

TECHNICAL REPORT

NASA CR-

141491

COMPARISON OF MX-857 versus MX-641 CHEMISTRIES
for
TYPE 2485 FILM

Prepared Under
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(Contract NAS 9-11500)

Written by

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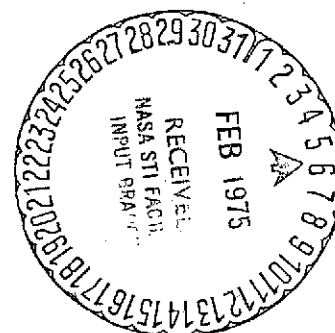
Photographic Technology Division
National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas



Technicolor Graphic Services, Inc.

Comparison of MX-857 versus MX-641 Chemistries
for
Type 2485 Film

This Report has been reviewed
and is approved.



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SUMMARY

Tests were conducted to evaluate Kodak MX-857 and MX-641 chemistry systems for use with Film Type 2485 to be used in the dim light experiments on Apollo 16.

The test program objectives were:

1. Retain a minimum ASA speed of at least 4000.
2. Maintain a base-plus-fog level of 0.21 density units or less.
3. Minimize the granularity but do not exceed the granularity level of the Apollo 15 imagery.

All tests in this series were conducted on the Versamat black and white processor and/or the Hi-Speed color processor reconfigured for black and white film.

Tests results on the Versamat processor indicate that the use of MX-857 chemistry is preferred over MX-641 chemistry in satisfying the stated test objectives. Additional tests showed that the MX-857 chemistry used in the Hi-Speed processor gave results comparable to those obtained for the same chemistry in the Versamat.

Comparison tests were also run with the chemistry-machine configuration (D-19/Hi-Speed processor) used for the Type 2485 film from the Apollo 15 mission. Results of these tests indicate that no advantage would be gained by utilizing MX-857 chemistry rather than D-19 chemistry.

SECTION I

INTRODUCTION

Certification requirements for Apollo Flight Film Type 2485 to be used in the dim light experiments on AS-16 are:

1. Retain a minimum ASA speed of at least 4000.
2. Maintain a base-plus-fog level of 0.21 density units or less.
3. Minimize the granularity but do not exceed the granularity level of the Apollo 15 imagery.

Prior to certification of a processor chemistry-machine configuration for Film Type 2485, a series of tests were undertaken to evaluate Kodak chemistry systems, MX-857 and MX-641.

Further tests were undertaken to compare the results of this evaluation with the certification configuration which had been used for the same film type from the previous Apollo mission.

SECTION II

TEST PROCEDURES

In order to perform the evaluation, a time-gamma series was run utilizing the prime Apollo mission processing machines for Film Type 2485, i.e. the Kodak Versamat 11C-M and the Hi-Speed Color Processor (converted to a black and white configuration). Recommended procedures by Kodak for MX-857 chemistry in a Versamat 11C-M processor were used for a range of transport speeds and temperatures in each machine, to determine the operational parameters for the test. Table I depicts the process parameters chosen. Where possible, each variable was cross-matched for full testing.

Although not shown in Table I, previous data obtained in the Hi-Speed processor concerning D-19 chemistry was correlated with the results obtained from the MX-857 test runs.

TABLE I
PROCESS PARAMETERS

Processor	Versamat	Hi-Speed
Configuration	1 tank; 2 tanks	Black and white
Developer	MX-857; MX-641	MX-857
Process Time	3,4,5,6,8 fpm	7,8,9 minutes
Developer Temps.	80°F., 90°F., 98°F.	80°F., 85°F., 90°F.

SECTION III

RESULTS AND CONCLUSIONS

A. Results

Versamat Process:

Figures 1 and 2 represent the results obtained by using the recommendations from Kodak on processing Film Type 2485 in MX-857 developer in a Versamat 11C-M processor (Figure 3). The test results do not correlate with the base line data supplied to PTD. The most dramatic deviations are that the process gammas are higher and base-plus-fog characteristics are lower for the "equivalent" machine speeds and temperature. Without further information from Kodak, the most obvious conclusion is that the differences are primarily due to the different emulsions and the variability between processing machines.

The results of the MX-641 developer tests (Figures 4 and 5) for the same temperature and processor speeds, indicate that the use of MX-857 is preferable. The resultant higher base-plus-fog for equivalent gammas with a slightly higher toe speed is not an acceptable factor, since the majority of the experimental imagery is recorded in the toe region of the D-Log E curve. The granularity comparison (Figure 9) of the two process systems again supports the use of MX-857 in a Versamat for this emulsion batch of Type 2485 Film.

Hi-Speed Process:

Since two of the three format sizes of Film Type 2485 on previous Apollo missions has been processed in D-19 chemistry in the Hi-Speed film processor, it was necessary that the new developer be evaluated in this machine as well. Comparative results were obtained between D-19 and MX-857. Both processing machines were also compared, since the particular film type and format size tested was compatible with both processors.

The Hi-Speed/MX-857 test results were again different, as expected, from those published by Kodak as base line data. Since the Hi-Speed processor has a mechanical drive characteristic which limits processing time variations, the times used were based on "nominal" processing conditions for Apollo films in D-19 chemistry.

Figures 1 and 6 show the differences between the processors. The gradual changes in gamma (Figure 7) for changes in process time were due to the minimal changes in agitation rates.

Time requirements precluded a full time/gamma series in D-19 or MX-641 chemistries in the Hi-Speed processor. Figure 8 represents the D-19 data obtained from the Apollo 16 Film Type 2485 certification tests. The results indicate a trend similar to that observed with MX-857 in changes in gamma as a result of process time changes.

Microdensitometry scans at similar density levels on the D-19 and MX-857, Hi-Speed processed strips (Figure 9) display similar grain characteristics.

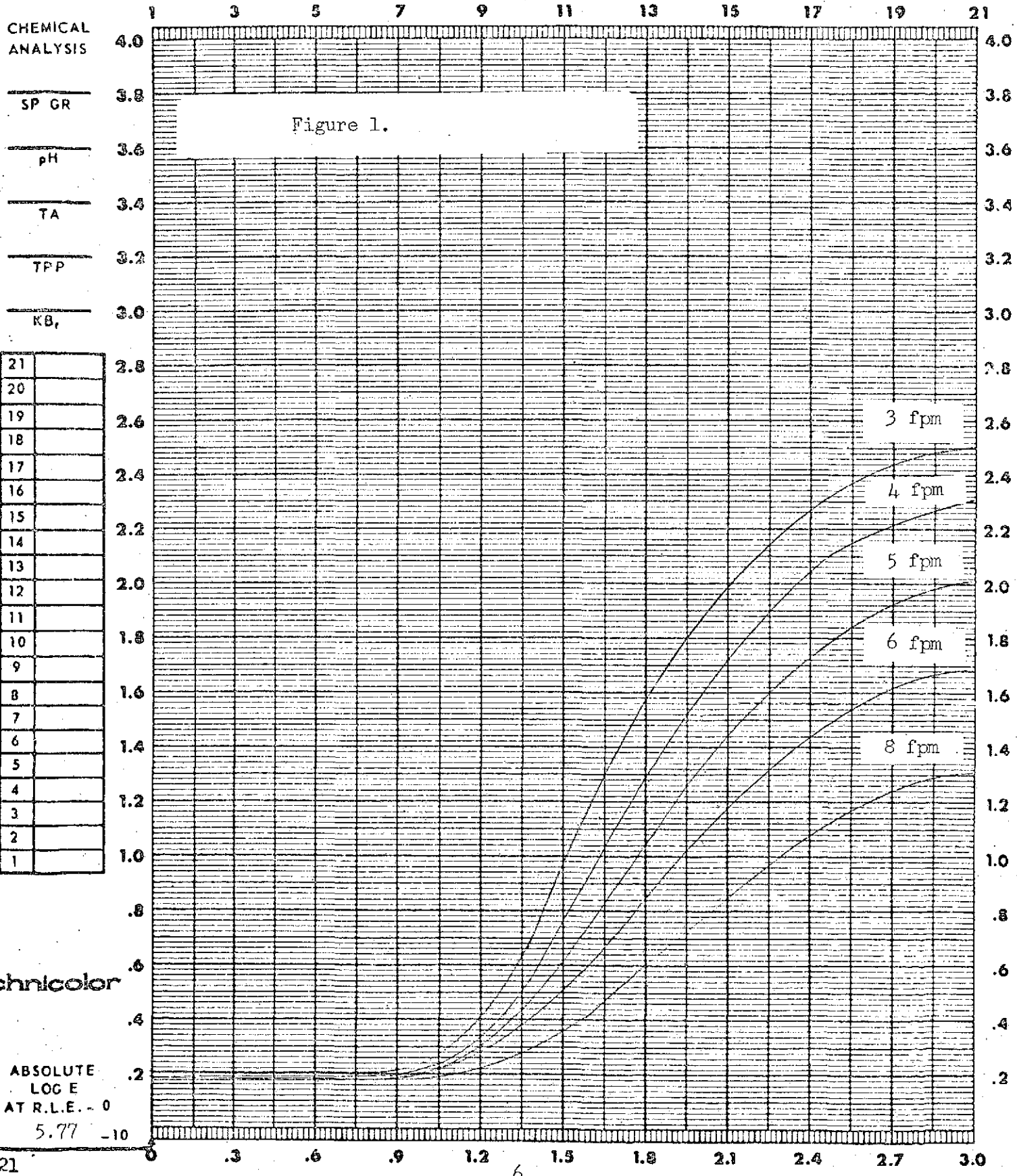
B. Conclusion

In the final analysis, the results obtained with this emulsion of 2485 as processed in MX-857 are favorable and comparable with those obtained using D-19 in the Hi-Speed processor; these results are much more acceptable than MX-641 in the Versamat 11C-M processor. Due to the other black and white flight films, which are to be processed in the Hi-Speed processor incorporating D-19 chemistry, and since both chemistries yielded similar results under the test conditions, it has been decided to retain the D-19 developer as the prime chemistry for Film Type 2485.

C. Recommendation

With each emulsion of Type 2485 film that PTD receives for future missions, it is recommended that similar analysis be repeated to determine the optimum process conditions.

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	<u>I-B</u>	PROCESSOR	<u>Versamat 11C-M</u>	INSTRUMENT	<u>MacBeth</u>
ILLUMINANT	<u>2850 °K</u>	CHEMISTRY	<u>MX-857</u>	TYPE	<u>TD217DR</u>
TIME	<u>1/100</u> SEC.	SPEED	<u>2</u>	TANKS	_____
FILTER	<u>5500+SCW+1.0 ND</u>	TEMP °F	<u>98</u>	FPM	_____
		TIME	_____	APERTURE SIZE	<u>2</u> MM
				FILTER	<u>Visual</u>
				SPEED ()	_____
				D-MAX	_____
				GAMMA	_____
				BASE + FOG	_____



BEE 20x20 TO INCH

MERSAMAT FILM
CHEMISTRY - MX-857
Temperature - 98°F
60°F
80°F

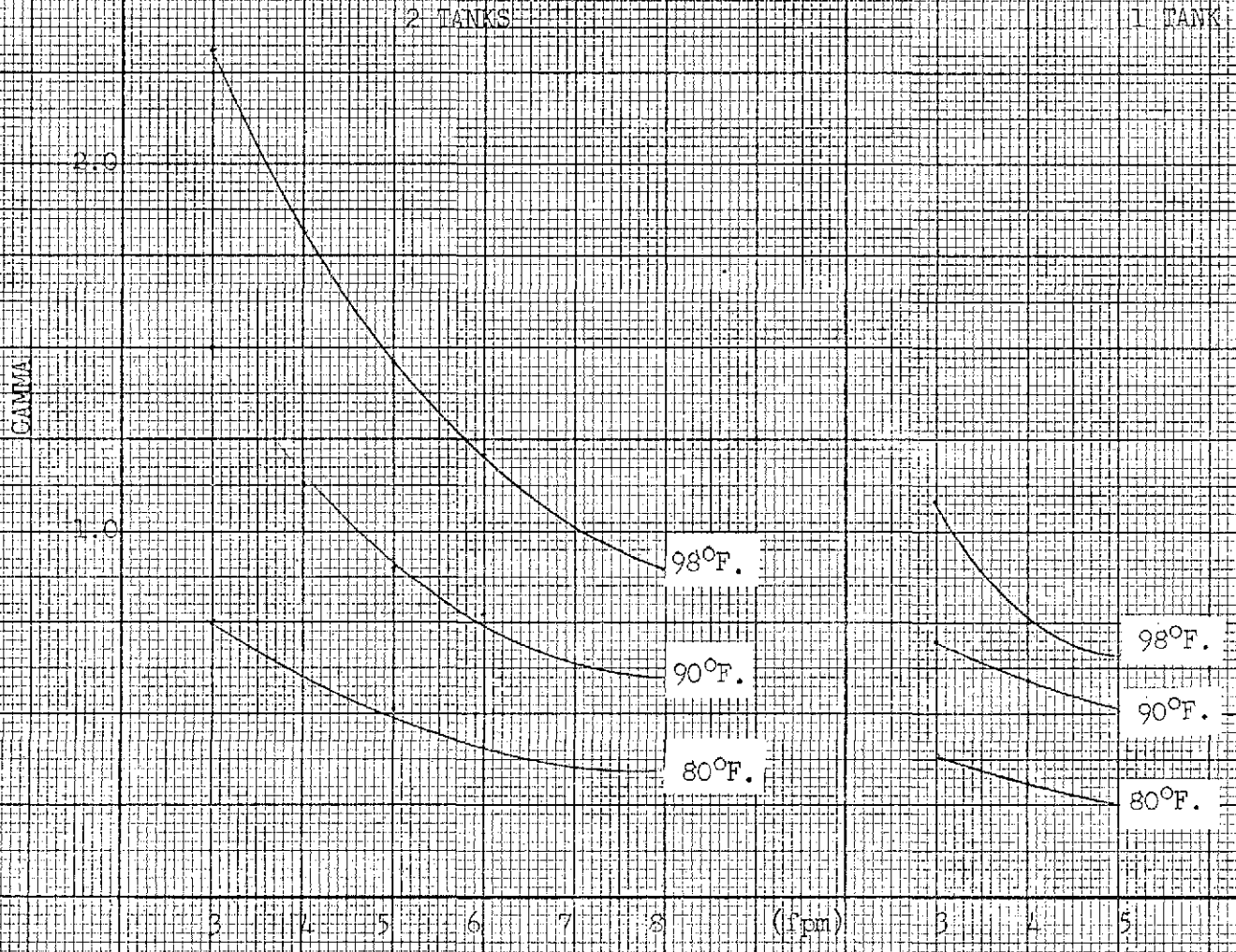
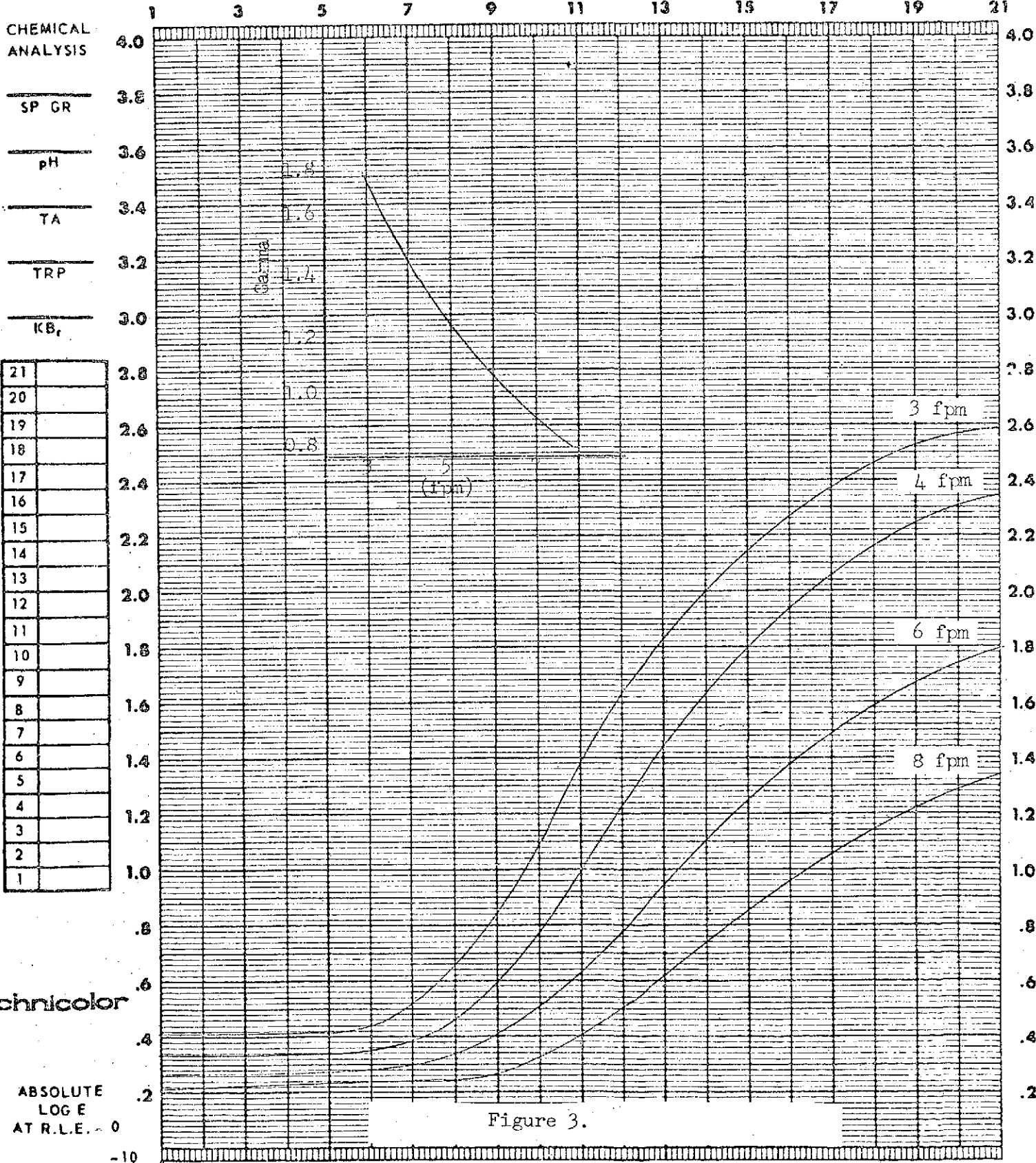


Figure 2.

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER _____	PROCESSOR <u>Versamat 11C-M</u>	INSTRUMENT _____	SPEED () _____		
ILLUMINANT _____ "K	CHEMISTRY <u>MX-857</u>	TYPE _____	D-MAX _____		
TIME _____ SEC.	SPEED <u>2</u> TANKS _____ FPM	APERTURE SIZE _____ MM	GAMMA _____		
FILTER _____	TEMP °F <u>98</u> TIME _____	FILTER _____	BASE + FOG _____		



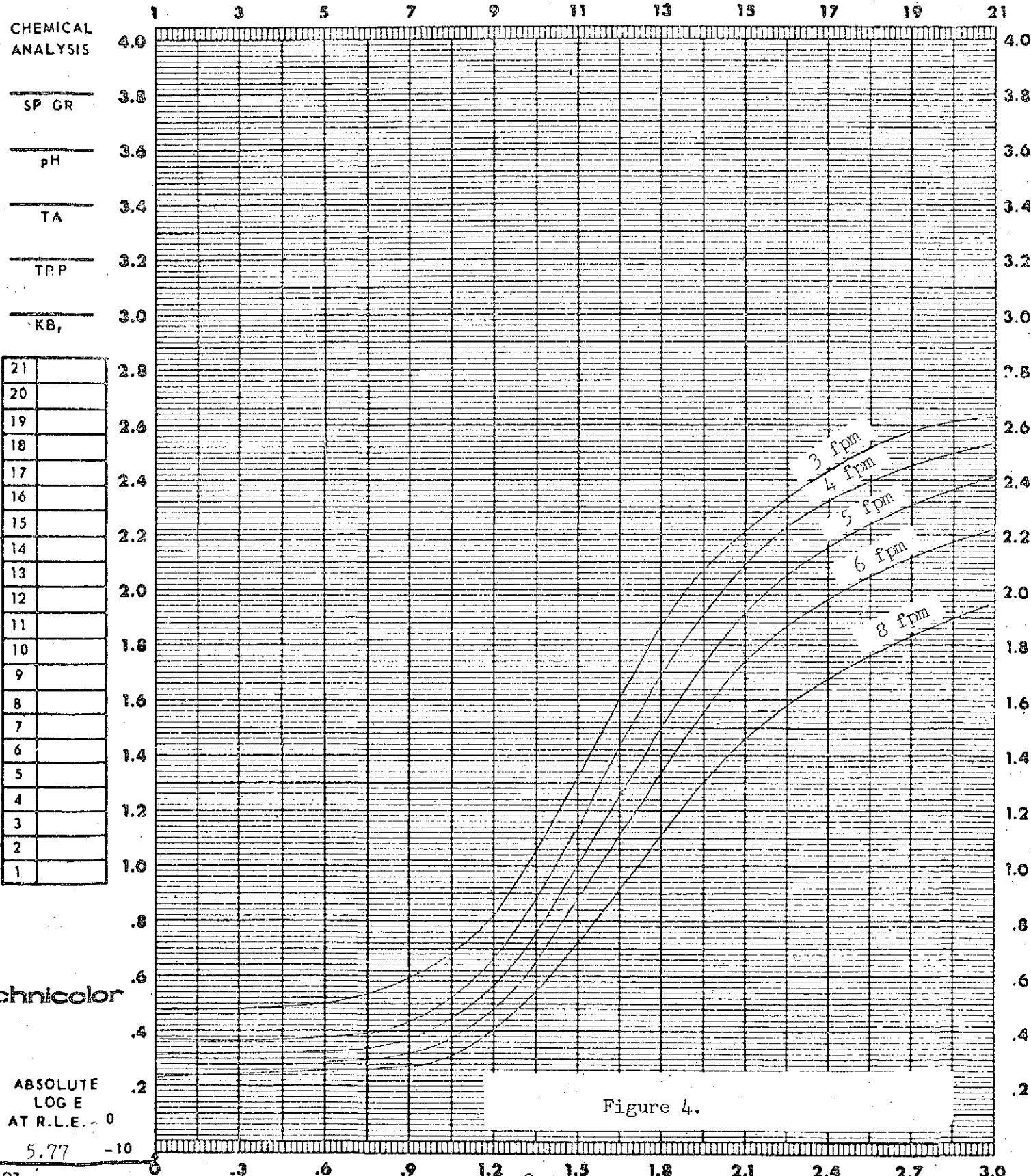
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ABSOLUTE LOG E AT R.L.E. = 0

Figure 3.

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	<u>I-B</u>	PROCESSOR	<u>Versamat</u>	INSTRUMENT	<u>MacBeth</u>
ILLUMINANT	<u>2850 K</u>	CHEMISTRY	<u>MX-641</u>	TYPE	<u>TD217DR</u>
TIME	<u>1/100 SEC.</u>	SPEED	<u>2</u>	TANKS	_____ FPM
FILTER	<u>5500+SCW+1.0ND</u>	TEMP °F	<u>98</u>	TIME	_____
				APERTURE SIZE	<u>4</u> MM
				FILTER	<u>Visual</u>
				SPEED ()	_____
				D-MAX	_____
				GAMMA	_____
				BASE + FOG	_____



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ABSOLUTE LOG E
AT R.L.E. = 0
5.77 -10

VERSAMAT FIC-M
CHEMISTRY MX-641
Temperature: 98°F
80°F
80°F

2 TANKS

1 TANK

GAMMA

2.0

1.0

98°F.

90°F.

80°F.

98°F.

90°F.

80°F.

3

4

5

6

7

8

(rpm)

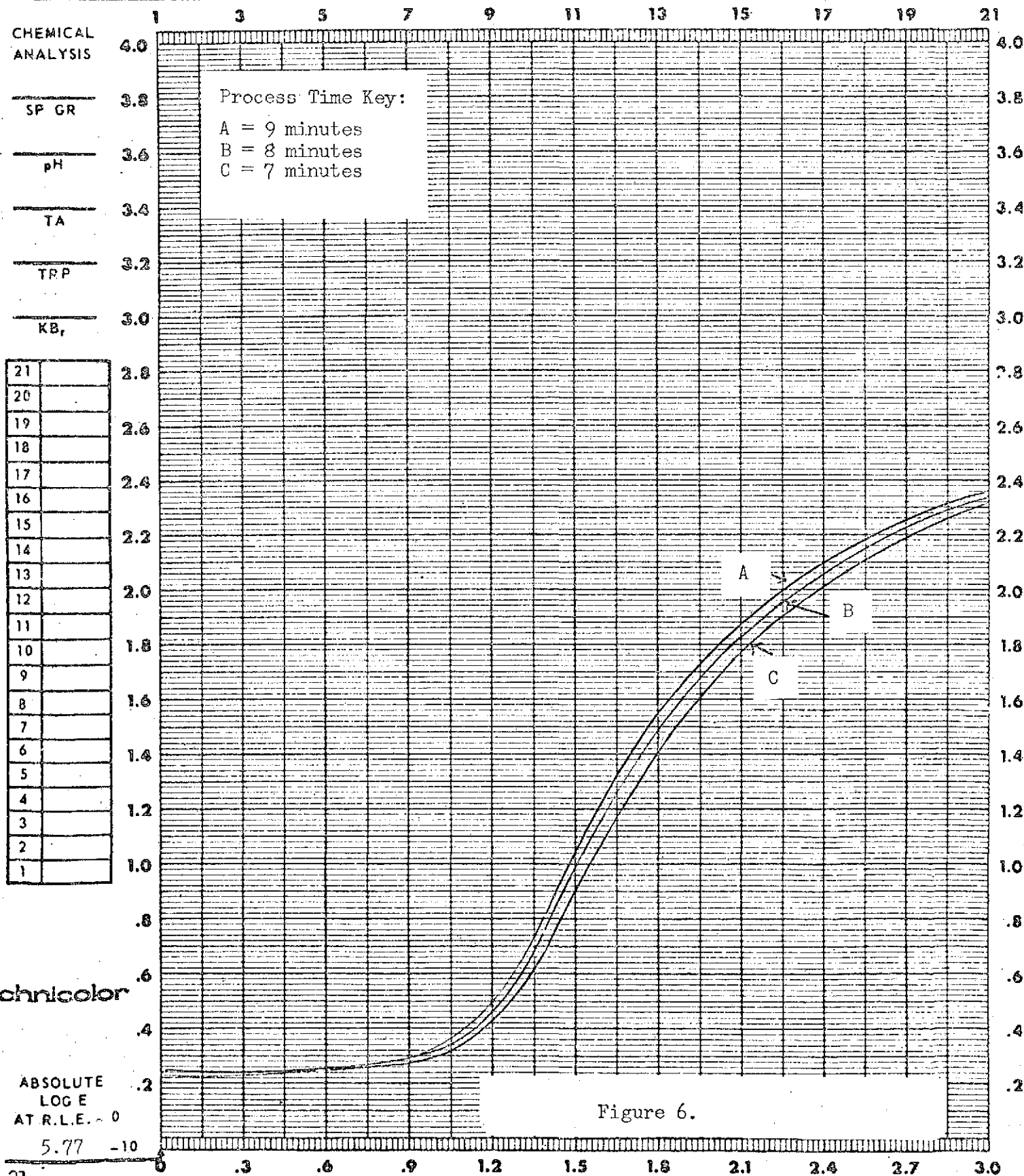
9

10

15

Figure 5.

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	<u>I-B</u>	PROCESSOR	<u>Hi-Speed</u>	INSTRUMENT	<u>MacBeth</u>
ILLUMINANT	<u>2850</u> K	CHEMISTRY	<u>MX-857</u>	TYPE	<u>TD217DR</u>
TIME	<u>1/100</u> SEC.	SPEED	TANKS	FPM	APERTURE SIZE
FILTER	<u>5500+SCW11 OND</u>	TEMP °F	<u>85</u>	TIME	<u>2</u> MM
				FILTER	<u>Visual</u>
					SPEED ()
					D-MAX
					GAMMA
					BASE + FOG



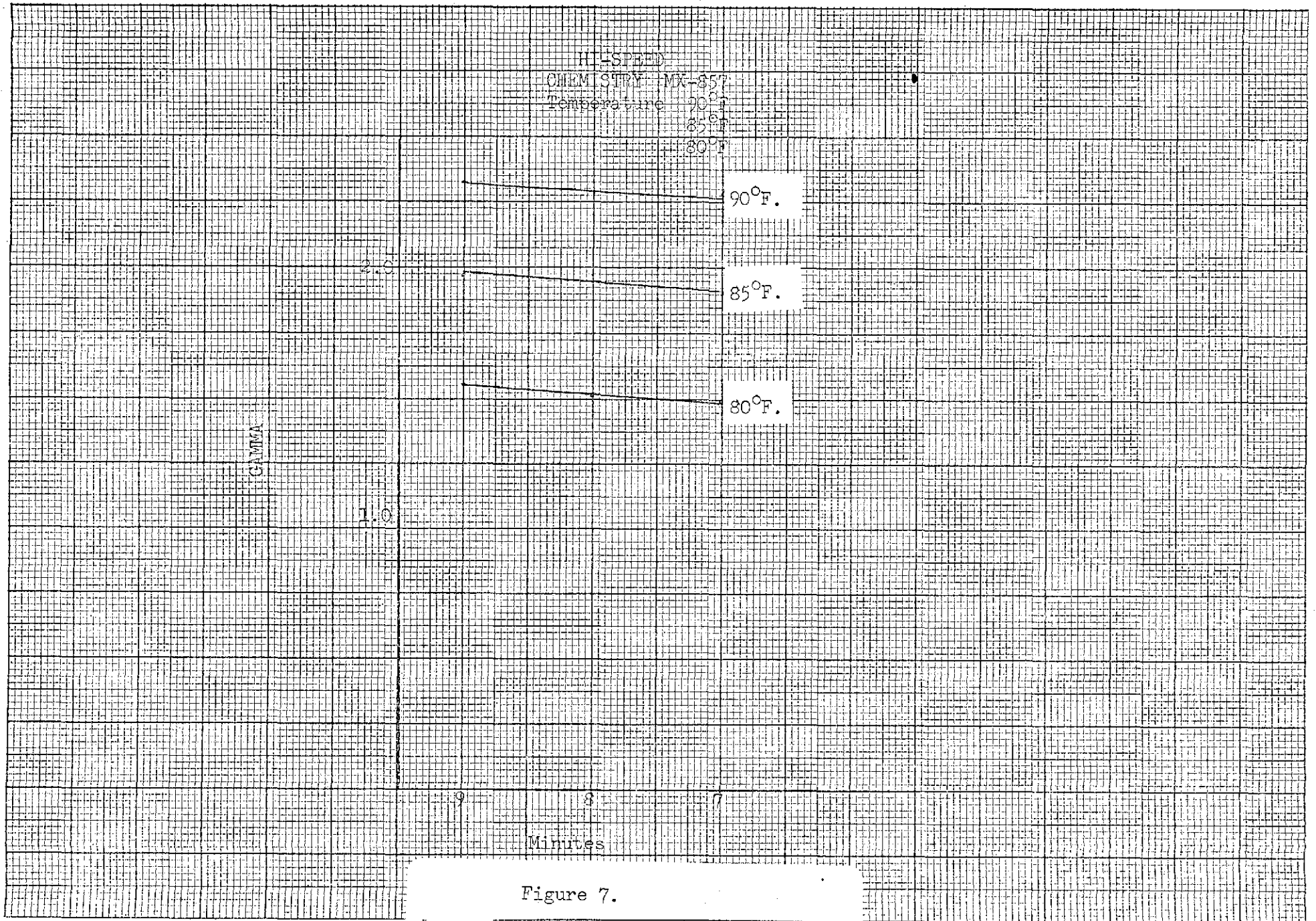


Figure 7.

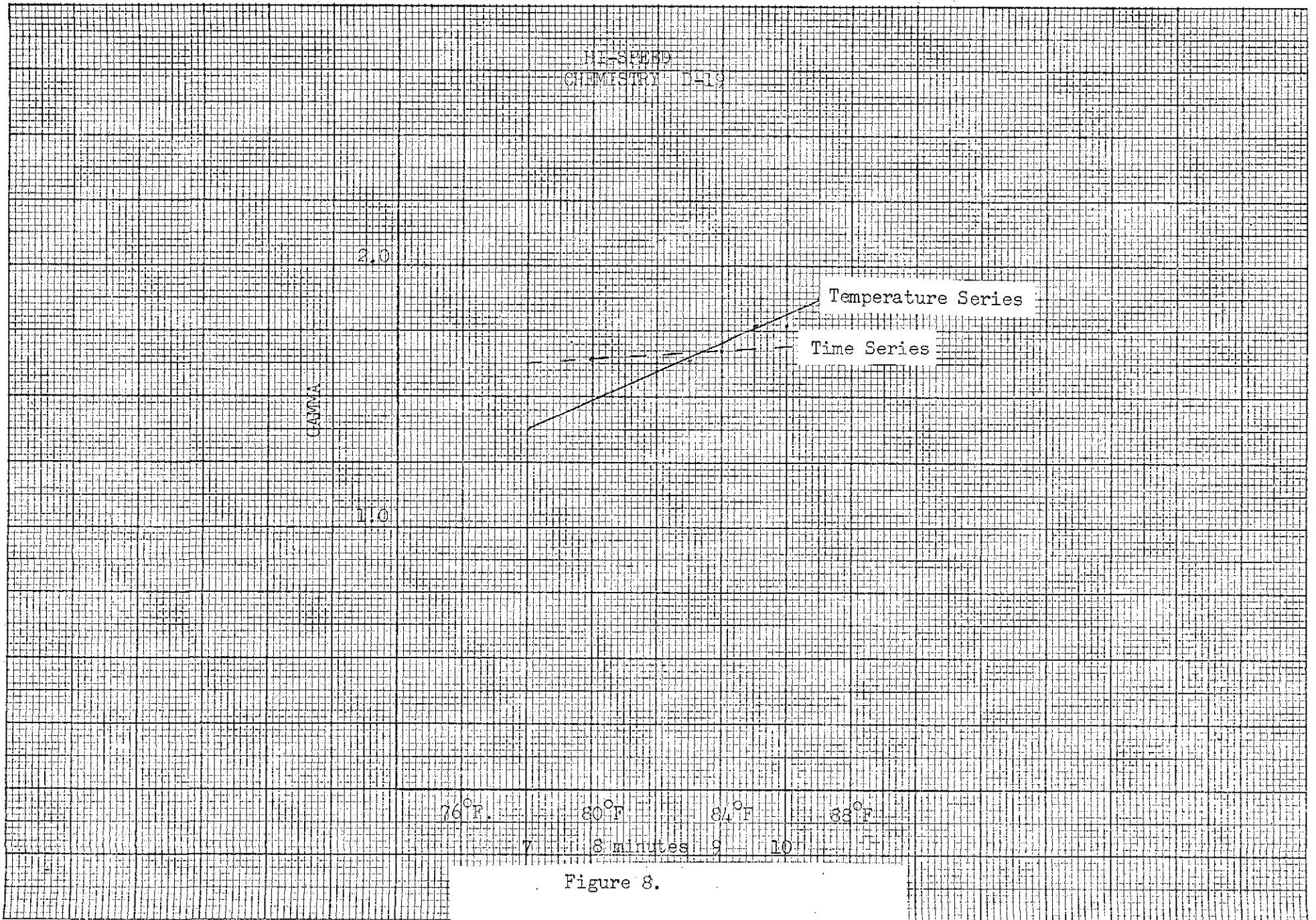


Figure 8.

SEE 20x30 TO INCH

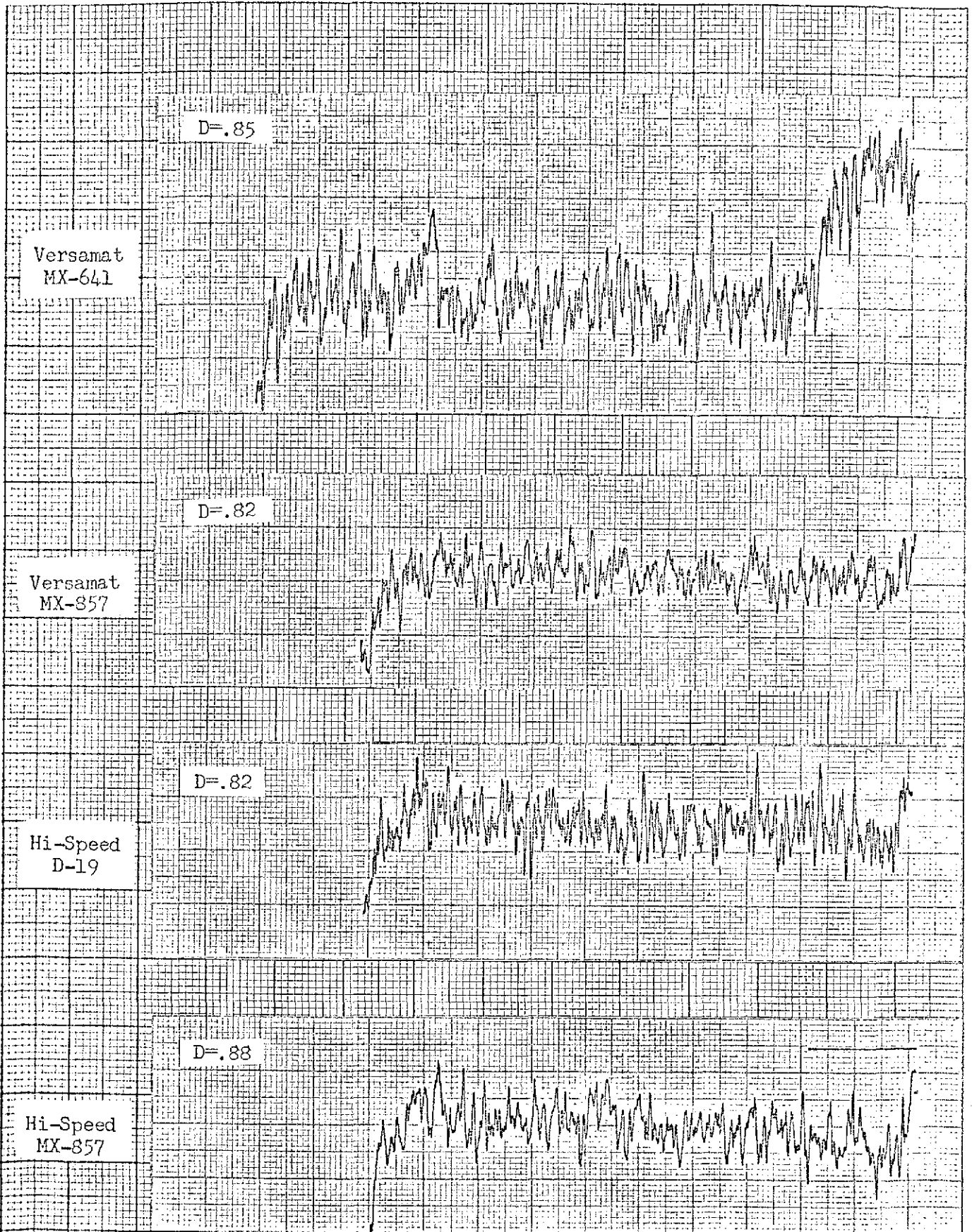


Figure 9. Joyce Loebel Microdensitometer
Traces - Slit Width 40μ