0	$\bar{X}$	.798	.917	.756	.783
	S	.034	.048	.053	.082
	CV	4.2	5.2	7.0	10.4

ASPHALT TYPE (A)

PERCENT RUBBER (B)

RUBBER TYPE (R)

	TP644				TP637				50% TP644 50% TP637				Q1214				U.S. Rubber Fms				50% S1274 50% S Fms			
	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30
ASPHALT TYPE (A)																								
PERCENT RUBBER (B)																								
RUBBER TYPE (R)																								

ASPHALT TYPE (A)

PERCENT RUBBER (B)

RUBBER TYPE (R)

Table CC-1 First Cycle Recovery Coefficient n

a. Calculated Data

U. S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	1.173	.759	.733	.749
	.749	.749	.856	.787
A R 1 0 0 0	.988	.768	.723	.696
	.779	.681	.742	.581

b. Summary

		U. S. Rubber Fine			
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	<u>.961</u>	<u>.754</u>	<u>.795</u>	<u>.768</u>
	s	<u>.376</u>	<u>.009</u>	<u>.109</u>	<u>.034</u>
	cv	39.1	1.2	13.7	4.4
A R 1 0 0 0	$\bar{x}$	<u>.884</u>	<u>.725</u>	<u>.733</u>	<u>.639</u>
	s	<u>.185</u>	<u>.077</u>	<u>.017</u>	<u>.102</u>
	cv	21.0	10.6	2.3	16.0

[illegible]

Table CC-1 First Cycle Recovery Coefficient n

a. Calculated Data

50% GT274 & 50% U.S. Rubber Fine				
	15%	20%	25%	30%
A R 4 0 0 0	.717	.704	.706	.669
	.744	.573	.763	.767
A R 1 0 0 0	.632	.795	.743	.627
	.167	.737	.716	.678

b. Summary

50% GT274 & 50% U. S. Rubber Fine					
		15%	20%	25%	30%
A R 4 0 0 0	$\bar{x}$	.731	.639	.735	.718
	s	.024	.116	.051	.087
	cv	3.3	18.2	6.9	12.1
A R 1 0 0 0	$\bar{x}$	.400	.766	.730	.653
	s	.412	.051	.024	.045
	cv	103.1	6.7	3.3	6.9

		ASPHALT TYPE (A)												PERCENT RUBBER (B)												RUBBER TYPE (C)											
GRADE	TEMPERATURE	TPQ48				TPQ51				50% TPQ48 50% TPQ51				GT274				U.S. Rubber Fine				50% GT274 50% U.S. Rubber															
		15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30	15	20	25	30								
100	100																																				
90	90																																				
80	80																																				
70	70																																				
60	60																																				
50	50																																				
40	40																																				
30	30																																				
20	20																																				
10	10																																				
0	0																																				

APPENDIX DD

TORQUE-FORK VISCOSITY
DURING MIXING AT 375F(191C) ,
AND 500 RPM

Table DD-1 Torque-Fork Viscosity During
Mixing at 375F(191C), Poises

		TP044			
		15%	20%	25%	30%
A R 4 0 0 0	15 min	11.9	15.8	23.6	36.0
	1 hr	13.0	19.9	35.2	44.9
A R 1 0 0 0	15 min	5.3	9.9	33.1	51.3
	1 hr	6.1	13.5	39.0	62.0

		TP027			
		15%	20%	25%	30%
A R 4 0 0 0	15 min	11.4	14.6	49.7	111.3
	1 hr	12.5	13.0	57.8	121.5
A R 1 0 0 0	15 min	11.9	19.9	32.4	22.4
	1 hr	13.0	24.3	40.4	21.8

Table DD-1 Torque-Fork Viscosity During
Mixing at 375F(191C), Poises

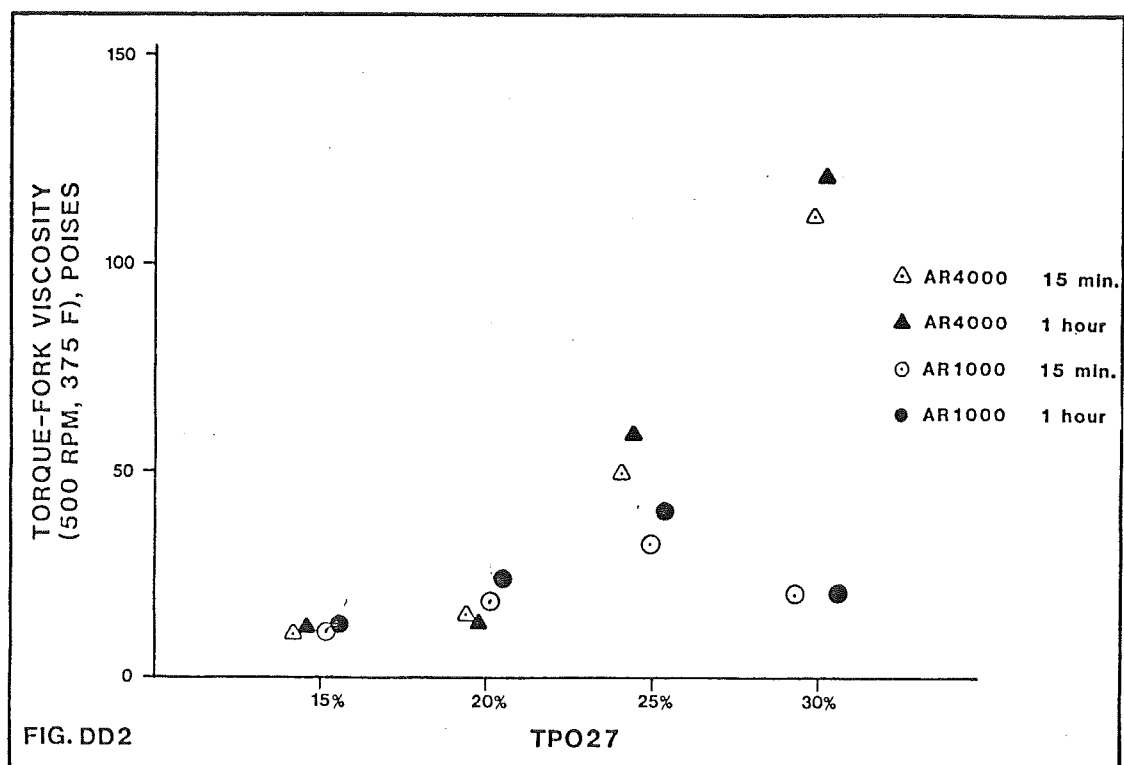
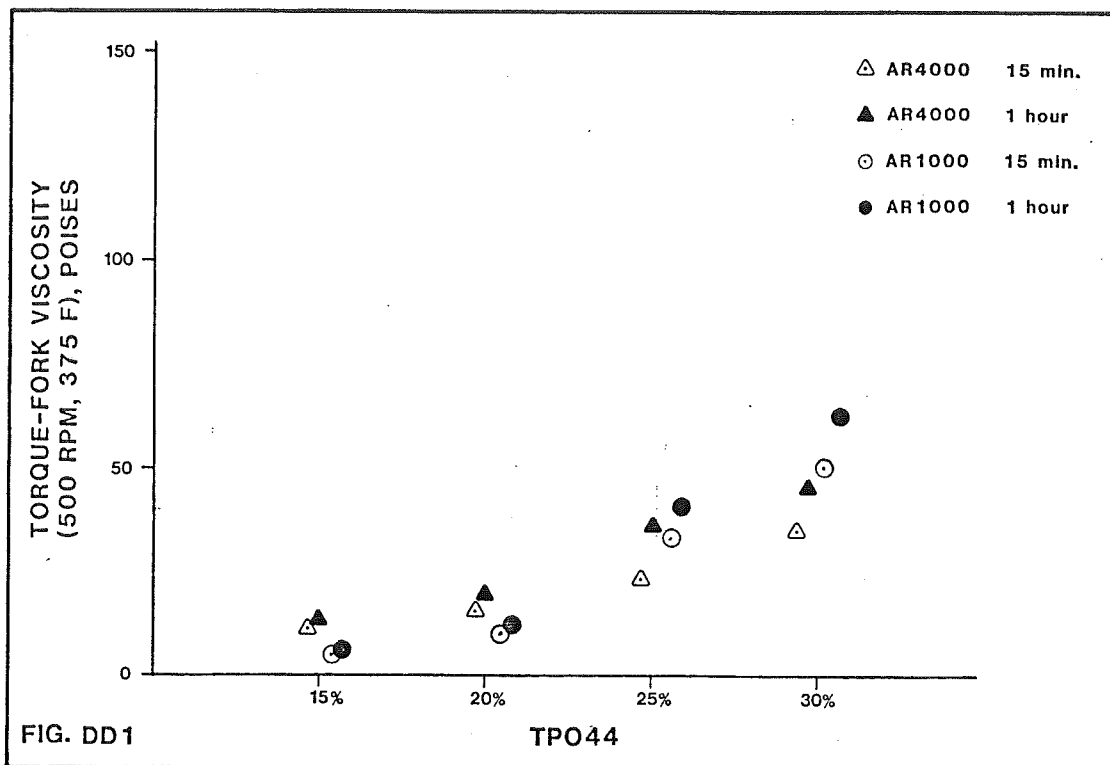
50% TP044 & 50% TP027					
		15%	20%	25%	30%
A R 4 0 0 0	15 min	12.5	18.1	30.3	64.6
	1 hr	14.1	22.0	45.7	80.5
A R 1 0 0 0	15 min	11.9	19.9	36.0	47.3
	1 hr	13.0	23.0	47.3	76.9

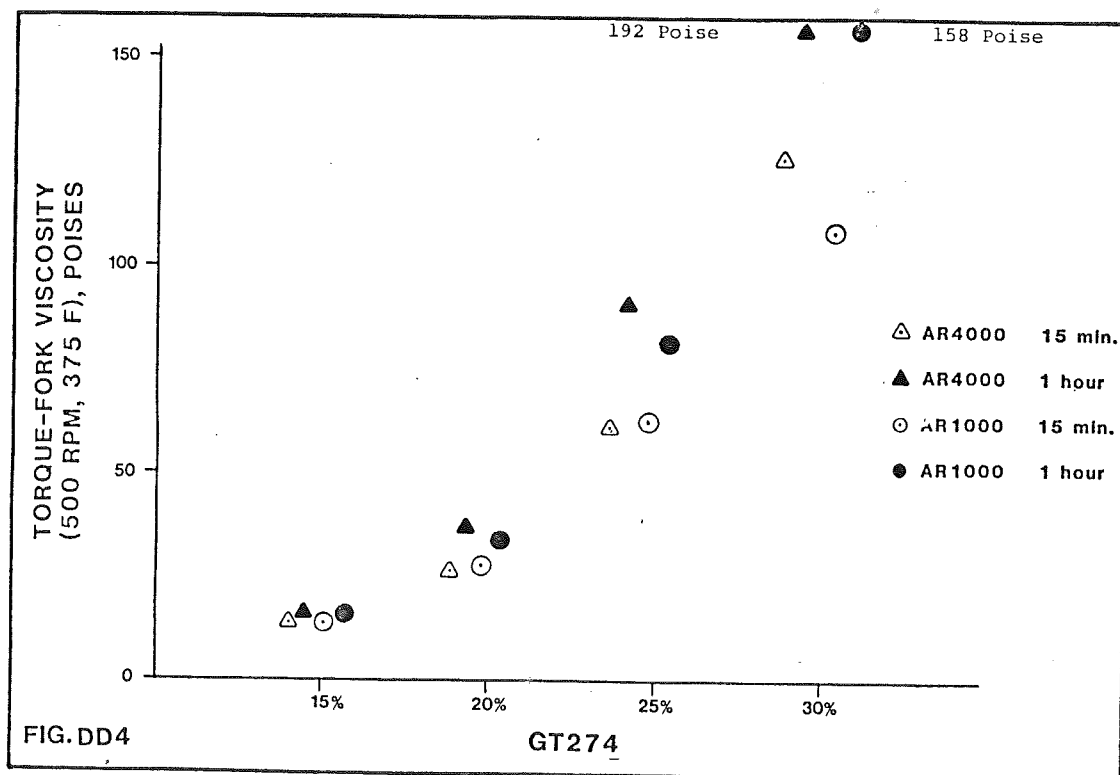
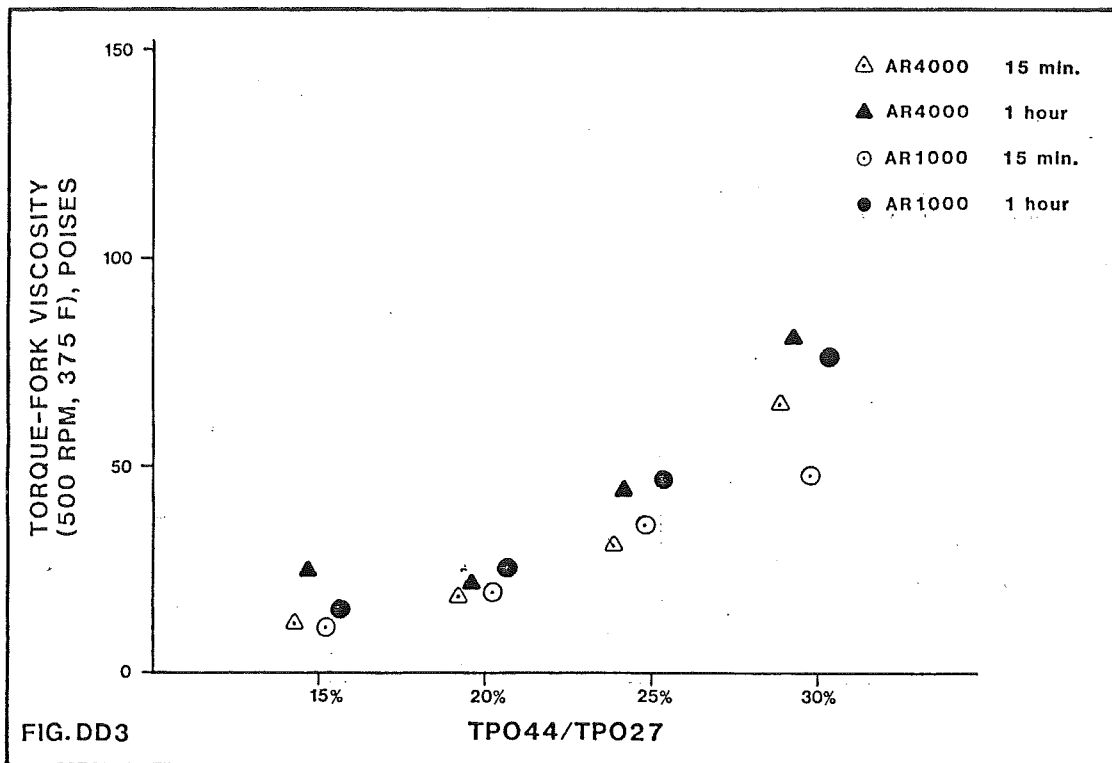
GT274					
		15%	20%	25%	30%
A R 4 0 0 0	15 min	14.1	27.6	60.3	123.6
	1 hr	16.3	37.4	91.7	192.4
A R 1 0 0 0	15 min	14.1	28.9	61.1	109.3
	1 hr	16.3	34.5	81.4	158.0

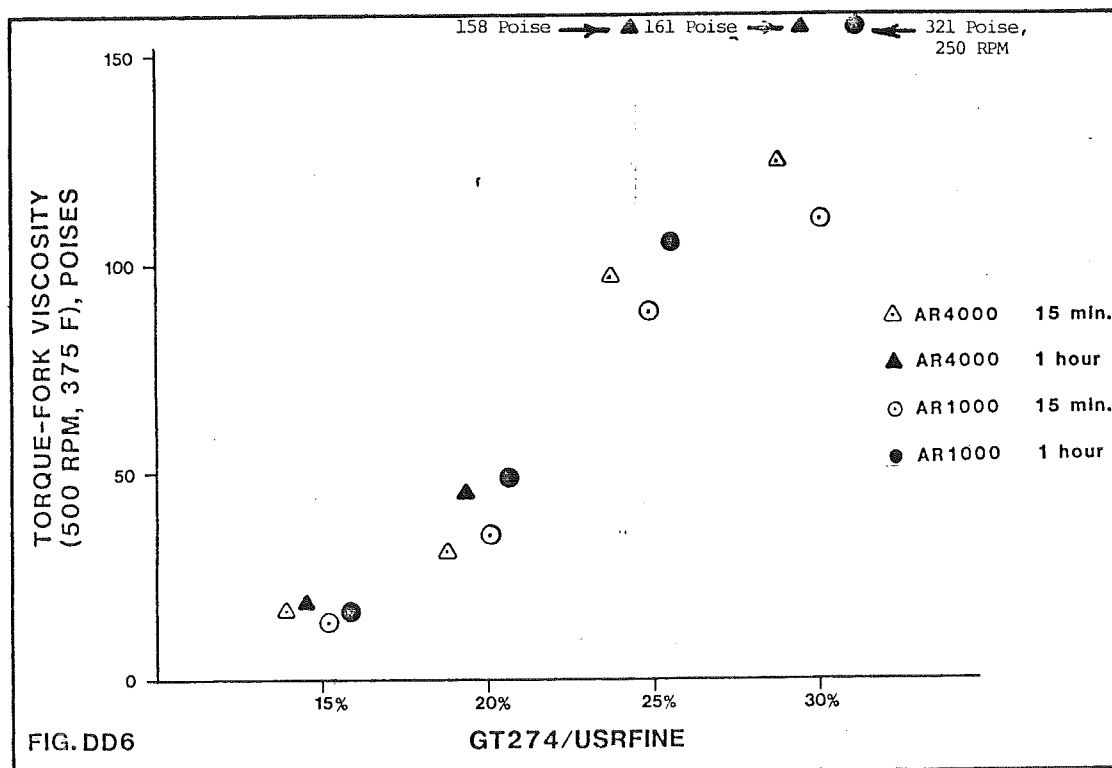
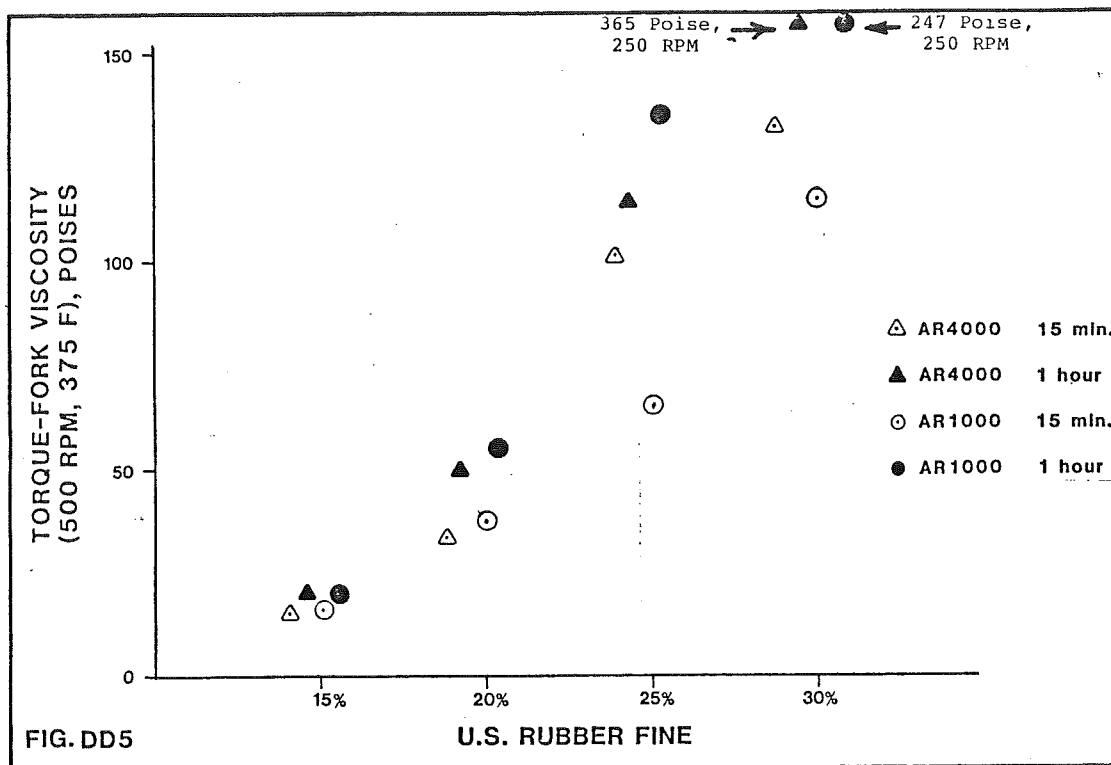
Table DD-1 Torque-Fork Viscosity During
Mixing at 375F(191C), Poises

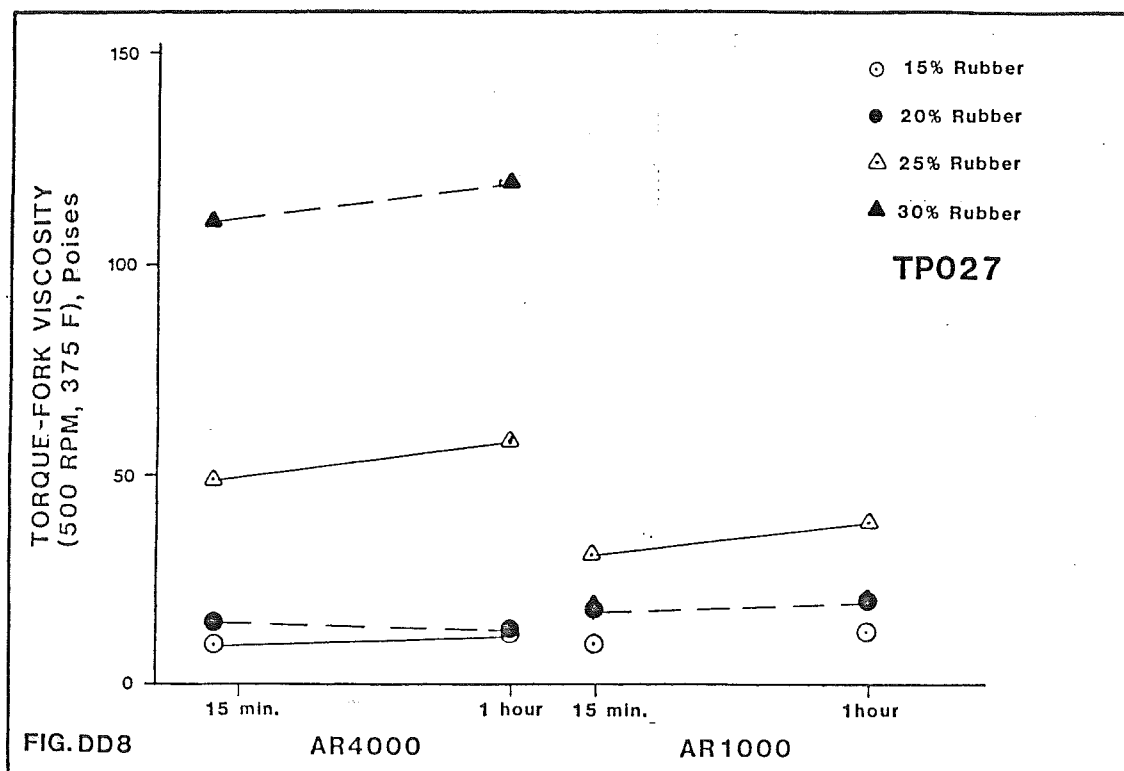
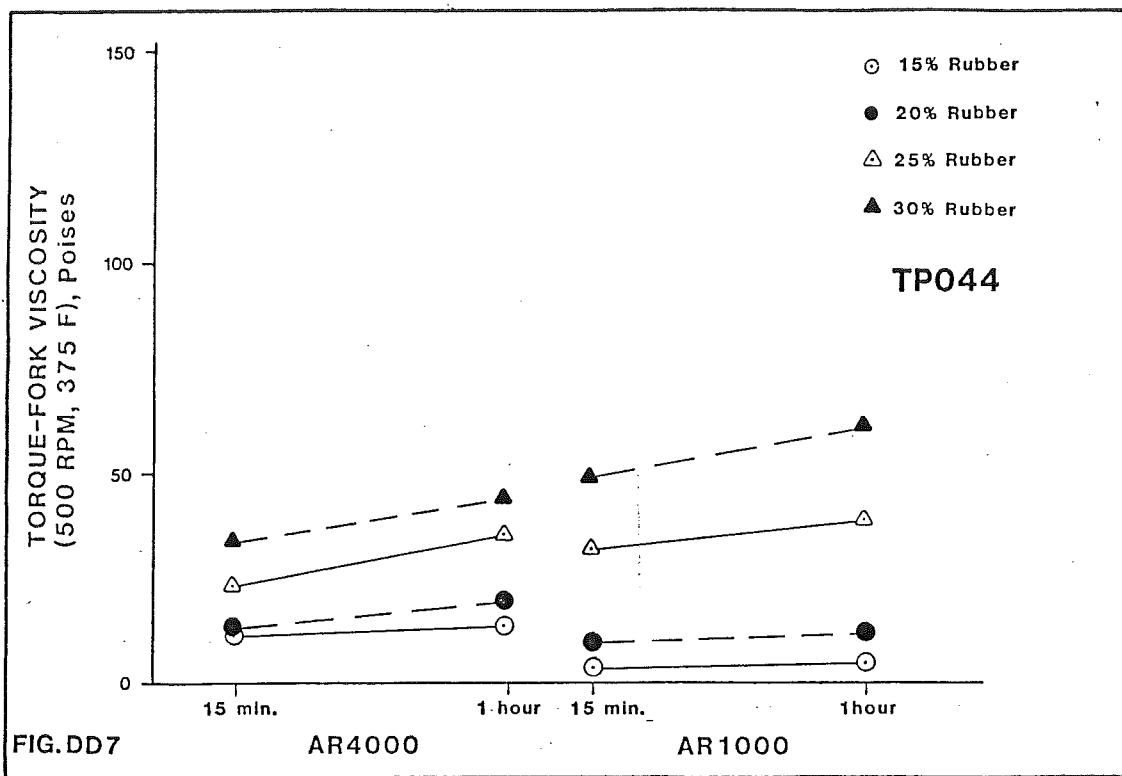
		U.S. Rubber Fine			
		15%	20%	25%	30%
A R 4 0 0 0	15 min	15.8	32.4	101.4	132.0
	1 hr	20.5	49.7	115.4	365.0*
A R 1 0 0 0	15 min	16.3	38.2	64.6	113.3
	1 hr	21.1	52.9	133.0	246.8*

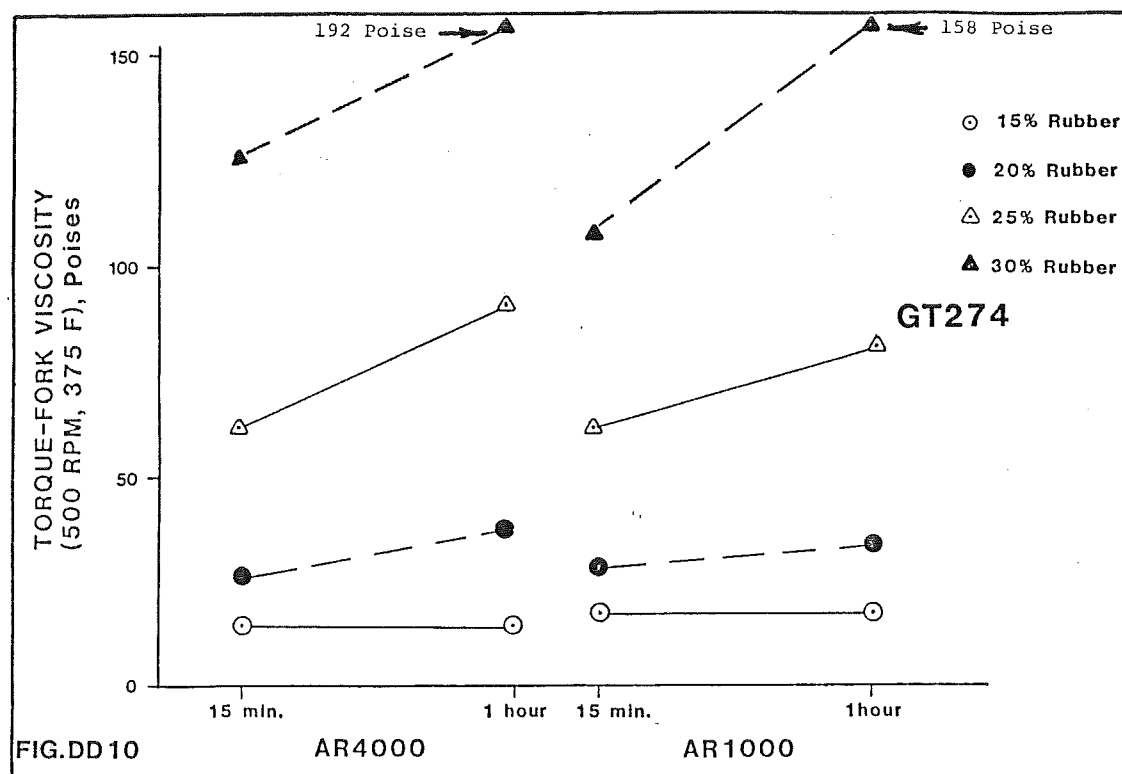
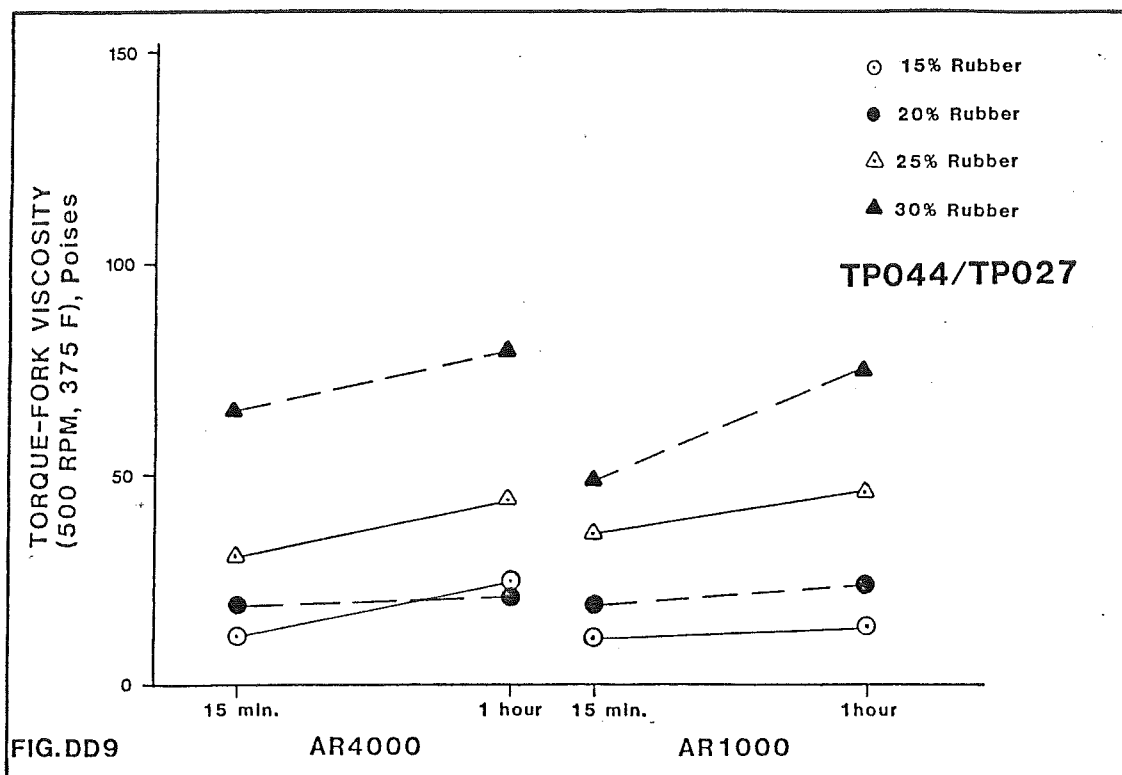
		50% GT274/50% U.S. Rubber Fine			
		15%	20%	25%	30%
A R 4 0 0 0	15 min	17.5	31.7	98.5	125.7
	1 hr	19.3	45.0	158.0	161.4
A R 1 0 0 0	15 min	15.2	36.7	89.8	110.3
	1 hr	18.7	48.1	106.3	320.6*

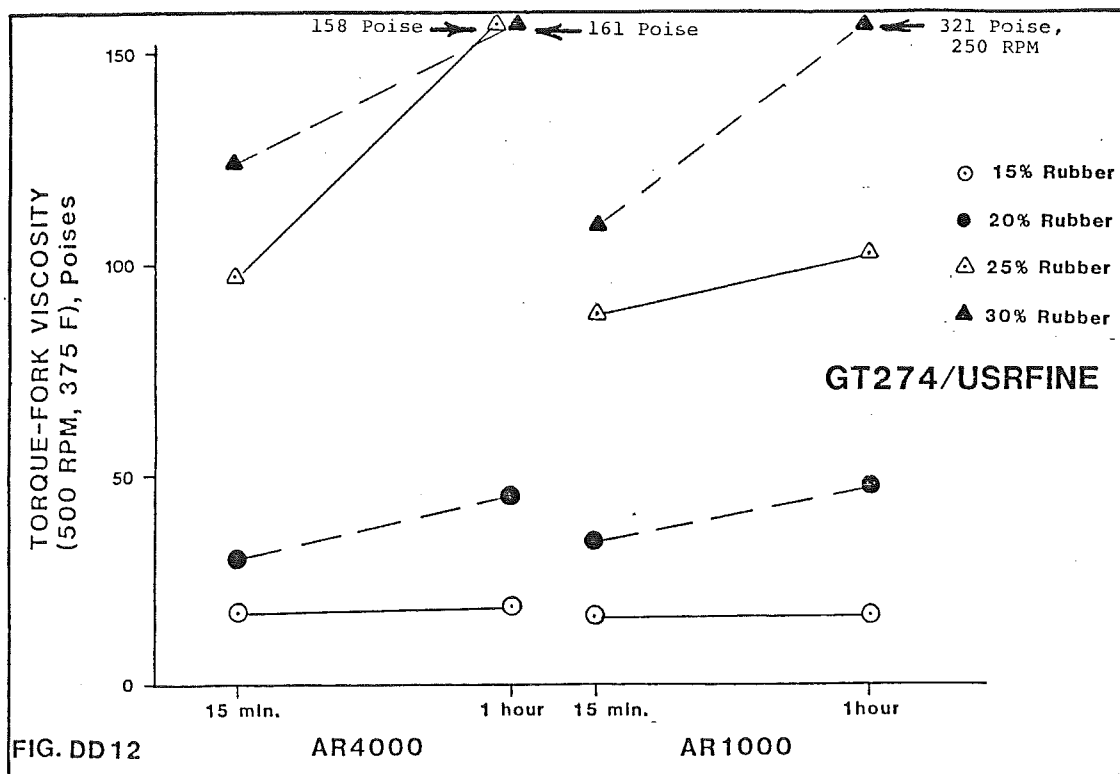
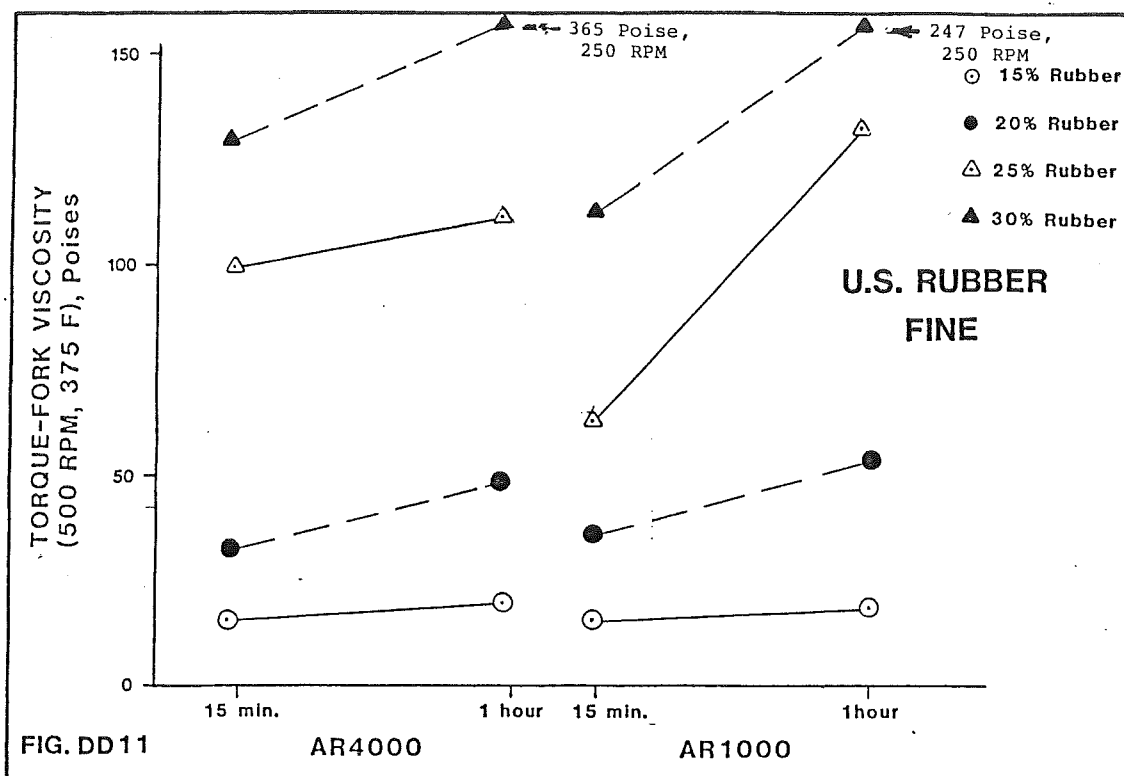












APPENDIX EE
HAAKE VISCOSITY DURING MIXING
AT 375F(191C)

Table EE-1 Haake Viscosity During Mixing
at 375F(191C), Poises

		TPO44			
		15%	20%	25%	30%
A R 4 0 0 0	15 min	4	12	28	45
	1 hr	6	18	38	75
A R 1 0 0 0	15 min	1.25	3.75	22.50	115
	1 hr	2.00	7.50	70	100

		TPO27			
		15%	20%	25%	30%
A R 4 0 0 0	15 min	9.5	42	175	150
	1 hr	12	60	150	300
A R 1 0 0 0	15 min	7	35	100	300
	1 hr	9	55	150	300

Table EE-1 Haake Viscosity During Mixing
at 375F(191C), Poises

		50% TPO44 & 50% TPO27			
		15%	20%	25%	30%
A R 4 0 0 0	15 min	6	18	50	150
	1 hr	7.50	30	100	150
A R 1 0 0 0	15 min	5	20	60	100
	1 hr	3.5	28	75	175

		GT274			
		15%	20%	25%	30%
A R 4 0 0 0	15 min	12	65	100	No Reading
	1 hr	20	125	225	350
A R 1 0 0 0	15 min	9.10	75	100	150
	1 hr	20	90	240	250

Table EE-1 Haake Viscosity During Mixing
at 375F(191C), Poises

U.S. Rubber Fine					
		15%	20%	25%	30%
A R 4 0 0 0	15 min	16	5	325	600
	1 hr	55	No Reading	275	375
A R 1 0 0 0	15 min	23	90	200	500
	1 hr	46	190	400	500

50% GT274/50% U.S. Rubber Fine					
		15%	20%	25%	30%
A R 4 0 0 0	15 min	18	140	300	450
	1 hr	35	175	275	500
A R 1 0 0 0	15 min	7	120	275	300
	1 hr	10.2	No Reading	300	450

