

MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

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Report No. CG-D-36-83

AD A139384

REVISION AND EXPERIMENTAL VERIFICATION OF THE HAZARD ASSESSMENT COMPUTER SYSTEM MODELS FOR SPREADING, MOVEMENT, DISSOLUTION, AND DISSIPATION OF INSOLUBLE CHEMICALS SPILLED ONTO WATER: TEST DATA VOLUME

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FINAL REPORT  
JUNE 1983

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Prepared for:

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United States Coast Guard

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Washington, D.C. 20593

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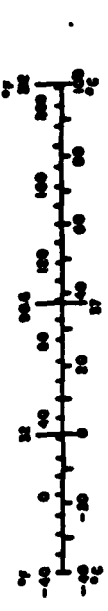
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Technical Report Documentation Page

1. Report No. CG-D-36-83		2. Government Accession No. ADA139 384		3. Recipient's Catalog No.	
4. Title and Subtitle Revision and Experimental Verification of the Hazard Assessment Computer System Models for Spreading, Movement, Dissolution, and Dissipation of Insoluble Chemicals Spilled Onto Water: <input checked="" type="checkbox"/> Test Data <input checked="" type="checkbox"/> Volume				5. Report Date June 1983	
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7. Author(s) F.T. Dodge, J.T. Park, J.C. Buckingham and R.J. Magott				8. Performing Organization Report No.	
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16. Abstract Computerized models are developed to predict the spreading, movement, evaporation, and dissolution of floating slicks formed by accidental spills of insoluble chemicals. Separate models are developed for continuous and instantaneous spills. The waterway can be a river, channel, lake, or coastal water. The models emphasize the dynamics of the thick slick (i.e., the gravity-viscous spreading phase) since the thick slick contains nearly all the spilled chemical and represents the most prolonged hazard.  Predictions of the spreading models are compared to results of instantaneous and continuous spill tests conducted in a large laboratory basin and a laboratory channel. The evaporation and dissolution predictions are compared to wind tunnel and wind-wave tunnel tests. Agreement of the models and the tests is generally good.					
17. Key Words Chemical Spills Waterways Floating Slicks Slick Movement			Evaporation Dissolution Dissipation Spreading		18. Distribution Statement Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 117	22. Price

### METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures			Approximate Conversions from Metric Measures					
Symbol	When You Have	Multiply by	To Find	Symbol	When You Have	Multiply by	To Find	Symbol
<b>LENGTH</b>								
m	inches	2.5	centimeters	cm	centimeters	0.4	inches	in
ft	feet	30	centimeters	cm	centimeters	0.4	inches	in
yd	yards	0.9	meters	m	meters	3.3	yards	yd
mi	miles	1.6	kilometers	km	kilometers	0.6	miles	mi
<b>AREA</b>								
sq ft	square feet	0.9	square centimeters	sq cm	square centimeters	1.1	square inches	sq in
sq yd	square yards	0.8	square meters	sq m	square meters	1.2	square yards	sq yd
sq mi	square miles	0.6	square kilometers	sq km	square kilometers	0.4	square miles	sq mi
ac	acres	2.5	hectares (10,000 m <sup>2</sup> )	ha	hectares	2.5	acres	ac
<b>MASS (weight)</b>								
lb	pounds	4.5	grams	g	grams	0.002	ounces	oz
kg	kilograms	2.2	grams	g	grams	0.002	ounces	oz
short ton (2000 lb)	short tons	0.9	kilograms (1000 g)	kg	kilograms	2.2	pounds	lb
<b>VOLUME</b>								
l	liters	1.05	quarts	qt	quarts	0.95	fluid ounces	fl oz
gal	gallons	3.8	quarts	qt	quarts	0.95	fluid ounces	fl oz
cu ft	cubic feet	7.5	liters	l	liters	1.05	fluid ounces	fl oz
cu yd	cubic yards	1.35	cubic meters	m <sup>3</sup>	cubic meters	1.35	cubic yards	cu yd
<b>TEMPERATURE (exact)</b>								
°F	Fahrenheit temperature	$(F - 32) \times \frac{5}{9}$	°C	Celsius temperature	$C \times \frac{9}{5} + 32$			



\* 1 in = 2.54 (exact). For other exact conversions and more detailed tables, see NBS Mon. Publ. 285, Guide for Weight and Measure, Price \$2.25, SD Catalog No. C13.10.285.

TABLE OF CONTENTS

	<u>Pages</u>
APPENDIX A - Spreading Test Series I - Non-Volatile Instantaneous Spills in Basin	A-1 - A-22
APPENDIX B - Spreading Test Series II - Non-Volatile Continuous Spills in Basin	B-1 - B-22
APPENDIX C - Spreading Test Series III - Volatile Instantaneous Spills in Basin	C-1 - C-21
APPENDIX D - Spreading Test Series IV - Volatile Continuous Spills in Basin	D-1 - D-21
APPENDIX E - Spreading Test Series V - Flow Channel Tests	E-1 - E-22

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Availability Codes	
Special and/or	
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A-1	



APPENDIX A

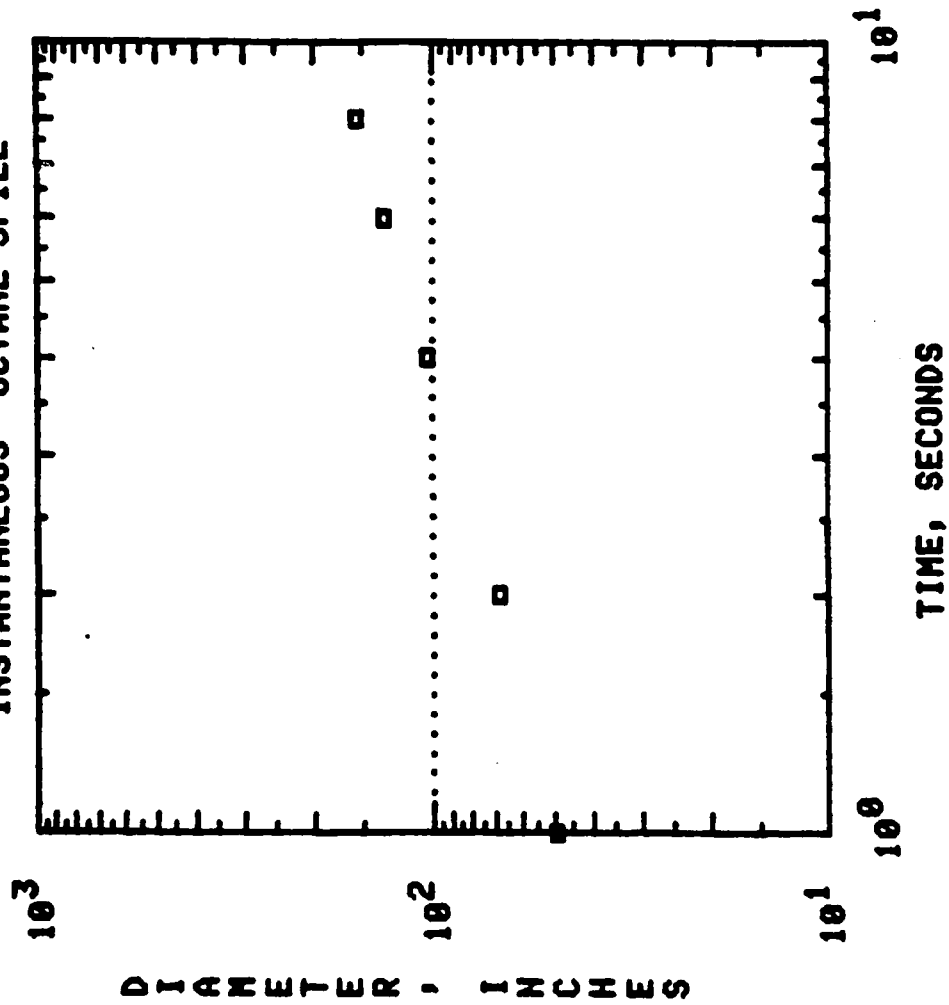
SPREADING TEST SERIES I -  
NON-VOLATILE INSTANTANEOUS SPILLS IN BASIN



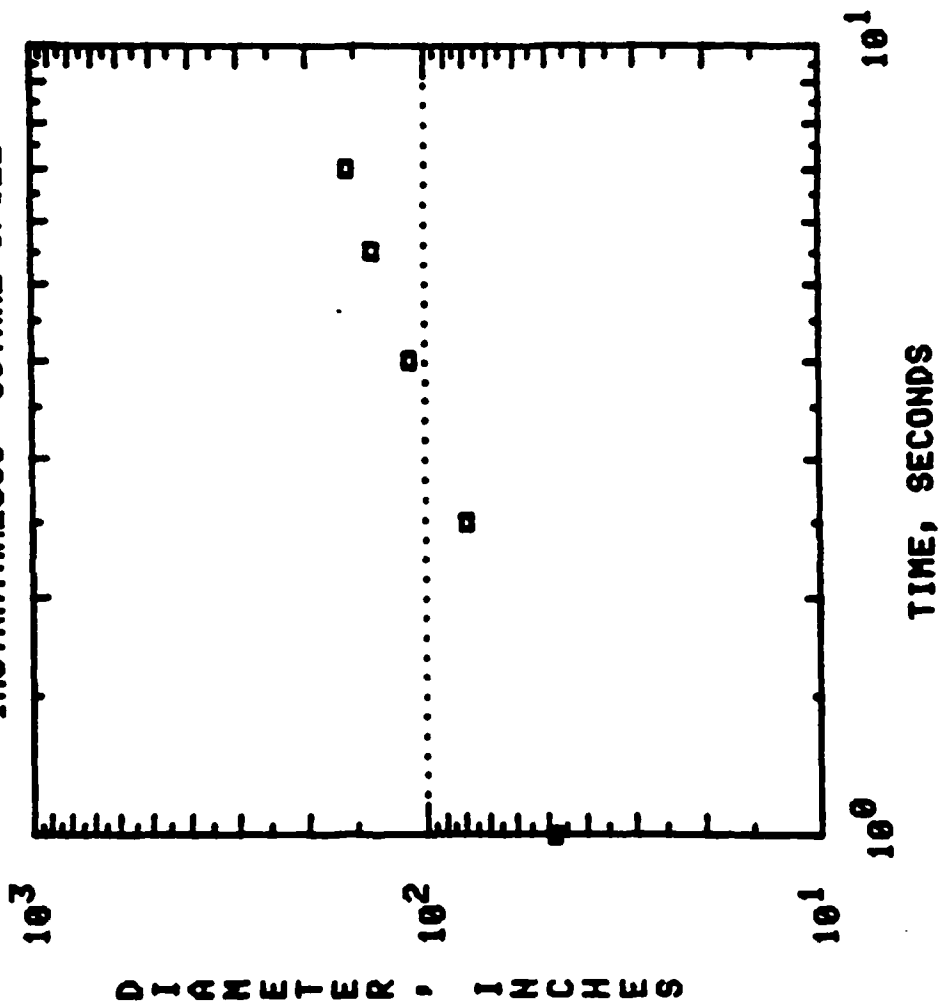
SUMMARY OF TEST CONDITIONS FOR  
SPREADING TEST SERIES I -  
NON-VOLATILE INSTANTANEOUS SPILLS IN BASIN

Run Number	Chemical	Specific Gravity	$\sigma_{sp}$ Coef.	Spill Diameter (cm)	Spill Volume (liters)
I.1-1	Octane	0.703	0.3	20.3	5
I.1-2				30.5	10
I.1-3				40.6	20
I.1-4				61.0	40
I.2-1	Kerosene	0.795	-2.7	20.3	5
I.2-2				30.5	10
I.2-3				40.6	20
I.2-4				61.0	40
I.3-1	n-Hexanol	0.819	39.75	20.3	5
I.3-2				30.5	10
I.3-3				40.6	20
I.3-4				61.0	40
I.4-1	Naphtha	0.860	7.8	20.3	5
I.4-2				30.5	10
I.4-3				40.6	20
I.4-4				61.0	40
I.4-5				61.0	60
I.5-1	m-Xylene	0.864	7.0	20.3	5
I.5-2				30.5	10
I.5-3				40.6	20
I.5-4				61.0	40

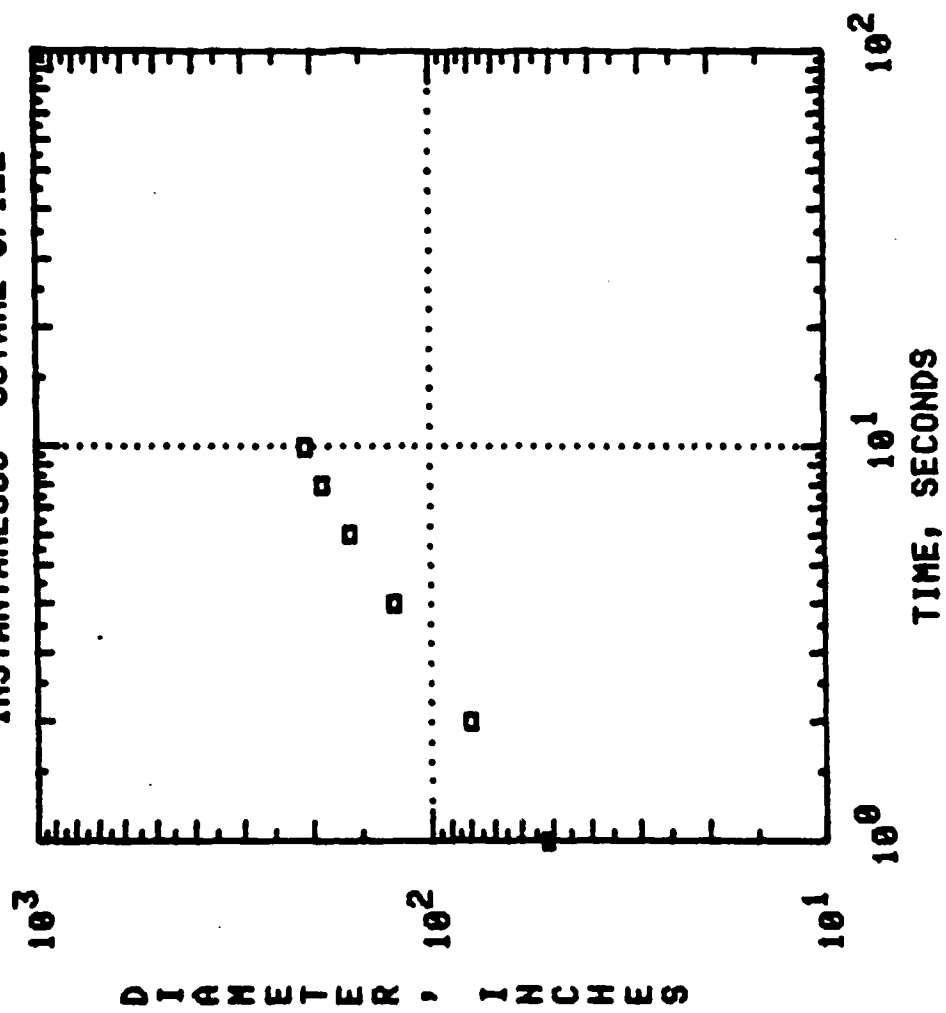
1.1-1 5. LITER NON-VOLATILE  
INSTANTANEOUS OCTANE SPILL



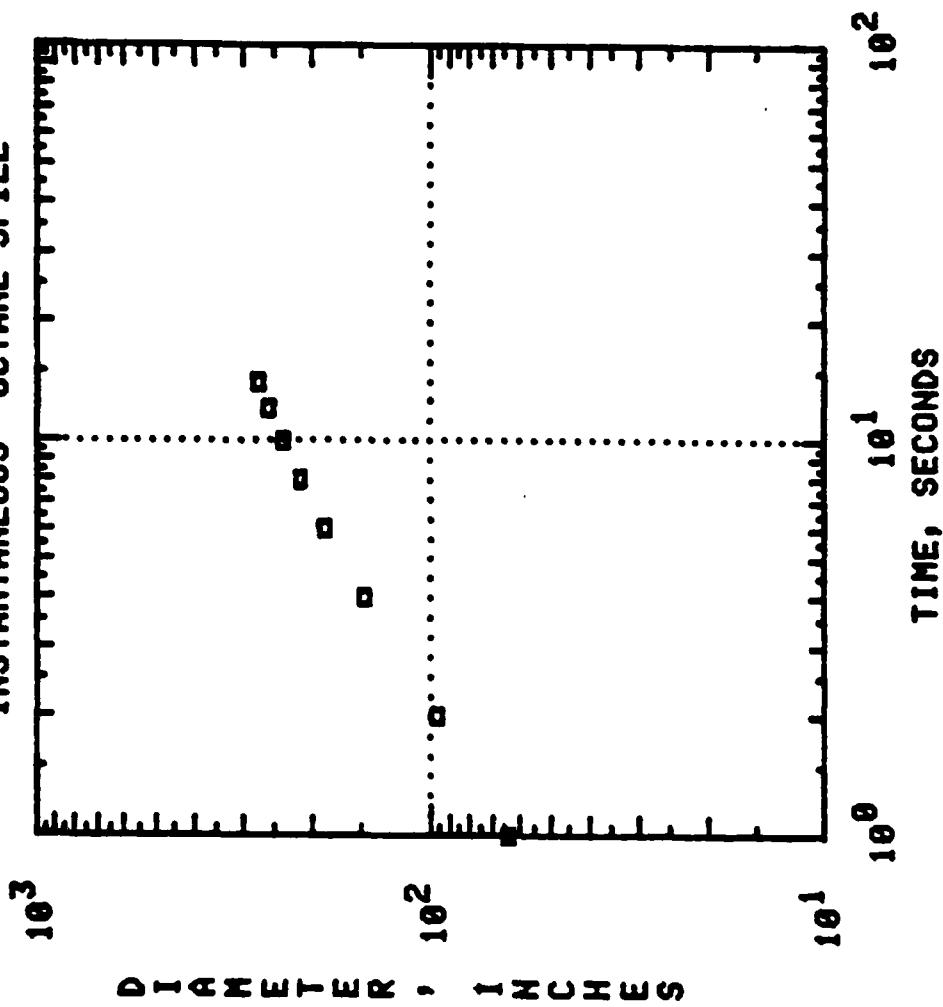
**I.1-2 10. LITER NON-VOLATILE  
INSTANTANEOUS OCTANE SPILL**



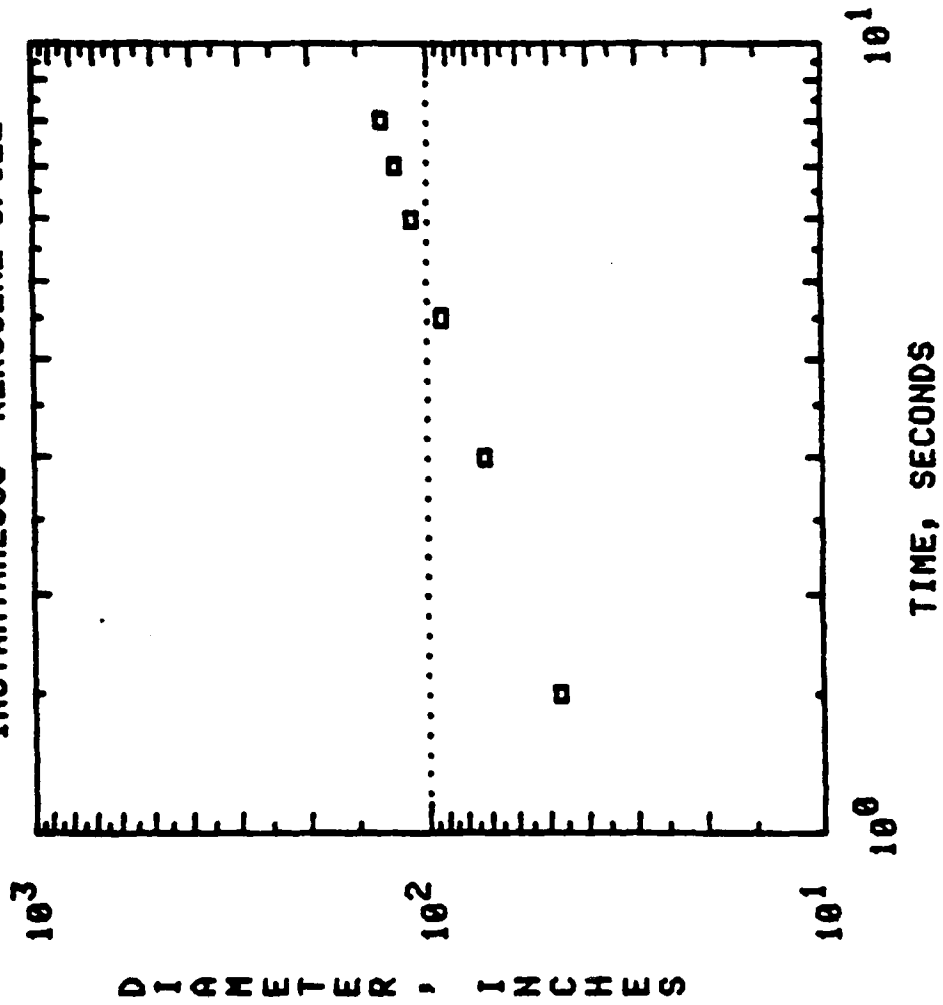
1.1-3 20. LITER NON-VOLATILE  
INSTANTANEOUS OCTANE SPILL



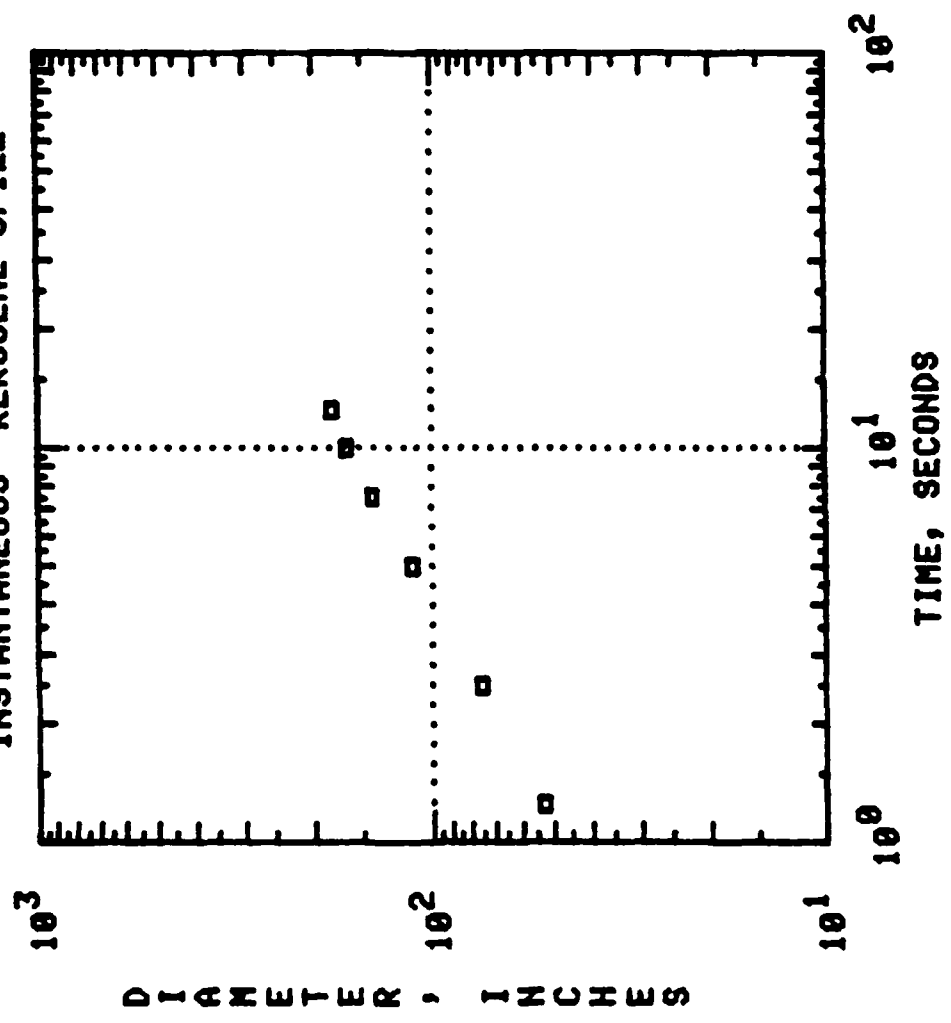
I.1-4 40. LITER NON-VOLATILE  
INSTANTANEOUS OCTANE SPILL



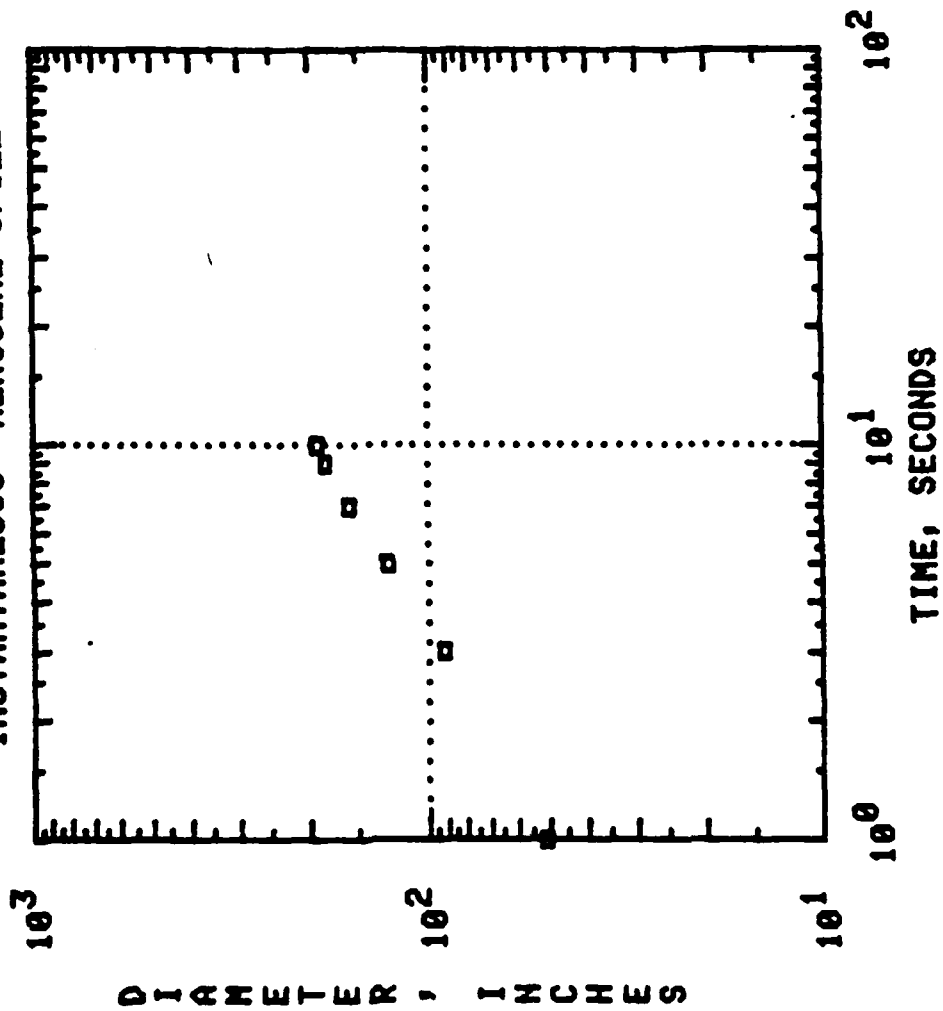
I.2-1 5. LITER NON-VOLATILE  
INSTANTANEOUS KEROSENE SPILL



I.2-2 10. LITER NON-VOLATILE  
INSTANTANEOUS KEROSENE SPILL

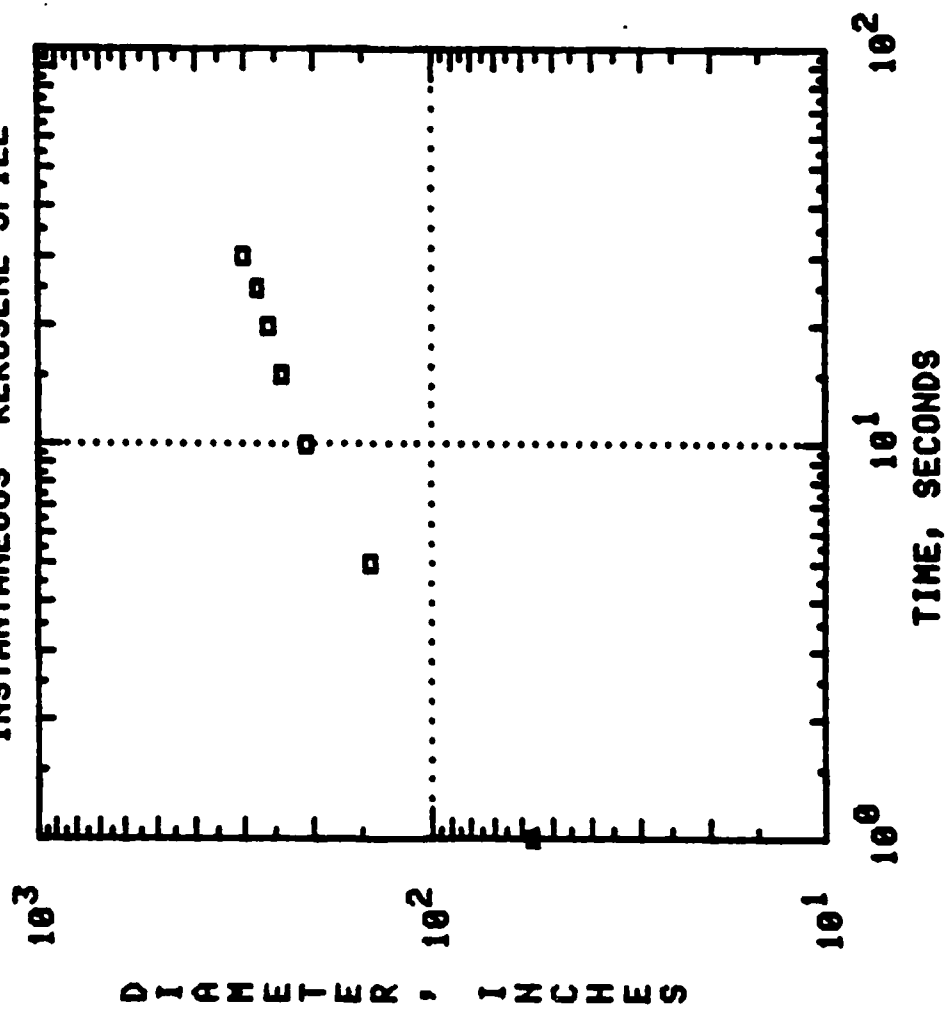


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INSTANTANEOUS KEROSENE SPILL

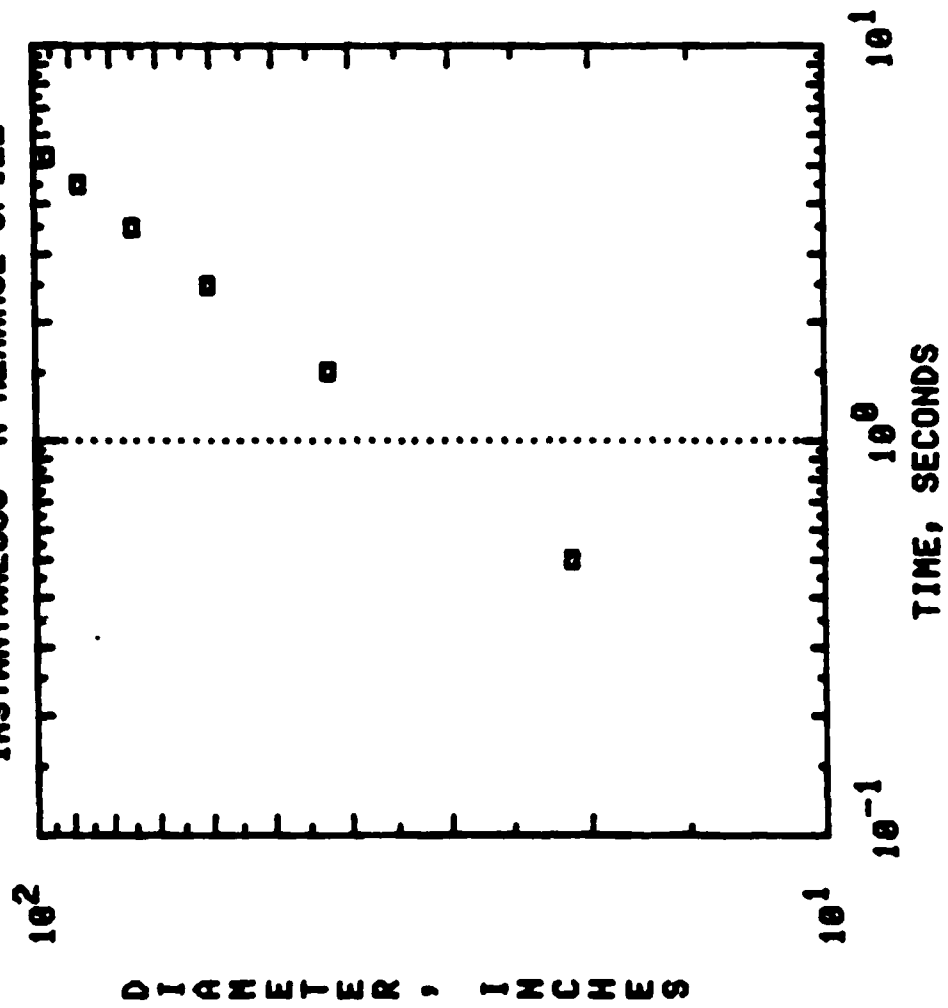




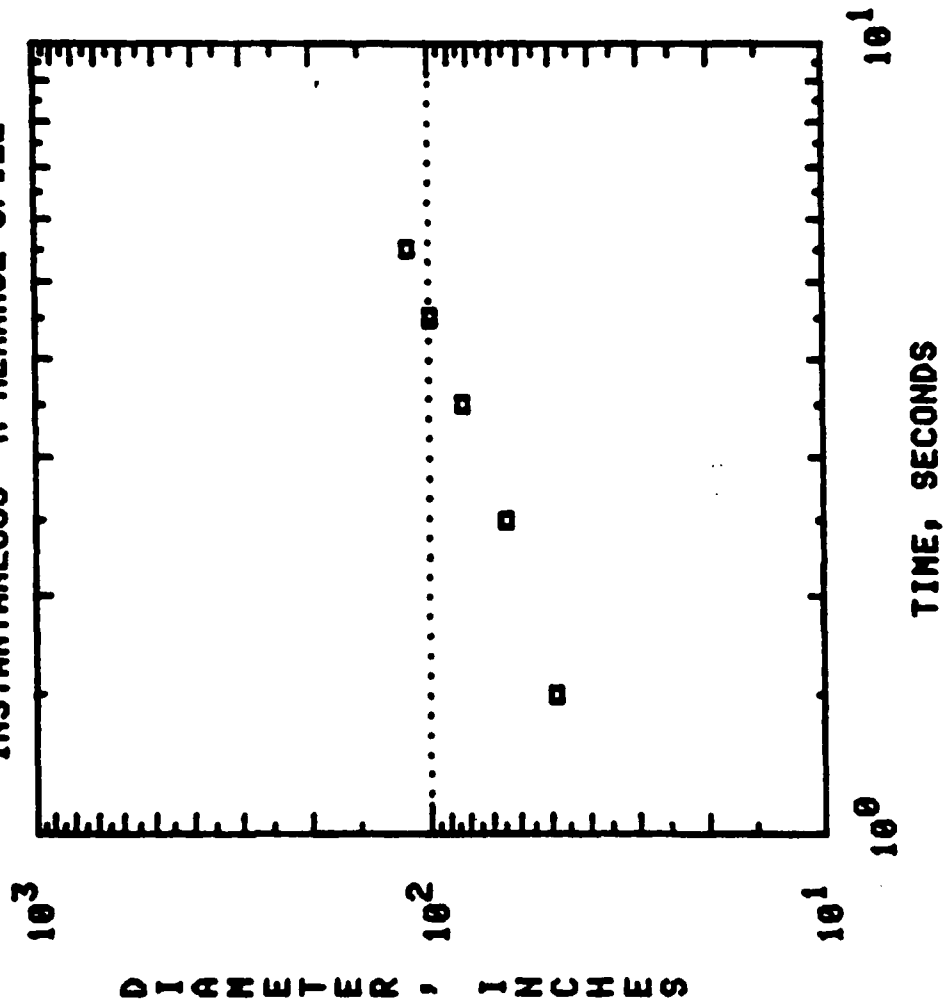
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INSTANTANEOUS KEROSENE SPILL**



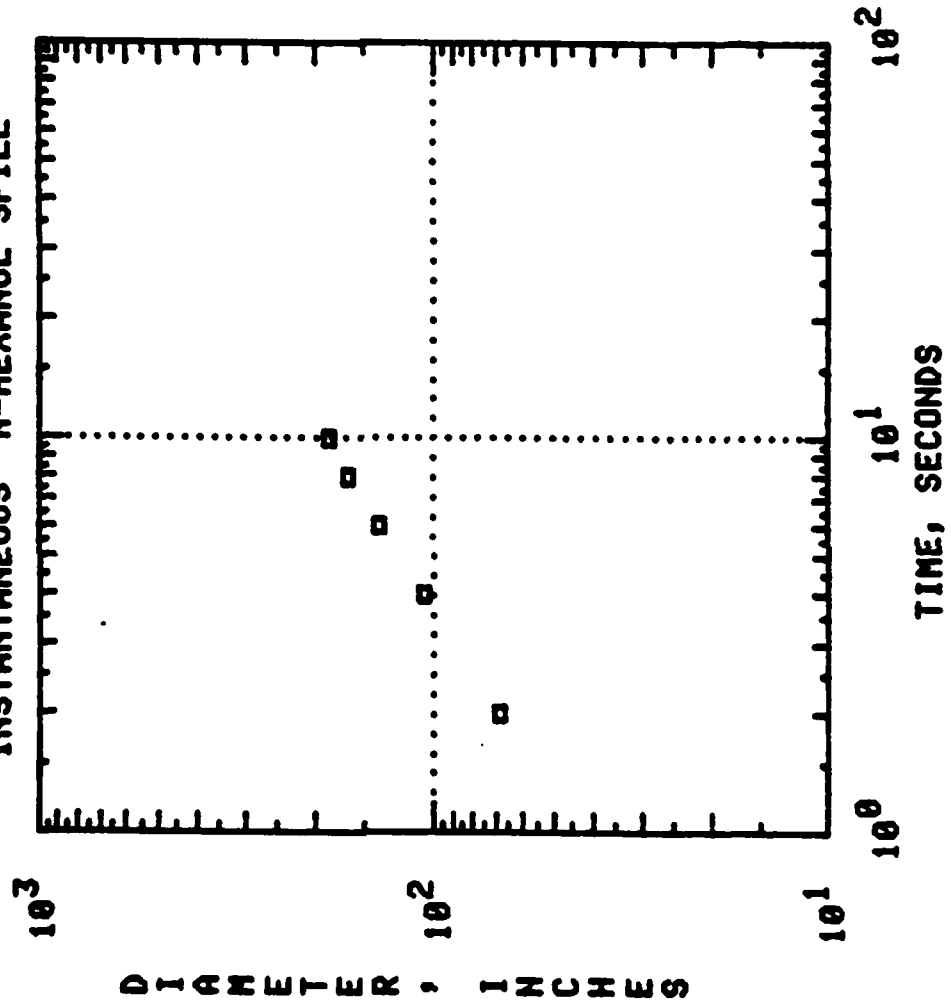
I.3-1 5. LITER NON-VOLATILE  
INSTANTANEOUS N-HEXANOL SPILL



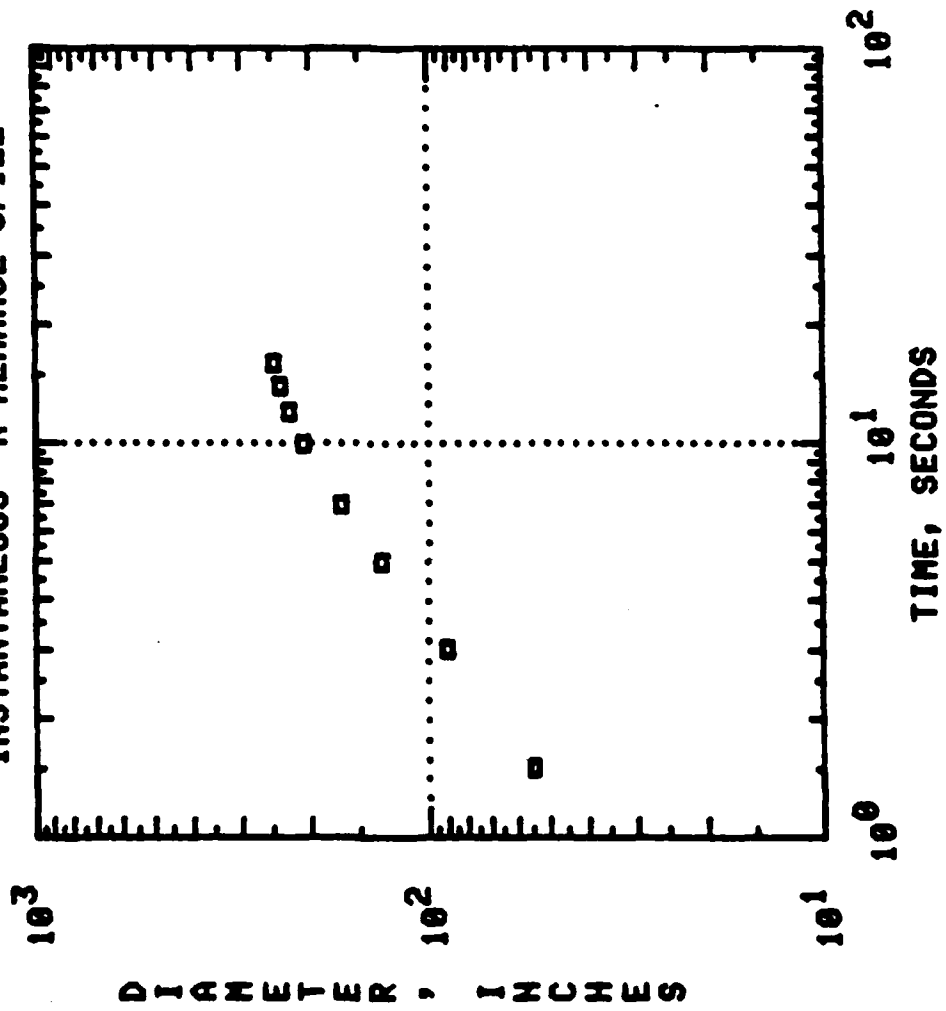
**1.3-2 10. LITER NON-VOLATILE  
INSTANTANEOUS N-HEXANOL SPILL**



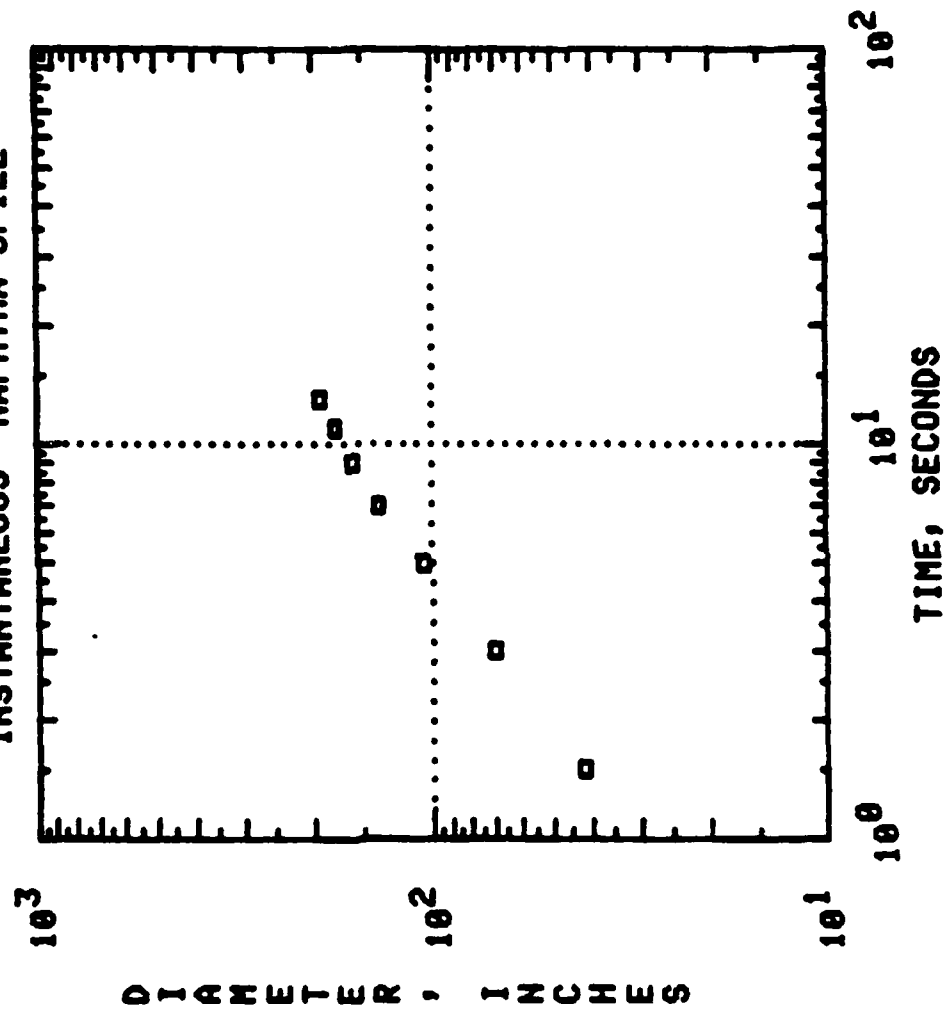
**1.3-3 20, LITER NON-VOLATILE  
INSTANTANEOUS N-HEXANOL SPILL**



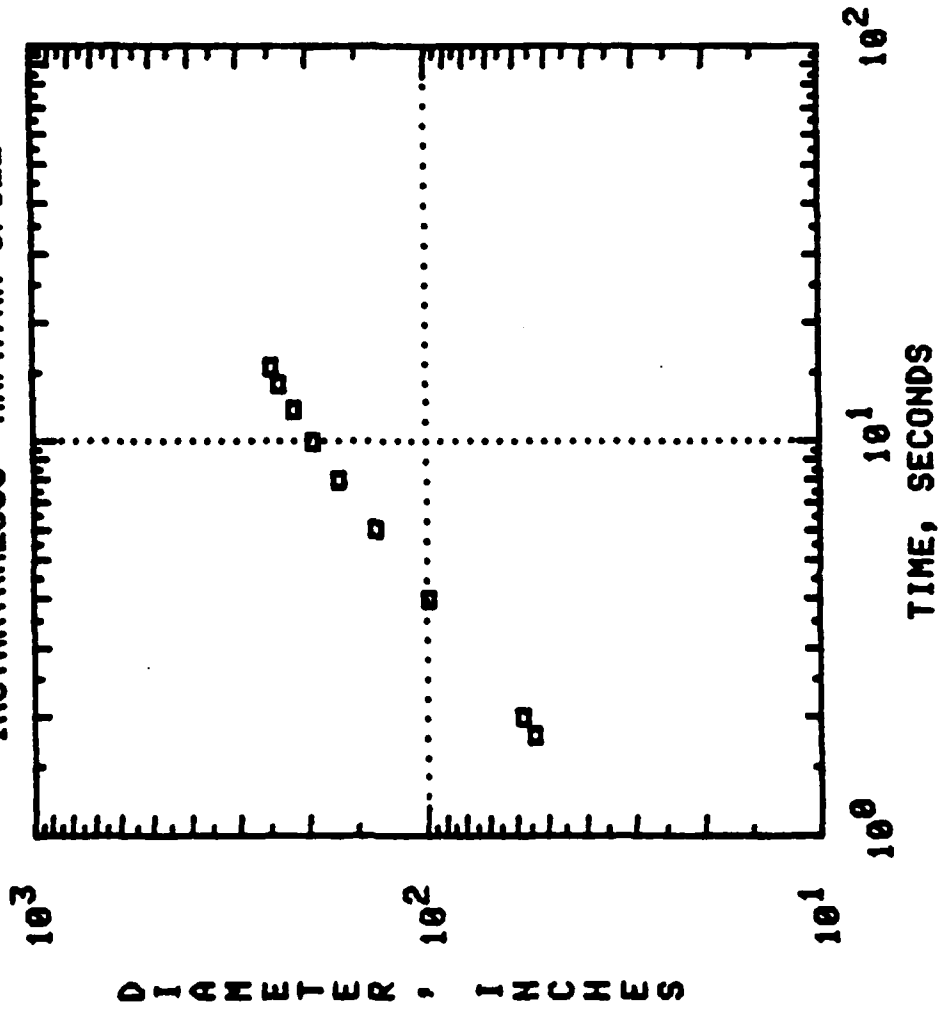
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INSTANTANEOUS N-HEXANOL SPILL



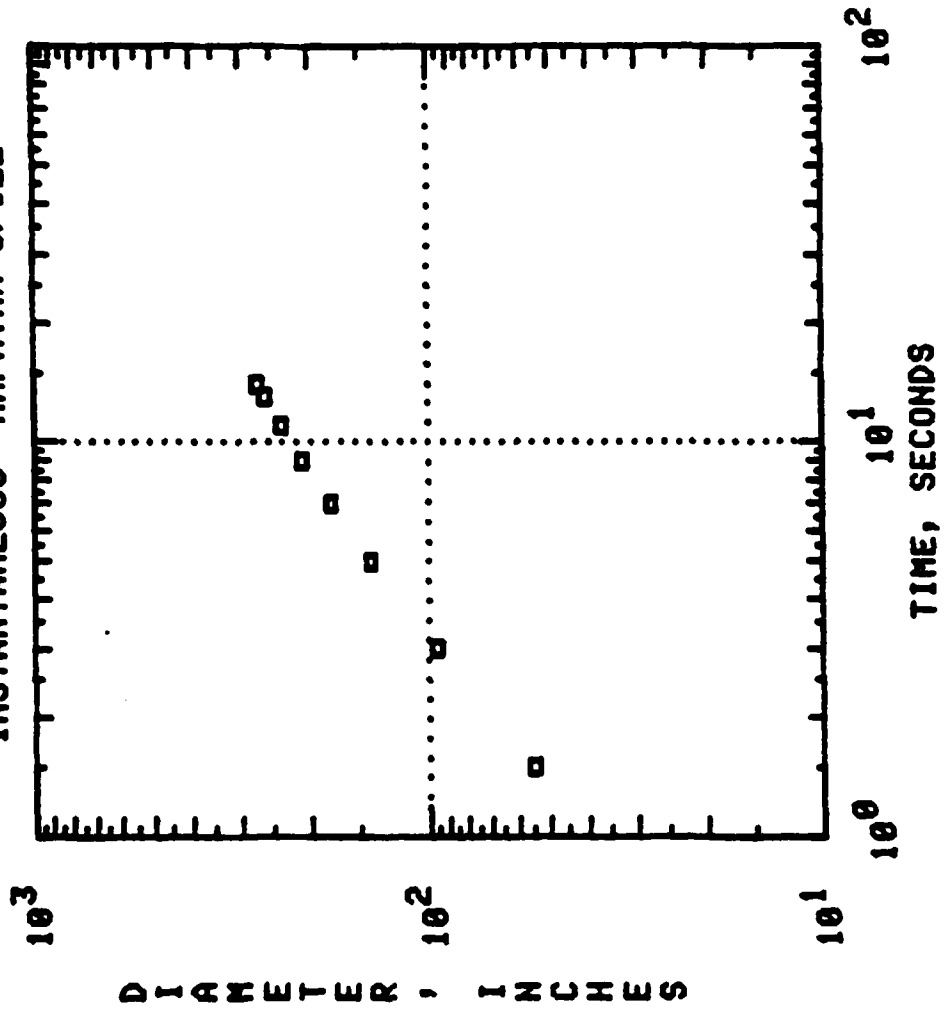
**1.4-1 5. LITER NON-VOLATILE  
INSTANTANEOUS NAPHTHA SPILL**



1.4-2 10. LITER NON-VOLATILE  
INSTANTANEOUS NAPHTHA SPILL

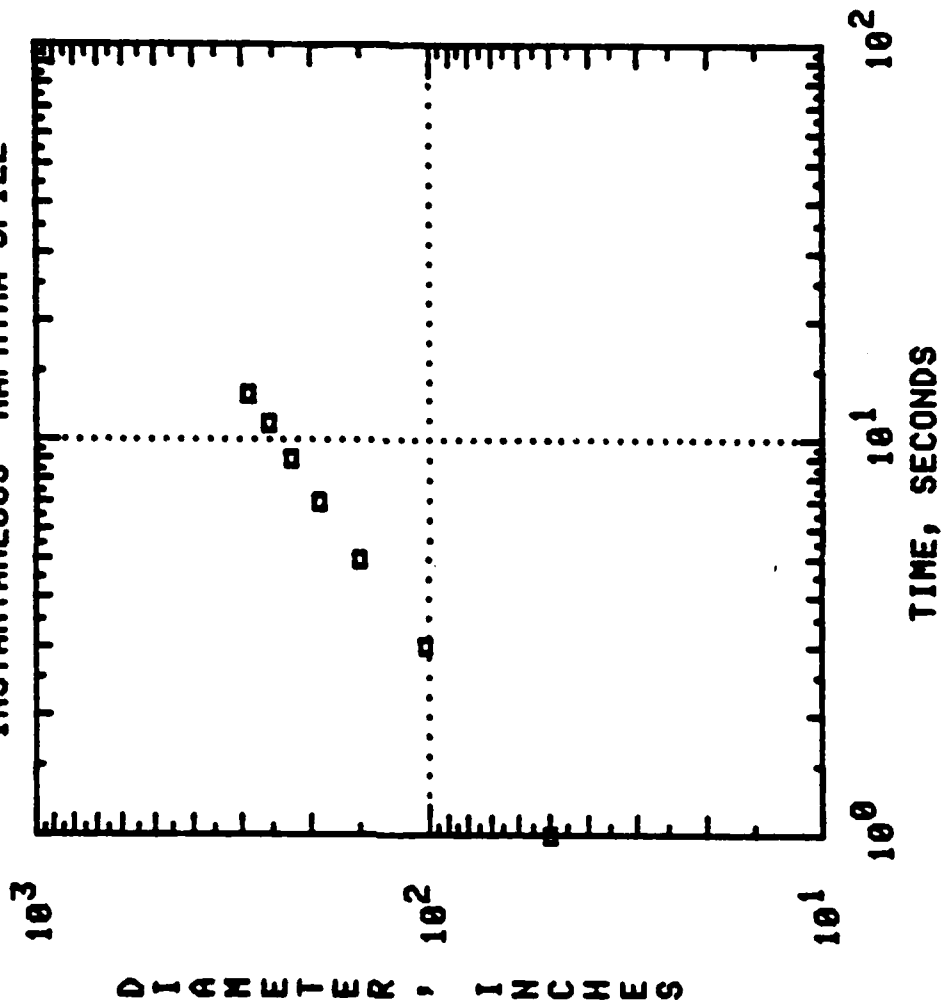


1.4-3 20. LITER NON-VOLATILE  
INSTANTANEOUS NAPHTHA SPILL

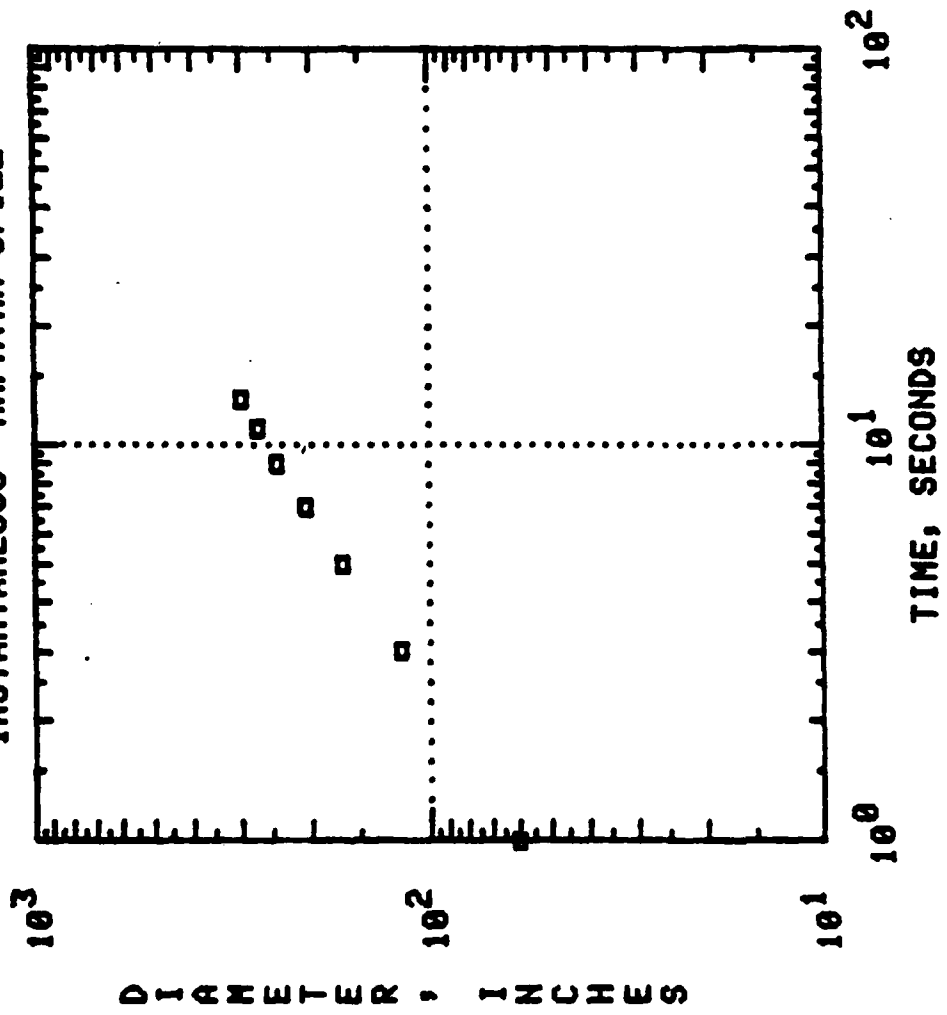




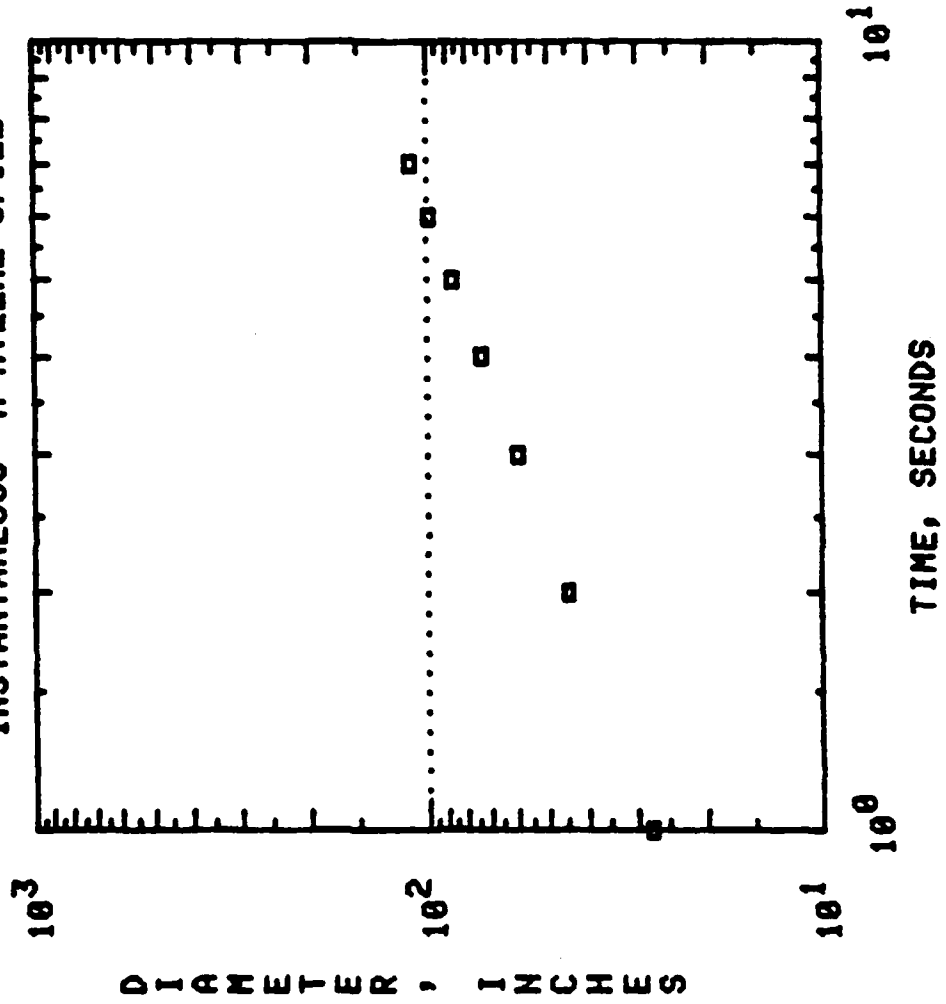
**I.4-4 40. LITER NON-VOLATILE  
INSTANTANEOUS NAPHTHA SPILL**



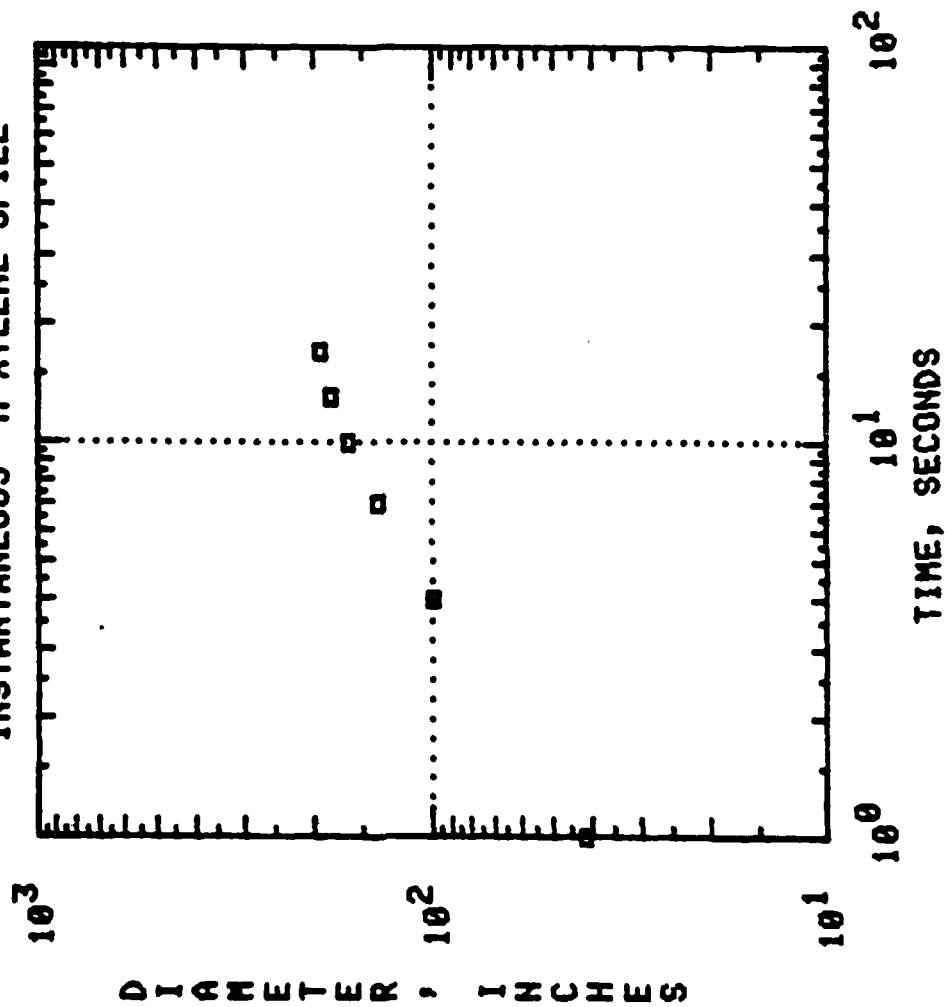
1.4-5 60. LITER NON-VOLATILE  
INSTANTANEOUS NAPHTHA SPILL



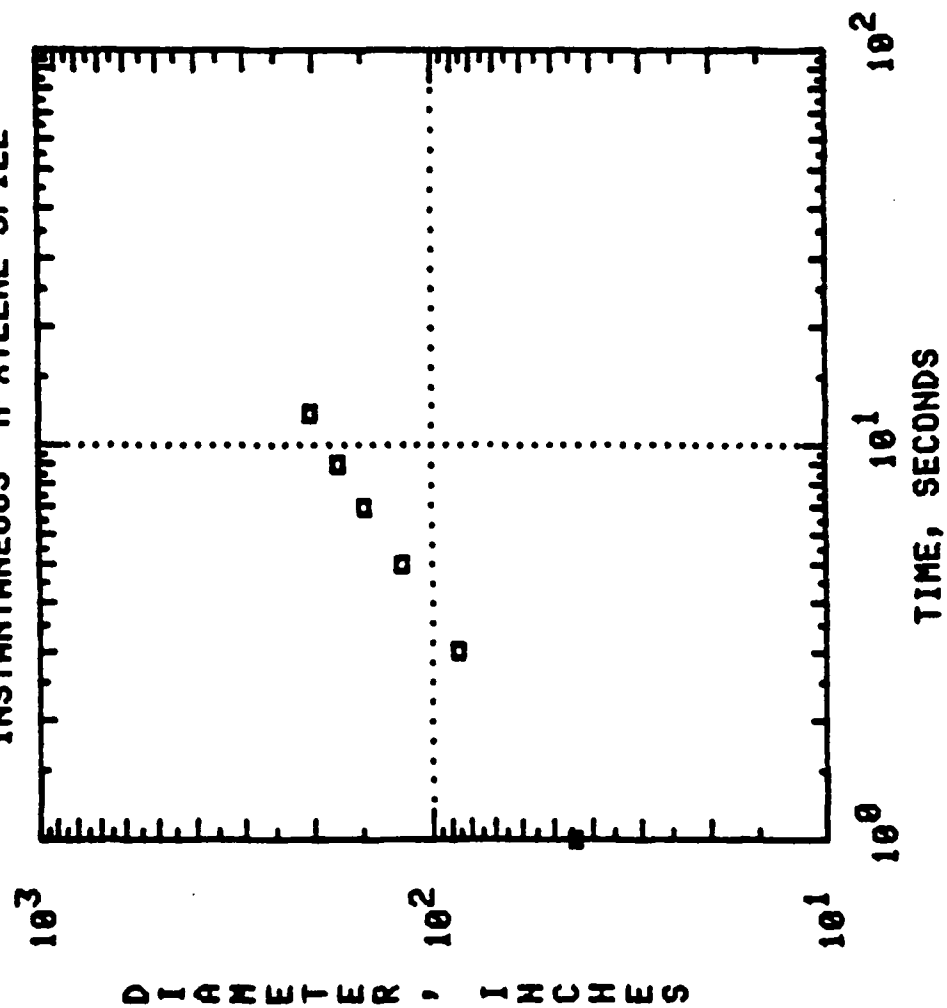
I.5-1 5. LITER NON-VOLATILE  
INSTANTANEOUS M-XYLENE SPILL



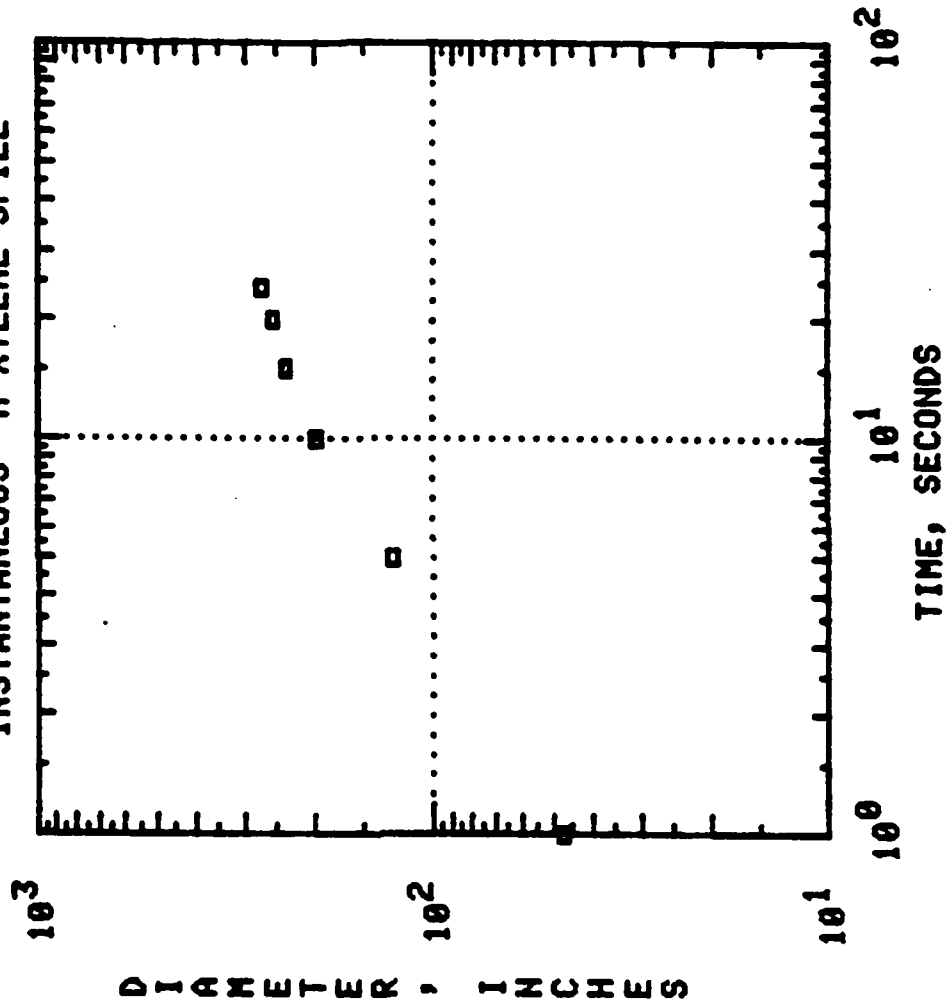
1.5-2 10. LITER NON-VOLATILE  
INSTANTANEOUS M-XYLENE SPILL



I.5-3 20. LITER NON-VOLATILE  
INSTANTANEOUS M-XYLENE SPILL



1.5-4 40. LITER NON-VOLATILE  
INSTANTANEOUS M-XYLENE SPILL



APPENDIX B

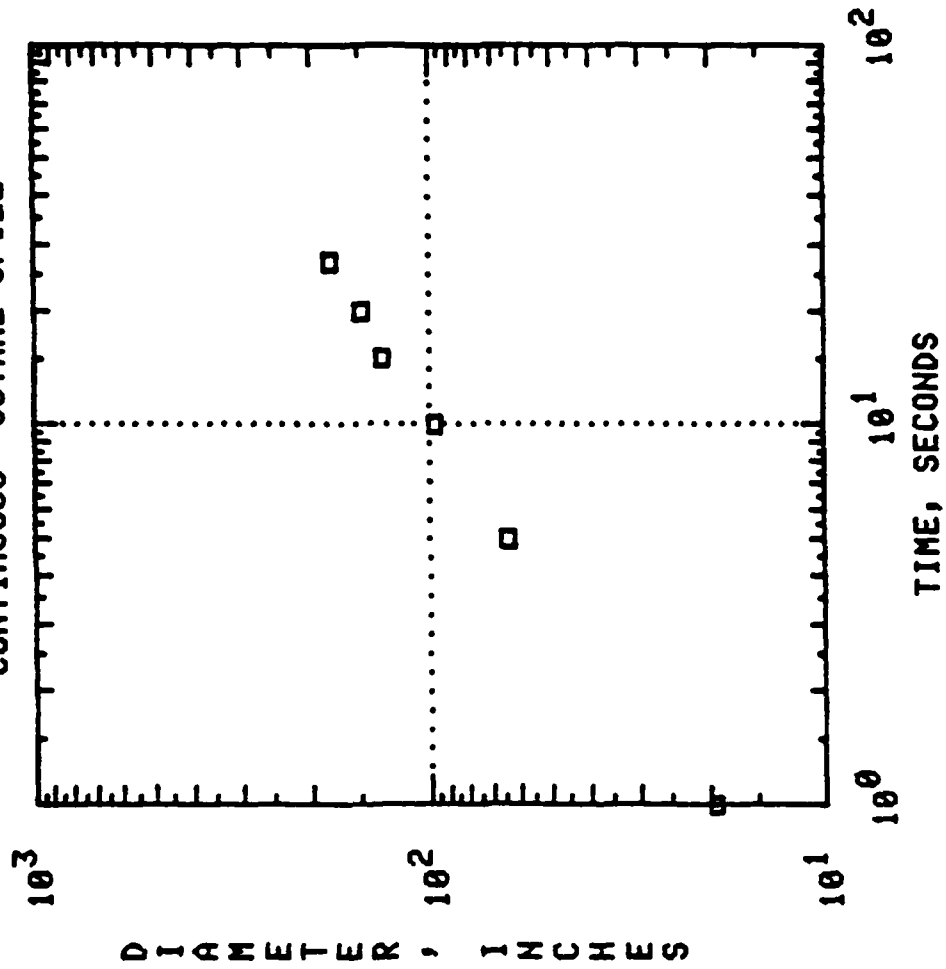
SPREADING TEST SERIES II -  
NON-VOLATILE CONTINUOUS SPILLS IN BASIN

SUMMARY OF TEST CONDITIONS FOR  
SPREADING TEST SERIES II -  
NON-VOLATILE CONTINUOUS SPILLS IN BASIN

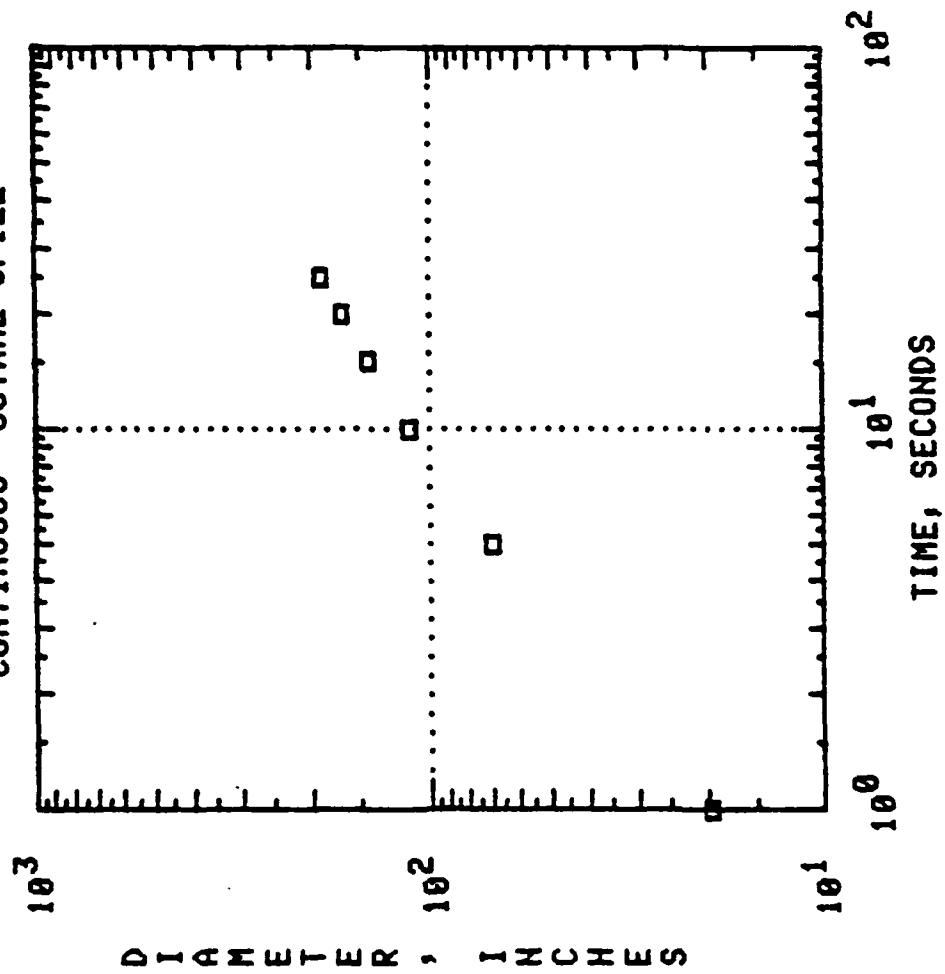
Run Number	Chemical	Specific Gravity	$\sigma_{sp}$ Coef.	Spill Diameter (cm)	Spill Rate (liters/sec)
II.1-1	Octane	0.703	0.3	7.6	0.50
II.1-2					0.82
II.1-3					1.01
II.1-4					1.26
II.2-1	Kerosene	0.795	-2.7	7.6	0.50
II.2-2					0.82
II.2-3					1.01
II.2-4					1.26
II.3-1	n-Hexanol	0.819	39.75	7.6	0.50
II.3-2					0.82
II.3-3					1.01
II.3-4					1.26
II.4-1	Naphtha	0.860	7.8	7.6	0.50
II.4-2					0.63
II.4-3					0.95
II.4-4					1.10
II.4-5					1.26
II.5-1	m-Xylene	0.864	7.0	7.6	0.50
II.5-2					0.82
II.5-3					1.01
II.5-4					1.26



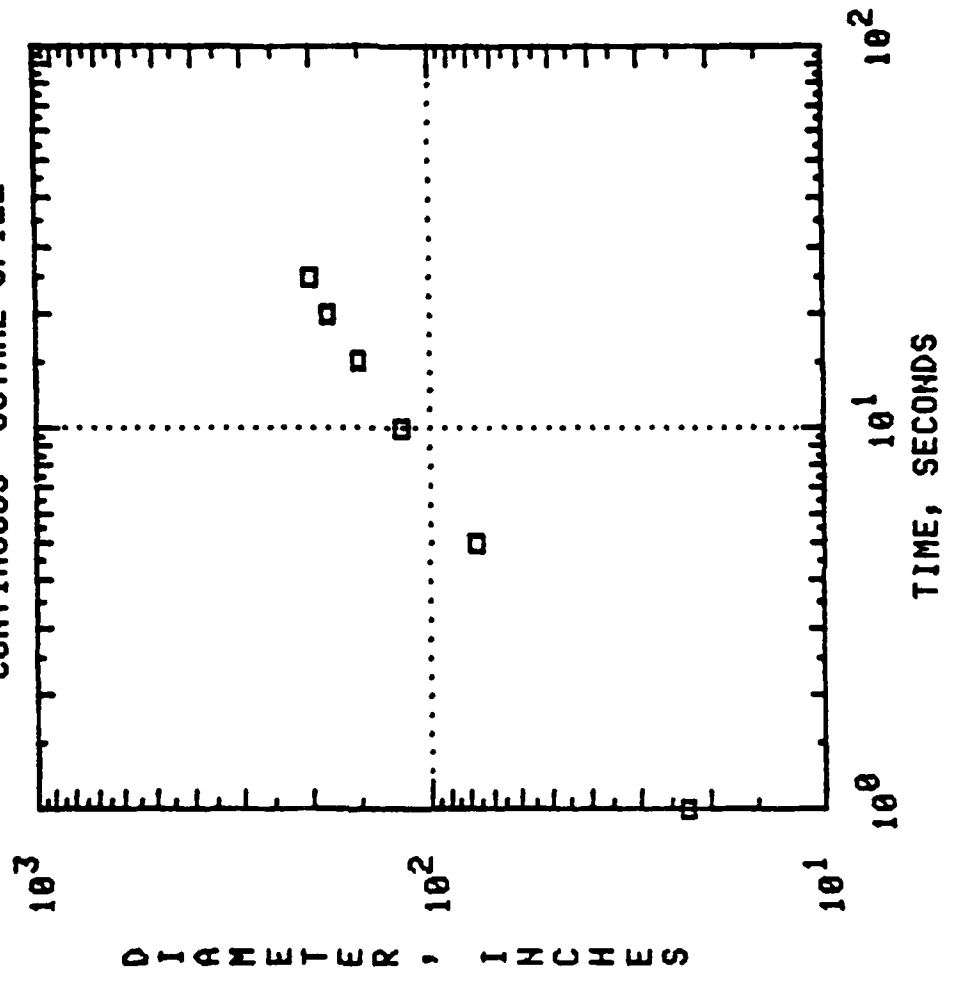
II.1-1 0.50 L/SEC NON-VOLATILE  
CONTINUOUS OCTANE SPILL



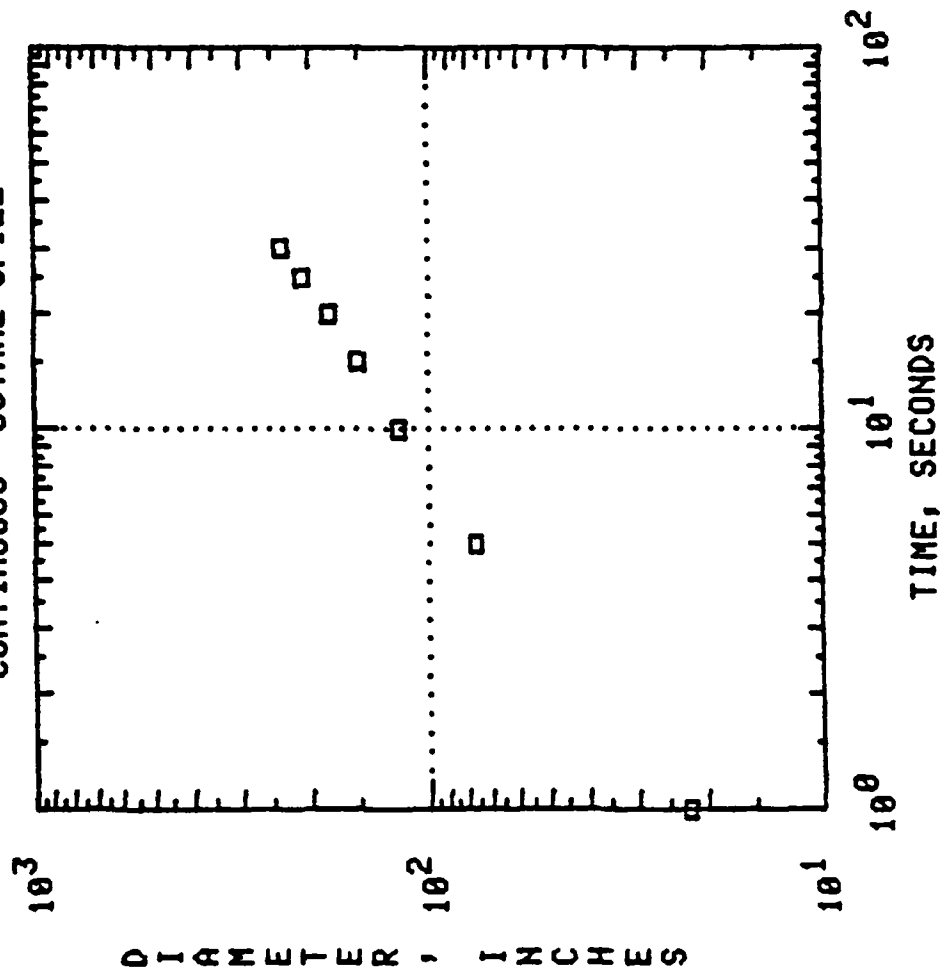
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CONTINUOUS OCTANE SPILL



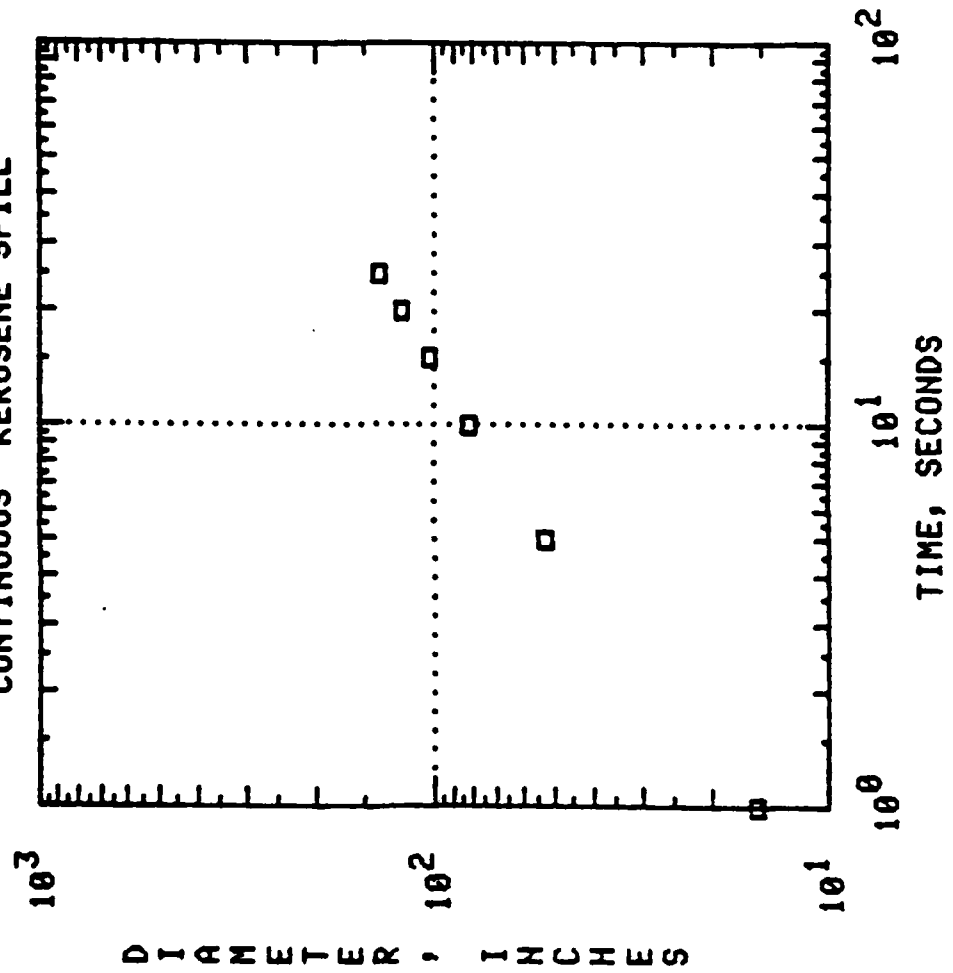
II.1-3 1.01 L/SEC NON-VOLATILE  
CONTINUOUS OCTANE SPILL



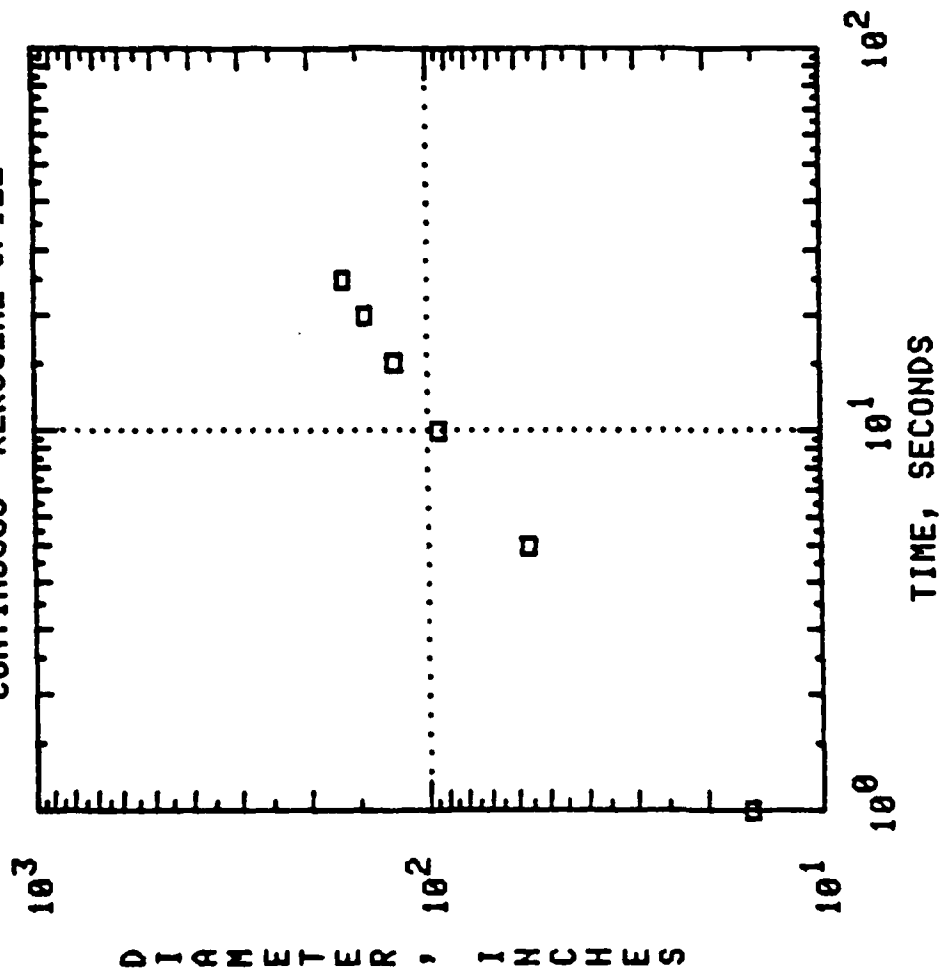
II.1.1-4 1.26 L/SEC NON-VOLATILE  
CONTINUOUS OCTANE SPILL



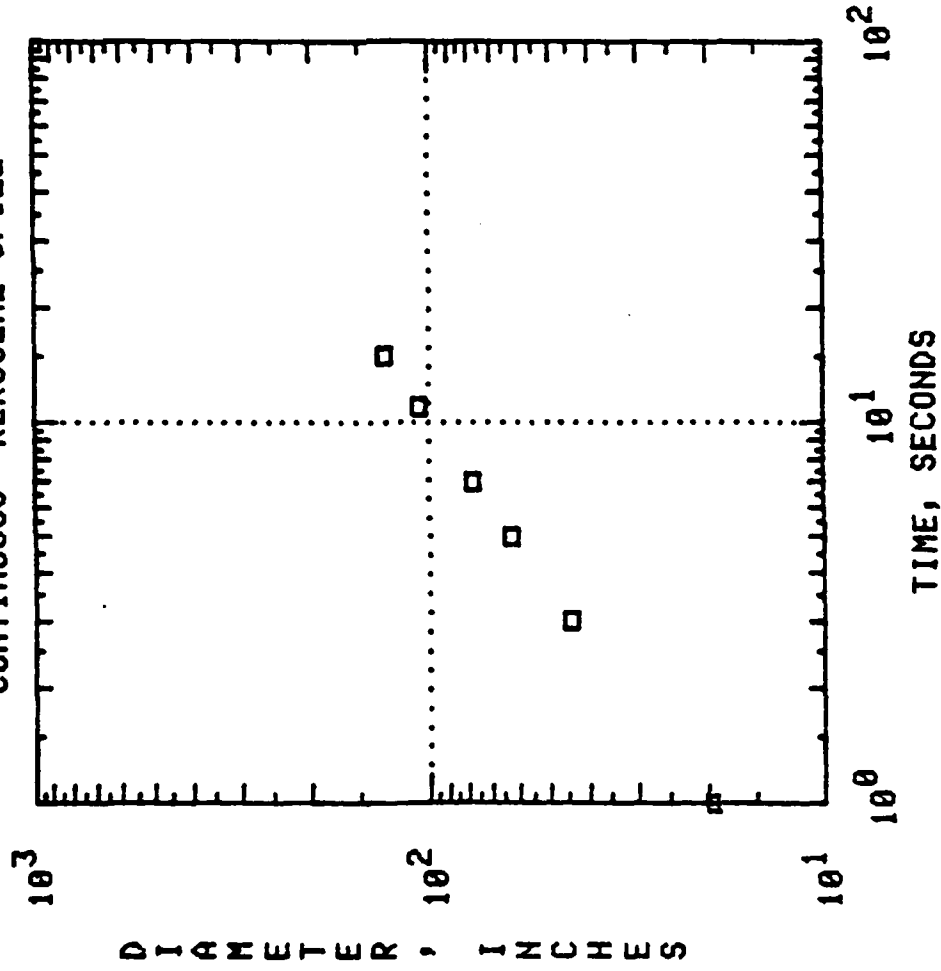
II.2-1 0.50 L/SEC NON-VOLATILE  
CONTINUOUS KEROSENE SPILL



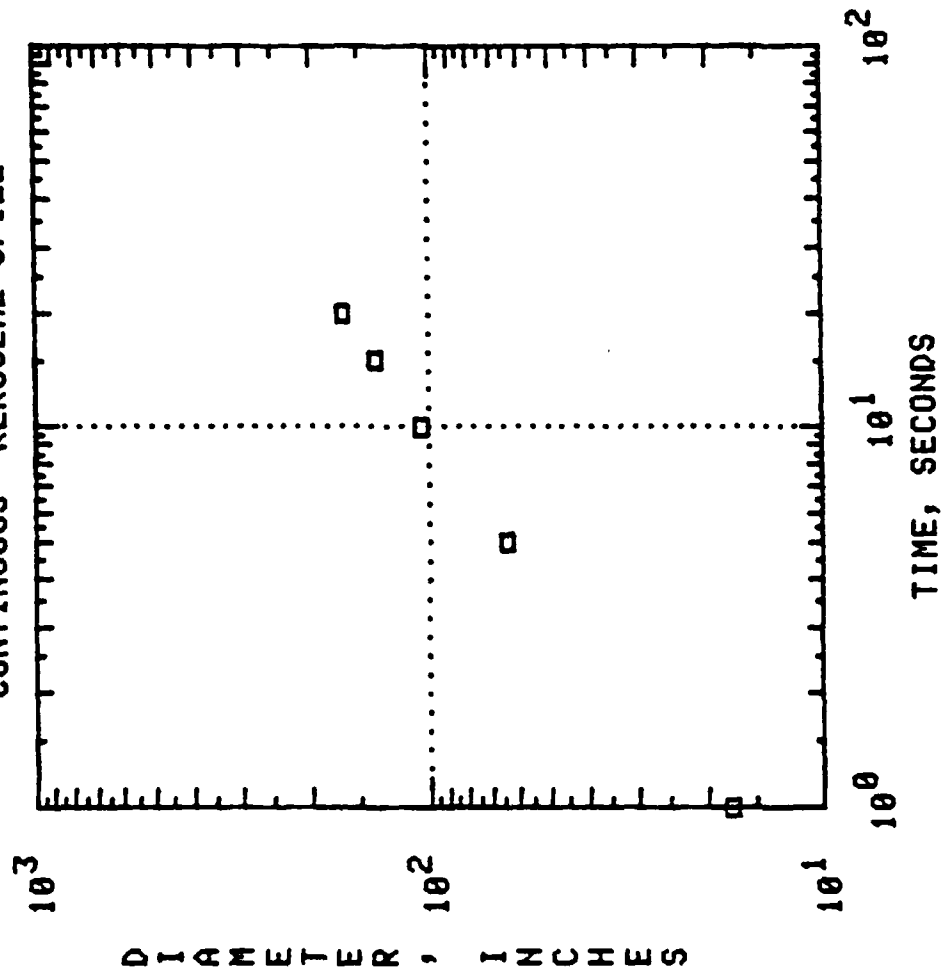
II.2-2 0.82 L/SEC NON-VOLATILE  
CONTINUOUS KEROSENE SPILL



II.2-3 1.01 L/SEC NON-VOLATILE  
CONTINUOUS KEROSENE SPILL

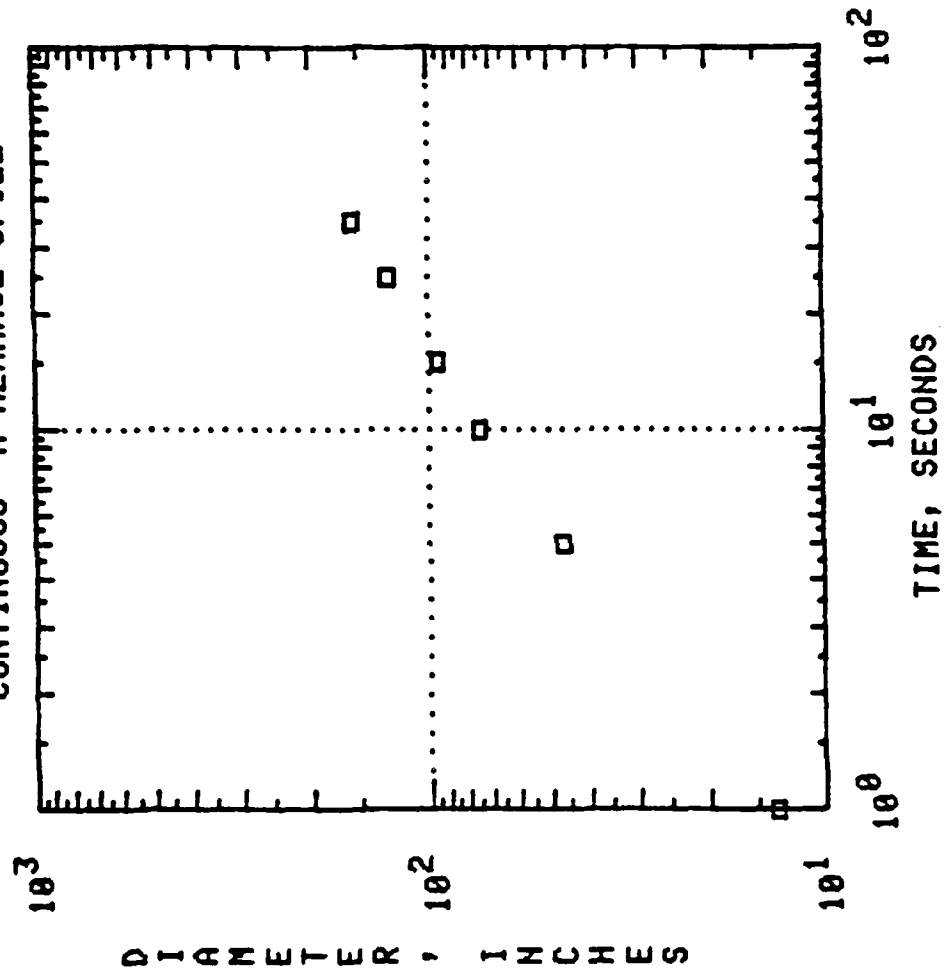


11.2-4 1.26 L/SEC NON-VOLATILE  
CONTINUOUS KEROSENE SPILL

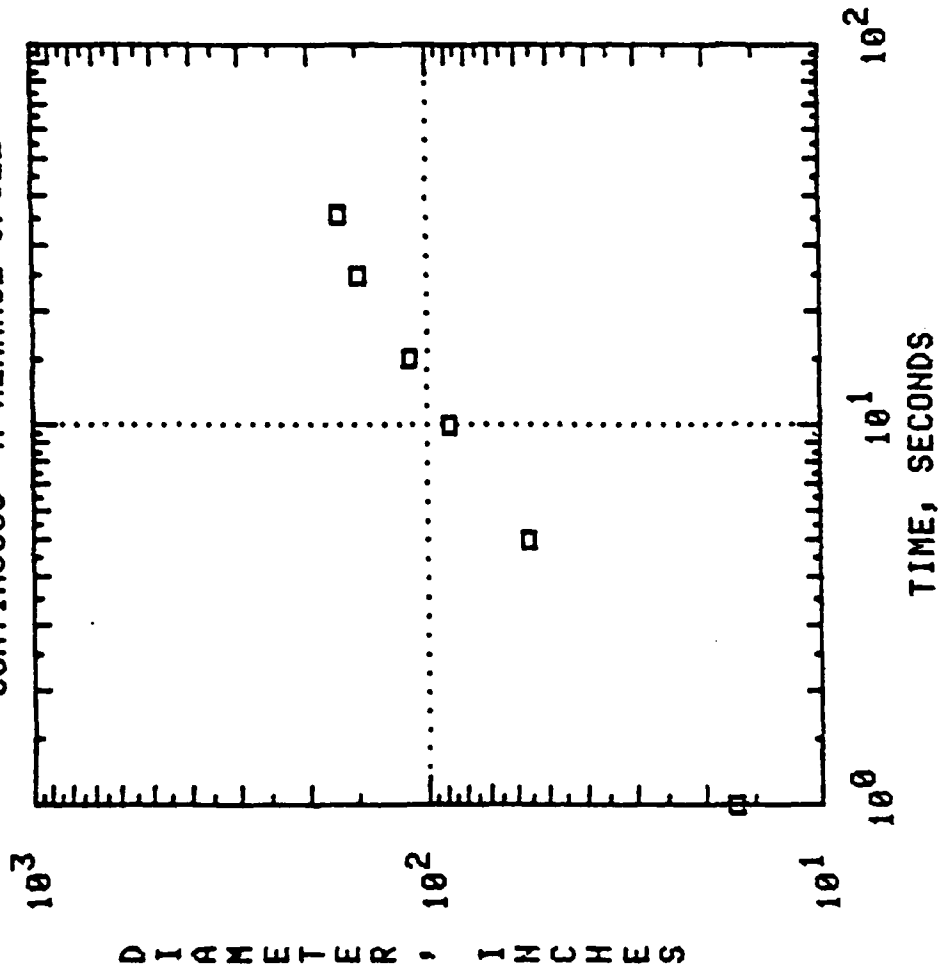




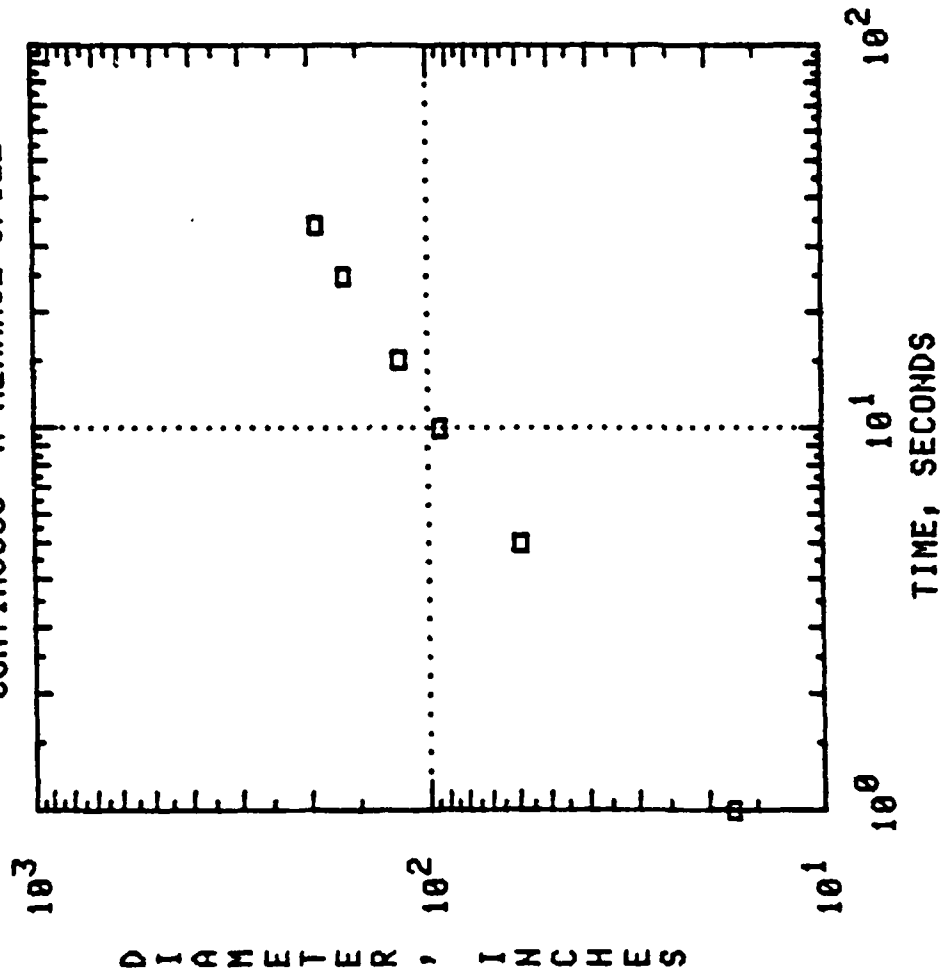
11.3-1 0.50 L/SEC NON-VOLATILE  
CONTINUOUS N-HEXANOL SPILL



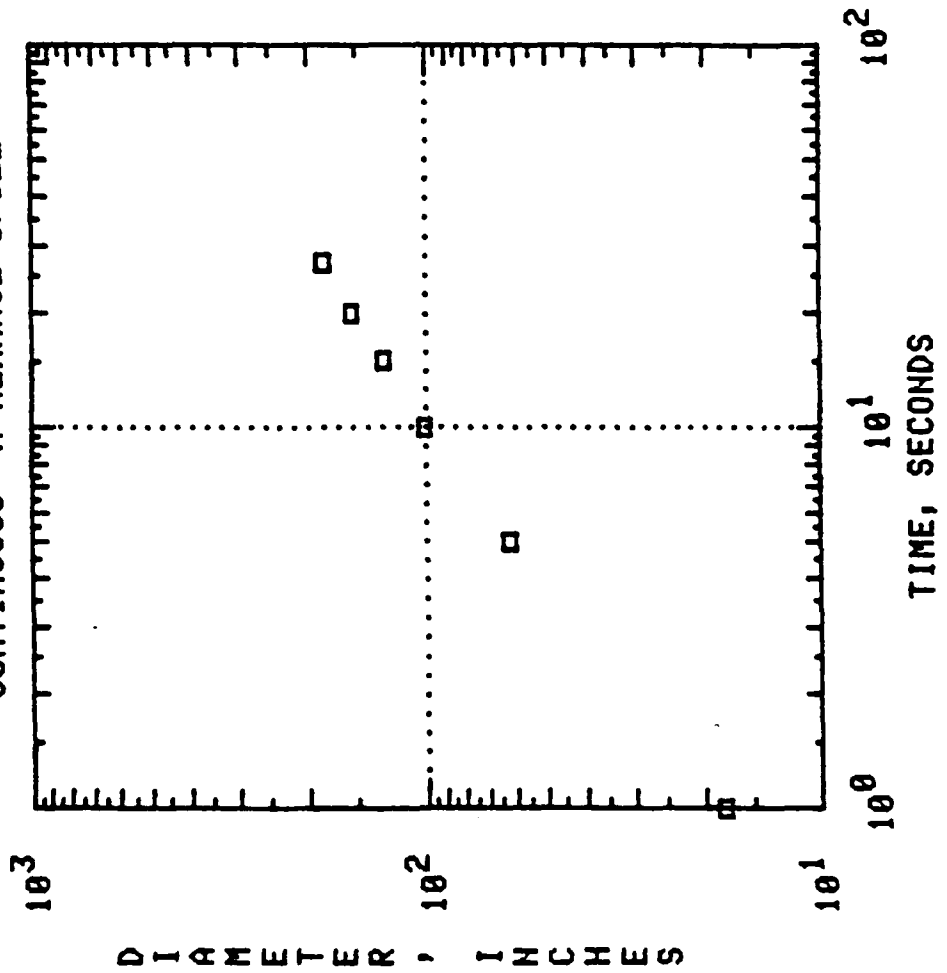
11.3-2 0.82 L/SEC NON-VOLATILE  
CONTINUOUS N-HEXANOL SPILL



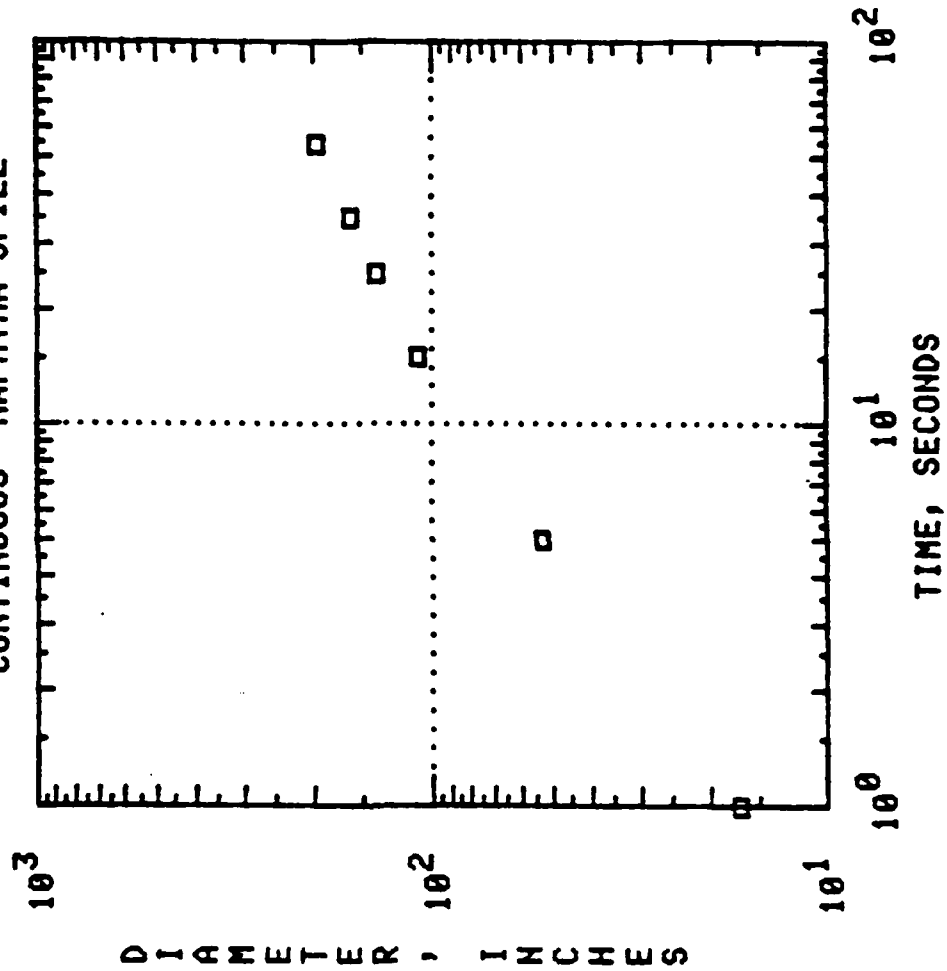
II.3-3 1.01 L/SEC NON-VOLATILE  
CONTINUOUS N-HEXANOL SPILL



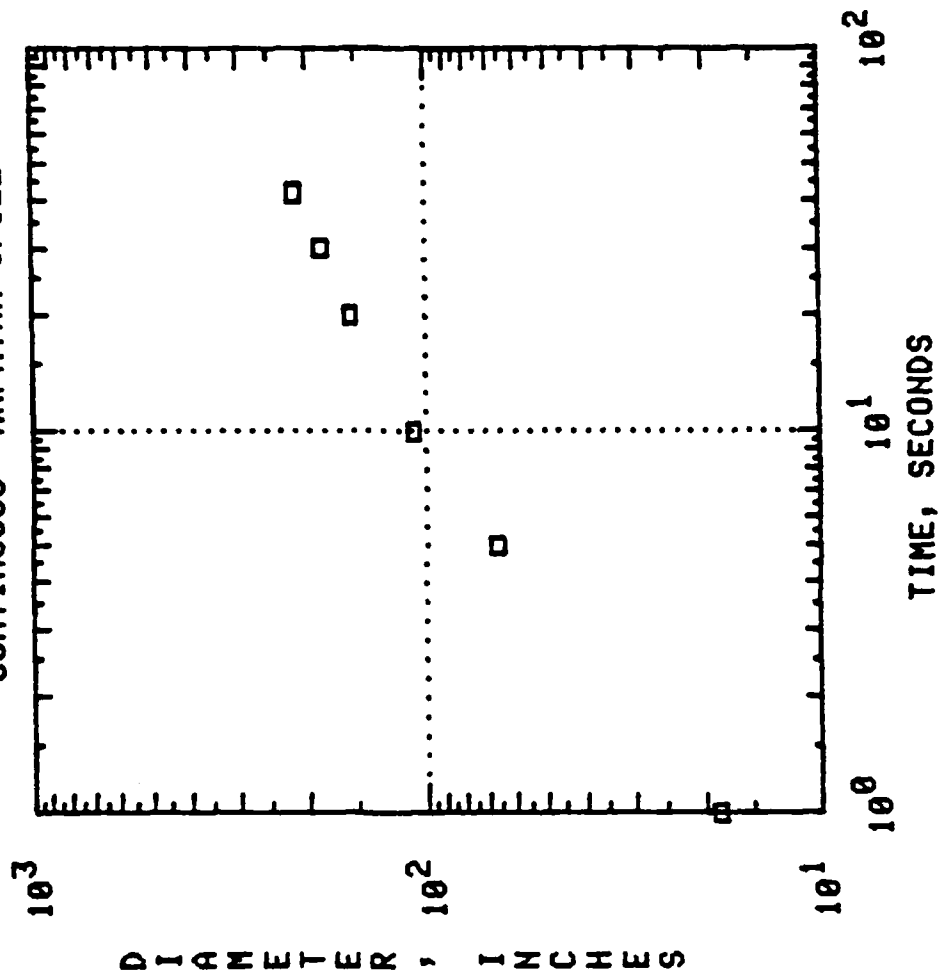
II.3-4 1.26 L/SEC NON-VOLATILE  
CONTINUOUS N-HEXANOL SPILL



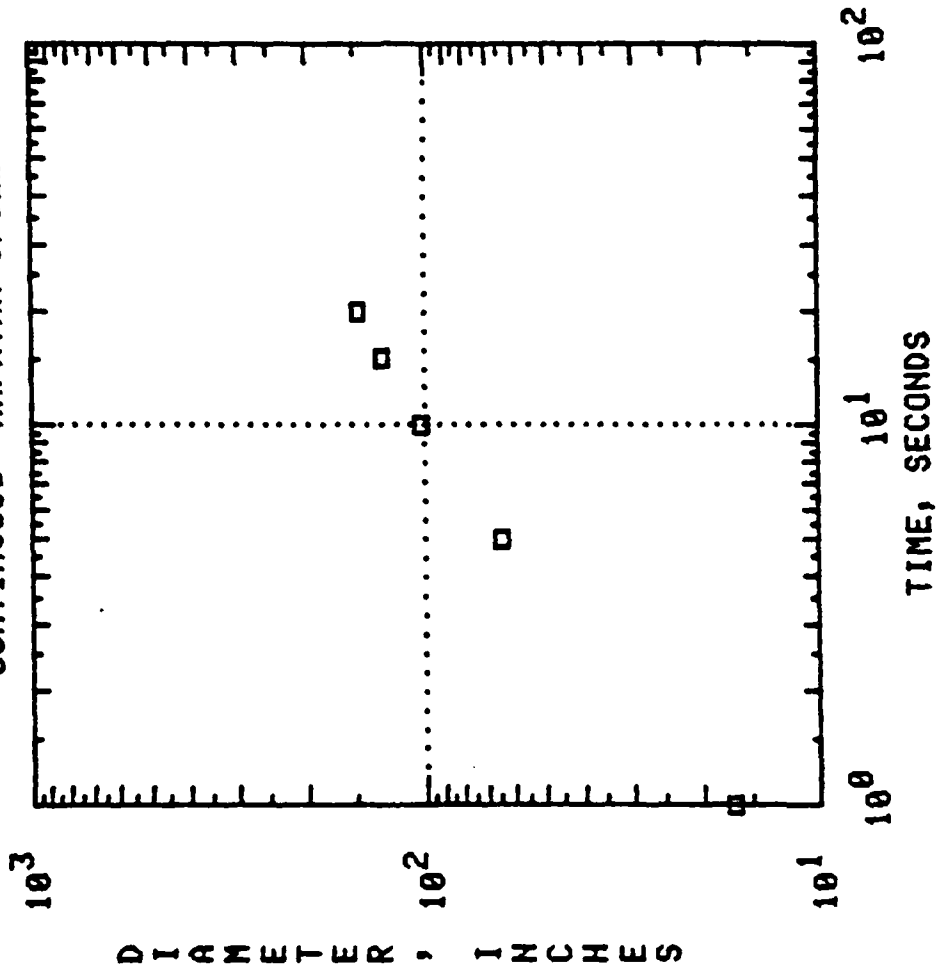
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CONTINUOUS NAPHTHA SPILL



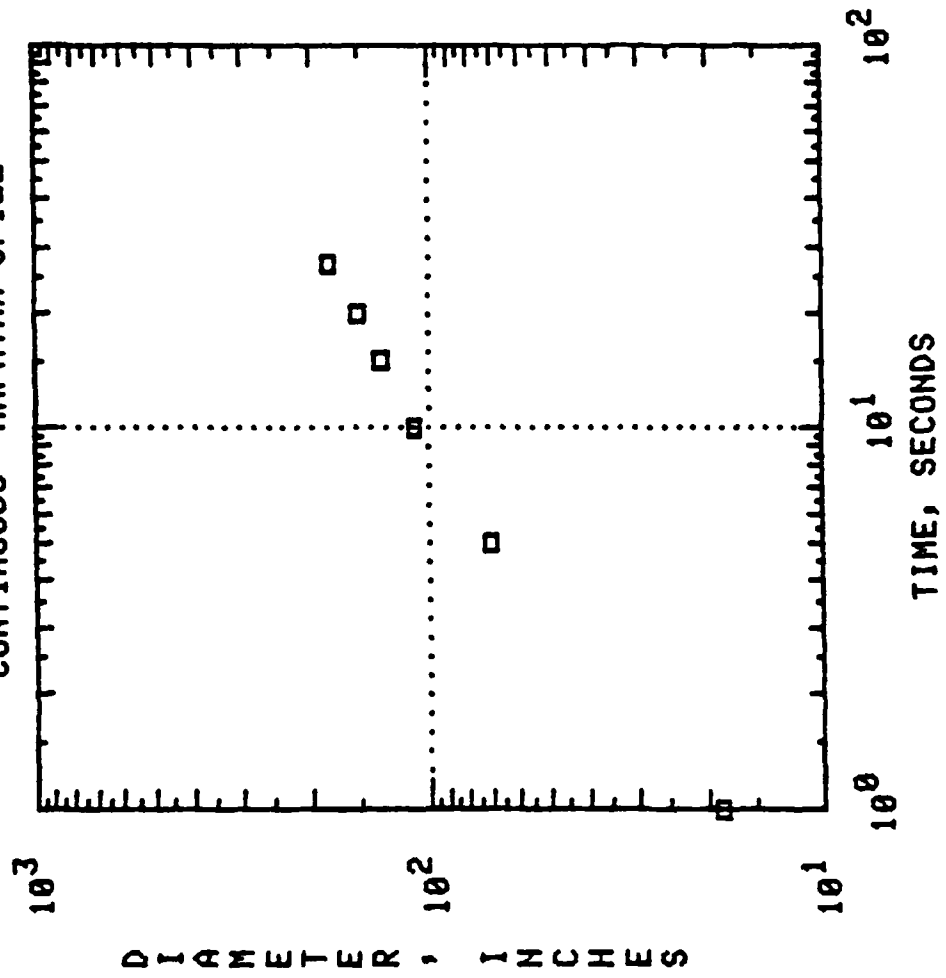
11.4-2 0.63 L/SEC NON-VOLATILE  
CONTINUOUS NAPHTHA SPILL



II.4-3 0.95 L/SEC NON-VOLATILE  
CONTINUOUS NAPHTHA SPILL

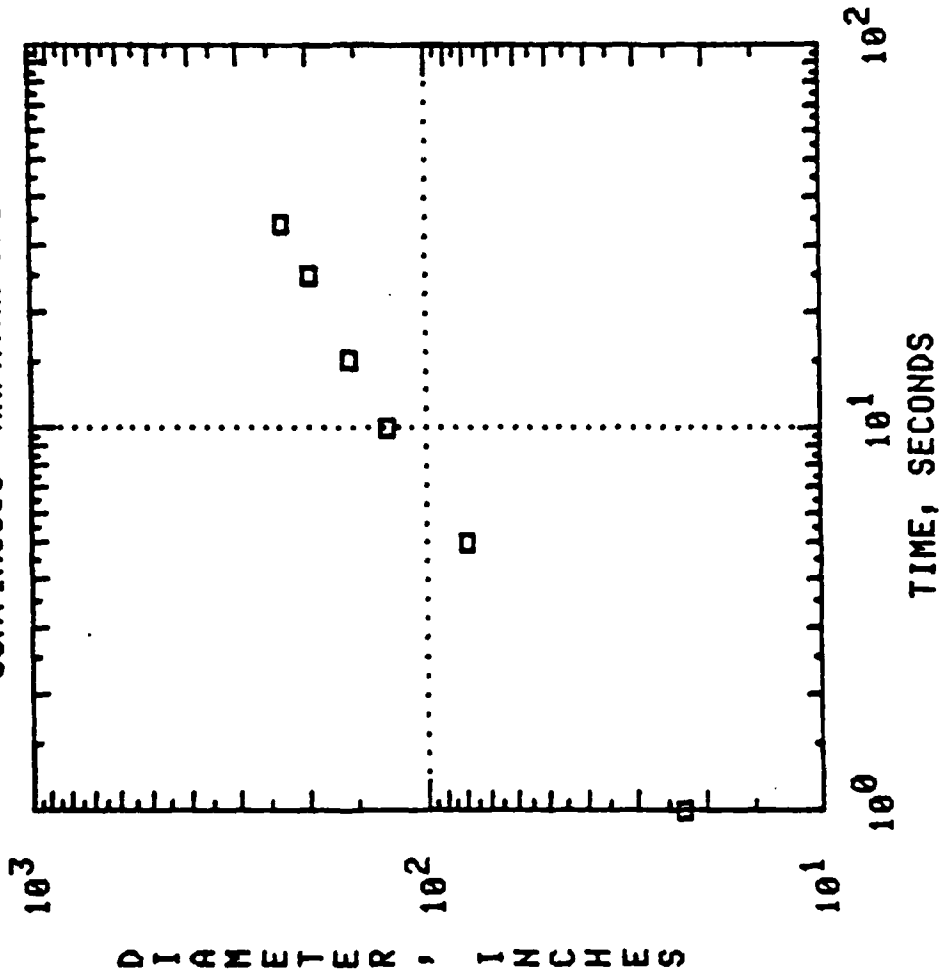


II.4-4 1.10 L/SEC NON-VOLATILE  
CONTINUOUS NAPHTHA SPILL

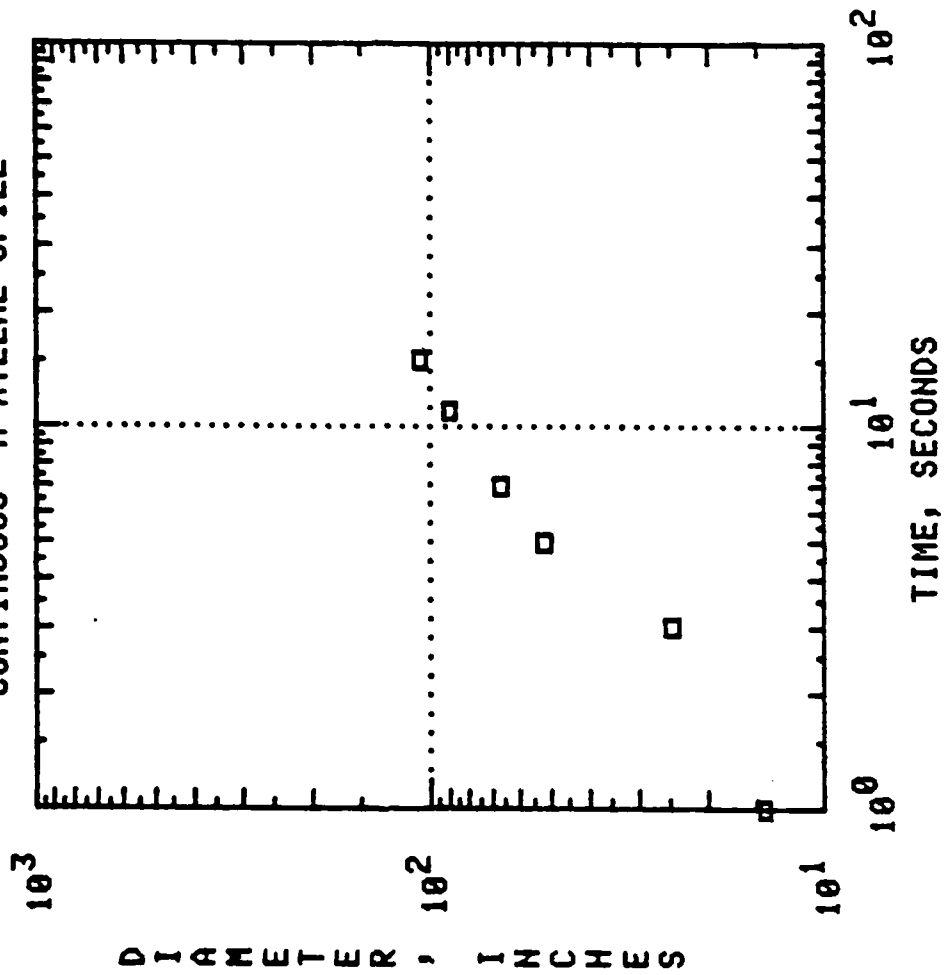




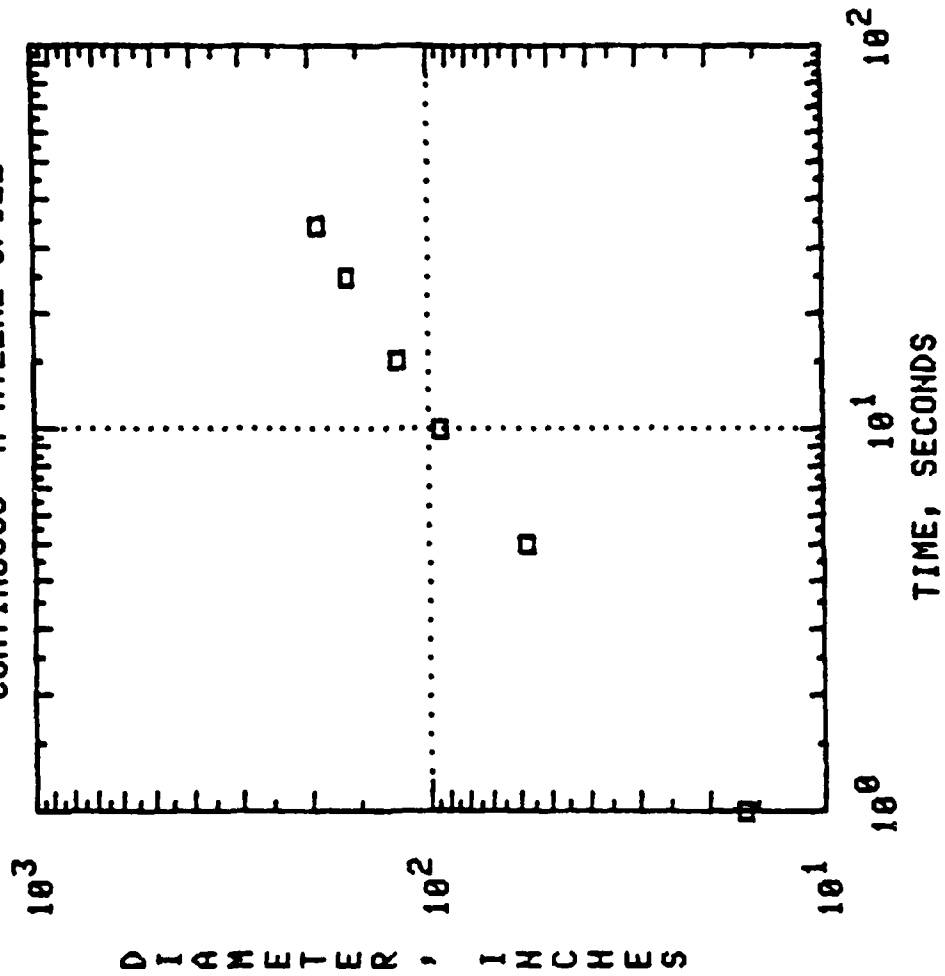
II.4-5 1.26 L/SEC NON-VOLATILE  
CONTINUOUS NAPHTHA SPILL



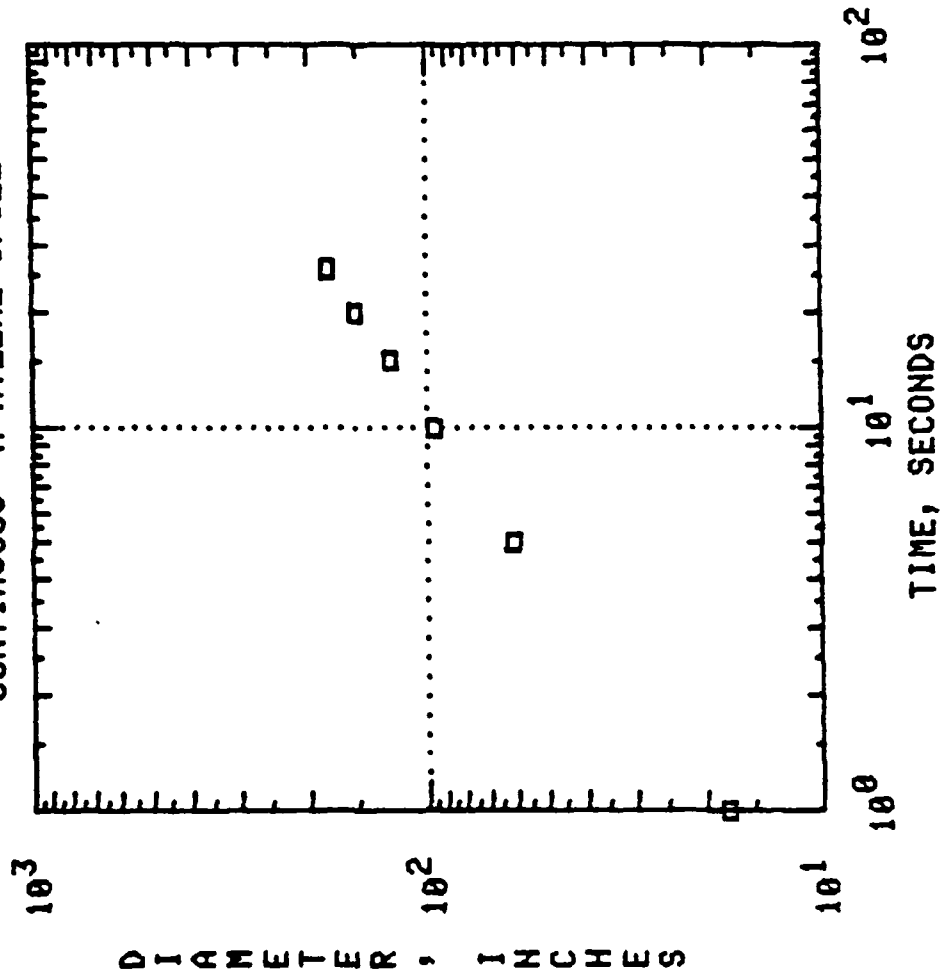
11.5-1 0.50 L/SEC NON-VOLATILE  
CONTINUOUS M-XYLENE SPILL



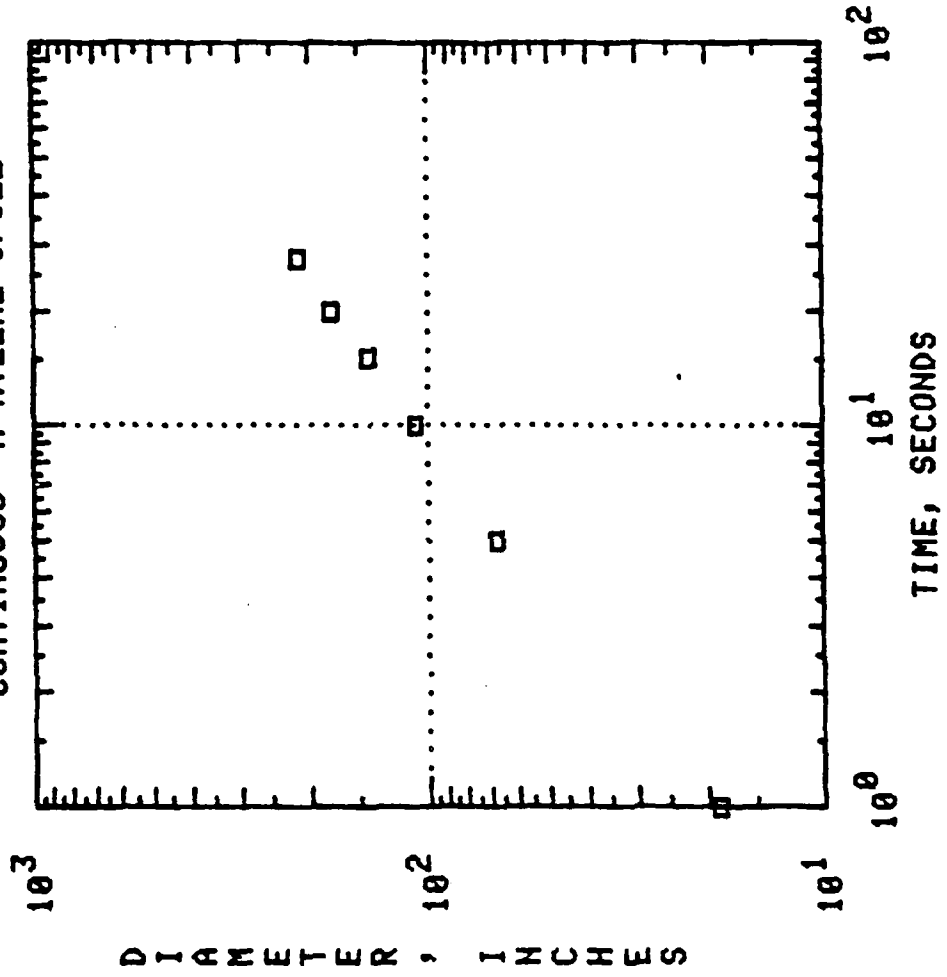
II.5-2 0.82 L/SEC NON-VOLATILE  
CONTINUOUS M-XYLENE SPILL



11.5-3 1.01 L/SEC NON-VOLATILE  
CONTINUOUS M-XYLENE SPILL



II.5-4 1.26 L/SEC NON-VOLATILE  
CONTINUOUS M-XYLENE SPILL



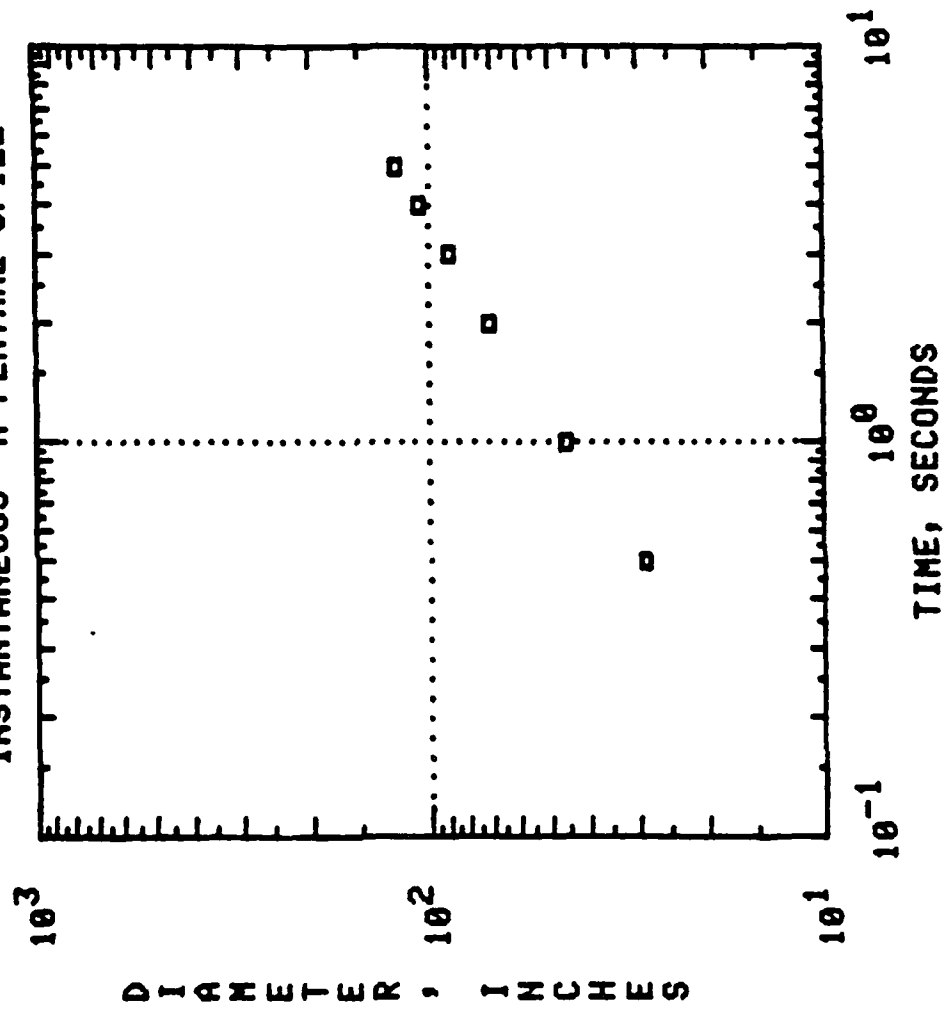
APPENDIX C

SPREADING TEST SERIES III -  
VOLATILE INSTANTANEOUS SPILLS IN BASIN

SUMMARY OF TEST CONDITIONS FOR  
SPREADING TEST SERIES III -  
VOLATILE INSTANTANEOUS SPILLS IN BASIN

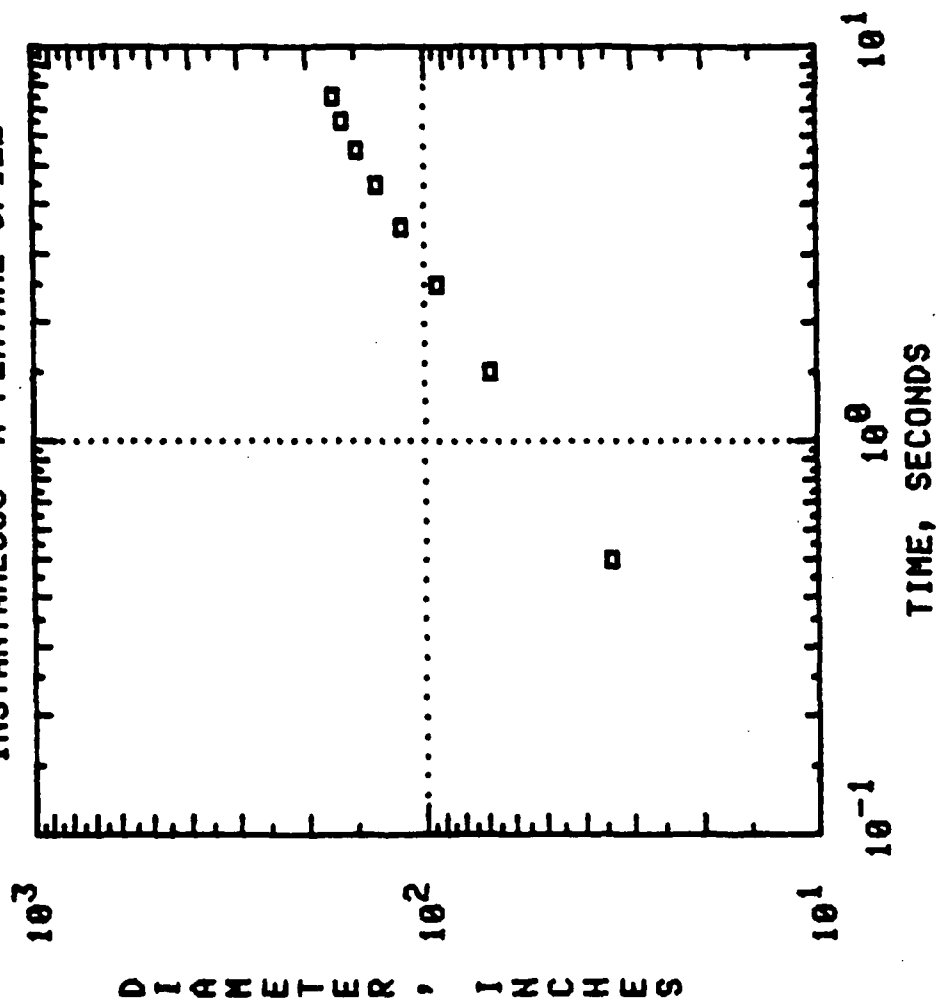
Run Number	Chemical	Specific Gravity	$\sigma_{sp}$ Coef.	Spill Diameter (cm)	Spill Volume (liters)	Wind Speed (m/s)
III.1-1	n-Pentane	0.626	6.5	20.3	5	1.67
III.1-2				30.5	10	0.68
III.1-3				40.6	20	0.81
III.1-4				61.0	40	1.83
III.2-1	Heptane	0.684	1.6	20.3	5	2.44
III.2-2				30.5	10	1.30
III.2-3				40.6	20	1.20
III.2-4				61.0	40	1.69
III.3-1	Octane	0.703	0.3	20.3	5	0.56
III.3-2				30.5	10	0.80
III.3-3				40.6	20	1.46
III.3-4				61.0	40	1.30
III.4-1	m-Xylene	0.864	7.0	20.3	5	1.72
III.4-2				30.5	10	1.39
III.4-3				40.6	20	2.87
III.4-4				61.0	40	1.40
III.5-1	Ethyl Acetate	0.901	45.89	20.3	5	1.01
III.5-2				30.5	10	0.81
III.5-3				40.6	20	2.12
III.5-4				61.0	40	1.83

III.1-1 5. LITER VOLATILE  
INSTANTANEOUS N-PENTANE SPILL

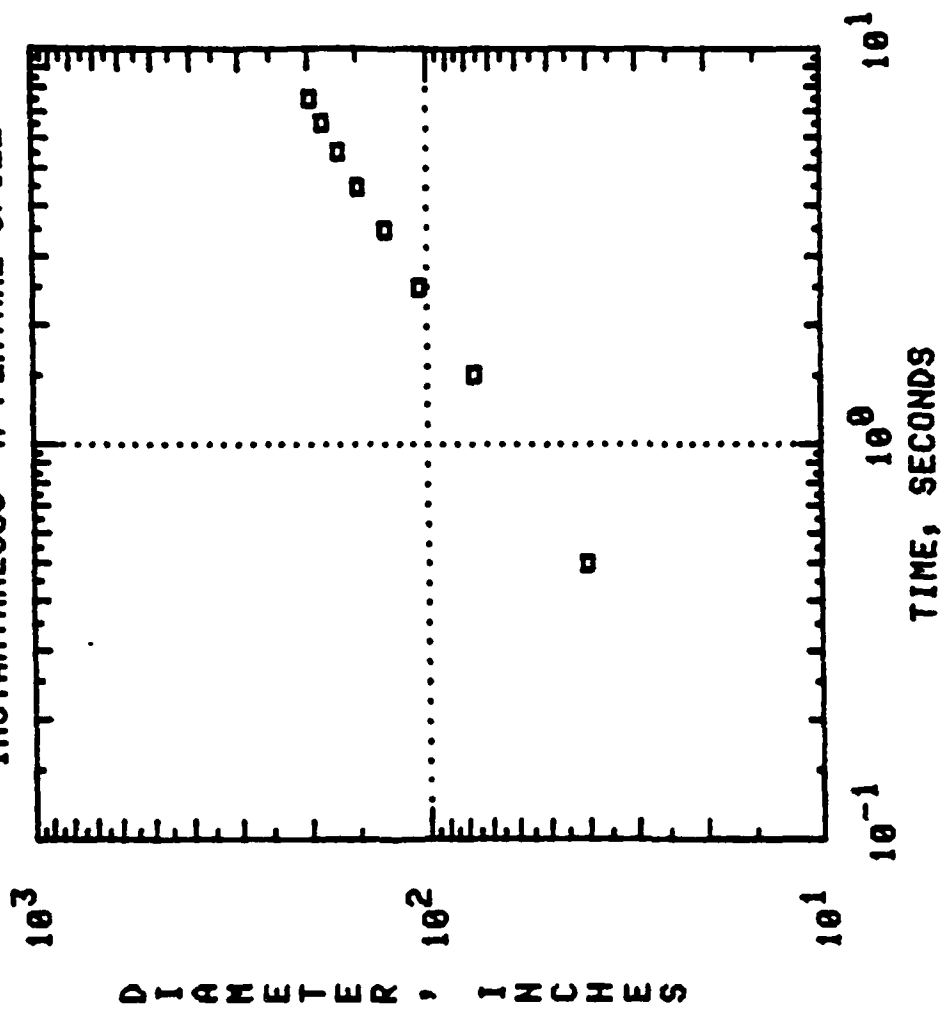




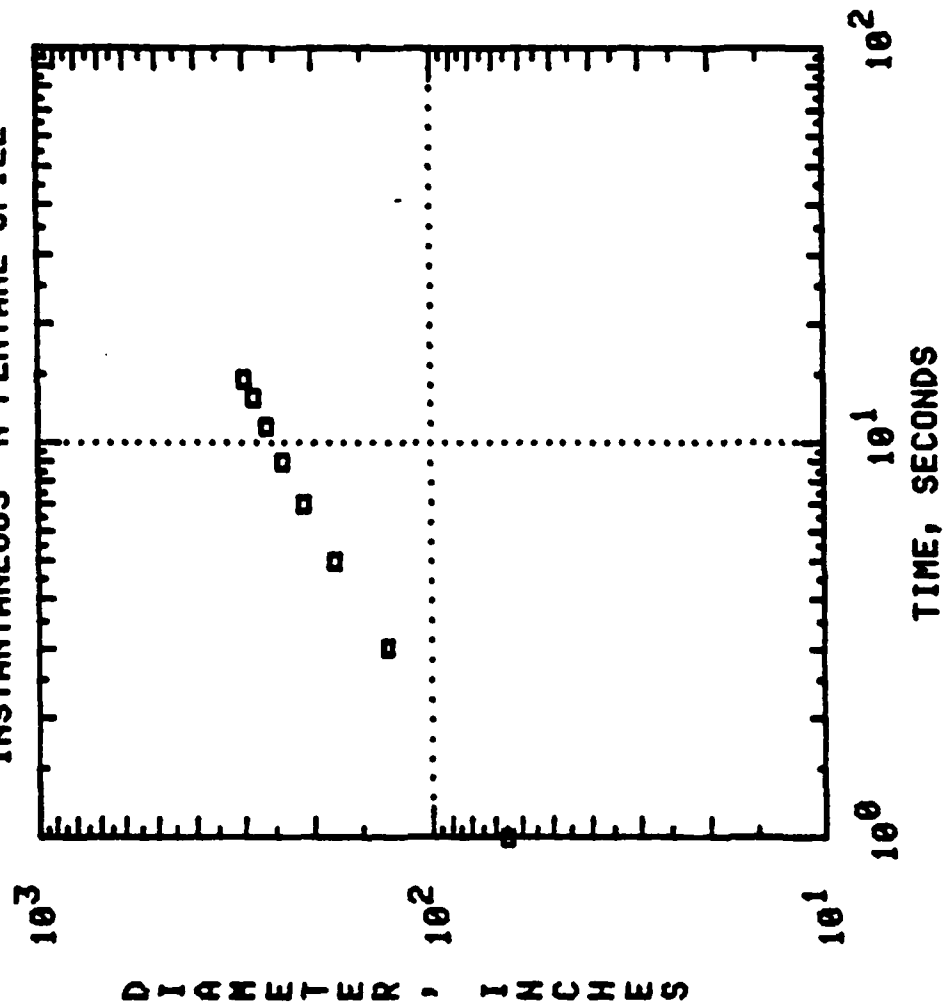
III.1-2 10. LITER VOLATILE  
INSTANTANEOUS N-PENTANE SPILL



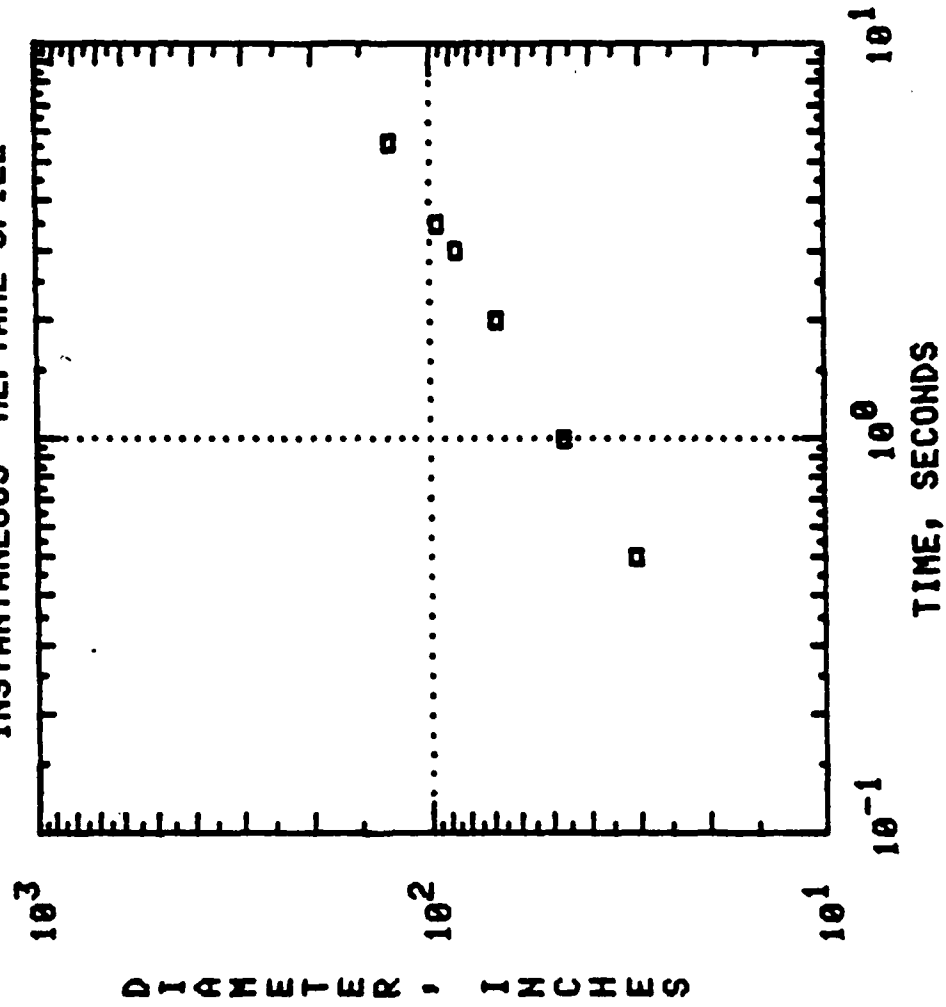
III.1-3 20. LITER VOLATILE  
INSTANTANEOUS N-PENTANE SPILL



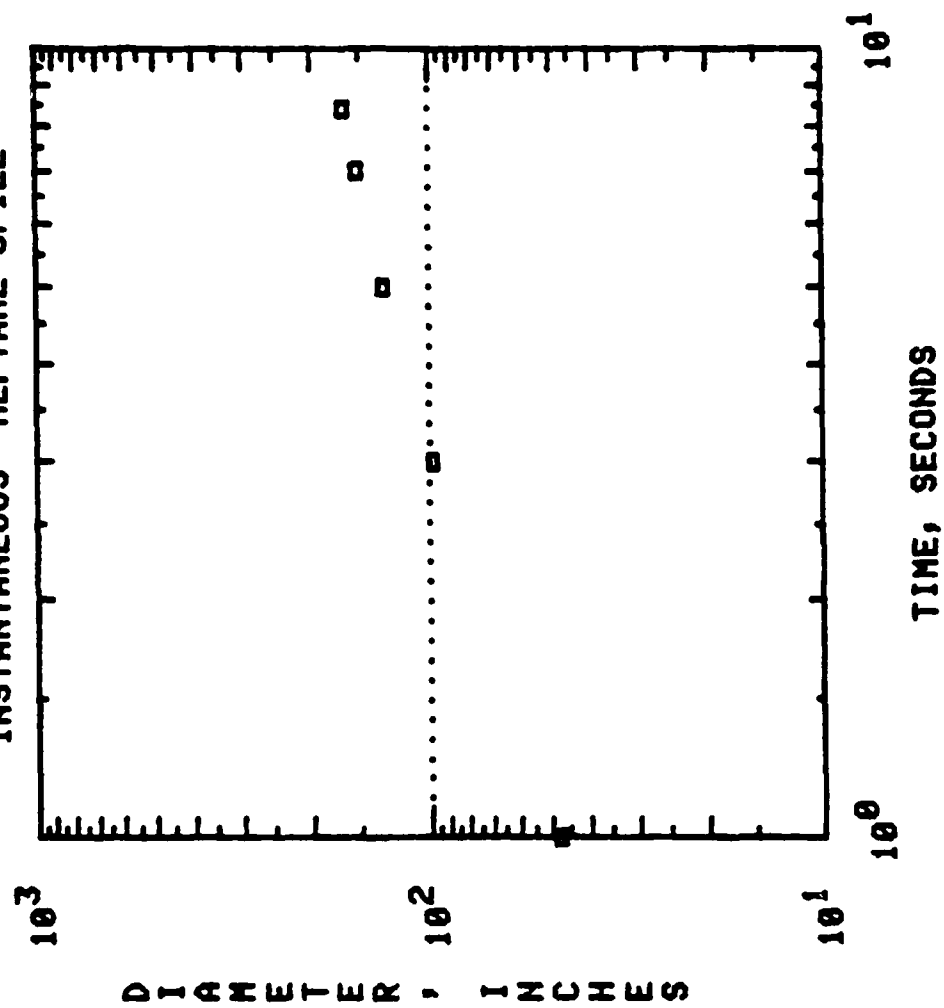
III.1-4 40. LITER VOLATILE  
INSTANTANEOUS N-PENTANE SPILL



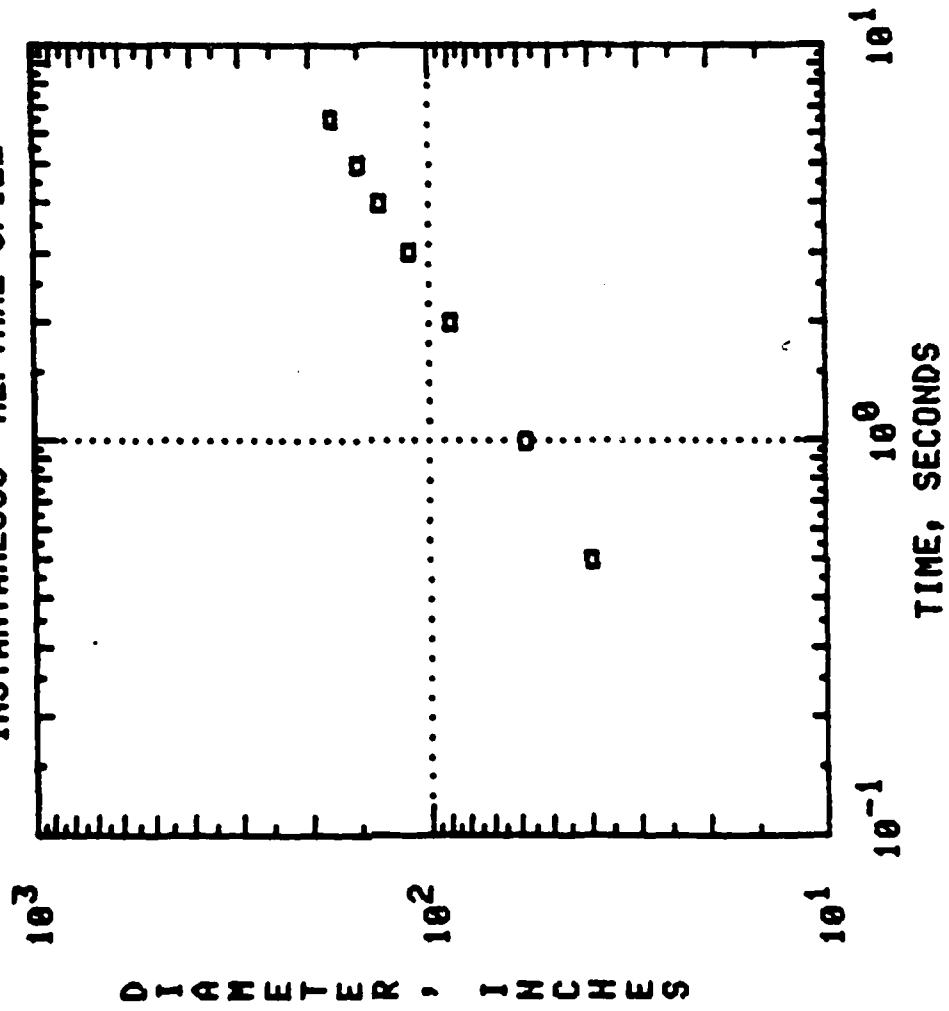
III.2-1 5. LITER VOLATILE  
INSTANTANEOUS HEPTANE SPILL



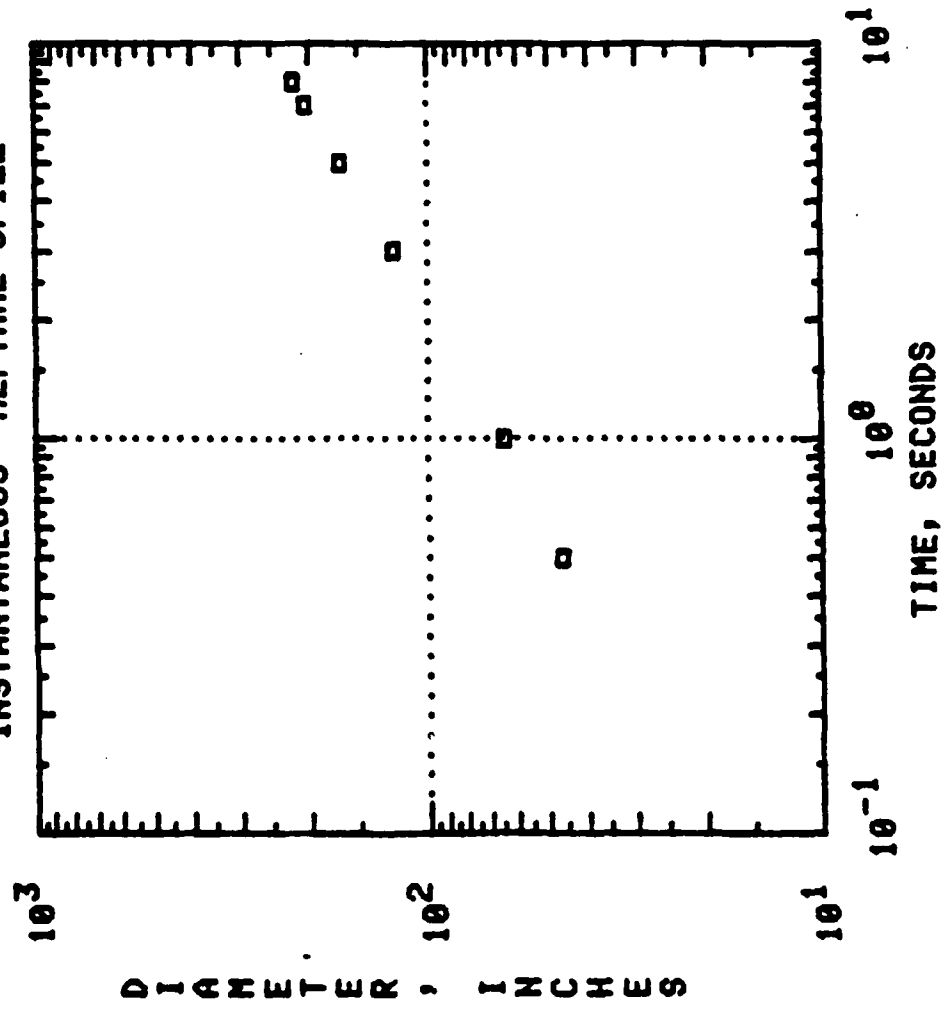
III.2-2 10. LITER VOLATILE  
INSTANTANEOUS HEPTANE SPILL



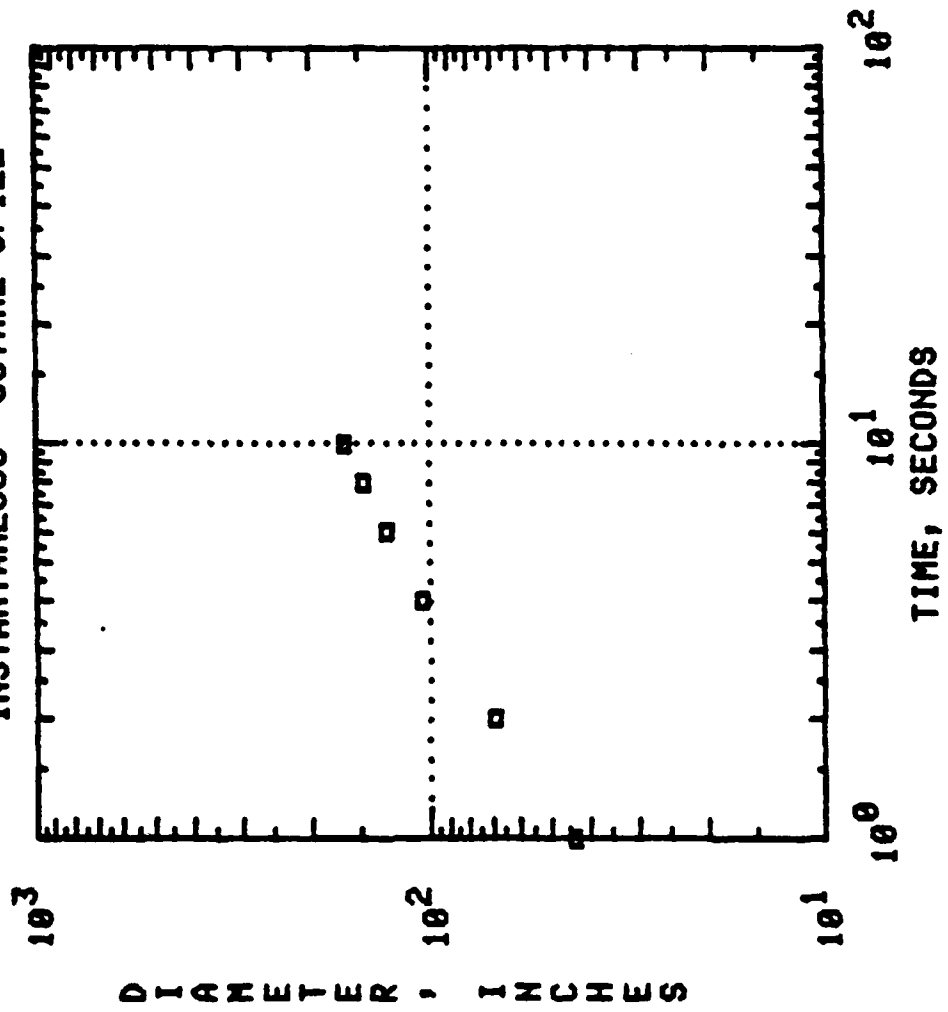
III.2-3 20. LITER VOLATILE  
INSTANTANEOUS HEPTANE SPILL



III.2-4 40. LITER VOLATILE  
INSTANTANEOUS HEPTANE SPILL

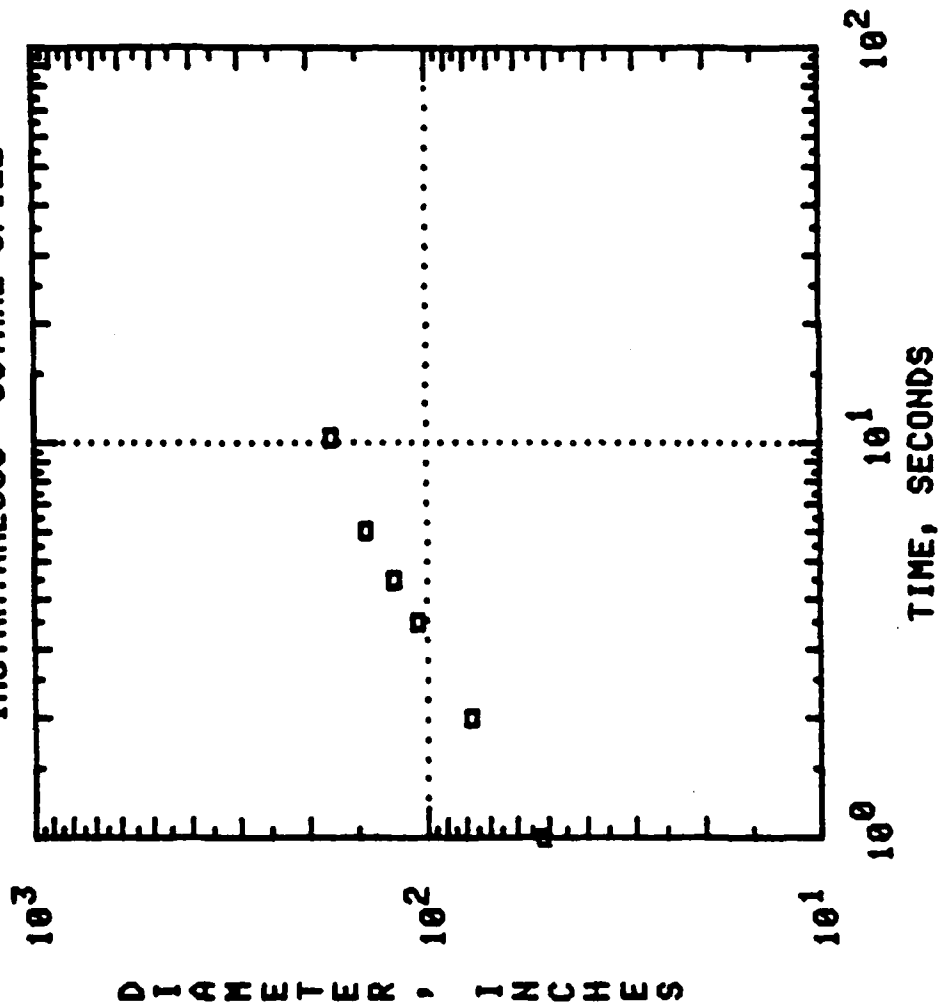


III.3-1 5. LITER VOLATILE  
INSTANTANEOUS OCTANE SPILL

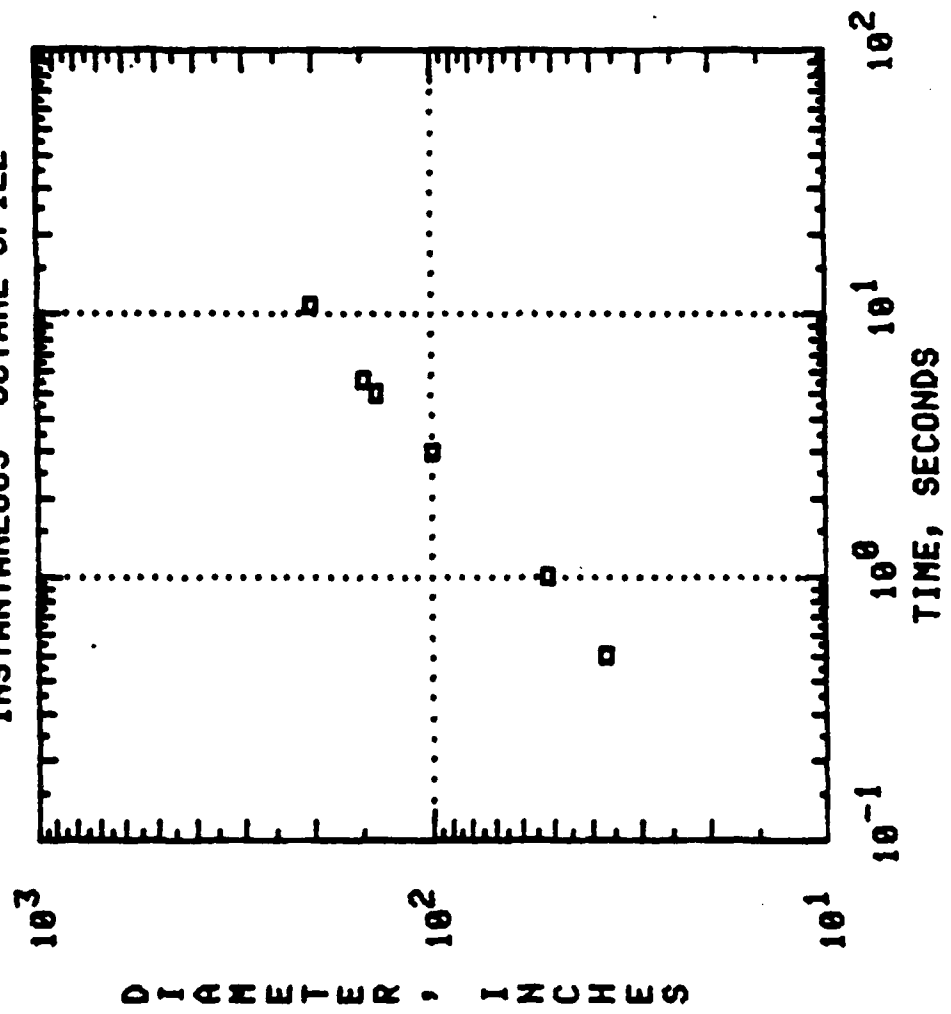




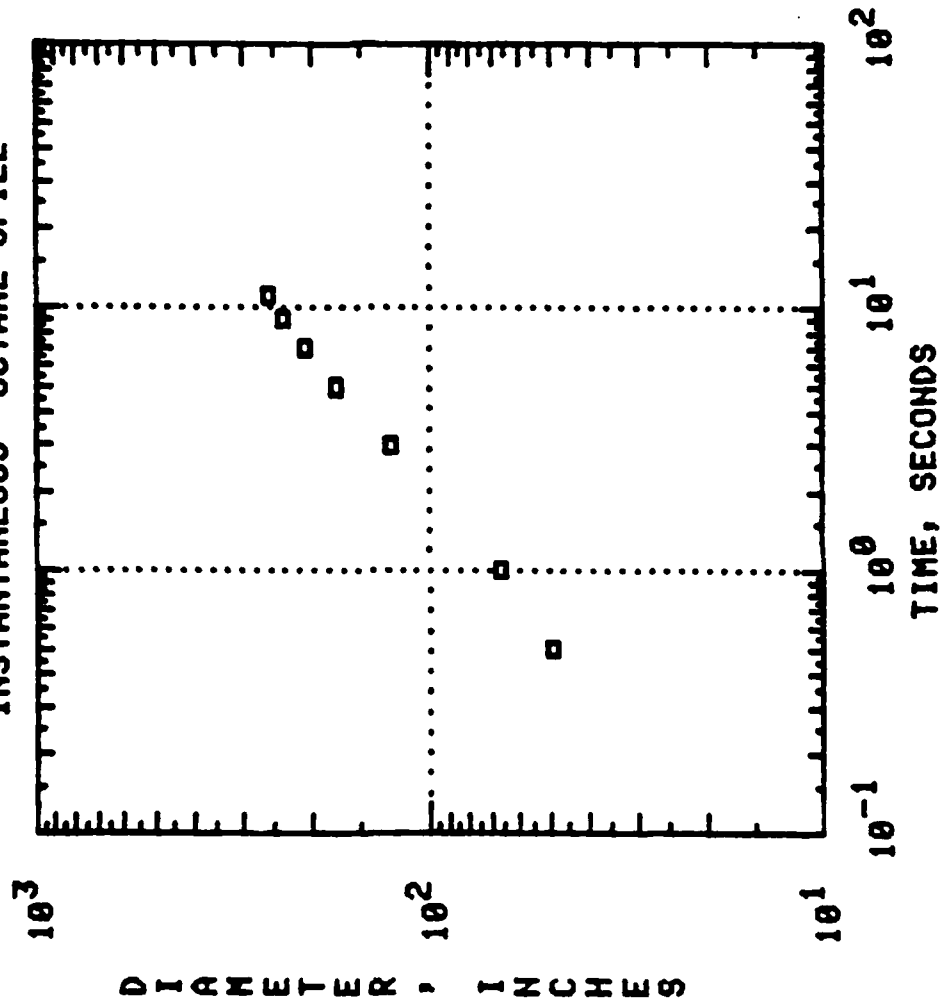
III.3-2 10. LITER VOLATILE  
INSTANTANEOUS OCTANE SPILL



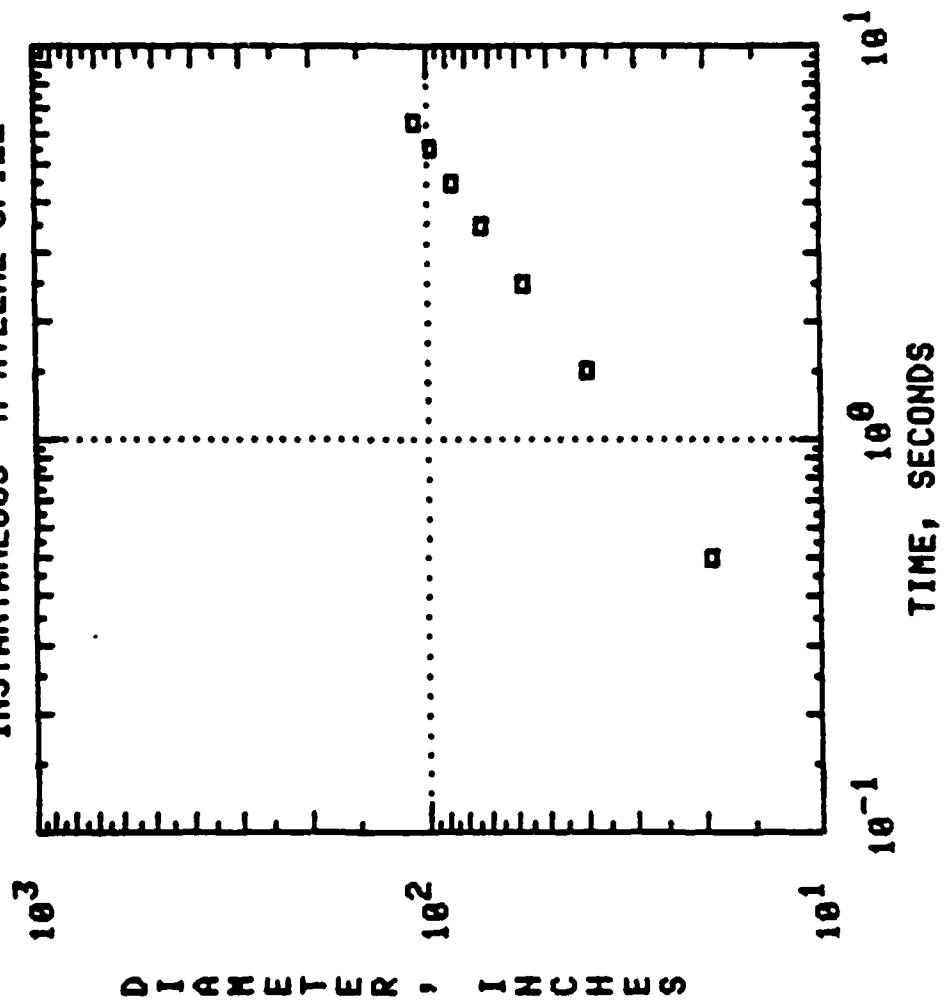
III.3-3 20. LITER VOLATILE  
INSTANTANEOUS OCTANE SPILL



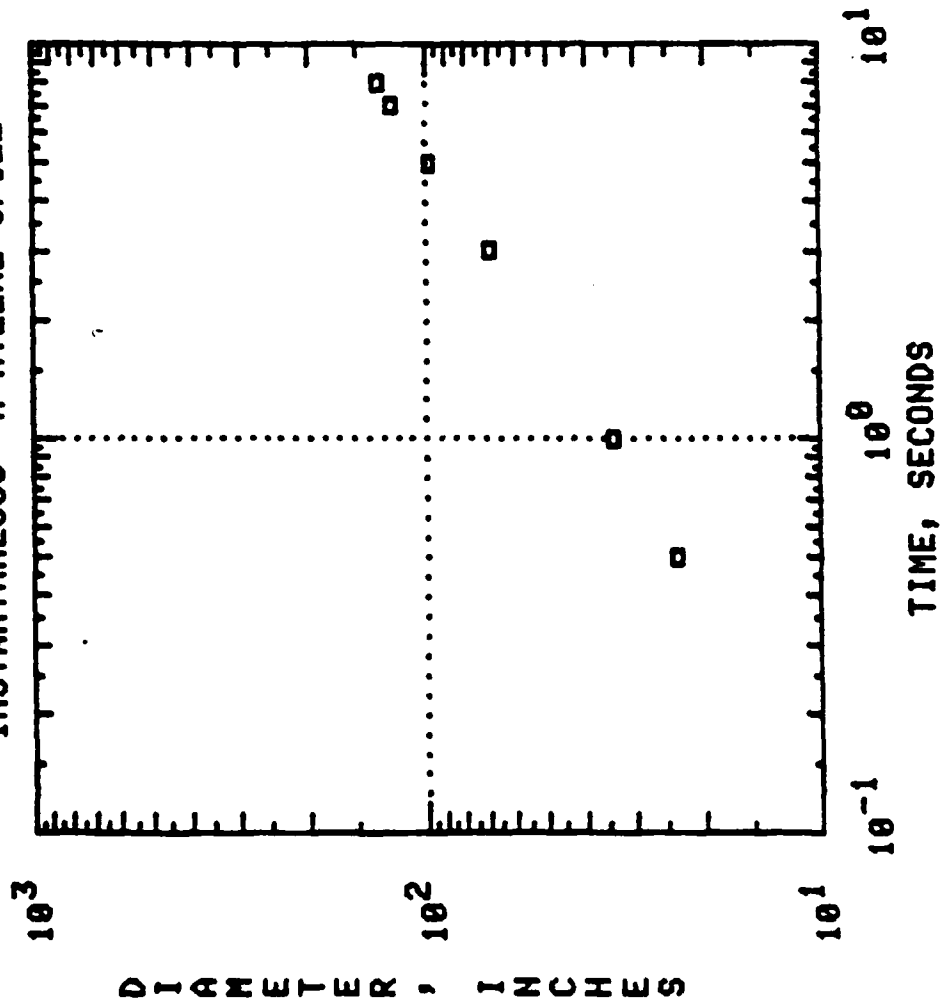
III.3-4 40. LITER VOLATILE  
INSTANTANEOUS OCTANE SPILL



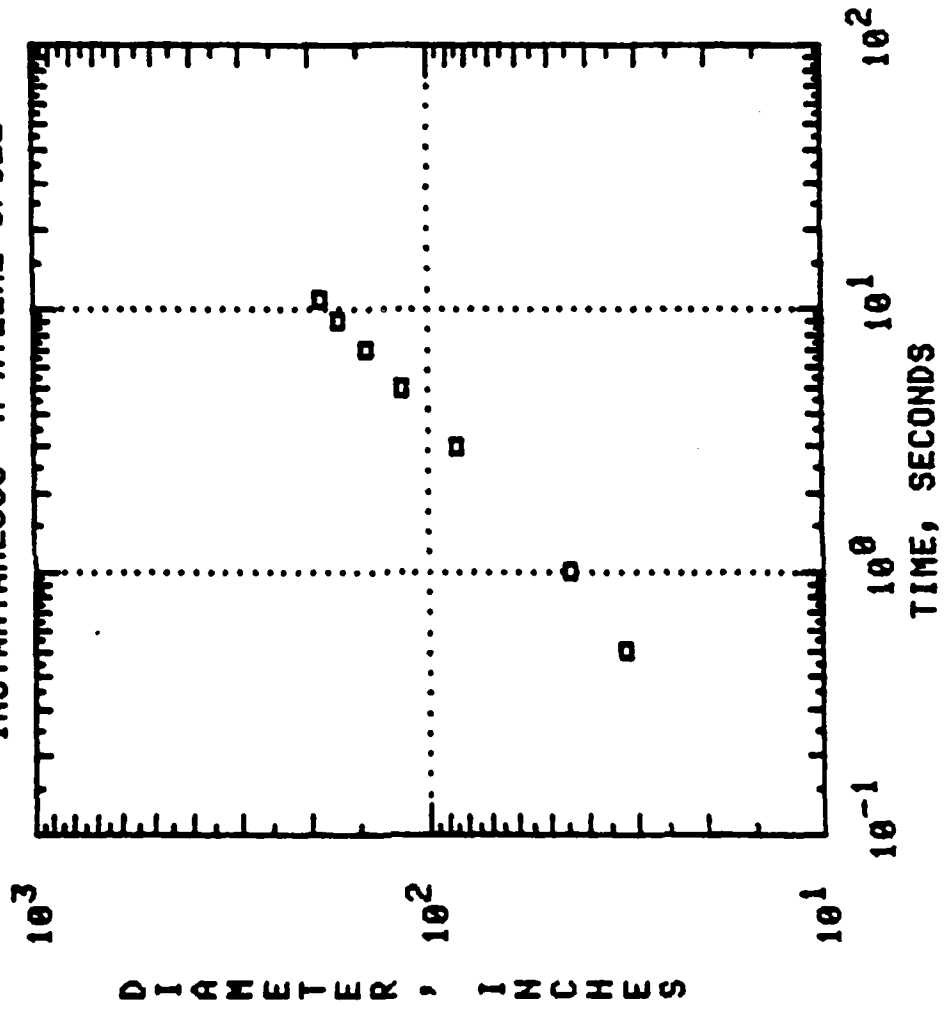
III.4-1 5. LITER VOLATILE  
INSTANTANEOUS M-XYLENE SPILL



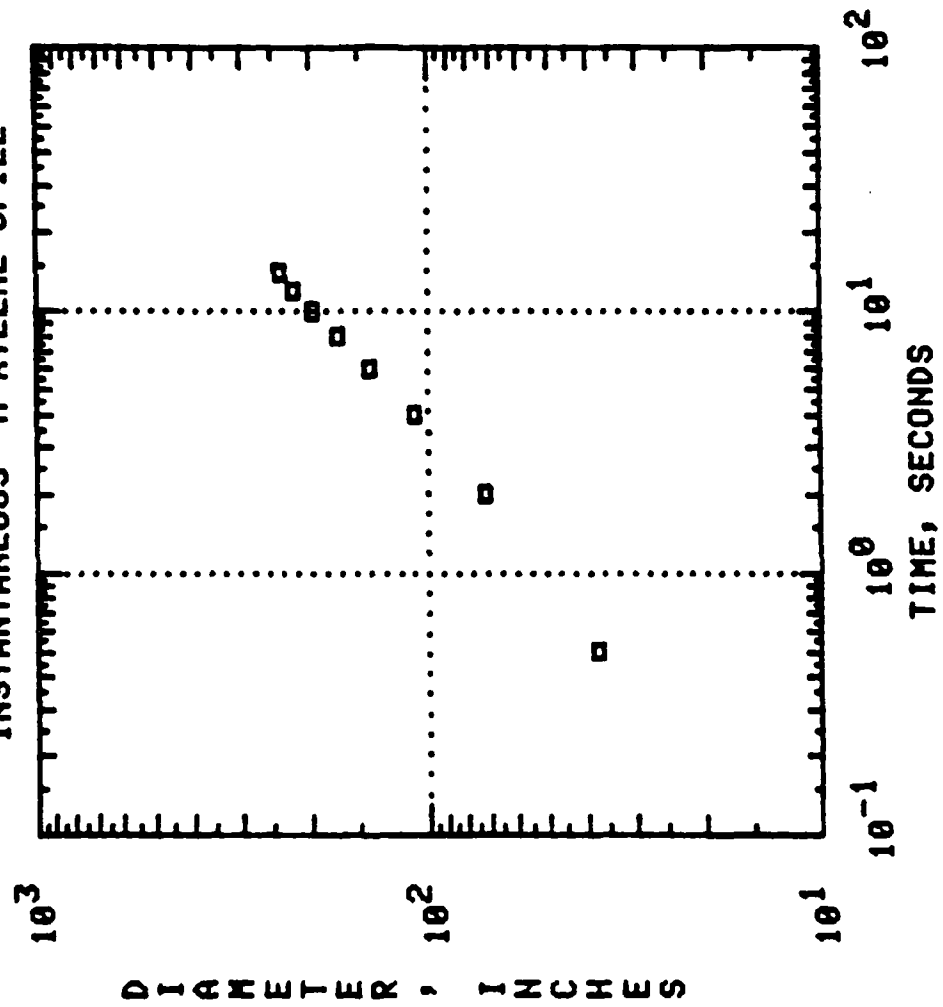
III.4-2 10. LITER VOLATILE  
INSTANTANEOUS M-XYLENE SPILL



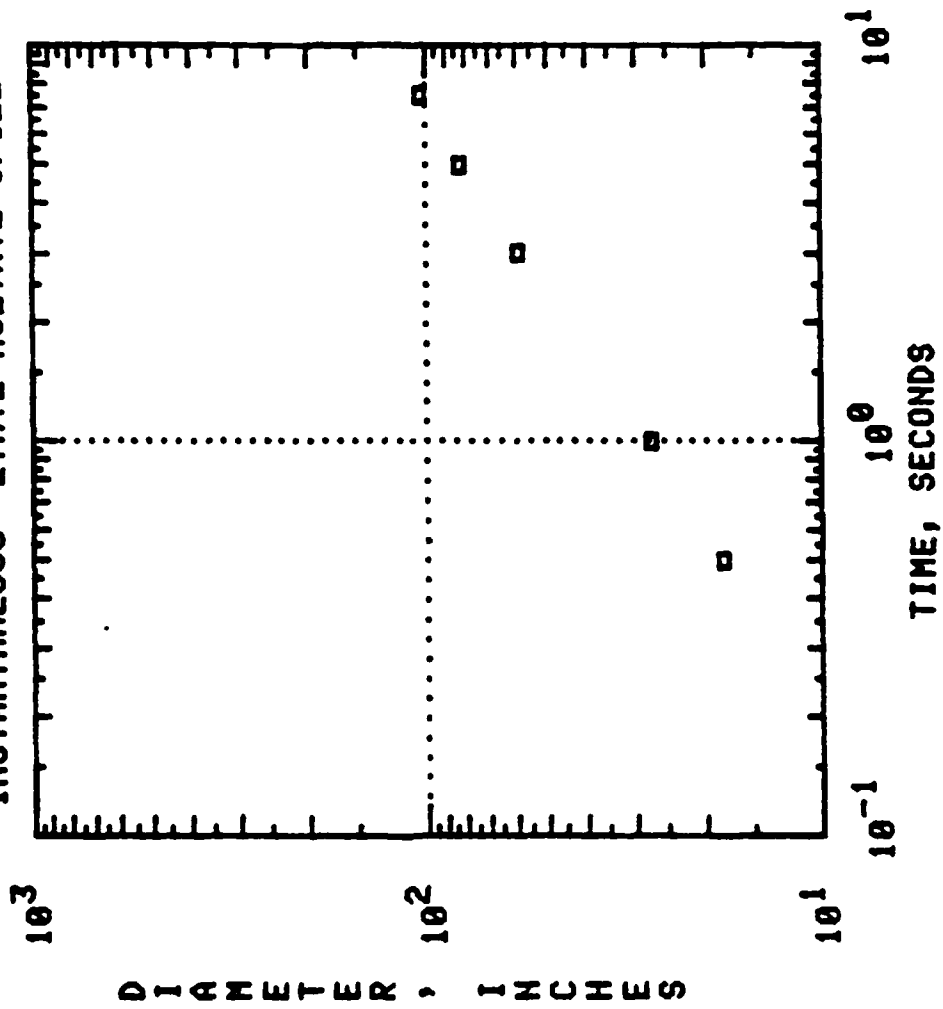
III.4-3 20. LITER VOLATILE  
INSTANTANEOUS M-XYLENE SPILL



III.4-4 40. LITER VOLATILE  
INSTANTANEOUS M-XYLENE SPILL

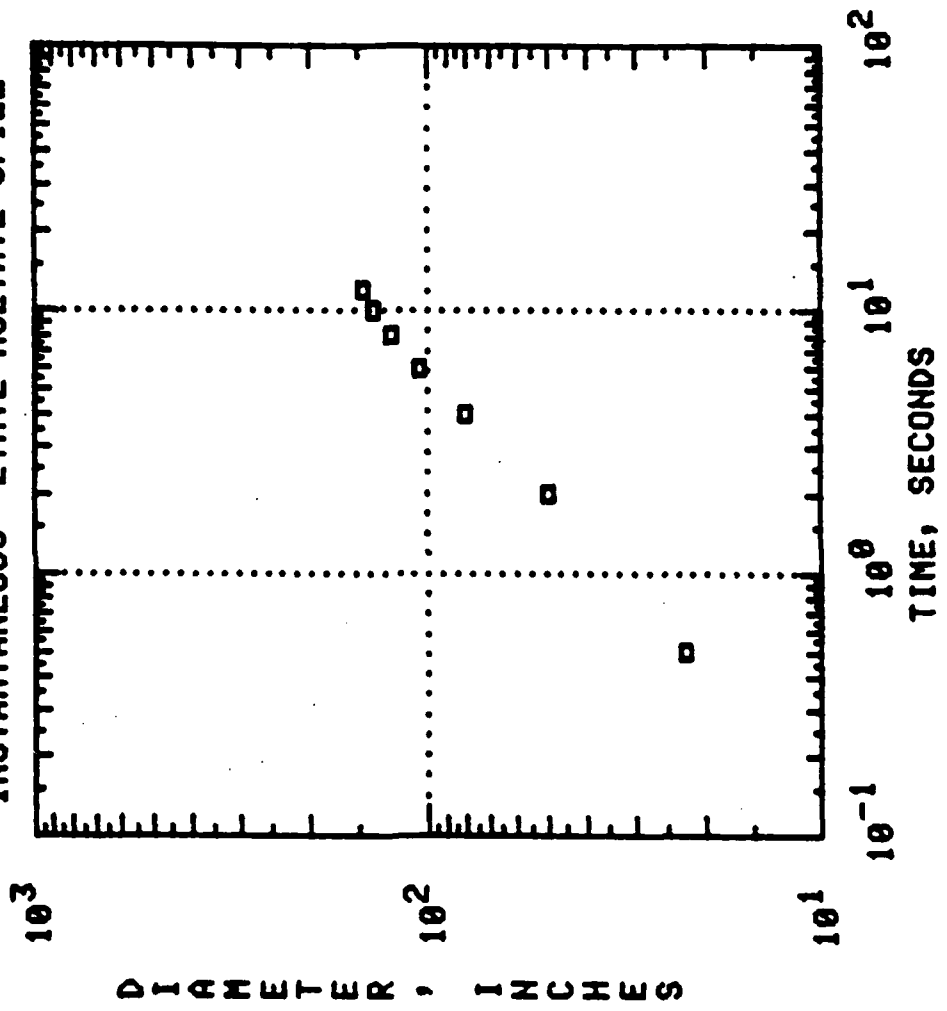


III.5-1 5. LITER VOLATILE  
INSTANTANEOUS ETHYL ACETATE SPILL

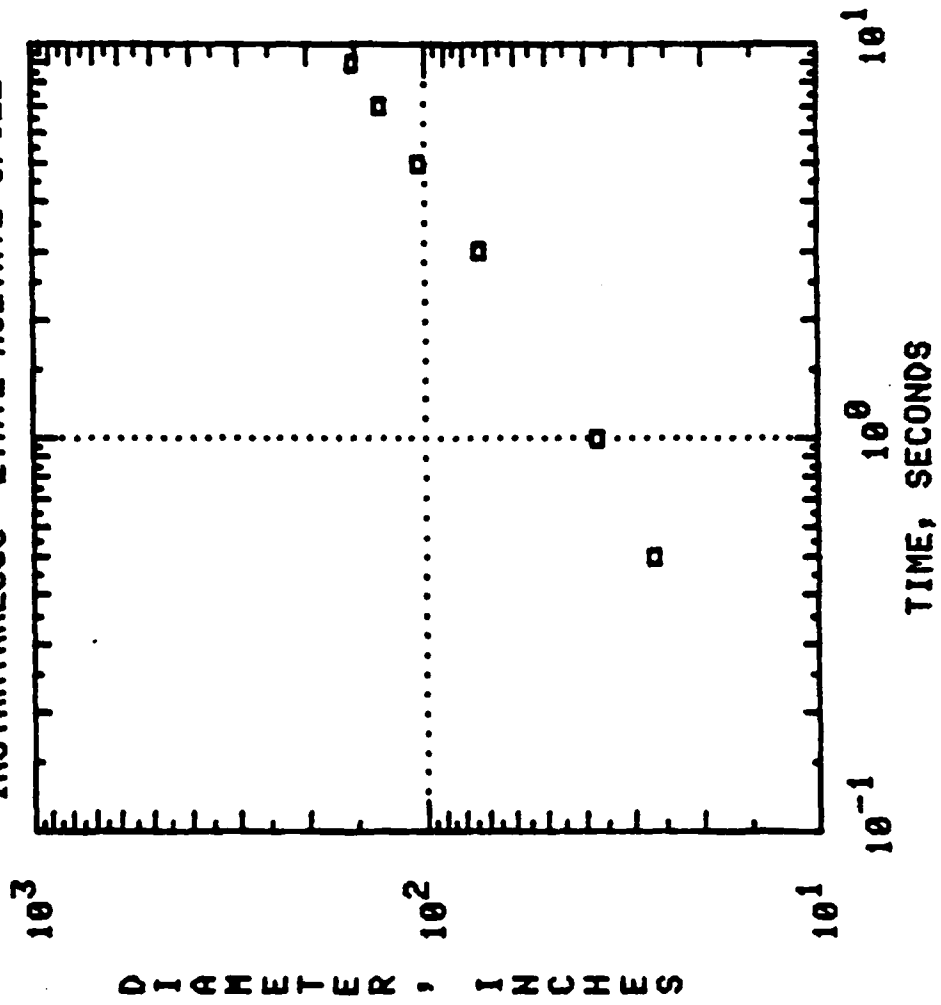




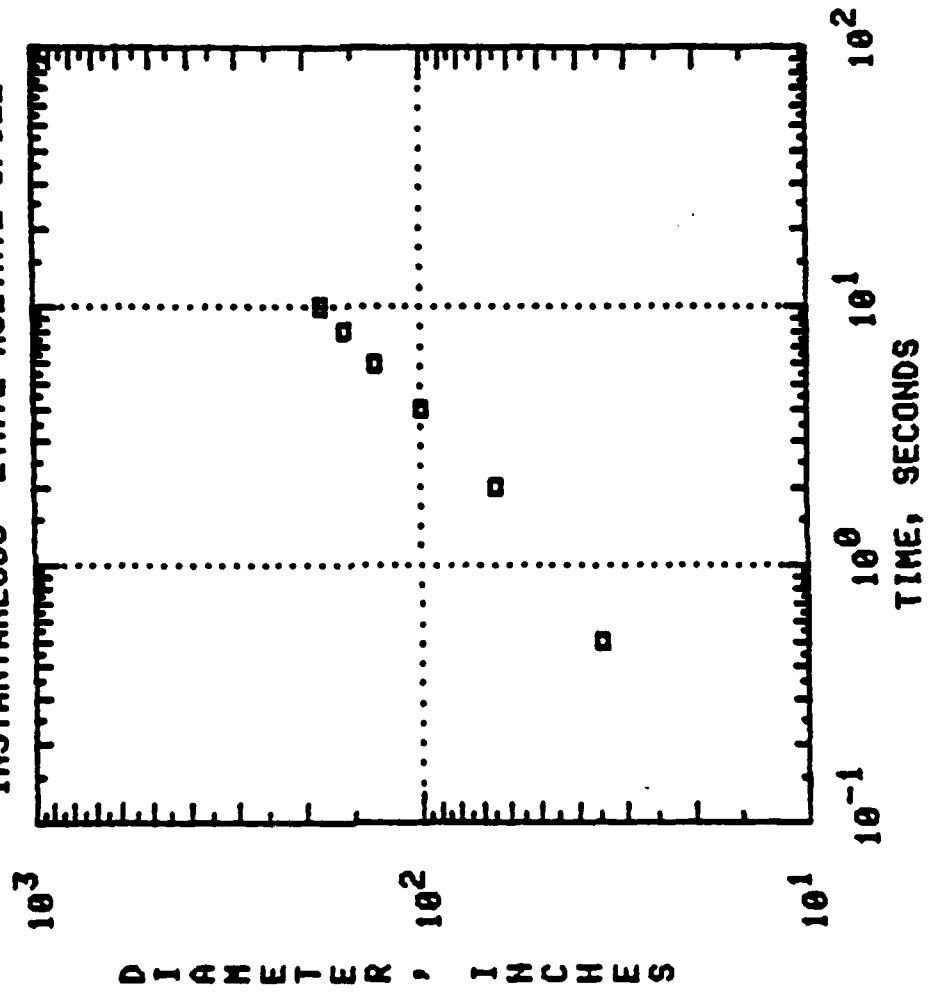
III.5-2 10. LITER VOLATILE  
INSTANTANEOUS ETHYL ACETATE SPILL



III.5-3 20. LITER VOLATILE  
INSTANTANEOUS ETHYL ACETATE SPILL



111.5-4 40. LITER VOLATILE  
INSTANTANEOUS ETHYL ACETATE SPILL



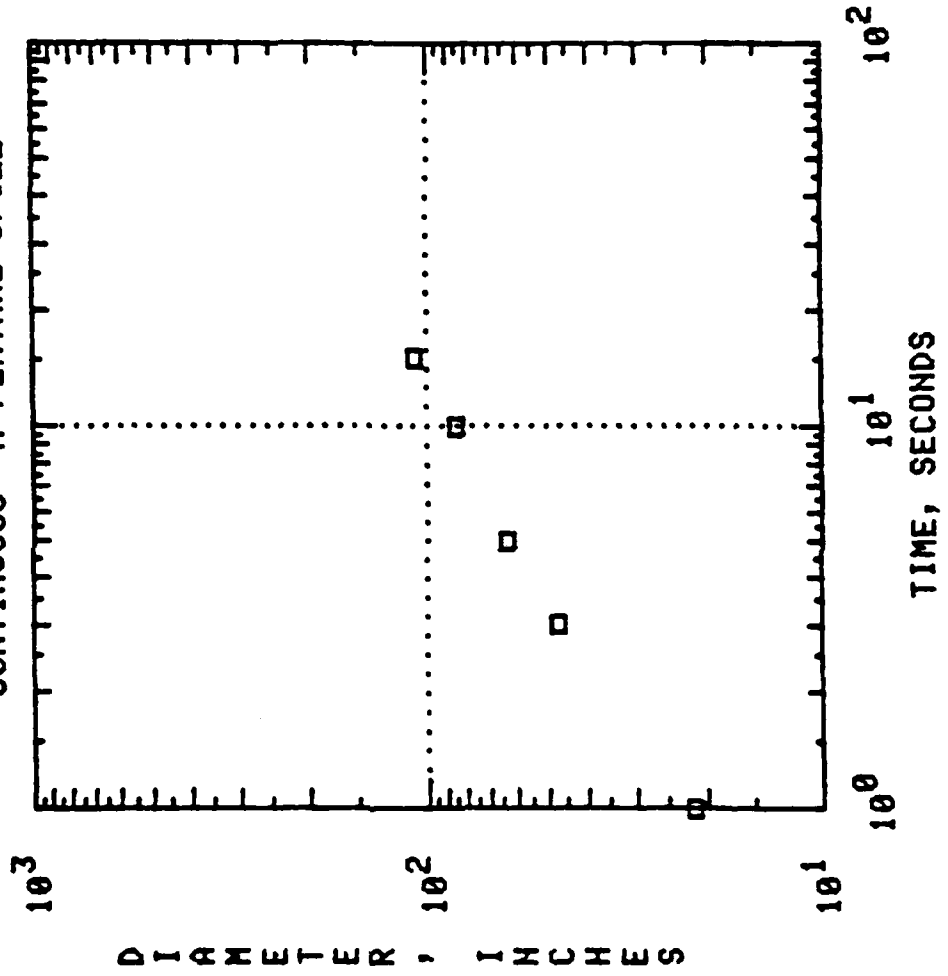
APPENDIX D

SPREADING TEST SERIES IV -  
VOLATILE CONTINUOUS SPILLS IN BASIN

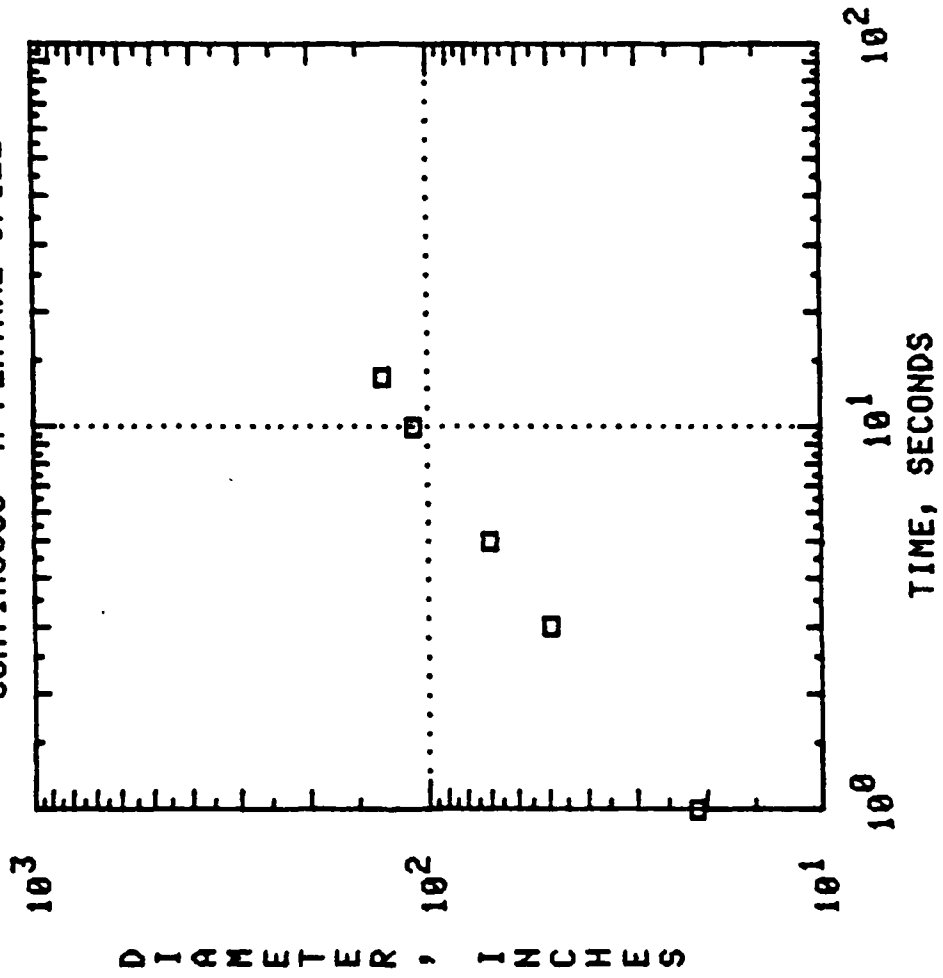
SUMMARY OF TEST CONDITIONS FOR  
SPREADING TEST SERIES IV -  
VOLATILE CONTINUOUS SPILLS IN BASIN

Run Number	Chemical	Specific Gravity	$\sigma_{sp}$ Coef.	Spill Diameter	Spill Rate (liters/sec)	Wind Speed (m/s)
IV.1-1	n-Pentane	0.626	6.5	7.3	0.50	3.53
IV.1-2					0.82	1.68
IV.1-3					1.01	1.94
IV.1-4					1.26	2.62
IV.2-1	Heptane	0.684	1.6	7.6	0.50	1.57
IV.2-2					0.82	0.74
IV.2-3					1.01	4.29
IV.2-4					1.26	4.29
IV.3-1	Octane	0.703	0.3	7.6	0.50	0.87
IV.3-2					0.82	1.30
IV.3-3					1.01	1.36
IV.3-4					1.26	1.24
IV.4-1	m-Xylene	0.864	7.0	7.6	0.50	2.05
IV.4-2					0.82	0.94
IV.4-3					1.01	1.15
IV.4-4					1.26	1.11
IV.5-1	Ethyl Acetate	0.901	45.89	7.6	0.50	0.67
IV.5-2					0.82	0.80
IV.5-3					1.01	1.53
IV.5-4					1.26	1.80

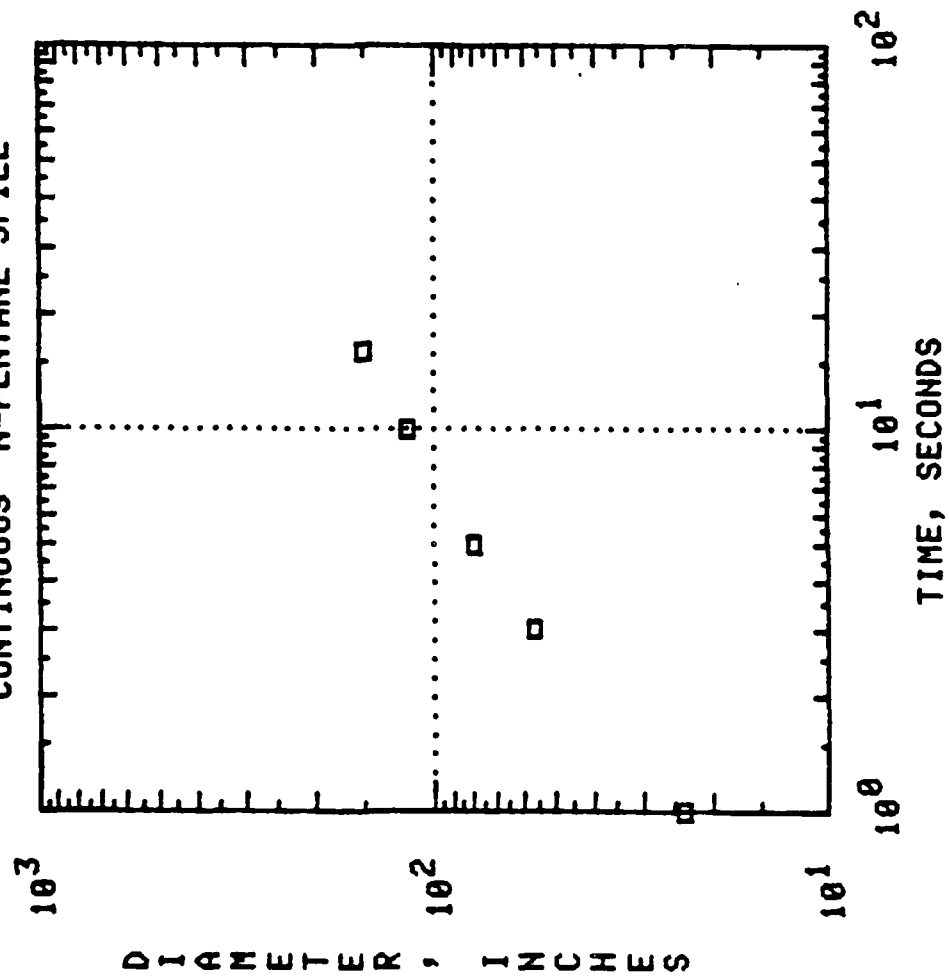
IV.1-1 0.50 L/SEC VOLATILE  
CONTINUOUS N-PENTANE SPILL



IV.1-2 0.82 L/SEC VOLATILE  
CONTINUOUS N-PENTANE SPILL

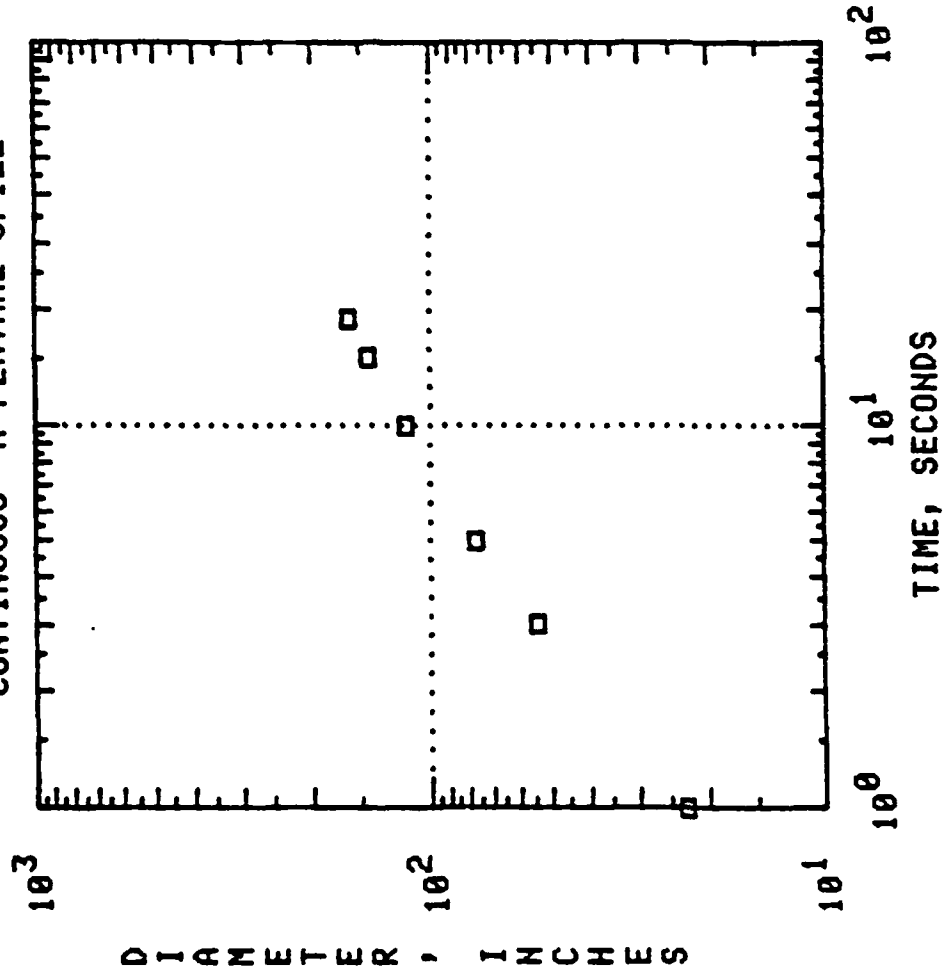


IV.1-3 1.01 L/SEC VOLATILE  
CONTINUOUS N-PENTANE SPILL

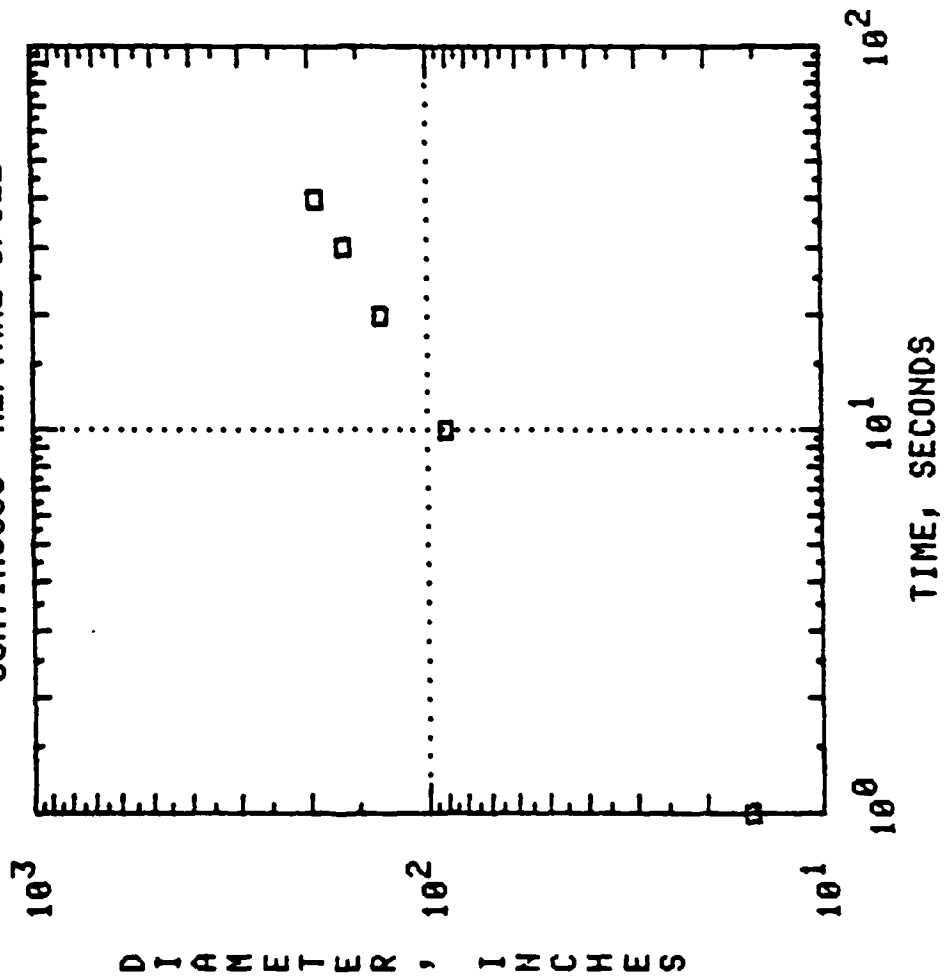




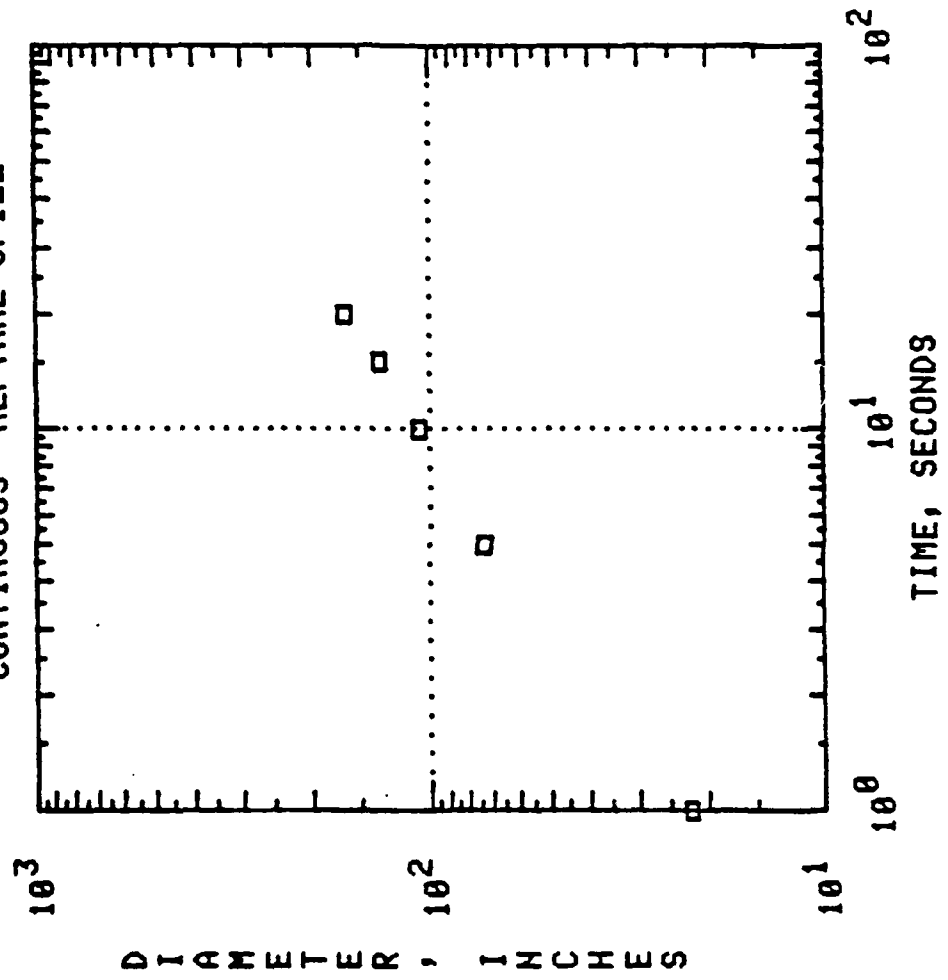
IV.1-4 1.26 L/SEC VOLATILE  
CONTINUOUS N-PENTANE SPILL



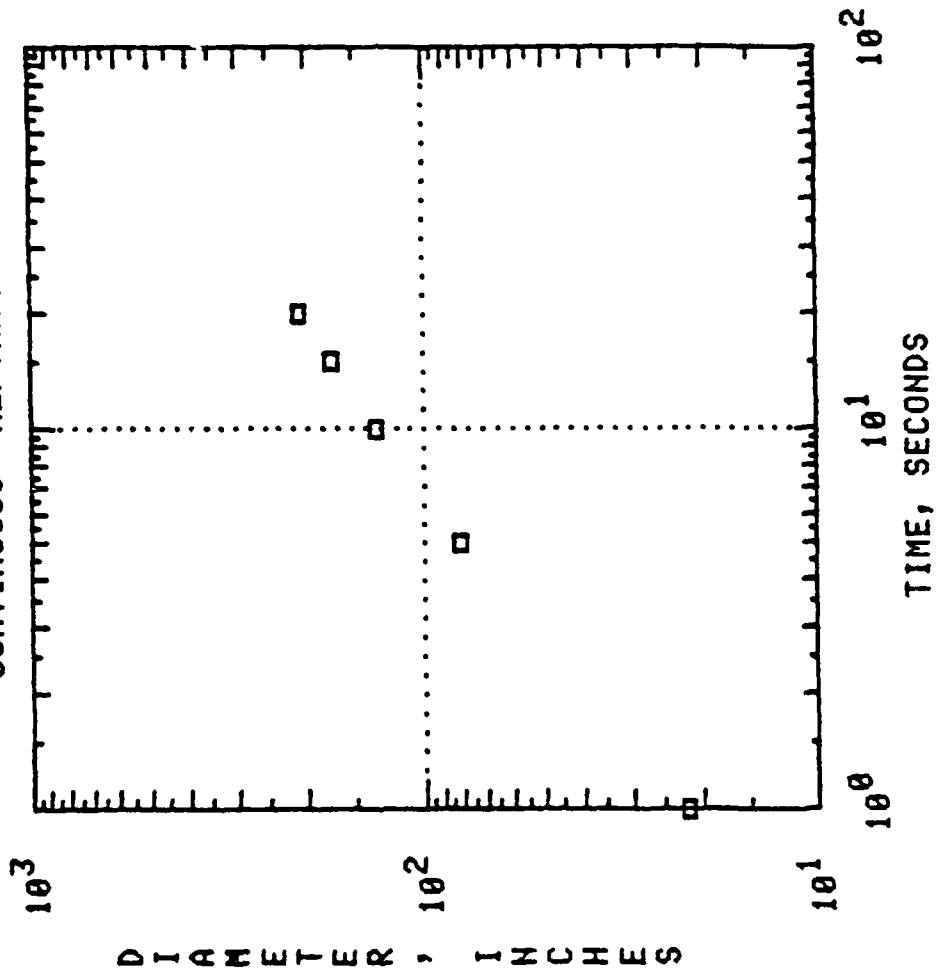
IV.2-1 0.50 L/SEC VOLATILE  
CONTINUOUS HEPTANE SPILL



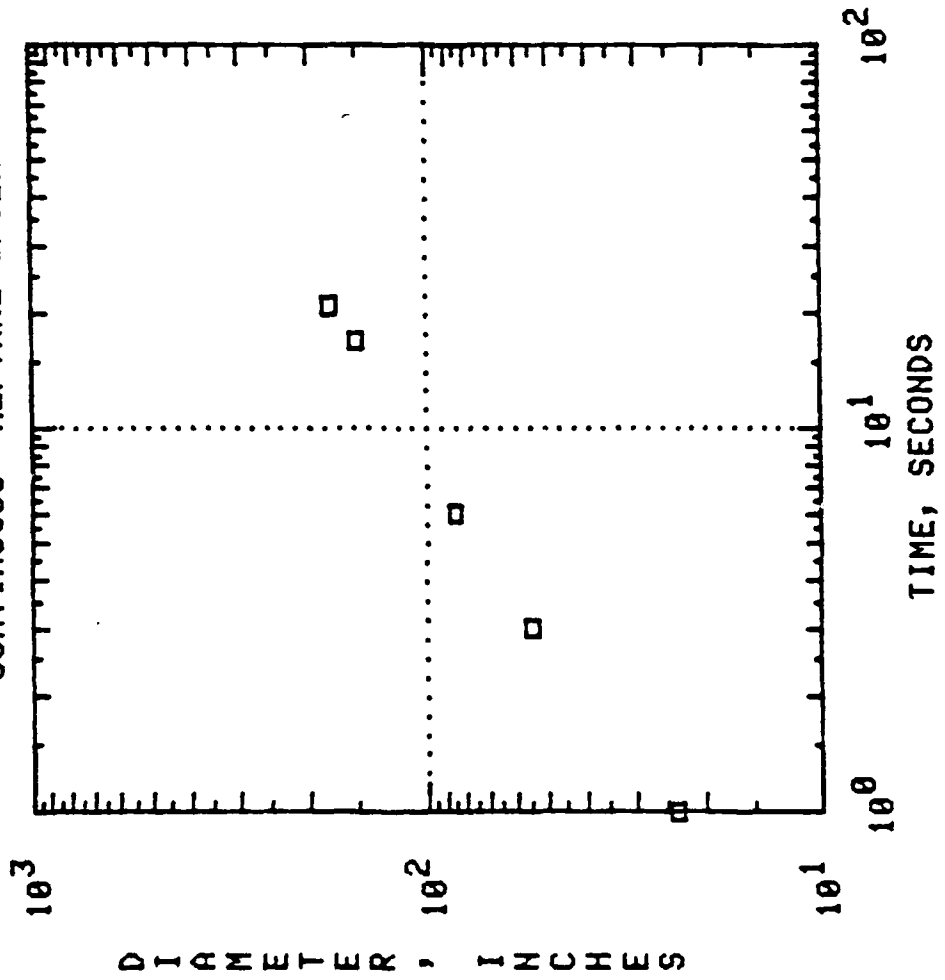
IV.2-2 0.82 L/SEC VOLATILE  
CONTINUOUS HEPTANE SPILL



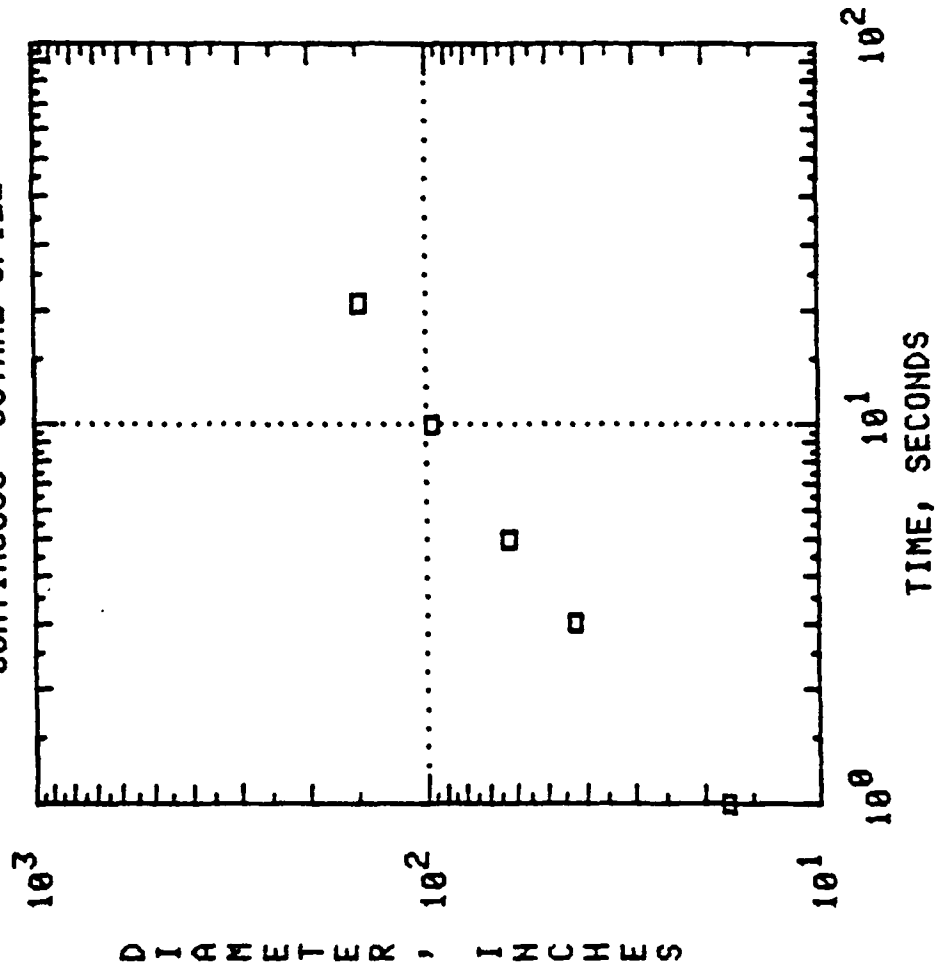
IV.2-3 1.01 L/SEC VOLATILE  
CONTINUOUS HEPTANE SPILL



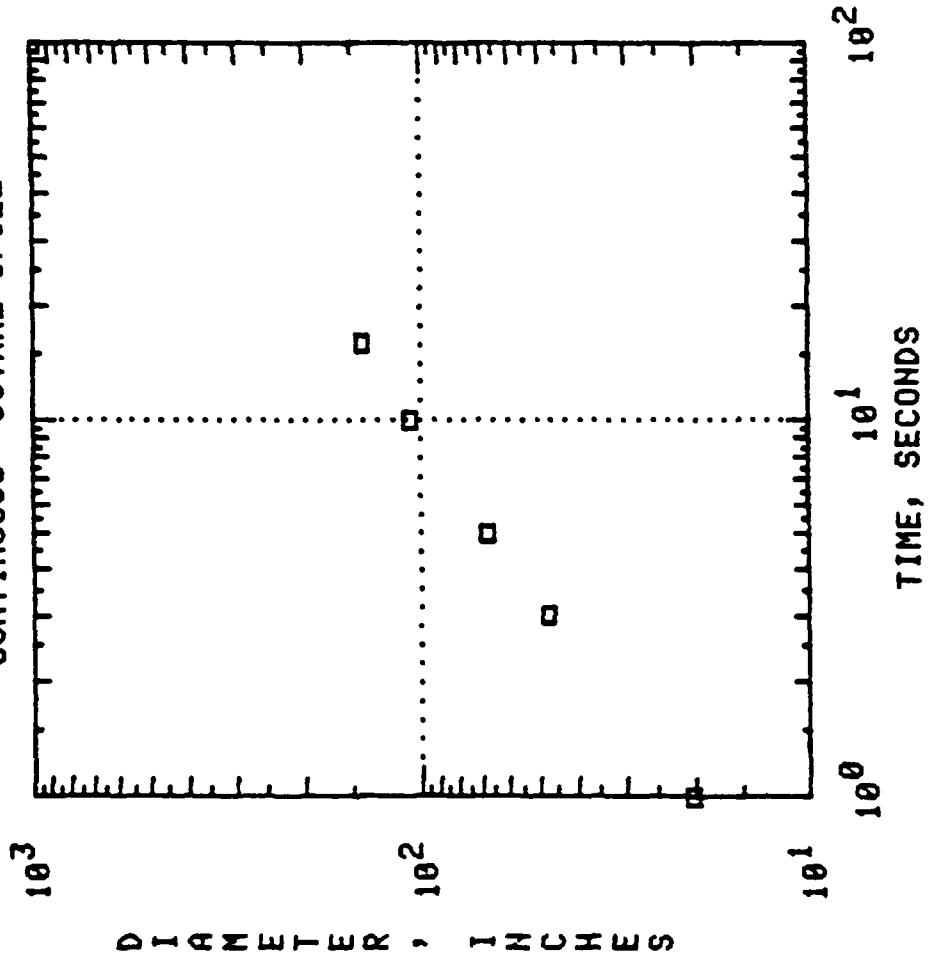
IV.2-4 1.26 L/SEC VOLATILE  
CONTINUOUS HEPTANE SPILL



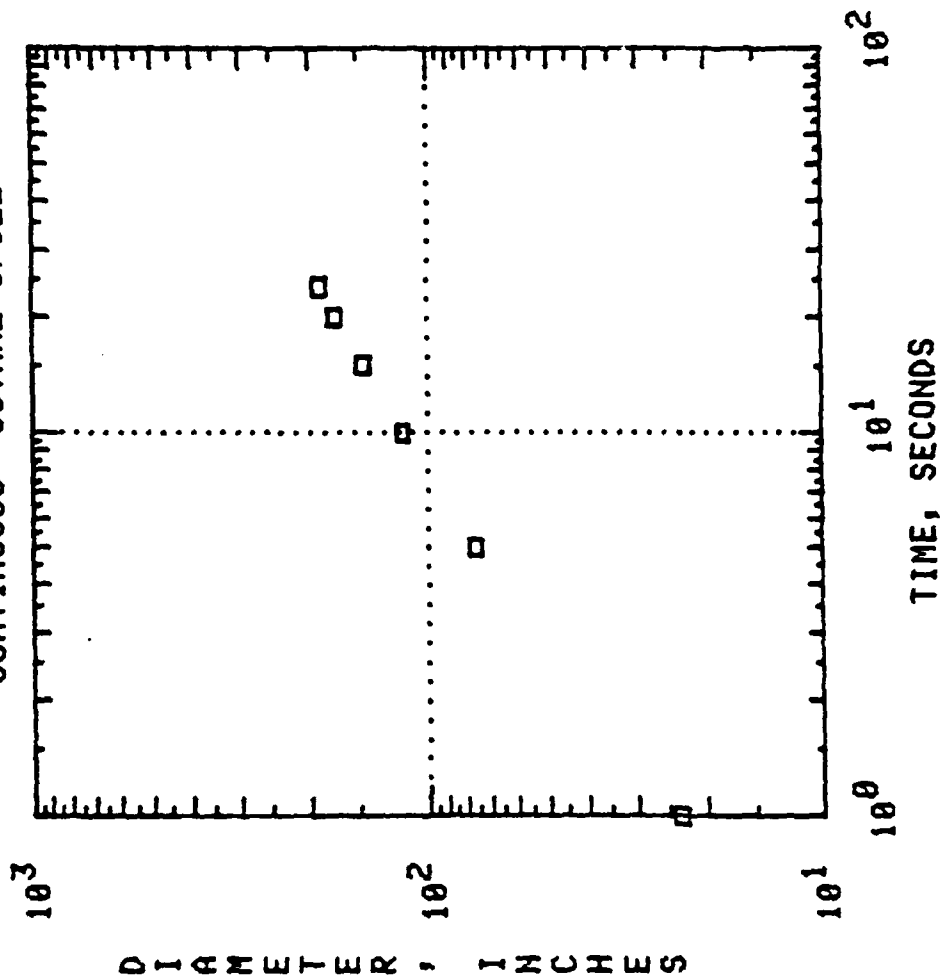
IV.3-1 0.50 L/SEC VOLATILE  
CONTINUOUS OCTANE SPILL



IV.3-2 0.82 L/SEC VOLATILE  
CONTINUOUS OCTANE SPILL

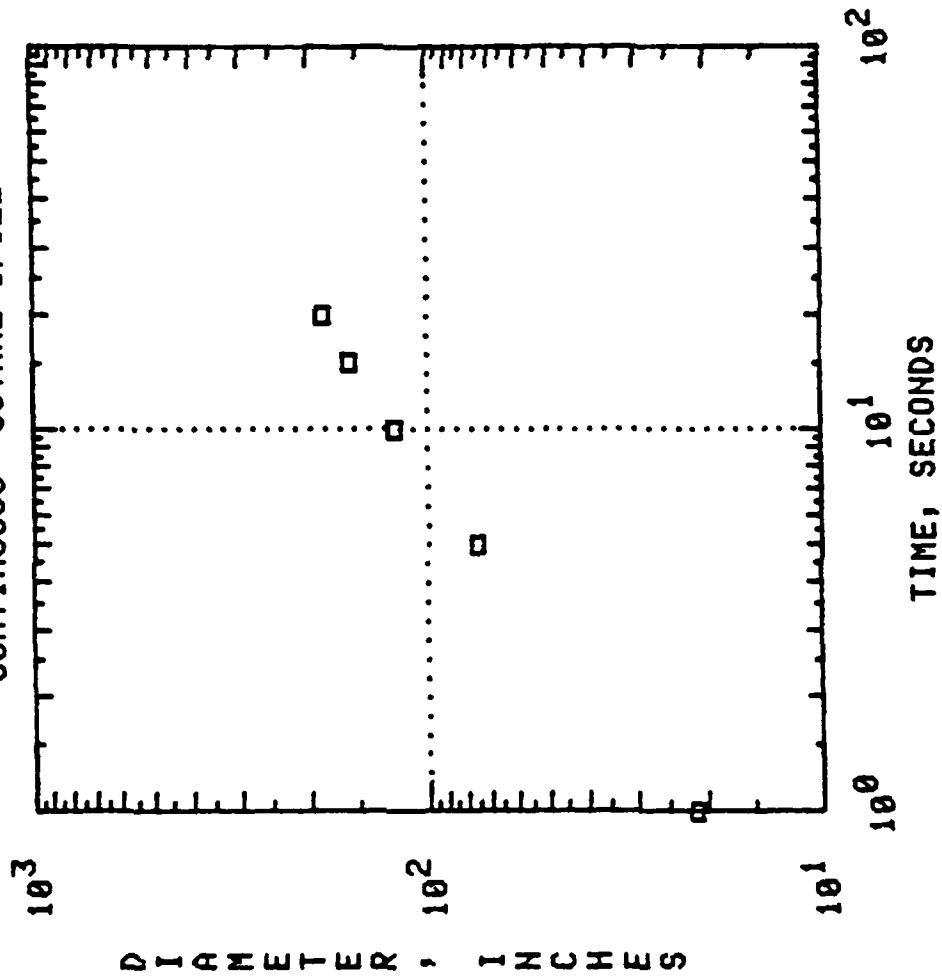


IV.3-3 1.01 L/SEC VOLATILE  
CONTINUOUS OCTANE SPILL

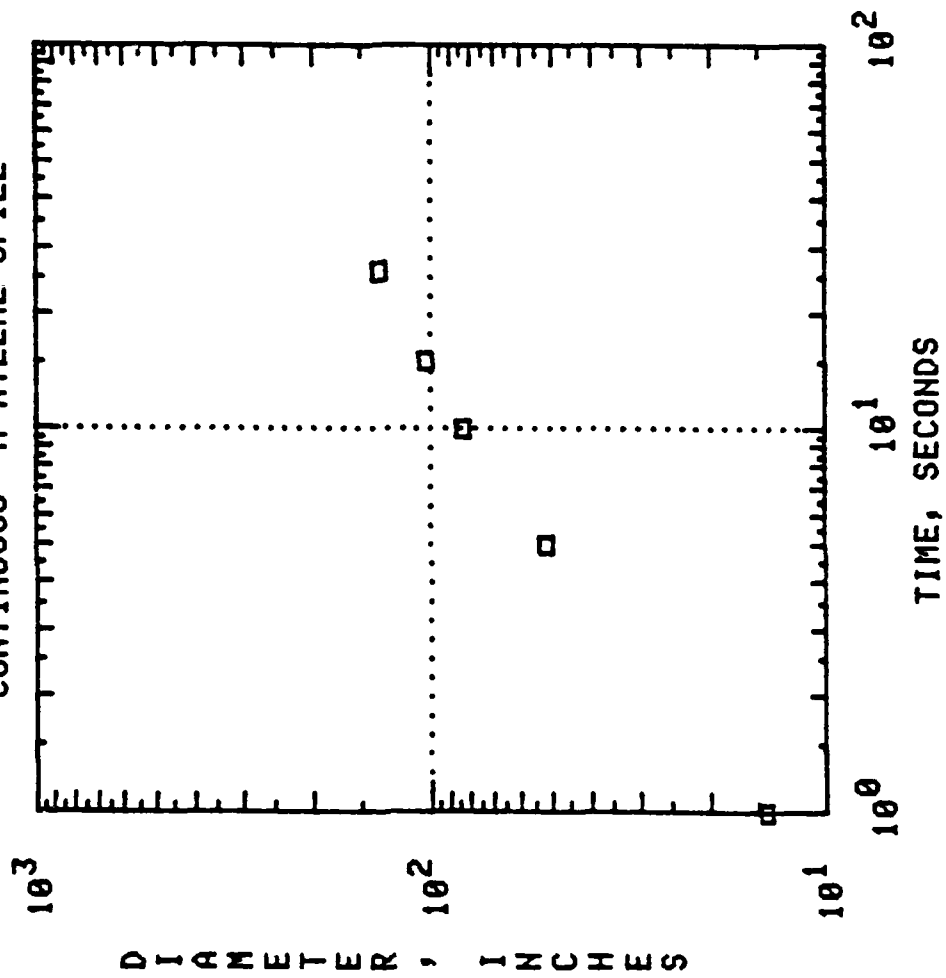




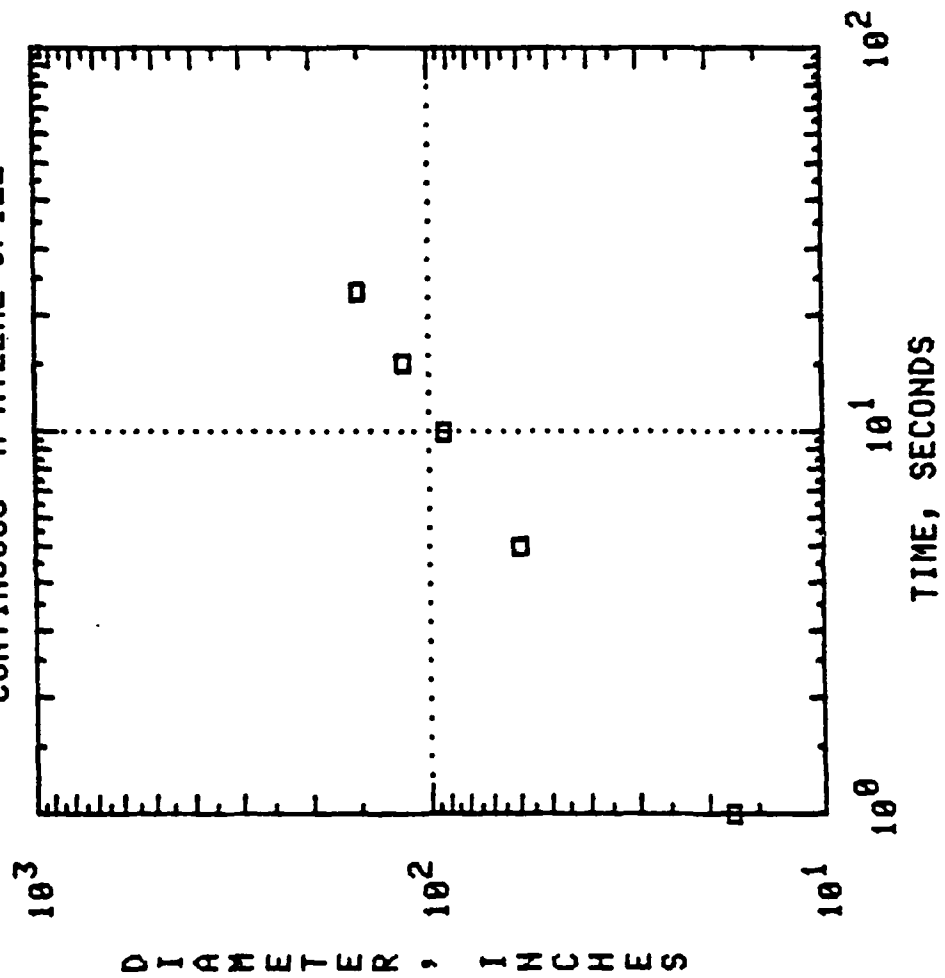
IV.3-4 1.26 L/SEC VOLATILE  
CONTINUOUS OCTANE SPILL



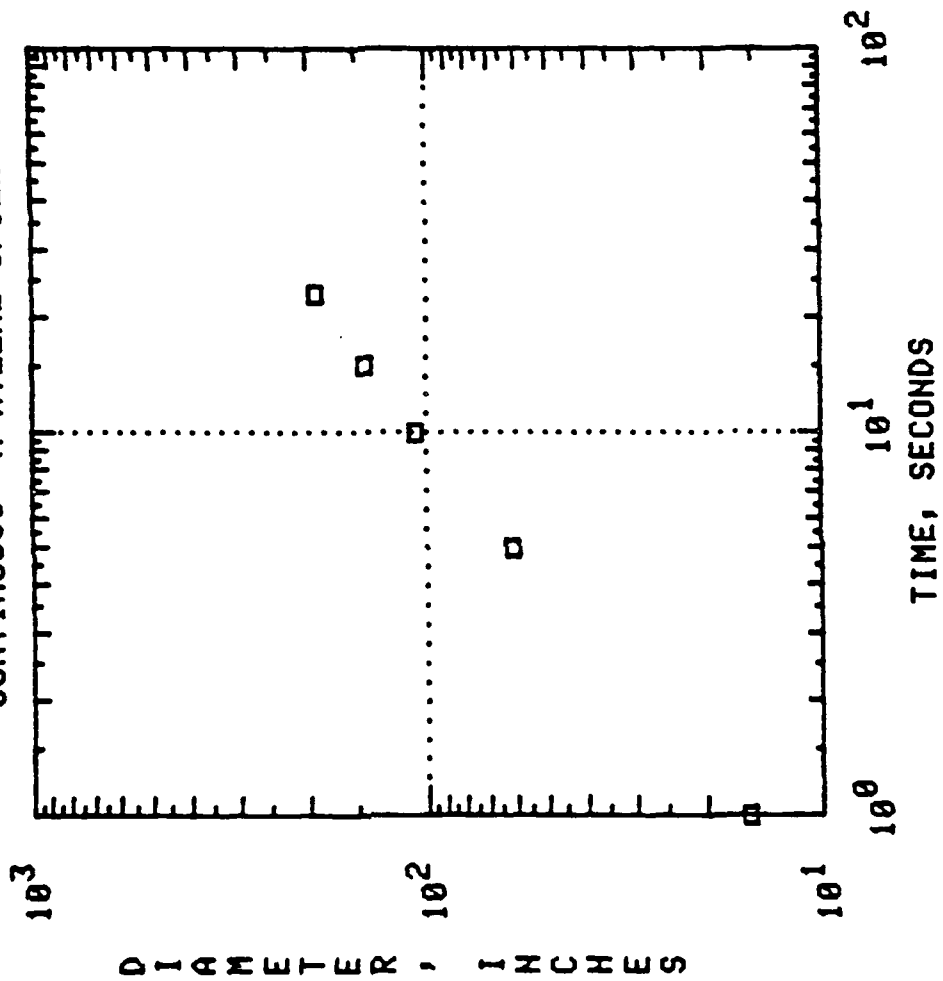
IV.4-1 0.50 L/SEC VOLATILE  
CONTINUOUS M-XYLENE SPILL



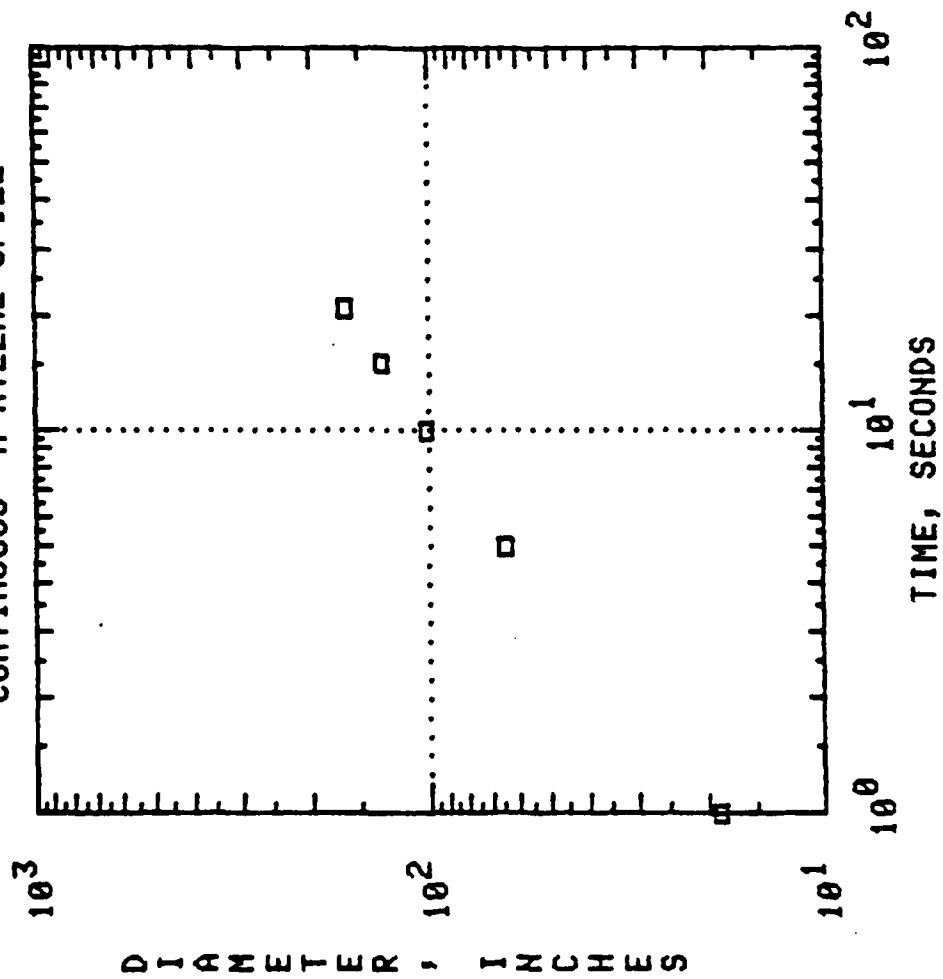
IV.4-2 0.82 L/SEC VOLATILE  
CONTINUOUS M-XYLENE SPILL



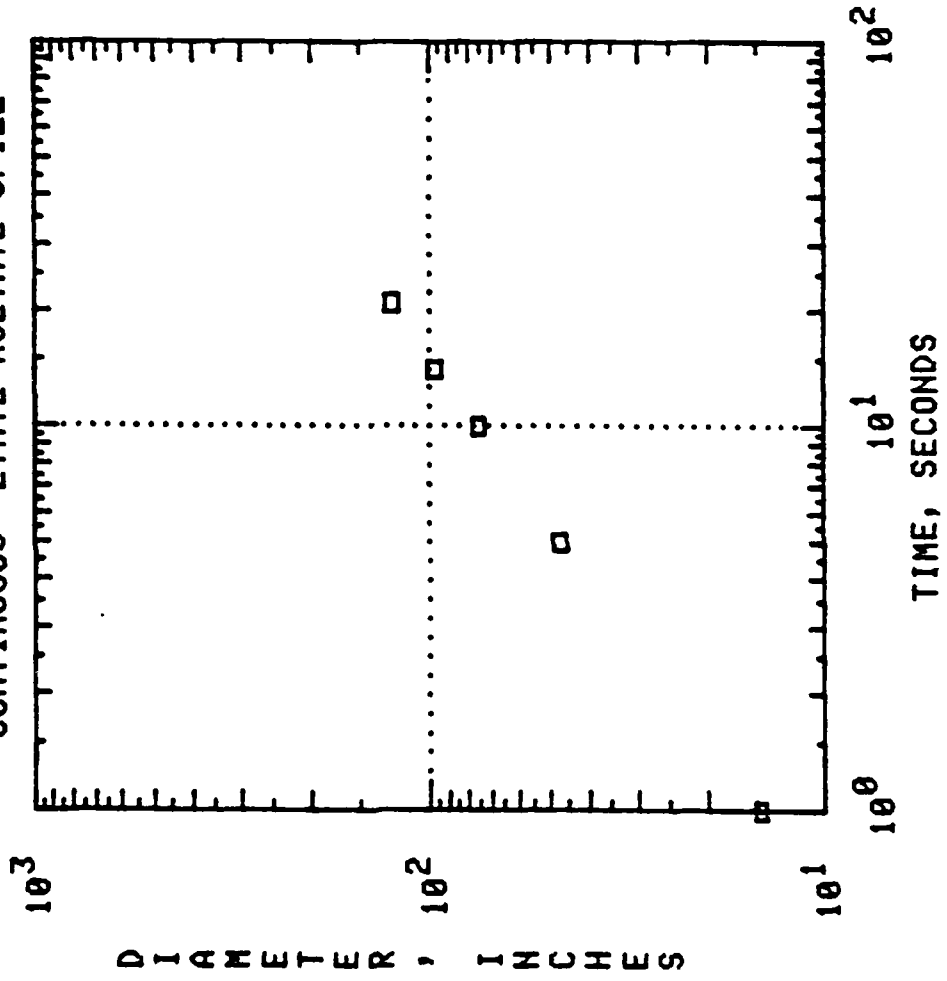
IV.4-3 1.01 L/SEC VOLATILE  
CONTINUOUS M-XYLENE SPILL



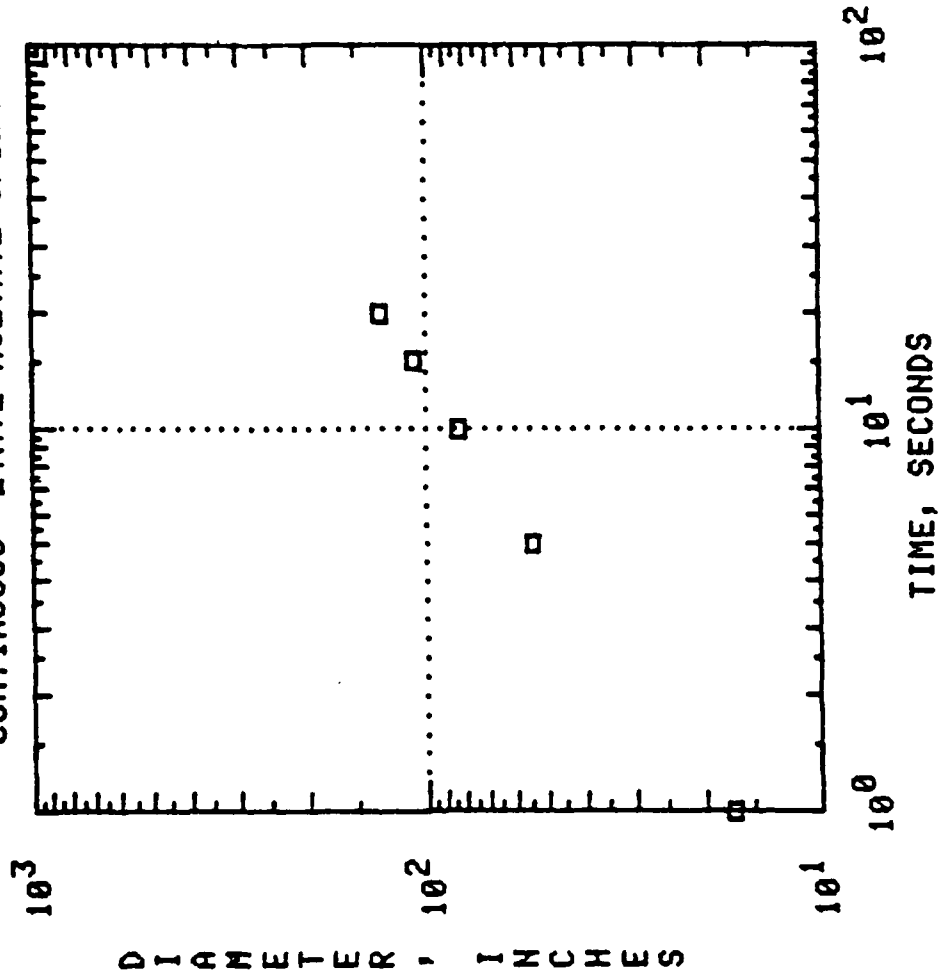
IV.4-4 1.26 L/SEC VOLATILE  
CONTINUOUS M-XYLENE SPILL



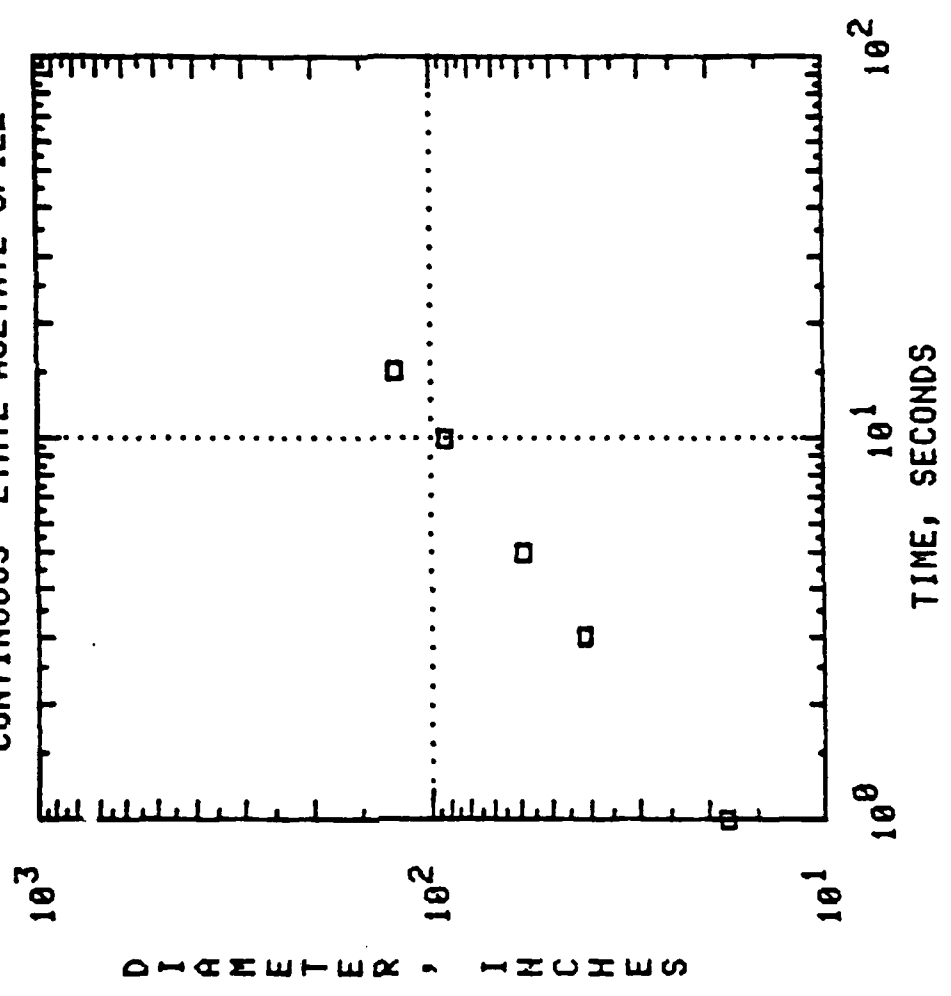
IV.5-1 0.50 L/SEC VOLATILE  
CONTINUOUS ETHYL ACETATE SPILL



IV.5-2 0.82 L/SEC VOLATILE  
CONTINUOUS ETHYL ACETATE SPILL

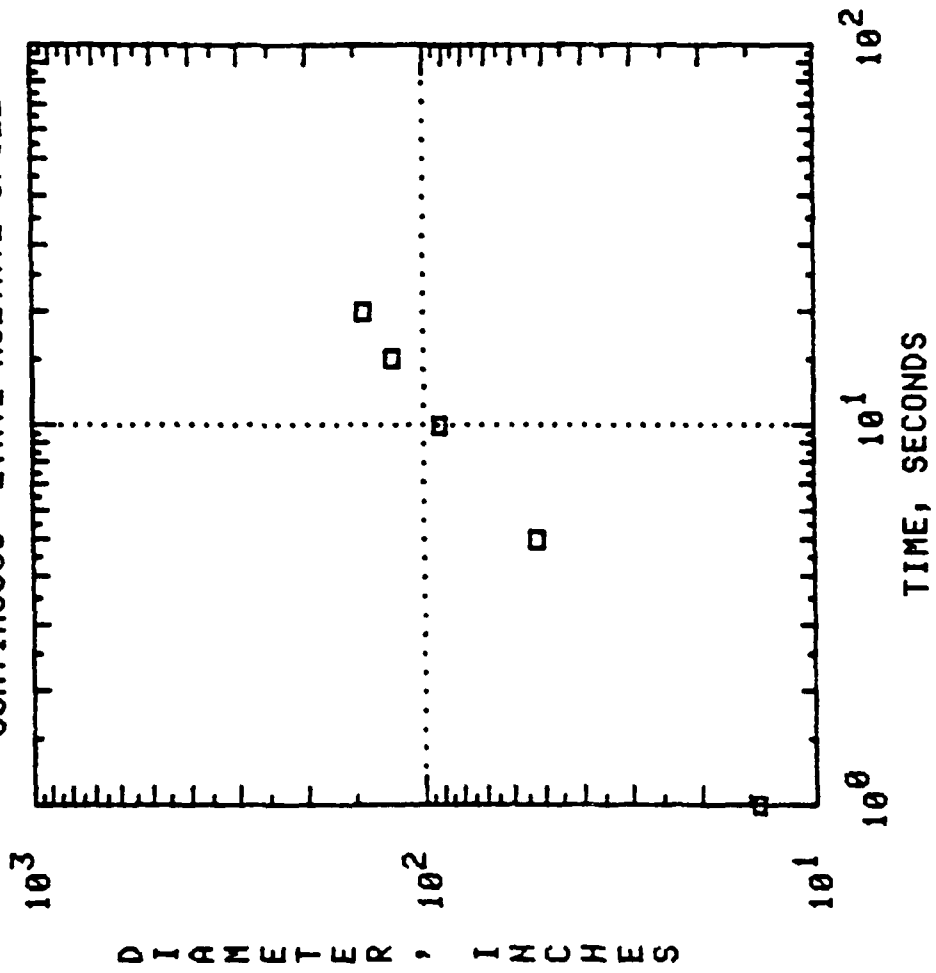


IV.5-3 1.01 L/SEC VOLATILE  
CONTINUOUS ETHYL ACETATE SPILL





IV.5-4 1.26 L/SEC VOLATILE  
CONTINUOUS ETHYL ACETATE SPILL



APPENDIX E

SPREADING TEST SERIES V -  
FLOW CHANNEL TESTS

AD-A139 384

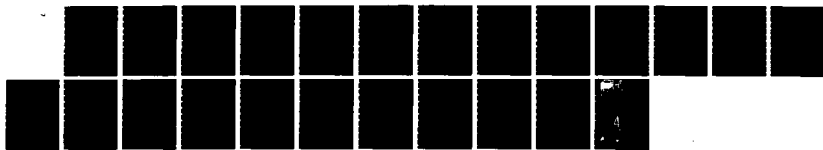
REVISION AND EXPERIMENTAL VERIFICATION OF THE HAZARD  
ASSESSMENT COMPUTER. (U) SOUTHWEST RESEARCH INST SAN  
ANTONIO TX F T DODGE ET AL. JUN 83 USCG-D-36-83  
DTICG23-80-C-20026

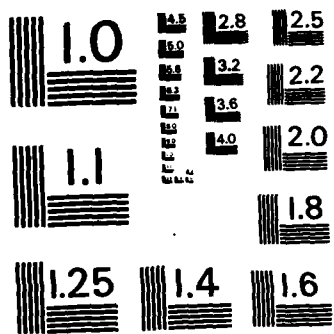
2/2

UNCLASSIFIED

F/G 13/2

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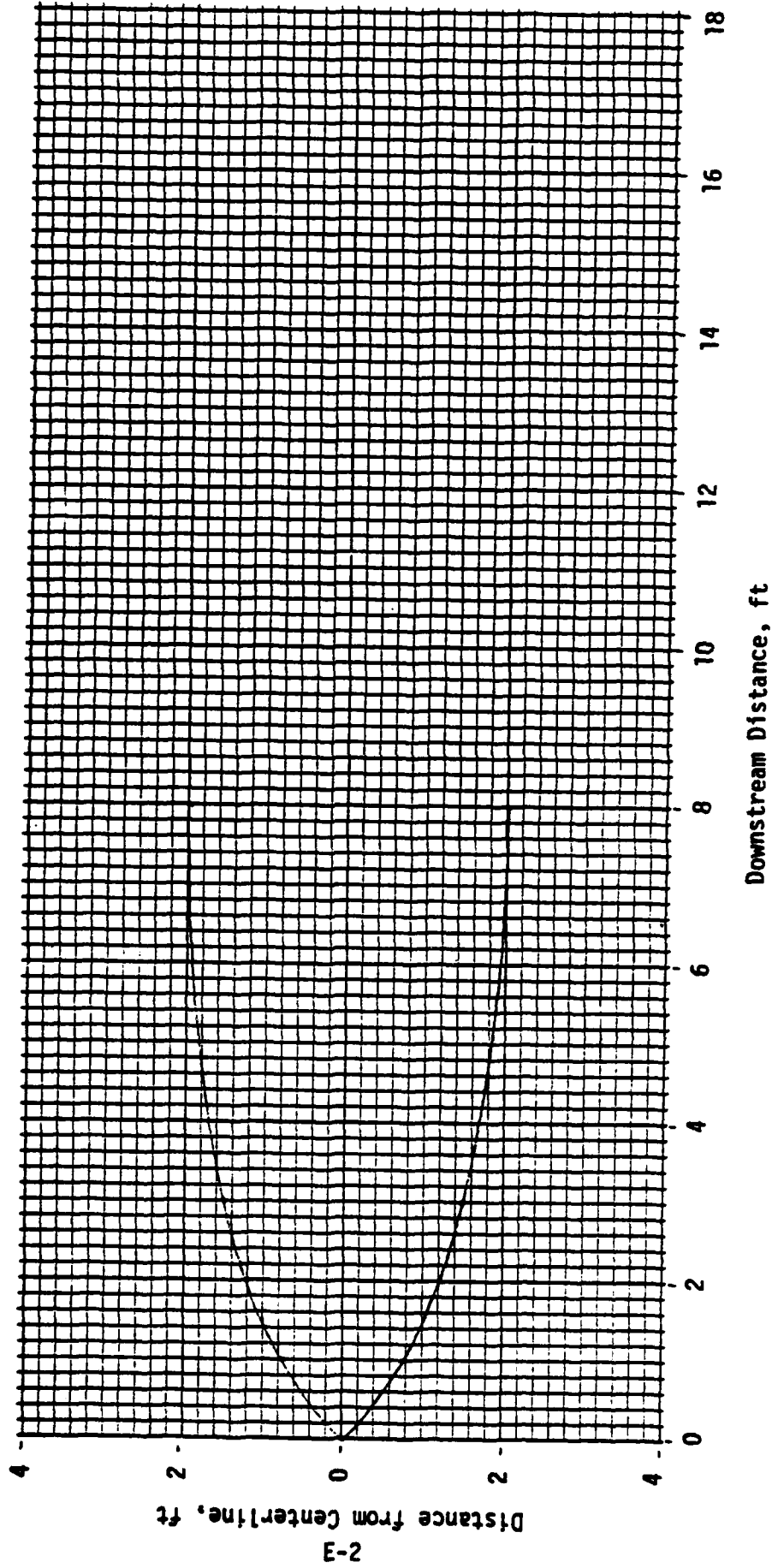


MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

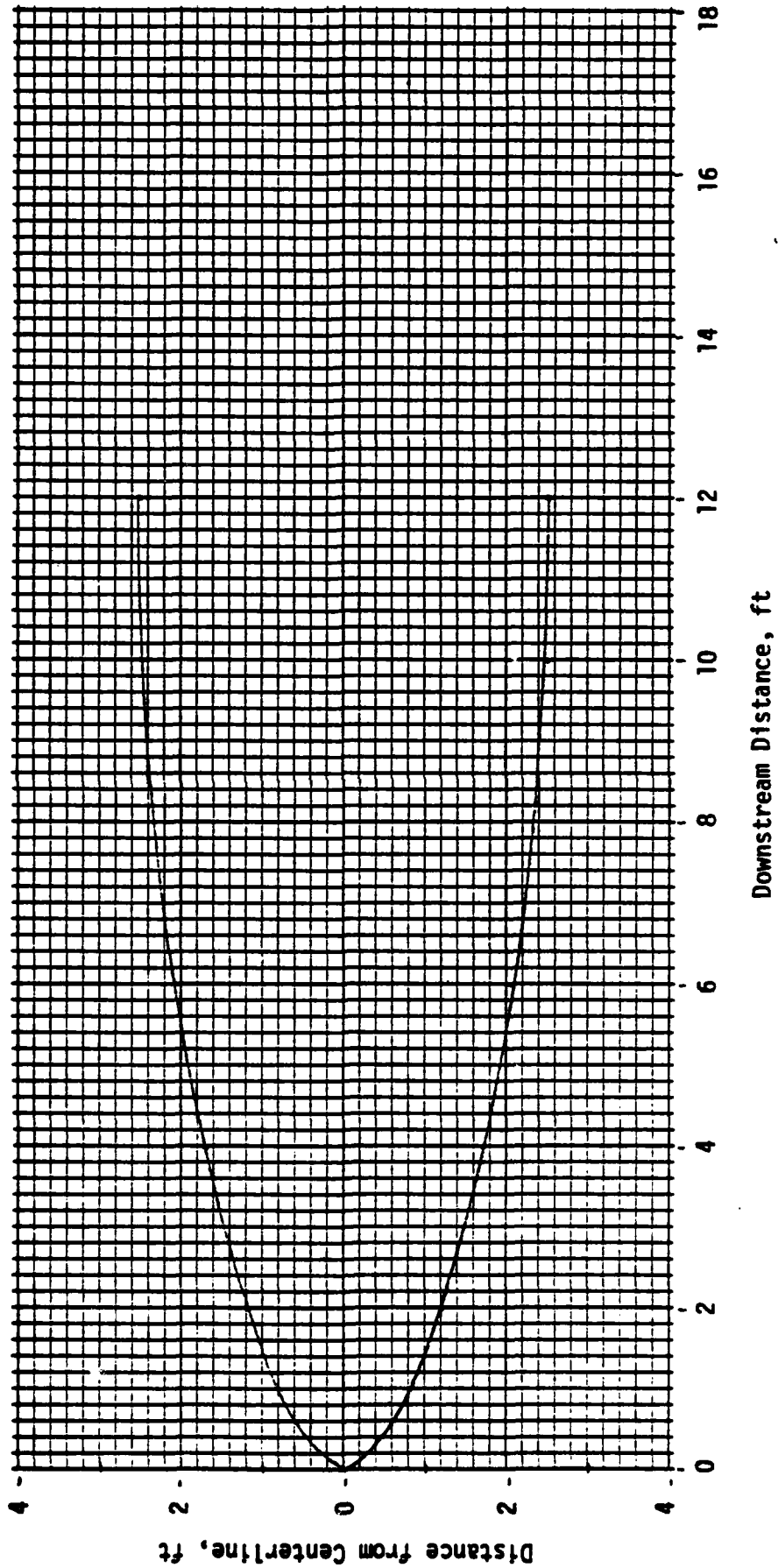
SUMMARY OF TEST CONDITIONS FOR  
SPREADING TEST SERIES V -  
FLOW CHANNEL TESTS

Run Number	Chemical (Sp.Gravity)	Spreading Coefficient (dyne/cm)	Discharge Rate (liters/sec)	Current m/sec
V.1-1	Octane (0.703)	0.3	0.038	0.134
V.1-2			0.050	0.189
V.1-3			0.100	0.241
V.1-4			0.149	0.290
V.2-1	Kerosene (0.795)	-2.7	0.038	0.134
V.2-2			0.050	0.189
V.2-3			0.100	0.241
V.2-4			0.149	0.290
V.3-1	n-Hexanol (0.819)	39.75	0.038	0.134
V.3-2			0.050	0.189
V.3-3			0.100	0.241
V.3-4			0.149	0.290
V.4-1	Naphtha (0.785)	7.8	0.025	0.119
V.4-2			0.050	0.189
V.4-3			0.100	0.241
V.4-4			0.100	0.290
V.5-1	m-Xylene (0.864)	7.0	0.038	0.134
V.5-2			0.050	0.189
V.5-3			0.100	0.241
V.5-4			0.149	0.290

RUN NUMBER V.1-1

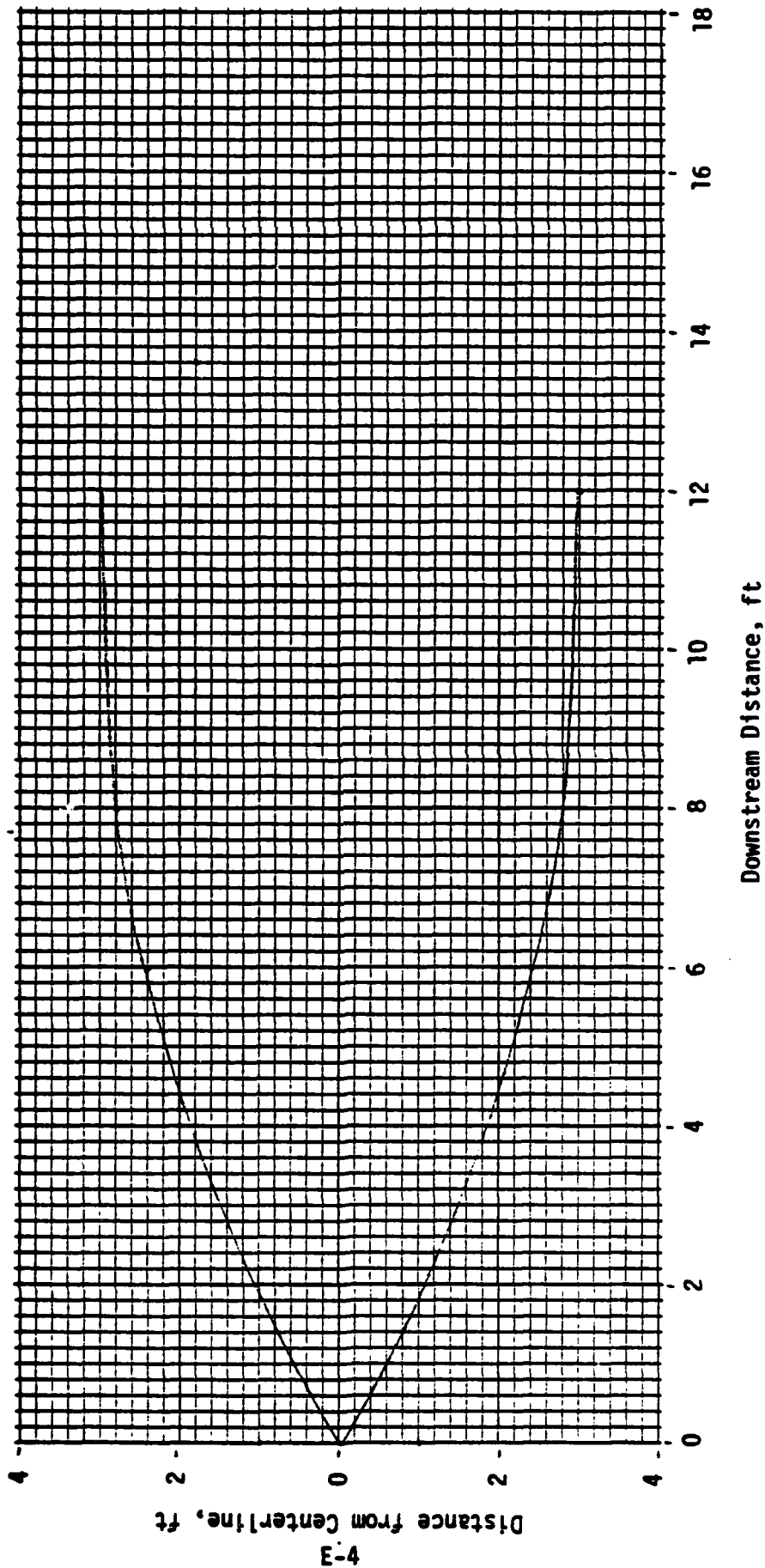


RUN NUMBER V.1-2



E-3

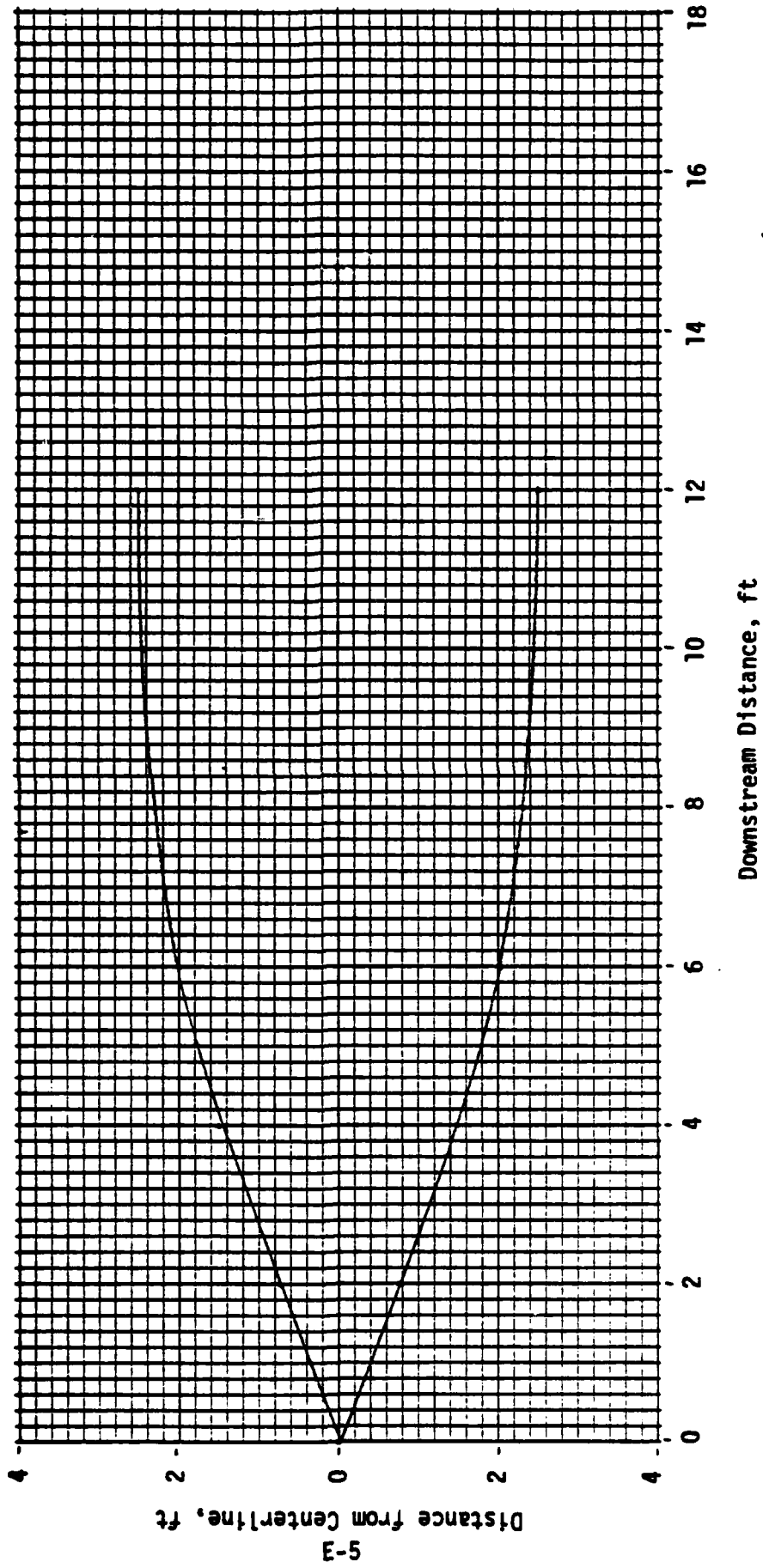
RUN NUMBER V.1-3



4-3

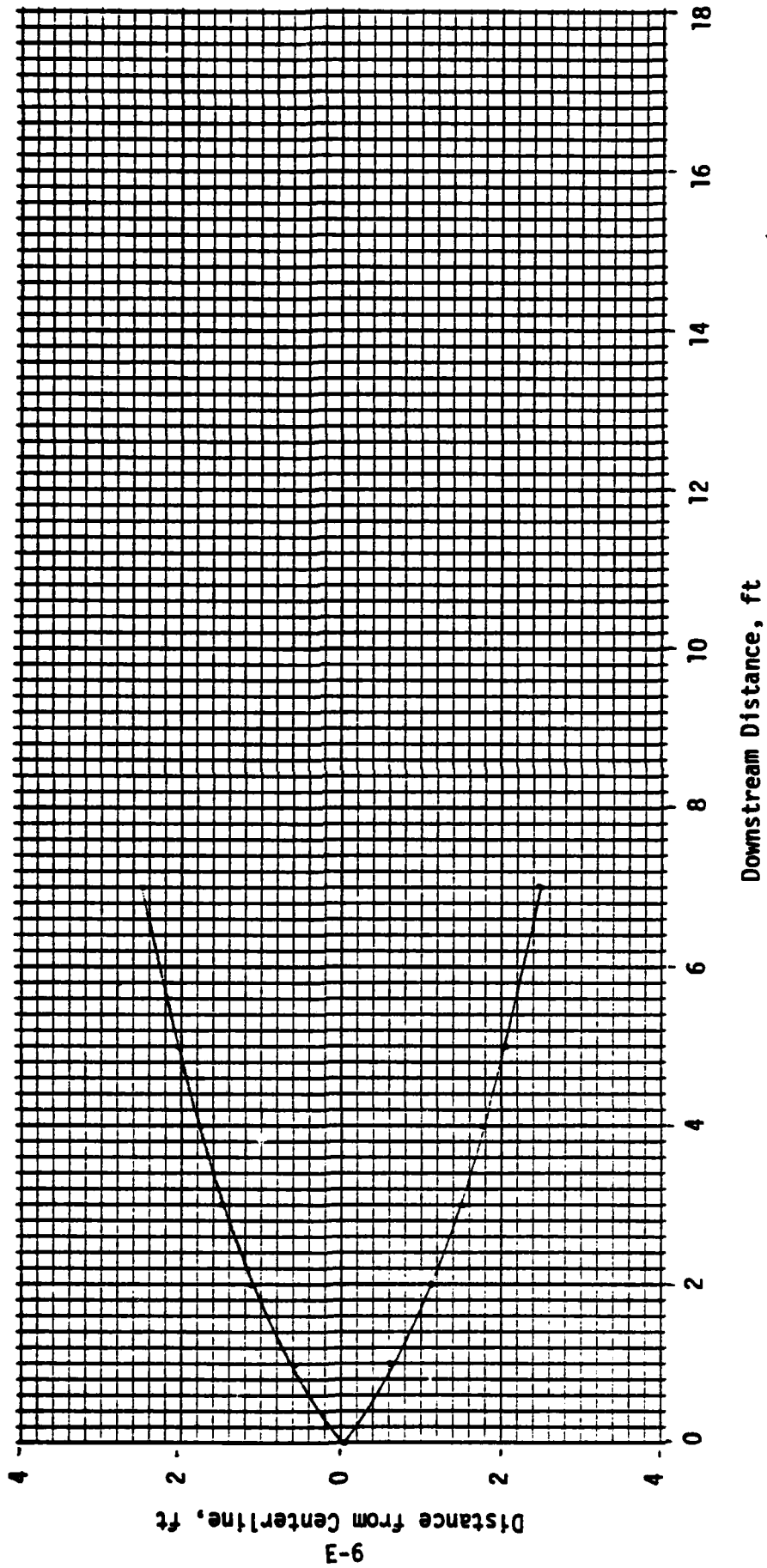


RUN NUMBER V.1-4



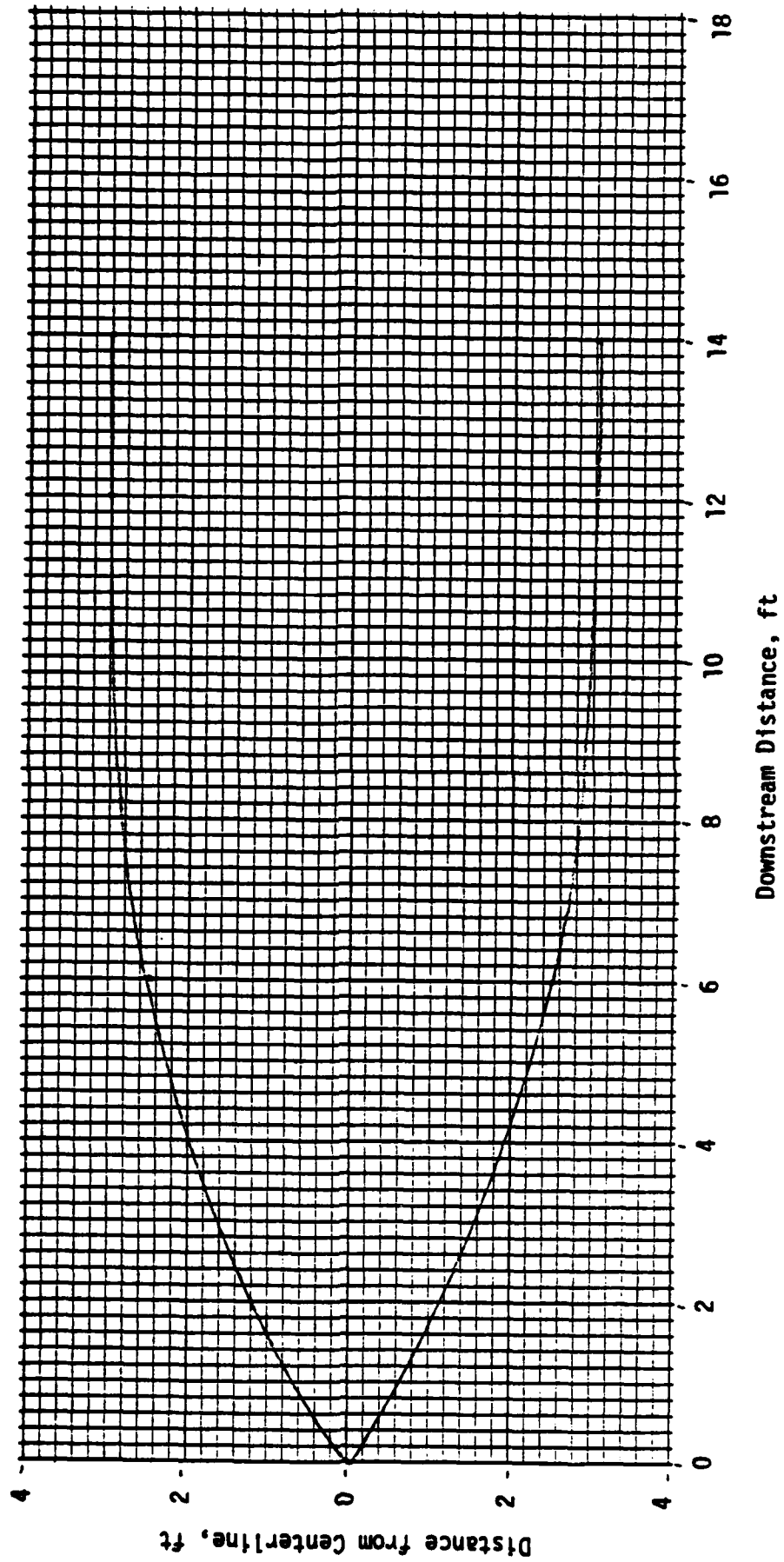
5-3

RUN NUMBER V.2-1

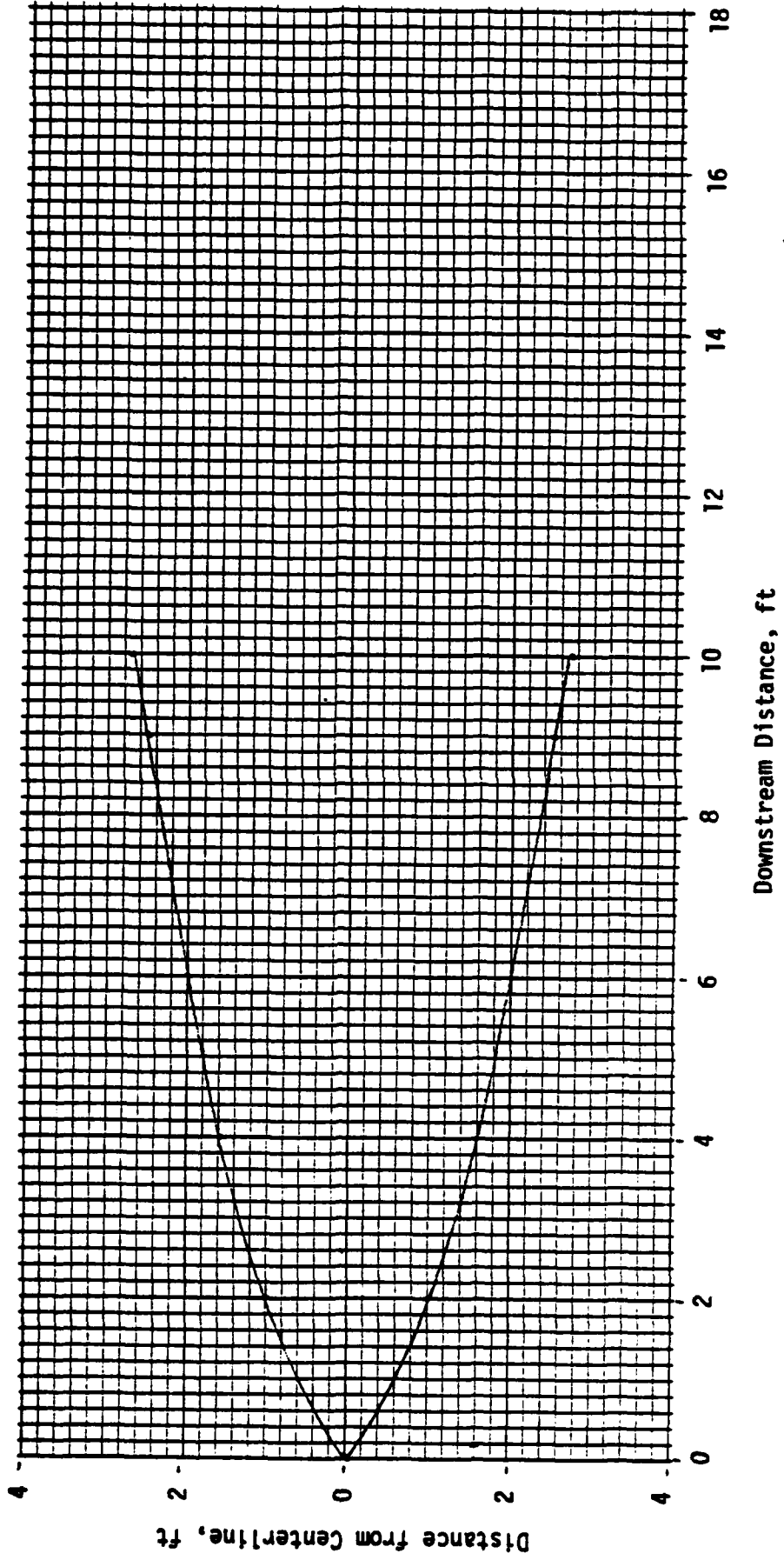


9-3

RUN NUMBER V.2-2

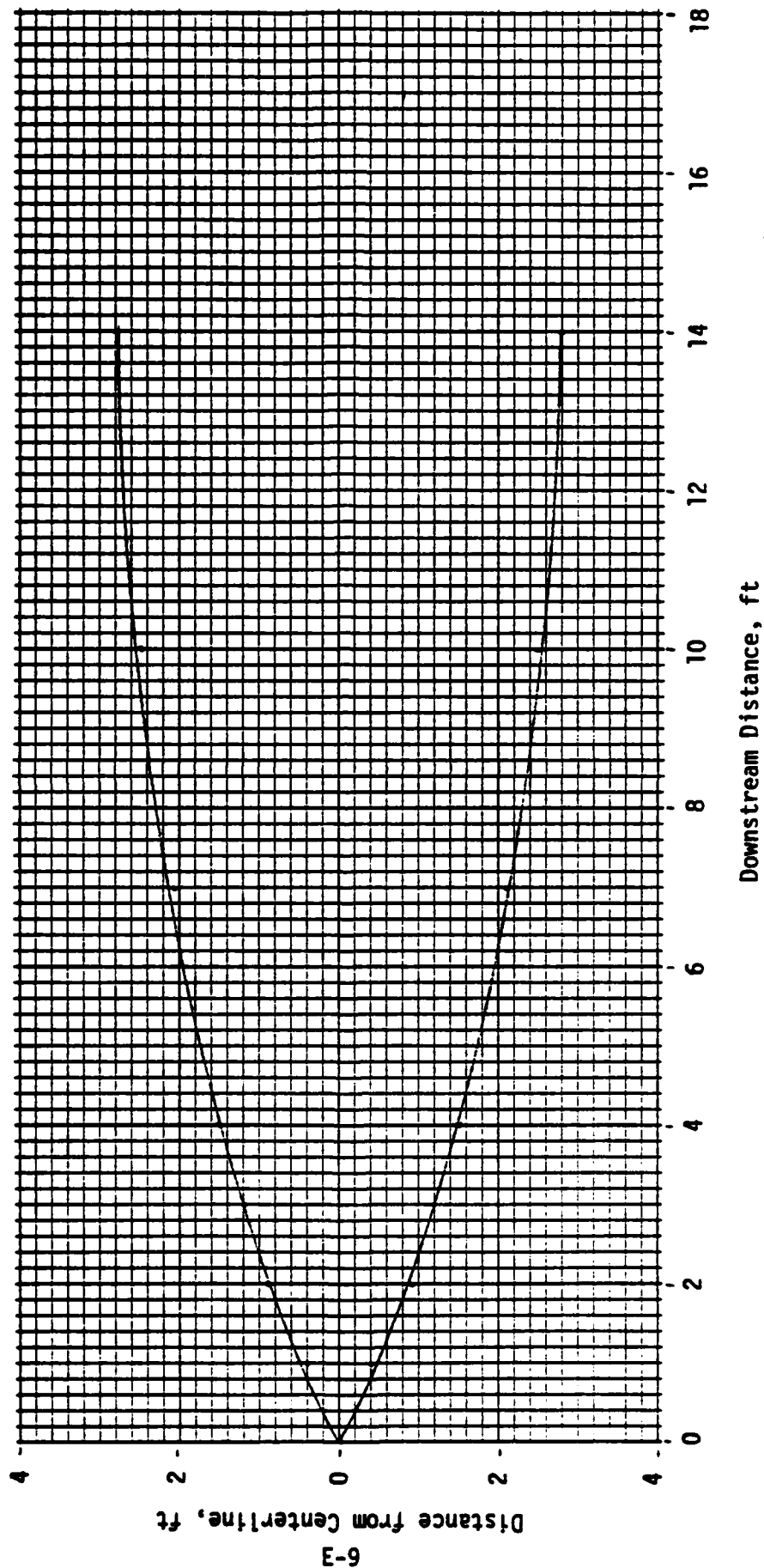


RUN NUMBER V.2-3



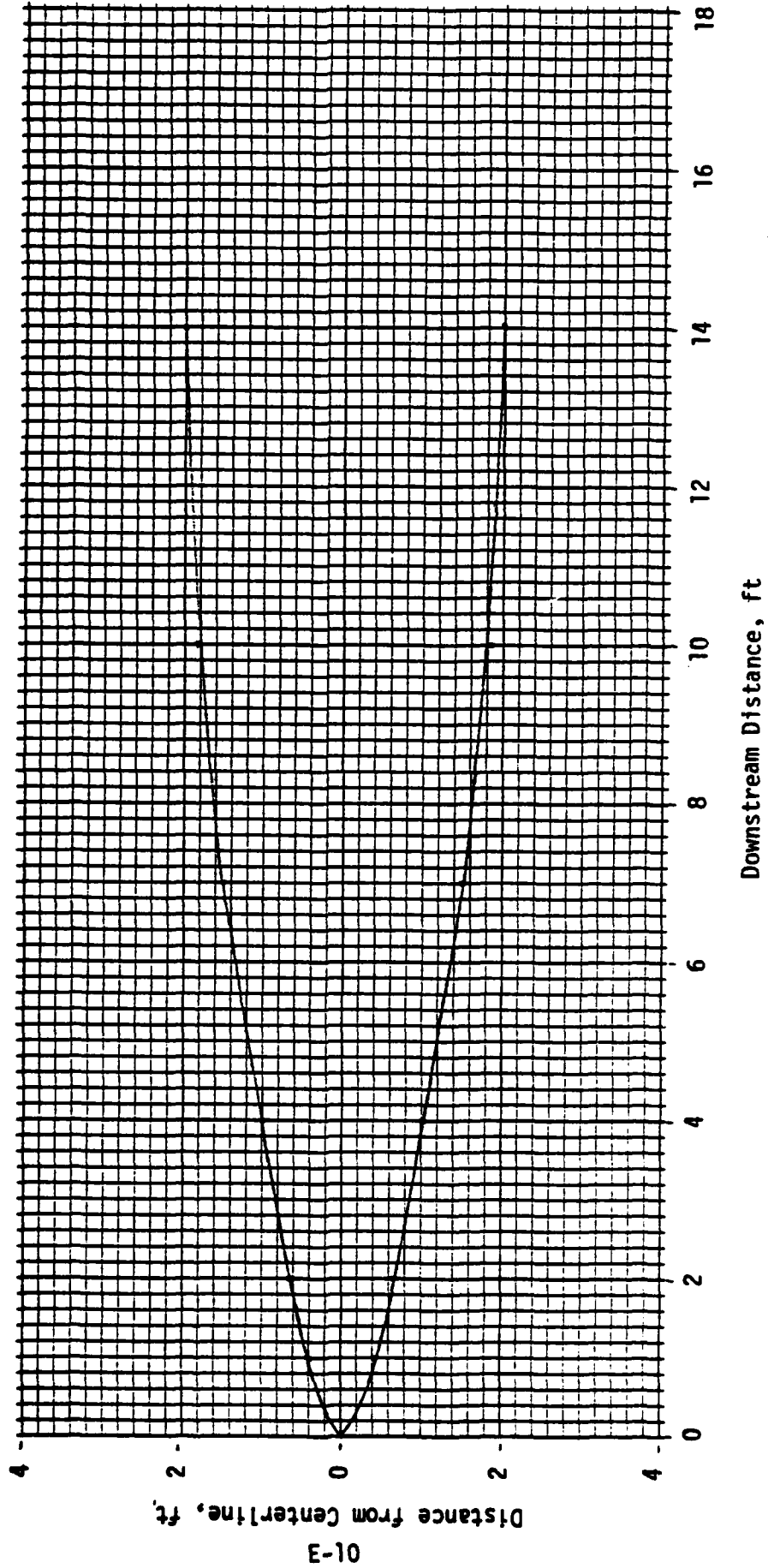
8-3

RUN NUMBER V.2-4



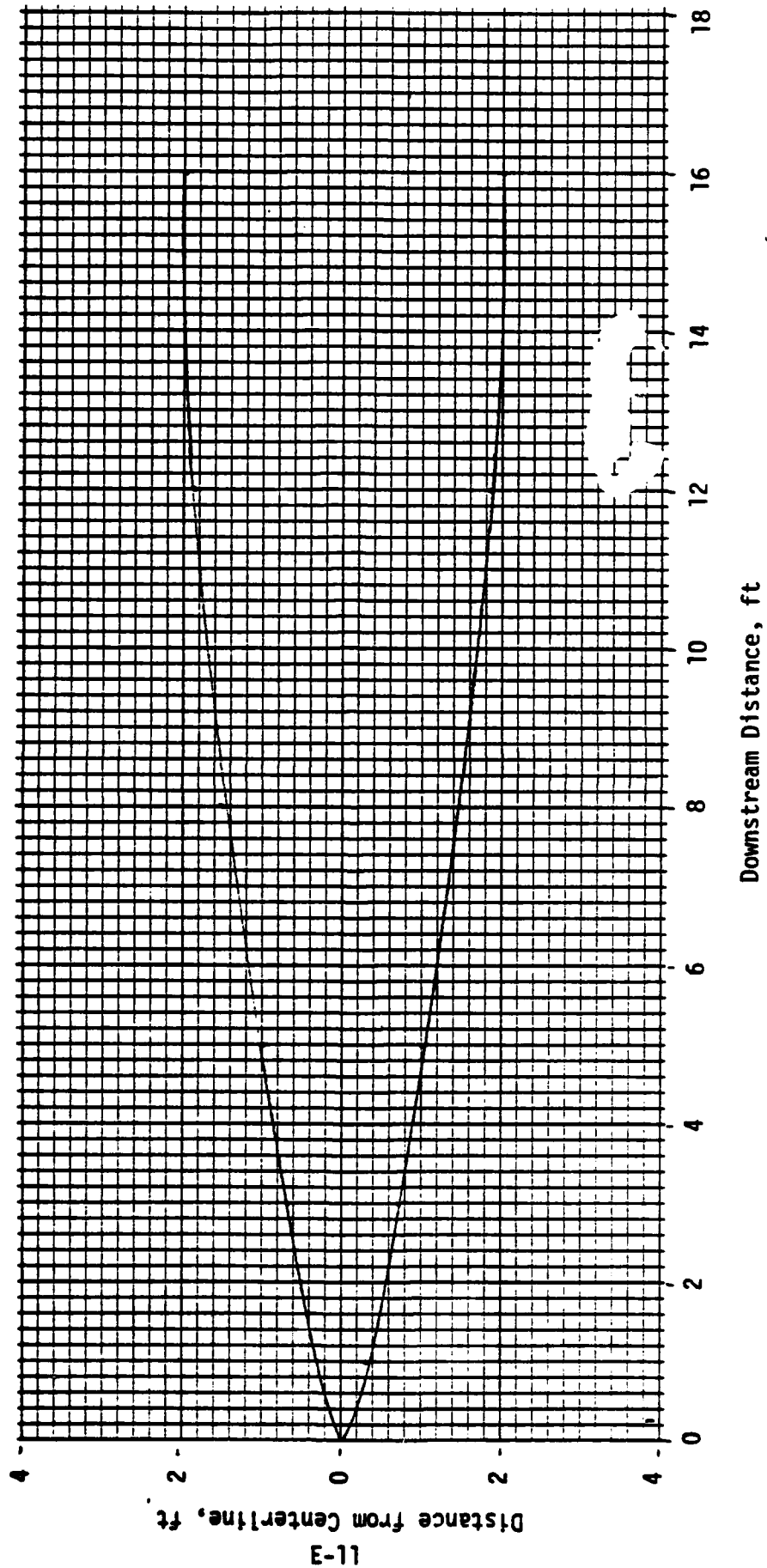
6-3

RUN NUMBER V.3-1



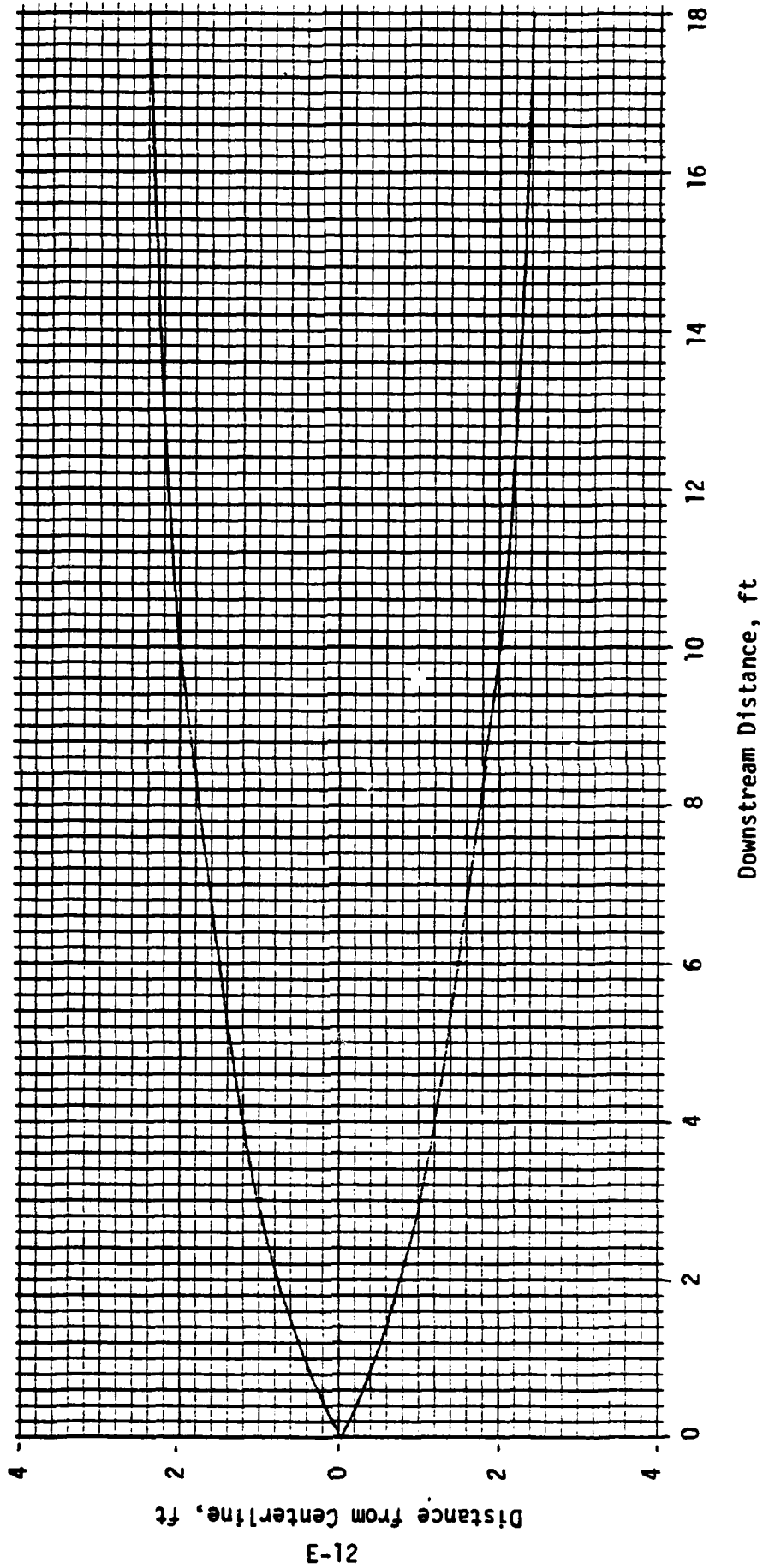
01-3

RUN NUMBER V.3-2



11-3

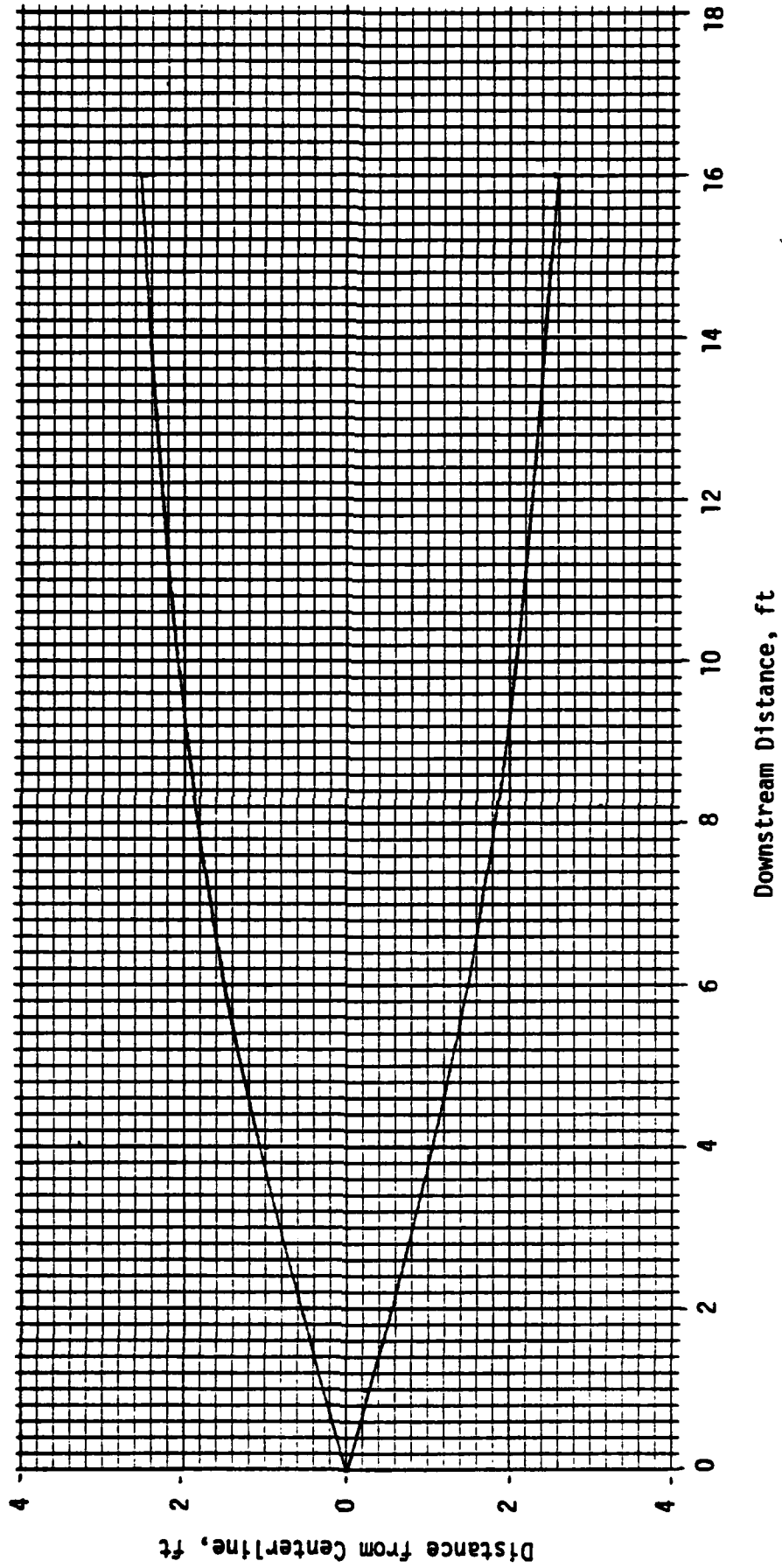
RUN NUMBER V.3-3



21-3

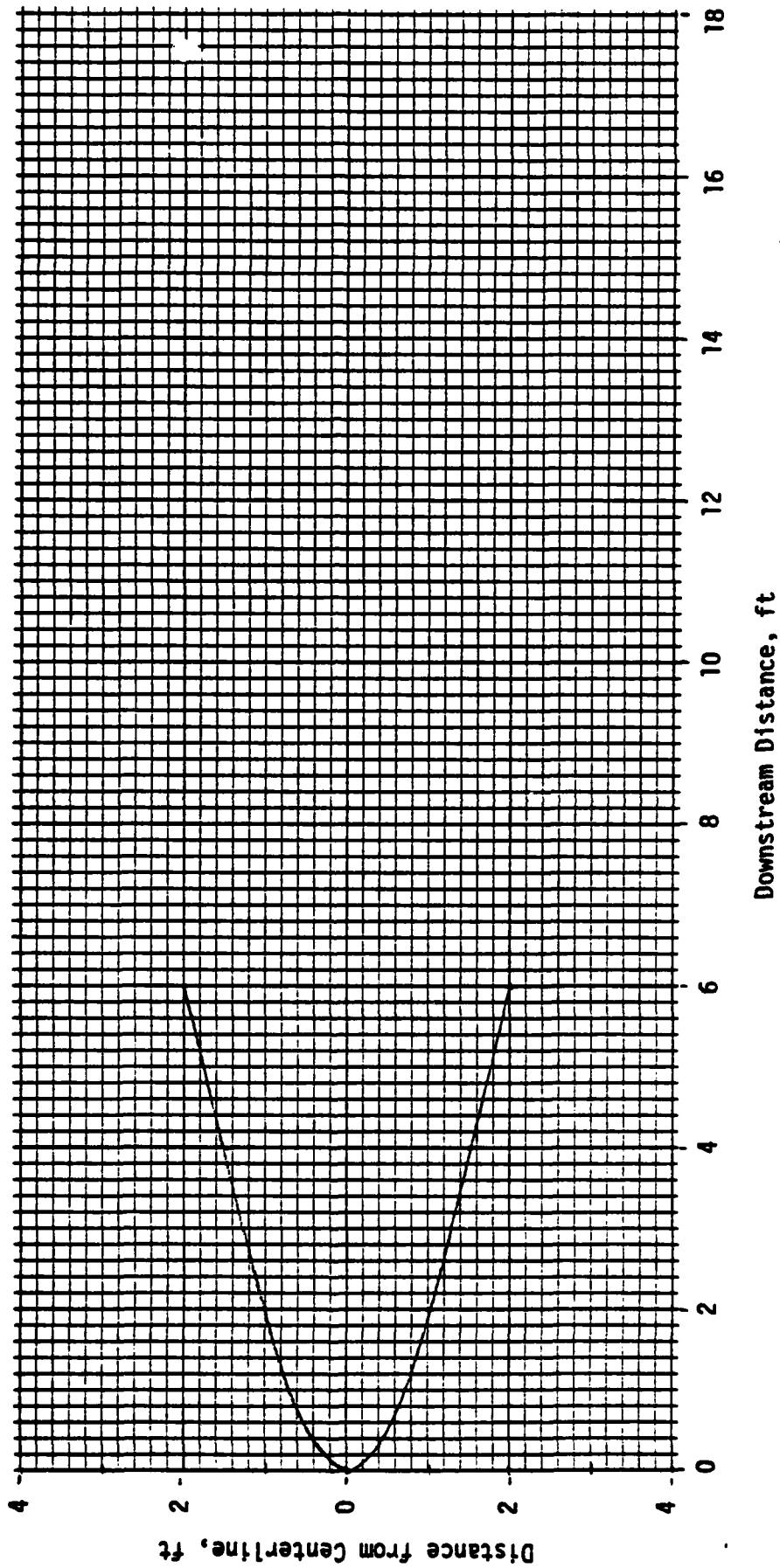


RUN NUMBER V.3-4



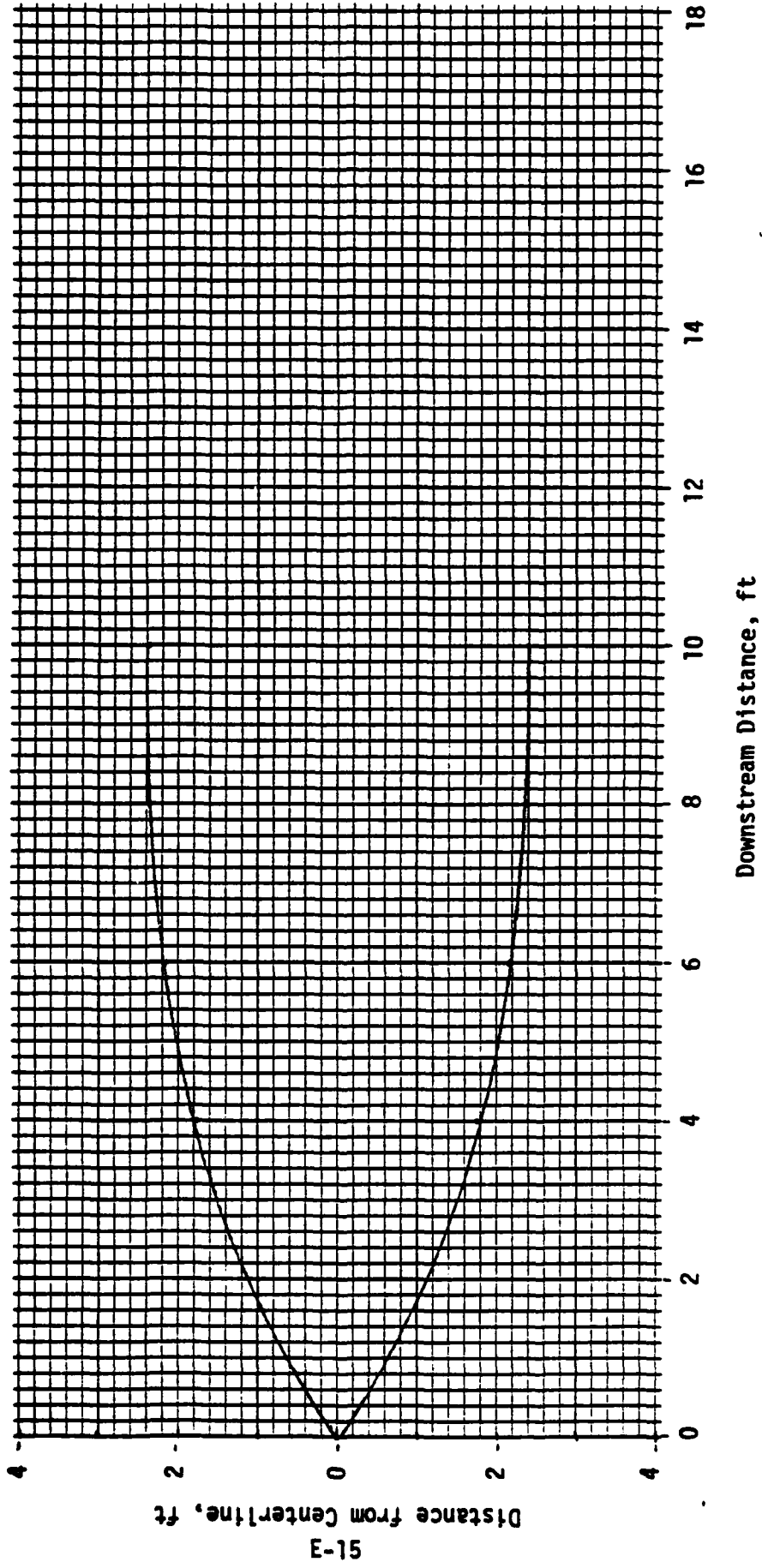
31-3

RUN NUMBER V.4-1



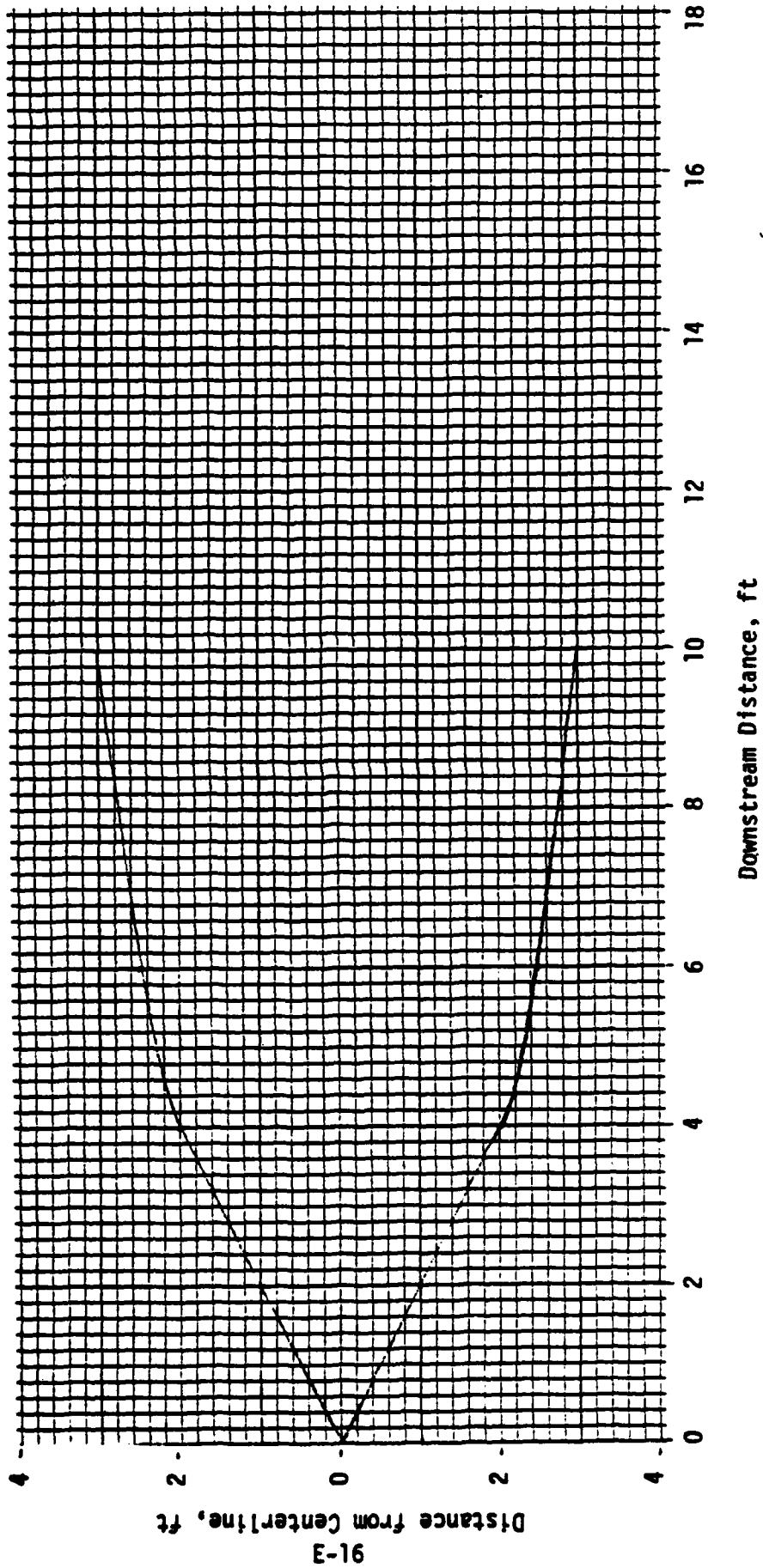
41-3

RUN NUMBER V.4-2



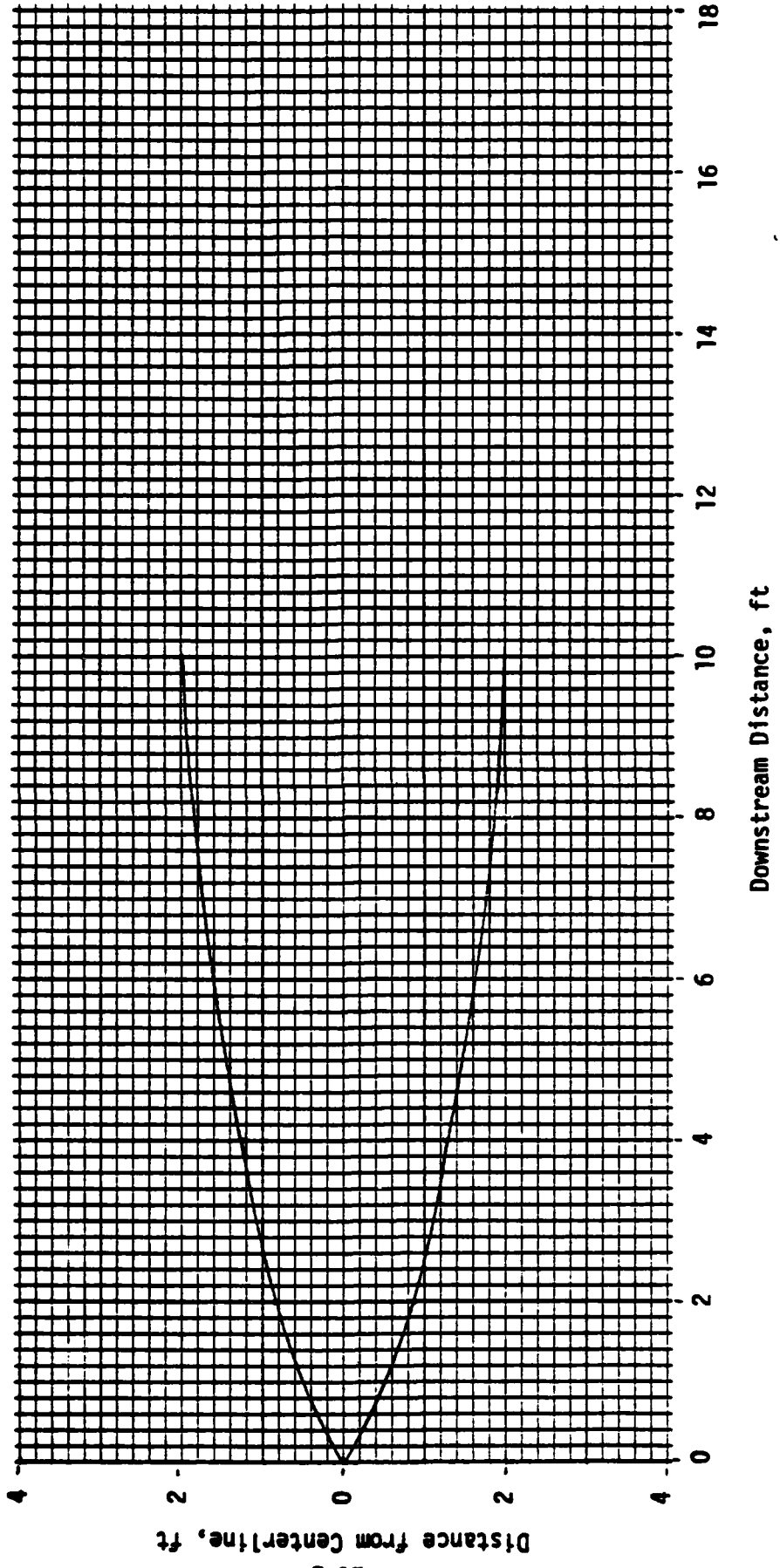
51-3

RUN NUMBER V.4-3



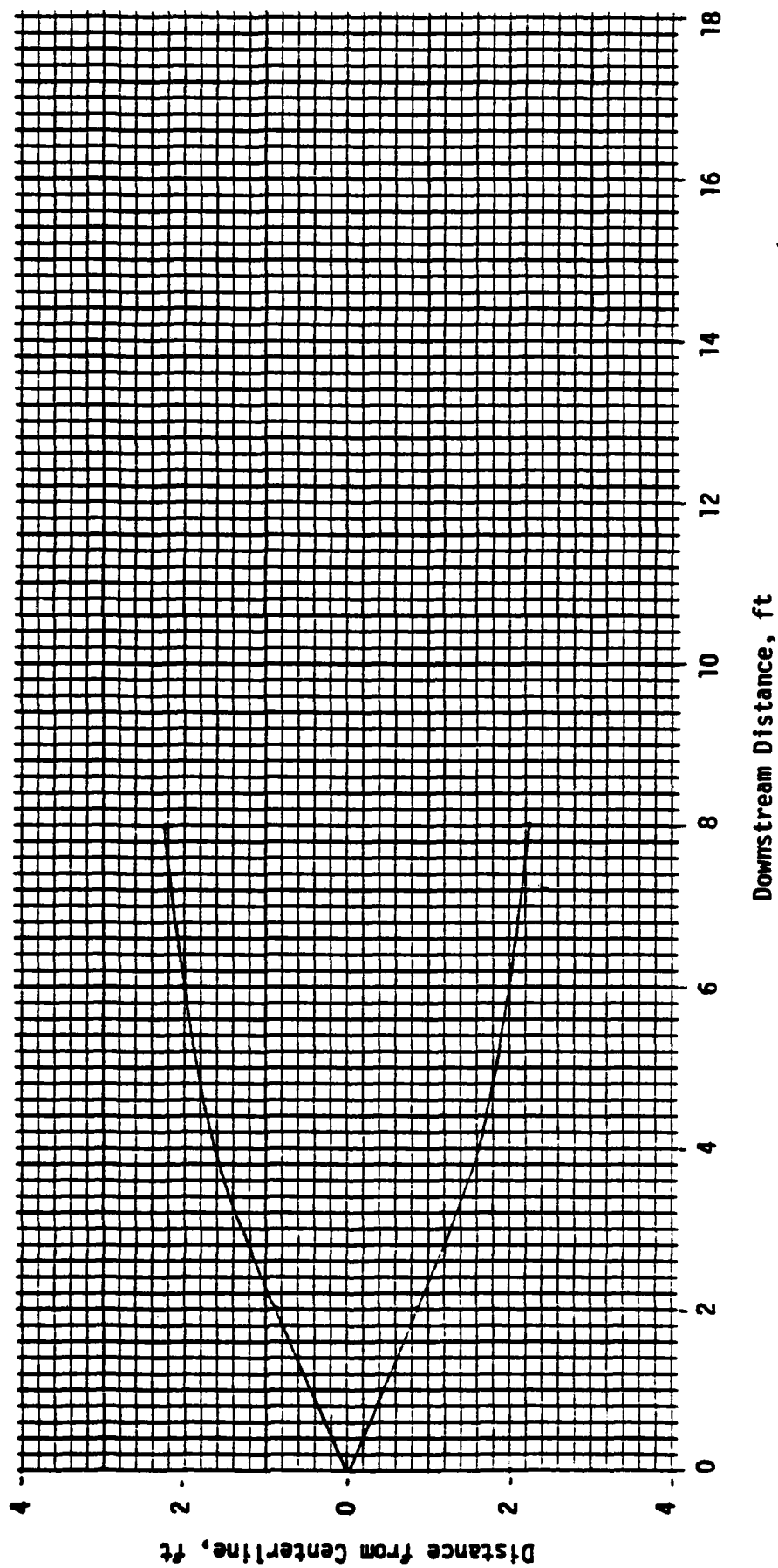
91-3

RUN NUMBER V.4-4



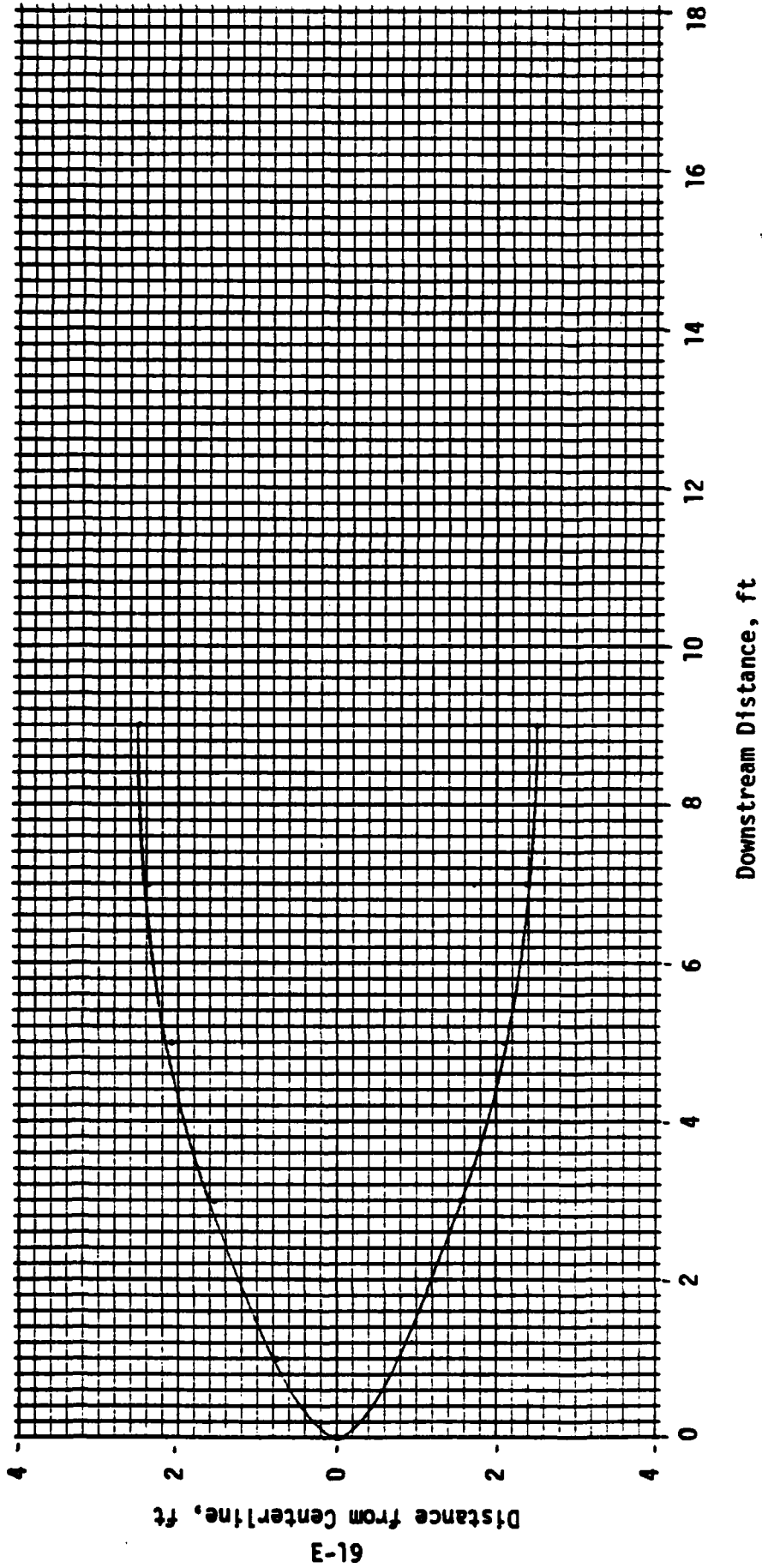
71-3

RUN NUMBER V.4-5

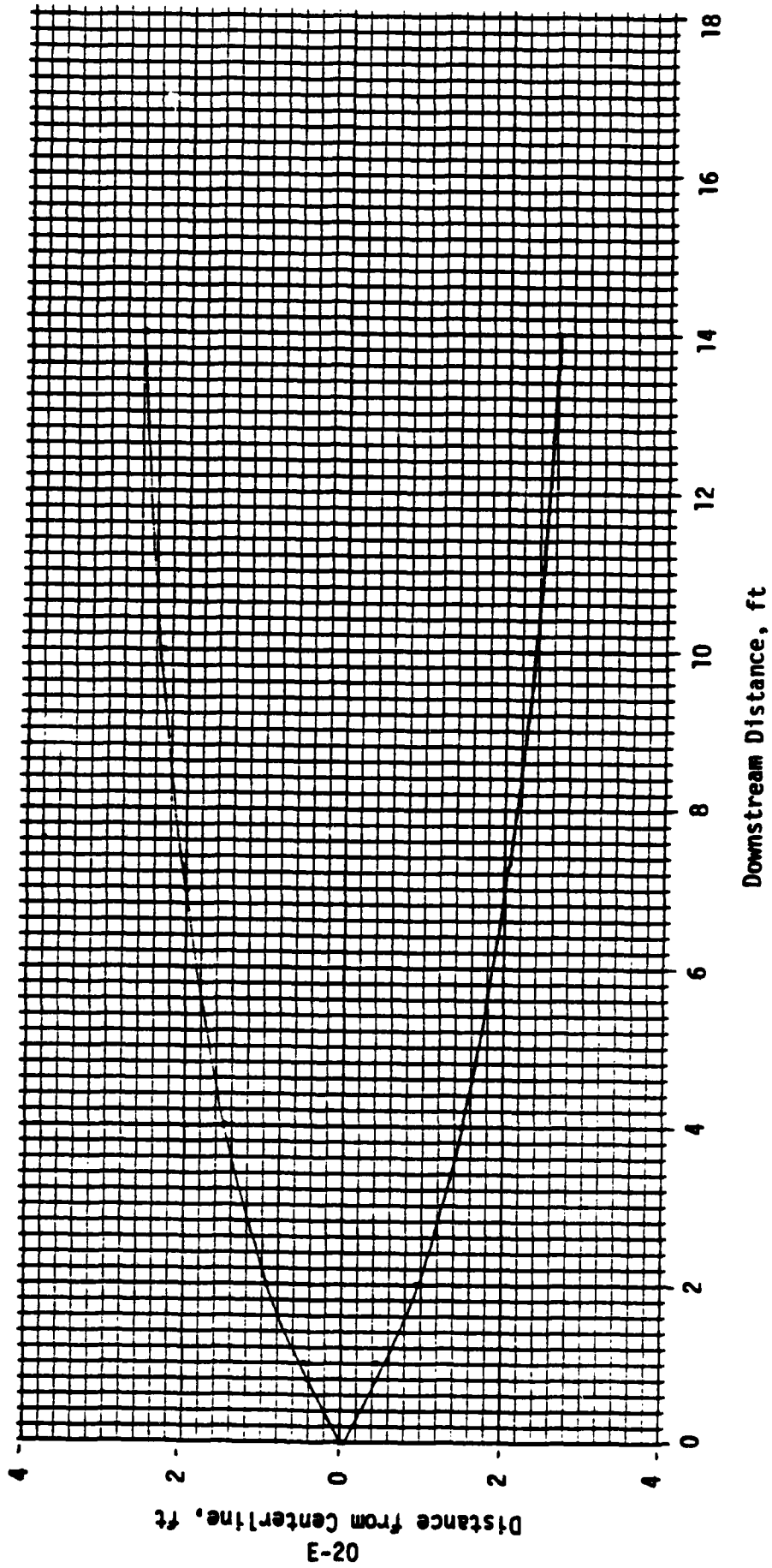


81-3

RUN NUMBER V.5-1

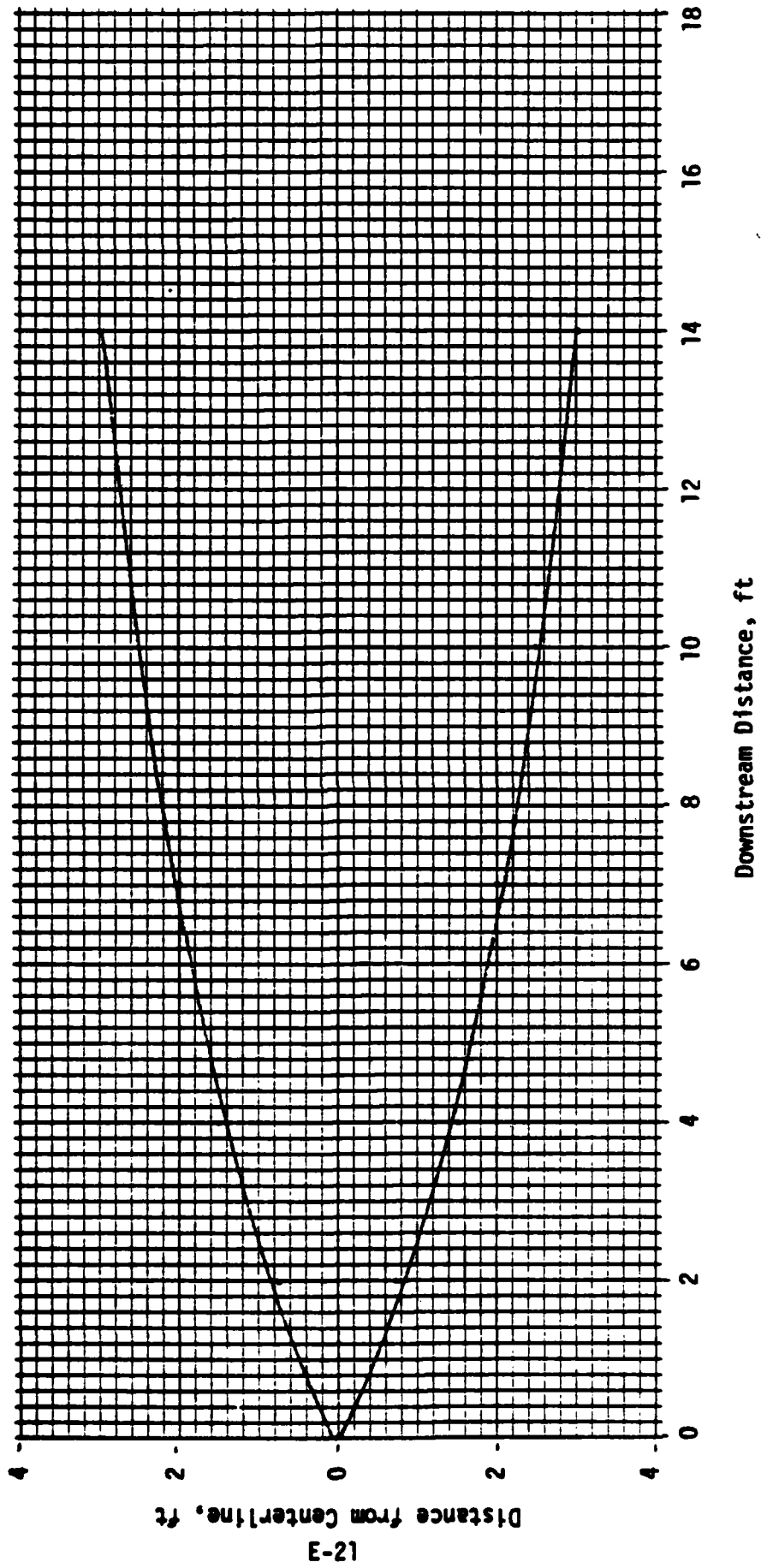


RUN NUMBER V.5-2



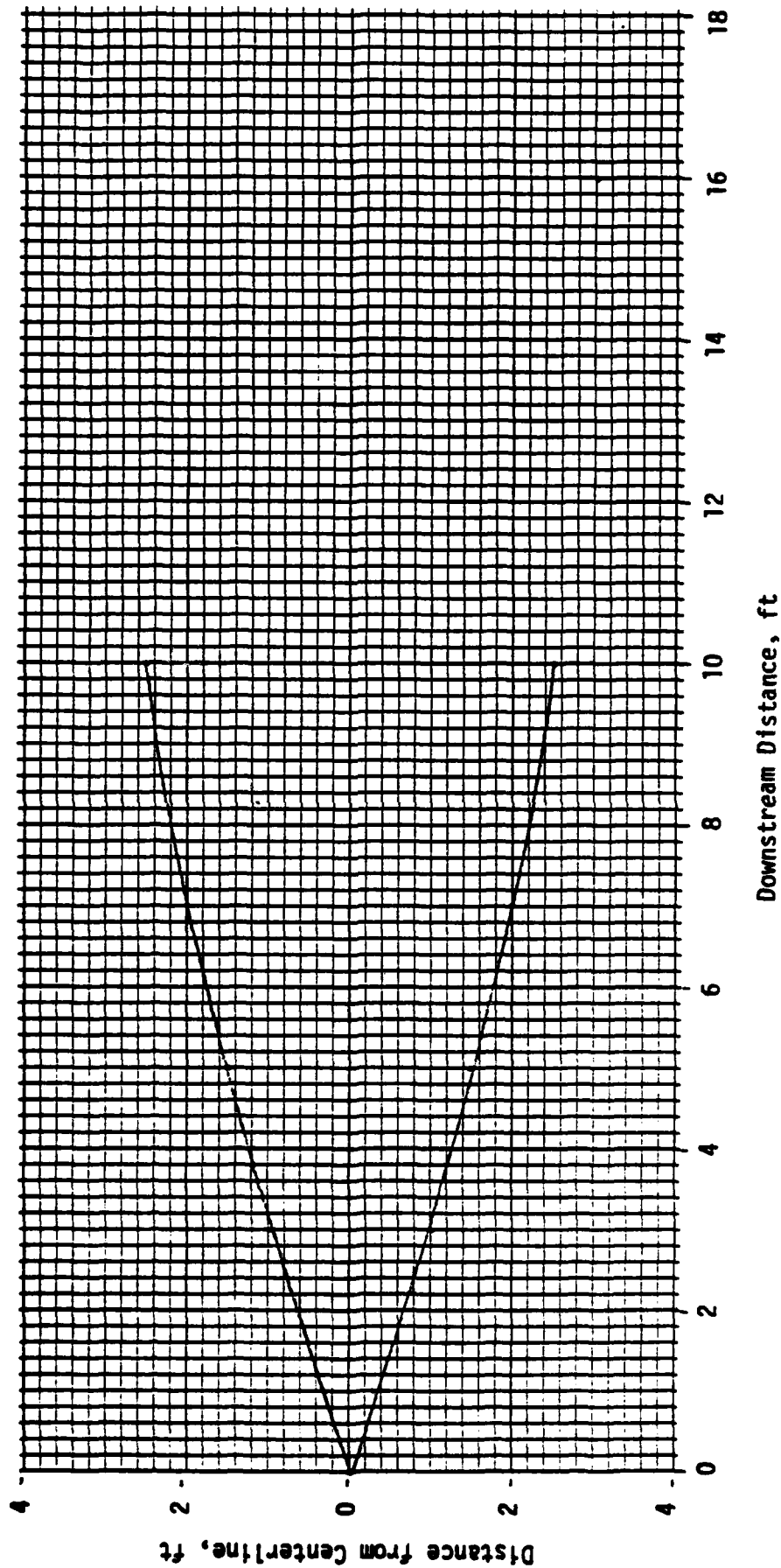


RUN NUMBER V.5-3



12-3

RUN NUMBER V.5-4



22-3

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