B A U S C H & L O M B I N C O R P O R A T E D

R O C H E S T E R 2, N E W Y O R K

August 16, 1963

Subject: Contract 705 - Task Order 3

Reference: Letter May 14, 1963

Gentlemen:

Since my letter, a meeting has been held with your technical representatives to review this project to determine the work yet to be done. The following deficiencies, as previously reported, remain to be corrected:

(1) Insufficient illumination

(2) Instability of enlarger support

(3) Insufficient film protection at the film stage

(4) Lack of magnification setting indicators

The modifications recommended to provide you with an instrument which will compliment your photographic laboratory are as follows:

(1) Insufficient Illumination will be corrected by providing a lamphouse and condenser system designed for highest efficiency for its intended purpose. A 500 watt horizontal burning projection lamp will be used. It has a 12 x 14mm filament size and using a 13mm diameter for calculation purposes it provides 8.96 candles/mm^2. The calculated brightness is 17 foot Lamberts on axis at 16X (the most severe condition) which is a significant improvement over the 2-1/2 foot candles in the present system. The brightness was calculated assuming that a standard tracing vellum is the diffusing medium to be used on the clear glass screen; therefore, all calculations assume a 50% loss at this point. Additionally, a general 50% loss in transmission is assumed for the optics. These total assumed transmission losses have proved to be somewhat conservative as evidenced by tests performed on a similar instrument (See enclosure "A"). A preliminary design of the required condenser system indicates it will consist of three fixed-position lenses; two are plano-convex and the third a parabolic condenser lens. The lamp may be repositioned for optimum efficiency of the aperture. A forced air cooling system will prevent overheating of the film.

(2) Instability of the basic enlarger portion of the instrument causes the imagery to move about on the tracing surface as various motions and vibrations are transmitted through the instrument. This will be corrected by the combination of two actions. Special castors that lock in rotation as well as transverse movement (e.g. Jarvis & Jarvis) will replace those presently used. A new enlarger framework specifically designed for the application will be used. It will provide the required stability plus a means of holding the film flat while affording adequate protection to the film.

(3) Nylon rollers will be provided for protection of the film at the film gate. If necessary, a nylon or teflon material will cover the film stage for additional protection.

(4) Magnification setting indicators will be added when calibration and alignment have been completed.

The resultant instrument will correct the deficiencies listed and be representative of a production unit. Another approach is to rigidize the existing enlarger support. This is only an interim solution.

The attached cost summary reflects the cost to complete the instrument as described and recommended above. Also included for comparison purposes is the cost to complete the instrument as above with the exception that we would only rigidize the present enlarger support. If this approach is taken, redesign of the enlarger support would still be required prior to additional production.

The instrument can be delivered 14 weeks after receipt of your verbal notification that the additional funds have been allocated to this program. The residual inventory list and final report will be submitted 30 days thereafter.

At your request, Bausch & Lomb personnel are available to come to Washington to discuss in detail the technical or cost portion of this letter.

25X1A Very truly yours,

[redacted]

Analytical & Photogrammetric
Instrument Sales

RHT:bp
Enc.

"Enclosure A"

VARIABLE MAGNIFICATION TRACING PROJECTOR

Illumination. The instrument in its present form has an illumination system composed of the original D-2 Enlarger condenser system and a 150 watt PAR-38 Spot Lamp. Test readings were made using this system operating at 120 Volts, open gate, without diffusing filters, and with the movable mirrors set at their longest conjugate (70 inches) position (fully down).

Following are the readings in ft. Candles at the clear glass surface:

Lens F.L.	Magnification	On Axis	Corners
4" f/5.6	16X	2-1/2	4-1/2, 2, 2, 4-1/2
7" f/5.6	9X	4-1/2	4, 8, 9, 5
12" f/16	5X	3	2, 2, 2, 3

In order to evaluate the anticipated illumination level of redesigned system, a comparison was made with values, both calculated and realistic, of a similar rear projection instrument.

This instrument has four fixed magnifications of 5X, 10X, 15X and 25X, a total conjugate length of 54 inches, format size 4-1/2 x 4-1/2 inches and a screen size of 30 x 30 inches. Standard drafting vellum is the diffusing medium to be used on the clear glass screen; therefore, all calculations assume a 50% loss at this point. Additionally, a general 50% loss in transmission is assumed for the optics. These total assumed transmission losses proved to be somewhat conservative.

The lamp used in this system and proposed for the VMTP is a 500-watt, horizontal burning, projection lamp. It has a 12 x 14mm filament size; using a 13mm diameter for calculation purposes, it provides 8.96 candles/mm^2.

Following are the comparative illumination calculations:

	Sloping Screen Viewer				Variable Magnification Tracing Projector		
Lens Focal Length	2"	3"	4-3/8"	8-1/4"	4"	7"	12"
F/Stop	2.0	2.8	2.8	4.5	5.6	5.6	16
Magnification	25X	15X	10X	5X	8-16X	4-9X	2-5X
Entrance Pupil Diameter (mm)	25.0	27.1	40.0	46.6	18.0	31.7	25.3
Magnification Required By Condenser System	1.90X	2.08X	3.08X	3.58X	1.4X	2.4X	1.9X
F# at Screen (N)	60	45	31	27	50-98	28-56	48-93
Calculated Brightness B_L in foot lamberts*	45	80	169	224	65-17	206-52	60-22

* Using $B_L = \frac{\Pi \, t \, KB}{4 \, n^2}$ where, B_L = Brightness on screen in foot lamberts

B = Brightness of source in candles/mm^2

t = Total transmission factor (screen x optics)

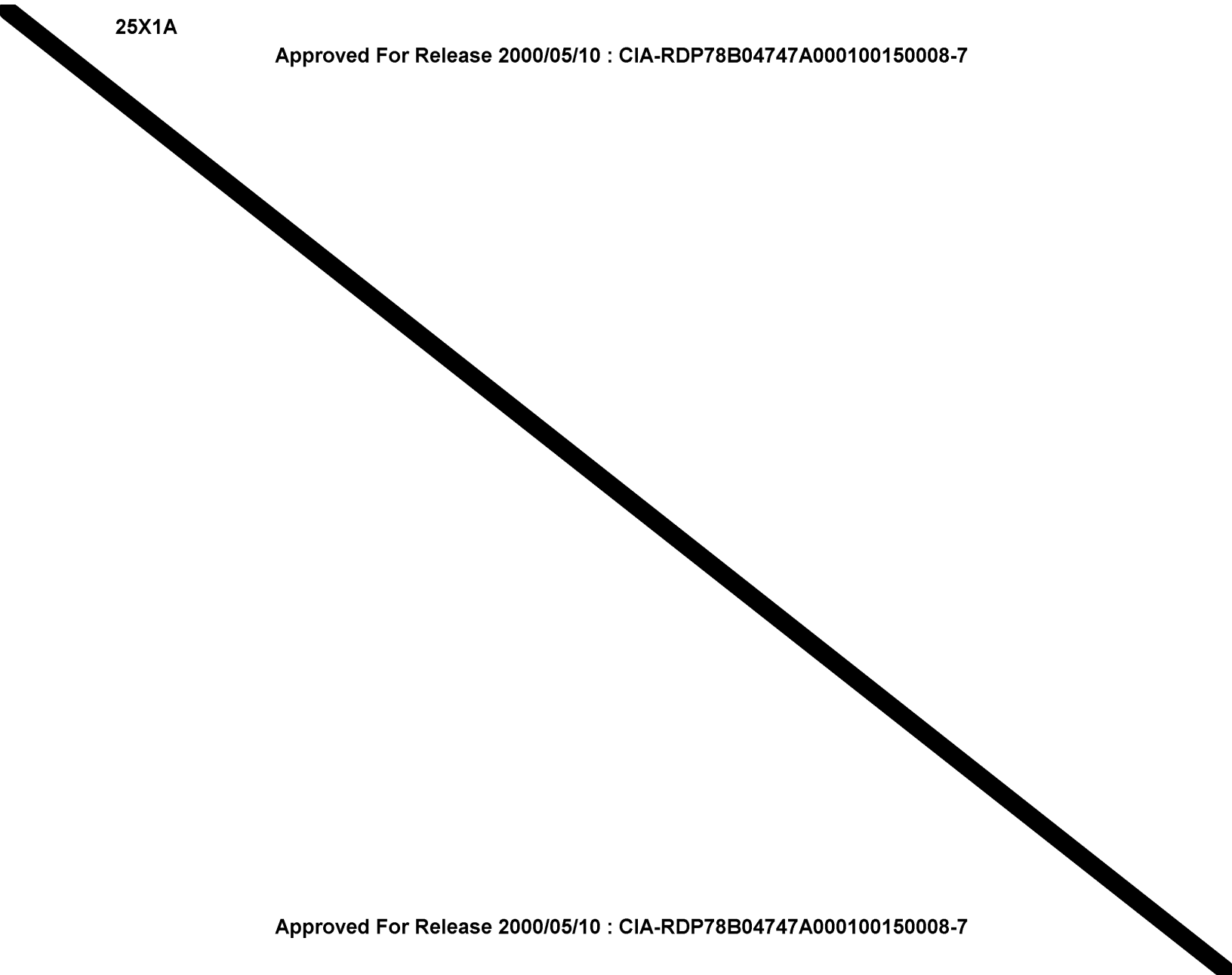
K = Conversion factor (92903- from GE handbook on illumination)

n = f # of screen

In substantiation of the above values, a breadboard was constructed containing the components of the SSV system. At 25X, where the calculated value was 45 ft. Lamberts, the Spectra Brightness Spotmeter registered 115 ft. Lamberts with standard tracing vellum as the screen. It read 800 ft. Lamberts when matte acetate drafting material was used as the screen. Thus, the criteria of judgment of illumination becomes a factor dependent on the screen "gain". The above figures may, therefore, be used for comparative evaluation of anticipated brightness.

The recorded readings were taken open gate; however, aerial photographic positives were projected and evaluated for illumination qualities from a personal judgment standpoint. A uniform density of 1.0, since it has a 10% transmission value, can be expected to decrease the illumination by a factor of ten.

A preliminary design has been made of the condenser system required to fulfill the above calculations. It consists of three fixed-position lenses; two are plano-convex, and the third is a parabolic condenser lens. The lamp may be repositioned for optimum efficiency of the aperture.



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