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TECHNICAL PROPOSAL 66-234

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COLOR PRINT
DRYER COLOR
SHEET FILM DRYER

[redacted]

CONFIDENTIAL

31 October 1966

25X1A [redacted]
Fort Davis Station
Washington, D.C. 20020

Subject: RFP RD-3-67
Project No. 10047

Gentlemen:

We are pleased to submit our proposal for the performance of the tasks contemplated by subject RFP. Our CPFF Proposal is based upon an eight month performance period.

We have costed our proposal (Alternate A) to provide for the delivery and demonstration of the feasibility model if you so desire. If in-plant demonstration will suffice, our proposal may be reduced by the costs attributable to this activity (Alternate B).

I trust this meets all of your requirements. If you have any questions, please contact me.

25X1A [redacted]

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TECHNICAL PROPOSAL

COLOR PRINT DRYER

COLOR SHEET FILM DRYER

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INTRODUCTION

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INTRODUCTION

The drying operation of the photographic process involves the removal of moisture from the material so that an equilibrium is reached with the air in which the material is to be stored and handled. The best results are accomplished by natural evaporation; however, the process is much too slow. Techniques which reduce the drying time are usually accompanied by undesirable effects on the material such as curl, brittleness, distortion, and sensitometric changes. In recent years, color films and papers have placed even more stringent requirements on drying techniques because of their soft emulsion and many layers. The purpose of this program is to establish a rapid drying technique for sheet color films and papers which retains the product quality of natural evaporation.

The overall program is divided into two phases. Phase I is to be an investigation and design analysis of drying techniques with the objective of arriving at recommended techniques and demonstrating these techniques with breadboard hardware. Phase II will be a hardware prototype stage in which equipment suitable for operational use will be fabricated.

This proposal is confined to the Phase I effort and describes our approach to investigations of drying techniques for (a) sheet color film both negative and positive material, (b) matte drying of sheet color papers, and (c) gloss drying of sheet color papers.

It is anticipated that the Phase I effort will require approximately eight months and will consist of the following subphases:

A. Preliminary Investigation.
B. Test and Analysis Phase.
C. Preparation and Submission of Recommendation.
D. Development of Breadboard Hardware.

SECTION 2

TECHNICAL DISCUSSION

SECTION 2
TECHNICAL DISCUSSION

GENERAL CONSIDERATIONS

The goal of this program is to provide automated high quality rapid drying techniques for color sheet material. Considerable research has been and is being done to provide quality rapid drying methods for continuous roll black and white material. This is the result of pressures brought to bear in the motion picture, television, and aerial reconnaissance fields. A reasonably high level of technology has been established as is evidenced in investigation by [redacted] proposes to use this advantage. The requirements of this program then are to expand the present technical level of rapid drying methods to include sheet color material. The prime considerations are the drying characteristics of the various color materials in use, the correlation of these characteristics with existing advanced drying techniques and the mechanical considerations of automation in the handling of soft color material in sheet form.

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Photographic drying is a complex process of controlled moisture removal. It is generally accepted that optimum photographic and physical characteristics of films and papers are obtained when the materials are dried to a 50 percent relative humidity equilibrium. This does not mean that the moisture content of the various materials must be brought to the same point, since different materials have different moisture capacities. As an example, the amount of water to be removed from an acetate butyrate base is about seven times as great as from an estar base[4]. The problem then is that different materials vary widely both in their capacity for moisture in the processing phase and in their moisture content when in the optimum relative humidity equilibrium. Since undesirable changes occur when color materials are brought to equilibrium outside of the optimum range (40-60 percent), the drying requirements must be accurately determined and the drying rates closely controlled. [redacted] Self regulating feedback systems are feasible in which the drying energy level is controlled by the moisture content of the material. This is the key to optimum quality rapid drying and may allow both

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color film and paper drying to be accomplished in a single piece of equipment.

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To accomplish the investigation and design analysis goals, [redacted] proposes to divide the effort into four subphases.

Subphase A. Preliminary Investigation: This portion of the program will consist of those activities necessary to prepare for the test and analysis portion and will include such things as: (1) establishment of test requirements and measurement procedures, (2) drying techniques search, (3) accumulation of test equipment and materials, (4) analysis of material drying characteristics, and (5) establishment of experimental design parameters.

1. Establishment of Test Requirements and Measurement Procedures.

The analysis of drying techniques requires the determination of drying rates and an assessment of the resulting quality. Establishment of measuring techniques and quality levels are required in the following area:

- (a) Moisture Content
- (b) Physical Characteristics
  - (1) Dimensional (overall and local)
  - (2) Curl
  - (3) Brittleness
  - (4) Abrasion
  - (5) Peeling
  - (6) Water marks
  - (7) Surface texture
- (c) Sensitometric Characteristics
  - (1) Density
  - (2) Color
  - (3) Mottle

The ability to accurately measure moisture content in this investigation is of considerable importance. The desired moisture content must be established for each color material in terms of equilibrium relative humidity. The drying rates required to bring each material to this optimum condition can then be determined and compared for each of the drying techniques analyzed. Several moisture measurement techniques are known; however, the electrical hygrometer technique appears to offer the most potential to this investigation. The advantages of this method are (1) speed of measurement and calibration, and (2) convenience in use, as readings are obtained directly in terms of relative humidity which eliminates the need for moisture equilibrium curves. More detailed information on this subject can be found in Colton and Weigand's paper on "Moisture in Photographic Film and Its Measurement"[5].

The analysis of resulting physical and sensitometric characteristics in the quality control consideration of this investigation. A rapid drying technique is of little value if the product is physically or sensitometrically changed. Most of the undesired physical conditions are readily apparent or can be determined by available ASA Standards procedures. Dimensional change measurements are probably the most complex. [redacted]

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[redacted] proposes to use the moire' cancellation method in which both local and overall dimensional changes can be quantitatively determined. The principle involves the registration of a master halftone screen to a screen on the test material. Irregularities in the formed moire' pattern are used to determine the location and magnitude of dimensional changes. This method has been used and described on several occasions by people [redacted]

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2. Drying Techniques Search

The purpose of this portion of the investigation is to accumulate as much information as possible with reference to drying techniques. This will be done through (1) literature search, (2) manufacture search, and (3) laboratory testing. The choice of the drying techniques to be tested under the Test and Analysis Subphase will be based on this investigation. Emphasis will be placed on advanced techniques which show potential in the color field. Such techniques are characterized by selective energy absorption, positive and instantaneous energy control, elimination of surfaces-to-interior energy transfer, and cold source energy.

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[redacted] engineers have been involved in photographic drying problems for several years and are presently involved as a monitoring agency on an Air Force development program in ultra-rapid microwave film drying technique.

The type of rapid drying technique to be investigated will include but not be limited to the following.

1. Air Impingement
2. [redacted]
3. Chemical Displacement
4. Dielectric
5. Microwave

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Equally important during the search phase is the consideration of automated sheet material transport techniques. Color sheet film has been successfully dried in the [redacted] processor using roller transport. The transport mechanism of other processors [redacted] will be investigated.

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Plans are to consider color paper matte drying under the same conditions as film with the hope that one method or piece of equipment can be designed to do both jobs. Gloss drying of color paper will be considered separately both in terms of initial drying and as an emulsion rewet system.

3. Accumulation of Test Equipment and Materials

The anticipated requirement for equipment and materials falls into three general classes: (1) measurement and instrumentation apparatus for use in the test and analysis phase and (3) drying equipment utilizing the techniques to be investigated.

As often as possible access to existing equipment or manufacturers' development models will be pursued; however, in some of the more advanced techniques, test models may have to be fabricated.

4. Analysis of Material Drying Characteristics

Dryer requirements are based on the amount of moisture absorbed in the processing. The amount of moisture absorbed is dependent upon the type of material, processing treatment, and use and storage environment. By performing an analysis of drying characteristics of the color materials, the range of dryer requirements can be established. Materials to be tested will include: Ektachrome, Ektacolor, Ektacolor Print Film, Ektaprint C, Ektaprint R, Anscochrome and Printon. Depending on the results of these tests, it may be possible to establish the extremes and choose two materials which represent this range for use in the test and analysis phase.

5. Establishment of Experimental Design

Near the end of this subphase, decisions will have been made regarding the test procedures and the techniques to be analyzed and will permit a final experimental design to be established for the Test and Analysis phase. At this time the requirements for statistical confidence will be determined and the necessary ANOVA tables prepared.

Subphase B. Test and Analysis: It is during this phase that the potential techniques found in the search effort will be tested and analyzed. Three general areas will be investigated: (1) the drying techniques, (2) the resulting quality and (3) the operational considerations.

Under the drying technique, such things as drying rate, energy control, and moisture level monitoring will be considered. The quality requirements will be established as outlined earlier while the operational consideration will include such things as size, weight, cost, power requirement, mechanical complexity, and automation potential.

The test portion will consist of a closely controlled sequence of investigation for each technique. Color material used for testing purposes will be exposed to a test frisket composed of neutral areas, step tablets and halftone screen background. These sheets will be exposed and processed under recommended conditions just prior to the test. These sheets will then be cut lengthwise and one-half will be placed in a 70° F 50 percent RH enclosure to be dried by natural evaporation for reference purposes. The other half will be the test material to be used with the various drying techniques. Sufficient samples will be tested to insure valid results.

Comparison will be made of the drying rates and resulting quality for various conditions within each technique and between techniques.

Subphase C. Preparation and Submission of Recommendations: The data generated in the test phase will be reduced and analyzed and a report of the findings prepared. At the end of this phase a meeting will be scheduled in which the capabilities and limitations of all systems will be presented along with our recommendations regarding the technique or combination of techniques which we feel offers the greatest potential.

<u>Subphase D. Development of Breadboard Hardware:</u> Upon the customer's approval of the technique choice, [redacted] engineers will design and fabricate a breadboard model to adequately demonstrate the system. This model, though not finished operational hardware, will possess design features which will contribute to the Phase II fabrication effort.

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REFERENCES

1. Miller, Dana, "Rapid Drying of Normally Processed Black and White Motion Picture Film", S.M.P.T.E., Feb. 1953.

2. Boyd, J. W., "Rapid Drying Characteristics of Several Films for Aerial Photography", PSE, 4, No. 6, 354-358 (1960).

3. Michener, B. C., "Drying of Processed Aerial Films", Photogrammetric Engineering, Vol. XXIX, No. 2, 321-326 (1963).

4. Op. cit, p. 323.

5. Colton, E. K., Wiegand, E. J., "Moisture in Photographic Film and Its Measurement", PSE, 2, No. 3, 170-176 (1958)

6. Adelstein, P. Z., Leister, D. A., "Non-Uniform Dimensional Changes in Topographic Aerial Films", Photogrammetric Engineering, Vol. XXIX, No. 1, 149-161 (1963.

SECTION 3

PROGRAM ORGANIZATION

SECTION 3
PROGRAM ORGANIZATION

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If this program is awarded to [redacted] it will be assigned to the Physical Services Laboratory [redacted] will be the project engineer. [redacted] will be assigned as the electronic engineer with [redacted] serving as the photoscientist. Assistance in mathematical analysis and computer programming, if necessary, is available from the Systems Analysis Department. Mechanical design and model shop facilities are available as required for fabrication of the Breadboard Equipment.

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Since its organization in [redacted] has specialized in applied research, test, evaluation and product improvement programs involving reconnaissance and intelligence equipment. The present staff of approximately one hundred ninety-five people includes ninety-eight professionals and eighty-five highly skilled technicians and supporting personnel with experience in reconnaissance equipment and associated technologies.

The company has specifically avoided entering into competition with production suppliers to permit emphasis on applied research, test, evaluation and development of special purpose instrumentation.

This program in itself will not require the hiring of additional engineering personnel. Unforeseen problems requiring skills and technical experience which the aforelisted personnel do not possess may arise. In that event, other personnel available within our company structure and consultant staff will be assigned as necessary to break these problem areas. [redacted] Vice President of Research and Engineering is an example of the level of individual we have available in this category.

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This task fits ideally into our company structure and long range planning. A large percentage of our effort has gone into the test and evaluation of printers, driers processors and all other types of ground support equipment for reconnaissance systems. The experience gained in these programs and our more recent color programs will permit us to avoid the mistakes and problem areas contained in earlier versions of equipment.

Moreover, since we do not compete in the production area, we are not trying to sell a particular product. Rather, we can take advantage of all of the known techniques, thus resulting in a better product for the customer

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SUBCONTRACTING

We do not envision a requirement for subcontracting under this task.

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SECTION 4

PERSONNEL QUALIFICATIONS

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SECTION 5

PROGRAM SCHEDULES

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SECTION 6

QUALIFICATIONS AND EXPERIENCE

SECTION 6
QUALIFICATIONS AND EXPERIENCE

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Since its beginning in [redacted] has been heavily engaged in research and development related to reconnaissance. Consequently, the company has extensive experience in all phases of reconnaissance and its attendant sciences and technologies. We believe we are the only company who views the reconnaissance problem from an overall systems point of view in that we deal with (1) overall system design and analysis, (2) the fabrication of prototype equipment, both airborne and ground, (3) test and evaluation of prototype and production equipment, both airborne and ground, (4) the test and evaluation of films, chemistries and other sensitive materials; research processing, black and white, color and sensitometric, and (5) modification engineering and retrofit of in-being systems.

The company has specifically avoided entering into competition with production suppliers to permit emphasis on applied research, test, evaluation and development of special purpose instrumentation.

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In order to acquaint the reader with specific company experience, there follows brief descriptions of work on current and recent [redacted] contracts in these many areas:

COLOR ANALYSIS

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[redacted] designed and fabricated an automatic color analyser to be used [redacted] process. This device is capable of area averaging operation or spot sampling and is equipped with the necessary override and balance controls. In operation, the device eliminates completely the requirement for manual balance and trial prints, thereby improving production rate and lowering cost appreciably. The system incorporates such advanced features as automatic reciprocity and latent image failure compensation. The interface is designed such that all controls on the basic machine are automatically set with no manual intervention required.

PHOTO-INTERPRETER VIEWER DESIGN STUDIES

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Under contract to the [redacted] has performed

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theoretical and experimental studies in rear projection viewer design. In addition, [redacted] performed investigations, redesign and production design of modification kits for the retro-fitting of rear projection viewers now in production. Some fifteen major deficiencies were found and corrected.

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Research by [redacted] in this area led to the development of the first liquid gate viewer with extremely high light intensity. Other research was directed toward the use of highly optimized reflective condensor systems in high intensity viewers.

PHOTOGRAPHIC PROCESSING

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[redacted] is completely equipped with photographic laboratories including automatic continuous processing equipment. In addition, we are heavily involved in the development of a totally new processing concept including the required chemistry. Over the past ten years [redacted] has been continuously engaged in various programs relating to both color and black and white processing.

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MICRODENSITOMETRIC STANDARDS

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Under contract to the [redacted] has designed, fabricated and calibrated a new set of standards for use in microdensitometer calibration. Included as part of this project was a new machine-readable resolution target. The configuration of this target was presented to the ABC committee during their past meeting for consideration as a new national standard. Density standards and calibration techniques for microdensitometers have been developed including bar targets, mensurating standards, micro-macro step wedges and other test objects. These standards are presently being developed for the Air Force in cooperation with the National Bureau of Standards.

IMAGE FORMATION RESEARCH

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[redacted] has performed research in image formation in optical systems. This work has led to interesting anomalies in testing procedure and to clearer definition of film-optics interaction. The investigation has been performed in conjunction with [redacted] laboratories. In-house work has been conducted on the [redacted] optical bench with microtome sectioning frequently used to assess development penetration. Under this program the effects of sensitometric testing were also analyzed, particularly with respect to the use of projection sensitometry.

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SENSITIZED MATERIALS ANALYSIS

During the past eight years, under the auspices of various [redacted] contracts, [redacted] has analyzed new sensitized materials and chemicals. Complete sensitometric measurements, resolution, granularity, and physical properties were measured for black and white and color paper and films. The laboratory tests of these new materials are complemented with actual flight or ground tests where applicable. New chemistries are analyzed by processing standard or special emulsions and comparing the results under various time and temperature conditions to standardized solutions. [redacted] has designed and fabricated special laboratory equipments for performance of sensitometric processing and printing. These special purpose test equipments have enabled us to keep abreast with the materials analysis field. During the past several years, our work has expanded into the field of unconventional photographic systems, and associated processing materials and chemistries.

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EQUIPMENT FABRICATION

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[redacted] has designed and developed many types of Laboratory Instrumentation. Some examples of these devices are:

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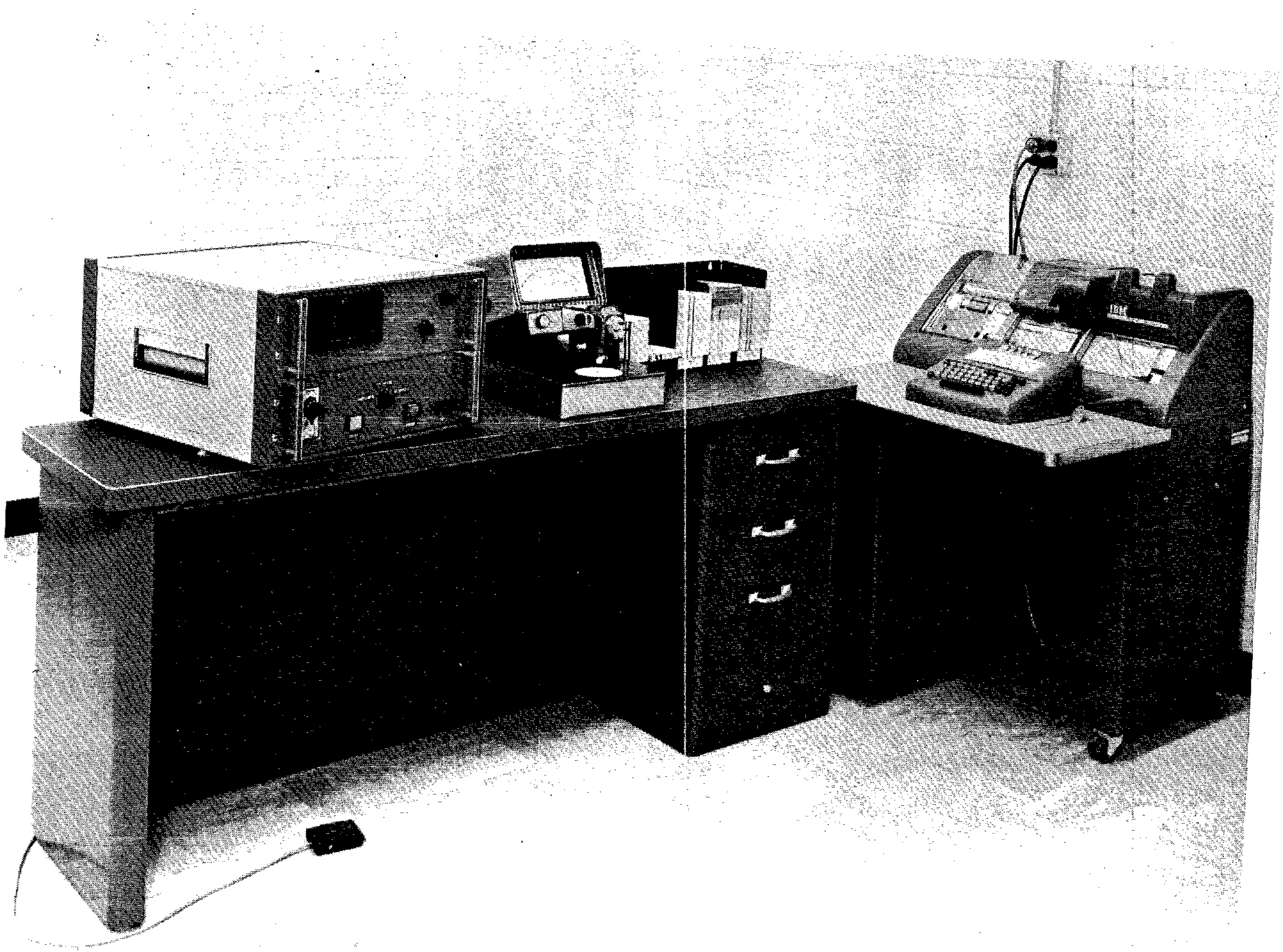

DIGITIZED DENSITOMETER

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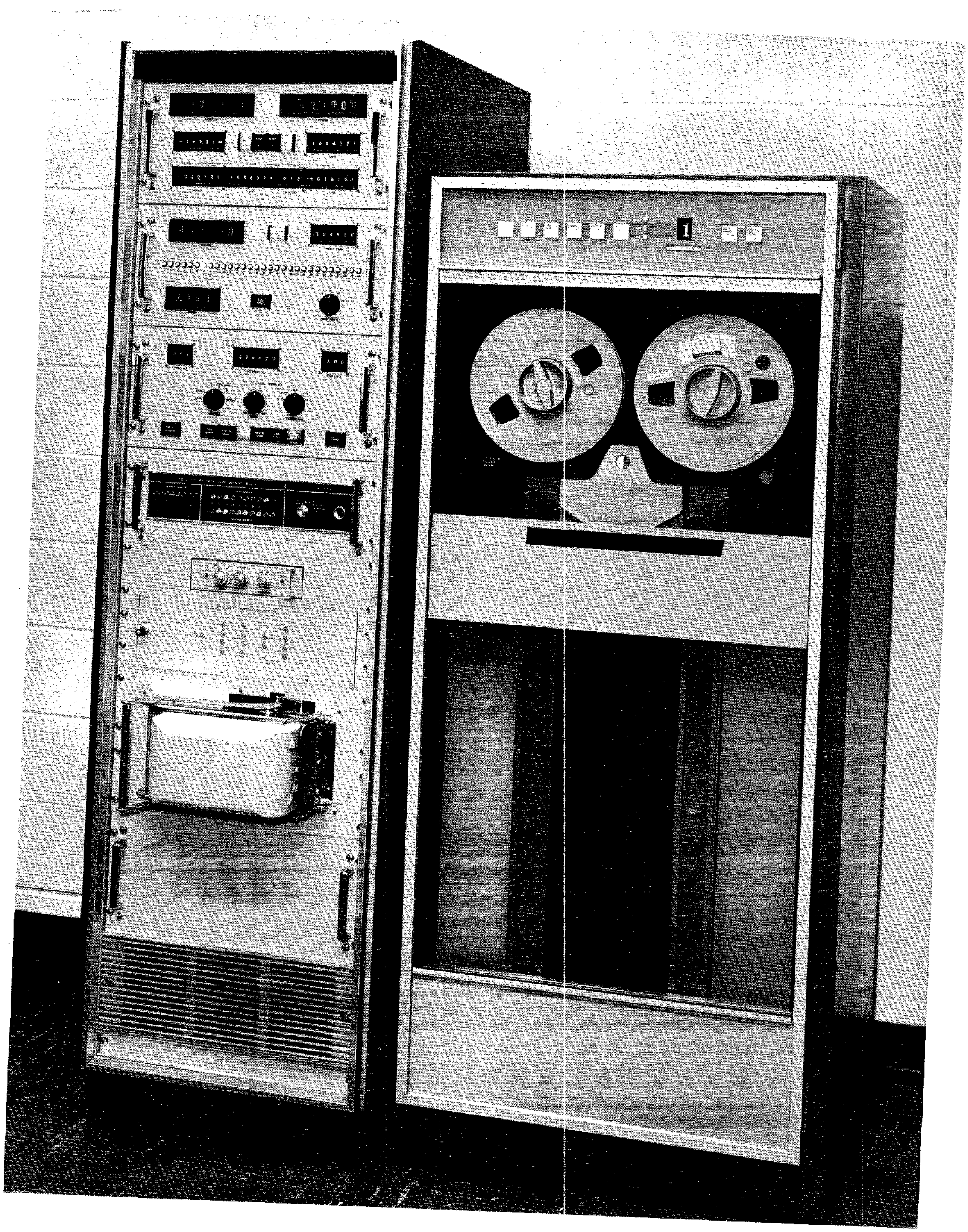
[redacted] has designed a digitizer to permit printout of density directly on an IBM 526 card punch. Standard 21 step sensitometric strips are recorded directly on an IBM card with printout. The cards are then available for computer manipulation.



DIGITIZERS

Magnetic tape and paper tape digitizers are used to read out Micro-Analyzer outputs. These units were designed and built by [redacted] to provide flexible inputs to the computers. Included are programming features for automatic sensitometric readouts, random scanning, spot sampling, automatic area sampling and cut-off.

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SECTION 7

FACILITIES AND EQUIPMENT

SECTION 7
FACILITIES AND EQUIPMENT

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The facilities at [redacted] have been systematically designed so as to assure the "in-house" availability of all equipment which is necessary to pursue applied research programs involving theoretical study, laboratory analysis, and design and fabrication of prototypes, if necessary. The company's facilities are located at [redacted] These facilities comprise sixty-thousand square feet of floor area housed principally in two (2) buildings. [redacted]

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The company's facilities are oriented towards work in the areas of photography, electronics, optics, mechanics, and combinations of these fields. The companies facilities include a photosecience laboratory, computational facilities, electronics laboratory, optics laboratory and machine shop.

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More complete descriptions of a representative sampling of our facilities is included in the following pages.

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