Accelerated Life Testing

Digital Images

Executive Summary

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Executive Summary

The purpose of this test series was to evaluate the image permanence performance of a variety of media and ink combinations. Images were exposed to the following tests, designed to demonstrate the permanence of the image:

- Accelerated Ozone Exposure
- Elevated Temperature and Humidity
- Accelerated UV Light Exposure
- Casual exposure to everyday accidents and materials.

The test used a minimum of four different media types, and images were placed on those media using printing technologies and equipment specific to the media under test. All media was imaged with the same image content, driven from the same software, through the drivers specific to the output device for the media under test (the only exception was AgX paper exposures, as dictating software for use at an external laboratory is not practical). Three different finishes were also compared, uncoated, and two types of overcoat.

Pre- and post- test measurements and observations were taken, and the results summarized in this report. Results from this test will not be shared with any other potential customers of TPR without the expressed written consent of the customer contracting the services.

A single rating system was derived using **ΔL*, Δa*,** and **Δb***to obtain an overall **Δ** rating for each paper/overcoat combination.

1.0 Overall Effects – Accelerated Ozone Exposure

The Epson papers are most negatively affected when they are not coated (except Watercolor Radiant White Paper). The aqueous overcoat proves most protective for the Premium Luster Photo Paper, and Watercolor Radiant White. The Premium Glossy Photo Paper seems equally protected from change by both aqueous and lacquer overcoats. The paper that is the most unaffected by the ozone environment is the Professional Photo Paper. The Premium Luster Photo Paper and the Premium Glossy Photo Paper are almost equally affected. The most affected papers are the Archival Matte and the Watercolor Radian White.

The HP papers are both more protected by the lacquer overcoat. Overall, the Premium Plus Glossy Photo Paper reacted better to the lacquer overcoat than the Colorfast Glossy Photo Paper.

The Kodak ink jet papers are affected differently from the lacquer overcoat. The Premium Plus Photo Paper shows slightly more protection than no overcoat, while the Ink Jet Photo Paper is protected more when the lacquer overcoat is not applied. The Professional Silver Halide paper shows very little to no change regardless of what is done to the paper.

The Fuji paper shows very little to no change regardless of what is done to the paper.

Rank	Paper	Delta
1	Kodak Professional Silver Halide	0
2	Epson Professional Photo Paper	3
3	HP Premium Plus Photo Paper - glossy	6
4	Fujicolor Crystal Archive	7
5	HP Colorfast Photo Paper - glossy	48
6	Epson Premium Glossy Photo Paper	178
7	Epson Prem. Luster Photo Paper	179
8	Epson Archival Matte	603
9	Kodak Premium Picture Paper	700
10	Kodak Ink Jet Photo Paper	754
11	Epson Watercolor Radiant White	796

Table 1 – Lacquer Covered Samples Ranking

Rank	Paper	Delta
1	Kodak Professional Silver Halide	0
2	Fujicolor Crystal Archive	3
3	Epson Prem. Luster Photo Paper	108
3	Epson Professional Photo Paper	108
5	Epson Premium Glossy Photo Paper	161
6	Epson Archival Matte	616
7	Epson Watercolor Radiant White	637

Table 2 – Aqueous Overcoat Covered Samples Ranking

Rank	Paper	Delta
1	Fujicolor Crystal Archive	3
1	Kodak Professional Silver Halide	3
3	HP Colorfast Photo Paper - glossy	84
4	HP Premium Plus Photo Paper - glossy	195
5	Epson Professional Photo Paper	440
6	Kodak Ink Jet Photo Paper	576
7	Epson Premium Glossy Photo Paper	599
8	Epson Prem. Luster Photo Paper	631
9	Epson Watercolor Radiant White	710
10	Kodak Premium Picture Paper	738
11	Epson Archival Matte	742

Table 3 – Unprotected Samples Ranking

2.0 Overall Effects – Elevated Temperature and Humidity

The Epson papers were quite evenly affected by all three applications. Each responded slightly better to one over the others. Overall, the Premium Luster Photo Paper and Archival Matte responded best to the aqueous overcoat. The Premium Glossy Photo Paper responded equally well to the aqueous overcoat and no overcoat. The Professional Photo Paper responded equally well to all three applications. The Watercolor Radiant White Paper responded best to the lacquer overcoat. None of the Epson papers showed any signs of bleed in the relevant sites.

The HP papers reacted differently to the lacquer overcoat and no overcoat. Overall, the Colorfast Glossy Photo Paper tested better with no overcoat, while the Premium Plus Glossy Photo Paper tested worse with no overcoat. Both HP papers showed signs of bleed in varying degrees in the relevant sites. The Colorfast Photo Paper did not bleed nearly as much as the Premium Plus Photo Paper. The lacquer overcoat protected the Colorfast Photo Paper slightly better than no overcoat. The cyan and green solid color patches bled the least for both papers. Photomicrographs indicate the extend of bleed for each relevant site.

The Kodak papers also responded differently to the lacquer overcoat. The Premium Picture Paper responded very negatively overall to the lacquer overcoat, while the Ink Jet Photo Paper responded fairly equally to both lacquer overcoat and no overcoat. The Professional Silver Halide paper showed best protection with no overcoat. The paper reacted most to the lacquer overcoat, while the aqueous overcoat was slightly better. Both ink jet papers showed fairly equal signs of bleed in the relevant sites. Both were protected slightly better from the occurrence of bleed when no overcoat was applied. The cyan, magenta, yellow, and green solid color patches bled the least for both papers. Photomicrographs indicate the extent of bleed for each relevant site.

The Fuji paper was most negatively affected from the lacquer overcoat, followed closely by the aqueous overcoat and then no overcoat. The Fuji paper did not show any signs of bleed in the relevant sites.

Rank	Paper	Delta
1	Epson Professional Photo Paper	0
2	Epson Prem. Luster Photo Paper	3
2	Epson Watercolor Radiant White	3
4	Epson Archival Matte	9
5	Epson Premium Glossy Photo Paper	12
6	Fujicolor Crystal Archive	21
7	Kodak Professional Silver Halide	168
8	Kodak Ink Jet Photo Paper	347
9	HP Premium Plus Photo Paper - glossy	386
10	Kodak Premium Picture Paper	464
11	HP Colorfast Photo Paper – glossy	470

Table 4 – Lacquer Covered Samples Rankings

Rank	Paper	Delta
1	Epson Prem. Luster Photo Paper	0
1	Epson Premium Glossy Photo Paper	0
1	Epson Professional Photo Paper	0
1	Epson Archival Matte	0
5	Fujicolor Crystal Archive	17
6	Epson Watercolor Radiant White	26
7	Kodak Professional Silver Halide	139

Table 5 – Aqueous Overcoat Covered Samples Rankings

Rank	Paper	Delta
1	Epson Premium Glossy Photo Paper	0
1	Epson Professional Photo Paper	0
3	Epson Archival Matte	3
4	Epson Watercolor Radiant White	6
5	Epson Prem. Luster Photo Paper	8
6	Fujicolor Crystal Archive	10
7	Kodak Professional Silver Halide	102
8	Kodak Premium Picture Paper	154
9	Kodak Ink Jet Photo Paper	346
10	HP Colorfast Photo Paper - glossy	395
11	HP Premium Plus Photo Paper - glossy	535

Table 6 – Unprotected Samples Rankings

3.0 Overall Effects – Accelerated UV Light Exposure

The Epson papers are most negatively affected from the lacquer overcoat (except Premium Luster Photo Paper). The aqueous overcoat proves less protective than the glass cover, but both give better protection than the lacquer overcoat. Some papers perform better than others depending on if they are glass covered or have no overcoat. If each paper were to be glass covered (which is most likely in a office or home environment), the order of Epson papers from least affected to most affected is as follows: Premium Luster Photo Paper, Professional Photo Paper, Premium Glossy Photo Paper, Watercolor Radian White, and Archival Matte.

The HP papers show little distinction between the lacquer overcoat and no overcoat. Overall, the Colorfast Glossy Photo Paper tested slightly better with the lacquer overcoat, while the Premium Plus Glossy Photo Paper tested slightly worse with the lacquer overcoat. Regardless of overcoat combinations, the Colorfast Glossy Photo Paper outperformed the Premium Plus Glossy Photo Paper.

The Kodak ink jet papers are most negatively affected from the lacquer overcoat, while the Professional Silver Halide paper shows slightly more change with the aqueous overcoat than the lacquer overcoat. If each paper were to be glass covered (which is most likely in a office or home environment), the order of Kodak papers from least affected to most affected is as follows: Ink Jet Photo Paper, Premium Picture Paper, and Professional Silver Halide.

The Fuji paper is most negatively affected from the lacquer overcoat, followed closely by the aqueous overcoat and then the glass cover.

Rank	Paper	Rating
1	Fujicolor Crystal Archive	27
2	Epson Premium Glossy Photo Paper	30
3	Epson Professional Photo Paper	32
4	Epson Prem. Luster Photo Paper	33
5	Epson Watercolor Radiant White	39
6	Epson Archival Matte	72
7	HP Colorfast Photo Paper - glossy	192
8	Kodak Ink Jet Photo Paper	276
9	Kodak Premium Picture Paper	288
10	Kodak Professional Silver Halide	424
11	HP Premium Plus Photo Paper - glossy	663

Table 7 – Glass Covered Samples Rankings

Rank	Paper	Rating
1	Fujicolor Crystal Archive	27
2	Epson Prem. Luster Photo Paper	30
3	Epson Premium Glossy Photo Paper	68
4	Epson Professional Photo Paper	78
5	Epson Watercolor Radiant White	214
6	Epson Archival Matte	220
7	HP Colorfast Photo Paper - glossy	371
8	Kodak Professional Silver Halide	424
9	Kodak Ink Jet Photo Paper	630
10	Kodak Premium Picture Paper	683
11	HP Premium Plus Photo Paper - glossy	812

Table 8 – Lacquer Covered Samples Rankings

Rank	Paper	Rating
1	Fujicolor Crystal Archive	3
2	Epson Prem. Luster Photo Paper	27
3	Epson Professional Photo Paper	30
4	Epson Premium Glossy Photo Paper	39
5	Epson Watercolor Radiant White	87
6	Epson Archival Matte	123
7	Kodak Professional Silver Halide	385
8	HP Colorfast Photo Paper - glossy	453
9	Kodak Ink Jet Photo Paper	474
10	Kodak Premium Picture Paper	490
11	HP Premium Plus Photo Paper - glossy	893

Table 9 – Unprotected Samples Rankings

Rank	Paper	Rating
1	Fujicolor Crystal Archive	12
2	Epson Premium Glossy Photo Paper	36
3	Epson Professional Photo Paper	46
4	Epson Prem. Luster Photo Paper	48
5	Epson Watercolor Radiant White	112
6	Epson Archival Matte	139
7	Kodak Professional Silver Halide	449

Table 10 – Glass Covered Samples Rankings

4.0 Overall Effects – Accelerated UV Light Exposure (Long-term)

The Epson papers are most negatively affected from the lacquer overcoat (except Premium Luster Photo Paper and Premium Glossy Photo Paper). The Archival Matte and Watercolor Radiant White paper showed more overall change than the other Epson papers. The aqueous overcoat proves less protective than the glass cover, but both give better protection than the lacquer overcoat. If each paper were to be glass covered (which is most likely in a office or home environment), the order of Epson papers from least affected to most affected is as follows: Professional Photo Paper, Watercolor Radian White, Premium Luster Photo Paper, Premium Glossy Photo Paper, and Archival Matte.

Regardless of overcoat combinations, the HP Colorfast Photo Paper did much better overall than the Premium Plus Photo paper. Overall, the Colorfast Photo Paper was least protected by the lacquer overcoat, while no overcoat was slightly better.

The Kodak ink jet papers and the Professional Silver Halide paper are most negatively affected from the lacquer overcoat. No overcoat is clearly better than the lacquer overcoat, but the glass cover gives the best protection. If both inkjet papers were to be glass covered (which is most likely in a office or home environment), the order from least affected to most affected is Premium Picture Paper and Ink Jet Photo Paper.

The Fuji paper is most negatively affected from aqueous overcoat. No overcoat was slightly better than the aqueous overcoat, and the glass cover proved slightly better than both of these did. The lacquer overcoat did not yield any overall change for the Fuji paper.

If each paper type were to be glass covered (which is most likely in a office or home environment), the overall ranking from least affected to most affected is shown in Table 11 on the following page.

Rank	Paper	Rating
1	Fujicolor Crystal Archive	12
2	Epson Professional Photo Paper	26
3	Epson Watercolor Radiant White	28
4	Epson Prem. Luster Photo Paper	33
5	Epson Premium Glossy Photo Paper	43
6	Epson Archival Matte	45
7	HP Colorfast Photo Paper - glossy	157
8	Kodak Premium Picture Paper	203
9	Kodak Ink Jet Photo Paper	216

Table 11 – Glass Covered Samples Rankings

Rank	Paper	Rating
1	Fujicolor Crystal Archive	0
2	Epson Premium Glossy Photo Paper	48
3	Epson Professional Photo Paper	55
4	Epson Prem. Luster Photo Paper	59
5	Kodak Professional Silver Halide	155
6	Epson Watercolor Radiant White	218
7	Epson Archival Matte	233
8	HP Colorfast Photo Paper - glossy	244
9	Kodak Premium Picture Paper	426
10	Kodak Ink Jet Photo Paper	474

Table 12 – Lacquer Covered Samples Rankings

Rank	Paper	Rating
1	Fujicolor Crystal Archive	14
2	Epson Professional Photo Paper	53
3	Epson Premium Glossy Photo Paper	58
4	Epson Prem. Luster Photo Paper	66
5	Epson Watercolor Radiant White	85
6	Kodak Professional Silver Halide	140
7	Epson Archival Matte	141
8	HP Colorfast Photo Paper - glossy	231
9	Kodak Ink Jet Photo Paper	308
10	Kodak Premium Picture Paper	346
11	HP Premium Plus Photo Paper - glossy	702

Table 13 – Unprotected Samples Rankings

Rank	Paper	Rating
1	Fujicolor Crystal Archive	16
2	Epson Prem. Luster Photo Paper	39
3	Epson Professional Photo Paper	47
4	Epson Premium Glossy Photo Paper	53
5	Epson Watercolor Radiant White	75
6	Epson Archival Matte	137

Table 14 – Glass Covered Samples Rankings

5.0 Overall Effects - Casual Contact Contaminants

A brief summary for each of the casual contact contaminants follows. Due to the overwhelming amount of data that would be required to rank each of the individual casual contact contaminants, the numeric ranking system was not used.

5.1 Handling Contaminants

None of the sample papers experienced any significant changes (>10) from the **skin oil** contaminant.

For the **hand lotion** contaminant, Epson papers showed that wiping the sample before storing decreases the overall amount of change for that sample except for the Archival Matte and Watercolor Radiant White papers. For these last two papers, a much higher overall change was measured. The hand lotion seemed to leave a film on all the papers, and in these two paper types the film was much denser. The color of the papers did not shift, but the film fogged up the color. The Archival Matte paper that had the aqueous overcoat showed that the ink and paper itself was beginning to come off of the paper. This was most likely caused from the wiping contact of the brush, and the lotion affects this paper in a very negative way.

The HP papers, for the most part, showed low overall change. However, some of them experienced bleed and smearing (for those that were wiped) to some degree. The Premium Plus Photo paper that had no overcoat and was wiped suffered massive smearing. However, the lacquer overcoat version experienced almost no changes.

The Kodak ink jet papers also experienced some bleed from the hand lotion when no overcoat was applied. However, both ink jet papers show lower overall change when wiped. This may indicate that the wiping process removes more of the contaminant, thus minimizing the effects of the contaminant on the sample as it is stored. The Professional Silver Halide image did not experience noticeable changes, other than the film that the hand lotion commonly leaves.

The Fuji paper also did not experience noticeable changes except for the film.

For the **deodorant** contaminant, Epson papers showed that wiping the sample before storing greatly decreases the overall amount of change for that sample with the exception (again) of the Archival Matte and Watercolor Radiant White papers. However, these two papers performed better when an aqueous overcoat was applied. When there was no wipe and no overcoat, the Epson papers were damaged the most. There was a film covering most samples, as before with the hand lotion, but with the deodorant the film was not fogged but more reflective. When the film seemed thicker in the cases of the lacquer/no wipe cases, there was a white residue build up.

The HP papers showed less overall change when the lacquer overcoat was applied. Also, wiping reduced the overall change for the Colorfast Photo paper, but was as effective as no wipe for the Premium Plus Photo paper. This second paper showed some light signs of bleed on the black color patch when not wiped.

The Kodak papers performed fairly even regardless of overcoat and wipe combinations. Wiping proved slightly better for all three Kodak papers coated or not. It was more effective for the silver halide paper combinations. All three papers proved to be slightly more protected when the lacquer overcoat was applied. The aqueous overcoat was most harmful to the Professional Silver Halide paper. This paper showed light ink transfer. Also, the Ink Jet Photo paper showed small signs of ink transfer when no overcoat was applied.

The Fuji paper also shows that the aqueous overcoat is the most harmful. Unlike the two other overcoat combinations, the lacquer overcoat worked well with the wipe. When it was not wiped the lacquer overcoat paper showed the white residue build up. When the lacquer overcoat and no wipe was applied the paper showed no overall changes greater than 2. A subjective observation revealed that the reflective film was there, but it must have been too light for the SP60 to read.

The Epson papers all responded similarly to the **antiperspirant** contaminant. No overcoat proved most harmful in every paper type for both wipe and no wipe. All papers had to some degree an oily film that could best be seen in the light. It resembled the 'rainbow effect' from a puddle of oil. This film may have been noticed by the SP60. However, no noticeable changes were subjectively observed under controlled lighting. The Watercolor Radiant White showed a very slight darkening of color for the cyan patch. Wiping did not seem to have a consistent effect on the papers.

The HP papers also showed little to no overall change. No overcoat proved more harmful for the Colorfast Photo paper only. While there was no overall objective change, very light smearing was observed in two samples that were wiped – Colorfast Photo paper with lacquer, and Premium Plus Photo paper with no overcoat.

The Kodak ink jet papers responded more negatively to no overcoat than the lacquer overcoat. Wiping had no positive effect on these papers. For the Ink Jet Photo paper that did not receive an overcoat, wiping caused very slight smearing. There was no overall change in the Professional Silver Halide paper.

The Fuji paper also showed no overall changes from this contaminant.

5.2 Solvents

For the **Acetone** contaminant, the Epson papers have mixed results. The Archival Matte and Watercolor Radiant White paper show no changes in any paper overcoat or wipe combinations. The other three papers behave similar in that the aqueous overcoat is most harmful. Also, two papers smeared slightly when wiped. They are Premium Luster Photo paper with an aqueous overcoat and Premium Glossy Photo paper with a lacquer overcoat.

The HP papers also had mixed results and the overall changes in these papers were quite small. The Colorfast Photo paper responded more negatively to no overcoat than a lacquer overcoat. Wiping did not have a significant effect.

Kodak papers showed that wiping did have a small effect on reducing the overall change. While the Premium Picture paper responded relatively worse to the lacquer overcoat than the Ink Jet Photo paper, the Professional Silver Halide paper showed no significant signs of change (except a very slight change when the lacquer overcoat was applied).

The Fuji paper only responded negatively to the lacquer overcoat. Wiping did help somewhat reduce the changes in this paper overcoat combination.

None of the sample papers experienced any significant changes (>10) from the **lighter fluid** contaminant.

None of the sample papers experienced any significant changes (>10) from the **paint thinner** contaminant. A very small trend can be seen in these two solvents. The no overcoat combined with wiping causes a slight overall change in the three Epson photo papers.

The **denatured alcohol** has quite negative effects on almost all types of papers. For the Epson papers, the Archival Matte and the Watercolor Radiant White paper again show no signs of overall change. Wiping causes smearing for the uncoated Premium Luster Photo paper and Premium Glossy Photo paper. The aqueous coated Professional Photo paper also shows smearing when wiped. The lacquer overcoat proved best for these three paper types when wiped and when left alone.

The HP Colorfast Photo paper showed no change according to the SP60 when the lacquer overcoat was applied. Although a change was measured with no overcoat, no significant change was subjectively observed. Only the Premium Plus Photo paper that received no overcoat suffered severe smearing when wiped.

The Kodak ink jet papers experienced the most problems with this contaminant. Most suffered from minor bleed (mainly on the black and blue color patches) if not wiped. The ones that were wiped experienced smearing (mainly red), and ink transfer. The least affected ink jet paper was the lacquer coated Ink Jet Photo paper. The Professional Silver Halide paper showed no overall changes.

The Fuji paper did not show any noticeable bleed, smearing, or ink transfer. However, the lacquer coated and unwiped paper had a film that appeared white in some places. Wiping, in this case, reduced that problem significantly without doing any other damage to the image.

5.3 Household Cleaners

The **Windex glass cleaner** has probably the most negative effect on almost every paper type. For all papers, wiping causes the most severe problems. Only a few papers show significant change when no wipe was applied. For the Epson papers, the Archival Matte paper and the Watercolor Radiant White paper show very little overall change. Also, the Professional Photo paper showed little change except that the uncoated paper, when wiped, showed signs of light smearing and a slight greening of the cyan color patch. The other two papers reacted most negatively to the no overcoat. When wiped, the two paper types smeared severely. The Premium Glossy Photo paper also showed a greening of the cyan color patch when wiped. However, when these two papers were not wiped, a pooling occurred on both the green and red color patches. The Premium Luster Photo paper showed some problems with the aqueous overcoat, as well. When wiped, there was moderate ink transfer (primarily on green and red patches). When the paper was not wiped, there was light bleeding.

The HP papers also show that wiping is quite harmful regardless of overcoat combination. Common problems from wiping were severe bleed, severe smearing, and in some cases ink transfer. No overcoat proved far less protective than the lacquer overcoat for the Colorfast Photo paper. The lacquer coated Colorfast Photo was the only HP paper type that did not show signs of bleed.

The Kodak ink jet papers both responded more negatively to no overcoat than the lacquer overcoat. The wiped Premium Photo paper with no overcoat showed the most change and suffered from severe smearing, severe ink transfer, and moderate bleeding. However, when this paper was not wiped, very little overall change was seen. The Ink Jet Photo paper showed signs of smearing and ink transfer when wiped. The Professional Silver Halide showed little overall change in all cases. However, the combination that yielded the most overall change was the aqueous overcoat with the wipe.

The Fuji paper again shows no signs of smearing, bleeding or ink transfer, yet has a significant film residue on the color patches to indicate an overall change greater than ten. The film is ‘foggy’ and seems to affect the paper when it is wiped. However, the lacquer overcoat seems to prevent this film, and the overall changes are non-existent.

The **Isopropyl Alcohol** contaminant showed little overall change for most of the Epson papers. The only two papers that showed negative effects from the contaminant were the Premium Luster Photo paper and the Premium Glossy Photo paper. Among these two papers, only the no overcoat papers that were wiped showed the changes. Both papers showed a moderate smearing of the black color patch. The Premium Luster Photo paper also showed light smearing of the blue and magenta color patches.

The HP papers showed no significant overall changes.

The Kodak Premium Picture paper showed the most overall change. This occurred when the papers were not wiped. When there was a lacquer overcoat, the paper showed a light ink transfer on the black color patch. For no overcoat, both ink jet papers exhibited a light bleed mainly on the black and blue color patches, but also on the red and magenta patches. No significant overall change occurred for the Professional Silver Halide paper, but the aqueous overcoat shows more change than the other overcoat possibilities.

The Fuji paper showed no overall changes from this contaminant.

The Epson papers showed no significant overall changes from the **water** contaminant.

The HP papers experienced the most overall change when wiped. When the papers were not wiped, the overall changes were quite small. Also, because the wiped paper was placed behind the paper that was not wiped, ink transfer occurred for all of these wiped papers. The largest overall changes occurred with no overcoat for both HP papers. Problems encountered with these papers are light to severe bleed, severe ink transfer, and light smear.

The Kodak ink jet papers also experienced the most overall change when wiped and with no overcoat. Both papers showed very similar results, but to a different extent. The Premium Picture paper suffered more damage than the Ink Jet Photo paper. Problems encountered were severe ink transfer, smearing (from the blue color patch), and light bleed. The Professional Silver Halide paper did not experience any significant changes.

The Fuji paper showed no significant overall changes from this contaminant. However, the paper that received the wipe and no overcoat, experienced light ink transfer. Again, wiped papers are placed behind the papers that aren't wiped. This paper combination is slightly susceptible to ink transfer when the back of another paper is in contact with the contaminated surface.

5.4 Writing Contaminants

The **ball point pen** caused no significant overall changes for any of the paper samples.

The **fountain pen** caused the aqueous coated Epson Professional Photo paper to receive an overall change greater than ten, but when subjectively observed under controlled lighting conditions, there were no noticeable changes. This may have been a misreading that the SP60 gives on rare occasions.

All other papers showed no significant overall changes.

The **India ink, permanent marker, water-based marker,** and **dry-erase marker** caused no significant overall changes for any of the paper samples.

5.5 Storage Contaminants

The **PVC** contaminant caused no significant overall changes for any of the paper samples.

The **Acetate** contaminant caused no significant overall changes for any of the paper samples.

The **Post-it Note adhesive** contaminant caused very little significant changes. The only paper that showed significant overall change was the Epson Professional Photo paper. The Epson Premium Luster Photo paper and Epson Premium Glossy Photo paper showed very slight change, but were worth a subjective investigation. The changes only occurred for the papers that received a lacquer overcoat. After subjectively observing these papers, the cause for the change is seen in the removal of the overcoat from the paper.

The **Scotch tape** contaminant affected certain Epson papers greatly, while leaving others virtually unchanged. The Archival Matte paper was severely affected, regardless of overcoat, such that the tape would completely remove the top layer of paper, thus making any post exposure measurements impossible. The three Epson photo papers were unaffected when coated with the aqueous overcoat. However, when given a lacquer overcoat or no overcoat, moderate to severe ink transfer occurred. The Premium Luster Photo paper was the most affected photo paper from the tape contaminant.

The HP papers had very little overall change from the tape. Very slight ink transfer occurred when the tape was removed.

The Kodak papers showed no significant overall changes from this contaminant.

The Fuji paper showed no significant overall changes from this contaminant.

The **glue stick** contaminant affects nearly every paper type in that it leaves a film residue. Depending on the paper, the film will appear clear, foggy, or leave chunks of white residue.

For the Epson papers, the Archival Matte and Watercolor Radiant White paper had a foggy, and at times whitish, film that covered the color patches. This film caused the greatest overall change. Wiping did not seem to have any effect on these papers. All the Epson papers were best protected with the aqueous overcoat. The three photo papers had a lower overall change. For these papers, a clear film covers the color patches. The lacquer coated Premium Glossy Photo paper that was not wiped showed the most overall change, and when subjectively observed, a very thick film (and white chunks) covered the color patches. This may have been caused by an over-application of the contaminant. The glue stick easily came apart as it was applied to the papers. Small pieces of the glue stick may have been smeared on too thick in some papers. This problem should not negatively reflect on the paper's ability to protect against this contaminant.

The HP papers were better protected from the contaminant film when no overcoat was applied. The wiping process did not noticeably affect the results. A clear film covered the color patches.

The Kodak papers were better protected from the contaminant film when a lacquer overcoat was applied. No overcoat was the least protective, even for the Professional Silver Halide. For these papers, a clear film covered the color patches. The uncoated Ink Jet Photo paper that was wiped showed a very small smear from the red color patch.

The Fuji paper was best protected from the aqueous overcoat. A light foggy film covered these paper combinations.

The paper samples were not greatly affected by the **rubber cement** contaminant. In every paper a clear and sometimes reflective film covered the color patches. The thickness and luster of the film for each paper sample most likely dictated the overall changes.

All of the Epson papers were least protected from no overcoat. A lacquer or aqueous overcoat eliminated nearly all changes in the three photo papers. The color patches appeared slightly darker for the Archival Matte and Watercolor Radiant White papers when there was no overcoat. Wiping did not have any significant effect for any of the Epson papers.

The HP papers were protected slightly more from no overcoat.

The Kodak papers were protected slightly more from a lacquer overcoat. The Professional Silver Halide paper showed no overall changes.

The Fuji paper showed no significant overall changes. However, a very slight change occurred when a lacquer overcoat was applied (for both wipe and no wipe papers).