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INTERIM REPORT

FULTRON PROCESSING OF EARTH RESOURCES ORIGINAL FIIMS

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Prepared By

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Houston, Texas

Technicolor Graphic Services, Inc

FULTRON PROCESSING OF EARTH RESOURCES ORIGINAL FILMS

This report has been reviewed and

is approved.

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FULTRON PROCESSING OF EARTH RESOURCES ORIGINAL FILMS

A review has been conducted of the film/process combinations being used in the Earth Resources programs to determine if it is possible to reduce the number of original film processing controls.

The current multiband photography generally requires four separate black-and-white controls to attain a specified gamma for each film/filter combination. Additional control must be established for other black-and-white films flown. The common configuration for multiband photography is:

Film	Filter
2402	47B
2402	57
2402	25
2424	89B

Simultaneous processing of the three filter bands using 2402 film has given the following typical values of gamma:

Film	Filter	Gamma
2402	47B	1.2
2402	57	1.5
2402	25	1.6

This degree of deviation from equal gammas is unacceptable for multispectral photography.

Tests were conducted on film type SO-022 in the Fultron processors using both MX-641 and MX-819 chemistries. Gammas obtained with MX-641 were unacceptably high. The resultant gammas

for SO-022 with MX-819 chemistry and a common process control were:

Film	Filter	Gamma
SO-022	47B	1.60
SO-022	57	1.70
SO-022	25	1.75

The variation between gammas is less than 10% and should be acceptable for multiband use.

Type SO-022 film has finer grain, higher resolution, and slower speed than type 2402 film.

TABLE I

Film	RMS Granularity	Resolution (l/mm)		Speed (Nominal AFS)	
		1000:1	1.6:1	Versamat	Fultron
2402	30	112	50	140	140
SO-022	18	200	80	22	60

As can been seen from Table I, the normal Versamat processing for SO-022 is almost three stops slower than for the corresponding 2402 process. By processing in the Fultron with MX-819 chemistry, the speed loss is reduced to 1 1/2 stops.

With the present Earth Resources cameras, particularly the KA-62's, SO-022 processed in the Versamat does not have sufficient film speed for multispectral photography. The increased speed achieved in the Fultron process will allow the use of SO-022 for all normal black-and-white Earth Resources photography, including multiband.

An additional advantage of the Fultron processor is increased wash efficiency. The Versamat processor must be run at 25 feet per minute in order to achieve a suitable gamma for Earth Resources photography, thus leaving a greater amount of residual hypo in the film.

Testing is presently underway on film type FE 3215, a black-and-white infrared film from Eastman Kodak. This film has finer grain and better resolution than 2424, the black-and-white film presently in use.

Preliminary indications are that FE 3215 can be processed in the same configuration used to process SO-022. If this proves feasible, it would allow us to run all Earth Resources original black-and-white films in one long run in the Fultron.

RECOMMENDATIONS:

1. Convert to SO-022 film for all Earth Resources black-and-white photography. Processing must be done in the Fultron with MX-819 chemistry.

2. As soon as FE 3215 becomes available from Eastman Kodak, adopt this film as a replacement for 2424, if feasible.

3. Revise the standard black-and-white original process gamma to 1.60. This should be an acceptable compromise between the 1.40 gamma used for low altitude imagery and the 1.80 gamma used for high altitude. This gamma is also necessary in order to process SO-022 and FE 3215 together.

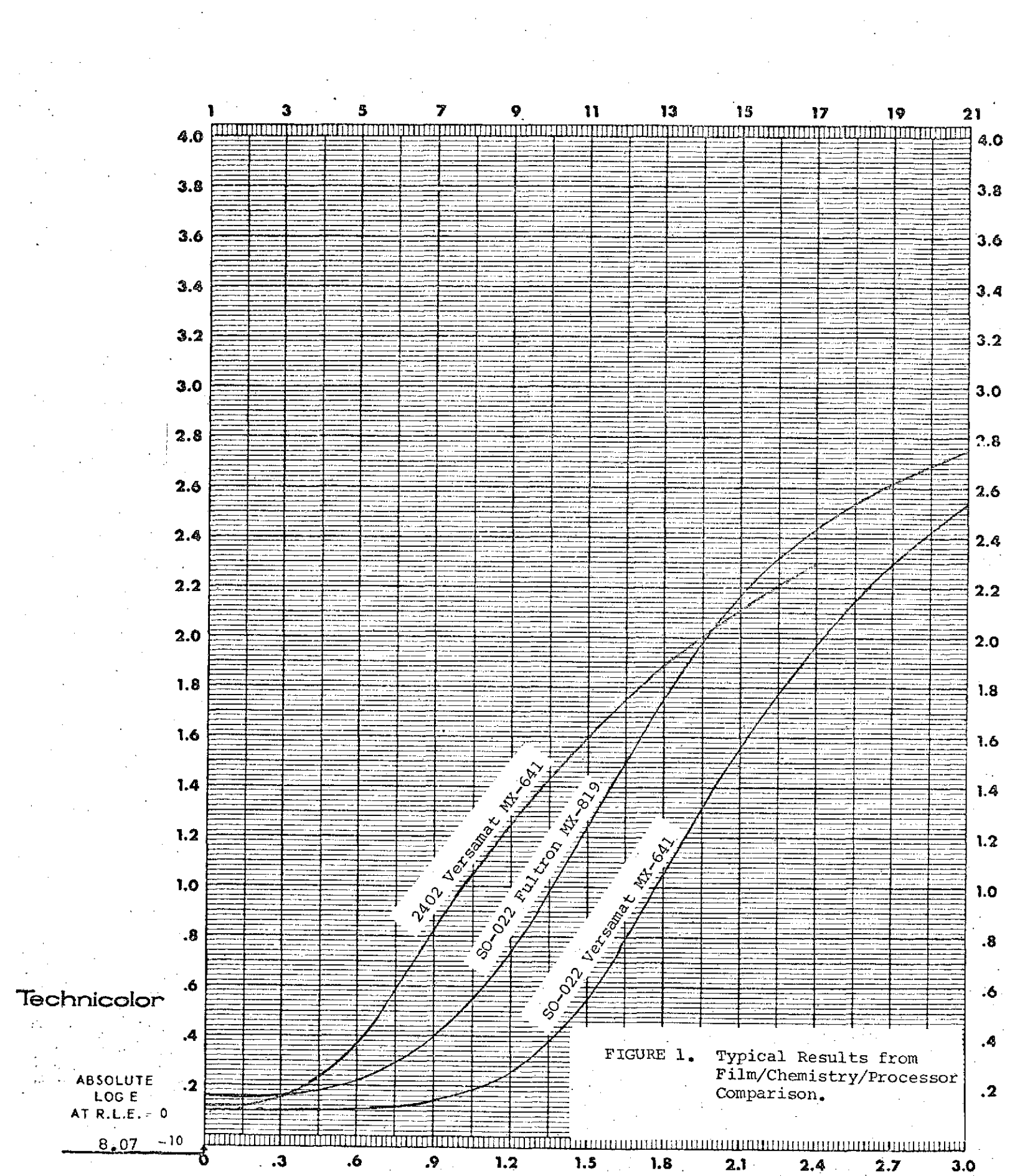

FIGURE 1. Typical Results from Film/Chemistry/Processor Comparison.

DATE _____ CONTROL # _____ TASK _____ PREPARED BY _____

FILM SO-022 EMULSION # _____ MFG _____ EXPIRATION DATE _____

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY			
SENSITOMETER	I-B	PROCESSOR	Fultron #2	INSTRUMENT	MacBeth	SPEED ( )	
ILLUMINANT	2850 °K	CHEMISTRY	MX-819	TYPE	Td217DR	D-MAX	
TIME	1/10 SEC.	SPEED	Full TANKS 5,10,15,20 FPM	APERTURE SIZE	2 MM	GAMMA	
FILTER	5500°K + W25	TEMP °F	85 TIME	FILTER	Visual	BASE + FOG	

CHEMICAL ANALYSIS

SP GR

pH

TA

TRP

KB_r

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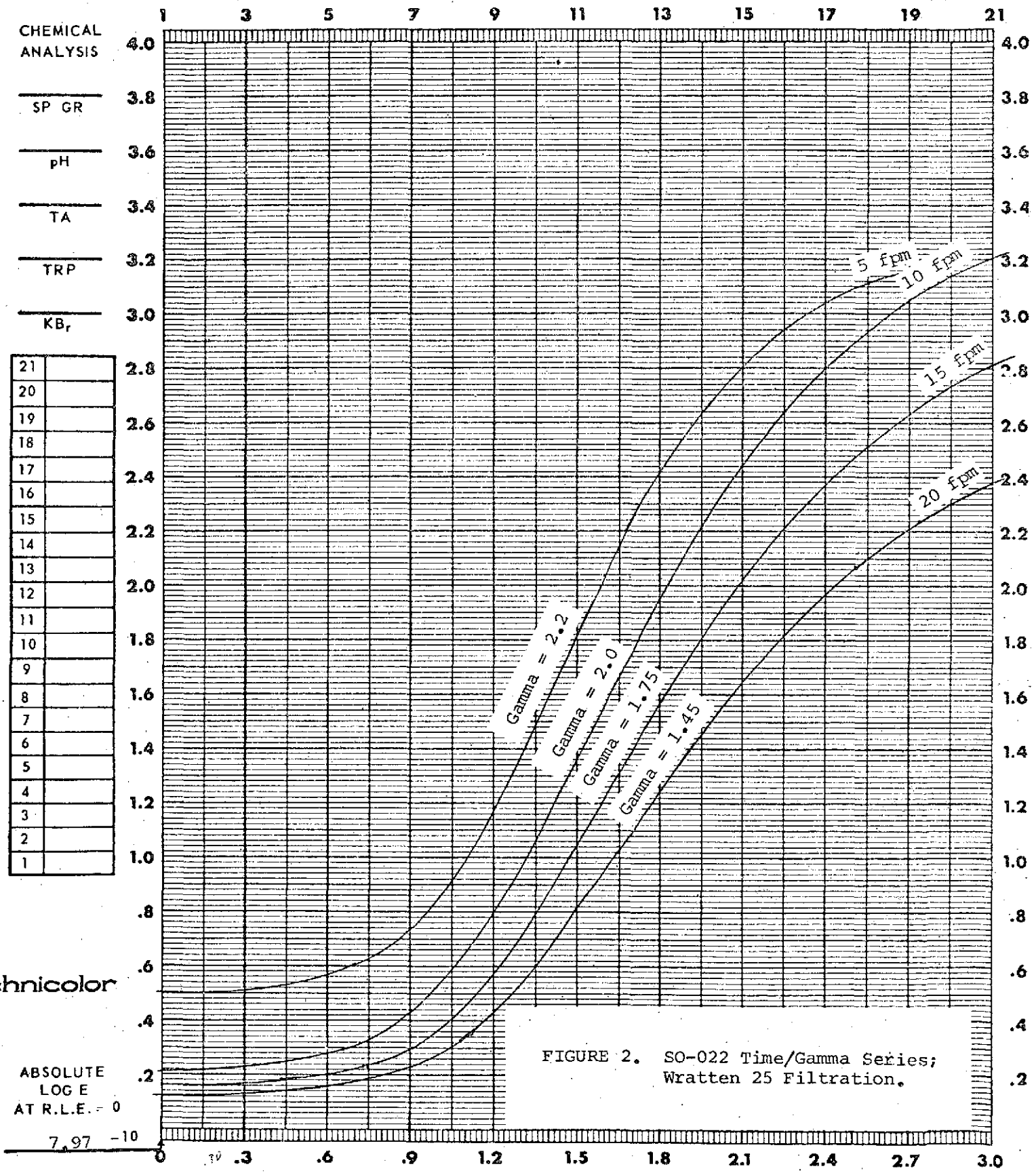

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ABSOLUTE LOG E AT R.L.E. = 0

7.97 -10

FIGURE 2. SO-022 Time/Gamma Series; Wratten 25 Filtration.

DATE _____ CONTROL # _____ TASK _____ PREPARED BY _____

FILM SO-022 EMULSION # _____ MFG _____ EXPIRATION DATE _____

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY			
SENSITOMETER	I-B	PROCESSOR	Fultron #2	INSTRUMENT	MacBeth	SPEED ( )	
ILLUMINANT	2850 °K	CHEMISTRY	MX-819	TYPE	TD217DR	D-MAX	
TIME	1/5 sec.	SPEED	Full TANK 5,10,15,~~20~~	APERTURE SIZE	2 MM	GAMMA	
FILTER	5500°K + W57	TEMP °F	85 TIME	FILTER	Visual	BASE + FOG	

CHEMICAL ANALYSIS

SP GR

pH

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TRP

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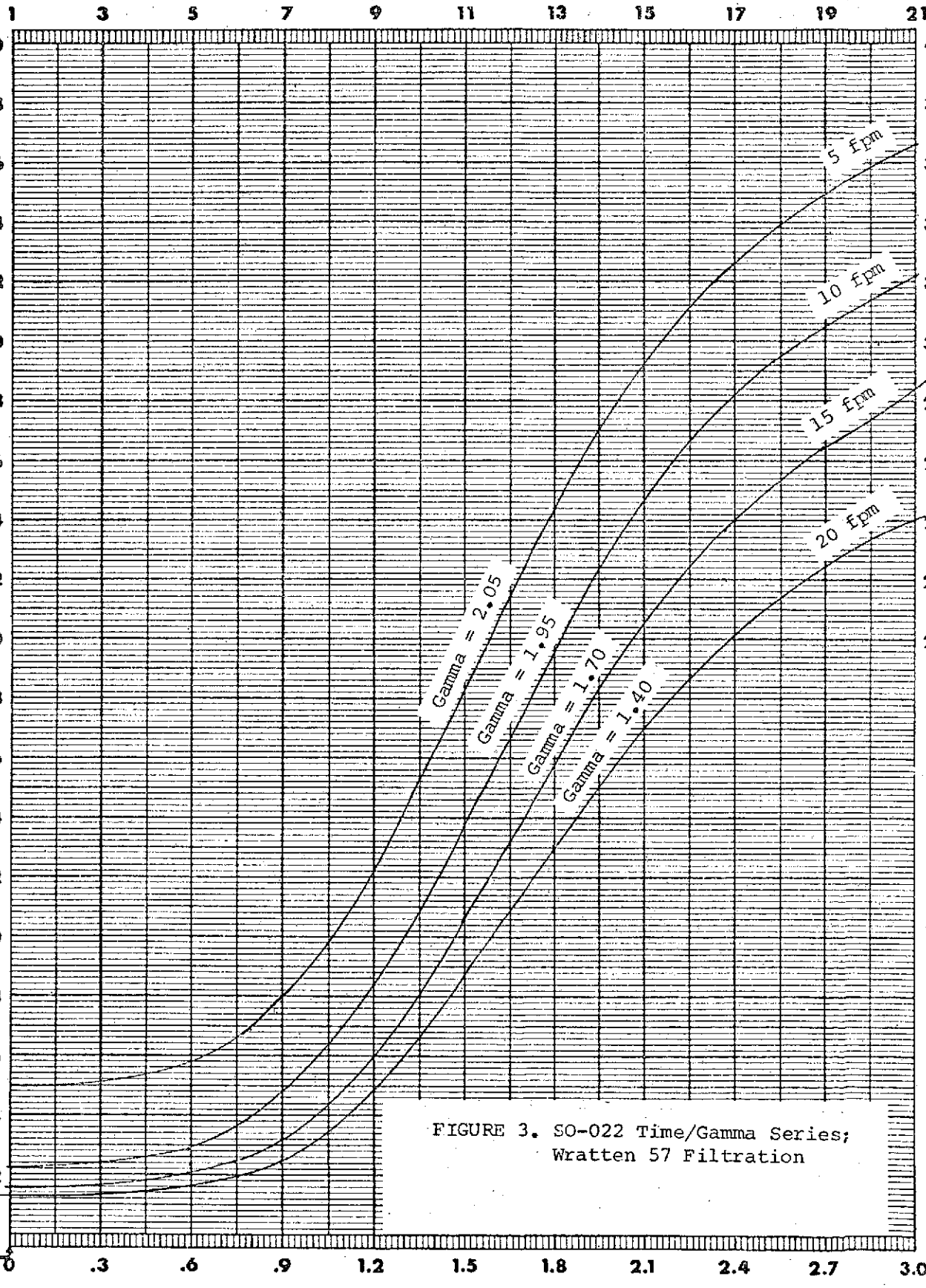

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ABSOLUTE LOG E AT R.L.E. = 0

8.27 -10

FIGURE 3. SO-022 Time/Gamma Series; Wratten 57 Filtration

DATE _____ CONTROL # _____ TASK _____ PREPARED BY _____

FILM SO-022 EMULSION # _____ MFG _____ EXPIRATION DATE _____

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	I-B	PROCESSOR	Fultron #2	INSTRUMENT	MacBeth
ILLUMINANT	2850 °K	CHEMISTRY	MX-819	TYPE	TD217DR
TIME	1/5 SEC.	SPEED	Full TANKS 5,10,15,20 FPM	APERTURE SIZE	2 MM
FILTER	5500°K + W47B	TEMP °F	85 TIME	FILTER	Visual
				SPEED ( )	
				D-MAX	
				GAMMA	
				BASE + FOG	

CHEMICAL ANALYSIS

SP GR

pH

TA

TRP

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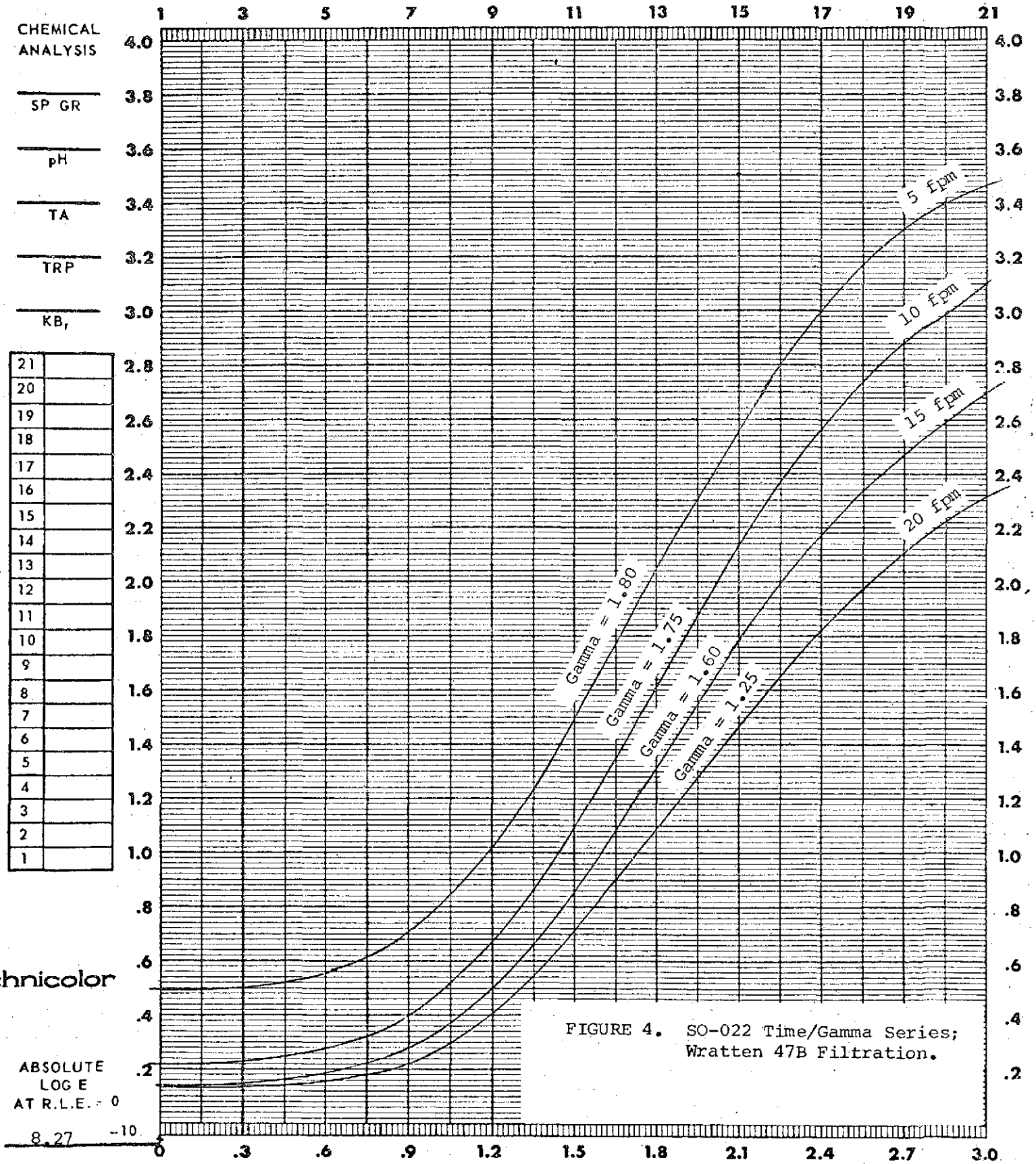

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ABSOLUTE LOG E AT R.L.E. = 0

8.27 -10

FIGURE 4. SO-022 Time/Gamma Series; Wratten 47B Filtration.

DATE _____ CONTROL # _____ TASK _____ PREPARED BY _____

FILM SO-022 EMULSION # _____ MFG _____ EXPIRATION DATE _____

EXPOSURE DATA	PROCESSING DATA	DENSITOMETRY	
SENSITOMETER I-B	PROCESSOR Fultron #2	INSTRUMENT MacBeth	SPEED ( )
ILLUMINANT 2850 °K	CHEMISTRY MX-819	TYPE TD217DR	D-MAX
TIME 1/5 SEC.	SPEED Full TANKS 15 FPM	APERTURE SIZE 2 MM	GAMMA
FILTER see below	TEMP °F 85 TIME	FILTER Visual	BASE + FOG

CHEMICAL ANALYSIS

SP GR

pH

TA

TRP

KB_r

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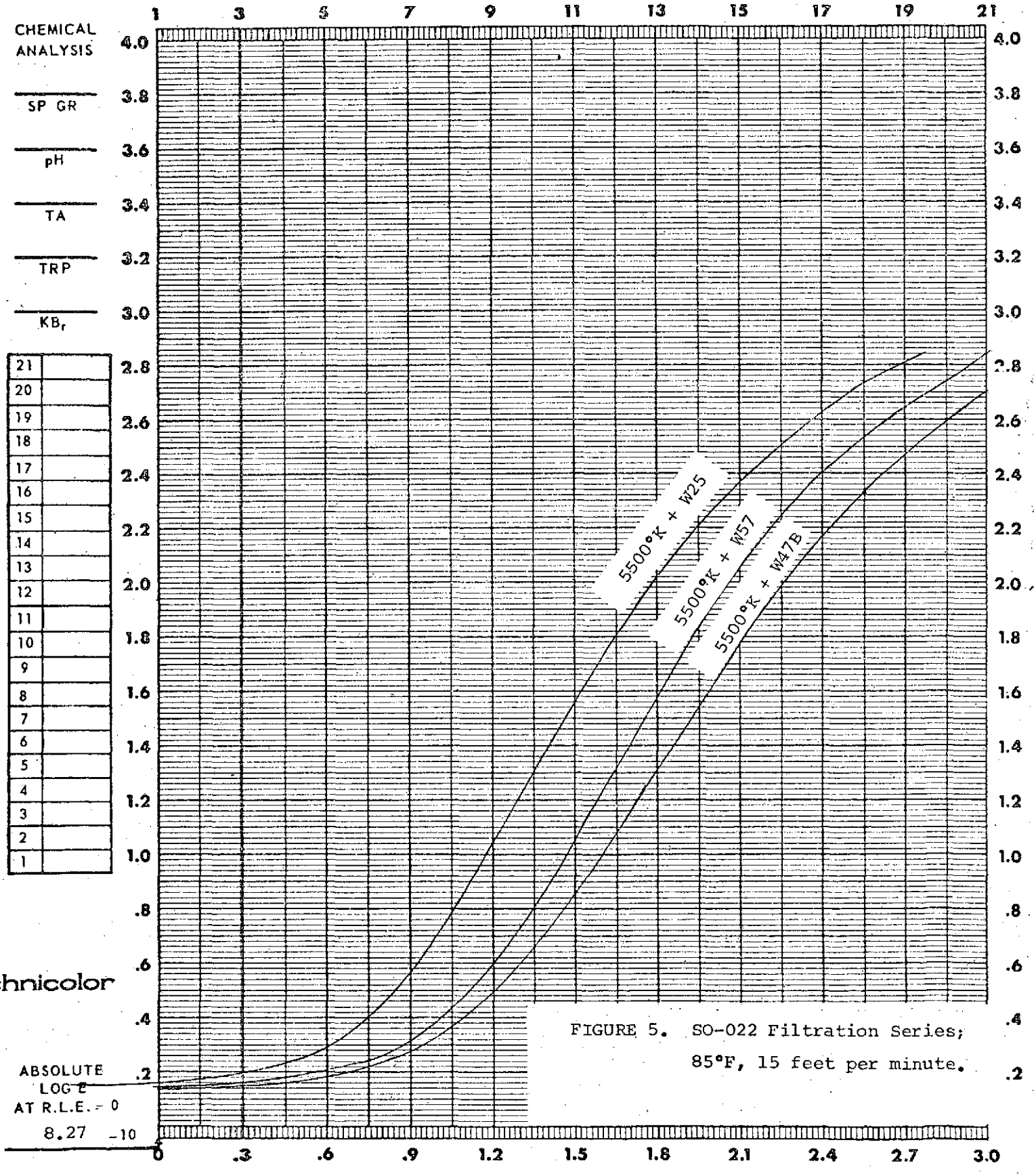

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FIGURE 5. SO-022 Filtration Series; 85°F, 15 feet per minute.