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FINAL REPORT

Technical/Consultative Contractor Services to Improve Production Methods at Customer's Facility

4 June 1970

Prepared by:

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Date: 22 June 1970

25X1 [redacted]

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SUMMARY

With the provision of production specifications and training for handling SO-239, 6451 and SO-369, the black-and-white operations at NPIC can achieve improvement in quality and effectiveness. NPIC's on-hand equipment, personnel and procedures are adequate to meet both mainstream and special production requirements in support of photo-interpreter activities with black-and-white materials.

Production of color enlargements and briefing boards at NPIC can be made more effective with judicious use of available materials. Support effort given the Photo Lab under this PAR included information, sample materials, and orientation to enable that facility to select appropriate materials and processes. Some of the options now available can result in a savings of up to two generations of printing. Current equipment and personnel capability at NPIC would have to be augmented considerably to exercise some of these options, however; and training effort would be required subsequent to such augmentation for adequate production of color materials on an operational basis. Among the equipment needs are continuous color processors of the roller-transport type.

SUBJECT: Technical/Consultative Contractor Services to Improve Production Methods at Customer's Facility

TASK/PROBLEM

1. Perform studies and conduct experimental investigations for improvement of production methods and techniques at NPIC that would:

a. Permit direct coupling into an integrated National distribution plan, and

b. Increase production quality and efficiency.

2. Determine the changes in equipment, material, personnel and/or procedure that would be required to achieve the above.

3. Provide technical and/or consultative services, personnel training support, and samples of materials as available and appropriate to achieve the above.

INTRODUCTION

4. Black-and-White Production Support. Three new black-and-white duplicating products have been introduced to the Photo Lab at NPIC. These products are Kodak Direct Duplicating Aerial Film (Estar Base) SO-239, Kodak Minicard Film 6451 (Clear Base), and Recordak Print Film SO-369. The emphasis with SO-239 was on how duplicate negatives from the contractor's facility should be used in the preparation of enlargements, although the capability to use SO-239 rawstock was also established in the Lab. With the high-contrast, fine-grained duplicating films 6451 and SO-369, the emphasis was on providing the Photo Lab with the capability to print and process these products for special applications.

5. Color Production Support

a. With the increased level of color acquisition material being used in the national program, work was done under this contract in support of NPIC to determine what materials and procedures would improve the quality and efficiency of their color duplication systems. Recognizing

the limitations of the present system for color duplication, studies were aimed at determining whether an interim system might not be feasible using various presently available products. This report deals with such an interim system, as developed under another project, and the technical consultative liaison to implement its use at NPIC.

b. In addition, color enlargement production in the preparation of briefing materials at NPIC was investigated in support of operations at the customer's shop. The remaining efforts under the color portion of this PAR were directed in that area.

DISCUSSION (Black-and-White)

6. SO-239. Kodak Direct Duplicating Aerial Film (Estar Base) SO-239 was accepted by the customer for use in preparing duplicate negatives of all very high altitude missions in their shop. [redacted] was the first of these missions, and a contractor representative was present at the customer's facility on 10 and 11 Sept. 1969, as the SO-239 duplicate negatives were received and used for the first time. The following is based on observations and discussions with customer personnel during that visit. 25X1

a. Effect

(1) Photo Lab technicians had been thoroughly briefed and trained in the proper manner to handle the SO-239 duplicate negatives, which are a mirror image of conventional third generation negatives. No problems unique to SO-239 were encountered.

(2) Photointerpreters prefer the third generation enlargements they now receive from the Photo Lab over the fourth generation ones of the past. As most of these enlargements are at magnifications of 40X or greater, the matte particles in the SO-239 emulsion appear as very small plus density spots on the enlargements. However, these are not considered objectionable in view of the overall improvement with SO-239, and the fact that the enlargements are used mainly for briefing purposes rather than interpretation.

b. Short Range Improvements. Two minor changes in the packing configuration of the SO-239 copies were requested. First, all copies are to be wound emulsion out to simplify handling on enlargers. Second, an extra label is to be applied to each can stating that the SO-239 dupe negative is wound emulsion out, and indicating in brief phrases how the material should be handled. This request was confirmed by message on 29 September 1969 and took effect with [redacted] 25X1

c. Long Range Improvements

(1) Matte Particles. Although the matte particles are accepted as the trade-off for improved definition in enlargements from SO-239, it would be very desirable if their effect could be eliminated. Liquid gate printing (or possible manufacturing changes in SO-239) may ultimately offer a solution to the matte problem.

(2) Selective Target Printing. The Photo Lab actually uses only a very small percentage of the total square footage delivered to it in the duplicate negative, and selective target printing could assist the Photo Lab. Current contractor reproduction techniques are aimed at providing the best overall density level in each duplicate copy on a part-by-part basis, without knowledge of what the targets of interest might be. (This necessarily requires compromises, because a series of many frames must be printed at a single level.) The Photo Lab feels that sometimes target areas which must be enlarged could have been more desirably recorded at a different density level or contrast in the duplicate negative. It is too early to tell whether or not SO-239 will have any effect on this problem.

(3) Contrast and Density of SO-239 Copies

(a) SO-239 film affords the capability for higher or lower system contrast than that provided in the duplicate negatives 25X1 for [redacted] and subsequent missions for which the product was used. Given a choice, the Photo Lab would prefer lower contrast. They are currently using Grade 1 paper for 90% of the work and this leaves many higher contrast grade papers, but only one lower contrast paper, from which to choose. This limits the lab's versatility for obtaining

better prints of high contrast imagery. They would prefer to have Grade 2 and 3 paper be the big runner, so there would be more flexibility in both directions. Therefore, a lower contrast duplicate negative would be preferred. Unfortunately, this could have an undesirable effect on the very low contrast imagery that is frequently acquired, especially at low solar altitudes. This is recognized as a limitation of current part-by-part printing techniques and is being considered in the overall concept of selective target printing. No immediate change in overall density or contrast of the SO-239 duplicate negatives is indicated.

(b) Another factor which must be considered is the variation from one photointerpreter to another in what each wants in enlargements. Some prefer higher or lower densities or contrasts than others, and some are more concerned with shadow detail than others. This could perhaps be related to the target specialty of each PI, but it does represent a problem of the Photo Lab and a further complication for selective target printing.

(4) Photo Lab Capability to Use SO-239 Rawstock. Because there may be other uses for SO-239 in the Photo Lab, exposed sensitometric control strips and a Versamat processing specification were left with lab personnel on the visit in conjunction with [redacted] 25X1 Subsequently, a more comprehensive data package, as well as a new batch of sensitometric control strips, were provided.

7. 6451 and SO-369. During the course of study, the customer made several requests for high-contrast duplicate positives (contact and enlargement) of certain low-contrast target areas in past missions. These requests were satisfied by using fine-grained, high-contrast duplicating films 6451 and SO-369. These copies provided NPIC photointerpreters with additional intelligence data over what was obtained in the standard 2430 duplicating film system. It was requested that the NPIC Photo Lab be given the capability to print and process 6451 and SO-369. The following discusses the visit to the Photo Lab to introduce these new products.

a. Printing and Processing. Photo Lab personnel were given a package of data containing process control curves, printer control curves and tone reproduction curves for both films. A processor and printer were brought into control according to these standards and a typical "flat" original negative was printed onto each of the two films. The advantages of these products were evident from the duplicate positives printed.

b. Special Considerations. Artifacts (e.g. measles, Newton rings, non-uniformity, etc.) associated with high-contrast, fine-grained duplicating films, were pointed out and explained. Lab personnel were also given a set of curves showing the differences in contrast between contact and enlargement prints on 6451 and SO-369 from the same original negative.

c. Intended Applications. The Lab Chief mentioned, with some concern, that the Photo Lab does not usually receive the original negative until about six weeks after acquisition and that any special prints, required by their photointerpreters before this time, would have to be from the duplicate negative. It was pointed out that the original intent was to give each of the labs having access to the original negative the capability of printing and processing from the original negative, depending on which lab has the original negative at the time a special print is needed. However, the duplicate negative can be printed onto 6451 or SO-369 to yield easier-to-interpret imagery for low-contrast scenes, and with only the minimal quality losses for an extra generation.

d. General Result. Photo Lab personnel felt that the new high-contrast films offered their lab another tool for improving the reproduction of low-contrast imagery which may not have been possible with their present methods. They were satisfied with the informational package that was provided.

8. 2430 Duplication System. Copies of the contractor's up-to-date process control and system curve data for printing Kodak Fine Grain Aerial Duplicating Film (Estar Base) 2430 have been prepared for transmittal to the Photo Lab. This will enable them to satisfy special requests that may require printing as it would be done on a large-volume basis in the contractor's facility.

DISCUSSION (Color)

9. Interim Color Duplication System

a. Background

(1) With the introduction of Kodak Aerial Color Film (Estar Thin Base) SO-242 for use as an original acquisition product, there is available a significant increase in image quality for color acquisition systems. In the operational color using the forerunner of SO-242 -- Kodak Aerial Color Film (Estar Thin Base) SO-121 -- one of the weakest elements was the limited resolution of the duplicating film, Kodak Aerial Color Duplicating Film SO-271. The advent of SO-242 has magnified this inadequacy.

(2) An obvious solution to the above problem would be an improved color duplicating film. While efforts are currently aimed in this direction by the manufacturer, such a product is not presently available. In an effort to extract as much information as possible from the improved SO-242 color original, the use of other available duplicating products was investigated. The result, from work under another project, was an interim color duplicating system that offered a somewhat improved quality and flexibility over the SO-271 system. Figure 1 illustrates the product types that comprise this interim duplication system for color.

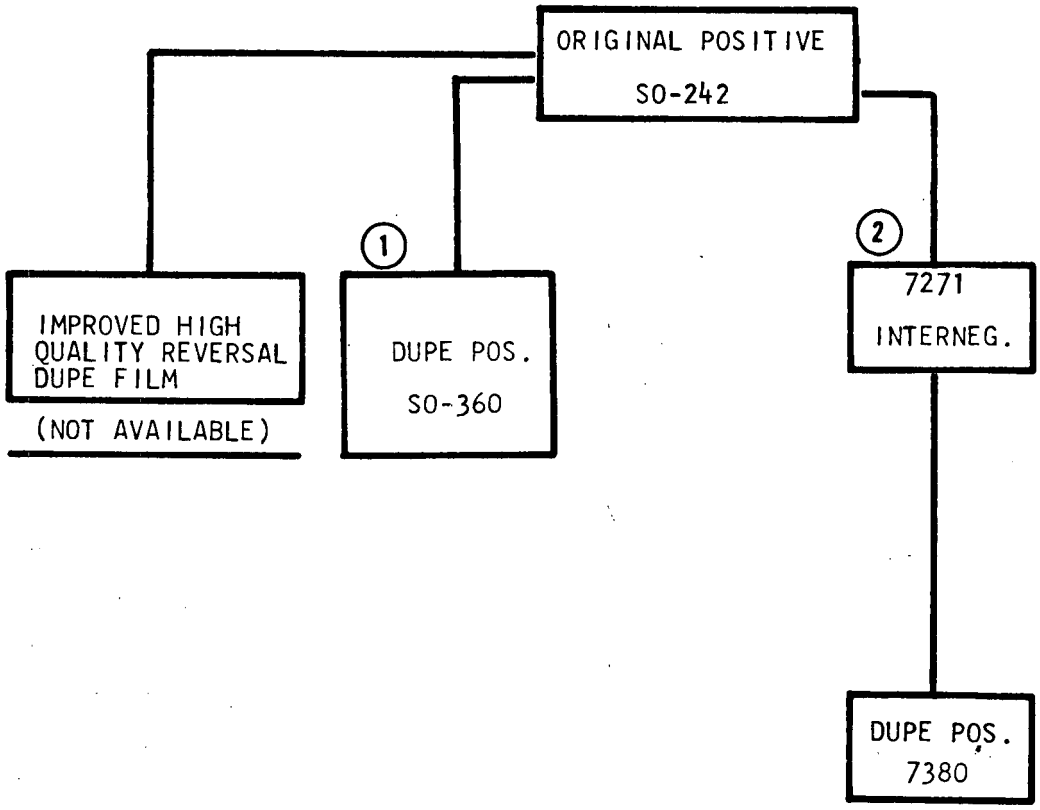
b. SO-360

(1) Block 1 of Figure 1 illustrates the use of Kodak Ektachrome Aerographic Duplicating Film (Estar Base) SO-360 as a replacement for SO-271. This product, like SO-271, is an Ektachrome reversal color film that is usable in generating 1X (contact) duplicates. The procedure is the same as that used for SO-271.

(2) While SO-360 offers only a small improvement in resolving power capability, it does offer a somewhat improved (lowered) color contrast relationship and superior dye homogeniety (or "color granularity").

Figure 1

Interim Color Duplication System



(3) Figures 2 and 3 illustrate printer curves of SO-271 and SO-360. The major improvement in SO-360 with regard to color balance comes primarily from the lower red contrast of SO-360.

(4) Figure 5 illustrates tone reproduction of a specific set of CORN ground targets for a color system using SO-242 as an original, and SO-360 as the duplicating product. In this illustration, the printer has been balanced to obtain equal status "A" integral densities of 16% neutral ground reflectance objects. Figure 4 illustrates (for one color only) the constituents of the system used to generate the tone reproduction curves shown in Figure 5.

c. 7271 and 7380

(1) Both Eastman Color Internegative Film 7271, and Eastman Color Print Film 7380, are high-quality, commercial motion picture products capable of yielding good color balance and high resolution. Their use in some cases results in an improvement in both color balance and resolution capability over SO-360. This is true in terms of the duplicate positive, despite the fact that prints produced from 7380 internegatives require an additional third generation step compared to direct reversal second generation duplicates onto SO-360.

(2) Independently of this project, the contractor is conducting a thorough follow-on investigation with operational material to determine if the 7271/7380 route offers a real improvement over duplicates produced directly onto SO-360. All testing will include duplicates produced from operational missions onto both products so that all image characteristics can be evaluated.

(3) Desirable features of the use of 7271 internegatives includes their use in the production of paper prints (discussed later in this report) and in the preparation of a composite master roll from which "adjusted" 7380 prints can be made.

(4) The production of duplicate prints from recent operational color missions have required the use of many different printing conditions to produce satisfactory results. Reversal duplicating film, which necessitates the use of the original for each duplicate

Figure 2

SO-271 Printer Curve

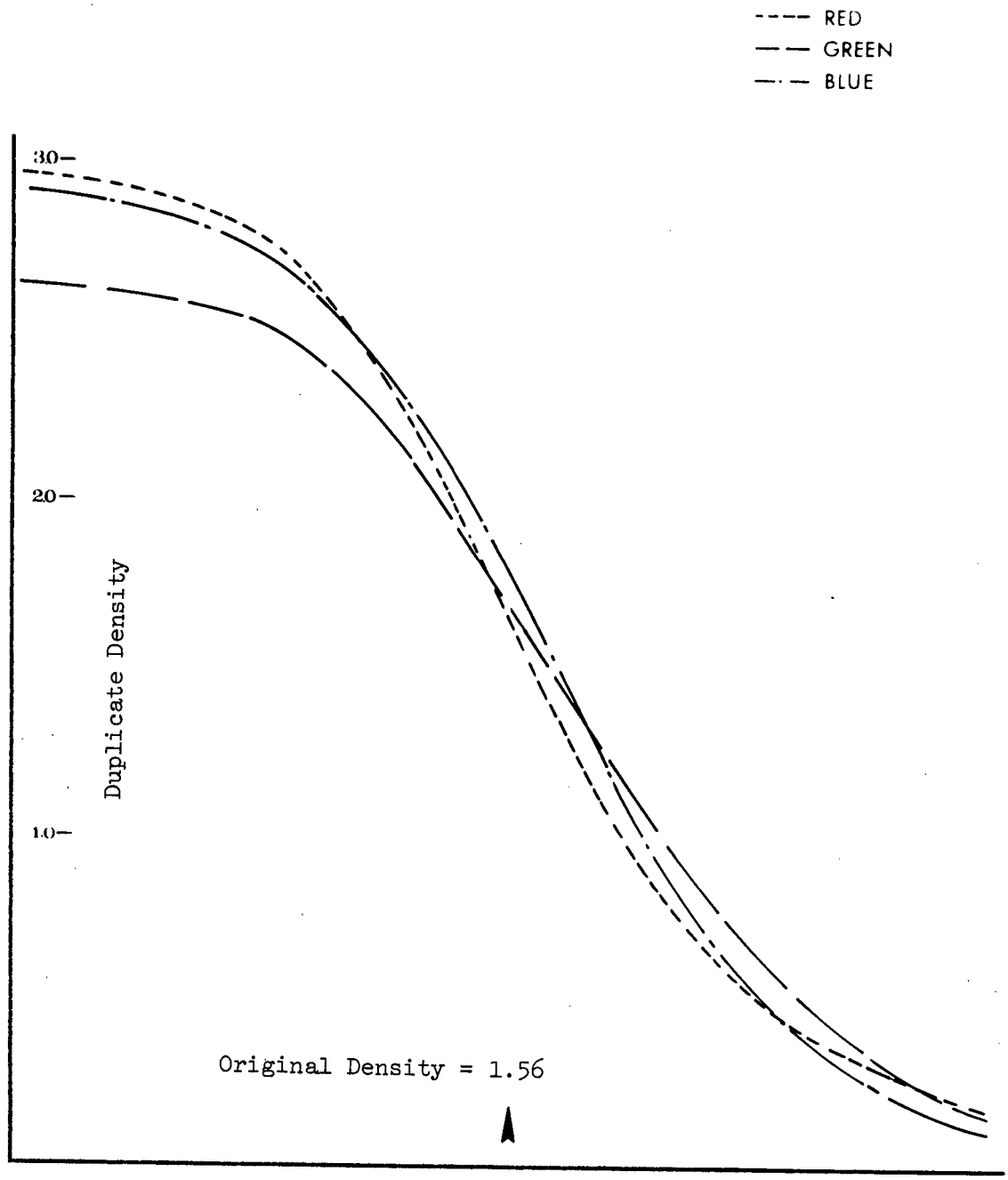


Figure 3

SO-360 Printer Curve

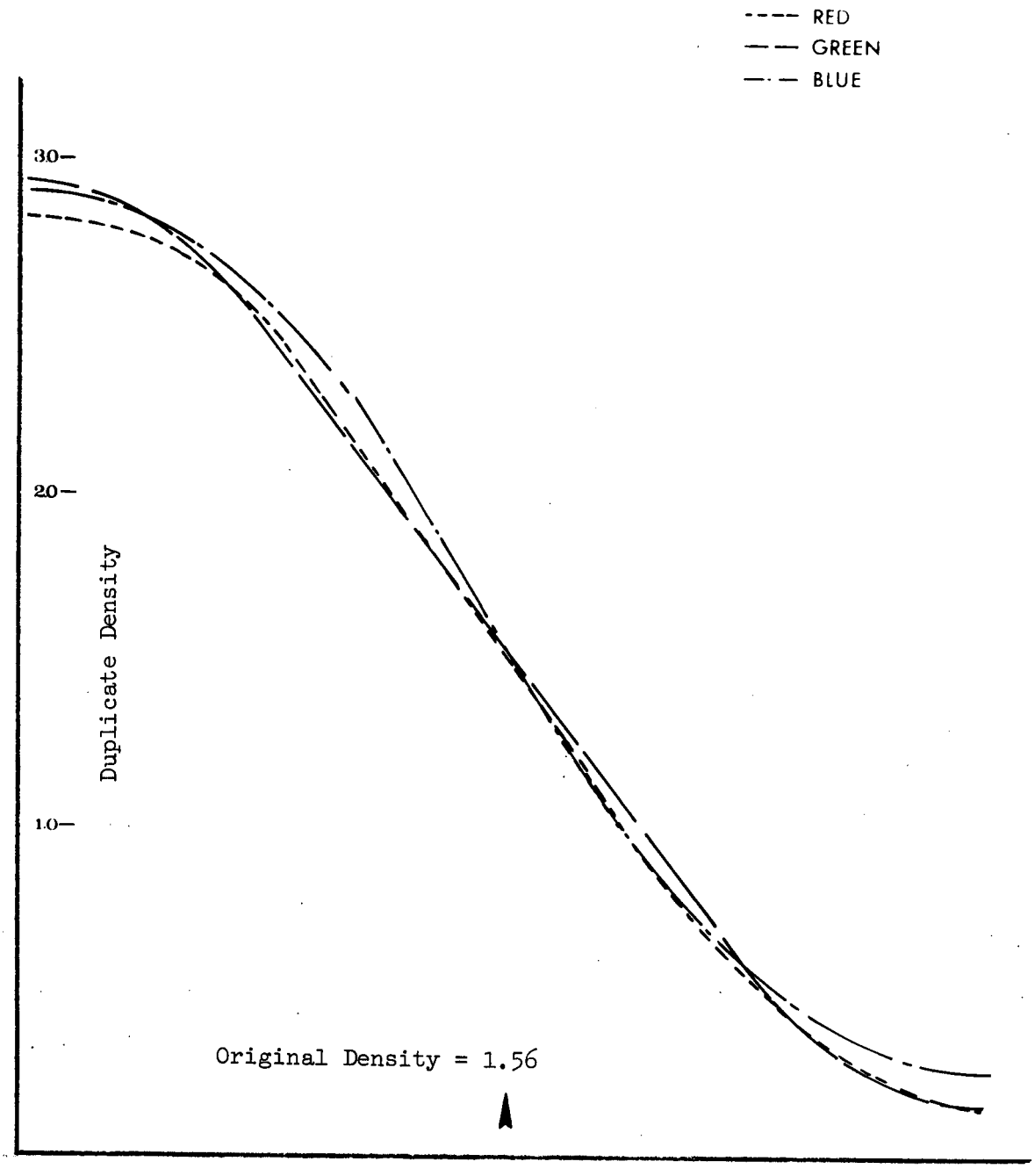
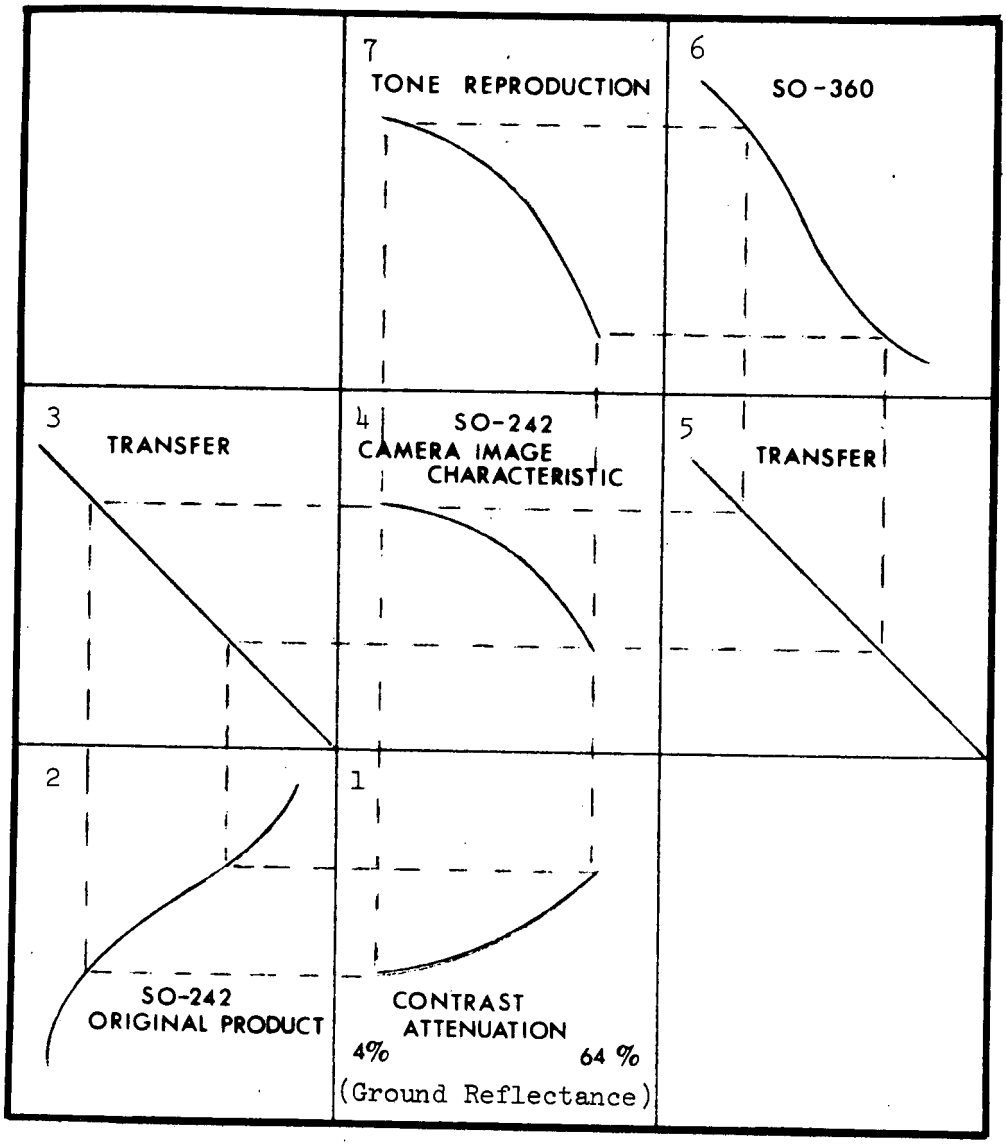


Figure 4

Simplified Tone Reproduction Diagram



This diagram represents a set of conditions with original film SO-242 printed onto duplicating film SO-360. (Only one color in each block has been shown for simplicity.)

Block 1 - Contrast attenuation of the ground CORN Gray scale.

Block 2 - The characteristic curve of the original material.

(Blocks 3 and 5 are used to transfer data)

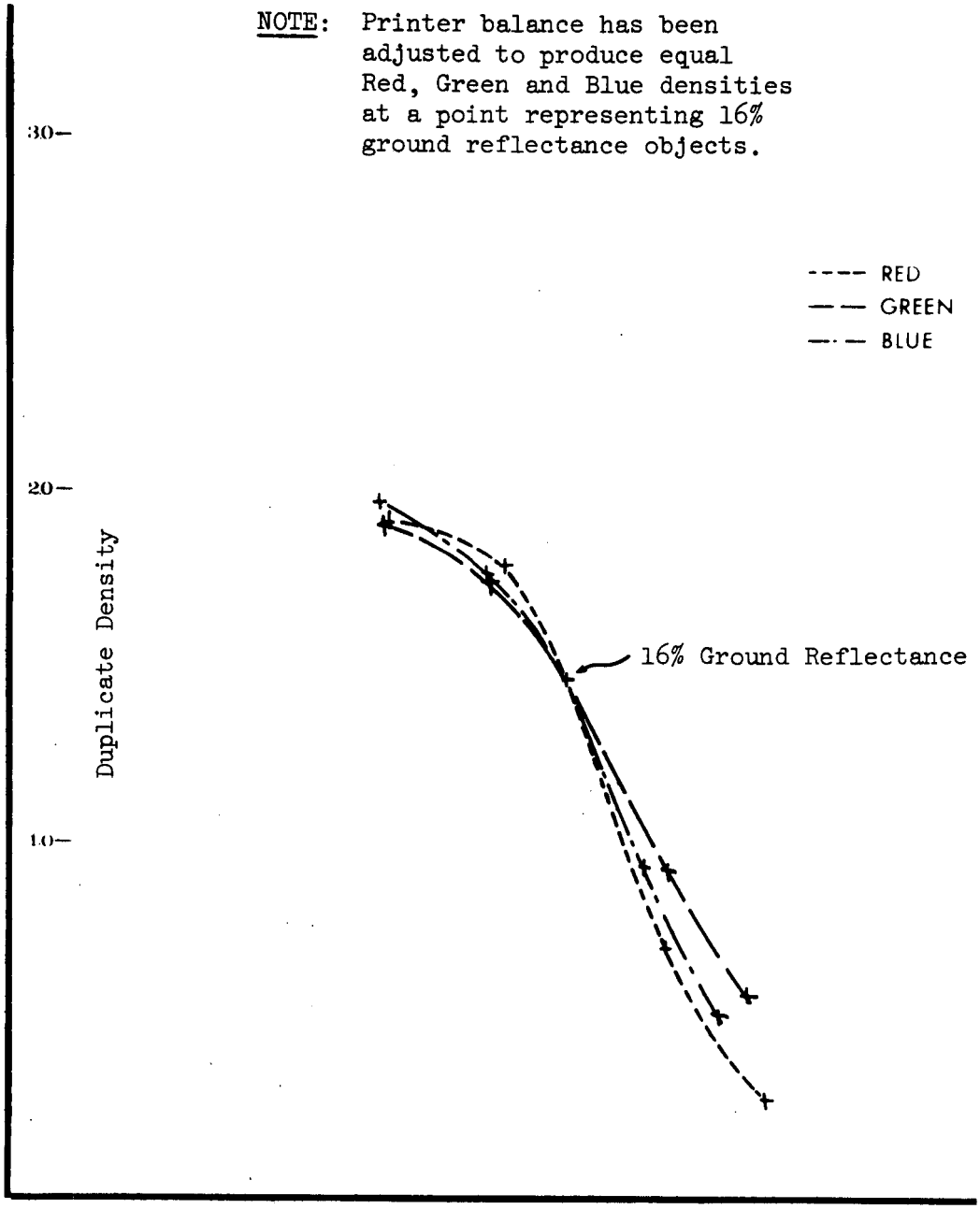
Block 4 - The camera image characteristic of the original product. This includes the effects of such things as the atmosphere, camera flare, optics, etc.

Block 6 - Characteristic curve of the printer/product/process of the duplicating material.

Block 7 - Tone reproduction of the ground CORN objects (Block 1) when the printer balance is adjusted to produce equal integral densities of a 16% neutral reflectance object.

Figure 5

Tone Reproduction Curves -- SO-242/SO-360



copy, requires the further breakdown of the original according to printing conditions, or the reassembly of multiple printings in the composition of the duplicate, if the original is not broken down as such.

(5) Use of internegative systems permits the printing of a "timed" internegative (adjusted in density and color balance) on a frame-by-frame basis, with subsequent assembly of a composite master internegative. This master internegative can in turn be printed at a single (or possible double) level for the entire mission.

(6) The use of such a system with operational missions is currently underway. Prints produced in such a way will be carefully compared to those produced with various printing levels onto SO-360 film.

(7) Figures 6 and 7 illustrate the tone reproduction for these internegative/print materials as used with SO-242 color acquisition film.

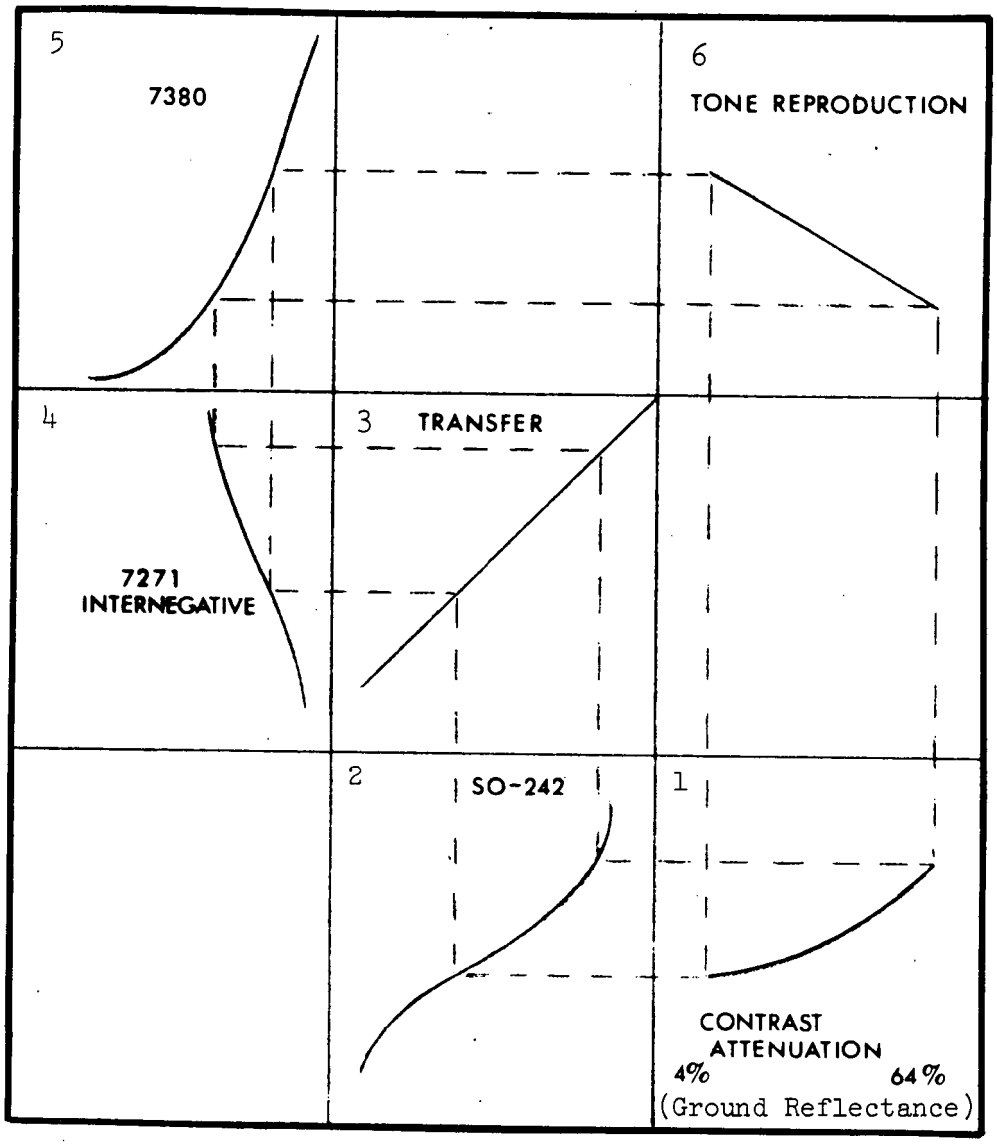
10. Requirements for Briefing Materials

a. Briefing materials used in black-and-white systems consist of up to 40X enlargements onto 24" x 30" photographic print paper to which annotations have been made. (Sometimes, small areas of higher magnification imagery in the form of inserts also are added to the print.) A typical example of a briefing board might be a 4X, 24 x 30 print of a particular target with an insert consisting of a small print (about 6 x 8) magnified to 20X. The insert is usually of the same target as the larger print and is designated by means of the annotation.

b. These briefing boards are called for during the first and second phase readout. Requirements are usually for a total of about 17 copies, one copy being of special priority. This special priority print is usually printed and annotated directly. An insert is added to the enlargement at this time in the form of a paste up, if required. Another print made in a similar fashion is used as a master from which a copy negative is produced. Another requirement of briefing materials is the production of 8 x 10 hard copy reference prints and 8 x 10 Vu-graph transparencies (approximately 60-80 required). These prints are made by contact printing from the 8 x 10 master negative.

Figure 6

Simplified Tone Reproduction of Eastman Color Negative Products -- SO-242/7271/7380



This diagram represents a set of conditions with original film SO-242 printed onto Eastman Color Print film via Eastman Internegative Film. (Only one color in each block has been shown for simplicity.)

Block 1 - Contrast attenuation of the ground CORN Gray scale.

Block 2 - The characteristic curve of the original material.

(Block 3 - Data transfer)

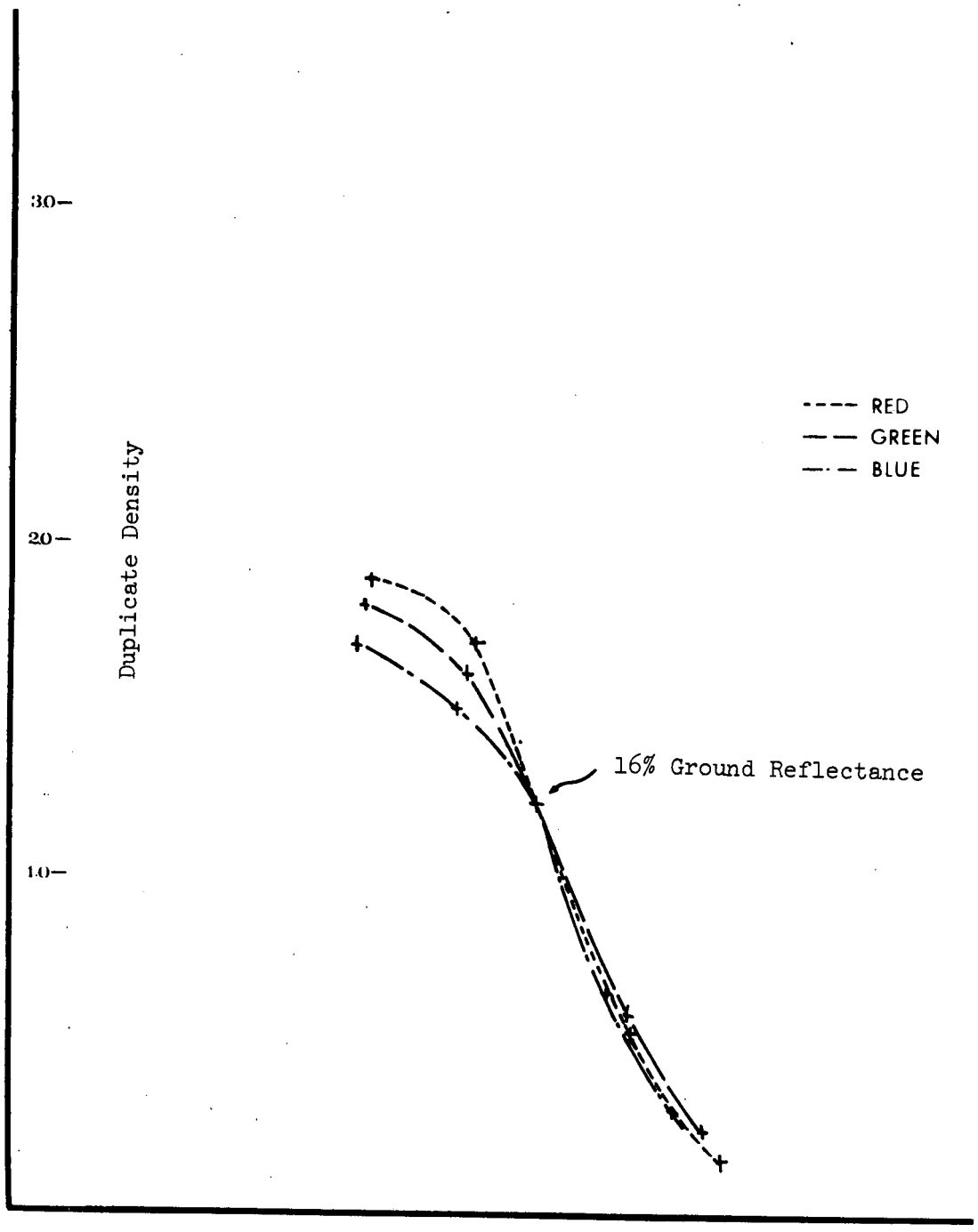
Block 4 - Characteristic curve of the printer/product/process of Eastman Color Internegative Film.

Block 5 - Characteristic curve of the printer/product/process of Eastman Color Print Film.

Block 6 - Tone Reproduction of the ground CORN objects (Block 1) when the printer balance is adjusted to produce equal integral densities of a 16% reflectance object.

Figure 7

Tone Reproduction Curves -- SO-242/7271/7380



d. The requirements for color briefing materials are expected to be the same as that for black-and-white, with the exception that the magnification of the prints will probably be limited to 20X.

e. Materials would be requested from the Photo Lab on a rather timely basis. At this time original color acquisition is not available, so that NPIC must work from internegatives provided by another production facility, or from internegatives produced from the SO-360 reversal duplicate in the Photo Lab. A procedure for the production of color briefing materials must satisfy the requirement for producing the needed number of high-quality annotated prints on a timely basis.

11. Product Investigation

a. General

(1) A preliminary investigation was conducted in order to test and evaluate the various available color products for possible use in the preparation of color briefing materials.

(2) Table 1 gives the names and descriptions of the products evaluated.

(3) Figure 8 is a block diagram depicting the manner in which the products were tested, along with the various stages of enlargement used.

(4) Lines 5 to 8 of Figure 8 are reversal, second generation duplicate prints which were used for comparison purposes with the film and paper prints. Lines 9, 10, 11 and 12 depict prints made from two types of internegatives, Eastman Color Internegative Film 7271 and Kodak Ektacolor Internegative Film 6110 (lines 1,2,3 and 4). The equipment used for this testing is given in Appendix A.

(5) A summary of the results of prints made from these internegatives is given in Table 2. In all cases the comments in Table 2 apply to both film prints and Ektacolor paper prints. This is valid because the results from a particular type and magnification of internegative yield similar results when printed onto transparency or print material.

Table 1

Color Products Used For Duplication (Present)

PRODUCT NAME	TYPE	USE
EKTACHROME AEROGRAPHIC DUPLICATING FILM SO-360 (ESTAR BASE)	COLOR REVERSAL FILM	DUPLICATE TRANSPARENCIES
EASTMAN COLOR INTERNEGATIVE FILM 7271	COMMERCIAL MOTION PICTURE PRODUCT	INTERMEDIATE MATERIAL
EASTMAN COLOR PRINT FILM 7380	COMMERCIAL MOTION PICTURE PRODUCT	TRANSPARENCY (FROM 7271)
KODAK EKTACOLOR INTERNEGATIVE FILM 6110	PROFESSIONAL PRODUCT	INTERMEDIATE MATERIAL
KODAK EKTACOLOR PRINT FILM 6109	PROFESSIONAL PRODUCT	TRANSPARENCY (FROM 6110)
KODAK EKTACOLOR PROFESSIONAL PAPER	COLOR PAPER PRODUCT	PRINTS (FROM ALL NEGATIVES ABOVE)
KODAK EKTACHROME PAPER	COLOR REVERSAL PAPER	PREPARATION OF COLOR PRINTS FROM (ORIGINAL) POSITIVE TRANSPARENCIES

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Figure 8

Diagram of Products/Enlargements Used in Testing

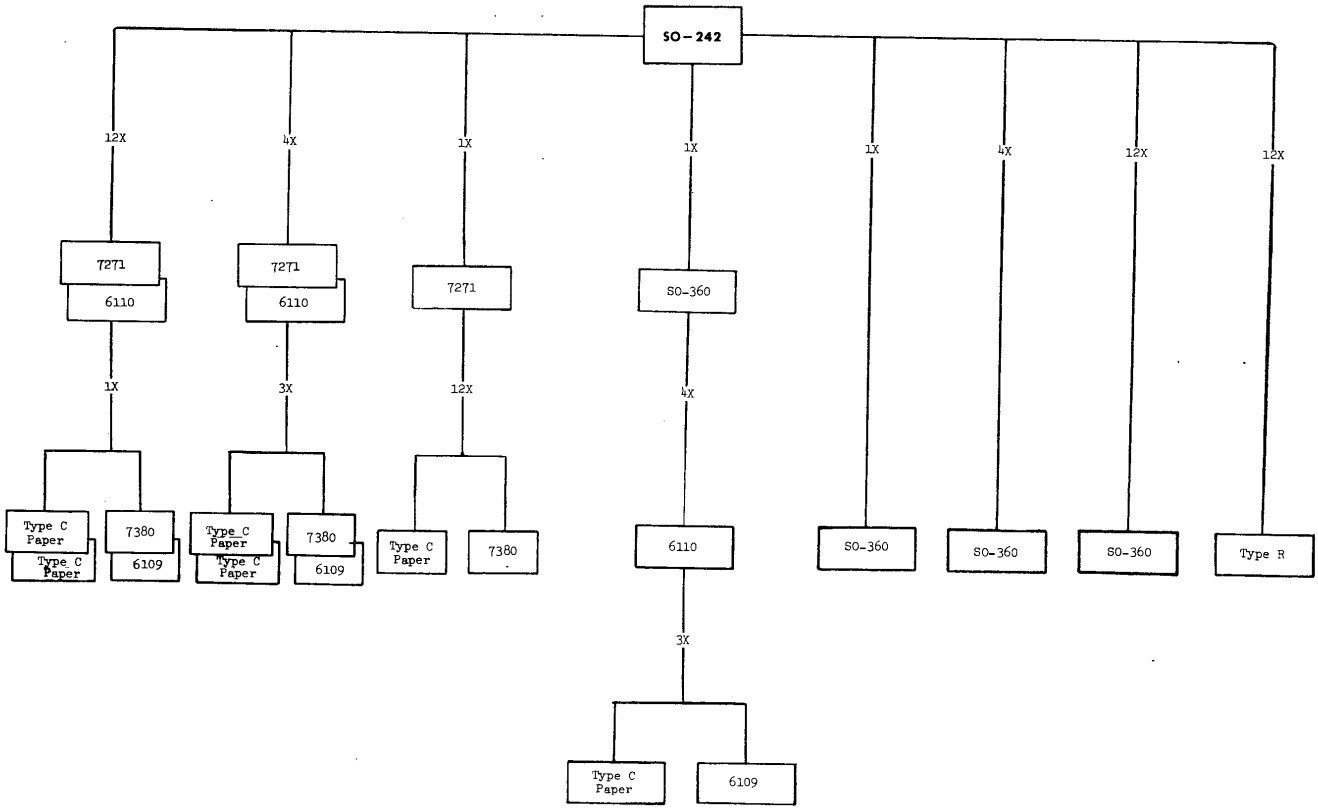

Table 2

12X Print Comparison Summary
(transparency and paper)

INPUT FILM AND MAGNIFICATION	1X7271	4X7271	12X7271	4X6110	12X6110	4X6110 VIA SO-360
SHARPNESS	FAIR	FAIR	GOOD	POOR	POOR	POOR
CONTRAST	GOOD	HIGH	HIGH	LOW	LOW	HIGH
GRAININESS (DYE HOMOGENITY)	GOOD	POOR	POOR	GOOD	GOOD	GOOD
SYSTEM COMPATIBILITY	GOOD	POOR	POOR	POOR	POOR	GOOD

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b. 7271 Internegatives

(1) Prints obtained from 1X (contact) 7271 internegatives were acceptable, while prints obtained from enlarged (both 4X and 12X) 7271 internegatives were unacceptable. The enlarged internegatives displayed evidence of excessive contrast and graininess.

(2) The excessive contrast can be attributed to a "reciprocity failure" effect with this product. Exposures longer than one second produce a non-linear increase in contrast. Enlarged 7271 negatives required the use of the BPE (Beacon Precision Enlarger) with exposures ranging from one to two minutes. This was in spite of the fact that the BPE lamphouse was converted to white light (subtractive) printing in order to gain as much illumination as possible. (This product is designed for use with exposures of less than one second.)

(3) The exact cause for the increased graininess of enlarged 7271 internegatives was not determined. The contact printed 7271 internegatives did not show this problem. It is possible that edge effects (of SO-242 enlarged onto 7271) are responsible for this phenomenon.

c. 6110 Internegatives from Color Originals. The enlarged 6110 internegatives produced from SO-242 originals lacked the sharpness of 7271 internegatives, but displayed good color balance and graininess characteristics. Evidence of increased contrast from reciprocity failure was not apparent on this product as was the case with the enlarged 7271 internegatives. The 6110 film was exposed for approximately 20 seconds as against the product recommendation for a range of 1 to 16 seconds.

d. 6110 Internegatives Via SO-360 Duplicate. The internegatives made from the SO-360 reversal duplicate as compared to internegatives made from the SO-242 original showed higher contrast and somewhat reduced sharpness. Color balance was perhaps a bit more saturated in color, especially with respect to reds.

e. Suitability of Color Products for Briefing Materials

(1) Both the Eastman Color products (7271/7380) and Ektacolor products (6110/6109) can be utilized in some form to produce enlargements for briefing material usage. The results obtained in the above preliminary product investigation precludes the use of enlarged 7271 internegatives in available systems.

(2) Contact 7271 internegatives and enlarged 6110 internegatives can be used in several schemes as intermediate products for the preparation of briefing materials. These intermediate films can in turn be used to produce briefing boards on Ektacolor Professional Paper. Vu-graphs can be produced on either 6109 or 7380 print film.

(3) Figures 9, 10 and 11 depict three viable routes that can be used for the production of briefing materials utilizing the products tested above. Details of these systems will be descussed below.

12. Preparation of Color Briefing Materials

a. Present Black-and-White System

(1) The system presently being utilized at NPIC for the preparation of black-and-white briefing materials (Figure 12), requires the use of five generations to produce the required briefing boards and VU-graphs. The two 24 x 30 (3rd generation) paper prints are annotated directly.

(2) Because of the requirement of approximately 17 briefing boards and 60 to 80 Vu-graphs, all with annotation, a master negative is made from one of the annotated paper prints and in turn used to produce the remaining prints and Vu-graphs.

(3) The systems shown in Figures 10 and 11 permit the production of briefing materials with fewer generations. The prints so produced display superior quality, especially with regard to sharpness.

b. Production of Briefing Materials Via Route 1(Figure 9)

(1) This system is similar to that used in the preparation of black-and-white briefing materials in that it requires direct annotation onto paper and subsequent copying onto a master negative.

Figure 9

Color Briefing Material Prepration -- Route 1

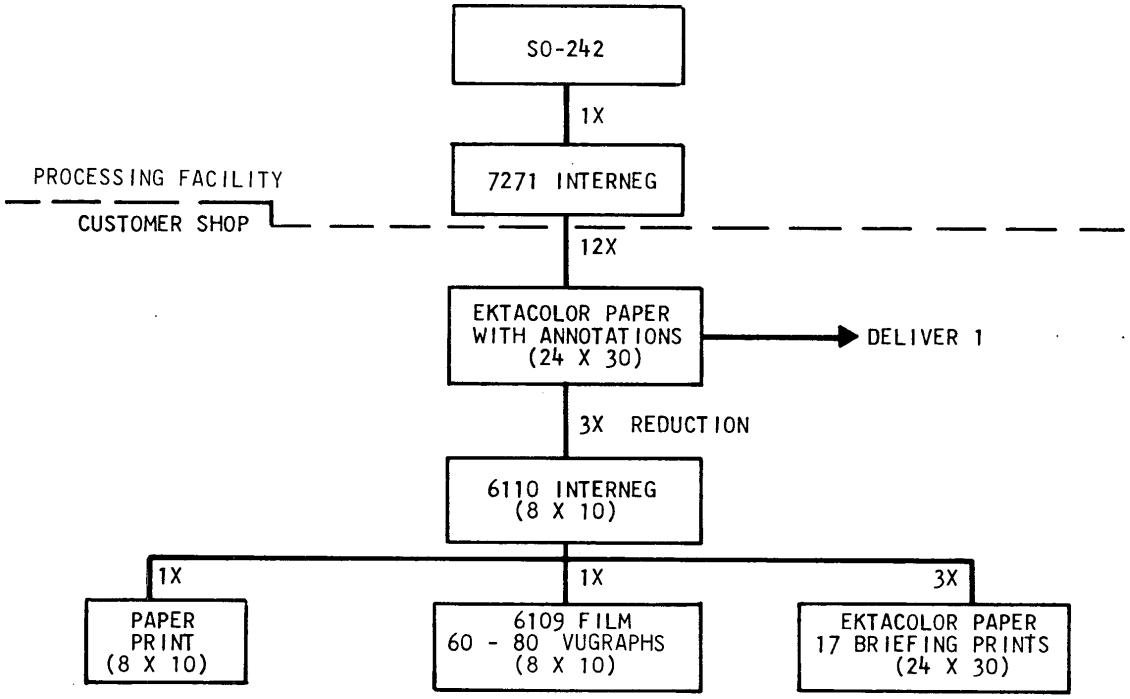

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Figure 10

Color Briefing Material Preparation -- Route 2

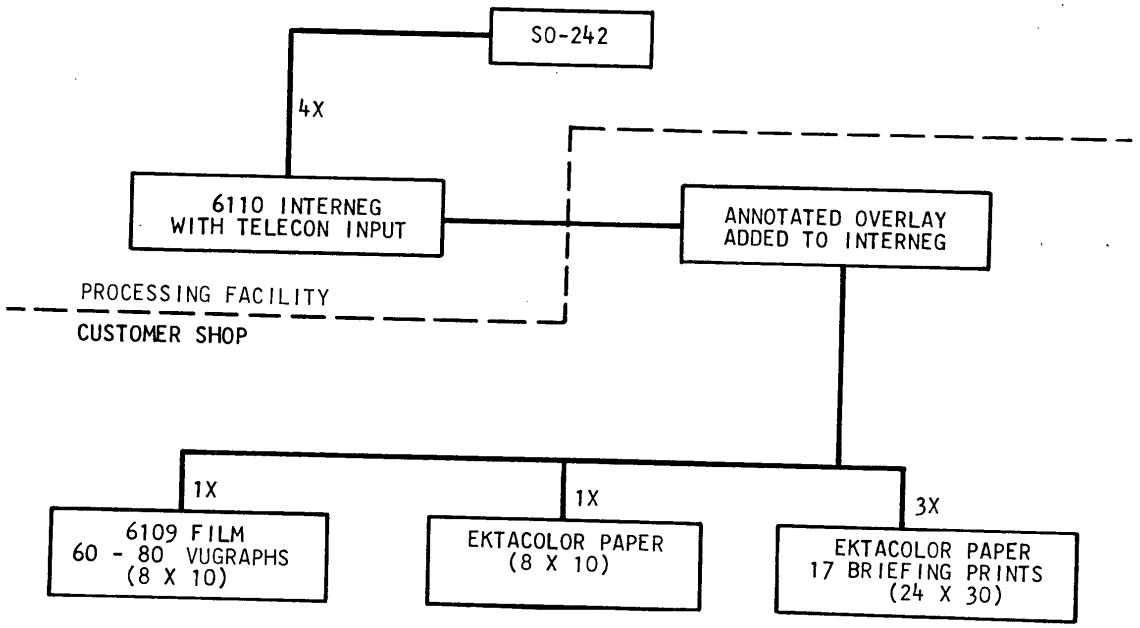

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Figure 11

Color Briefing Material Preparation -- Route 3

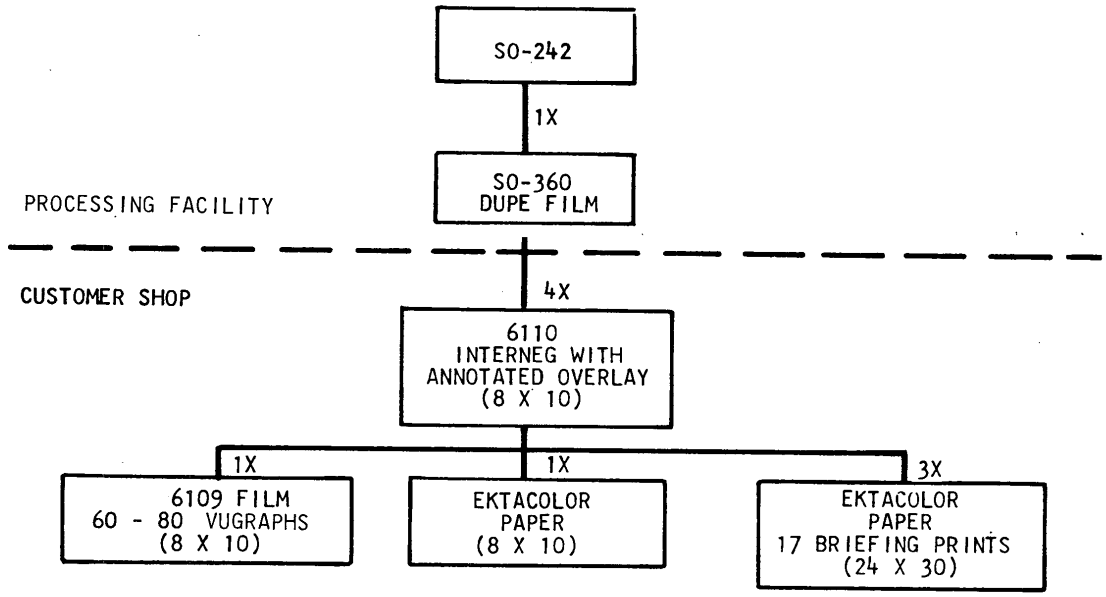

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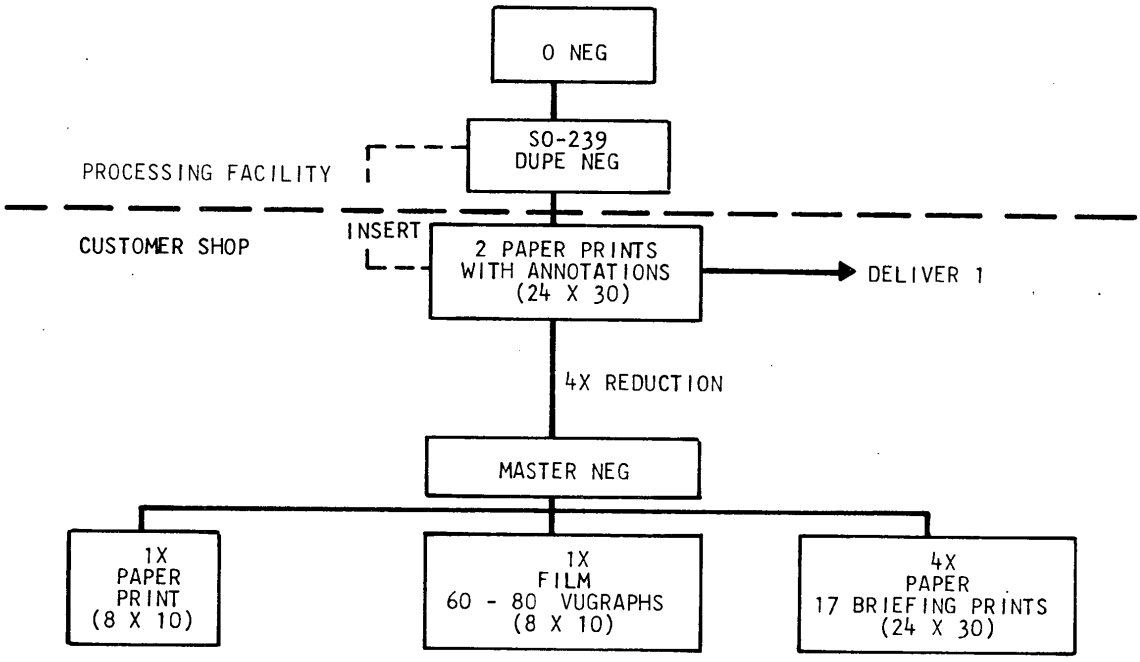
Figure 12

System Presently Used for Production of Black-and-White Briefing Materials



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(2) The final production briefing materials require five generations. The two 24 x 30 prints (3rd generation) produced from the 7271 internegative are of good quality, primarily because they are 3rd generation prints from a 7271 internegative possessing an inherent high resolving power.

(3) This system allows flexibility of target selection in that a complete mission copy 7271 internegative can be supplied to NPIC for use in the production of briefing materials at a time when they are being requested.*

c. Production of Briefing Materials Via Route 2 (Figure 10)

(1) This system permits the production of annotated briefing materials in three generation steps. Since the internegative is made directly from the SO-242 original immediately after processing, a telecon input to the processing facility is necessary to indicate the specific target area. (Figure 10 indicates an internegative of 4X magnification for illustration purposes. Other magnifications can be used to produce the 8 x 10 internegative, provided they are compatible with the equipment used and the coverage desired.)

(2) This system introduces the use of an 8 x 10 annotated overlay placed in contact with the 8 x 10 internegative. This overlay, which can be produced with materials such as opaque press-tape lettering deposited onto clear acetate sheet, contains the annotation and will show up as white letters** on the final briefing boards and Vu-graphs.

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* Request for briefing aids are normally made during phase 1 and 2 readout periods. At this time the Photo Lab does not have the original SO-242 acquisition film at their disposal. The production of enlargements at this time must be made from the 1X 7271 internegative shipped with the SO-360 color duplicates, or from internegatives produced at NPIC from the SO-360 duplicates.

** A procedure for the production of "outlined" letters which will show up on either light or dark backgrounds can be used for greater flexibility. This procedure is described in Kodak Publication No. Q-126 "A Method for Making Spreads and Chokes."

d. Production of Briefing Materials Via Route 3 (Figure 11)

(1) This system calls for production of an internegative (4X or larger) from the SO-360 reversal color duplicate. The internegative (6110) would be produced at NPIC and would offer complete selectivity of targets, as the complete mission is available at this time on the SO-360 duplicate. Use of the annotated overlay technique would reduce the number of generations required for final prints, although the system still requires four generations.

(2) The quality of this 6110 internegative produced from the dupe would be somewhat inferior, especially with regards to sharpness, to a 6110 or 7271 internegatives produced directly from the SO-242 original.

13. Summary of Available Systems for the Preparation of Briefing Materials

a. Route 1 (1X 7271 -- Produced from Original)

(1) Advantages

(a) Provides the best overall 2nd generation internegative.

(b) The entire record is available at NPIC on a timely basis.

(c) This system provides a high quality 3rd generation paper print for use as the two first priority briefing boards.

(2) Limitations. The production of the remaining quantity of briefing materials requires five generations.

b. Route 2 (4X 6110 -- Produced from Original)

(1) Advantages. This system requires only three generations to produce all annotated materials.

(2) Limitations

(a) Requires a telecon input* to designate target.

(b) Some target images in the internegatives may be lower than desirable in contrast. Special printing techniques could thus be required to maintain normal contrast.

c. Route 3

(1) Advantages. Entire record available to customer shop on a timely basis.

* Future communications improvement may make this easier.

(2) Limitations

(a) Requires four generations to produce all materials.

(b) Compromises quality, especially sharpness.

14. Possible Future Systems

a. General

(1) Systems which could employ the use of intermediate films are shown in Figures 13 and 14. These materials have not been tested in such systems and have been shown for illustrative purposes only as considerations for future systems. The color intermediate products shown have been designed for, and are only available in, motion picture sizes.

(2) The use of products such as these, if they become available, would be attractive in that they permit the use of a system having the quality capability of a 2nd generation 7271 internegative (as shown in Figure 9) along with the feasibility of "mass" producing the remaining annotated prints in one additional stage (Figures 13 and 14).

b. Negative Intermediate Film 5253

(1) Figure 13 describes a system utilizing Eastman Color Intermediate Film 5253 in conjunction with Eastman Color Internegative Film 7271.

(2) This intermediate product yields a positive image when printed from the 7271 internegative. Such a 3rd generation intermediate stage would permit inclusion of an annotated insert so that the final annotated prints can be produced in one additional generation. The final stage calls for the use of reversal materials because of the positive polarity of the intermediate stage.

c. Reversal Intermediate Film 5249

(1) Figure 14 shows a system similar to that described above except that it utilizes Eastman Color Reversal Intermediate Film 5249.

(2) The polarity of this material calls for the use of negative products in the final stage. The intermediate stage, however, permits the inclusion of the annotated insert.

Figure 13

Possible Future Color Negative System

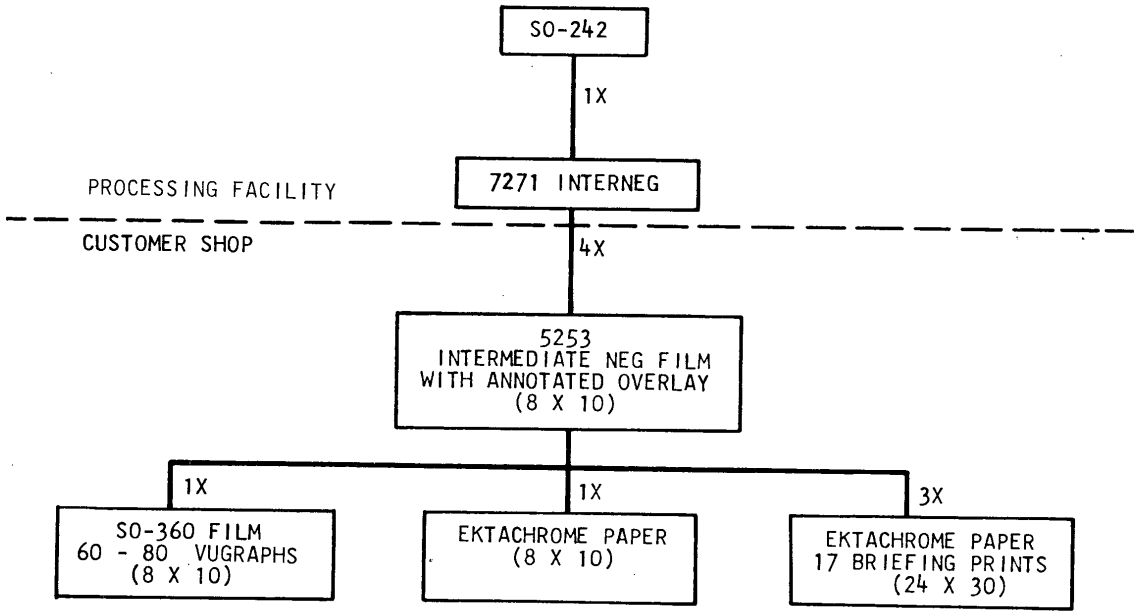

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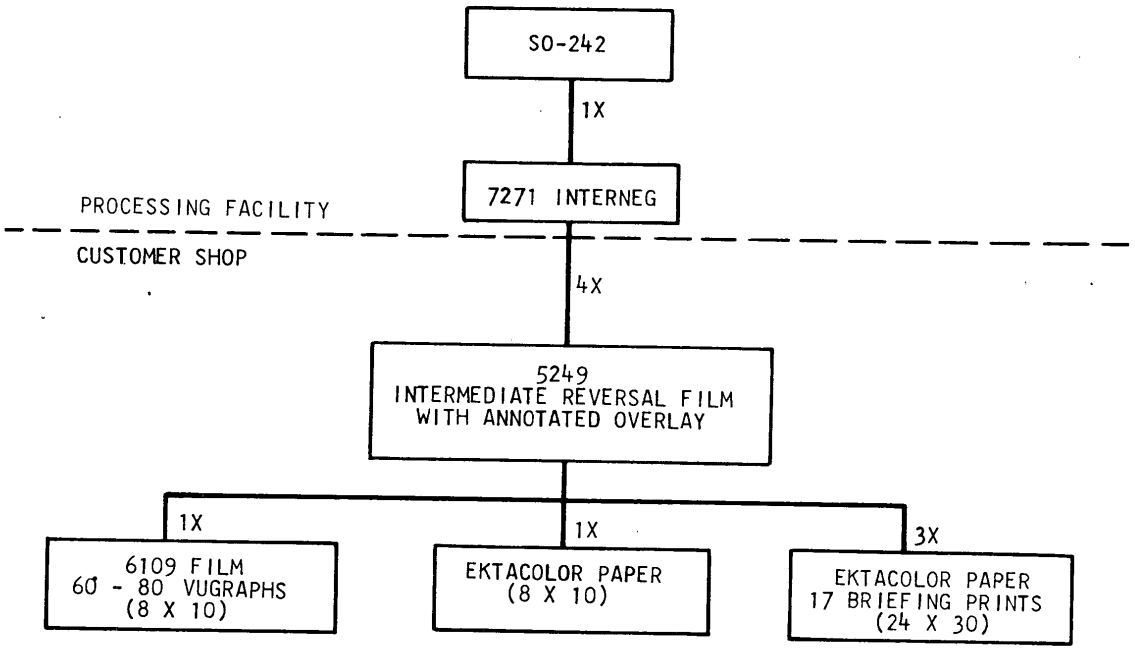
Figure 14

Possible Future Color Reversal System



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CONCLUSIONS

15. Black-and-White

a. The techniques provided to NPIC are adequate for improving the quality and effectiveness of production operations. Processing and printing specifications for Photo Lab personnel, and training in their use, have been given for three products:

(1) SO-239. This direct reversal duplicating film offers the improvement in quality of a duplicate negative at the second rather than the third generation level.

(2) 6451. A fine-grained, high-contrast duplicating material, this film facilitates extraction of additional information by photointerpreters in selective printing applications.

(3) SO-369. Characteristics and advantages similar to 6451 make this film another choice for selective printing.

b. The NPIC facility is now adequate in respect to equipment, personnel and procedures -- excepting only the possible need for more choices in low-contrast grade photographic paper print materials. This need is an item for customer evaluation.

16. Color

a. Procedures normally used for the production of black-and-white briefing materials are limiting in their capability to produce briefing materials in color. The current system is less than adequate, specifically, for attaining the quality and production capacity that would be consistent with a timely schedule.

b. There are presently available viable routes that can be taken to produce color briefing materials utilizing a reduced number of stages of printing.

c. The use of graphics in the form of annotated inserts is a workable approach, and will result in a savings of up to two generations of printing.

d. Products usable in the production of briefing materials can be processed in continuous color processors of the roller transport type in order to increase productivity.

e. Equipment and personnel capability at NPIC will require considerable augmentation to produce color materials, including enlargements and briefing boards, on an operational basis. Training would also be required subsequent to such augmentation.

f. While systems are available to handle color duplicating and enlarging operations, and the customer may at his option choose to implement such systems, flexibility should be maintained to take advantage of any new color products that may become available. At present, the resolving power capability of color duplicating products is considerably less than that of the new color acquisition material, SO-242, and improved color duplicating materials are highly desirable.

17. General. Because of the improvements of products and processes through constant development, this effort should be continued indefinitely.

18. Black-and-White. That the customer consider implementing use of the new materials, where applicable, to improve quality and effectiveness in his facility.

19. Color. That the customer consider:

a. Investigation of his needs to implement one of the three routes described in this report for the production of color briefing materials.

b. Implementing the use of such devices as contact inserts within the printing stages as a means of providing annotations to systems used to produce briefing materials.

c. Increasing the production capacity of the NPIC Photo Lab by considering the use of a continuous color processor such as the Kodak Ektachrome RT Processor, Model 1811M, or the Model 1411M. These processors could be modified to accept a negative process to permit the continuous processing of either 8-inch or 10-inch width Ektacolor 47 paper prints. A similar modification could be made to process either or both the 6110 internegatives and 6109 prints. The largest production capability could be realized with the processing of the Vu-graphs on continuous rolls of 6109 print film.

d. Updating or supplementing methods for the production of color briefing materials with improved systems as they become available. Investigate the feasibility of utilizing color intermediate products in systems to produce color briefing materials as they become available.

e. Providing technical liaison between NPIC and the contractor with regard to techniques to provide improved color briefing materials. This would include any required assistance and training in the implementation of continuous processing cycles for color materials at NPIC.

f. Continuing to investigate improved methods of providing duplicates from SO-242 originals. Studies should include the feasibility of utilizing timed contact internegatives on 7271 film printed onto 7380 film as a possible supplement or replacement for duplicates made onto SO-360.

APPENDIX

Equipment Used for Color Printing and Processing Operations

1. Printing

a. 1X (contact) 7271 Internegatives. Where printed on a Rainbow continuous contact color printer, the Rainbow printer was modified to run at 5-feet-per-minute, and the lamphouse was converted from an additive to a subtractive mode in order to obtain sufficient illumination.

b. 1X SO-360 duplicates were printed on a Conventional Rainbow Printer.

c. 1X Ektacolor paper prints were printed on a "Miller-Holzwarth" contact printer.

d. All enlargements onto internegative films 7271 and 6110, reversal duplicating film SO-360, and paper prints were printed on the BPE (Beacon Precision Enlarger). The lamphouse was converted to subtractive printing for the 7271 and 6110 internegative printing.

2. Processing

a. Eastman Color Internegative Film 7271 was processed in an Eastman Color Internegative type process in the Ragdoll continuous deep tank processor.

b. Ektachrome Aerographic Duplicating Film (Estar Base) SO-360 was processed in an ME-4 type process in the Grafton continuous deep tank processor.

c. Ektacolor Professional Paper was processed in the CP-100 process in the Kodak Rapid Color Processor, Model 30 (24 x 30 size only). The contact printed 9.5-inch wide prints were processed in a Kodak RT Color Processor, Model 1411CM, adapted to a special process for Ektacolor Paper.

d. Kodak Ektacolor Internegative Film 6110 was processed in a 3.5-gallon (Kodak C-22 process) sink line, using Kodak Internegative Developer.

e. Kodak Ektacolor Print Film 6109 was also processed in a 3.5-gallon sink line in C-22.

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