ANALYSIS OF DUPONT AND KODAK DUPLICATING FILMS
AND CHEMISTRIES IN A FULTRON SPRAY PROCESSOR

This Report has been reviewed
and is approved.

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ABSTRACT

This report describes a test program conducted with duPont duplicating film type SR 112 and SCOLOR developer and Kodak duplicating film types 2430, 2422, and FE 2628 (S0-467) and MX-641 developer to determine sensitometric and image quality characteristics of these materials when used with a Fultron Spray Processor.

The test results show that the SCOLOR developer foams excessively in the Fultron Processor when used without any additives and when used with the addition of .05 milliliter of antifoaming agent, tributyl phosphate, per liter of SCOLOR developer.

For the film/process combinations tested, the Kodak type FE 2628 film with MX-641 chemistry had the longest linear Log E range at a 1.0 gamma.

Sensitometric curves and granularity traces for all film/process combinations tested are included in the appendices.
INTRODUCTION

The duplication of photographic films is an especially critical task for the Photographic Technology Division (PTD), since most of the scientific investigations are conducted not with the original imagery, but with various generation copies.

The Photographic Science Office is, therefore, continually searching for new duplicating materials and techniques to insure that the duplicate imagery distributed by the PTD is of the highest possible quality.

One of the major problems confronting the Precision Laboratory is that of obtaining a high resolution duplicating material capable of producing a gamma of 1.0 with a linear Log E range of at least 1.4 using a chemistry compatible with the Fultron Spray Processors. This requirement comes about primarily because of the large density range encountered on much of the lunar imagery. A search was instituted for new duplicating materials capable of meeting the described parameters.

On January 4, 1972, representatives of the Photographic Science Office and the Precision Laboratory met with representatives of the E. I. duPont de Nemours & Company, Inc., to discuss their duplication materials. Two films, types CRN and SR 112, were described which appeared to offer advantages in latitude and
resolution over those materials presently being used. The film
type CRN is a direct reversal material similar to Kodak film
type 2422, but is claimed to have a longer linear Log E range.
Film type SR 112 is a negative type duplicating film with sensi-
tometric characteristics similar to Kodak film type 2420. The
recommended developer for these films is duPont SCOLOR. However,
this developer had never been used in a Fultron Spray Processor.
The PTD requested that duPont supply eight 5 inch by 500 foot
rolls of each film type and 500 gallons of SCOLOR developer
for testing in the Fultron Processor.

Shortly thereafter, Kodak informed the PTD of a new experimental
duplicating film similar to 2420 but with a longer linear Log E
range and improved MTF characteristics. This film was called
FE 2628 at the time, but has since been formally numbered SO-467.

A comprehensive test plan was prepared to evaluate the duPont
films and chemistry. This same plan was to be followed using
Kodak duplicating materials to provide a basis for comparison.
While awaiting arrival of the duPont materials, tests were
conducted with Kodak duplicating film types 2430, emulsion
batches 178 and 175, and 2422 processed in a Fultron Processor
with MX-641 developer.

Considerable difficulty was encountered in obtaining the duPont
materials. They were considerably late in arriving at MSC and
when they finally arrived, they were not complete as requested; no CRN material was received and only 60 gallons of SCOLOR developer arrived, as opposed to the 500 gallons requested. This quantity of developer was not nearly enough for evaluation in the Fultron Processor. The original test plan had to be altered and some of the objectives changed to account for a lack of materials and, by now, lack of time. The objectives and test procedures which follow reflect the required revisions.
TEST OBJECTIVES

I. Determine the gamut of sensitometric curves (D Log E) obtainable in a Fultron Processor for all film/chemistry combinations being tested.

II. Determine the image quality characteristics for all film/chemistry combinations being tested.

III. Determine if there are any operational problems in using duPont film type SR 112 with SCOLOR chemistry in a Fultron Processor.
TEST PROCEDURES

I. Prepare a printer loop make up of the following items:
   A. Twenty-one step tablet on Kodak type 3400 film with a
      nominal .15 density increment between steps.
   B. Twenty-one step, 5 modulation level resolution frisket
      superimposed on a step tablet made up of steps of
      Wratten #96 neutral density filters with a nominal
      .30 density increment between steps.
   C. Five 3 inch by 3 inch Wratten #96 neutral density patches
      with nominal density values of 0.3, 0.6, 0.9, 1.2, and
      1.5.
   D. Samples of pan and metric camera imagery including both
      high and low phase angle photography.

II. Determine the optimum exposure for duplicating the printer
    loop in a Niagara Printer with the mercury vapor lamp. Do
    this for each of the film/process conditions to be tested.

III. Expose one 500-foot rool for each film/process combination
     with the printer loop in a Niagara Printer using exposure
     criteria determined in Step II.

IV. Determine proper replenishment rate.

V. Process each film/process combination according to its
    respective specification except that 1/3 of each roll
    will be processed at a speed of 10 fpm, the second third
    at 20 fpm, and the last third at 40 fpm.
VI. Uniformly expose 2000 feet of each film type, so that when processed the nominal density will be 1.0.

VII. Process the exposed film in a Fultron Processor to specifications supplied by the Photo Science Office. Process a sensitometric control strip at 100-foot intervals, along with the 2000 feet of exposed film.

VIII. Expose 15 sensitometric strips from two different emulsion batches (if available) for each film type using the I-B sensitometer. Process the 30 strips from each film type randomly in a Fultron Processor to specifications supplied by the PSO.

IX. Throughout all steps continually be conscious of, and record, operational characteristics, including such problems as foaming, clogging of the spray heads, drying ability, tracking, and contamination.
DISCUSSION

The test procedure was followed first with Kodak duplicating film type 2430, a high resolution negative acting emulsion, and film type 2422, a direct reversal emulsion. Development was carried out in the Fultron Processor using MX-641 chemistry at 68°F. and 80°F. with machine speeds of 10, 20, and 40 feet per minute. Tests were conducted with two different emulsion batches of film type 2430. No problems were encountered during this phase of the testing program. These films and chemistry are normally used by the Precision Laboratory in the Fultron Processor.

The second phase of the testing program commenced with the arrival of film and chemistry from duPont. Two duplicating film types, SR 112, a negative acting emulsion, and CRN, a direct reversal emulsion, were to have been received. Only four 500-foot rolls of the SR 112 film were received initially. An additional four rolls were requested, and they arrived the following day. No CRN material was available. Only 60 gallons of SCOLOR chemistry were received for testing as opposed to the 500 gallons originally requested. The lack of chemistry resulted in an abbreviated test being carried out in the Fultron Processor.

The duPont SCOLOR chemistry was mixed in three 20-gallon batches. The resultant chemical analysis, pH and specific gravity (Table 1)
indicates that there is no difference between the three batches.

TABLE 1

duPont SCOLOR Chemical Analysis

<table>
<thead>
<tr>
<th>Batch</th>
<th>pH</th>
<th>Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9.87</td>
<td>1.062</td>
</tr>
<tr>
<td>2</td>
<td>9.87</td>
<td>1.063</td>
</tr>
<tr>
<td>3</td>
<td>9.87</td>
<td>1.062</td>
</tr>
</tbody>
</table>

As suggested by the duPont representative, Mr. Charles L. Wickham, no antifoaming agent was added initially to the chemistry. duPont had conducted tests with a spray processor and the SCOLOR chemistry that indicated that no antifoaming agent would be required.

Foaming of the developer occurred after about 200 feet of film had been processed. The foaming was of such magnitude that it began flowing out of the developer cabinet door and onto the processing feed elevator and floor of the room. At this point it was decided to add .05 milliliter of antifoaming agent, tributyl phosphate, per liter of SCOLOR developer. The developer was then recirculated for thirty minutes, and another processing cycle was attempted. The same foaming problem occurred again.
Due to the lack of developer solution, no further testing could be done. Subsequent testing of duPont film type SR 112 was carried out in Kodak MX-641 chemistry.

An additional operational problem was noted by the Precision Laboratory. They are of the opinion that the plastic cans the SR 112 film is packaged in would contribute a major handling problem due to the extreme effort required to remove the tops.

No further problems were encountered when using duPont SR 112 film with Kodak MX-641 developer in the Fultron Processor.

The final testing phase was carried out with Kodak film designated by an experimental emulsion, number FE 2628. This film is now produced as a special order item numbered S0-467. Only one 500-foot roll was received. This, however, was sufficient to determine sensitometric characteristics.
TEST RESULTS

Fifteen sensitometric strips exposed in the PTD I-B Precision Sensitometer were read on a MacBeth TD217DR densitometer, averaged, and plotted for each film/process combination tested. The resultant D Log E curves are included in Appendix A. The gamma derived from each curve and a listing of all film/process combinations tested can be found in Table 2.

A sensitometric comparison between the two emulsion batches of Kodak film type 2430 is illustrated in Figures 1 through 6. An examination of these curves shows that no significant sensitometric difference exists between the two emulsion batches.

D Log E curves derived by exposing the film in a Niagara printer using a Film Type 3400 step tablet to modulate the light are plotted and included in Appendix B.

The gamma derived from these plots for duPont film type SR 112 in both SC10R and MX-641 developers, and Kodak film type 2430 in MX-641 developer, are included in Table 2. A comparison of the Niagara derived gamma versus the I-B derived gamma shows that the Niagara gamma is lower in all cases but one. This is due primarily to a difference in spectral quality between the
Niagara printer and the Niagara simulation with the I-B sensitometer.

A program developed by Technicolor photoscientist, Bob Goodding, for the Wang 700B Programmable Calculator and Model 702 Plotter was used to provide a plot of the D Log E curve and a plot of the instantaneous slope at each point on the curve superimposed on the same graph. This technique is useful for showing graphically the amount of linearity inherent in the D Log E curve. These curves are included in Appendix C. The curve, displayed as a combination of crosses and dots, is the D Log E curve derived from the average of fifteen I-B sensitometric strips as described previously. The curve, displayed as a series of circles, is a representation of the slope at each point on the D Log E curve. If the D Log E curve was perfectly linear from one end to the other, then the plot of slope would show as a horizontal straight line positioned in the Y-axis at a point equal to the slope of the D Log E curve.

A relative number for linear Log E range was derived from the described slope curve by finding the two points on the curve equal to the maximum slope minus 10%. The Log E distance between these two points is defined as the linear Log E range. This data can be found in Table 2.
To simplify the analysis of the large amount of data collected, the information shown in Table 2 is illustrated graphically in Figures 7, 8, 9, and 10. Figure 7 is a graph of machine speed versus gamma. Figure 8 shows machine speed versus linear Log E range. Figures 9 and 10 illustrate gamma versus linear Log E range for two different temperatures.

Granularity traces were made at four density levels for each film/process combination using a Joyce Loebl microdensitometer with an effective aperture of approximately 23 by 23 microns. These traces are included in Appendix D.
<table>
<thead>
<tr>
<th>Film</th>
<th>Chemistry</th>
<th>Process</th>
<th>Speed (fpm)</th>
<th>Temp (°F.)</th>
<th>I-B Gamma</th>
<th>Niagara Gamma</th>
<th>Linear Log E Range</th>
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### TABLE 2 (continued)

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<th>Film</th>
<th>Chemistry</th>
<th>Process Speed (fpm)</th>
<th>Temp (°F)</th>
<th>I-B Gamma</th>
<th>Niagara Gamma</th>
<th>Linear Log E Range</th>
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</table>
FIGURE 1

Technicolor

ABSOLUTE LOG E AT R.L.E. = 0
FIGURE 2

EMULSION BATCH COMPARISON

2430-178
2430-175
**EXPOSURE DATA**

- **SENSITOMETER**
- **ILLUMINANT**
- **CHEMISTRY**
- **TIME**
- **FILTER**

**PROCESSING DATA**

- **PROCESSOR**
- **CHEMISTRY**
- **SPEED**
- **TANKS**
- **TEMP**

**DENSITOMETRY**

- **INSTRUMENT**
- **TYPE**
- **APERTURE SIZE**
- **GAMMA**
- **FILTER**
- **BASE**

### CHEMICAL ANALYSIS

<table>
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<tr>
<th>SP GR</th>
<th>pH</th>
<th>TA</th>
<th>TPP</th>
<th>KB,</th>
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<td>3.8</td>
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**EMULSION BATCH COMPARISON**

- **2430-178**
- **2430-175**

**FIGURE 3**

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

- **Tachnicolor**
### Film: 2430  Emulsion #: 178 175  MFG:  EXP. DATE:  

<table>
<thead>
<tr>
<th>Exposure Data</th>
<th>Processing Data</th>
<th>Densitometry</th>
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</thead>
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<td>Sensitometer</td>
<td>Processor</td>
<td>Instrument Speed</td>
</tr>
<tr>
<td>Illuminant</td>
<td>Chemistry</td>
<td>Speed ( )</td>
</tr>
<tr>
<td>Time</td>
<td>Speed</td>
<td>D-Max</td>
</tr>
<tr>
<td>Filter</td>
<td>Tanks</td>
<td>Aperture Size</td>
</tr>
<tr>
<td>Speed</td>
<td>Temp °F</td>
<td>Gamma</td>
</tr>
<tr>
<td>Filter</td>
<td>Time</td>
<td>Base Fog</td>
</tr>
</tbody>
</table>

#### Chemical Analysis

- SP Gr
- pH
- TA
- TFP
- KB,

#### Chemical IIll

- SP Gr
- pH
- TA
- TFP
- KB,

**Figure 4**

**Emulsion Batch Comparison**

- 2430-178
- 2430-175
### Exposure Data

- **Sensitometer**: 
- **Illuminant**: K
- **Time**: 30 sec
- **Filter**: 

### Processing Data

- **Processor**: Techicolor
- **Chemistry**: Type
- **Speed**: 40 FPM
- **Temp**: 80°F
- **Time**: 

### Densitometry

- **Speed (F-Max)**
- **Type**: D-Max
- **Aperture Size**: 150
- **Gamma**: 

### Chemical Analysis

- **SP GR**: 3.8
- **pH**: 3.6
- **TA**: 3.4
- **TPP**: 3.2
- **KB**: 3.0

### Emulsion Batch Comparison

- **2430-178**
- **2430-175**

---

**Figure 6**

**Technicolor**

**Absolute Log E at R.L.E.**

-10 -0.6 -0.2 0.2 0.6 1.0 1.4 1.8 2.2 2.6 3.0

0 0.3 0.6 0.9 1.2 1.5 1.8 2.1 2.4 2.7 3.0
FIGURE 7. Machine Speed vs. Gamma

- 2430 MX-641 68°F.
- FE-2628 MX-641 68°F.
- SR 112 MX-641 68°F.
- SR 112 SCOLOR 68°F.
- SR 112 SCOLOR 80°F.
- 2430 MX-641 80°F.
- FE-2628 MX-641 80°F.
- SR 112 MX-641 80°F.
- SR 112 SCOLOR 80°F.
FIGURE 8. Machine Speed vs. Linear Log E Range
FIGURE 9. Gamma vs. Linear Log E Range (68°F.)

- SR 112
- SC6OR 68°F.
- FE-2628 MX-641 68°F.
- SR 112 MX-641 68°F.
- 2430 MX-641 68°F.
FIGURE 10. Gamma vs. Linear Log E Range (80°F.)

- SR 112, SCOLOP 80°F.
- FE-2628, MX-641 80°F.
- 2430, MX-641 80°F.
CONCLUSIONS

The duPont SCOLOR Developer foamed excessively in the Fultron Processor when used without any additives and when used with the addition of .05 milliliter of antifoaming agent, tributyl phosphate, per liter of SCOLOR developer.

The film/process combinations tested produced the following range of gammas:

<table>
<thead>
<tr>
<th>Film</th>
<th>Chemistry</th>
<th>Minimum Gamma</th>
<th>Maximum Gamma</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR 112</td>
<td>SCOLOR</td>
<td>0.27</td>
<td>1.06</td>
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<tr>
<td>SR 112</td>
<td>MX-641</td>
<td>0.73</td>
<td>1.38</td>
</tr>
<tr>
<td>2430</td>
<td>MX-641</td>
<td>1.40</td>
<td>2.13</td>
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<tr>
<td>FE 2628</td>
<td>MX-641</td>
<td>0.86</td>
<td>1.77</td>
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</table>

The film/process combinations tested produced the following maximum linear Log E ranges:

<table>
<thead>
<tr>
<th>Film</th>
<th>Chemistry</th>
<th>Maximum Linear Log E Range</th>
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</thead>
<tbody>
<tr>
<td>SR 112</td>
<td>SCOLOR</td>
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<td>SR 112</td>
<td>MX-641</td>
<td>1.75</td>
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<tr>
<td>2430</td>
<td>MX-641</td>
<td>1.10</td>
</tr>
<tr>
<td>FE 2628</td>
<td>MX-641</td>
<td>2.00</td>
</tr>
</tbody>
</table>
For the film/process combinations tested, the Kodak film type FE 2628 with MX-641 chemistry had the longest linear Log E range at a 1.0 gamma.
**Exposure Data**: 792-15

**Films**: SR 112

**Exposed Data**: 24.89

**Sensitometer**: T-B, PS6809

**Illuminant**: 3000 K

**Time**: 1/2 sec.

**Speed**: TANKS 10, 20, 40

**Temp**: 68°F

**Filter**: none

**Chemical Analysis**

- SP GR: 3.8
- pH: 3.6
- TA: 3.4
- TRP: 3.2
- KB: 3.0

**Densitometry**

**Instruments**: MacBeth

**Speed**: TD217 DR

**Gamma**: Visual

**Base + Fog**: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21

**Abscissas (Log E, at R.L.E. = 0)**

**Tangents**: 10, 20, 40
<table>
<thead>
<tr>
<th>Task</th>
<th>Date</th>
<th>Control</th>
<th>Film</th>
<th>Emulsion</th>
<th>MFG</th>
<th>Expiration Date</th>
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<td></td>
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</tr>
</tbody>
</table>

**FILM** | **EMULSION** | **MFG** | **EXPIRATION DATE**
--- | --- | --- | ---
SR 112 | 150-3 | | |

**SENSITOMETER** | **PROCESSOR** | **INSTRUMENT** | **SPEED** | **TYPE** | **D-MAX** | **APERTURE SIZE** | **GAMMA** | **FILTER** | **BASE + FOG**
--- | --- | --- | --- | --- | --- | --- | --- | --- | ---
I-B | Fultron #1 | MacBeth | | | | | | | |
3000 ˚K | MX-641 | | | | | | | | |
1/2 sec | TANKS 10,20,40 | | | | | | | | |
none | TEMP °F 68 | | | | | | | | |

**CHEMICAL ANALYSIS**

|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| SP GR | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 | 3.4 |
| pH | 3.4 | 3.2 | 3.0 | 2.8 | 2.6 | 2.4 | 2.2 | 2.0 | 1.8 | 1.6 | 1.4 | 1.2 | 1.0 | 0.8 | 0.6 | 0.4 | 0.2 | 0.0 | 0.2 | 0.4 |
| TA | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 | 3.4 |
| TRP | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 |
| KBp | 2.0 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 3.0 | 3.2 | 3.4 | 3.6 |

**LOG E**

|  | 0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AT R.L.E. | 0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 |
**DATE**: Feb 1972  
**CONTROL #**:  
**TASK**:  
**PREPARED BY**:  

**FILM**: SR 112  
**EMULSION #**: 150-3  
**MFG**:  
**EXPIRATION DATE**:  

**792-150 EXPOSURE DATA**: 2489  
**PROCESSING DATA**:  
**PROCESSOR**: Fultron #1  
**SENSITOMETER**: I-B PS6809  
**CHEMISTRY**: MX-641  
**TIME**: 1/2 sec.  
**ILLUMINANT**: 3000 K  
**FILTER**: none  
**TEMP**: 80°F  

**PROCESSING DATA**:  
**TYPE**: TD217DR  
**PROCESSOR**: Fultron  
**INSTRUMENT**: Mac Beth  
**CHEMISTRY**: MX-641  
**APERTURE SIZE**: 4 mm  
**FILTER**: Visual  

**SENSITOMETER**: I-B PS6809  
**CHEMISTRY**: MX-641  
**TIME**: 1/2 sec.  
**ILLUMINANT**: 3000 K  
**FILTER**: none  
**TEMP**: 80°F  

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### Chemical Analysis

<table>
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<th>Chemical</th>
<th>Value</th>
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<td>KBf</td>
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### Chart

**Technicolor**  
**Absolute Log E**  
**AT R.L.E.** 0
| CHEMICAL ANALYSIS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|
| SP GR            | 3.0| 2.8| 2.6| 2.4| 2.2| 2.0| 1.8| 1.6| 1.4| 1.2| 1.0| 0.8| 0.6| 0.4| 0.2| 0.0| 0.2| 0.4| 0.6| 0.8| 1.0|
| pH               |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |
| TA               |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |
| TRP              |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |
| KB_f             |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |

Technicolor

ABSOLUTE LOG E AT R.L.E.

NASADMSC

DATE Feb 1972  CONTROL # 175-1  TASK  PREPARED BY

FILM 2430  EMULSION # 178-1  MFG  EXPIRATION DATE

SENSITOMETER I-B PS6809
ILLUMINANT 3000 °K
TIME 1 sec.
FILTER none

PROCESSOR Pulton # 1
CHEMISTRY MX-641
SPEED TANK 10.20.40 PM
TEMP °F 68

INSTRUMENT MacBeth
TYPE TD217DR
APERTURE SIZE 4 mm
FILTER Visual

DENSITOMETRY

GRAF

-10

-8

-6

-4

-2

0

0.2

0.4

0.6

0.8

1.0

1.2

1.4

1.6

1.8

2.0

2.2

2.4

2.6

2.8

3.0

2.1

2.2

2.3

2.4

2.5

2.6

2.7

2.8

2.9

3.0

2.1
**DATE**: Feb 1972  
**CONTROL #:** 2430  
**TASK #:** 175-25  
**FILM #:** 792-15  
**EXPOSURE DATA:** 2489  
**PROCESSING DATA:**  
- **SENSITOMETER**: I-B PS6809  
- **ILLUMINANT**: 3000 K  
- **TIME**: 1 sec.  
- **FILTER**: none  
- **CHEMISTRY**: MX-641  
- **PROCESSOR**: Fultron #1  
- **CHEMICAL ANALYSIS**:  
  - **SP GR**: 4.0  
  - **pH**: 3.6  
  - **TA**: 3.4  
  - **TRP**: 3.2  
  - **KB**: 3.0  
- **TIME**:  
  - **TEMP**: 80°F  
  - **TANKS**: 10, 20, 40°F  
- **FILTER**: Visual  
- **BASE + FOG**:  

---

**PROCESSING DATA**:  
- **PROCESSOR**: Fultron #1  
- **CHEMISTRY**: MX-641  
- **PROCESSOR**: Fultron #1  
- **CHEMISTRY**: MX-641  
- **INSTRUMENT**: MacBeth  
- **SPEED**:  
  - **TANKS**: 10, 20, 40°F  
  - **TEMP**: 80°F  
  - **TIME**:  
  - **FILTER**: Visual  
  - **BASE + FOG**:  

---

**DENSITOMETRY**:  
- **ILLUMINANT**: 3000 K  
- **CHEMISTRY**: MX-641  
- **PROCESSOR**: Fultron #1  
- **CHEMISTRY**: MX-641  
- **INSTRUMENT**: MacBeth  
- **SPEED**:  
  - **TANKS**: 10, 20, 40°F  
  - **TEMP**: 80°F  
  - **TIME**:  
  - **FILTER**: Visual  
  - **BASE + FOG**:  

---

**CHARTS**:

- **Technicolor**
- **ABSOLUTE LOG E AT R.L.E. - 0**

---

**TECHNICAL**:  
- **NASA MSC**: 71-21
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**Chemical Analysis**

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**Technicolor**

![Graph](image-url)
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**Technicolor**

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

| T71-21 | NASA - MSC | 0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0 |
DATE: Feb 1972

FILM: SR 112
EMULSION #: 3400

EXPOSURE DATA:
SENSITOMETER: Niagara
ILLUMINANT: "K"

PROCESSING DATA:
PROCESSOR: Fultron #1
CHEMISTRY: MX-641
TYPE: TD217 DR
APERTURE SIZE: 4

DENSITOMETRY:
INSTRUMENT: Macbeth
SPEED (F): 10, 20, 40
APERTURE SIZE: 4
GAMMA: 4

TIME (SEC.): 10, 20, 40
SPEED: TANKS 10, 20, 40 FPM
TEMP (OF 68): TIME
FILTER: Visual
BASE: FOG

CHEMICAL ANALYSIS:

SP GR
PH
TA
TRP
KB,

21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1

10 FPM
20 FPM

2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0

10 FPM
20 FPM

2.8
2.6
2.4
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ABSOLUTE LOG E
AT R.L.E.: 0
### Chemical Analysis

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### Densitometry

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**Technicolor**

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<th>Date</th>
<th>Feb 1972</th>
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<tr>
<td>Control #</td>
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<tr>
<td>Task</td>
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<td>Prepared By</td>
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<td>Emulsion #</td>
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<td>MFG</td>
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<td>Expiration Date</td>
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<tr>
<th>3400 Exposure Data</th>
<th>Processing Data</th>
<th>Densitometry</th>
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<tbody>
<tr>
<td>Sensitometer</td>
<td>Processor</td>
<td>Instrument</td>
</tr>
<tr>
<td></td>
<td>Fultron #1</td>
<td>MacBeth</td>
</tr>
<tr>
<td>Illuminant</td>
<td>Chemistry</td>
<td>Speed ( )</td>
</tr>
<tr>
<td></td>
<td>MX-641</td>
<td>D-MAX</td>
</tr>
<tr>
<td>Time</td>
<td>Speed</td>
<td>Type</td>
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<td>TANKS 10, 20, 40</td>
<td>TD217DR</td>
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<tr>
<td>Filter</td>
<td>Temp °F</td>
<td>Aperture Size</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>l mm</td>
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<tr>
<td>Base Fog</td>
<td>Time</td>
<td>Gamma</td>
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### Chemical Analysis

|        | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|--------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|
| SP GR  | 4.0| 3.8| 3.6| 3.4| 3.2| 3.0| 2.8| 2.6| 2.4| 2.2| 2.0| 1.8| 1.6| 1.4| 1.2| 1.0| 0.8| 0.6| 0.4| 0.2| 0.0| 0.01 |
| pH     |    |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |
| TA     |    |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |
| TRP    |    |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |
| KB,    |    |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |

Technicolor

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<tr>
<th>Absolute Log E</th>
<th>at R.L.E. = 0</th>
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<tbody>
<tr>
<td>10 Fpm</td>
<td>20 Fpm</td>
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T71—21
### Exposure Data
- **Film**: 2422
- **Emulsion**: 11-19
- **Processing Data**: Fultron #1
- **Instruments**: MacBeth

### Processing Data
- **Chemistry**: MX-641
- **Type**: TD217DR

### Densitometry
- **Illuminant**: OK
- **Chemistry**: MX-641
- **Type**: TD217DR

### Chemical Analysis
- **SP GR**: 4.0
- **pH**: 3.8
- **TA**: 3.4
- **TRP**: 3.2
- **KB**: 3.0

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<thead>
<tr>
<th>Chemical</th>
<th>Value</th>
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<tbody>
<tr>
<td>SP GR</td>
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<tr>
<td>pH</td>
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<tr>
<td>TA</td>
<td>3.4</td>
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<tr>
<td>TRP</td>
<td>3.2</td>
</tr>
<tr>
<td>KB</td>
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### Graphs
- Log E against ASA
- T.L.E. against ASA

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**Technicolor**

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<thead>
<tr>
<th>ABSOLUTE LOG E AT R.L.E. = 0</th>
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<tbody>
<tr>
<td>0.2</td>
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**NASA - MSC**

**T1-21**
TECHNICOLOR SENSITOMETRIC REPORT
SR-112 IB SCOLOR 20 fpm 68°F
Gamma = 1.4000
TECHNICOLOR SENSITOMETRIC REPORT
SR-112 13 MX-641 40 fpm 80°F
TECHNICOLOR SENSITOMETRIC REPORT
2430-178 IB MX641 10 fpm 80°F

Gamma = 2.0644
TECHNICOLOR SENSITOMETRIC REPORT
2430-175  IB  MX-641  20 fpm  68 deg.
TECHNICOLOR SENSITOMETRIC REPORT
FE-2628 IB MX-641 10 fpm 80°F
TECHNICOLOR SENSITOMETRIC REPORT
FE--2628 IB MX-641 20 fpm 80°F

4.0

3.5

3.0

2.5

2.0

1.5

1.0

0.5

0.3 0.6 0.9 1.2 1.5 1.8 2.1 2.4 2.7 3.0

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