US EPA ARCHIVE DOCUMENT

MAY 15 1995 (21) Sta 21

ENGINEERING DATA TRANSMITTAL

1. EDT № 611724

2. To: (Receiving Organization) Solid Waste Management	3. From: (Originating Organization) TRI\Environmental Inc. 817250	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: W-025 & W-025A	6. Cog. Engr.: R. W. Whitlock A7A48	7. Purchase Order No.: N/A
8. Originator Remarks: This EDT is for release of the "A Final Report: Laboratory Testing of Geomembrane for Waste Containment EPA Method 9090, March 1995". This report is for the Low-Level Burial Grounds Mixed Waste Disposal Trenches 31 and 34.		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: 218-W-5 Burial Ground
11. Receiver Remarks: None.	RECEIVED JUN 01 1995 OSTI	12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: ASAP

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-TRP-237		0	Laboratory Testing of Geomembrane for Waste Containment EPA Method 9090	N/A	2	N/A	N/A

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 4. Review 2. Release 5. Post-Review 3. Information 6. Dist. (Receipt Acknow. Required)	1. Approved 4. Reviewed no/comment 2. Approved w/comment 5. Reviewed w/comment 3. Disapproved w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
6	1	Cog. Eng. R.W. Whitlock	RWhitlock	5/5/95		Central Files	(2)	18-04			
6	1	Cog. Mgr. D.B. Powell	DBPowell								
		QA									
		Safety									
		Env. S.E. Campbell	SE Campbell	5/9/95							
		Brett M. Barnes		5/5/95							
		OSTI (2)			L8-07						

18.	19.	20.	21. DOE APPROVAL (if required)
RWhitlock 5/5/95 Signature of EDT Originator Date	Authorized Representative for Receiving Organization Date	DBPowell Cognizant Manager Date 5/10/95	Ctrl. No. [ ] Approved [ ] Approved w/comments [ ] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

INSTRUCTIONS FOR COMPLETION OF THE ENGINEERING DATA TRANSMITTAL

(USE BLACK INK OR TYPE)

BLOCK	TITLE	
(1)*	EDT	• Pre-assigned EDT number.
(2)	To: (Receiving Organization)	• Enter the individual's name, title of the organization, or entity (e.g., Distribution) that the EDT is being transmitted to.
(3)	From: (Originating Organization)	• Enter the title of the organization originating and transmitting the EDT.
(4)	Related EDT No.	• Enter EDT numbers which relate to the data being transmitted.
(5)*	Proj./Prog./Dept./Div.	• Enter the Project/Program/Department/Division title or Project/Program acronym or Project Number, Work Order Number or Organization Code.
(6)*	Cognizant Engineer	• Enter the name of the individual identified as being responsible for coordinating disposition of the EDT.
(7)	Purchase Order No.	• Enter related Purchase Order (P.O.) Number, if available.
(8)*	Originator Remarks	• Enter special or additional comments concerning transmittal, or "Key" retrieval words may be entered.
(9)	Equipment/Component No.	• Enter equipment/component number of affected item, if appropriate.
(10)	System/Bldg./Facility	• Enter applicable system, building or facility number, if appropriate.
(11)	Receiver Remarks	• Enter special or additional comments concerning transmittal.
(12)	Major Assm. Dwg. No.	• Enter applicable drawing number of major assembly, if appropriate.
(13)	Permit/Permit Application No.	• Enter applicable permit or permit application number, if appropriate.
(14)	Required Response Date	• Enter the date a response is required from individuals identified in Block 17 (Signature/Distribution).
(15)*	Data Transmitted	
	(A)* Item Number	• Enter sequential number, beginning with 1, of the information listed on EDT.
	(B)* Document/Drawing No.	• Enter the unique identification number assigned to the document or drawing being transmitted.
	(C)* Sheet No.	• Enter the sheet number of the information being transmitted. If no sheet number, leave blank.
	(D)* Rev. No.	• Enter the revision number of the information being transmitted. If no revision number, leave blank.
	(E) Title or Description of Data Transmitted	• Enter the title of the document or drawing or a brief description of the subject if no title is identified.
	(F)* Approval Designator	• Enter the appropriate Approval Designator (Block 15). Also, indicate the appropriate approvals for each item listed, i.e., SQ, ESQ, etc.
	(G) Reason for Transmittal	• Enter the appropriate code to identify the purpose of the data transmittal (see Block 16).
	(H) Originator Disposition	• Enter the appropriate disposition code (see Block 16).
	(I) Receiver Disposition	• Enter the appropriate disposition code (see Block 16).
(16)	Key	• Number codes used in completion of Blocks 15 (G), (H), and (I), and 17 (G), (H) (Signature/Distribution).
(17)	Signature/Distribution	
	(G) Reason	• Enter the code of the reason for transmittal (Block 16).
	(H) Disposition	• Enter the code for the disposition (Block 16).
	(J) Name	• Enter the signature of the individual completing the Disposition 17 (H) and the Transmittal.
	(K)* Signature	• Obtain appropriate signature(s).
	(L)* Date	• Enter date signature is obtained.
	(M)* MSIN	• Enter MSIN. Note: If Distribution Sheet is used, show entire distribution (including that indicated on Page 1 of the EDT) on the Distribution Sheet.
(18)	Signature of EDT Originator	• Enter the signature and date of the individual originating the EDT (entered prior to transmittal to Receiving Organization). If the EDT originator is the cognizant engineer, sign both Blocks 17 and 18.
(19)	Authorized Representative for Receiving Organization	• Enter the signature and date of the individual identified by the Receiving Organization as authorized to approve disposition of the EDT and acceptance of the data transmitted, as applicable.
(20)*	Cognizant Manager	• Enter the signature and date of the cognizant manager. (This signature is authorization for release.)
(21)*	DOE Approval	• Enter DOE approval (if required) by signature or control number that tracks the approval to a signature, and indicate DOE action.

*Asterisk denote the required minimum items check by Configuration Documentation prior to release; these are the minimum release requirements.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-TRP-237, Rev. 0
Document Title:	LABORATORY TESTING OF GEOMEMBRANE FOR WASTE CONTAINMENT EPA METHOD 9090
Release Date:	5/11/95

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Chris Willingham

C. Willingham 5/11/95

TRADEMARK DISCLAIMER. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy. Available in paper copy and microfiche. Printed in the United States of America. Available to the U.S. Department of Energy and its contractors from:

U.S. Department of Energy
Office of Scientific and Technical Information (OSTI)
P.O. Box 62
Oak Ridge, TN 37831
Telephone: (615) 576-8401

Available to the public from: U.S. Department of Commerce
National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Telephone: (703) 487-4650

SUPPORTING DOCUMENT

1. Total Pages 97

2. Title	3. Number	4. Rev No.
A Final Report: Laboratory Testing of Geomembrane for Waste Containment EPA Method 9090, March 1995	WHC-SD-WM-TRP-237	0

5. Key Words	6. Author
Trench 31, Trench 34, Low-Level Burial Grounds, EPA, Method 9090, geomembrane, HDPE	Name: Roger W. Whitlock R Whitlock 5/8/95 Signature Organization/Charge Code 87250/A7A48

7. Abstract

This document determines the chemical compatibility of one geomembrane and one seamed geomembrane with four synthetically generated leachates.

8. RELEASE STAMP

OFFICIAL RELEASE BY WHC 21
DATE MAY 15 1995
Sta. 21

A-6400-073 (08/94) WEF124

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

A Final Report:

Laboratory Testing of Geomembrane for Waste Containment EPA Method 9090

March 1995

Submitted to:
Westinghouse Hanford Company
Procurement & Materials Management
Building 1163
2355 Stevens Drive
Richland, Washington 99352

Attn: Mr. John Fleming

Submitted by:

TRI/Environmental, Inc.
9063 Bee Caves Rd.
Austin, Texas 78733

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED 35

MASTER

FOREWORD

The testing reported herein is based upon accepted industry practice as well as the test method listed. TRI/Environmental Inc. (TRI) neither accepts responsibility for nor makes claim as to the final use and purpose of the materials tested.

Tests were performed under laboratory conditions and not under actual usage conditions. TRI can give no conclusions as to the serviceability, life expectancy or general durability of the products tested when used in a lining and/or leachate collection system.

1.0 INTRODUCTION

This report describes the work performed by TRI/Environmental, Inc. (TRI) to determine the chemical compatibility of one geomembrane and one seamed geomembrane with four synthetically generated leachates. The objective was to determine the resistance of the geomembrane to changes caused by exposure to the leachates. Changes in physical and mechanical properties were measured after exposure to the leachates at 23°C and 50°C for 30, 60, 90 and 120 days. Exposures were performed in accordance with the exposure regimen specified in United States Environmental Protection Agency (EPA) Method 9090A.

Methods, results and discussion are provided in the sections which follow. Test results are provided in the Tables of Results which accompany this report.

2.0 METHODS

2.1 Materials

Table 1 lists products selected for evaluation in this chemical compatibility study..

Table 1. List of geomembranes evaluated in chemical compatibility study

Geosynthetic	Source
80 mil smooth HDPE geomembrane	Westinghouse Hanford Co.
80 mil HDPE seamed geomembrane (double track welds)	Westinghouse Hanford Co.

2.2Leachate

The waste leachates were synthetically generated from neat chemicals purchased by TRI. TRI's analytical staff performed the generation of leachates by adding appropriate amounts of chemicals to result in the solutions outlined in tables 1 through 4.

Leachates were generated in 100 liter stainless steel containers by successive addition of chemicals to the specified base. Upon completion of the additions, the containers were capped and rotated on a drum roller for 2 hours. The drums were then allowed to rest undisturbed for a period of 6 hours. The resulting supernatant liquid was then transferred directly into the exposure vessels via leachate transfer pumps.

Table 2. Organic Solution in Butanol		
Compound	**mg/Kg**	**Percent by Weight**
Acetone	40,000	4
Acetonitrile	8,000	0.8
Aliquat 336	8,000	0.8
Benzyl Alcohol	4,000	0.4
(2-chloroethyl) ether	2,000	0.2
2-Butanol		Matrix
Carbon Tetrachloride	2,000	0.2
Cyclohexane	500	0.05
Dichlorobenzene	2,000	0.2
Dioctyl Phthalate	2,000	0.2
Ethylene Glycol	8,000	0.8
1-Hexanol	8,000	0.8
Methylene Chloride	2,000	0.2
n-Butyl Acetate	5,000	0.5
Napthalene	2,000	0.2
Pentane	2,000	0.2
PCB - Aroclor 1242 Mix	2,000	0.2
Toluene	5,000	0.5
Tributyl Phosphate	2,000	0.2
Trichloroethane	2,000	0.2
Trichloroethylene	2,000	0.2
2-Butanol		89.35

Table 3. Organic Solution in Water		
Compound	**mg/Kg**	**Percent by Weight**
EDTA, Disodium Salt	50,000	5
Phenol	50,000	5
Water	14,400	90

Table 4. Metals in Nitric Acid Solution		
Compound	**mg/Kg**	**Percent by Weight**
Aluminum Nitrate-9-Water	375,000	37.5
Cadium Nitrate-4-Water	30.8125	0.003
Calcium Nitrate-4-Water	236,000	23.6
Cupric Nitrate-3-Water	24,000	0.24
Ferric Nitrate-9-Water	80,812.5	8.08
Lanthanum Nitrate-6-Water	4,300	0.43
Mercuric Nitrate-1-Water	34.3125	0.003
Nitric Acid	12,500	1.25
Potassium Permanganate	4,000	0.4
Sodium Molybdate-2-Water	2,400	0.24
Zinc Nitrate-6-Water	29,700	2.97
Water		28.25

Table 5. Alkaline Solution		
Compound	**mg/Kg**	**Percent by Weight**
Sodium Arsenate	20	0.002
Sodium Chloride	2,000	0.2
Sodium Dihydrogen Phosphate-1-Water	2,000	0.2
Potassium Ferrocyanide	50	0.005
Sodium Hydroxide	1875	.2875
Sodium Nitrite	10,000	1
Sodium Silicate	1,000	0.1
Sodium Sulfide	50	.005
Sodium Tetraborate	5,000	0.5
Water		97,613

2.3 Exposure Conditions

Geomembrane and seamed geomembrane specimens were exposed to the leachates following the specifications of EPA Method 9090A as they relate to exposure to waste fluids. The tanks used for these exposures were maintained at 23 $\pm$ 2°C and 50 $\pm$ 2°C throughout the 120-day exposure period. Tanks were constructed from chemically resistant glass, fitted with stirrers and heated with a circulating hot water heat exchanger system. The 50°C tanks were sealed with a lid, and a reflux condenser was installed to minimize loss of volatile leachate components.

2.4 Testing Procedures

Table 6 lists tests performed on the HDPE geomembrane and seamed geomembrane. The number of test replicates was doubled for baseline determinations on unexposed material.

Table 6. Tests performed on HDPE geomembrane

PROPERTY	TEST METHOD	NO. OF SPECIMENS
Thickness	EPA Method 9090	All
Mass	EPA Method 9090	All
Dimensions (Length & Width)	EPA Method 9090	All
Hardness	ASTM D 2240, Durometer D	2
Volatile Content	SW 870, Appendix IIID	2
Extractable Content	SW 870, Appendix IIIE	2
Specific Gravity	ASTM D792, Method A	3
Tear Resistance (MD & TD)	ASTM D 1004	3
Tensile Properties:	ASTM D638, Dumbbell	
Strength @ Yield & Beak		3
Strain @ Yield & Break		3
Strength @ 100 & 200% Strain		3
Tensile Set after Break		3
Modulus of Elasticity (2% secant modulus) (MD & TD)	ASTM D 882 (modified)	3
Hydrostatic Resistance	ASTM D751, Method A Procedure 1	3
Puncture Resistance	FTMS 101C, Meth. 2065	3
Seam Tests:		
Peel Mode	ASTM D413*	3
Shear Mode	ASTM D3083*	3

* As modified by NSF 54, Appendix A

Where appropriate testing was performed in both the machine and transverse directions.

3.0 Results and Discussion

Test results are presented in the Tables of Results which are included with this report. EPA Method 9090A is provided as an Appendix.

In considering these results, it must be determined through engineering judgment whether observed differences in the value of test results measured before and after immersion are due to product variability, unidentified factors relating to the test procedure, or leachate interaction with the products. Any significant chemical interaction with leachate would be expected to result in degradation trends which are consistent across the various properties being evaluated, and not isolated to one set of test results only. However, with each type of material there may be specific properties which are highly sensitive to leachate-induced effects. These factors must be considered in evaluating the various test results for a given product.

Also of critical importance is the issue of product variability. With geomembranes, a range of physical and mechanical index test values covering 15% or more of the average is not uncommon. This can be traced to variability inherent in the product, and the randomness associated with the onset of failure under the specified testing conditions. However, in chemical compatibility testing the statistical sampling of a broad range of manufactured product is not possible. Therefore, the small size of the sample population tested at each time point must be taken into consideration. The criteria to be applied in evaluating data measured before and after leachate immersion should be that property changes, if observed, are consistent and so great that product variability and experimental factors can be ruled out.

In this report, standard deviations (STD) are reported for most measurements involving three or more replicate specimens. In statistics, the standard deviation is defined as root of the mean squared deviations of individual test results about the mean value. The standard deviation is a quantitative measure of variability within a group of measurements.

One related measure of variability observed within a sample set, relative to the magnitude of the mean value itself, is the *coefficient of variation or variance* (COV). The coefficient of variance is defined as the standard deviation divided by the mean associated with a group of specimens, and may be expressed as a percentage. The COV provides an indication of what proportion of the mean value may be attributable to random experimental factors or product variability. It is useful to consider apparent changes in property values against the criterion of COV since observed changes which fall below the COV may not be significant. This approach was used in preparing the tables in the next sections.

The term *range* refers to the difference between the extreme highest and lowest points within a group of measured values. Considering range as a percentage of the mean values provides another measure of variability within a dataset.

In the tables, the high and low extremes for percentage change in mean values are listed for comparison against COV and range as a percentage of mean from the baseline sample group. The high and low percentage changes are the extremes from data measured at 30, 60, 90 and 120 days.

3.1 HDPE Geomembrane Exposed to Organic Solution in Butanol

Table 7 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for the HDPE geomembrane versus organic solution in butanol.

Table 7. Baseline coefficients of variation and range of percentage change results for 80 mil HDPE Geomembrane versus Organic Solution in Butanol

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at yield (MD)	1	3	-2	-12
Stress at break (MD)	10	26	+15	-2
Elongation at yield (MD)	8	20	+28	+5
Elongation at break (MD)	9	23	+15	-15
Modulus (MD)	5	15	+36	-2
Tear strength (MD)	1	1	+18	+7
Puncture Resistance	2	7	+10	-11
Hydrostatic Resistance	1	3	+5	-7
Seam Peel Adhesion	2	5	-3	-14
Shear Seam Strength	0	1	-11	-13

3.2 HDPE Geomembrane Exposed to Organic Solution in Water

Table 8 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for the HDPE geomembrane versus organic solution in water.

Table 8. Baseline coefficients of variation and range of percentage change results for 80 mil HDPE Geomembrane versus Organic Solution in Water

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at yield (MD)	1	3	+3	-8
Stress at break (MD)	10	26	+18	+1
Elongation at yield (MD)	8	20	+13	-8
Elongation at break (MD)	9	23	+20	-20
Modulus (MD)	5	15	+42	-2
Tear strength (MD)	1	1	+18	+12
Puncture Resistance	2	7	+21	-1
Hydrostatic resistance	1	3	+4	-2
Seam Peel Adhesion	2	5	0	-16
Shear Seam Strength	0	1	-13	-6

3.3 HDPE Geomembrane Exposed to Water Based Mixture of Metal Nitrates and Nitric Acid

Table 9 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for the HDPE geomembrane versus the water based mixture of metal nitrates and nitric acid.

Table 9. Baseline coefficients of variation and range of percentage change results for 80 mil HDPE Geomembrane versus Water Based Mixture of Metal Nitrates and Nitric Acid

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at yield (MD)	1	3	+4	-13
Stress at break (MD)	10	26	+19	-1
Elongation at yield (MD)	8	20	+8	-8
Elongation at break (MD)	9	23	+20	-19
Modulus (MD)	5	15	+28	-13
Tear strength (MD)	1	1	+11	+20
Puncture Resistance	2	7	+3	+6
Hydrostatic resistance	1	3	+4	-3
Seam Peel Adhesion	2	5	-6	-11
Shear Seam Strength	0	1	-3	-10

3.4 HDPE Geomembrane Exposed to Sodium Hydroxide Solution

Table 10 illustrates the range of variability in baseline data compared with some of the observed changes in average test values measured after immersion for the HDPE geomembrane versus the sodium hydroxide solution.

Table 10. Baseline coefficients of variation and range of percentage change results for 80 mil HDPE Geomembrane versus Sodium Hydroxide Solution

Test	Baseline COV (%)	Baseline Range as % of Mean	High Observed % Change	Low Observed % Change
Stress at yield (MD)	1	3	+2	-8
Stress at break (MD)	10	26	+22	0
Elongation at yield (MD)	8	20	+10	-10
Elongation at break (MD)	9	23	+22	-22
Modulus (MD)	5	15	+21	-6
Tear strength (MD)	1	1	+20	+11
Puncture Resistance	2	7	+4	0
Hydrostatic resistance	1	3	+2	-4
Seam Peel Adhesion	2	5	-2	-10
Shear Seam Strength	0	1	-6	-11

4.0 CONCLUSION

Because of random variability inherent in the geomembrane studied, results for most index mechanical property tests may be expected to vary within the $\pm$ 10-15% about the mean baseline values. Certain measurements are subject to greater random variability. These include modulus of elasticity (because of the visco-elastic properties of HDPE which cause uncertainty in the determination of the best linear fit), and tensile elongation at break and tensile set after break (attributed to the element of randomness associated with the initiation of tear upon failure). As a general rule, individual sample means showing changes within this range after exposure should not be considered significant, unless there is a pattern or trend which would suggest a time-dependent degradation process. Any loss of performance attributed to chemical interaction should be consistent across measurements of several physical and mechanical index properties, and would be expected to show changes outside the range of expected variability.

In this study, while changes in certain measured physical and mechanical properties were noted for the geomembrane, the effects of product variability and experimental factors could not be ruled out as causes. In the opinion of the authors, the data, considered together, do not support the conclusion that observed changes were consistently and uniformly caused by the test exposures.

TRI/Environmental, Inc. is pleased to have been selected to participate in this project. We trust that the information provided in this report meets your requirements for technical documentation of this chemical compatibility study. Please do not hesitate to call if we may provide any further information.

Respectfully submitted,

Sam R. Allen

Sam R. Allen
Program Manager: Geosynthetics Technologies

TRI/Environmental, Inc.

APPENDIX A - TEST RESULTS

This section includes generated test data provided in both tabular and graphical form. Each graph is represented by a series of "I" beam plots. Each "I" beam represents a single test population and illustrates the high and low value as the end points, and the mean as a central box on the beam.

At each testing period, two "I" beams are shown. The left beam represents the 23°C exposed specimens while the right beam represents the 50°C specimens. The initial "I" beam represents the baseline or unexposed test specimens. Only machine direction test specimens were plotted.

EPA METHOD 9090 TEST RESULTS

80 mil NATIONAL SEAL SMOOTH HDPE GEOMEMBRANE EXPOSED TO ORGANIC SOLUTION IN BUTANOL

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Butanol

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
GEOMEMBRANE: 80 mil SMOOTH HDPE									
Tensile Properties:									
Tensile Stress @ Yield (psi)	2488	2202	2293	2105	2046	2359	2449	2293	2257
ASTM D638	2439	2241	2232	2221	2174	2396	2379	2286	2272
Machine Direction	2439	2277	2253	2279	2238	2350	2393	2333	2244
	2476								
	2415								
	2415								
Average	2445	2240	2259	2202	2153	2368	2407	2304	2258
STD	28	31	25	72	80	20	30	21	11
Coefficient of Variation	1	1	1	3	4	1	1	1	1
% Change		-8	-8	-10	-12	-3	-2	-6	-8
Tensile Strength @ Break (psi)	4537	4905	5073	4882	4793	4960	5381	4850	3923
ASTM D638	4232	4916	4939	4698	4802	5343	5130	4791	5284
Machine Direction	5195	5060	4928	4186	4333	5174	5375	4860	5268
	4282								
	4146								
	5341								
Average	4622	4960	4980	4522	4643	5158	5295	4834	4825
STD	474	71	66	238	219	157	117	30	638
Coefficient of Variation	10	1	1	5	5	3	2	1	13
Change		7	8	-2	0	12	15	5	4
Tensile Properties:									
Elongation @ Yield (%)	20	22	22	23	28	27	25	22	23
ASTM D638	18	22	22	26	18	22	27	20	22
Machine Direction	22	20	23	23	29	25	25	21	22
	22								
	20								
	18								
Average	20	21	22	24	25	25	26	21	22
STD	2	1	0	1	5	2	1	1	0
Coefficient of Variation	8	4	2	6	20	8	4	4	2
% Change		7	12	20	25	23	28	5	12

Page 1 of 9

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Butanol

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Elongation @ Break (%)	795	918	918	861	910	833	794	701	570
ASTM D638	748	901	931	830	866	880	756	682	743
Machine Direction	905	984	919	753	790	769	874	694	756
	751								
	735								
	924								
Average	810	934	923	815	855	827	808	692	690
STD	77	36	6	45	50	45	49	8	85
Coefficient of Variation	9	4	1	6	6	5	6	1	12
% Change		15	14	1	6	2	-0	-14	-15
Set after Break (%)	682	685	728	696	698	705	739	611	510
ASTM D638	689	690	712	685	758	745	712	589	635
Machine Direction	658	697	695	652	672	770	702	606	617
	678								
	684								
	719								
Average	685	691	712	678	709	740	718	602	587
STD	19	5	13	19	36	27	16	9	55
Coefficient of Variation	3	1	2	3	5	4	2	2	9
% Change		1	4	-1	4	8	5	-12	-14
Stress @ 100% Elongation (psi)	1841	1679	1756	1659	1678	1838	1851	1749	1765
ASTM D638	1841	1735	1745	1721	1698	1808	1890	1776	1777
Machine Direction	1805	1711	1723	1744	1726	1820	1789	1796	1745
	1841								
	1793								
	1829								
Average	1825	1708	1741	1706	1701	1822	1843	1774	1762
STD	19	23	14	36	20	12	42	19	13
Coefficient of Variation	1	1	1	2	1	1	2	1	1
% Change		-8	-5	-8	-7	-0	1	-3	-3

Page 2 of 9

Project: Westinghouse File: West-L21.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Butanol

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Stress @ 200% Elongation (psi)	1902	1714	1805	1729	1747	1812	1838	1797	1804
ASTM D638	1854	1771	1805	1767	1720	1781	1808	1831	1835
Machine Direction	1817	1735	1747	1813	1809	1771	1820	1830	1808
	1866								
	1854								
	1878								
Average	1862	1740	1786	1770	1759	1788	1822	1819	1816
STD	26	24	27	34	37	17	12	16	14
Coefficient of Variation	1	1	2	2	2	1	1	1	1
% Change		-7	-4	-5	-6	-4	-2	-2	-2
Tensile Properties:									
Tensile Stress @ Yield (psi)	2524	2268	2253	2149	2265	2326	2420	2221	2224
ASTM D638	2398	2265	2226	2141	2217	2350	2464	2207	2232
Transverse Direction	2349	2293	2268	2094	2226	2381	2440	2229	2180
	2313								
	2439								
	2313								
Average	2389	2275	2249	2128	2236	2352	2441	2219	2212
STD	75	13	17	24	21	23	18	9	23
Coefficient of Variation	3	1	1	1	1	1	1	0	1
% Change		-5	-6	-11	-6	-2	2	-7	-7
Tensile Strength @ Break (psi)	5341	4122	4916	4977	5289	5269	5093	4748	5182
ASTM D638	5205	4675	4679	4905	5458	5252	4972	4600	5161
Transverse Direction	5169	4976	4939	4905	5262	5402	4918	4781	4829
	5253								
	5366								
	5253								
Average	5265	4591	4845	4929	5336	5306	4994	4710	5057
STD	70	354	118	34	87	67	73	79	162
Coefficient of Variation	1	8	2	1	2	1	1	2	3
% Change		-13	-8	-6	1	1	-5	-11	-4

Project: Westinghouse File: West-L31.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Butanol

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tensile Properties:									
Elongation @ Yield (%)	20	22	23	25	25	25	23	21	22
ASTM D638	20	22	22	25	25	21	22	22	24
Transverse Direction	22	23	23	25	28	24	21	21	23
	20								
	20								
	20								
Average	20	22	23	25	26	23	22	21	23
STD	1	0	0	0	1	2	1	0	1
Coefficient of Variation	4	2	2	0	5	7	4	2	4
% Change		10	11	23	28	15	8	5	13
Elongation @ Break (%)	946	776	945	931	975	899	927	704	759
ASTM D638	951	896	908	910	1008	904	914	677	751
Transverse Direction	936	944	941	910	1105	915	900	713	716
	928								
	938								
	930								
Average	938	872	931	917	1029	906	914	698	742
STD	8	71	17	10	55	7	11	15	19
Coefficient of Variation	1	8	2	1	5	1	1	2	3
% Change		-7	-1	-2	10	-3	-3	-26	-21
Set after Break (%)	724	606	718	698	752	840	729	628	641
ASTM D638	743	635	721	728	759	810	745	602	622
Transverse Direction	729	610	732	698	755	795	659	629	604
	738								
	740								
	731								
Average	734	617	724	708	755	815	711	620	622
STD	7	13	6	14	3	19	37	12	15
Coefficient of Variation	1	2	1	2	0	2	5	2	2
% Change		-16	-1	-4	3	11	-3	-16	-15

Project: Westinghouse File: West-L41.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Butanol

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Stress @ 100% Elongation (psi)	1854	1707	1735	1678	1723	1748	1866	1710	1732
ASTM D638	1795	1699	1655	1706	1687	1853	1835	1718	1748
Transverse Direction	1807	1732	1732	1718	1702	1819	1804	1730	1693
	1771								
	1829								
	1783								
Average	1807	1713	1707	1701	1704	1807	1835	1719	1724
STD	28	14	37	17	15	44	25	8	23
Coefficient of Variation	2	1	2	1	1	2	1	0	1
% Change		-5	-5	-6	-6	0	2	-5	-5
Stress @ 200% Elongation (psi)	1902	1732	1711	1724	1747	1714	1866	1749	1786
ASTM D638	1855	1735	1690	1800	1783	1735	1835	1763	1781
Transverse Direction	1831	1744	1742	1788	1738	1779	1803	1780	1738
	1795								
	1866								
	1843								
Average	1849	1737	1714	1771	1756	1743	1835	1764	1768
STD	33	5	21	33	19	27	26	13	22
Coefficient of Variation	2	0	1	2	1	2	1	1	1
% Change		-6	-7	-4	-5	-6	-1	-5	-4
Modulus of Elasticity:									
STM D882 (psi)	17074	17658	15695	20243	24923	16819	16604	16063	16667
Machine Direction	18042	15187	18903	20563	19481	16051	16802	16441	17160
	17673	15941	15985	20194	22508	16534	14746	16747	16985
	16448								
	15839								
	15205								
Average	16380	16282	16881	20333	22304	16468	16051	16417	16937
STD	888	1266	1774	200	2727	388	1134	343	250
Coefficient of Variation	5	8	11	1	12	2	7	2	1
% Change		-1	3	24	36	1	-2	0	3

Project: Westinghouse File: West-L51.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Butanol

Report Date: March 06, 1995

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Modulus of Elasticity:									
ASTM D882 (psi)	15951	15802	15400	21233	21364	17275	16023	16140	16588
Transverse Direction	15098	16069	15678	26037	17744	17640	15514	16511	16675
	15218	17324	16289	22132	22363	16756	15507	16286	16885
	15247								
	15180								
	15402								
Average	15349	16398	15789	23134	20490	17224	15681	16312	16649
STD	311	813	455	2554	2430	444	296	187	53
Coefficient of Variation	2	5	3	11	12	3	2	1	0
% Change		7	3	51	33	12	2	6	8
Indentation Hardness:									
Reading	57	56	56	58	58	56	56	61	55
ASTM D2240	50	58	57	58	58	58	58	60	58
(with TYPE D DUROMETER)	54	57	57	59	58	59	59	61	58
	50	59	57	59	56	58	58	60	59
	52	58	56	58	57	57	57	61	59
	55								
	58								
	58								
	58								
	54								
Average	55	58	57	58	57	58	58	61	58
STD	3	1	1	1	1	1	1	1	2
Coefficient of Variation	6	2	1	2	2	2	2	1	3
% Change		5	4	6	5	5	5	11	6
Specific Gravity:									
ASTM D792, Method A	0.948	0.935	0.929	0.944	0.942	0.936	0.947	0.941	0.946
	0.942	0.942	0.936	0.944	0.943	0.942	0.943	0.944	0.949
	0.937	0.940	0.940	0.946	0.946	0.940	0.943	0.944	0.947
	0.945								
	0.937								
	0.949								
Average	0.943	0.939	0.935	0.945	0.944	0.939	0.944	0.943	0.947
STD	0.005	0.004	0.006	0.001	0.002	0.003	0.002	0.002	0.002
Coefficient of Variation	1	0	1	0	0	0	0	0	0
% Change		-0.42	-0.85	0.18	0.07	-0.39	0.14	0.00	0.46
Environmental Stress Crack Resistance:									
ASTM D1693, Condition B									
Machine Direction (% Failed)	N/A	0	0	0	0	0	0	0	0
Transverse Direction (% Failed)	N/A	0	0	0	0	0	0	0	0

Page 6 of 9

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Butanol

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Puncture Resistance:									
Load @ Rupture (lbs)	121	119	120	117	112	113	112	132	132
FTMS 101C Method 2065	119	119	120	118	108	116	107	136	130
	124	118	120	117	113	115	107	135	133
	119								
	121								
	127								
Average	122	119	120	117	111	115	109	134	132
STD	3	0	0	0	2	1	2	2	1
Coefficient of Variation	2	0	0	0	2	1	2	1	1
% Change		-3	-2	-4	-9	-6	-11	10	8
Strain @ Rupture (in)	0.28	0.26	0.43	0.28	0.39	0.24	0.23	0.29	0.31
FTMS 101C Method 2065	0.25	0.26	0.42	0.30	0.42	0.28	0.41	0.28	0.29
	0.40	0.26	0.42	0.33	0.44	0.27	0.28	0.32	0.44
	0.24								
	0.24								
	0.40								
Average	0.30	0.26	0.42	0.30	0.42	0.26	0.31	0.30	0.35
STD	0.07	0.00	0.00	0.02	0.02	0.02	0.08	0.02	0.07
Coefficient of Variation	23	0	1	7	5	6	25	6	19
% Change		-14	40	1	38	-13	2	-2	15
Volatiles and Extractables:									
lachine Diameter Change (%)	-0.25	-0.10	-0.22	-0.38	-0.43	-1.28	-1.16	-0.57	-0.88
W 870 - Appendix III-D	-0.25	-0.30	-0.37	-0.48	-0.30	-1.45	-1.13	-0.53	-1.03
	-0.42								
	-0.38								
Average	-0.33	-0.20	-0.30	-0.43	-0.36	-1.36	-1.15	-0.55	-0.96
STD	0.08	0.10	0.08	0.05	0.06	0.09	0.02	0.02	0.08
Volatiles and Extractables:									
Transverse Diameter Change (%)	0.28	0.12	-0.05	0.10	0.03	0.25	0.18	0.13	0.10
SW 870 - Appendix III-D	-0.03	0.08	0.05	0.00	-0.18	0.10	0.25	-0.13	-0.10
	0.33								
	0.20								
Average	0.20	0.10	0.00	0.05	-0.08	0.18	0.21	0.00	0.00
STD	0.14	0.02	0.05	0.05	0.10	0.08	0.04	0.13	0.10
% Volatiles	0.04	0.25	0.34	0.24	0.36	0.78	0.46	0.54	0.27
SW 870 - Appendix III-D	0.04	0.28	0.39	0.30	0.32	0.81	0.46	0.49	0.27
	0.04								
	0.04								
Average	0.04	0.27	0.37	0.27	0.34	0.80	0.46	0.52	0.27
STD	0.00	0.02	0.02	0.03	0.02	0.02	0.00	0.03	0.00
% Extractables	0.06	0.62	0.98	0.63	1.12	0.20	1.13	0.44	1.08
SW 870 - Appendix III-D	0.07	0.61	0.91	0.57	0.92	0.16	1.11	0.52	1.03
	0.08								
	0.07								
verage	0.07	0.62	0.95	0.60	1.02	0.18	1.12	0.48	1.06
STD	0.01	0.01	0.03	0.03	0.10	0.02	0.01	0.04	0.03

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Butanol

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tear Resistance:									
ASTM D1004	58	69	65	65	66	63	64	66	67
(lbs)	59	71	66	65	65	63	64	66	67
Machine Direction	58	67	66	65	66	62	64	66	67
	59								
	58								
	59								
Average	59	69	66	65	66	63	64	66	67
STD	1	2	1	0	1	1	0	0	0
Coefficient of Variation	1	3	1	0	1	1	0	0	0
% Change		18	12	11	12	7	9	13	15
Tear Resistance:									
ASTM D1004	56	69	66	66	66	62	62	66	66
(lbs)	56	66	63	65	65	62	63	66	66
Transverse Direction	57	71	65	64	65	62	63	66	65
	58								
	58								
	57								
Average	57	69	65	65	65	62	63	66	66
STD	1	3	2	1	1	0	1	0	1
Coefficient of Variation	2	4	2	2	1	0	1	0	1
% Change		20	13	14	15	9	10	16	15
Hydrostatic Resistance:									
ASTM D751	595	595	590	570	580	565	560	600	665
(psi)	595	585	595	580	575	575	550	600	605
	590	590	600	570	575	570	550	590	600
	605								
	595								
	590								
Average	595	590	595	573	577	570	553	597	623
STD	5	5	5	6	3	5	6	6	36
Coefficient of Variation	1	1	1	1	1	1	1	1	6
% Change		-1	0	-4	-3	-4	-7	0	5
Hydrostatic Resistance:									
ASTM D751	11.90	13.44	13.50	9.97	8.31	12.31	7.00	10.38	8.75
time to burst (sec)	12.62	13.35	12.84	7.63	8.28	8.31	7.88	10.21	11.50
	12.44	13.72	11.53	9.78	8.75	9.58	6.78	10.59	10.94
	12.63								
	11.50								
	12.03								
Average	12.19	13.50	12.62	9.13	8.45	10.07	7.22	10.39	10.40
STD	0	0	1	1	0	2	1	0.	1
Coefficient of Variation	4	1	8	14	3	20	8	2	14
% Change		11	4	-25	-31	-17	-41	-15	-15

Page 8 of 9

Project: Westinghouse File: West-L81.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Butanol

Report Date: March 06, 1995

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Seam Peel Adhesion:									
ASTM D4437 (lbs)	153	138	138	136	138	140	134	147	151
	157	130	135	134	139	143	143	144	158
	154	132	139	141	141	141	132	139	148
	155	139	136	131	136	143	143	147	153
	155	137	141	135	140	138	131	148	143
	161	133	137	127	138	141	144	140	148
	154								
	154								
	153								
	154								
	160								
	153								
Average	155	135	138	134	139	141	138	144	150
STD	3	3	2	4	2	2	6	4	5
Coefficient of Variation	2	2	1	3	1	1	4	2	3
% Change		-13	-11	-14	-11	-9	-11	-7	-3
Failure Mode (FTB = All Film Tear Bond)	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB
Shear Seam Strength:									
Shear Seam Strength (lbs)	168	150	147	150	152	146	143	150	145
ASTM D4437	168	150	146	148	149	147	147	151	149
	168	149	147	148	149	147	146	149	153
	167								
	169								
	167								
Average	168	150	147	149	150	147	145	150	149
STD	1	0	0	1	1	0	2	1	3
Coefficient of Variation	0	0	0	1	1	0	1	1	2
% Change		-11	-13	-11	-11	-13	-13	-11	-11

Page 9 of 9

Project: Westinghouse File: West-L91.WB1

EPA METHOD 9090 TEST RESULTS

80 mil NATIONAL SEAL SMOOTH HDPE GEOMEMBRANE EXPOSED TO ORGANIC SOLUTION IN WATER

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Water

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
GEOMEMBRANE: 80 mil SMOOTH HDPE									
Tensile Properties:									
Tensile Stress @ Yield (psi)	2488	2432	2296	2310	2256	2465	2363	2273	2353
ASTM D638	2439	2321	2293	2326	2233	2442	2607	2320	2379
Machine Direction	2439	2383	2321	2261	2233	2449	2557	2264	2423
	2476								
	2415								
	2415								
Average	2445	2379	2303	2299	2241	2452	2509	2286	2385
STD	28	45	13	28	11	10	105	25	29
Coefficient of Variation	1	2	1	1	0	0	4	1	1
% Change		-3	-6	-6	-8	0	3	-7	-2
Tensile Strength @ Break (psi)	4537	5272	5160	5701	5442	4936	5303	4648	4783
ASTM D638	4232	5160	4810	5012	5198	5481	5201	5133	5009
Machine Direction	5195	5148	5111	5557	5756	5241	5028	4811	4258
	4282								
	4146								
	5341								
Average	4622	5193	4960	5423	5465	5219	5177	4864	4683
STD	474	56	249	297	228	223	114	202	315
Coefficient of Variation	10	1	5	5	4	4	2	4	7
% Change		12	7	17	18	13	12	5	1
Tensile Properties:									
Elongation @ Yield (%)	20	22	22	18	20	22	21	23	18
ASTM D638	18	20	20	22	23	21	21	20	18
Machine Direction	22	22	22	22	25	21	20	21	19
	22								
	20								
	18								
Average	20	21	21	21	23	21	21	21	18
STD	2	1	1	2	2	0	0	1	0
Coefficient of Variation	8	4	4	9	9	2	2	6	3
% Change		7	7	3	13	7	3	7	-8

Project: Westinghouse File: West-L12.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Water

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Elongation @ Break (%)	795	944	925	966	1000	709	748	673	685
ASTM D638	748	916	843	901	948	808	721	733	678
Machine Direction	905	921	921	956	975	753	698	704	593
	751								
	735								
	924								
Average	810	927	896	941	974	757	722	703	645
STD	77	12	38	29	21	40	20	24	37
Coefficient of Variation	9	1	4	3	2	5	3	3	6
% Change		14	11	16	20	-7	-11	-13	-20
Set after Break (%)	882	733	722	704	752	715	739	580	588
ASTM D638	689	724	686	689	713	800	712	649	592
Machine Direction	656	708	715	698	745	725	702	613	591
	678								
	684								
	719								
Average	685	722	708	697	737	747	718	614	590
STD	19	10	16	6	17	38	16	28	2
Coefficient of Variation	3	1	2	1	2	5	2	5	0
% Change		5	3	2	8	9	5	-10	-14
Stress @ 100% Elongation (psi)	1841	1827	1765	1701	1698	1891	1820	1713	1811
ASTM D638	1841	1778	1756	1756	1698	1830	1934	1791	1806
Machine Direction	1805	1753	1753	1682	1721	1840	1919	1730	1837
	1841								
	1793								
	1829								
Average	1825	1786	1758	1713	1706	1854	1891	1745	1819
STD	19	31	5	31	11	27	51	33	13
Coefficient of Variation	1	2	0	2	1	1	3	2	1
% Change		-2	-4	-6	-7	2	4	-4	-0

Project: Westinghouse File: West-L22.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Water

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Stress @ 200% Elongation (psi)	1902	1827	1728	1724	1767	1854	1821	1760	1853
ASTM D638	1854	1815	1780	1779	1767	1833	1934	1825	1864
Machine Direction	1817	1802	1790	1670	1756	1782	1919	1768	1879
	1866								
	1854								
	1878								
Average	1862	1815	1766	1724	1763	1823	1891	1784	1865
STD	26	10	27	44	5	30	50	29	11
Coefficient of Variation	1	1	2	3	0	2	3	2	1
% Change		-3	-5	-7	-5	-2	2	-4	0
Tensile Properties:									
Tensile Stress @ Yield (psi)	2524	2293	2288	2326	2317	2070	2292	2305	2381
ASTM D638	2398	2272	2247	2306	2378	2197	2301	2276	2321
Transverse Direction	2349	2268	2093	2165	2386	2174	2323	2295	2382
	2313								
	2439								
	2313								
Average	2389	2278	2209	2266	2360	2147	2305	2292	2361
STD	75	11	84	72	31	55	13	12	29
Coefficient of Variation	3	0	4	3	1	3	1	1	1
% Change		-5	-8	-5	-1	-10	-4	-4	-1
Tensile Strength @ Break (psi)	5341	5073	5150	5733	4854	4963	5303	5187	5151
ASTM D638	5205	4778	4988	5882	5329	5480	5201	5038	5189
Transverse Direction	5169	4829	4767	4741	5277	5241	5028	4777	5226
	5253								
	5366								
	5253								
Average	5265	4893	4968	5452	5153	5228	5177	5001	5189
STD	70	129	157	506	213	211	114	169	31
Coefficient of Variation	1	3	3	9	4	4	2	3	1
% Change		-7	-6	4	-2	-1	-2	-5	-1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Water

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tensile Properties:									
Elongation @ Yield (%)	20	20	22	20	23	22	21	20	19
ASTM D638	20	20	22	18	22	20	21	21	20
Transverse Direction	22	20	22	20	22	21	21	20	20
	20								
	20								
	20								
Average	20	20	22	19	22	21	21	20	20
STD	1	0	0	1	0	1	0	0	0
Coefficient of Variation	4	0	0	5	2	4	0	2	2
% Change		-2	8	-5	10	3	3	0	-3
Elongation @ Break (%)	946	928	955	978	865	883	945	754	748
ASTM D638	951	876	936	998	954	902	968	748	749
Transverse Direction	936	895	953	895	951	811	825	706	743
	928								
	938								
	930								
Average	938	900	948	957	924	865	813	736	747
STD	8	21	9	45	40	39	63	21	3
Coefficient of Variation	1	2	1	5	4	5	7	3	0
% Change		-4	1	2	-1	-8	-3	-22	-20
Set after Break (%)	724	742	738	759	739	745	729	658	643
ASTM D638	743	708	693	751	732	785	745	653	617
Transverse Direction	729	692	722	736	704	725	659	631	649
	738								
	740								
	731								
Average	734	714	718	749	725	752	711	647	636
STD	7	21	19	10	15	25	37	12	14
Coefficient of Variation	1	3	3	1	2	3	5	2	2
% Change		-3	-2	2	-1	2	-3	-12	-13

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Water

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Stress @ 100% Elongation (psi)	1854	1732	1737	1733	1780	1807	1907	1748	1760
ASTM D638	1795	1753	1741	1729	1756	1897	1826	1760	1774
Transverse Direction	1807	1732	1593	1718	1771	1873	1862	1729	1805
	1771								
	1829								
	1783								
Average	1807	1739	1690	1727	1769	1859	1865	1746	1780
STD	28	10	69	6	10	38	33	13	19
Coefficient of Variation	2	1	4	0	1	2	2	1	1
% Change		-4	-6	-4	-2	3	3	-3	-1
Stress @ 200% Elongation (psi)	1902	1768	1750	1756	1817	1829	1907	1790	1814
ASTM D638	1855	1790	1778	1765	1793	1794	1826	1788	1814
Transverse Direction	1831	1780	1651	1741	1771	1882	1862	1800	1854
	1795								
	1866								
	1843								
Average	1849	1779	1726	1754	1794	1835	1865	1793	1827
STD	33	9	54	10	19	36	33	5	19
Coefficient of Variation	2	1	3	1	1	2	2	0	1
% Change		-4	-7	-5	-3	-1	1	-3	-1
Modulus of Elasticity:									
\STM D882 (psi)	17074	17467	16658	21298	24374	17463	16604	17359	16723
lachine Direction	16042	16507	15812	23056	22986	17119	16802	16170	17440
	17673	14551	15673	25471	19580	16795	14746	17610	17558
	16448								
	15839								
	15205								
Average	16380	16175	16048	23275	22313	17126	16051	17046	17240
STD	888	1486	533	2095	2487	334	1134	769	452
Coefficient of Variation	5	9	3	9	11	2	7	5	3
% Change		-1	-2	42	36	5	-2	4	5

Page 5 of 9

Project: Westinghouse File: West-L52.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Water

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Modulus of Elasticity:									
ASTM D882 (psi)	15951	15096	15531	24694	19265	19902	15225	16844	16865
Transverse Direction	15098	15040	14589	28700	20720	19599	16129	16521	16346
	15218	15090	17146	25018	21187	18522	15338	16831	16343
	15247								
	15180								
	15402								
Average	15349	15075	15755	26137	20391	19341	15564	16732	16518
STD	311	31	1293	2225	1002	725	493	183	301
Coefficient of Variation	2	0	8	9	5	4	3	1	2
% Change		-2	3	70	33	26	1	9	8
Indentation Hardness:									
Reading	57	53	56	58	61	59	59	61	60
ASTM D2240	50	52	57	62	62	58	58	61	60
(with TYPE D DUROMETER)	54	55	55	59	60	57	57	61	60
	50	56	55	59	61	58	58	60	62
	52	52	55	60	61	57	58	61	61
	55								
	58								
	58								
	58								
	54								
Average	55	54	56	60	61	58	58	61	61
STD	3	2	1	2	1	1	1	0	1
Coefficient of Variation	6	3	2	3	1	1	1	1	1
% Change		-2	2	9	12	6	6	11	11
Specific Gravity:									
ASTM D792, Method A	0.948	0.939	0.948	0.941	0.947	0.940	0.942	0.946	0.942
	0.942	0.942	0.947	0.942	0.951	0.940	0.944	0.946	0.946
	0.937	0.945	0.939	0.943	0.950	0.946	0.940	0.946	0.945
	0.945								
	0.937								
	0.949								
Average	0.943	0.942	0.945	0.942	0.949	0.942	0.942	0.946	0.944
STD	0.005	0.003	0.005	0.001	0.002	0.003	0.002	0.000	0.002
Coefficient of Variation	1	0	1	0	0	0	0	0	0
% Change		-0.11	0.18	-0.11	0.67	-0.11	-0.11	0.32	0.14
Environmental Stress Crack Resistance:									
ASTM D1693, Condition B									
Machine Direction (% Failed)	N/A	0	0	0	0	0	0	0	0
Transverse Direction (% Failed)	N/A	0	0	0	0	0	0	0	0

Page 6 of 9

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Water

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Puncture Resistance:									
Load @ Rupture (lbs)	121	121	124	121	125	120	118	143	147
FTMS 101C Method 2065	119	122	124	121	127	125	125	143	148
	124	121	125	119	125	123	125	147	147
	119								
	121								
	127								
Average	122	121	124	120	126	123	123	144	147
STD	3	0	0	1	1	2	3	2	0
Coefficient of Variation	2	0	0	1	1	2	3	1	0
% Change		-0	2	-1	3	1	1	18	21
Strain @ Rupture (in)	0.28	0.26	0.43	0.32	0.40	0.29	0.27	0.52	0.49
FTMS 101C Method 2065	0.25	0.26	0.43	0.35	0.41	0.41	0.44	0.50	0.46
	0.40	0.26	0.40	0.37	0.44	0.28	0.48	0.50	0.50
	0.24								
	0.24								
	0.40								
Average	0.30	0.26	0.42	0.35	0.42	0.33	0.40	0.51	0.48
STD	0.07	0.00	0.01	0.02	0.02	0.06	0.09	0.01	0.02
Coefficient of Variation	23	0	3	6	4	18	23	2	4
% Change		-14	39	15	38	8	31	68	60
Volatiles and Extractables:									
Machine Diameter Change (%)	-0.25	-0.65	-0.08	-0.28	-0.15	-0.93	-0.10	-1.52	-3.40
SW 870 - Appendix III-D	-0.25	0.20	-0.28	0.16	-0.42	-0.80	-0.40	-2.40	-6.46
	-0.42								
	-0.38								
Average	-0.33	-0.23	-0.18	-0.05	-0.29	-0.86	-0.25	-1.96	-4.93
STD	0.08	0.43	0.10	0.23	0.14	0.06	0.15	0.44	1.53
Volatiles and Extractables:									
Transverse Diameter Change (%)	0.28	0.00	0.35	0.13	0.08	0.35	-0.20	0.22	-0.43
SW 870 - Appendix III-D	-0.03	0.15	0.10	0.10	0.05	0.38	0.13	-0.05	-0.60
	0.33								
	0.20								
Average	0.20	0.08	0.23	0.11	0.06	0.36	-0.04	0.09	-0.52
STD	0.14	0.08	0.12	0.01	0.01	0.01	0.16	0.14	0.09
% Volatiles	0.04	0.06	0.11	0.09	0.09	0.19	0.22	0.18	0.21
SW 870 - Appendix III-D	0.04	0.05	0.12	0.09	0.13	0.19	0.24	0.19	0.22
	0.04								
	0.04								
Average	0.04	0.06	0.12	0.09	0.11	0.19	0.23	0.19	0.22
STD	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.01	0.01
% Extractables	0.06	0.20	0.18	0.19	0.30	0.06	0.04	0.12	0.15
SW 870 - Appendix III-D	0.07	0.20	0.24	0.17	0.27	0.05	0.04	0.15	0.11
	0.08								
	0.07								
Average	0.07	0.20	0.21	0.18	0.29	0.06	0.04	0.14	0.13
STD	0.01	0.00	0.03	0.01	0.01	0.00	0.00	0.02	0.02

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Water

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tear Resistance:									
ASTM D1004	58	68	69	68	68	65	65	67	69
(lbs)	59	70	68	68	68	65	67	68	69
Machine Direction	58	69	69	67	69	66	67	67	69
	59								
	58								
	59								
Average	59	69	69	68	68	65	66	67	69
STD	1	1	1	1	1	1	1	1	0
Coefficient of Variation	1	1	1	1	1	1	2	1	0
% Change		18	17	16	17	12	13	15	18
Tear Resistance:									
ASTM D1004	56	68	67	68	67	65	65	67	68
(lbs)	56	70	71	67	67	64	65	68	68
Transverse Direction	57	68	67	68	66	64	66	68	68
	58								
	58								
	57								
Average	57	69	68	68	67	64	65	68	68
STD	1	1	2	1	1	1	1	1	0
Coefficient of Variation	2	2	3	1	1	1	1	1	0
% Change		20	20	19	17	13	15	19	19
Hydrostatic Resistance:									
ASTM D751	595	600	615	600	590	580	590	620	615
(psi)	595	590	615	590	600	590	585	620	620
	590	595	605	590	595	580	580	610	620
	605								
	595								
	590								
Average	595	595	612	593	595	583	585	617	618
STD	5	5	6	6	5	6	5	6	3
Coefficient of Variation	1	1	1	1	1	1	1	1	0
% Change		0	3	-0	0	-2	-2	4	4
Hydrostatic Resistance:									
ASTM D751	11.90	13.85	11.75	7.75	10.22	7.43	6.72	9.97	11.78
time to burst (sec)	12.62	12.78	12.06	9.79	7.66	8.97	6.75	13.16	8.22
	12.44	13.37	12.69	8.53	8.28	8.82	6.96	10.63	11.22
	12.63								
	11.50								
	12.03								
Average	12.19	13.27	12.17	8.69	8.72	7.74	6.81	11.25	10.41
STD	0	0	0	1	1	1	0	2	2
Coefficient of Variation	4	3	4	12	15	14	2	15	18
% Change		9	-0	-29	-28	-36	-44	-8	-15

Page 8 of 9

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Organic Solution in Water

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

.est Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Seam Peel Adhesion:									
ASTM D4437 (lbs)	153	137	150	137	122	137	146	154	161
	157	146	147	138	139	146	152	153	149
	154	135	145	134	131	128	127	152	151
	155	136	127	140	140	146	151	158	162
	155	136	144	141	112	145	139	157	160
	161	138	146	139	137	148	150	153	148
	154								
	154								
	153								
	154								
	160								
	153								
Average	155	138	143	138	130	142	144	155	155
STD	3	4	7	2	10	7	9	2	6
Coefficient of Variation	2	3	5	2	8	5	6	1	4
% Change		-11	-8	-11	-16	-9	-7	-0	-0
Failure Mode (FTB = All Film Tear Bond)	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB
Shear Seam Strength:									
Shear Seam Strength (lbs)	168	156	152	154	155	153	143	159	158
ASTM D4437	168	157	153	153	155	154	147	159	159
	168	157	153	155	155	155	146	150	156
	167								
	169								
	167								
erage	168	157	153	154	155	154	145	156	158
)	1	0	0	1	0	1	2	4	1
oefficient of Variation	0	0	0	1	0	1	1	3	1
% Change		-7	-9	-8	-8	-8	-13	-7	-6

Page 9 of 9

EPA METHOD 9090 TEST RESULTS

80 mil NATIONAL SEAL SMOOTH HDPE GEOMEMBRANE EXPOSED TO WATER BASED MIXTURE OF METAL NITRATES IN NITRC ACID

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Water Based Mixture of Metal Nitrates and Nitric Acid

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
GEOMEMBRANE: 80 mil SMOOTH HDPE									
Tensile Properties:									
Tensile Stress @ Yield (psi)	2488	2093	2390	2463	2287	2521	2524	2520	2391
ASTM D638	2439	2115	2427	2258	2281	2481	2441	2531	2381
Machine Direction	2439	2195	2415	2244	2256	2461	2435	2544	2397
	2476								
	2415								
	2415								
Average	2445	2134	2411	2322	2275	2488	2467	2532	2390
STD	28	44	15	100	13	25	41	10	7
Coefficient of Variation	1	2	1	4	1	1	2	0	0
% Change		-13	-1	-5	-7	2	1	4	-2
Tensile Strength @ Break (psi)	4537	4767	5610	6244	5425	4368	3254	5202	4837
ASTM D638	4232	4897	5683	5415	4831	5072	5030	4874	4725
Machine Direction	5195	4851	4878	4878	4600	5323	5393	5464	4470
	4282								
	4146								
	5341								
Average	4822	4838	5390	5512	4952	4921	4559	5180	4677
STD	474	54	363	562	348	404	935	241	154
Coefficient of Variation	10	1	7	10	7	8	21	5	3
% Change		5	17	19	7	6	-1	12	1
Tensile Properties:									
Elongation @ Yield (%)	20	22	20	20	20	21	20	19	19
ASTM D638	18	23	22	22	20	21	21	19	18
Machine Direction	22	20	20	17	20	18	20	19	18
	22								
	20								
	18								
Average	20	22	21	20	20	20	20	19	18
STD	2	1	1	2	0	1	0	0	0
Coefficient of Variation	8	6	5	10	0	7	2	0	3
% Change		8	3	-2	0	0	2	-5	-8

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Water Based Mixture of Metal Nitrates and Nitric Acid

Report Date: March 06, 1995

MDN
Quality Review

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Elongation @ Break (%)	795	953	1006	1024	919	830	771	708	652
ASTM D638	748	933	1030	954	909	729	701	662	663
Machine Direction	905	926	884	931	881	767	760	742	645
	751								
	735								
	924								
Average	810	937	973	970	903	775	744	704	653
STD	77	11	64	40	16	42	31	33	7
Coefficient of Variation	9	1	7	4	2	5	4	5	1
% Change		16	20	20	12	-4	-8	-13	-19
Set after Break (%)	682	708	756	713	684	680	568	620	573
ASTM D638	689	718	759	729	711	709	689	570	586
Machine Direction	656	744	732	711	679	703	714	540	553
	678								
	684								
	719								
Average	685	723	749	718	691	697	657	577	571
STD	19	15	12	8	14	12	64	33	14
Coefficient of Variation	3	2	2	1	2	2	10	6	2
% Change		6	9	5	1	2	-4	-16	-17
Stress @ 100% Elongation (psi)	1841	1593	1780	1793	1701	1858	1849	1883	1807
ASTM D638	1841	1713	1756	1719	1674	1850	1886	1836	1846
Machine Direction	1805	1655	1780	1633	1611	1773	1921	1862	1788
	1841								
	1793								
	1829								
Average	1825	1654	1772	1715	1662	1827	1879	1854	1814
STD	19	49	11	65	38	38	31	12	24
Coefficient of Variation	1	3	1	4	2	2	2	1	1
% Change		-9	-3	-6	-9	0	3	2	-1

Project: Westinghouse File: West-L23.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Water Based Mixture of Metal Nitrates and Nitric Acid

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Stress @ 200% Elongation (psi)	1902	1651	1805	1829	1724	1811	1849	1897	1856
ASTM D638	1854	1747	1768	1817	1707	1813	1866	1890	1895
Machine Direction	1817	1736	1805	1689	1677	1813	1922	1908	1833
	1866								
	1854								
	1878								
Average	1862	1711	1793	1712	1703	1812	1879	1898	1861
STD	26	43	17	88	19	1	31	7	26
Coefficient of Variation	1	3	1	5	1	0	2	0	1
% Change		-8	-4	-8	-9	-3	1	2	-0
Tensile Properties:									
Tensile Stress @ Yield (psi)	2524	2305	2395	2373	2273	2450	2442	2384	2376
ASTM D638	2398	2390	2341	2410	2302	2457	2391	2394	2370
Transverse Direction	2349	2341	2407	2410	2314	2421	2415	2399	2362
	2313								
	2439								
	2313								
Average	2389	2345	2381	2398	2296	2443	2416	2392	2369
STD	75	35	29	17	17	16	21	6	6
Coefficient of Variation	3	1	1	1	1	1	1	0	0
% Change		-2	-0	0	-4	2	1	0	-1
Tensile Strength @ Break (psi)	5341	5024	5235	5783	5693	5034	5206	5194	4012
ASTM D638	5205	4463	5415	5229	6000	5343	4878	5430	5272
Transverse Direction	5169	5122	5556	5265	5058	4981	4631	4862	4535
	5253								
	5366								
	5253								
Average	5265	4870	5402	5426	5564	5119	4905	5162	4606
STD	70	290	131	253	392	160	236	233	517
Coefficient of Variation	1	6	2	5	7	3	5	5	11
% Change		-7	3	3	6	-3	-7	-2	-13

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Water Based Mixture of Metal Nitrates and Nitric Acid

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tensile Properties:									
Elongation @ Yield (%)	20	20	20	17	18	19	21	18	19
ASTM D638	20	20	20	18	17	19	22	18	18
Transverse Direction	22	20	22	17	20	24	18	18	19
	20								
	20								
	20								
Average	20	20	21	17	18	21	20	18	19
STD	1	0	1	0	1	2	2	0	0
Coefficient of Variation	4	0	5	3	7	11	8	0	3
% Change		-2	2	-15	-10	2	0	-11	-8
Elongation @ Break (%)	946	934	958	1081	1012	944	855	745	587
ASTM D638	951	812	1015	946	1053	897	902	761	757
Transverse Direction	936	928	1032	968	952	847	866	699	649
	928								
	938								
	930								
Average	938	891	1002	996	1006	896	874	735	664
STD	8	56	32	59	41	40	20	26	70
Coefficient of Variation	1	6	3	6	4	4	2	4	11
% Change		-5	7	6	7	-4	-7	-22	-29
Set after Break (%)	724	687	719	767	748	749	775	635	531
ASTM D638	743	699	762	711	783	780	710	730	640
Transverse Direction	729	722	754	739	759	739	720	610	570
	738								
	740								
	731								
Average	734	703	745	739	783	756	735	658	580
STD	7	15	19	23	15	17	29	52	45
Coefficient of Variation	1	2	3	3	2	2	4	8	8
% Change		-4	1	1	4	3	0	-10	-21

Page 4 of 9

Project: Westinghouse File: West-L43.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Water Based Mixture of Metal Nitrates and Nitric Acid

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Stress @ 100% Elongation (psi)	1854	1756	1778	1735	1636	1731	1871	1794	1755
ASTM D638	1795	1732	1756	1735	1709	1807	1887	1851	1829
Transverse Direction	1807	1756	1765	1735	1721	1750	1858	1776	1814
	1771								
	1829								
	1783								
Average	1807	1748	1766	1735	1689	1763	1872	1807	1799
STD	28	11	9	0	38	32	12	32	32
Coefficient of Variation	2	1	1	0	2	2	1	2	2
% Change		-3	-2	-4	-7	-2	4	0	-0
Stress @ 200% Elongation (psi)	1902	1793	1778	1687	1659	1825	1887	1851	1825
ASTM D638	1855	1805	1793	1795	1744	1843	1857	1878	1863
Transverse Direction	1831	1780	1815	1795	1744	1817	1871	1826	1870
	1795								
	1866								
	1843								
Average	1849	1793	1795	1759	1716	1828	1872	1852	1853
STD	33	10	15	51	40	11	12	21	20
Coefficient of Variation	2	1	1	3	2	1	1	1	1
% Change		-3	-3	-5	-7	-1	1	0	0
Modulus of Elasticity:									
STM D882 (psi)	17074	14985	14545	18719	21249	17769	16980	16498	16184
achine Direction	16042	14957	13681	18990	21051	15943	15851	16979	17319
	17673	14952	14385	19007	20532	16525	16537	16939	16501
	16448								
	15839								
	15205								
Average	16380	14965	14197	16905	20944	16746	16746	16805	16668
STD	888	18	471	162	370	933	933	267	586
Coefficient of Variation	5	0	3	1	2	6	6	2	4
% Change		-9	-13	15	28	2	2	3	2

Page 5 of 9

Project: Westinghouse File: West-L53.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Water Based Mixture of Metal Nitrates and Nitric Acid

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Modulus of Elasticity:									
ASTM D882 (psi)	15951	15585	14895	19976	17545	17769	16461	16950	17507
Transverse Direction	15098	14777	15074	18164	20248	15943	15359	16762	17446
	15218	15689	14273	19080	20413	16525	15098	16607	17201
	15247								
	15180								
	15402								
Average	15349	15350	14747	19073	19402	16746	16746	16773	17385
STD	311	499	420	906	1610	933	933	172	162
Coefficient of Variation	2	3	3	5	8	6	6	1	1
% Change		0	-4	24	26	9	9	9	13
Indentation Hardness:									
Reading	57	57	58	61	59	60	57	62	63
ASTM D2240	50	57	55	62	61	60	59	62	61
(with TYPE D DUROMETER)	54	54	57	62	62	60	59	60	63
	50	56	57	61	60	59	58	62	63
	52	55	56	59	60	61	61	61	62
	55								
	58								
	58								
	58								
	54								
Average	55	56	57	61	60	60	59	61	62
STD	3	1	1	1	1	1	1	1	1
Coefficient of Variation	6	2	2	2	2	1	3	1	1
% Change		2	4	12	11	10	8	12	14
Specific Gravity:									
ASTM D792, Method A	0.948	0.938	0.945	0.948	0.941	0.943	0.940	0.945	0.937
	0.942	0.948	0.938	0.950	0.938	0.941	0.940	0.947	0.941
	0.937	0.937	0.947	0.948	0.939	0.942	0.941	0.946	0.945
	0.945								
	0.937								
	0.949								
Average	0.943	0.940	0.943	0.949	0.939	0.942	0.940	0.946	0.941
STD	0.005	0.007	0.005	0.001	0.002	0.001	0.001	0.001	0.004
Coefficient of Variation	1	1	1	0	0	0	0	0	0
% Change		-0.28	0.04	0.60	-0.39	-0.11	-0.28	0.32	-0.21
Environmental Stress Crack Resistance:									
ASTM D1693, Condition B									
Machine Direction (% Failed)	N/A	0	0	0	0	0	0	0	0
Transverse Direction (% Failed)	N/A	0	0	0	0	0	0	0	0

Page 6 of 9

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Water Based Mixture of Metal Nitrates and Nitric Acid

MDN
Quality Review

Report Date: March 06, 1995

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
		Exposure Time and Temperature							
Puncture Resistance:									
Load @ Rupture (lbs)	121	126	127	129	127	127	131	131	128
FTMS 101C Method 2065	119	125	125	127	128	127	130	129	129
	124	125	124	124	126	126	128	128	127
	119								
	121								
	127								
Average	122	125	125	127	127	127	130	129	128
STD	3	0	1	2	1	0	1	1	1
Coefficient of Variation	2	0	1	2	1	0	1	1	1
% Change		3	3	4	4	4	6	6	5
Strain @ Rupture (in)	0.28	0.40	0.39	0.39	0.40	0.27	0.44	0.50	0.47
FTMS 101C Method 2065	0.25	0.26	0.42	0.33	0.42	0.40	0.47	0.44	0.45
	0.40	0.39	0.39	0.35	0.39	0.41	0.44	0.44	0.48
	0.24								
	0.24								
	0.40								
Average	0.30	0.35	0.40	0.36	0.40	0.36	0.45	0.46	0.47
STD	0.07	0.06	0.01	0.02	0.01	0.06	0.01	0.03	0.01
Coefficient of Variation	23	18	4	7	3	18	3	6	3
% Change		16	33	18	34	19	49	52	55
Volatiles and Extractables:									
Machine Diameter Change (%)	-0.25	-0.28	-0.45	-0.33	-0.13	-0.60	-0.28	-0.55	-0.38
SW 870 - Appendix III-D	-0.25	-0.18	-0.40	0.03	-0.50	-0.35	-0.18	-0.33	-0.70
	-0.42								
	-0.38								
Average	-0.33	-0.23	-0.43	-0.15	-0.31	-0.48	-0.23	-0.44	-0.54
STD	0.08	0.05	0.02	0.18	0.19	0.13	0.05	0.11	0.16
Volatiles and Extractables:									
Transverse Diameter Change (%)	0.28	0.43	0.30	0.25	0.18	0.63	0.43	0.25	0.30
SW 870 - Appendix III-D	-0.03	0.48	0.40	0.05	0.15	0.35	0.30	0.33	0.40
	0.33								
	0.20								
Average	0.20	0.46	0.35	0.15	0.16	0.49	0.36	0.29	0.35
STD	0.14	0.02	0.05	0.10	0.01	0.14	0.06	0.04	0.05
% Volatiles	0.04	0.02	0.05	0.03	0.03	0.07	0.08	0.06	0.13
SW 870 - Appendix III-D	0.04	0.02	0.04	0.03	0.04	0.06	0.09	0.05	0.03
	0.04								
	0.04								
Average	0.04	0.02	0.05	0.03	0.04	0.07	0.09	0.06	0.08
STD	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.05
% Extractables	0.06	0.15	0.14	0.10	0.15	0.06	0.07	0.03	0.04
SW 870 - Appendix III-D	0.07	0.14	0.09	0.16	0.15	0.02	0.04	0.03	0.03
	0.06								
	0.07								
Average	0.07	0.15	0.12	0.13	0.15	0.04	0.06	0.03	0.04
STD	0.01	0.00	0.03	0.03	0.00	0.02	0.02	0.00	0.01

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Water Based Mixture of Metal Nitrates and Nitric Acid

SRA
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tear Resistance:									
ASTM D1004	58	71	71	68	69	65	65	66	69
(lbs)	59	68	67	68	70	65	64	64	70
Machine Direction	58	71	71	68	69	65	64	66	69
	59								
	58								
	59								
Average	59	70	70	68	69	65	65	66	69
STD	1	2	2	0	1	0	1	0	1
Coefficient of Variation	1	2	3	0	1	0	2	0	1
% Change		20	19	16	19	11	11	16	19
Tear Resistance:									
ASTM D1004	56	71	71	67	69	66	66	69	69
(lbs)	56	68	69	67	67	66	66	68	69
Transverse Direction	57	69	68	67	67	66	66	67	69
	58								
	59								
	57								
Average	57	69	69	67	68	66	66	68	69
STD	1	2	2	0	1	0	0	1	0
Coefficient of Variation	2	2	2	0	2	0	0	1	0
% Change		22	22	18	19	16	16	19	21
Hydrostatic Resistance:									
ASTM D751	595	610	605	600	595	570	656	610	630
(psi)	595	600	605	590	585	580	570	620	600
	590	605	615	590	590	575	570	600	625
	605								
	596								
	590								
Average	595	605	608	593	590	575	599	610	618
STD	5	5	6	6	5	5	50	10	16
Coefficient of Variation	1	1	1	1	1	1	8	2	3
% Change		2	2	-0	-1	-3	1	3	4
Hydrostatic Resistance:									
ASTM D751	11.90	12.53	14.34	10.47	10.37	9.29	8.06	6.97	10.72
time to burst (sec)	12.62	12.50	13.12	10.38	9.86	8.59	8.84	10.03	10.87
	12.44	11.72	11.75	10.72	10.37	8.63	7.44	8.38	8.28
	12.03								
	11.50								
	12.03								
Average	12.19	12.25	13.07	10.52	10.21	8.84	8.11	8.46	9.96
STD	0	0	1	0	0	0	1	2	1
Coefficient of Variation	4	4	10	2	3	4	9	18	15
% Change		1	7	-14	-16	-27	-33	-31	-18

Page 8 of 9

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Water Based Mixture of Metal Nitrates and Nitric Acid

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Seam Peel Adhesion:									
ASTM D4437 (lbs)	153	139	151	137	140	148	147	154	150
	157	147	140	143	136	150	152	153	150
	154	144	149	139	134	145	145	143	149
	155	146	140	143	137	146	153	150	145
	155	151	147	133	145	147	147	144	142
	161	147	144	131	137	149	151	151	147
	154								
	154								
	153								
	154								
	160								
	153								
Average	155	146	145	138	138	148	149	149	147
STD	3	4	4	5	4	2	3	4	3
Coefficient of Variation	2	2	3	3	3	1	2	3	2
% Change		-6	-6	-11	-11	-5	-4	-4	-5
Failure Mode (FTB = All Film Tear Bond)	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB
Shear Seam Strength:									
Shear Seam Strength (lbs)	168	153	151	152	160	156	155	164	155
ASTM D4437	166	154	151	156	158	156	156	163	157
	168	152	152	152	158	156	156	163	155
	167								
	169								
	167								
verage	168	153	151	153	159	156	156	163	156
TD	1	1	0	2	1	0	0	0	1
Coefficient of Variation	0	1	0	1	1	0	0	0	1
% Change		-9	-10	-9	-5	-7	-7	-3	-7

Page 9 of 9

EPA METHOD 9090 TEST RESULTS

80 mil NATIONAL SEAL SMOOTH HDPE GEOMEMBRANE EXPOSED TO SODIUM HYDROXIDE SOLUTION

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Sodium Hydroxide Solution

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
GEOMEMBRANE: 80 mil SMOOTH HDPE									
Tensile Properties:									
Tensile Stress @ Yield (psi)	2488	2253	2383	2489	2457	2533	2493	2469	2296
ASTM D638	2439	2209	2366	2439	2390	2504	2322	2383	2390
Machine Direction	2439	2267	2341	2519	2420	2480	2356	2416	2405
	2476								
	2415								
	2415								
Average	2445	2243	2363	2482	2422	2506	2390	2423	2364
STD	28	25	17	33	27	22	74	35	48
Coefficient of Variation	1	1	1	1	1	1	3	1	2
% Change		-8	-3	2	-1	2	-2	-1	-3
Tensile Strength @ Break (psi)	4537	5126	5531	5915	5284	5540	5266	4388	4553
ASTM D638	4232	4663	5183	6220	5146	5265	5030	4536	4838
Machine Direction	5195	5047	5488	4780	6222	5160	5518	4880	4644
	4282								
	4146								
	5341								
Average	4622	4945	5401	5638	5551	5322	5272	4601	4678
STD	474	202	155	620	478	160	199	206	119
Coefficient of Variation	10	4	3	11	9	3	4	4	3
% Change		7	17	22	20	15	14	-0	1
Tensile Properties:									
Elongation @ Yield (%)	20	20	20	17	22	21	21	18	20
ASTM D638	18	22	20	20	20	21	21	19	19
Machine Direction	22	20	22	17	18	21	24	18	19
	22								
	20								
	18								
Average	20	21	21	18	20	21	22	18	19
STD	2	1	1	1	2	0	1	0	0
Coefficient of Variation	8	5	5	8	8	0	6	3	2
% Change		3	3	-10	0	5	10	-8	-3

Project: Westinghouse File: West-L14.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Sodium Hydroxide Solution

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Elongation @ Break (%)	795	987	1008	922	924	805	787	604	650
ASTM D638	748	881	944	984	900	767	765	626	672
Machine Direction	905	970	1001	819	1007	744	739	674	662
	751								
	735								
	924								
Average	810	946	984	908	944	772	764	635	661
STD	77	46	29	68	46	25	20	29	9
Coefficient of Variation	9	5	3	7	5	3	3	5	1
% Change		17	22	12	17	-5	-6	-22	-18
Set after Break (%)	682	702	739	718	748	778	575	628	553
ASTM D638	689	708	724	715	697	802	751	671	571
Machine Direction	656	714	728	673	779	792	712	576	570
	678								
	684								
	719								
Average	685	708	730	702	741	791	679	625	565
STD	19	5	6	21	34	10	75	39	8
Coefficient of Variation	3	1	1	3	5	1	11	6	1
% Change		3	7	3	8	15	-1	-9	-18
Stress @ 100% Elongation (psi)	1841	1632	1765	1829	1802	1918	1909	1826	1744
ASTM D638	1841	1616	1732	1780	1756	1829	1850	1838	1797
Machine Direction	1805	1651	1744	1841	1765	1817	2169	1831	1801
	1841								
	1793								
	1829								
Average	1825	1633	1747	1817	1774	1854	1976	1832	1781
STD	19	14	14	26	20	44	139	5	26
Coefficient of Variation	1	1	1	1	1	2	7	0	1
% Change		-11	-4	-0	-3	2	8	0	-2

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Sodium Hydroxide Solution

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Stress @ 200% Elongation (psi)	1902	1690	1827	1866	1815	1864	1916	1902	1800
ASTM D638	1854	1674	1756	1854	1817	1826	1829	1889	1846
Machine Direction	1817	1696	1756	1890	1840	1840	1817	1879	1845
	1866								
	1854								
	1878								
Average	1862	1687	1780	1870	1824	1843	1854	1890	1830
STD	26	10	33	15	11	16	44	9	21
Coefficient of Variation	1	1	2	1	1	1	2	0	1
% Change		-9	-4	0	-2	-1	-0	2	-2
Tensile Properties:									
Tensile Stress @ Yield (psi)	2524	2282	2354	2439	2415	2252	2315	2235	2422
ASTM D638	2398	2259	2341	2469	2439	2321	2342	2331	2464
Transverse Direction	2349	2298	2280	2427	2489	2330	2392	2395	2363
	2313								
	2439								
	2313								
Average	2389	2280	2325	2445	2448	2301	2350	2320	2416
STD	75	16	32	18	31	35	32	66	41
Coefficient of Variation	3	1	1	1	1	2	1	3	2
% Change		-5	-3	2	2	-4	-2	-3	1
Tensile Strength @ Break (psi)	5341	5012	4683	6000	5012	4818	5268	5271	5024
ASTM D638	5205	4729	4537	6333	5659	4440	5030	5349	5225
Transverse Direction	5169	5036	5390	6065	6073	4006	5518	4173	5063
	5253								
	5366								
	5253								
Average	5265	4926	4870	6139	5581	4422	5272	4931	5104
STD	70	139	372	141	437	331	199	537	87
Coefficient of Variation	1	3	8	2	8	7	4	11	2
% Change		-6	-7	17	6	-16	0	-6	-3

Page 3 of 9

Project: Westinghouse File: West-L34.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Sodium Hydroxide Solution

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tensile Properties:									
Elongation @ Yield (%)	20	20	22	18	18	21	22	19	19
ASTM D638	20	20	22	20	20	21	23	18	21
Transverse Direction	22	22	23	18	22	24	20	18	21
	20								
	20								
	20								
Average	20	21	22	19	20	22	22	18	20
STD	1	1	0	1	2	1	1	0	1
Coefficient of Variation	4	5	2	5	8	6	6	3	5
% Change		2	10	-8	-2	8	7	-10	0
Elongation @ Break (%)	946	964	1002	977	879	810	865	737	717
ASTM D638	951	914	858	1020	988	956	926	746	745
Transverse Direction	936	951	855	990	975	890	805	596	732
	928								
	938								
	930								
Average	938	943	905	996	947	885	865	693	731
STD	8	21	69	18	49	60	49	69	11
Coefficient of Variation	1	2	8	2	5	7	6	10	2
% Change		1	-4	6	1	-6	-8	-26	-22
Set after Break (%)	724	785	707	849	709	733	739	609	610
ASTM D638	743	704	689	758	728	670	709	608	622
Transverse Direction	729	785	684	738	786	604	753	541	623
	738								
	740								
	731								
Average	734	751	693	782	741	669	734	586	618
STD	7	34	10	48	33	53	18	32	6
Coefficient of Variation	1	5	1	6	4	8	3	5	1
% Change		2	-6	6	1	-9	-0	-20	-16

Page 4 of 9

Project: Westinghouse File: West-L44.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Sodium Hydroxide Solution

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Stress @ 100% Elongation (psi)	1854	1694	1768	1817	1805	1800	1840	1754	1819
ASTM D638	1795	1671	1707	1817	1854	1871	1933	1822	1843
Transverse Direction	1807	1702	1707	1744	1890	1901	1859	1835	1826
	1771								
	1829								
	1783								
Average	1807	1689	1727	1793	1850	1857	1877	1804	1829
STD	28	13	29	34	35	42	40	36	10
Coefficient of Variation	2	1	2	2	2	2	2	2	1
% Change		-7	-4	-1	2	3	4	-0	1
Stress @ 200% Elongation (psi)	1902	1753	1805	1805	1854	1763	1800	1823	1842
ASTM D638	1855	1694	1756	1876	1866	1785	1871	1892	1883
Transverse Direction	1831	1714	1732	1829	1802	1785	1901	1891	1864
	1795								
	1866								
	1843								
Average	1849	1720	1764	1837	1841	1778	1857	1869	1863
STD	33	24	30	29	28	10	42	32	17
Coefficient of Variation	2	1	2	2	2	1	2	2	1
% Change		-7	-5	-1	-0	-4	0	1	1
Modulus of Elasticity:									
ASTM D882 (psi)	17074	15237	16825	18824	18314	16835	15749	16291	16833
Machine Direction	16042	15810	16109	18056	17624	18186	16248	16550	17220
	17673	14971	16336	17521	23397	18048	16041	16665	16595
	16448								
	15839								
	15205								
Average	16380	15339	16423	18134	19778	17623	16013	16502	16883
STD	888	429	366	655	3153	858	251	192	315
Coefficient of Variation	5	3	2	4	16	5	2	1	2
% Change		-6	0	11	21	8	-2	1	3

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Sodium Hydroxide Solution

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Modulus of Elasticity:									
ASTM D882 (psi)	15951	14691	15743	41742	24327	16387	15139	16534	15836
Transverse Direction	15098	14886	15124	17888	21269	15725	16991	17878	17149
	15218	15160	15831	17086	20590	16786	16469	17057	17933
	15247								
	15180								
	15402								
Average	15349	14912	15566	25572	22062	16299	16200	17156	16973
STD	311	236	385	14009	1991	536	955	677	1060
Coefficient of Variation	2	2	2	55	9	3	6	4	6
% Change		-3	1	67	44	6	6	12	11
Indentation Hardness:									
Reading	57	54	57	61	56	60	58	60	61
ASTM D2240	50	52	56	60	61	57	59	60	61
(with TYPE D DUROMETER)	54	50	57	61	59	58	60	60	63
	50	58	55	57	58	56	60	60	63
	52	58	55	60	56	59	59	61	61
	55								
	58								
	58								
	58								
	54								
Average	55	54	56	60	58	58	59	60	62
STD	3	4	1	2	2	2	1	0	1
Coefficient of Variation	6	7	2	3	4	3	1	1	2
% Change		-0	3	10	6	6	6	10	13
Specific Gravity:									
ASTM D792, Method A	0.948	0.945	0.935	0.951	0.939	0.941	0.941	0.950	0.941
	0.942	0.933	0.943	0.945	0.943	0.946	0.940	0.951	0.947
	0.937	0.940	0.948	0.947	0.944	0.942	0.942	0.949	0.944
	0.945								
	0.937								
	0.949								
Average	0.943	0.939	0.942	0.948	0.942	0.943	0.941	0.950	0.944
STD	0.005	0.006	0.007	0.003	0.003	0.003	0.001	0.001	0.003
Coefficient of Variation	1	1	1	0	0	0	0	0	0
% Change		-0.39	-0.11	0.49	-0.11	0.00	-0.21	0.74	0.11
Environmental Stress Crack Resistance:									
ASTM D1693, Condition B									
Machine Direction (% Failed)	N/A	0	0	0	0	0	0	0	0
Transverse Direction (% Failed)	N/A	0	0	0	0	0	0	0	0

Project: Westinghouse File: West-L64.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Sodium Hydroxide Solution

Report Date: March 06, 1995

Exposure Time and Temperature

MDN
Quality Review

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Puncture Resistance:									
Load @ Rupture (lbs)	121	126	122	125	123	124	127	128	127
FTMS 101C Method 2065	119	125	123	122	123	121	123	127	127
	124	122	122	121	123	122	123	125	125
	119								
	121								
	127								
Average	122	124	122	123	123	122	124	127	126
STD	3	2	0	2	0	1	2	1	1
Coefficient of Variation	2	1	0	1	0	1	2	1	1
% Change		2	0	1	1	0	2	4	4
Strain @ Rupture (in)	0.28	0.43	0.43	0.38	0.43	0.44	0.44	0.45	0.46
FTMS 101C Method 2065	0.25	0.43	0.42	0.41	0.44	0.41	0.44	0.44	0.44
	0.40	0.43	0.39	0.44	0.40	0.44	0.43	0.43	0.43
	0.24								
	0.24								
	0.40								
Average	0.30	0.43	0.41	0.41	0.42	0.43	0.44	0.44	0.44
STD	0.07	0.00	0.02	0.02	0.02	0.01	0.00	0.01	0.01
Coefficient of Variation	23	0	4	6	4	3	1	2	3
% Change		43	37	36	40	43	45	46	47
Volatiles and Extractables:									
'achine Diameter Change (%)	-0.25	-0.88	-0.13	-0.40	-0.70	-0.35	-0.80	-0.13	-0.43
,W 870 - Appendix III-D	-0.25	-0.80	-0.23	-0.53	-0.68	-0.55	-0.93	-0.08	-0.37
	-0.42								
	-0.38								
Average	-0.33	-0.84	-0.18	-0.47	-0.69	-0.45	-0.87	-0.11	-0.40
STD	0.08	0.04	0.05	0.06	0.01	0.10	0.07	0.03	0.03
Volatiles and Extractables:									
Transverse Diameter Change (%)	0.28	0.43	-0.08	0.10	0.55	0.18	0.48	0.18	0.10
SW 870 - Appendix III-D	-0.03	0.48	0.12	0.38	-0.08	0.03	0.55	0.20	0.15
	0.33								
	0.20								
Average	0.20	0.48	0.02	0.24	0.24	0.11	0.52	0.19	0.13
STD	0.14	0.02	0.10	0.14	0.31	0.08	0.04	0.01	0.02
% Volatiles	0.04	0.05	0.06	0.05	0.09	0.08	0.13	0.05	0.12
SW 870 - Appendix III-D	0.04	0.05	0.06	0.06	0.07	0.08	0.14	0.04	0.10
	0.04								
	0.04								
Average	0.04	0.05	0.06	0.06	0.08	0.08	0.14	0.05	0.11
STD	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01
% Extractables	0.06	0.12	0.12	0.13	0.08	0.04	0.03	0.11	0.14
SW 870 - Appendix III-D	0.07	0.09	0.12	0.10	0.16	0.03	0.02	0.10	0.15
	0.08								
	0.07								
/erage	0.07	0.11	0.12	0.12	0.12	0.04	0.03	0.11	0.15
,TD	0.01	0.02	0.00	0.02	0.04	0.01	0.01	0.00	0.00

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Sodium Hydroxide Solution

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Tear Resistance:									
ASTM D1004	58	70	67	68	66	66	65	68	67
(lbs)	59	69	69	68	67	64	65	68	68
Machine Direction	58	71	68	67	66	65	66	68	67
	59								
	58								
	59								
Average	59	70	68	68	66	65	65	68	67
STD	1	1	1	1	1	1	1	0	1
Coefficient of Variation	1	1	1	1	1	2	1	0	1
% Change		20	16	16	13	11	12	16	15
Tear Resistance:									
ASTM D1004	56	69	69	68	69	64	66	68	67
(lbs)	56	68	67	67	69	64	66	68	67
Transverse Direction	57	69	69	67	68	65	66	68	67
	58								
	58								
	57								
Average	57	69	68	67	69	64	66	68	67
STD	1	1	1	1	1	1	0	0	0
Coefficient of Variation	2	1	2	1	1	1	0	0	0
% Change		20	20	18	20	13	16	19	18
Hydrostatic Resistance:									
ASTM D751	595	595	600	580	600	585	570	610	600
(psi)	595	590	595	585	590	580	560	590	600
	590	595	610	590	590	580	580	620	610
	605								
	595								
	590								
Average	595	593	602	585	593	582	570	607	603
STD	5	3	8	5	6	3	10	15	6
Coefficient of Variation	1	0	1	1	1	0	2	3	1
% Change		-0	1	-2	-0	-2	-4	2	1
Hydrostatic Resistance:									
ASTM D751	11.90	12.87	11.69	8.78	10.69	7.12	7.25	11.62	7.44
time to burst (sec)	12.62	12.35	12.90	8.62	11.66	8.56	8.54	13.22	8.65
	12.44	12.84	13.63	11.56	11.46	9.79	10.10	11.48	9.75
	12.63								
	11.50								
	12.03								
Average	12.19	12.69	12.74	9.65	11.27	8.49	8.63	12.10	8.61
STD	0	0	1	2	1	1	1	1	1
Coefficient of Variation	4	2	8	17	5	16	17	8	13
% Change		4	5	-21	-8	-30	-29	-1	-29

Page 8 of 9

Project: Westinghouse File: West-L84.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Exposed to Sodium Hydroxide Solution

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 23C	30 Day 50C	60 Day 23C	60 Day 50C	90 Day 23C	90 Day 50C	120 Day 23C	120 Day 50C
Seam Peel Adhesion:									
ASTM D4437 (lbs)	153	139	142	138	142	150	147	159	156
	157	149	141	143	140	145	145	150	150
	154	140	140	147	137	150	146	145	158
	155	135	141	133	138	149	145	140	150
	155	134	149	145	145	151	147	146	149
	161	144	140	134	137	145	147	154	154
	154								
	154								
	153								
	154								
	160								
	153								
Average	155	140	142	140	140	148	146	149	153
STD	3	5	3	5	3	2	1	6	3
Coefficient of Variation	2	4	2	4	2	2	1	4	2
% Change		-10	-8	-10	-10	-4	-6	-4	-2
Failure Mode (FTB = All Film Tear Bond)	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB	FTB
Shear Seam Strength:									
Shear Seam Strength (lbs)	168	157	151	154	158	157	155	156	155
ASTM D4437	168	156	151	154	156	157	155	157	155
	168	155	152	150	157	155	154	155	140
	167								
	169								
	167								
Average	168	156	151	153	157	156	155	156	150
STD	1	1	0	2	1	1	0	1	7
Coefficient of Variation	0	1	0	1	1	1	0	1	5
% Change		-7	-10	-9	-6	-7	-8	-7	-11

EPA METHOD 9090 TEST RESULTS

GEOSYNTHETIC DIMENSIONS

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Dimensional Stability Data

MDN
Quality Review

Report Date: March 06, 1995

Exposure Time and Temperature

.est Parameters	Temp.	Baseline	30 Day Exposed	% Change	Baseline	60 Day Exposed	% Change	Baseline	90 Day Exposed	% Change	Baseline	120 Day Exposed	% Change
GEOMEMBRANE: NATIONAL SEAL 80 mil SMOOTH HDPE exposed to Organic Solution in Butanol													
Thickness (mils)	23C	85	81	-4.7	86	82	-4.7	87	83	-4.6	85	82	-3.5
	50C	85	81	-4.7	86	81	-5.8	85	81	-4.7	87	82	-5.7
Length (inches)	23C	9.98	10.01	0.3	10.09	10.11	0.2	10.08	10.15	0.7	10.04	10.09	0.5
	50C	10.15	10.20	0.5	10.02	10.06	0.4	10.03	10.07	0.4	10.01	10.07	0.6
Width (inches)	23C	7.86	7.89	0.4	7.98	8.01	0.4	7.92	7.96	0.5	8.00	8.02	0.2
	50C	7.93	7.96	0.4	7.96	8.00	0.5	7.99	8.03	0.5	7.97	8.00	0.4
Mass (g)	23C	97.82	98.43	0.6	100.29	100.95	0.7	99.60	100.73	1.1	99.79	100.76	1.0
	50C	100.44	101.38	0.9	99.59	100.72	1.1	100.18	101.70	1.5	99.37	100.90	1.5
GEOMEMBRANE: NATIONAL SEAL 80 mil SMOOTH HDPE exposed to Organic Solution in Water													
Thickness (mils)	23C	81	81	0.0	81	82	1.2	82	82	0.0	82	83	1.2
	50C	82	81	-1.2	81	81	0.0	82	82	0.0	82	82	0.0
Length (inches)	23C	10.06	10.08	0.2	10.03	10.04	0.1	10.04	10.07	0.3	10.09	10.12	0.3
	50C	10.05	10.10	0.5	10.01	10.02	0.1	10.03	10.05	0.2	9.98	10.01	0.3
Width (inches)	23C	7.97	7.99	0.3	8.02	8.04	0.2	8.01	8.06	0.6	7.97	8.01	0.5
	50C	8.03	8.03	0.0	7.92	7.93	0.1	7.97	7.98	0.1	7.89	7.93	0.5
Mass (g)	23C	100.75	100.89	0.1	101.79	101.94	0.1	101.77	101.95	0.2	101.74	101.95	0.2
	50C	101.90	102.09	0.2	99.42	99.60	0.2	101.36	101.62	0.3	99.19	99.49	0.3

Project: Westinghouse File: West-Dim.WB1

TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS
Dimensional Stability Data

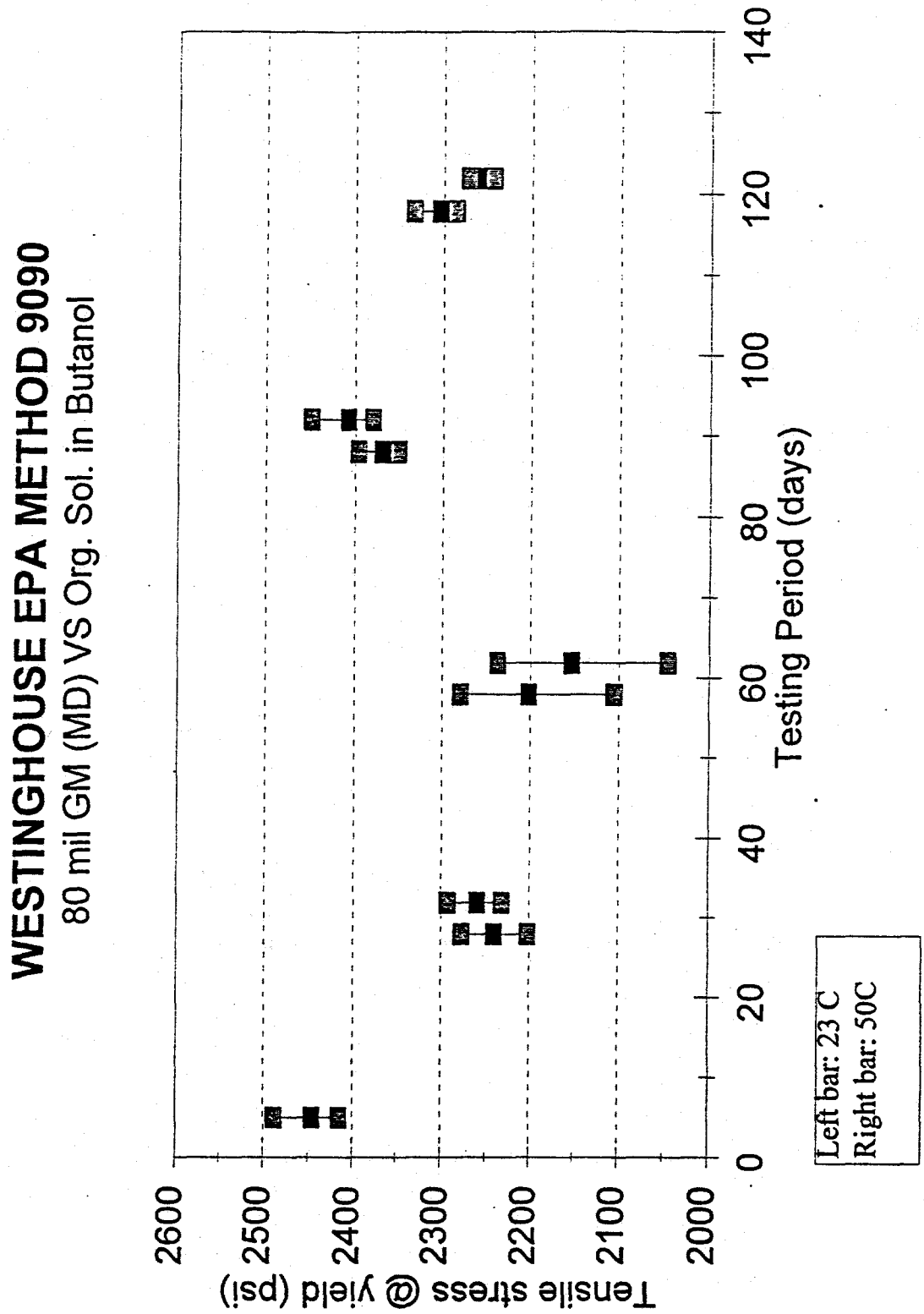
MDN
Quality Review

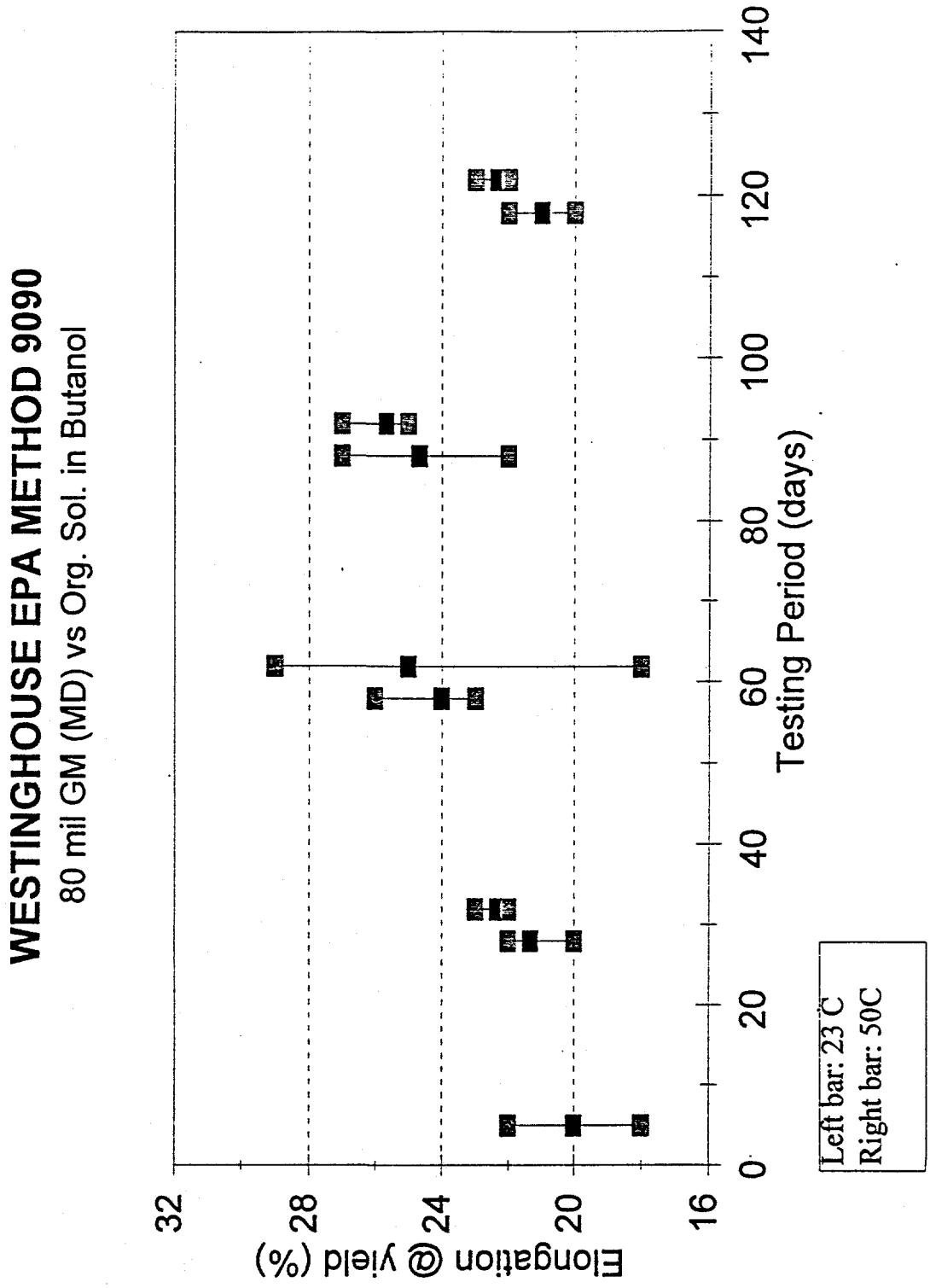
Report Date: March 06, 1995

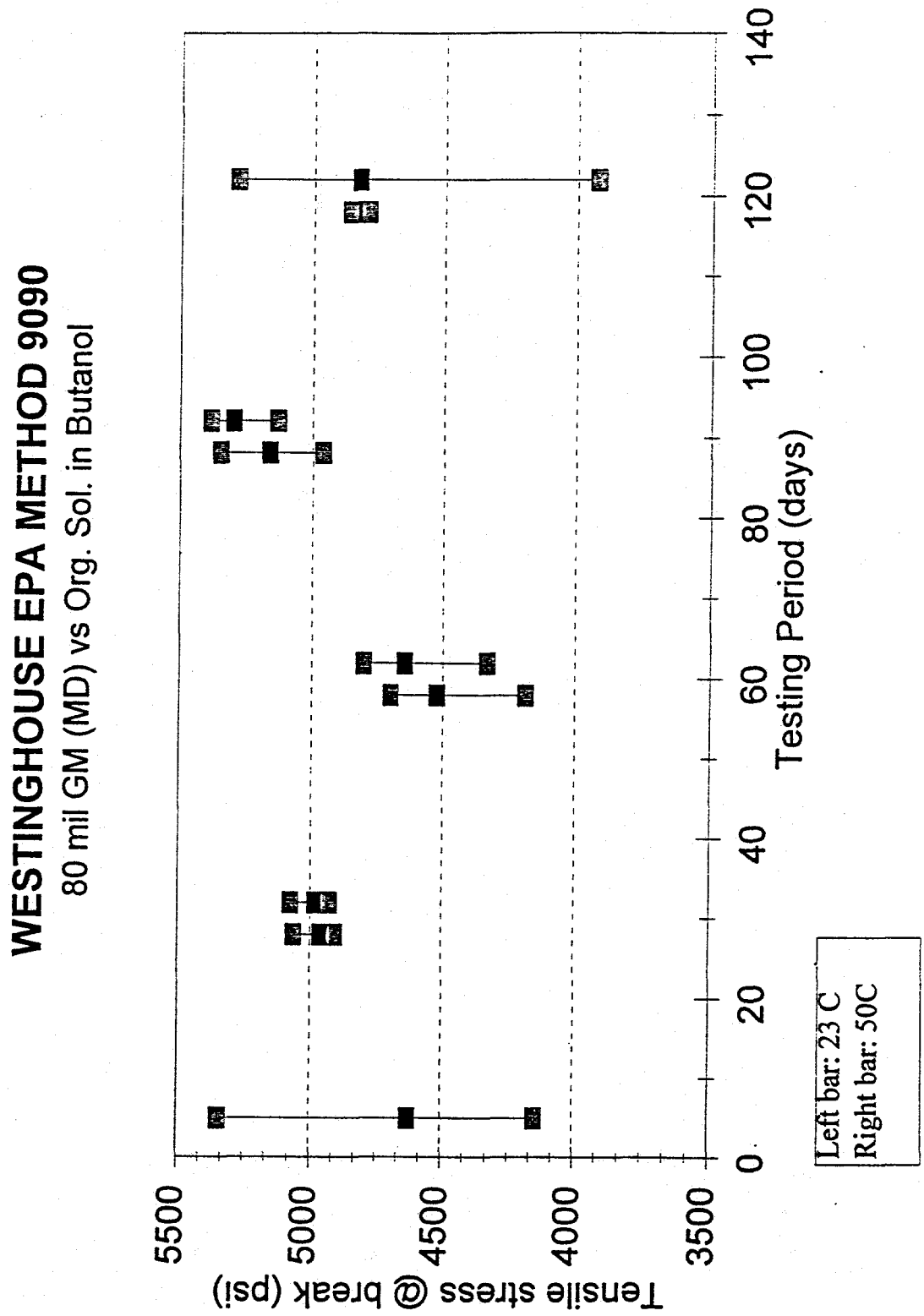
Exposure Time and Temperature

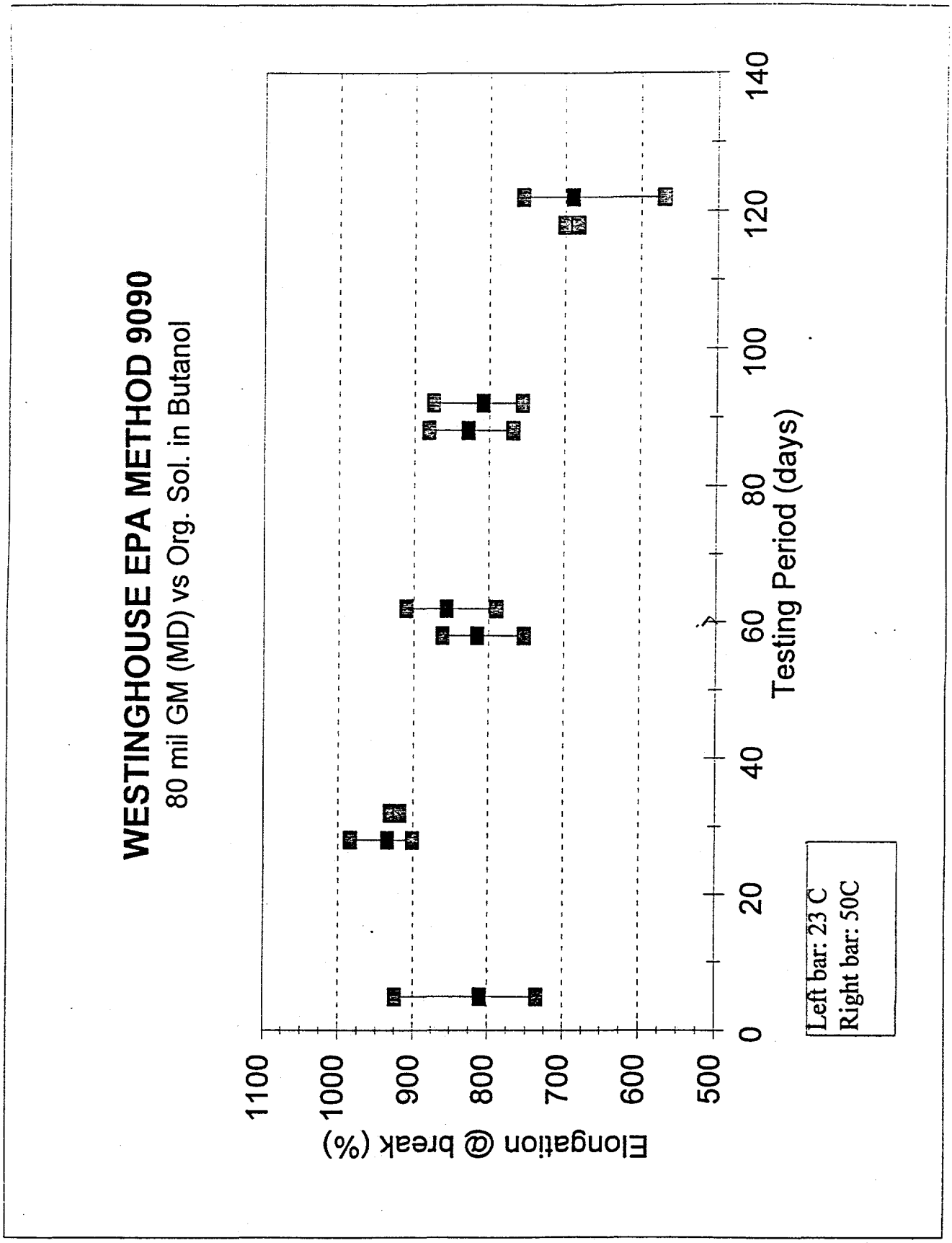
Test Parameters	Temp.	Baseline	30 Day Exposed	% Change	Baseline	60 Day Exposed	% Change	Baseline	90 Day Exposed	% Change	Baseline	120 Day Exposed	% Change
GEOMEMBRANE: NATIONAL SEAL 80 mil SMOOTH HDPE exposed to Water Based Mixture of Metal Nitrates and Nitric Acid													
Thickness (mils)	23C	82	81	-1.2	82	82	0.0	82	82	0.0	81	82	1.2
	50C	82	81	-1.2	82	82	0.0	81	81	0.0	82	82	0.0
Length (inches)	23C	10.03	10.03	0.0	10.03	10.05	0.2	10.07	10.08	0.1	9.95	9.97	0.2
	50C	10.01	10.02	0.1	10.04	10.08	0.4	10.07	9.97	-1.0	9.99	10.02	0.3
Width (inches)	23C	7.91	7.93	0.3	7.97	7.99	0.3	7.97	7.99	0.3	7.96	7.99	0.4
	50C	7.93	7.97	0.5	7.99	8.01	0.3	7.97	7.96	-0.1	7.95	7.96	0.1
Mass (g)	23C	100.12	100.18	0.1	101.28	101.33	0.0	101.67	101.74	0.1	99.40	99.47	0.1
	50C	100.69	100.72	0.0	101.68	101.74	0.1	99.52	99.67	0.2	100.23	100.28	0.0
GEOMEMBRANE: NATIONAL SEAL 80 mil SMOOTH HDPE exposed to Sodium Hydroxide Solution													
Thickness (mils)	23C	82	81	-1.2	81	81	0.0	81	81	0.0	82	83	1.2
	50C	81	81	0.0	81	81	0.0	81	80	-1.2	81	81	0.0
Length (inches)	23C	10.00	10.00	0.0	10.03	10.05	0.2	10.06	10.13	0.7	9.97	10.02	0.5
	50C	10.05	10.06	0.0	9.98	9.99	0.1	10.01	10.00	-0.1	10.03	10.06	0.3
Width (inches)	23C	8.00	8.01	0.1	8.01	8.01	0.0	8.01	8.03	0.2	7.93	7.96	0.4
	50C	7.94	7.95	0.1	8.01	8.02	0.1	7.93	7.97	0.5	7.96	7.97	0.1
Mass (g)	23C	100.85	100.82	-0.0	100.63	100.63	0.0	100.81	101.04	0.2	100.83	100.90	0.1
	50C	99.46	99.56	0.1	100.11	100.19	0.1	99.06	99.23	0.2	99.24	99.38	0.1

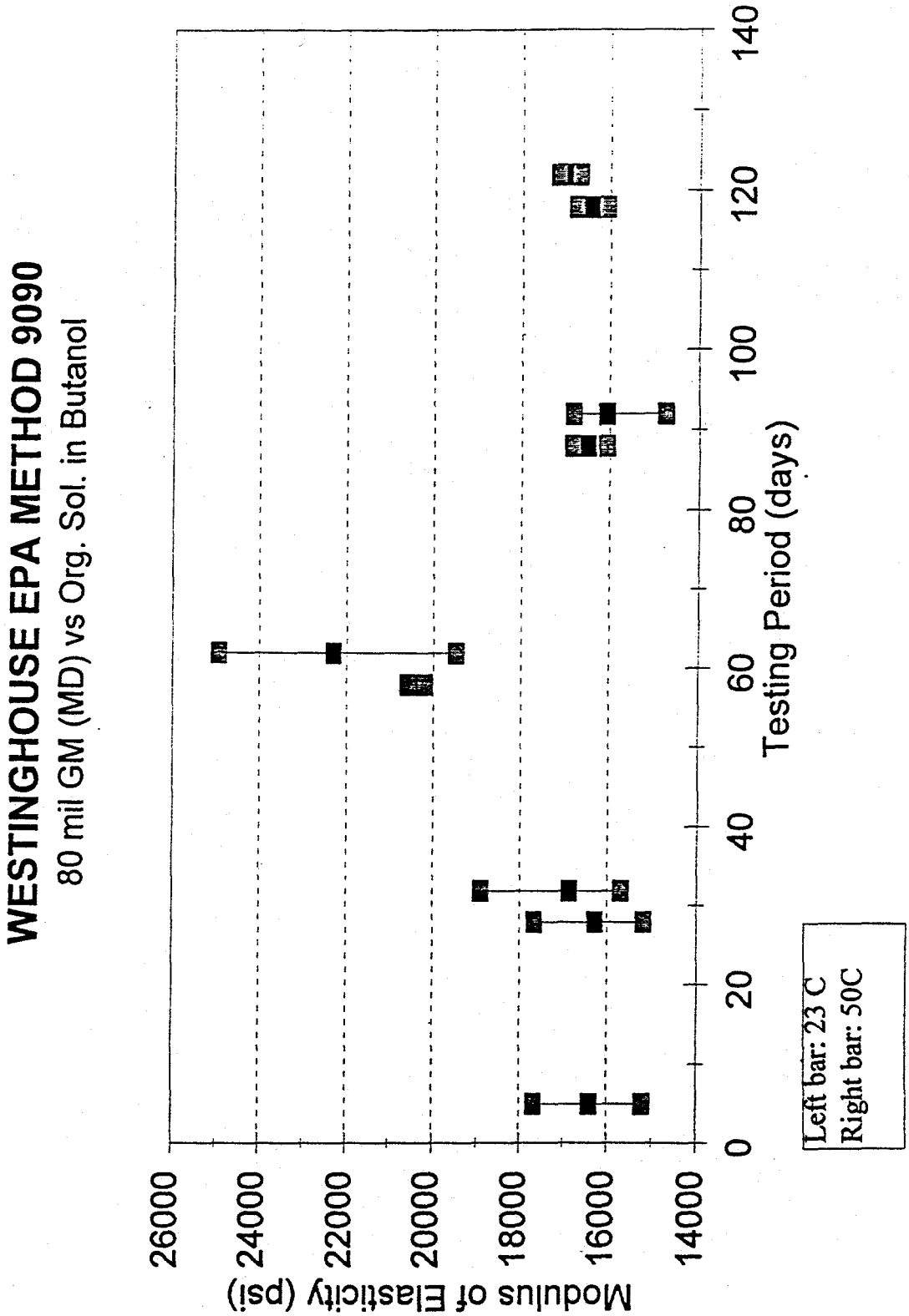
Project: Westinghouse File: West-Dim.WB1

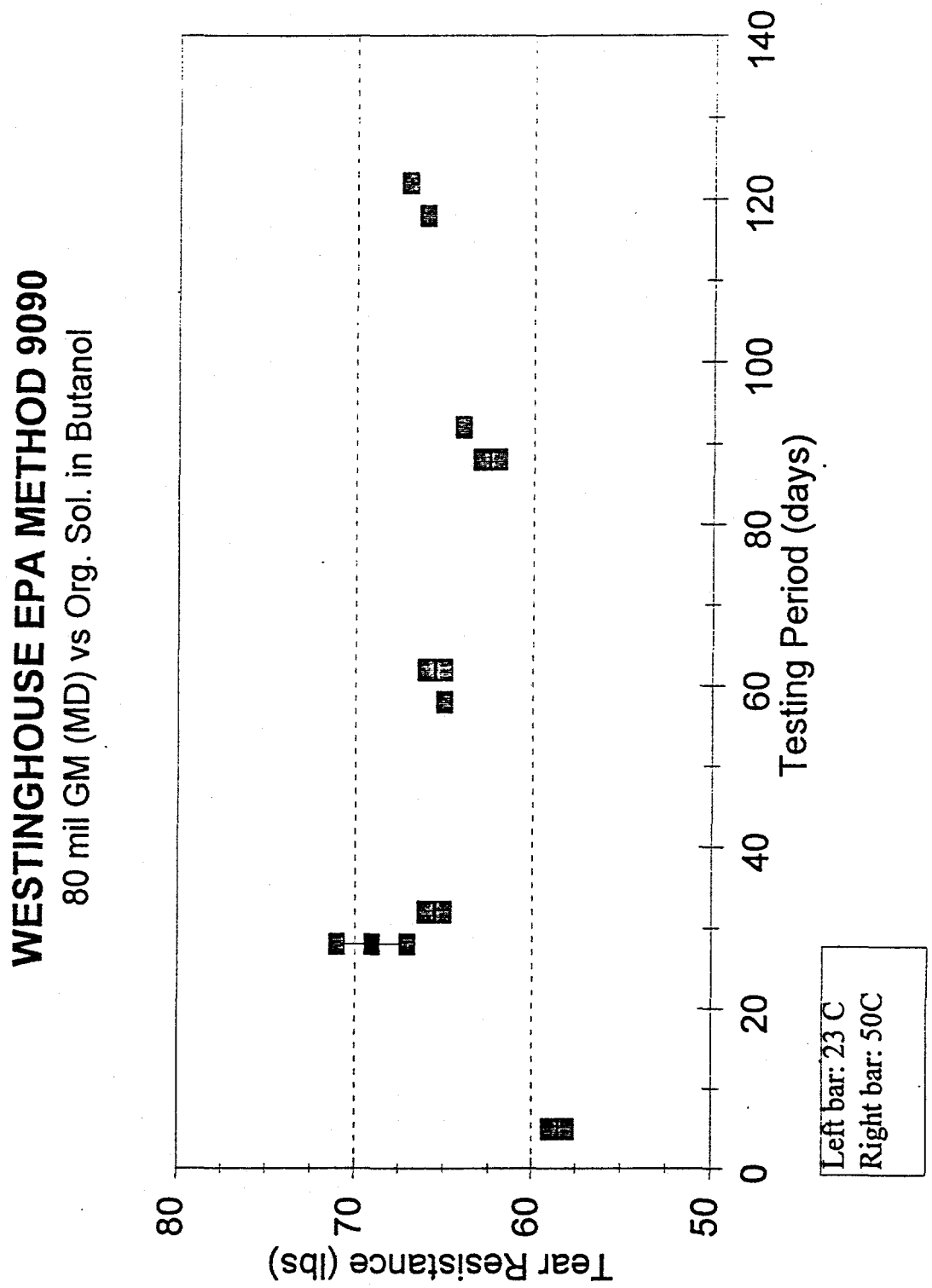

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) VS Org. Sol. in Butanol
Tensile stress @ yield (psi)
2600
2500
2400
2300
2200
2100
2000
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

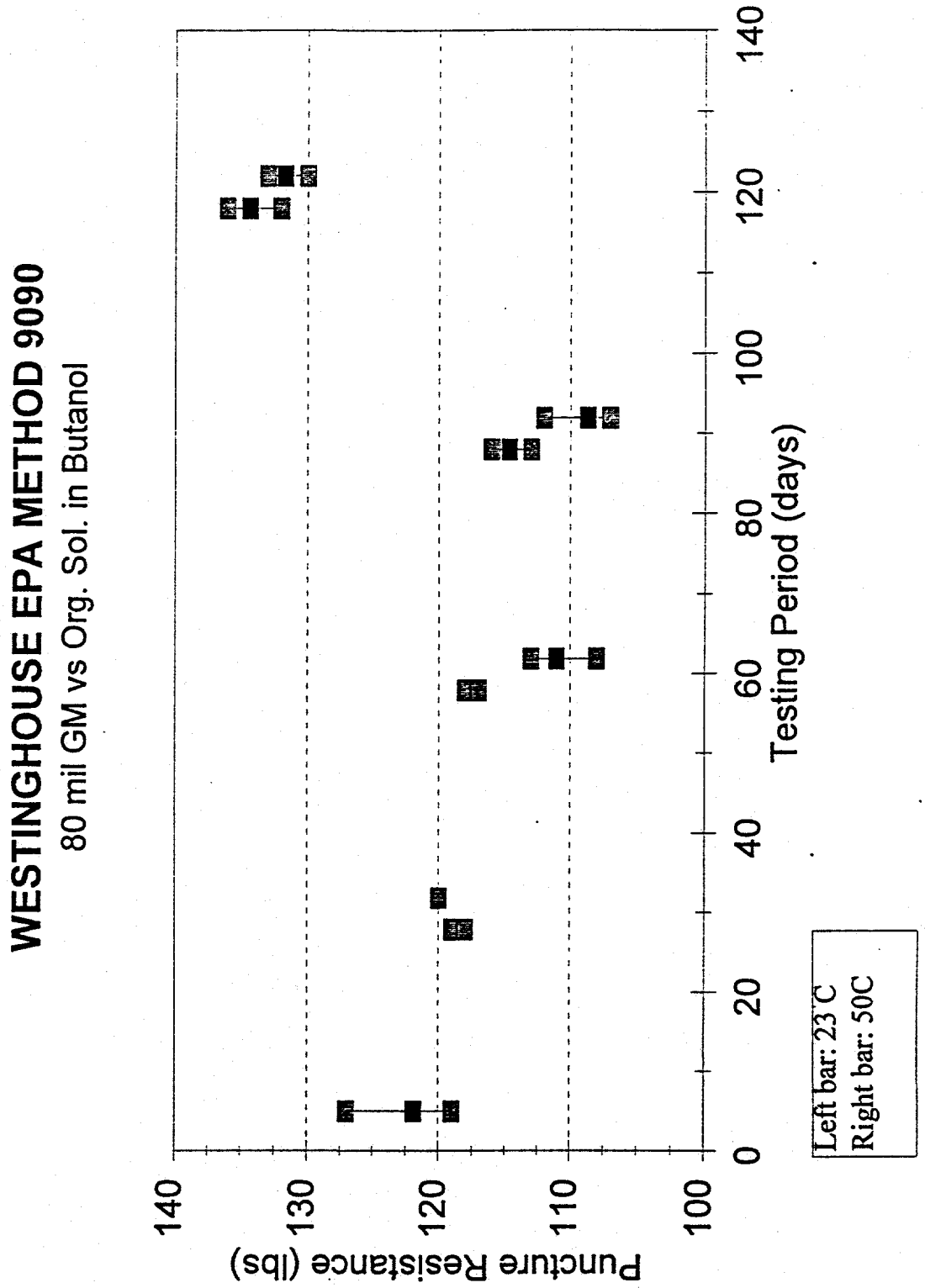

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol. in Butanol
Elongation @ yield (%)
32
28
24
20
16
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

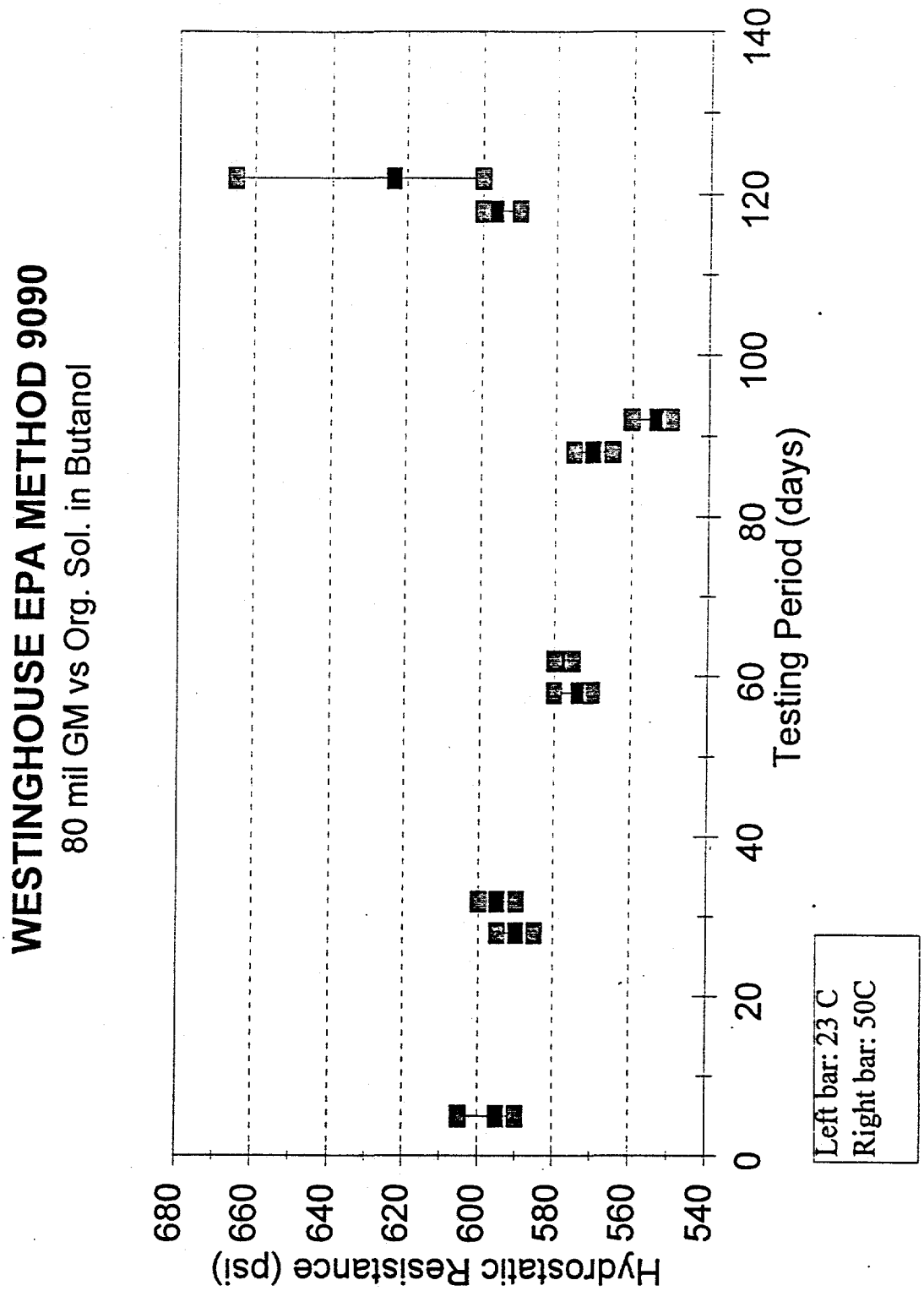

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol. in Butanol
Tensile stress @ break (psi)
5500
5000
4500
4000
3500
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

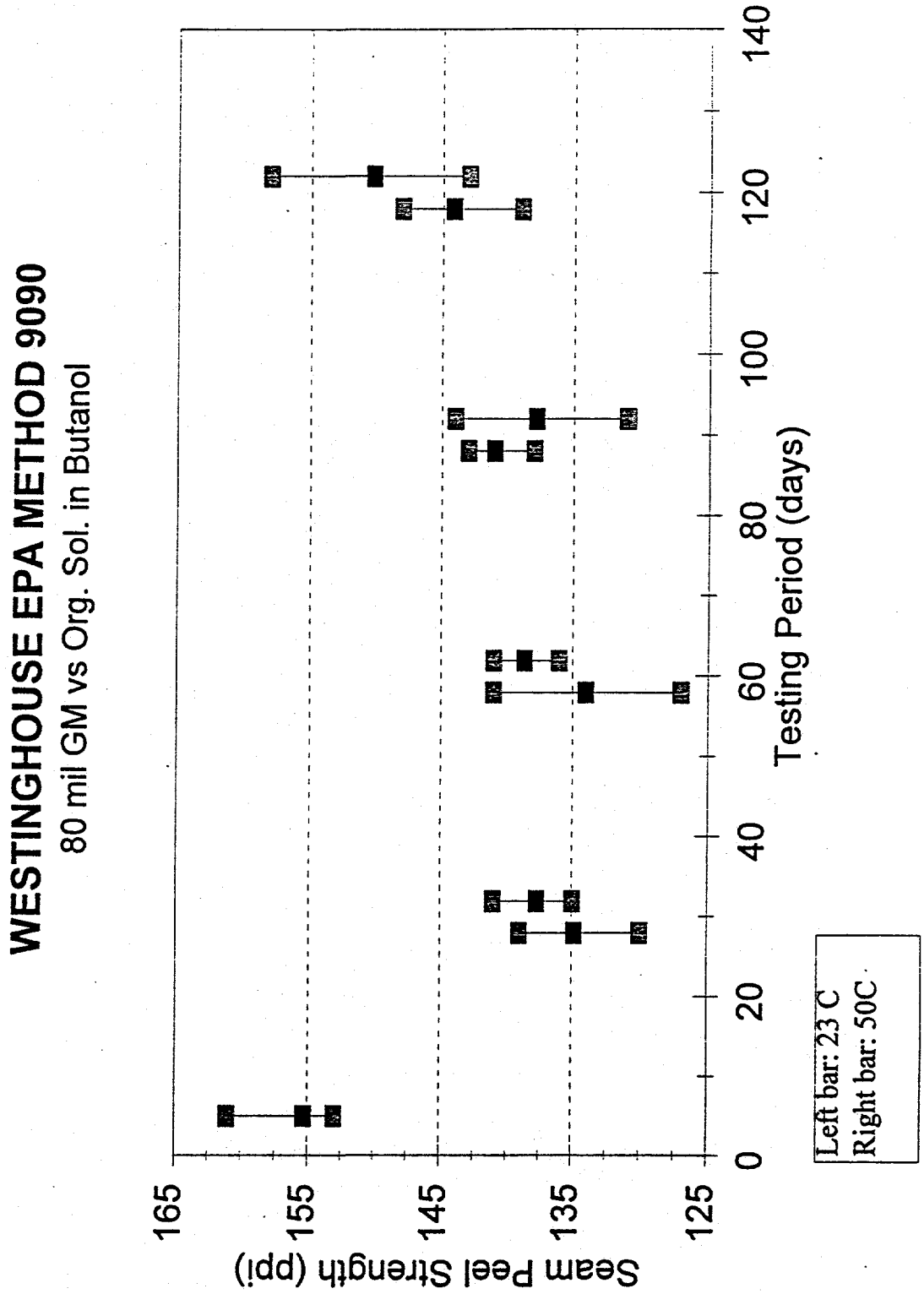

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol. in Butanol
Elongation @ break (%)
1100
1000
900
800
700
600
500
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

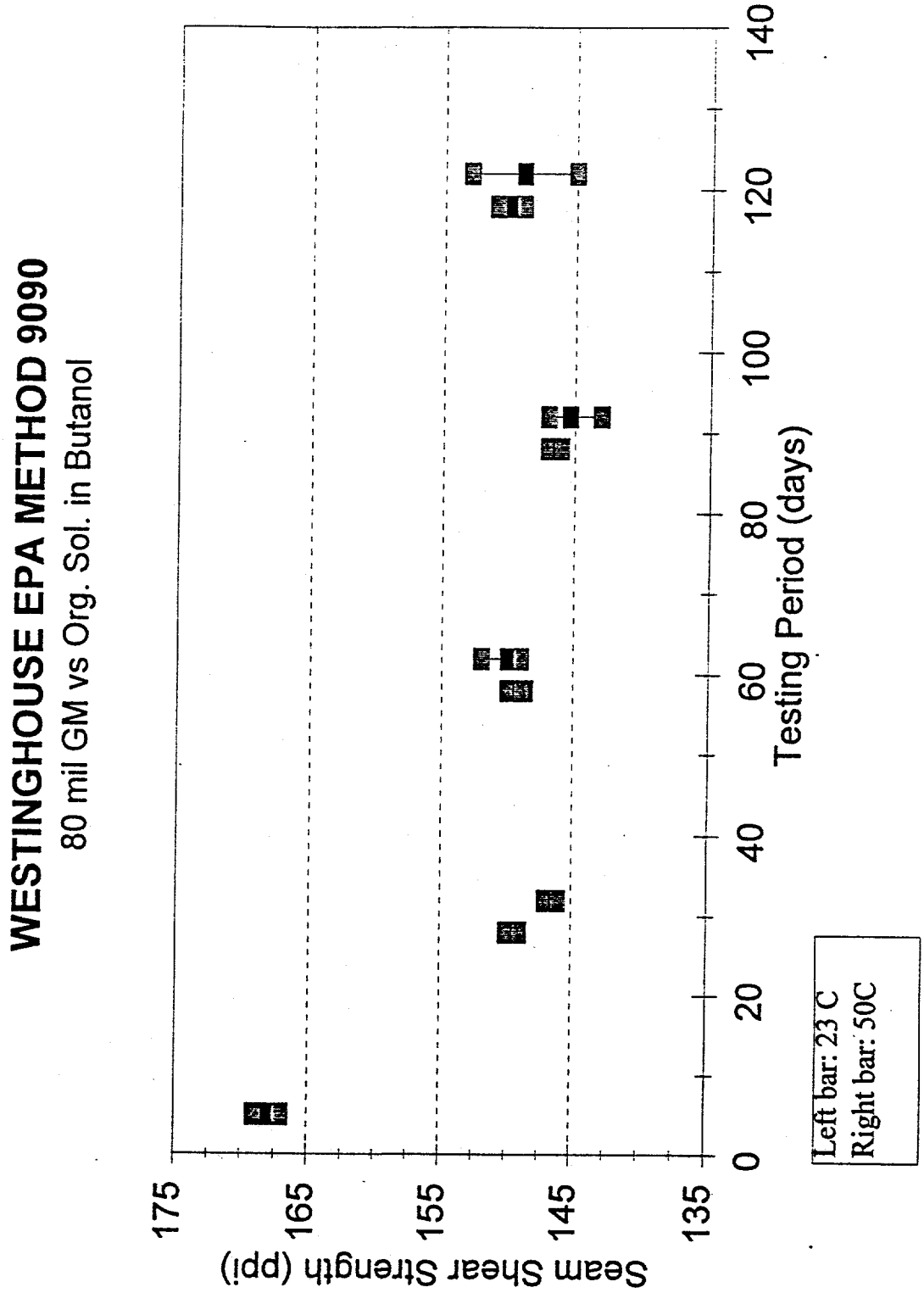

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol. in Butanol
Modulus of Elasticity (psi)
26000
24000
22000
20000
18000
16000
14000
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

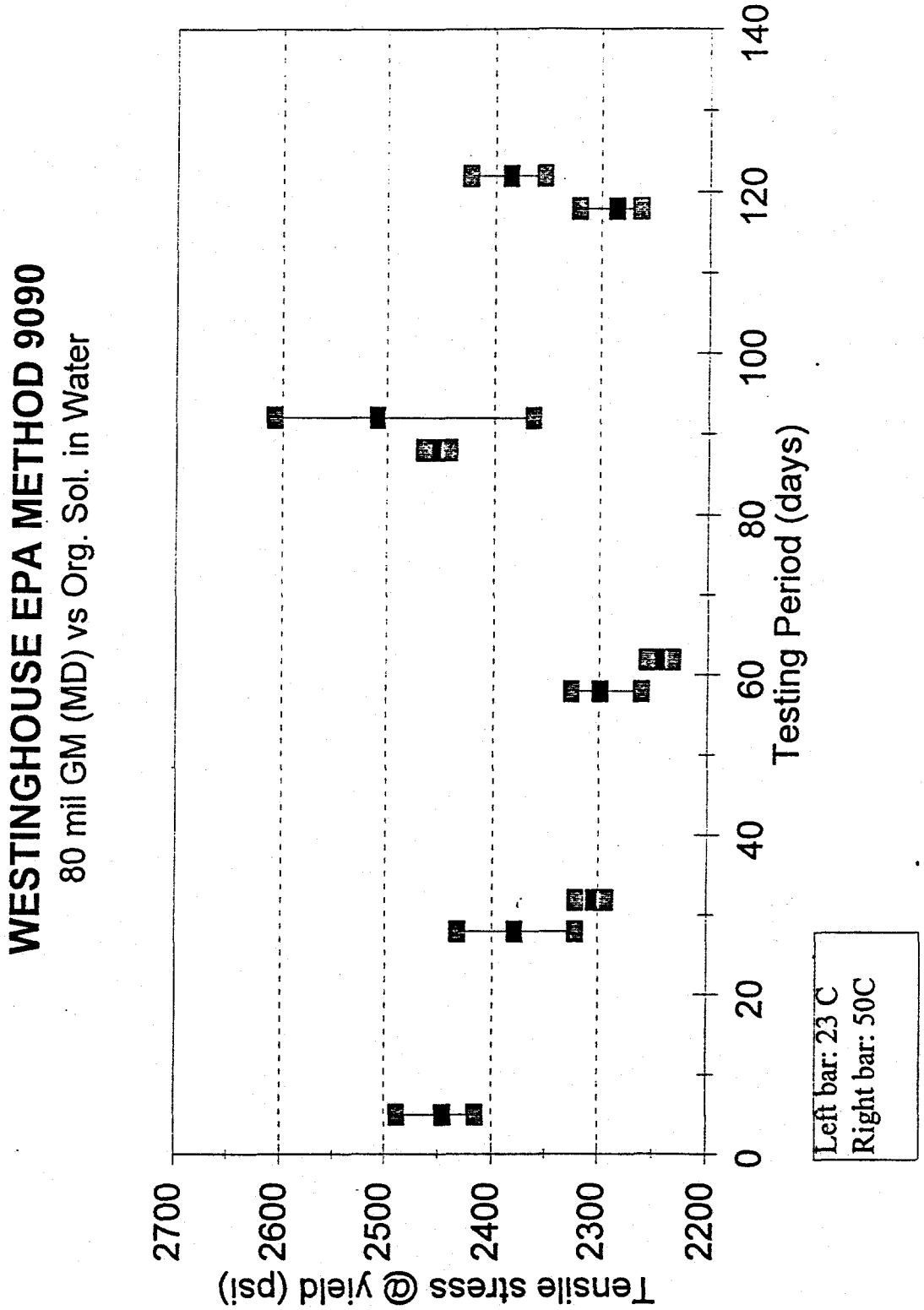

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol. in Butanol
Tear Resistance (lbs)
80
70
60
50
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

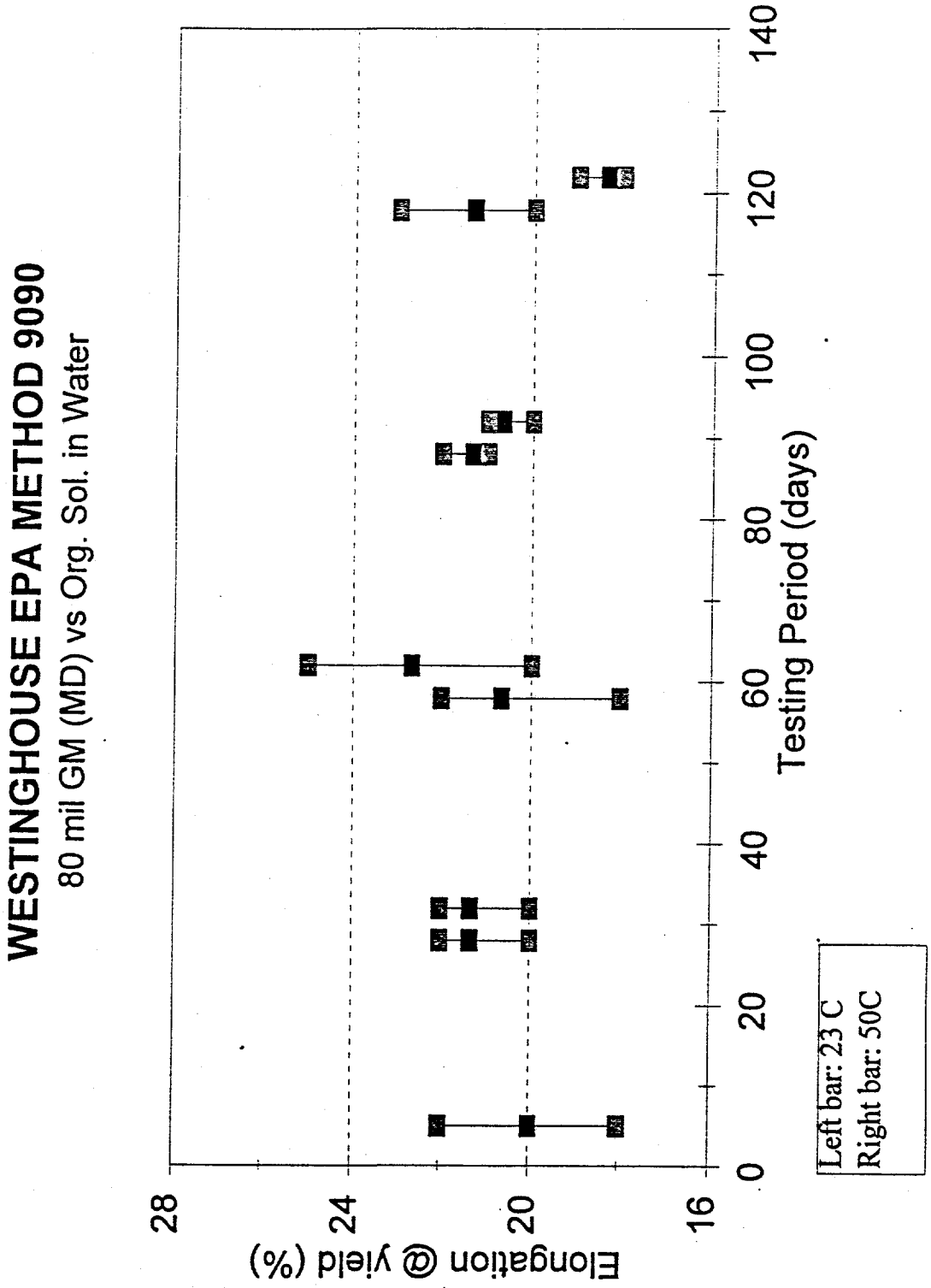

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Org. Sol. in Butanol
Puncture Resistance (lbs)
140
130
120
110
100
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

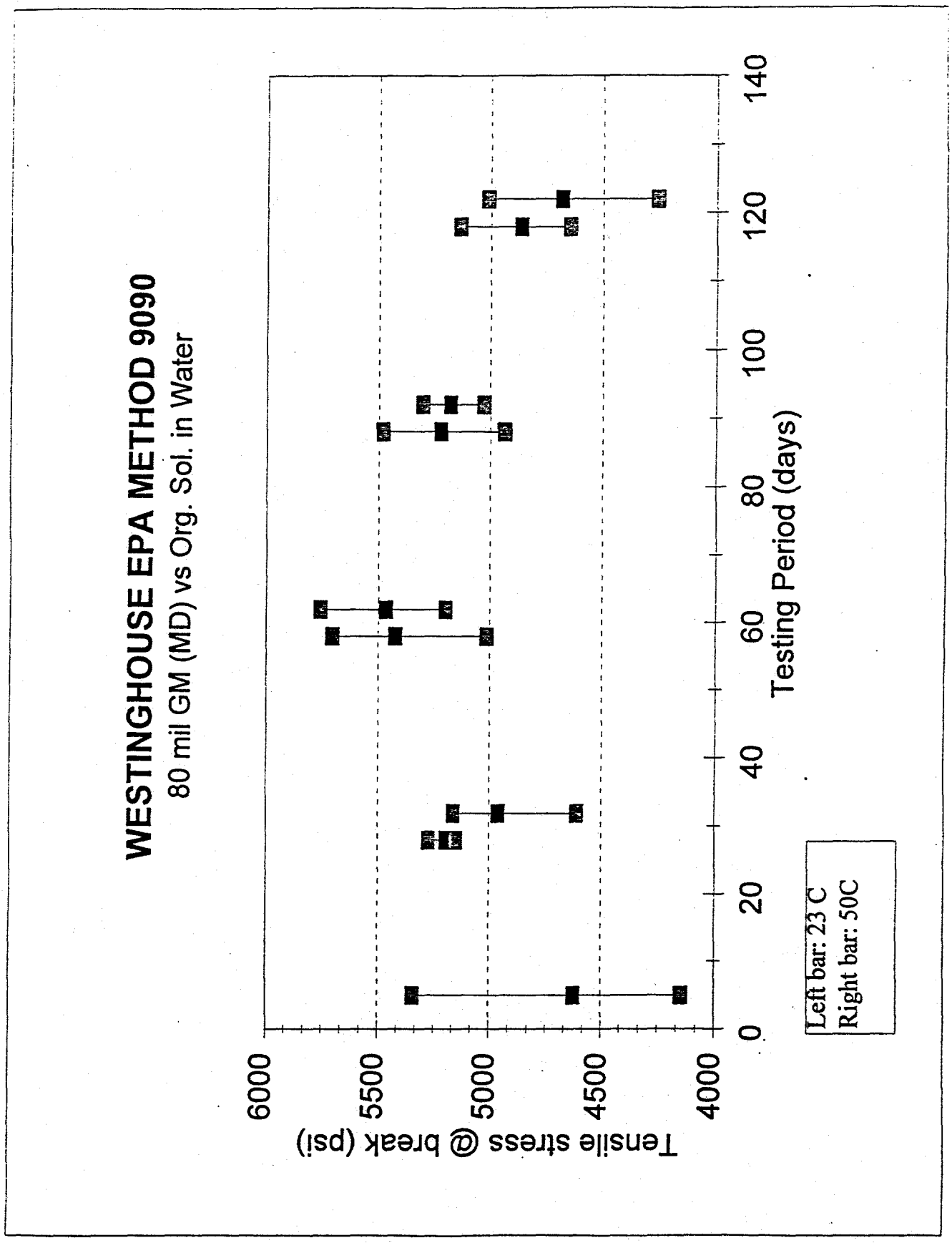

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Org. Sol. in Butanol
Hydrostatic Resistance (psi)
680
660
640
620
600
580
560
540
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

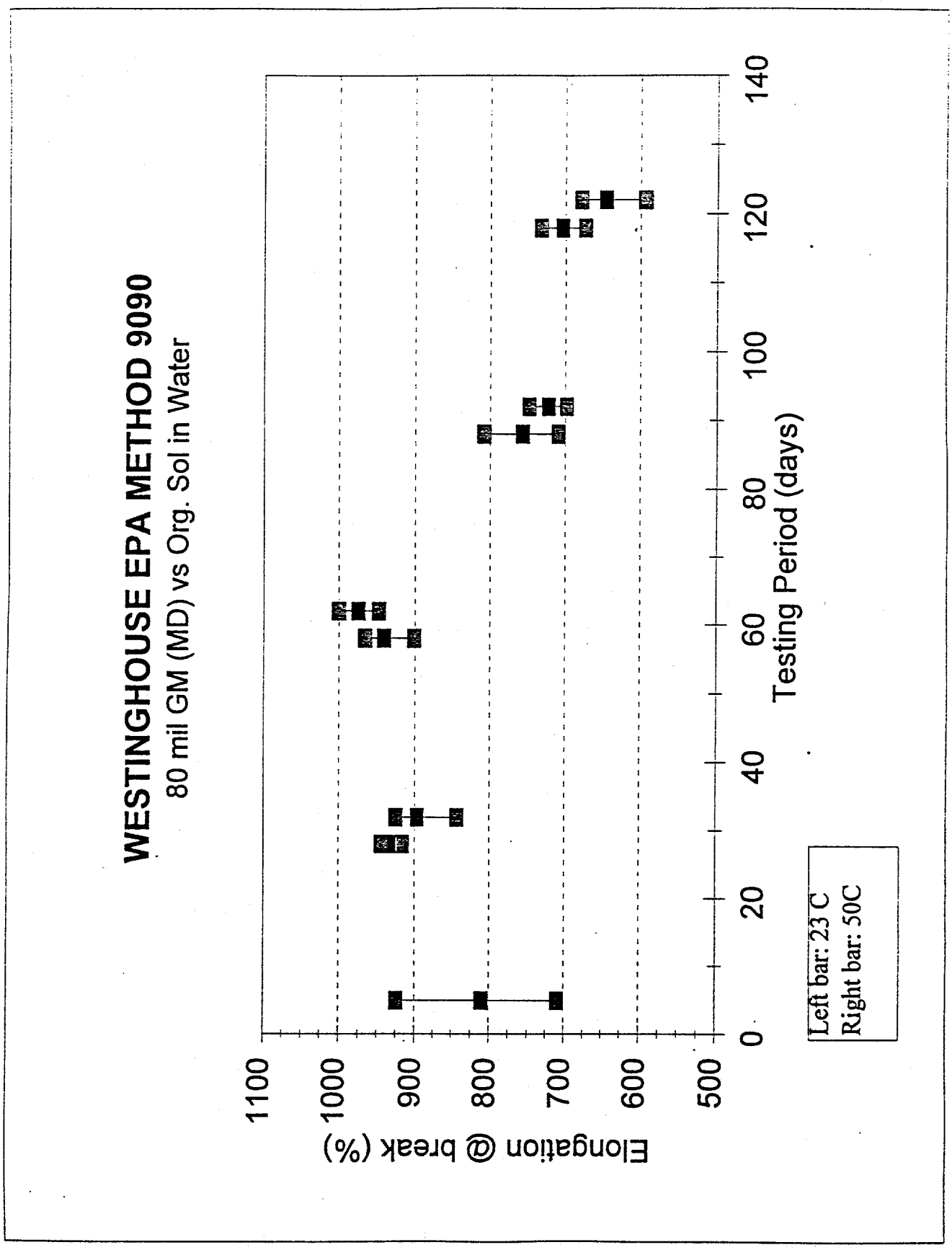

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Org. Sol. in Butanol
Seam Peel Strength (ppi)
165
155
145
135
125
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

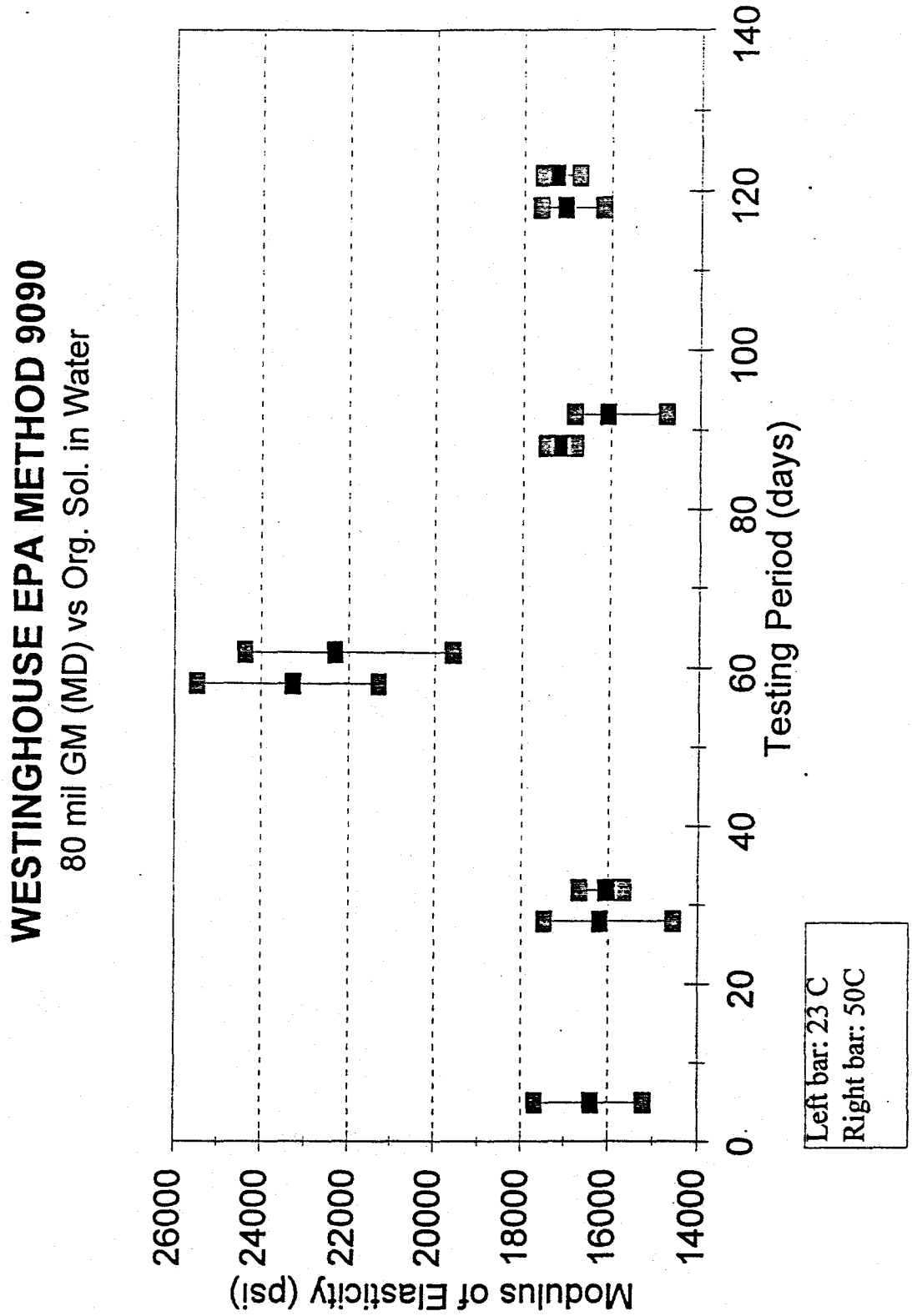

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Org. Sol. in Butanol
Seam Shear Strength (ppi)
175
165
155
145
135
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

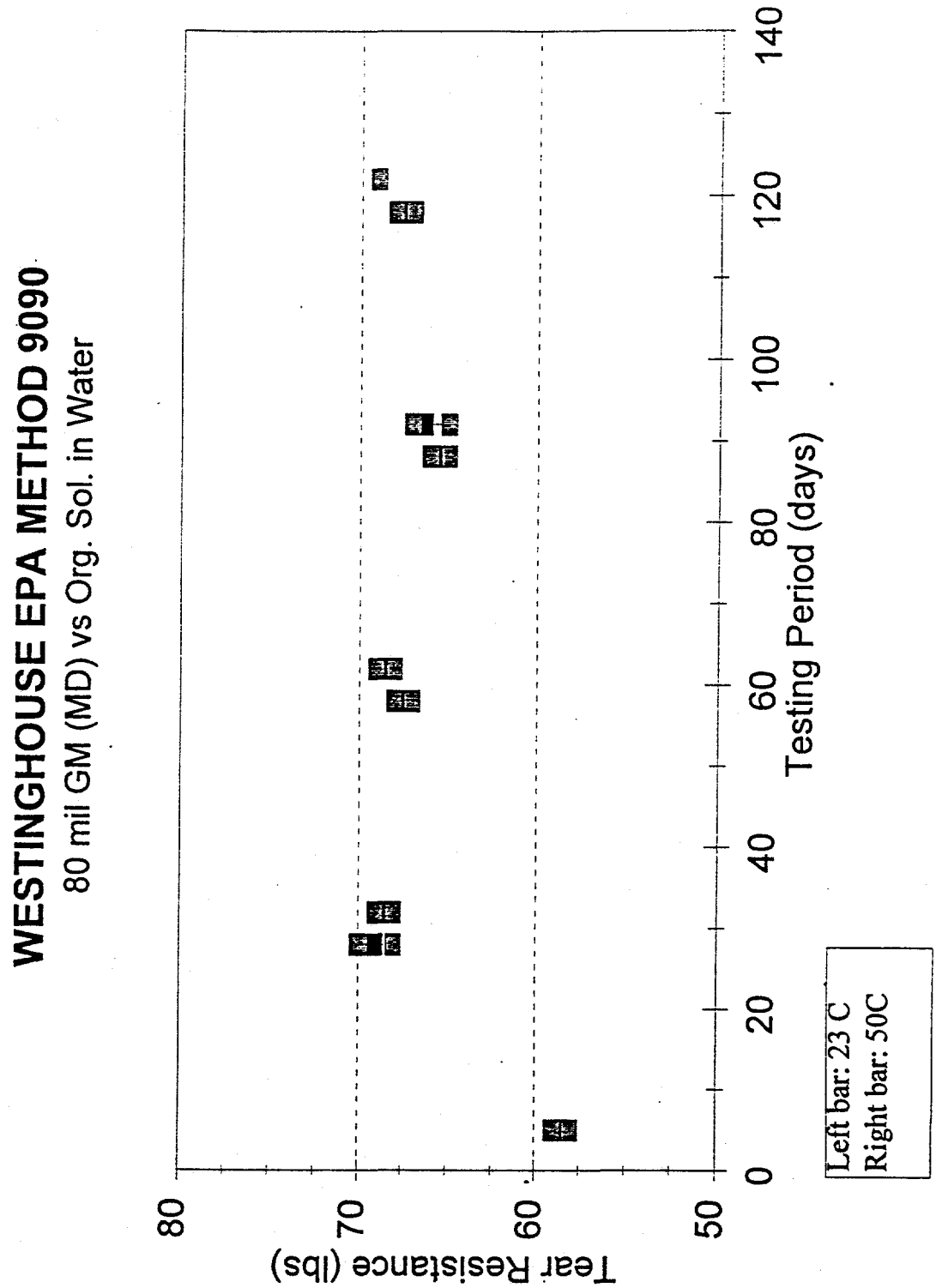

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol. in Water
Tensile stress @ yield (psi)
2700
2600
2500
2400
2300
2200
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

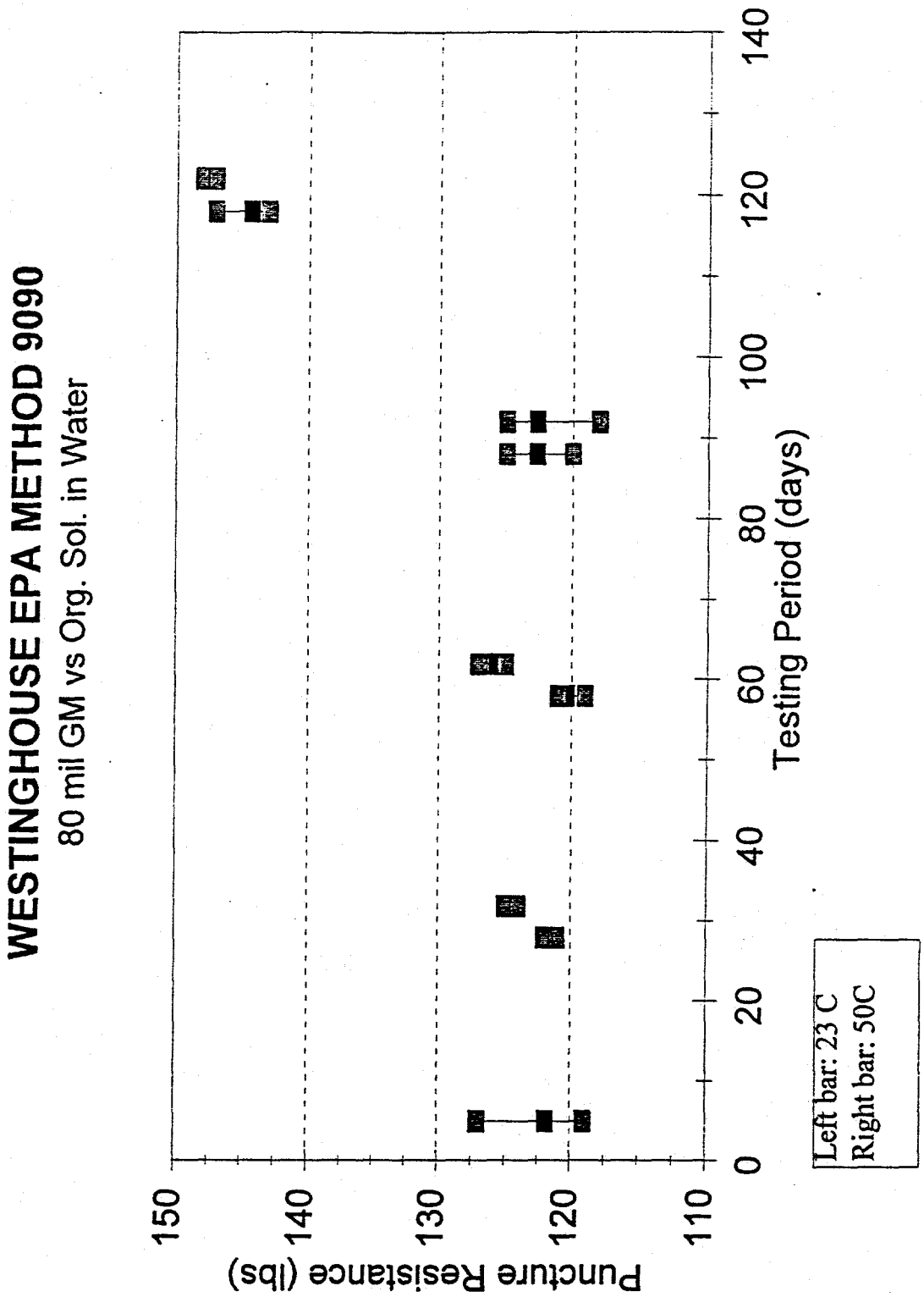

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol. in Water
Elongation @ yield (%)
28
24
20
16
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

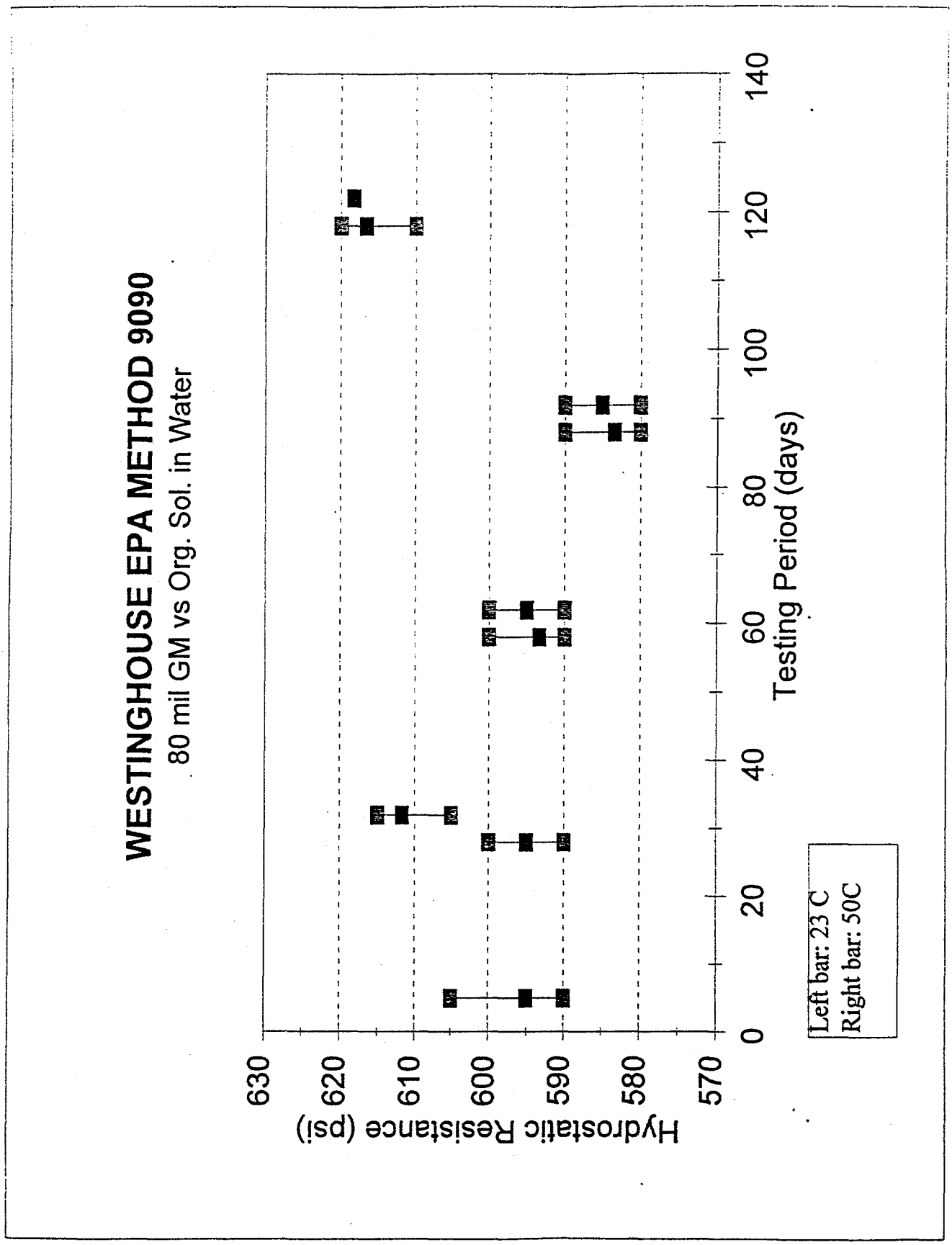

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol. in Water
Tensile stress @ break (psi)
6000
5500
5000
4500
4000
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

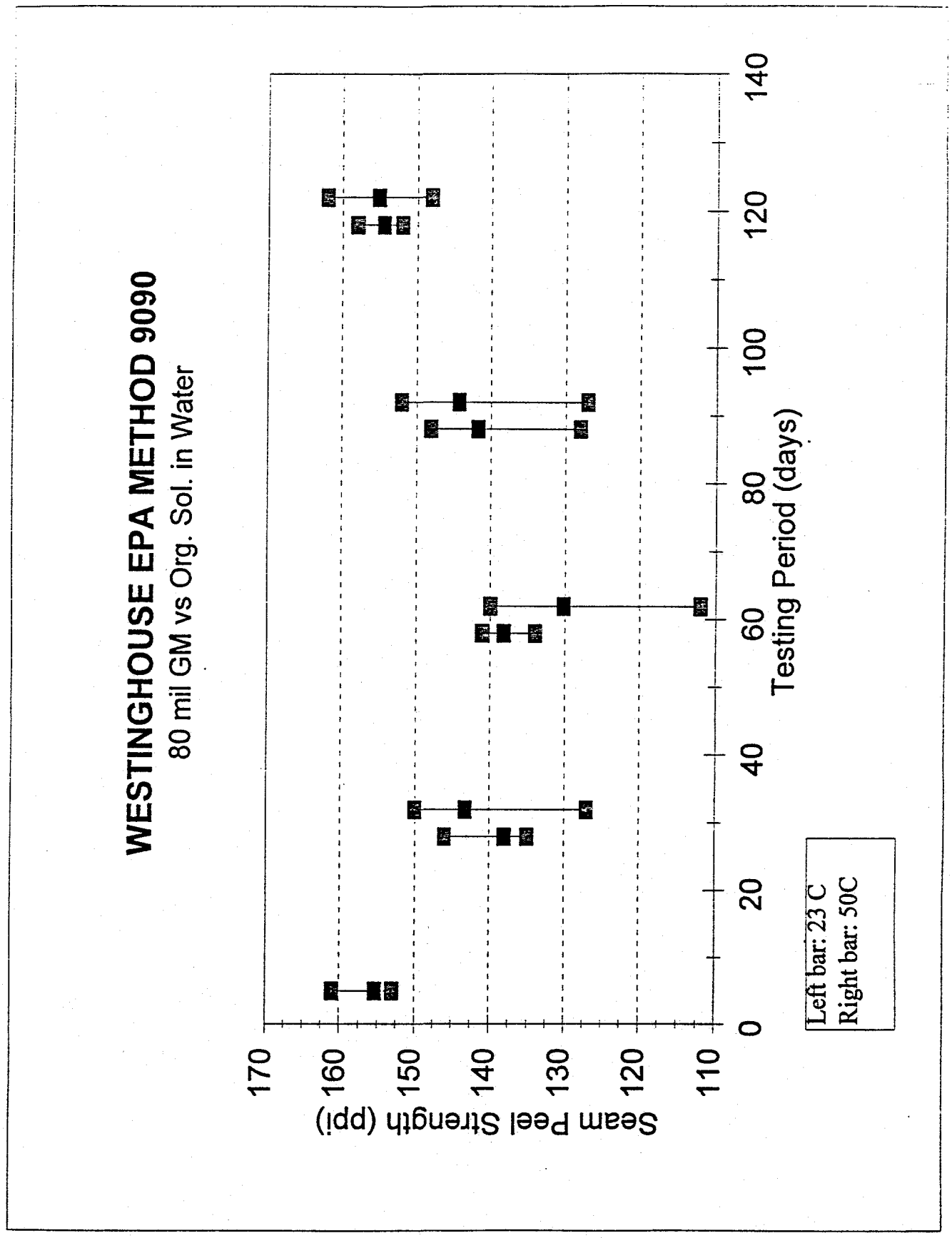

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol in Water
Elongation @ break (%)
1100
1000
900
800
700
600
500
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

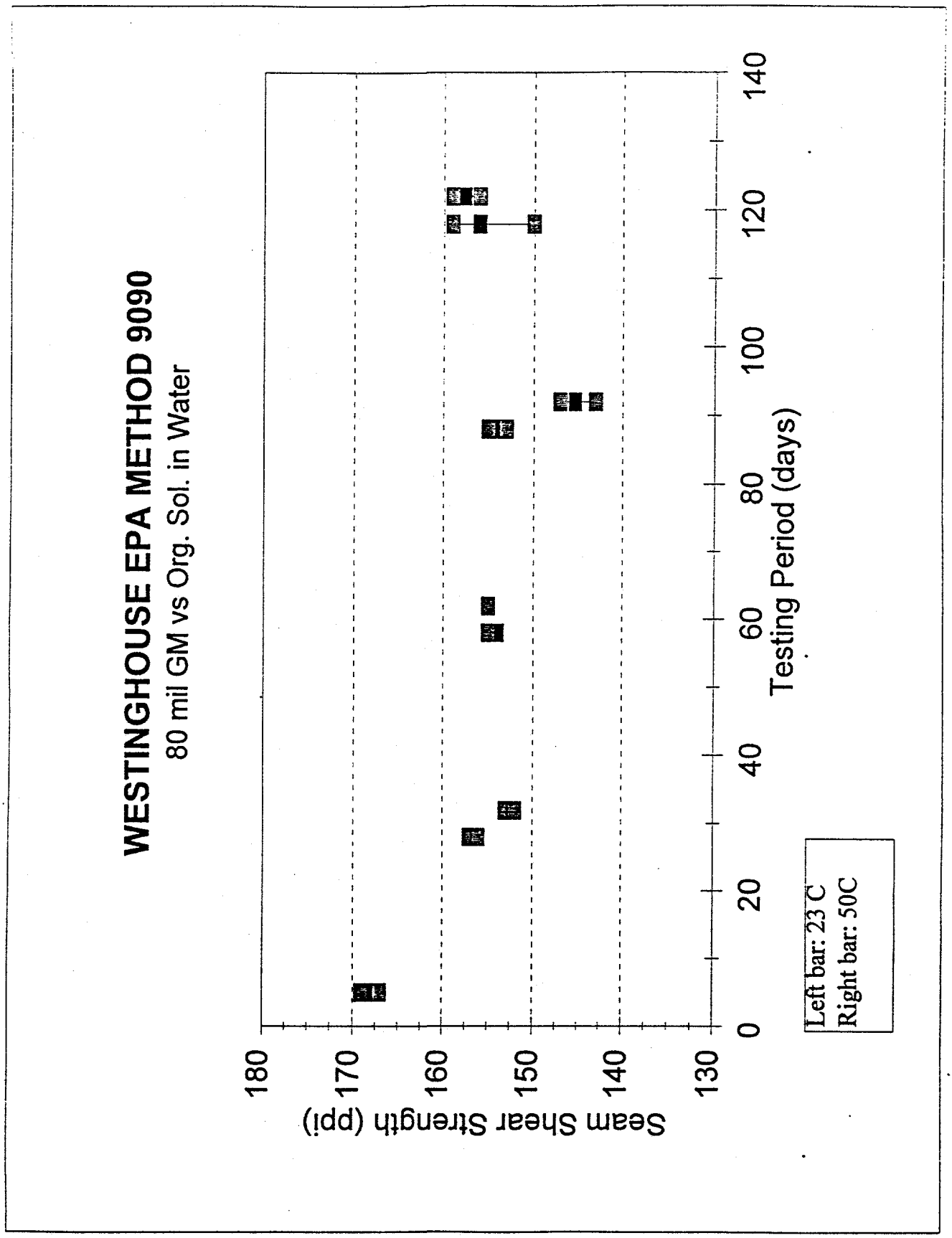

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol. in Water
Modulus of Elasticity (psi)
26000
24000
22000
20000
18000
16000
14000
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

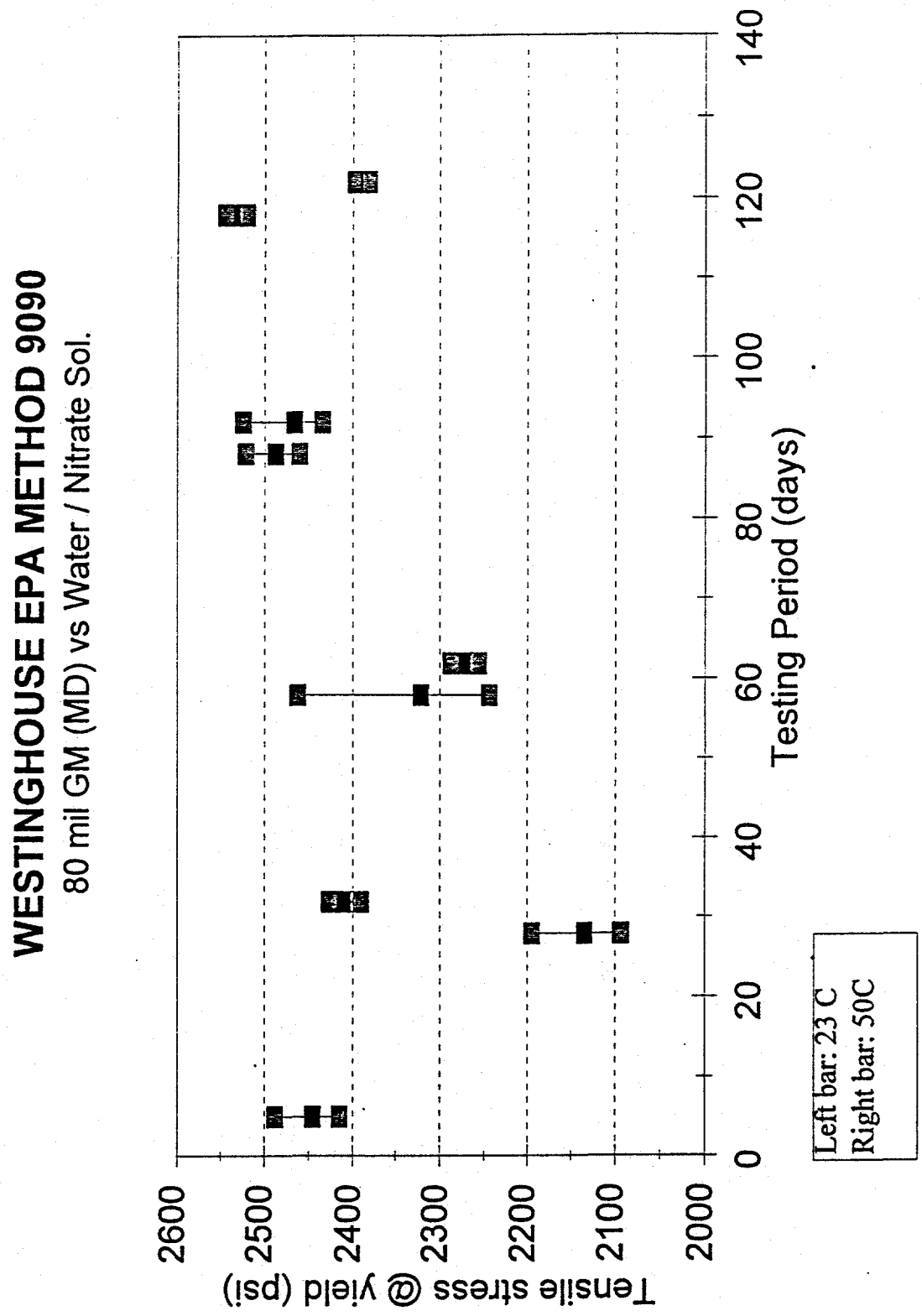

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Org. Sol. in Water
Tear Resistance (lbs)
80
70
60
50
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

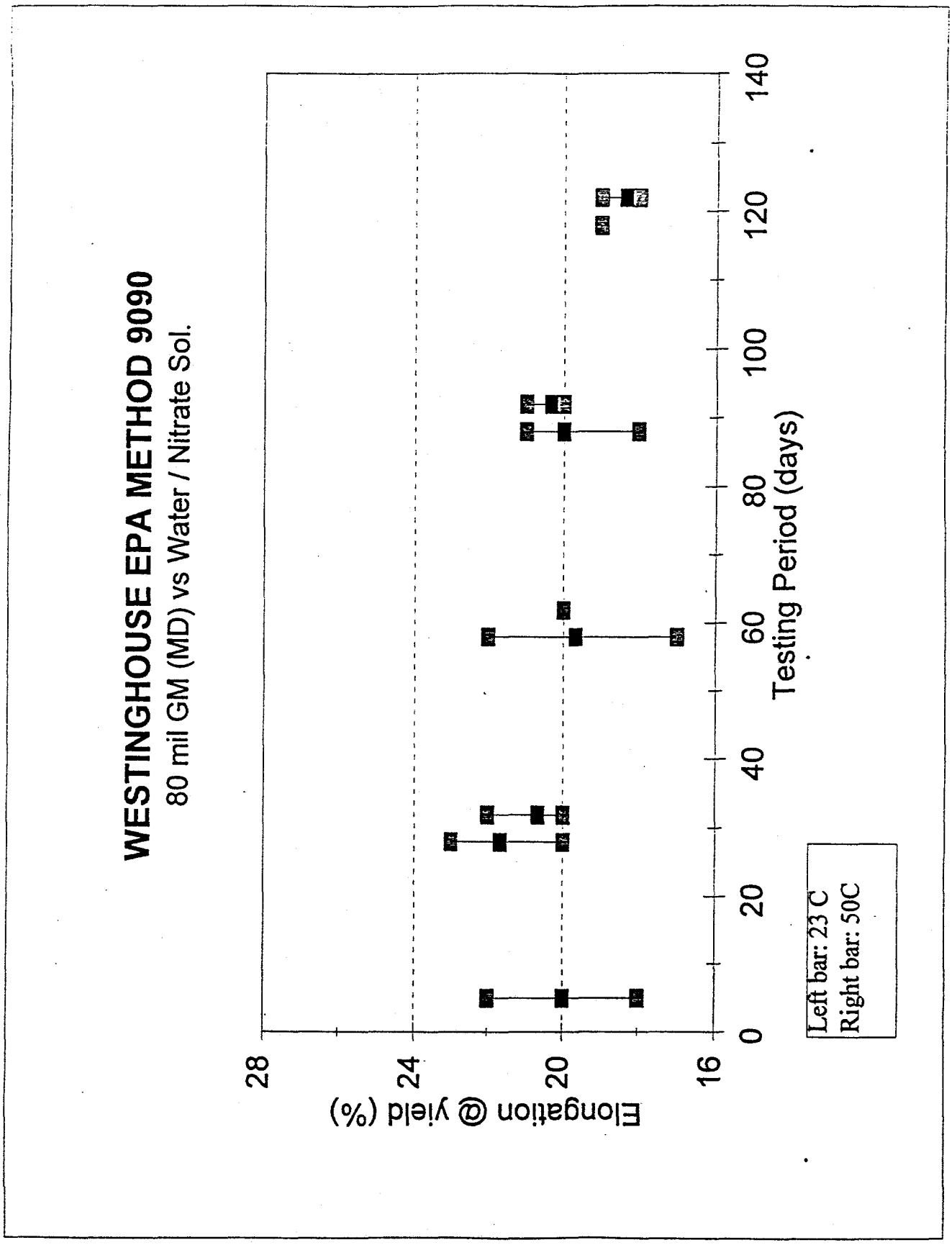

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Org. Sol. in Water
Puncture Resistance (lbs)
150
140
130
120
110
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

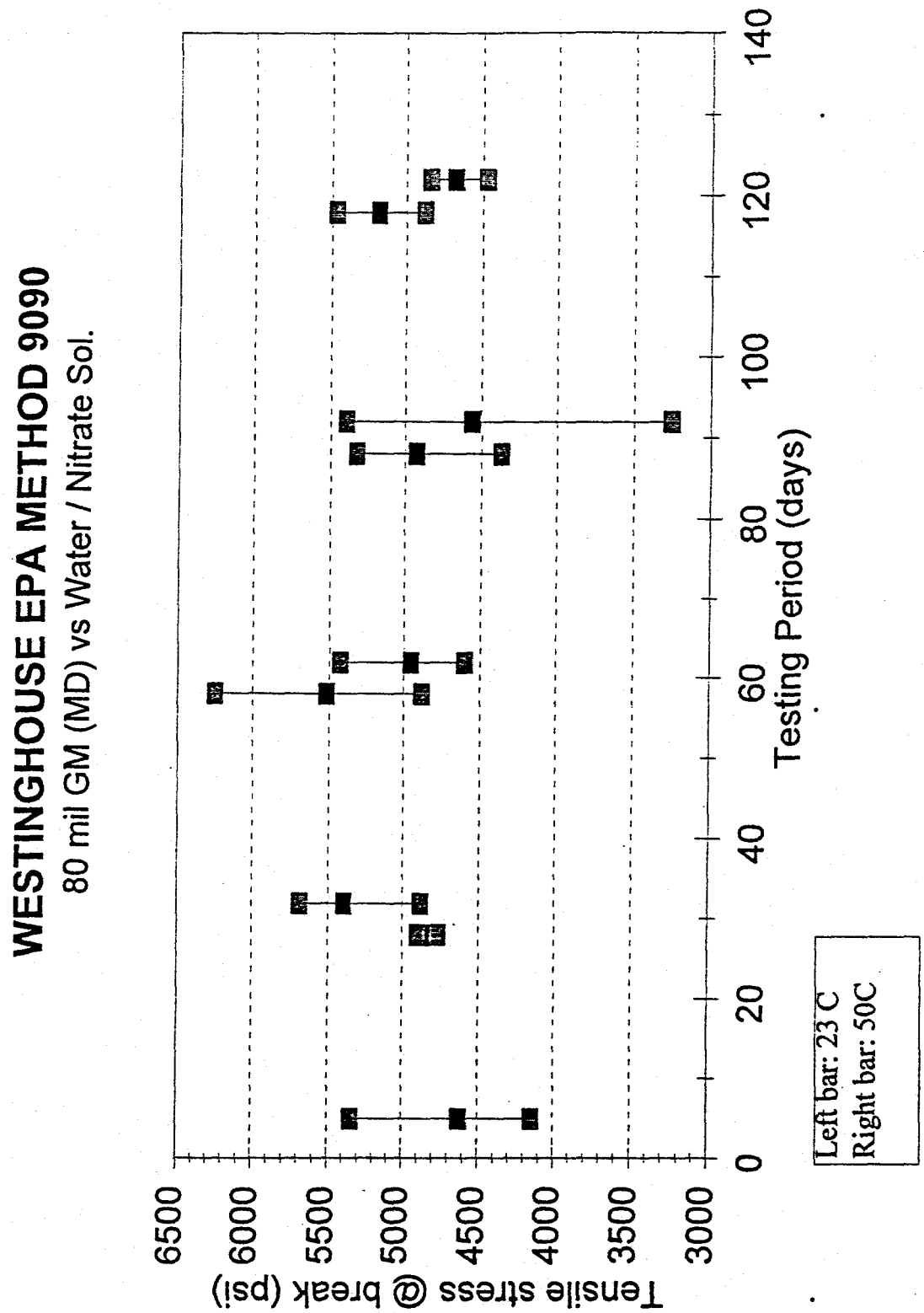

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Org. Sol. in Water
Hydrostatic Resistance (psi)
630
620
610
600
590
580
570
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

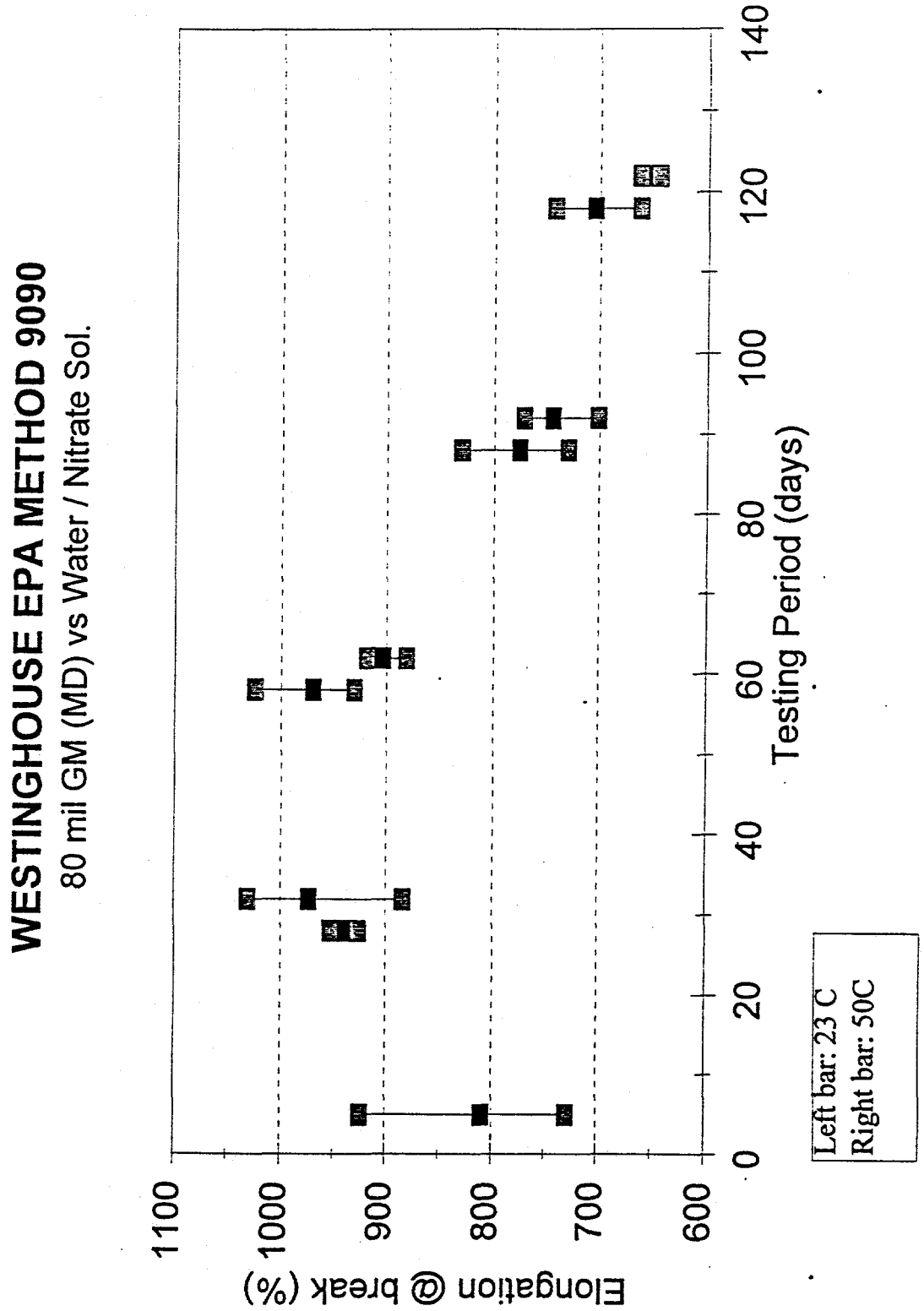

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Org. Sol. in Water
Seam Peel Strength (ppi)
170
160
150
140
130
120
110
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

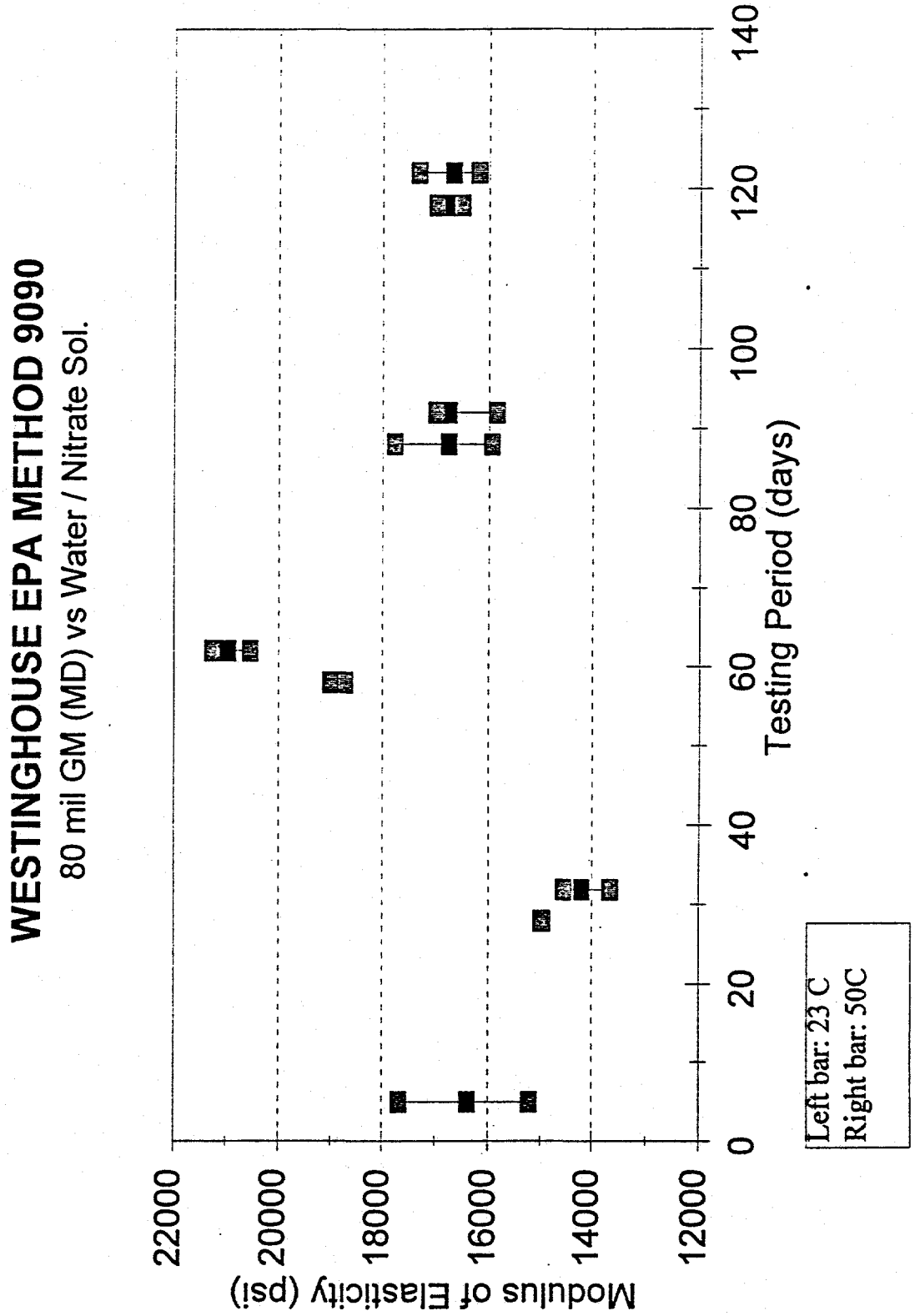

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Org. Sol. in Water
Seam Shear Strength (ppi)
180
170
160
150
140
130
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

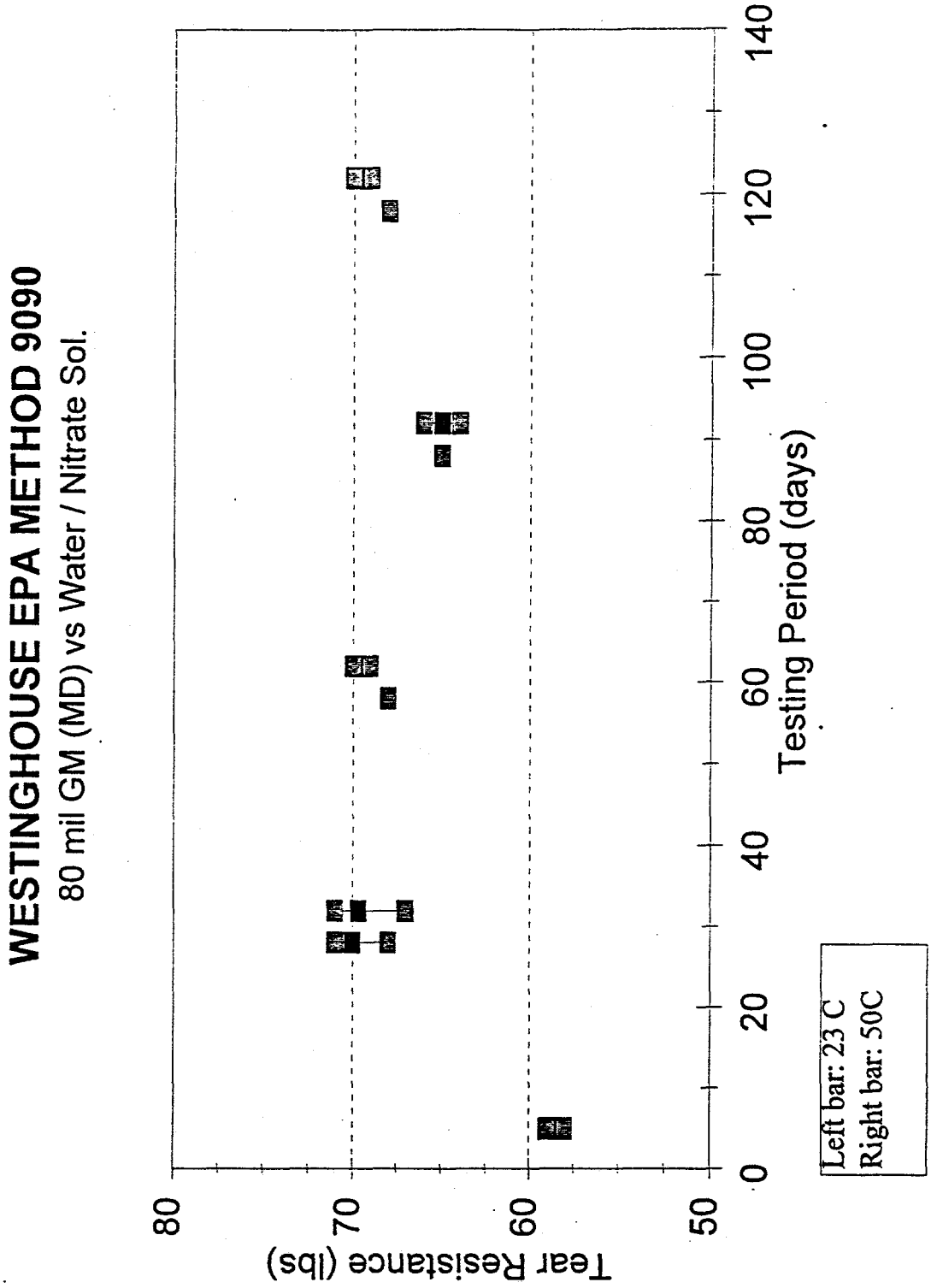

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Water / Nitrate Sol.
Tensile stress @ yield (psi)
2600
2500
2400
2300
2200
2100
2000
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

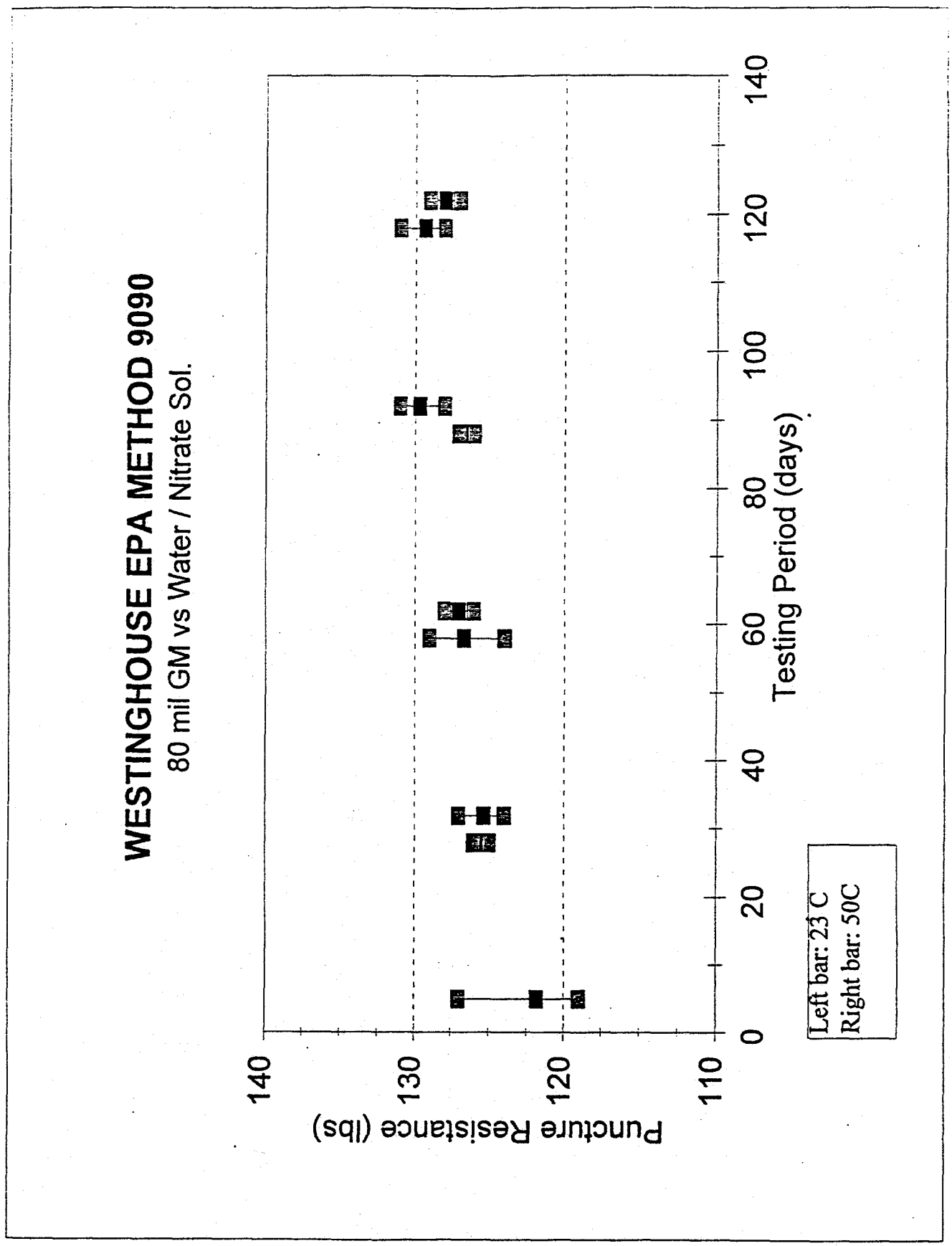

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Water / Nitrate Sol.
Elongation @ yield (%)
28
24
20
16
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

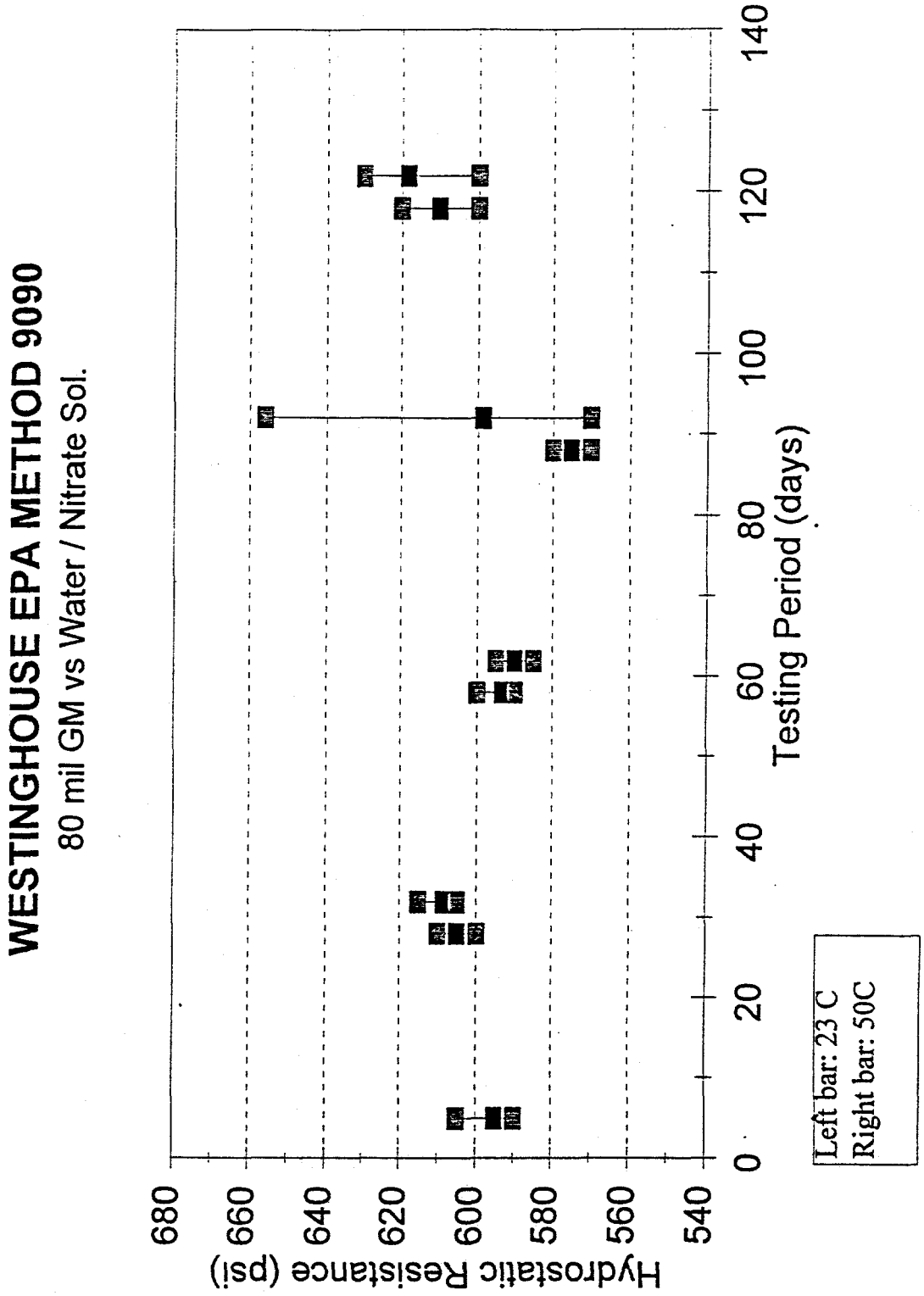

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Water / Nitrate Sol.
Tensile stress @ break (psi)
6500
6000
5500
5000
4500
4000
3500
3000
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

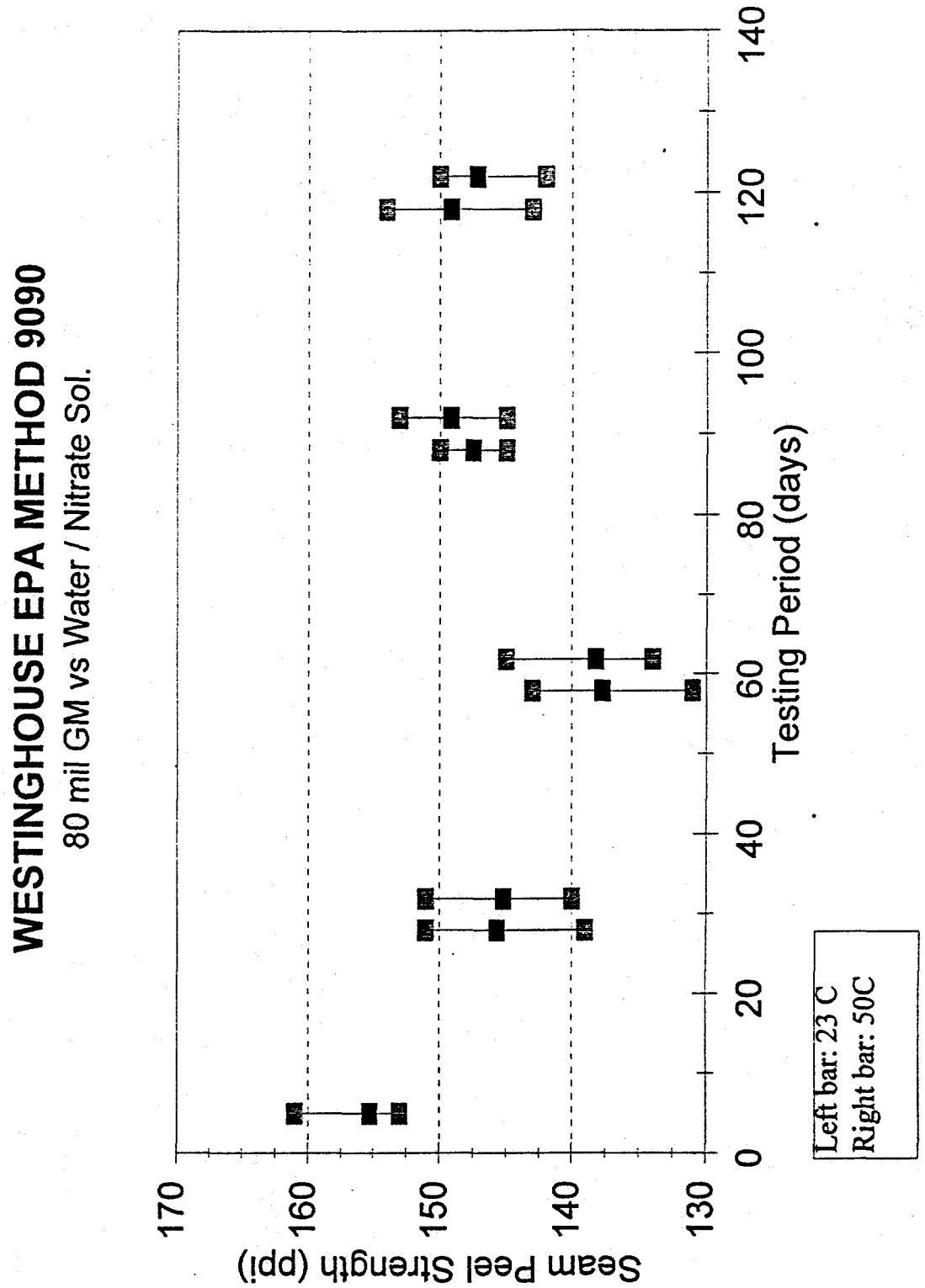

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Water / Nitrate Sol.
Elongation @ break (%)
1100
1000
900
800
700
600
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

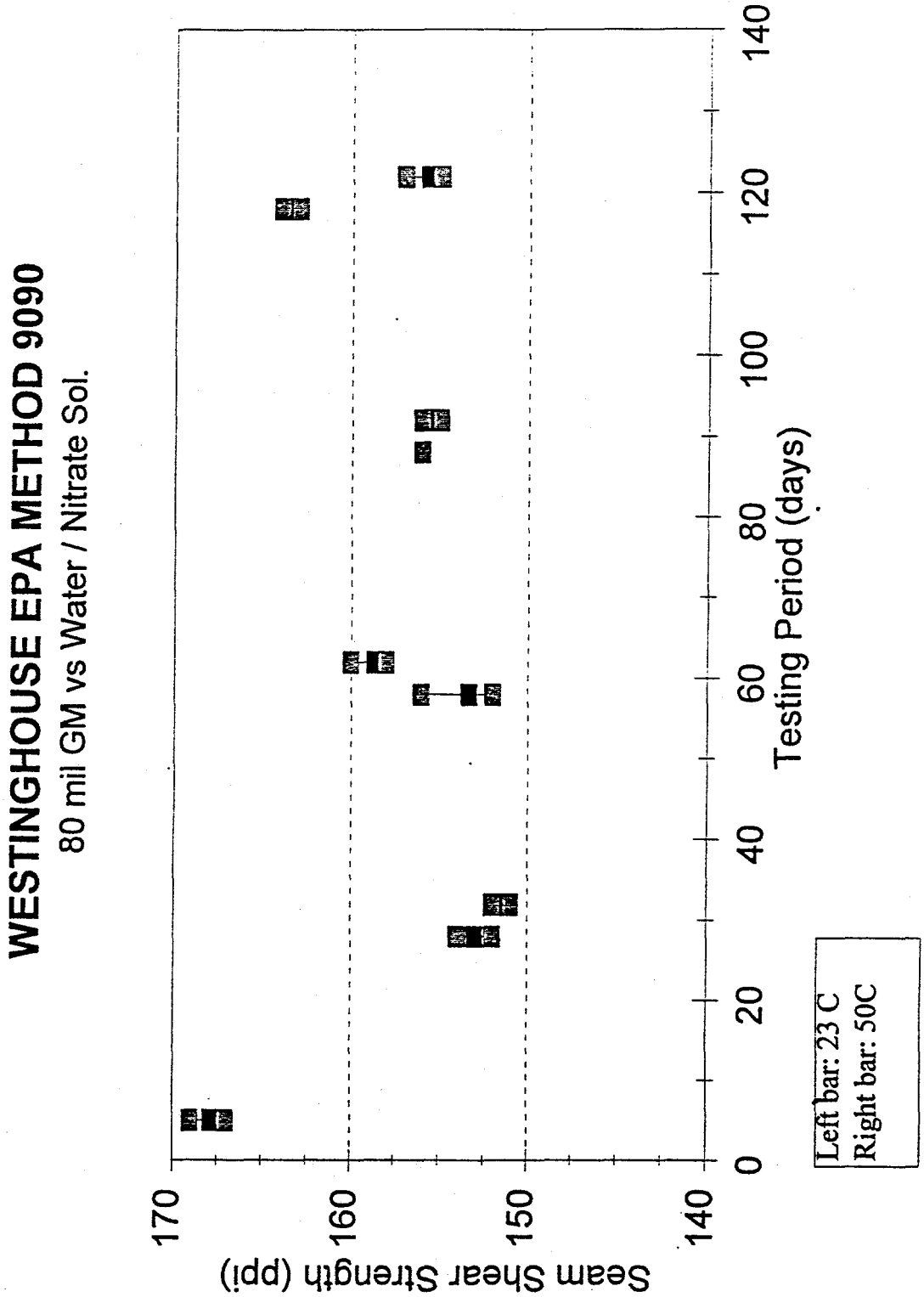

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Water / Nitrate Sol.
Modulus of Elasticity (psi)
22000
20000
18000
16000
14000
12000
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

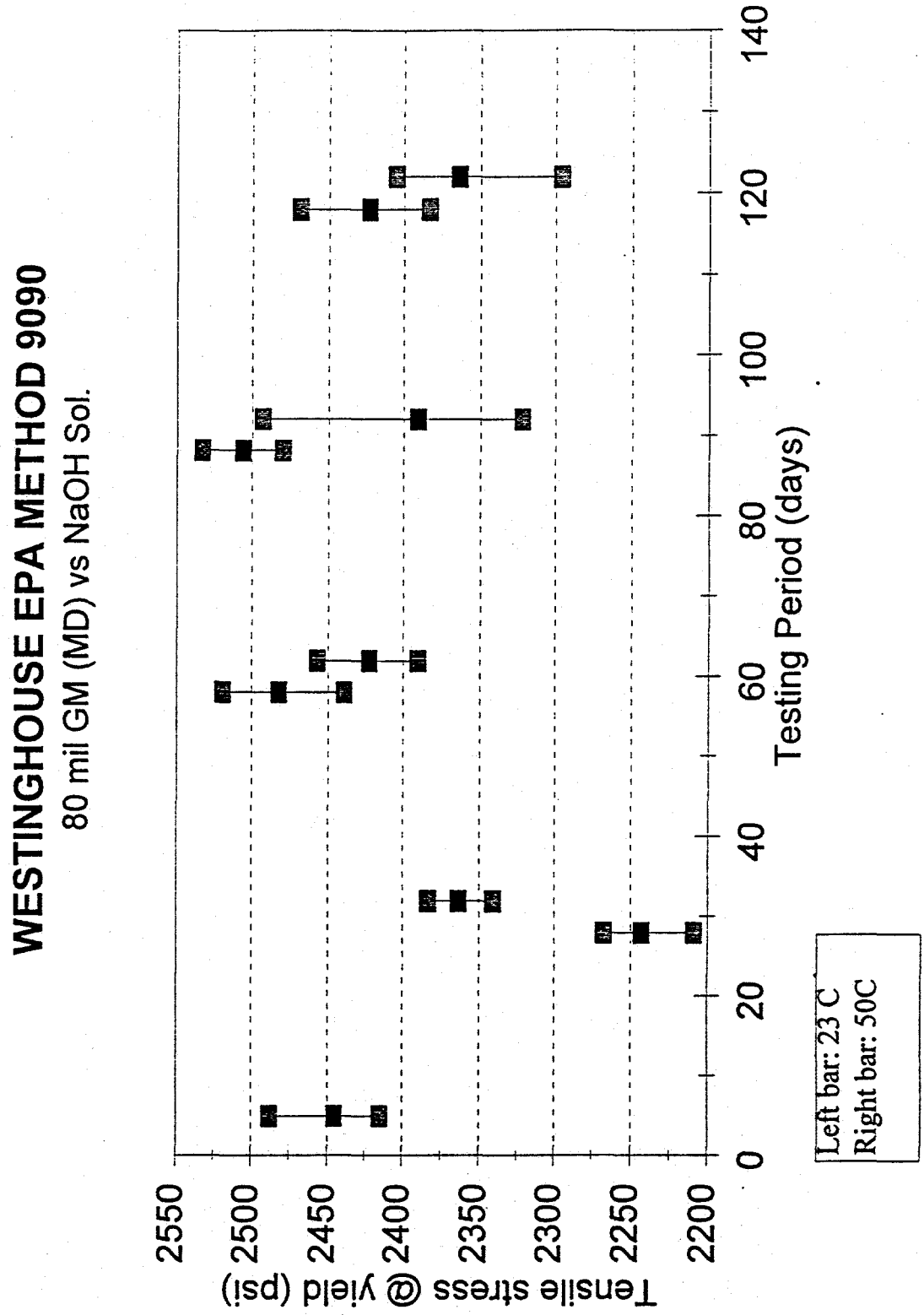

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs Water / Nitrate Sol.
Tear Resistance (lbs)
80
70
60
50
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

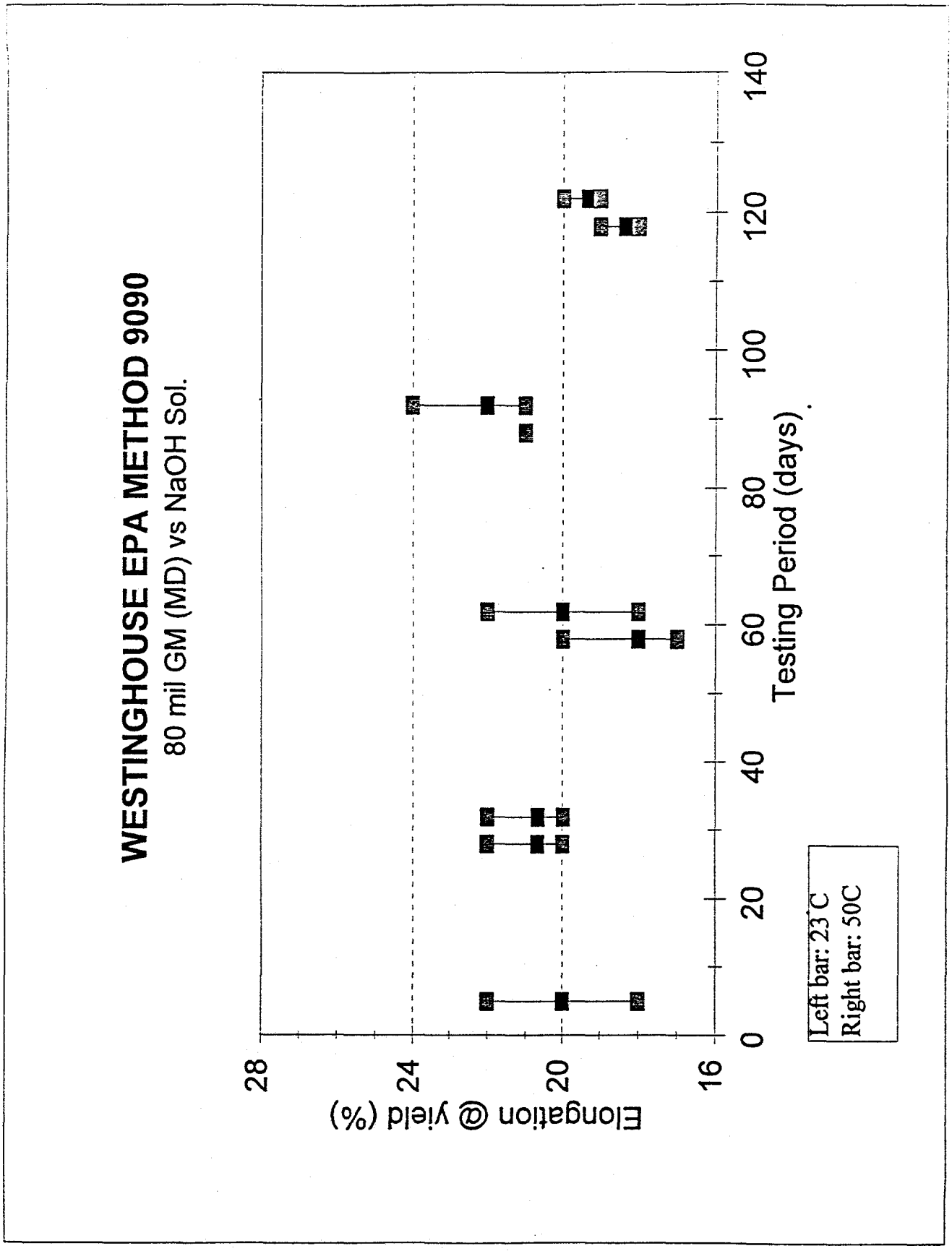

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Water / Nitrate Sol.
Puncture Resistance (lbs)
140
130
120
110
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

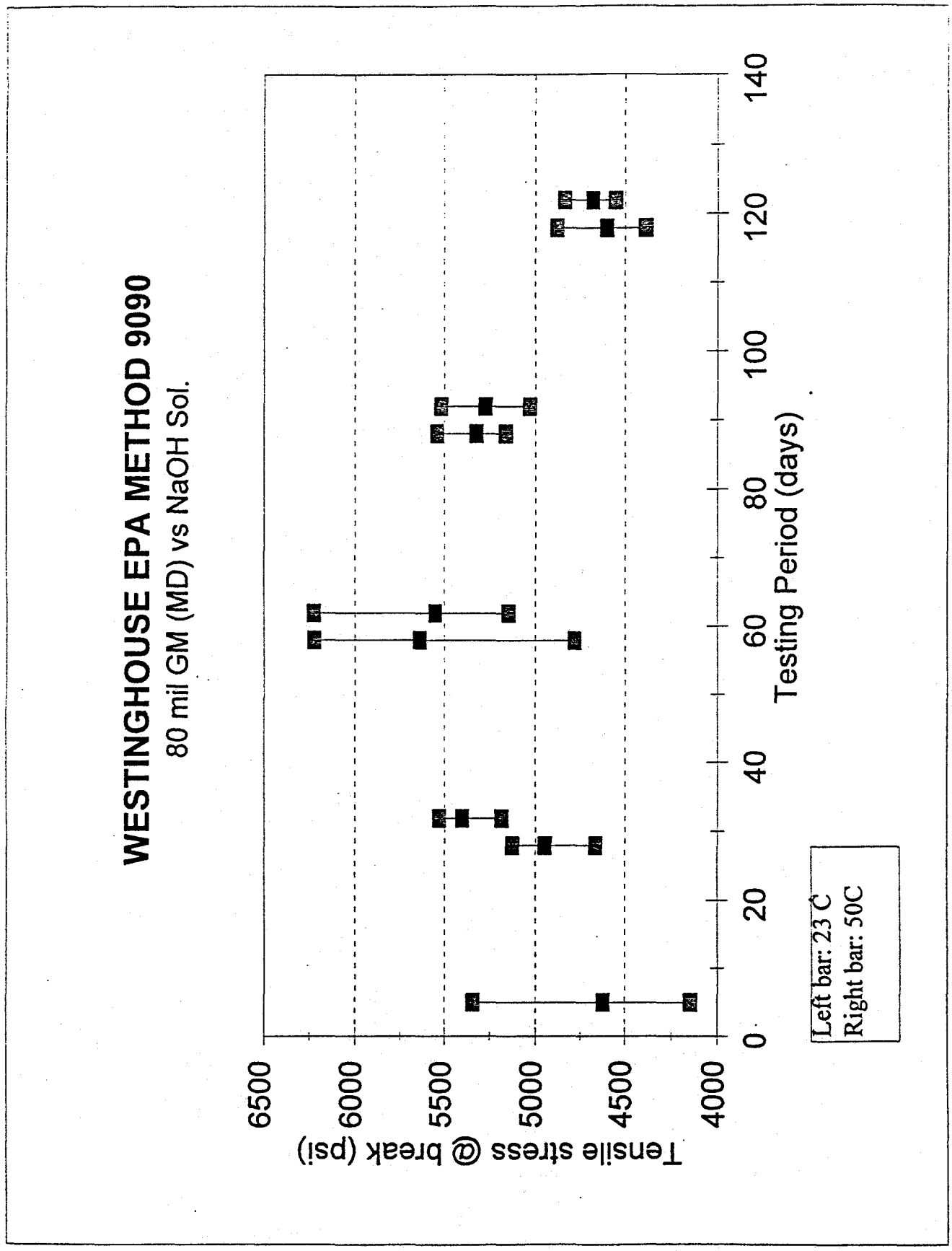

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Water / Nitrate Sol.
Hydrostatic Resistance (psi)
680
660
640
620
600
580
560
540
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

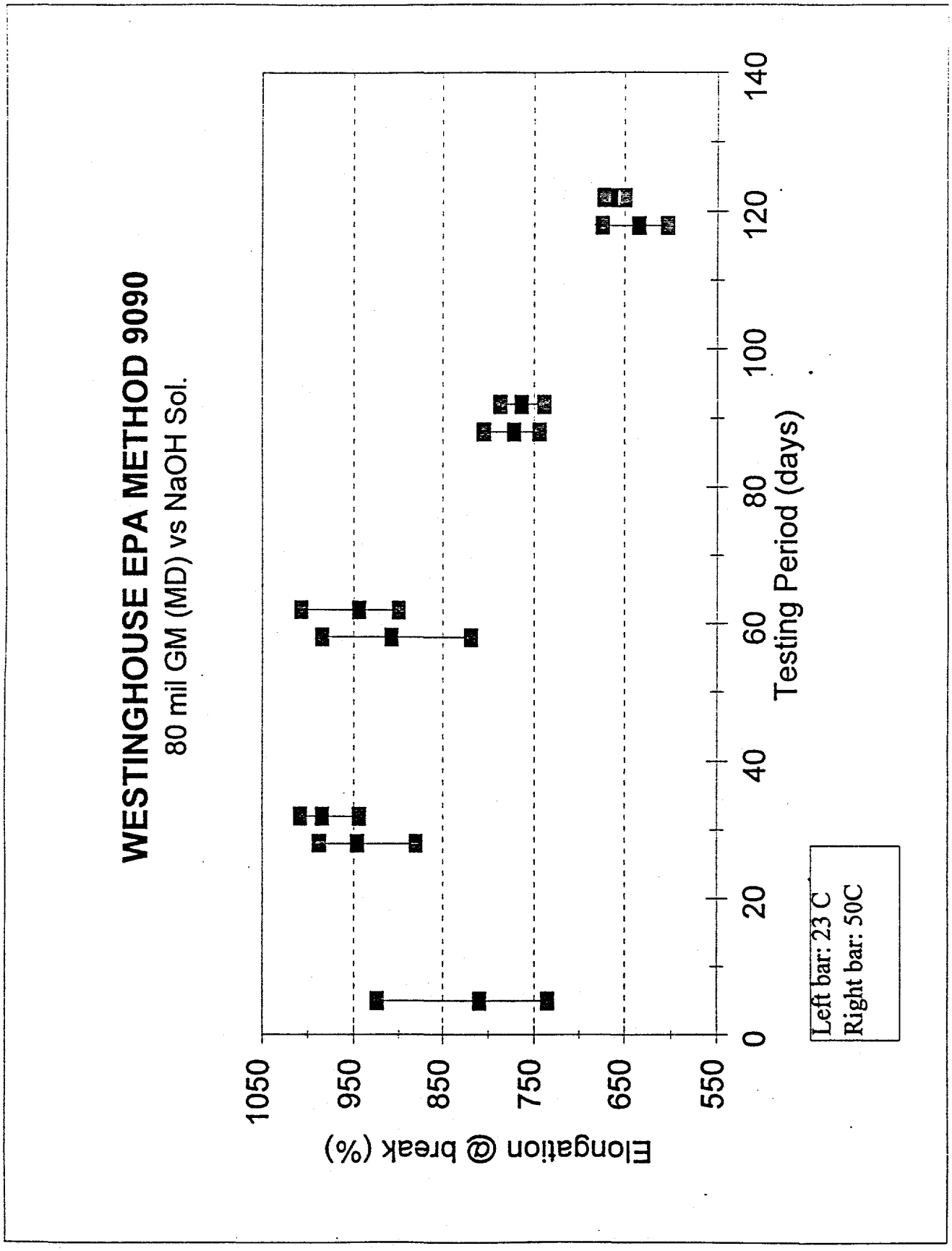

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Water / Nitrate Sol.
Seam Peel Strength (ppi)
170
160
150
140
130
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

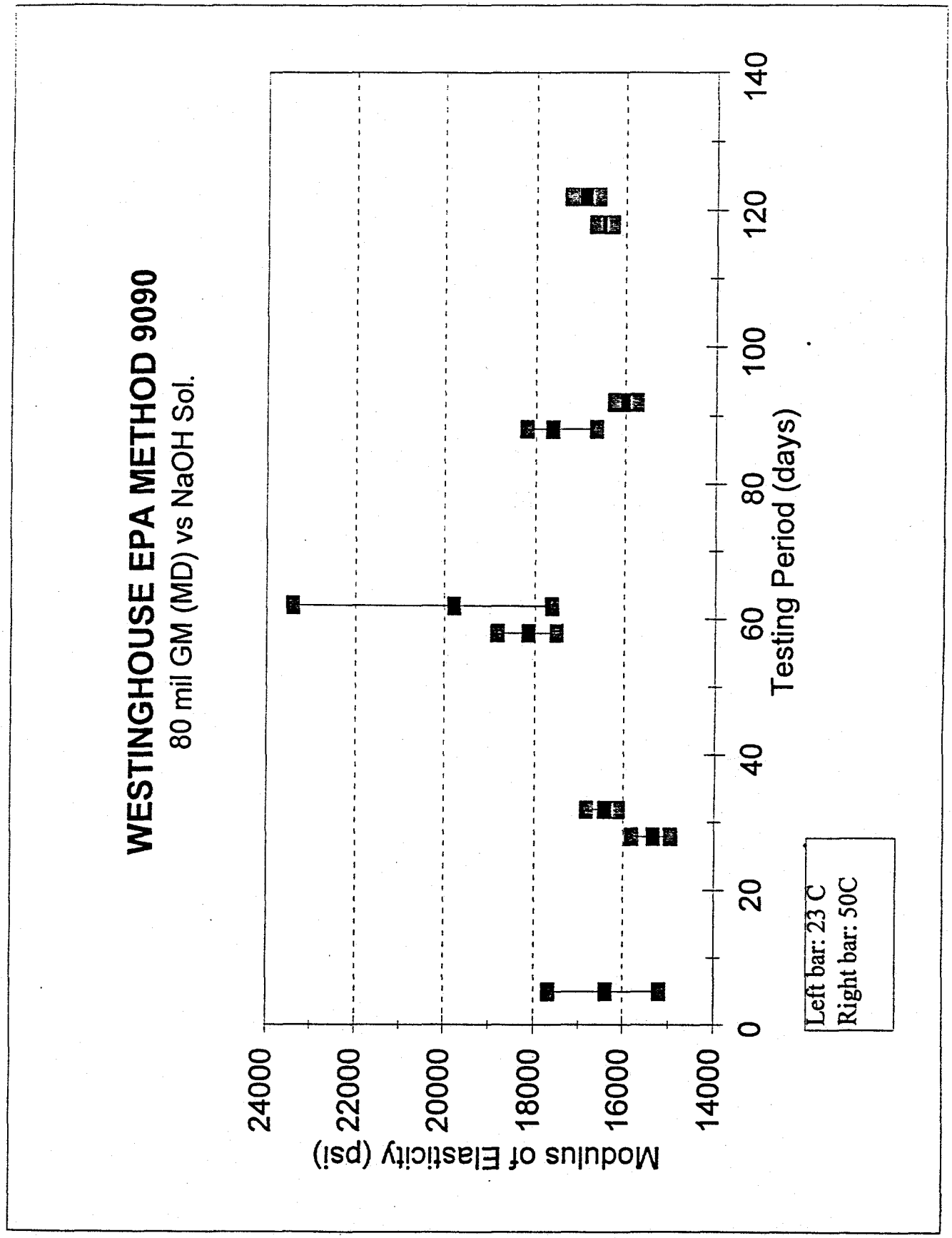

WESTINGHOUSE EPA METHOD 9090
80 mil GM vs Water / Nitrate Sol.
Seam Shear Strength (ppi)
170
160
150
140
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

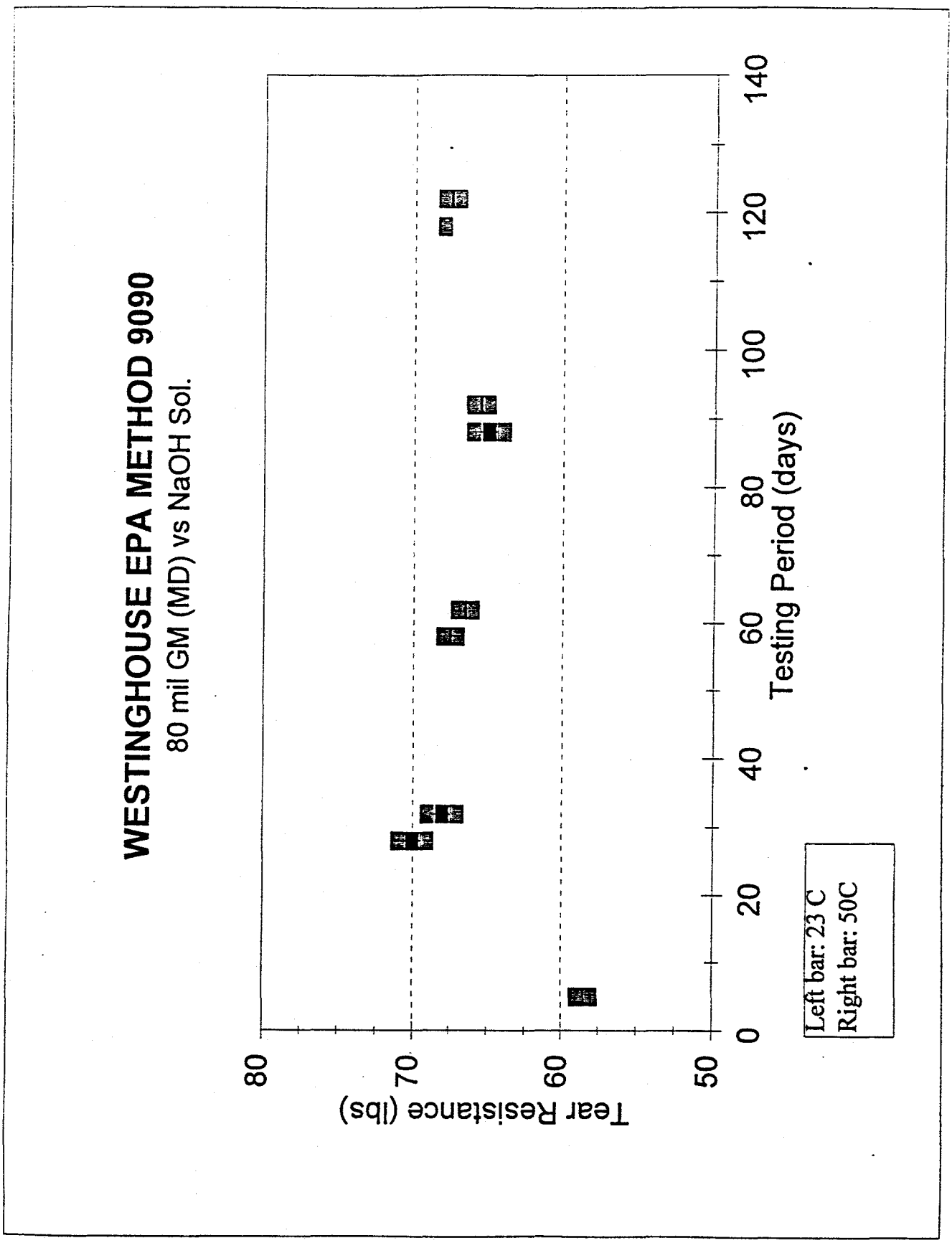

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs NaOH Sol.
Tensile stress @ yield (psi)
2550
2500
2450
2400
2350
2300
2250
2200
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

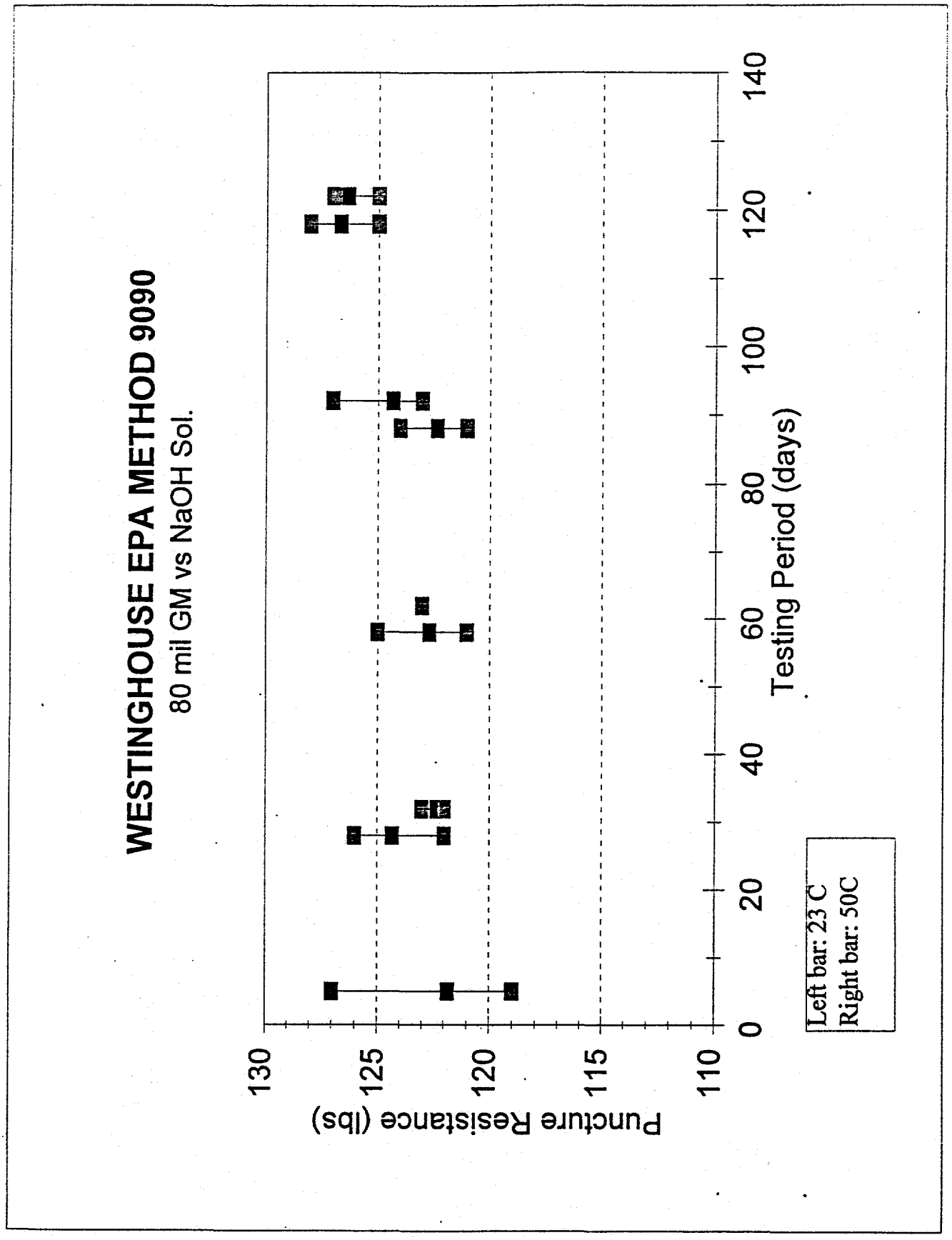

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs NaOH Sol.
Elongation @ yield (%)
28
24
20
16
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

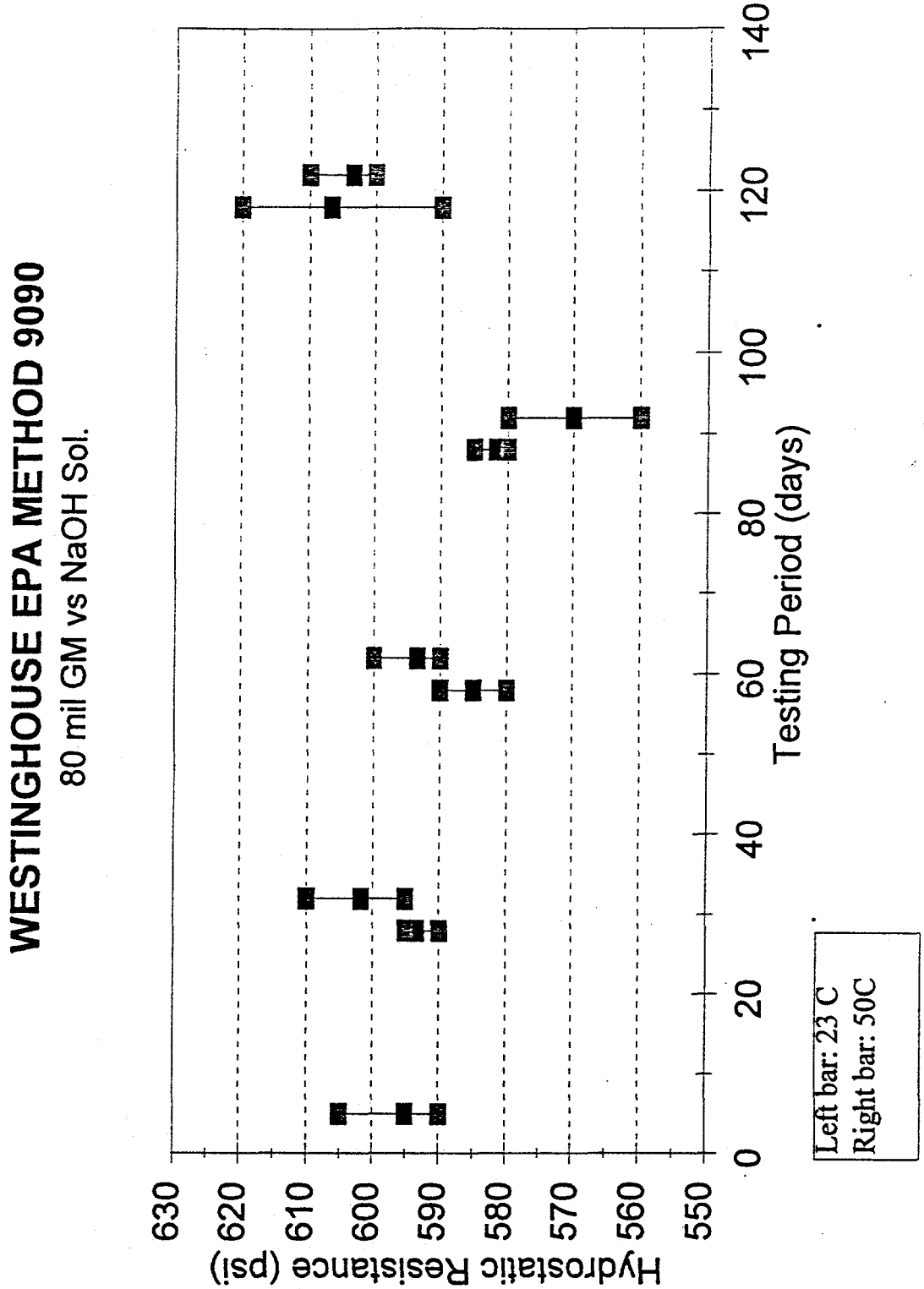

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs NaOH Sol.
Tensile stress @ break (psi)
6500
6000
5500
5000
4500
4000
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

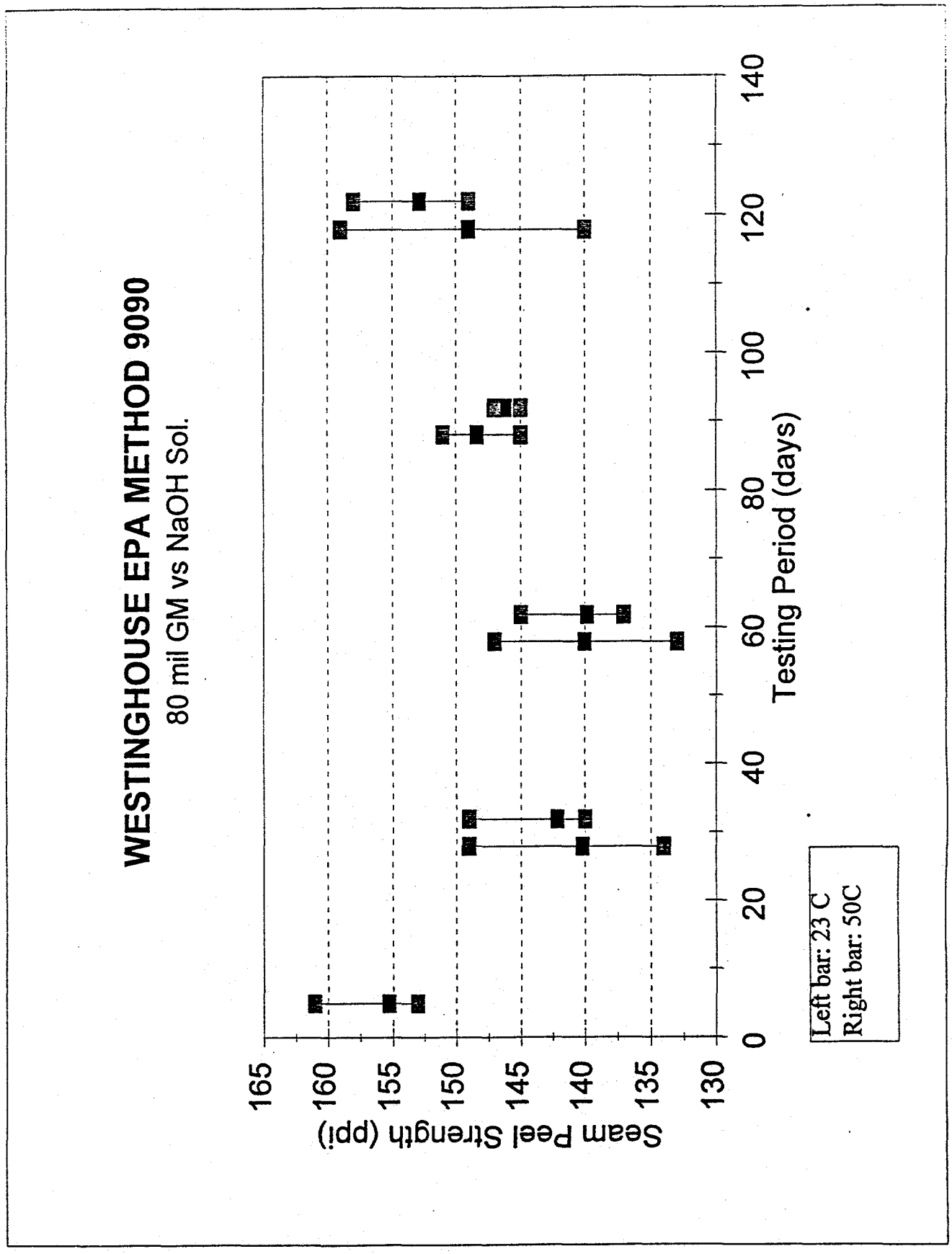

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs NaOH Sol.
Elongation @ break (%)
1050
950
850
750
650
550
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C

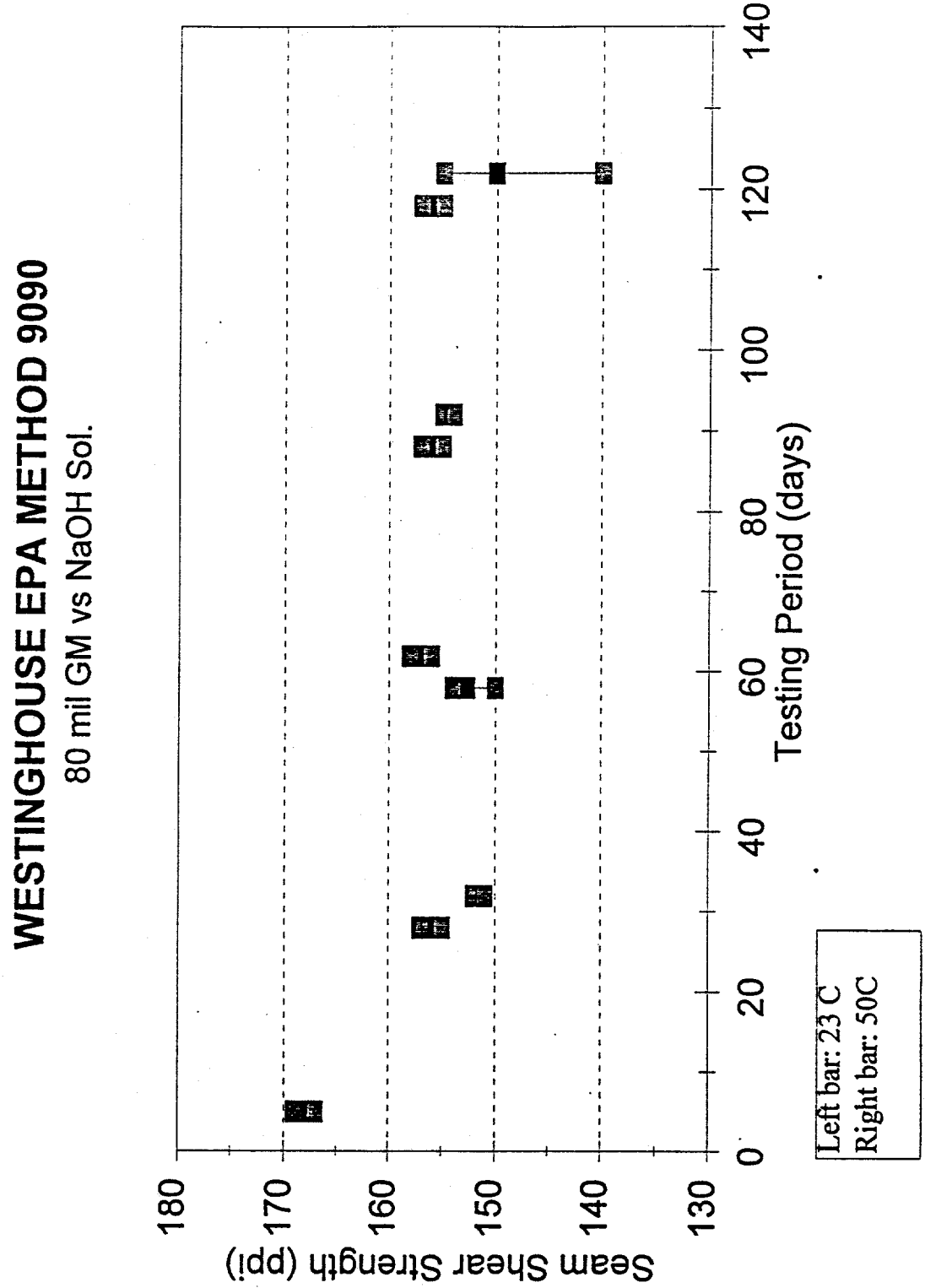

WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs NaOH Sol.
Modulus of Elasticity (psi)
24000
22000
20000
18000
16000
14000
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C


WESTINGHOUSE EPA METHOD 9090
80 mil GM (MD) vs NaOH Sol.
Tear Resistance (lbs)
80
70
60
50
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C


WESTINGHOUSE EPA METHOD 9090
80 mil GM vs NaOH Sol.
Puncture Resistance (lbs)
130
125
120
115
110
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C


WESTINGHOUSE EPA METHOD 9090
80 mil GM vs NaOH Sol.
Hydrostatic Resistance (psi)
630
620
610
600
590
580
570
560
550
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C


WESTINGHOUSE EPA METHOD 9090
80 mil GM vs NaOH Sol.
Seam Peel Strength (ppi)
165
160
155
150
145
140
135
130
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C


WESTINGHOUSE EPA METHOD 9090
80 mil GM vs NaOH Sol.
Seam Shear Strength (ppi)
180
170
160
150
140
130
0
20
40
60
80
100
120
140
Testing Period (days)
Left bar: 23 C
Right bar: 50C