10 February 1969

STAFF STUDY
MICRODENSITOMETER MODIFICATIONS

1. PROBLEM:

To modify the existing 1032T Microdensitometer with an improved optical system, an electronic scan controller, and additional selections of sampling frequencies.

2. FACTS BEARING ON THE PROBLEM:

a. The 1032T Microdensitometer, although sold as a trichromatic microdensitometer, does not have the capability to perform high resolution readouts of color film.

b. The scanning system on the microdensitometer is controlled by microswitches which are imprecise, inefficient, and result in the production of unwanted data requiring extra time for data reduction.

c. In order to properly sample the densities along the scan line, the sampling frequency should be six times the highest frequency recorded on the film, i.e., if the film has a peak resolution of 200 lines/mm, the sampling frequency should be 1200 samples/mm. The 1032T now has a maximum sampling frequency of 1,000 samples/mm. Although present operational films rarely exceed 125 lines/mm in resolution, other materials such as diazo, free radical, kalvar and some silver halides exceed 1,000 lines/mm. The microdensitometer is therefore, extremely limited in use with any of these new materials.

3. DISCUSSION:

a. Current Procedures - Many areas of interest imaged on black and white film are analyzed with the microdensitometer in the scan, step-over, scan mode. The imagery is centered on the stage and after calibration, focusing, etc., microswitches are set to control the reversing of the stage motion. When the machine is started, the stage moves across the optical path and density readings are taken at preset intervals. The densities are recorded in digital form on magnetic tape. After the scanning is completed, the data is fed into the computer for processing. Since most of the areas scanned are smaller than the closest settings of the microswitches, extraneous data is collected on each scan. This data must be sifted out by the computer before any final processing can be achieved.

To date, very little color film has been analyzed with the microdensitometer because the optical system contains chromatic abberation. It is possible to focus the system for a single color, but not simultaneously for the three colors found in tripack color film. This precludes any meaningful analysis of the film.

In order to analyze film, or any other photographic material which exceeds 166 lines/mm in resolution, the data points from the scan must be taken by hand from the analog graphic record and fed into the computer. This process is extremely time consuming and subject to many errors.

b. Origin of Concept - The limitations of the [redacted] 1032T Micro- 25X1
densitometer were discovered by the operating component (NPIC/TSSG/APSD/ISAB/DAS) after the instrument was put into regular operation. Attempts have been made to minimize the optics problem by inserting different lenses into the system, but since one of the most optically degrading factors is the glass film stage, the attempts have been futile.

c. Proposed Program - It is proposed that a digital controller (consisting of a set of decade switches, an up-down counter and comparison logic) be added to the Microdensitometer. The stage scanning motion could then be reversed after it had moved a programmed distance. This distance would be variable from 10 microns to the limits of the stage motion.

It is also proposed that the optical system be upgraded by first building an alternate film stage which would have a very thin piece of glass in the center. This development would minimize the aberrations caused by the stage and would allow for testing of other commercially available lenses. If no suitable lens or lens system can be found on the market, a special lens system would be designed and built. In other words, the modified stage would be contracted for, built, and tested. Then if no suitable lens were found, a contract for the lens design would be let. Staging the developments of the optical system seems to be the most economical approach to the solution.

The sampling frequency could be increased by adding an oscillator which would be synchronized with the motor and which would control the sampling rate.

d. Selection of Contractor - The contractor selected to add the programmable controller and the new sampling control to the system must have a thorough knowledge of electronics and the circuitry in
25X1 the microdensitometer. The [redacted] owns the stage design and due to the complexity of the stage, it would be impractical to go to any other source for that development. If a new optical design is required, only those contractors having a proven ability in optical design and fabrication should be solicited.

e. Coordination - The proposed task would be of no benefit to anyone who did not possess a 1032T Microdensitometer. The only other 1032T belongs to [redacted] so outside coordination was deemed unnecessary. Close liaison between DED and ISAB will be maintained.

25X1

f. Alternatives - The alternatives to this proposed program are either to live with the status quo or to undertake a specific task in the program or to develop entirely new pieces of equipment to perform the task. If none of the optical modifications were undertaken, NPIC would be precluded from scanning color film simultaneously in three colors and thereby eliminate the possibility that NPIC would delve into color image signature analysis or extensive technical analysis of color film. If the digital controller were not added, machine and computer time would continue to be lost processing unneeded data. Fabricating a totally new device to perform the task appears unrealistic from both a time and a cost standpoint. An alternative to the new sampling control is additional software that would interpolate between the samples now recorded digitally by the microdensitometer. The cost of designing this software and the computer time it would require, however, would exceed the cost of the hardware in the long run.

4. CONCLUSIONS:

The proposed program to modify the microdensitometer would be a small but worthwhile investment to upgrade the capability of NPIC and to improve the efficiency of one of the operating divisions within the Center. The digital controller modification to the microdensitometer would probably pay for itself within a year. The additional sampling frequencies would provide the Center with the capability of being able to scan very high resolution materials with the same ease that is required to scan present operational films.

Without too much investment, the 1032T Microdensitometer could be modified so that it could be used as a tool to study color image structure, to perform image manipulations or possibly to analyze the color signatures of imagery. By phasing this part of the modifications to the microdensitometer, the cost of development can be held to a minimum.

5. RECOMMENDATIONS:

It is recommended that the digital controller development be procured through open bid procedures (estimated cost - [redacted] 25X1

It is recommended that a new sampling control be procured through open bid procedures (estimated cost - [redacted] 25X1

It is recommended that a modified stage be purchased from [redacted] 25X1
25X1 [redacted] (estimated cost - [redacted]

If it is deemed necessary, after trying commercial lenses in the system with the modified stage, it is recommended that a lens development be purchased through open bid procedures (estimated cost - [redacted] 25X1