Part 4

Practical Camera Testing with the B&H 414PD Camera

The Quest for Cameras, Film and Process:

Undertaking the challenge of describing the technical parameters of a vintage camera requires more than a literature search. Photo journals do provide reviews, and "Consumer's Report" may include the model in one of its rating tests. But, the only sure way to evaluate the essential image parameters is to do some "hands-on" testing. Thus a plan that requires a camera, film and a process.

With the archives of the George Eastman House 'in town', and my awareness of their having the Bell and Howell collection and many cameras from the Kodak patent museum, a call to Todd Gustavson (Motion Picture Curator) was one of my first considerations. The Eastman House did have a Bell & Howell 414PD camera in their collection and, with Board approval, there was the possibility of obtaining a loan for testing.

My background made me aware of several amateur camera collectors, and with the exception of Alan Kattel, of the Movie Machine Society, I "batted-a-zero". "Alan had a 414PD and willing to let me give it a try. However, my first choice was to obtain my own camera that I could use or abuse at will.

In pursuit of a used piece of equipment I turned to the classified ads. The publication of choice for cameras is "Shutterbug", and I explored many avenues from ads and leads without success.

If I wanted a used Kodak camera, I knew that Rochester was saturated because of employee purchase opportunities. My brother-in-law, Bud, lived in Chicago, the home of Bell & Howell, and the logical assumption was that this could be worth a try. An ad in the Sunday classified turned up a Bell & Howell 414 Director Series camera. It was similar to the Zapruder camera, but without the power zoom and dual electric eye. A second source yielded a Bell & Howell 414PD, not only the same model but also only 30 serial numbers different than Mr. Zapruder's camera (SN134567). Subsequently, I acquired two more

414PD's and a 414P. I was "in business" for practical evaluation. Bud had become a major contributor to the project.

Test film: Kodak had not sold double 8mm film for many years and no perforators were available in Rochester. There was some non-USA film available and the Rocky Mountain Film Lab could supply infrequent processing[1] (a contingency plan at best!).

Kodachrome as a daylight 25 and Tungsten 40 were still being manufactured. With significant cooperation, I located a double-8 perforator in Colorado, and was able to obtain a dozen 8mm camera rolls of spooled Kodachrome 25 Movie Film (Daylight)/7267 and Kodachrome 40 Movie Film Type A/7270. Qualex, of Dallas, Texas, was found to be the only USA source for processing the Kodachrome film and assisted in supporting my first few camera tests.[2]

My success in locating Bell & Howell 414 cameras gave me the opportunity to do practical tests with several cameras, and to dissect and dissemble a camera to view its components. Because the feature of a ratcheting pawl adjacent to the image forming aperture contributed to images forming light between the perforations, I desired to study and obtain other cameras with similar design characteristics for testing. Like-it-or-not I was becoming an 8mm-camera collector by default.

The camera tests and their analyses are described throughout the text of the report. In spite of their age, all Bell & Howell and other test cameras performed remarkably well.

Practical Camera Test:

A series of camera tests were conducted to gain an appreciation for the operation of the B&H 414PD camera and to structure specific camera tests to attempt to replicate and analyze the reported image anomalies.

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[1] They were my source of 25ft. camera spools and cans.

[2] Qualex ceased processing movie film at the end of 1997. A test process was used for the balance of the tests.

Camera Test 1

One of my goals was to shoot a test scene from the same position Zapruder used in Dealey Plaza. In July of 1997, I got the opportunity and filmed a test with a minimum of structure. I used my wife as a model and exposed scenes at various camera settings. That first roll of film contained all of the reported anomalies except first-frame over exposure. In addition, because what appeared to be inconsistencies at that time, it raised many questions and dictated additional structured tests.

Camera Test 2

A test was set up with studio conditions to try and determine the influence of various footage, f-stop and lens focal length settings on the magnitude of image penetration between the perforations. With this test we began to gain some insight toward understanding lens focal length and f-stop impact on image penetration.

Tests were also run with a Kodak Brownie and a Wollensak Model 53. Both of these cameras have the intermittent adjacent to the primary image. Both showed image penetration into the perforations and claw shadow and what at that time we referred to as "perforation flare".

Camera Test 3

This test was structured for a third party photographer and failed to be conducted.

Camera Test 4

This test was conducted at the Eastman Kodak Apparatus Division using a wall of resolution targets. It confirmed the quality of the image that penetrated in between the perforations and expanded our knowledge of full exposure area by the use of single frame exposures. We also noticed, for the first time, one camera that had a plus 1/3 stop first frame.

Camera Test 5

Using a model motorcycle and a "brass ball" I attempted, with backlighting, to see if I could replicate the motorcycle fender I thought at that time, to be related to sun angle and flare. I got some very interesting scenes, found my model motorcycle was too small and had a good learning experience.

Camera Test 6

We wondered what shifts from normal to slow motion would reveal. We found that the exposure compensation was very effective but detectable. From a camera operational standpoint we considered it highly doubtful that Zapruder could have inadvertently moved the sliding release momentarily from normal to slow motion. The test would bear repeating if this parameter is considered to be of greater importance than "an opinion".

Camera Test 7 - Blue Sky

By now we had zeroed in on the practical impact of lens focal length and the degree of image penetration between the perforations. There was a need for a fairly high brightness uniform field and blue sky provided the opportunity. Various neutral density filters were incorporated to maintain a consistent density with a variety of f-stops. A visual examination only provided the basis for a more controlled test to a gray wall with studio lighting.

Camera Test 8

This test became Camera Test number 9 because I skipped a number. This test was conducted using a uniform gray wall to gain the opportunity to achieve measurable uniform exposed areas between the perforation, compared to the normal picture area. No attempt was made to hold the gray wall in focus, rather Telephoto with infinity focus as well as other lens settings were used. These tests confirmed our findings for claw shadow and lens *exit window* size without the problem of a disturbing scene content.

Epilogue

Locating Former Bell and Howell Optical and Photographic Engineering Personnel:

The role of writing a monograph on a 35-year-old camera is a significant challenge and one needs all the help he can get. Alan Kattelle of the Movie Machine Society had undertaken to write a history of 8mm several years ago. When I contacted Alan in search of a B&H 414 PD camera, he mentioned that he was aware that Malcolm Townsley was probably Engineering Vice President when the camera was designed.

This lead gave me two approaches - direct contact and patent search. With help, I located Malcolm's patent, and then learned how to use the www in search of him. After a few blind leads I became lucky and with US Post Office forwarding found Malcolm.

Malcolm identified Thomas Harris and David McMillin. Through the cooperation of Tom Harris, I located Dr. Cox, who identified Frank Mellberg, who identified Hal Miller and Rudolf Hartmann. I was astounded and pleased that in six weeks of searching and I had located everyone except David McMillin.

A search of SMPTE Journals turned up an article by David MacMillin of Bell & Howell, which allowed me to scrap my list of 35 McMillins. I found David, and had a great support team. The patents, articles, and direct correspondence contained in this report attest to their cooperation and support.

The organization chart that applied to their positions in the early sixties follows. My letters to them and their responses are appended.

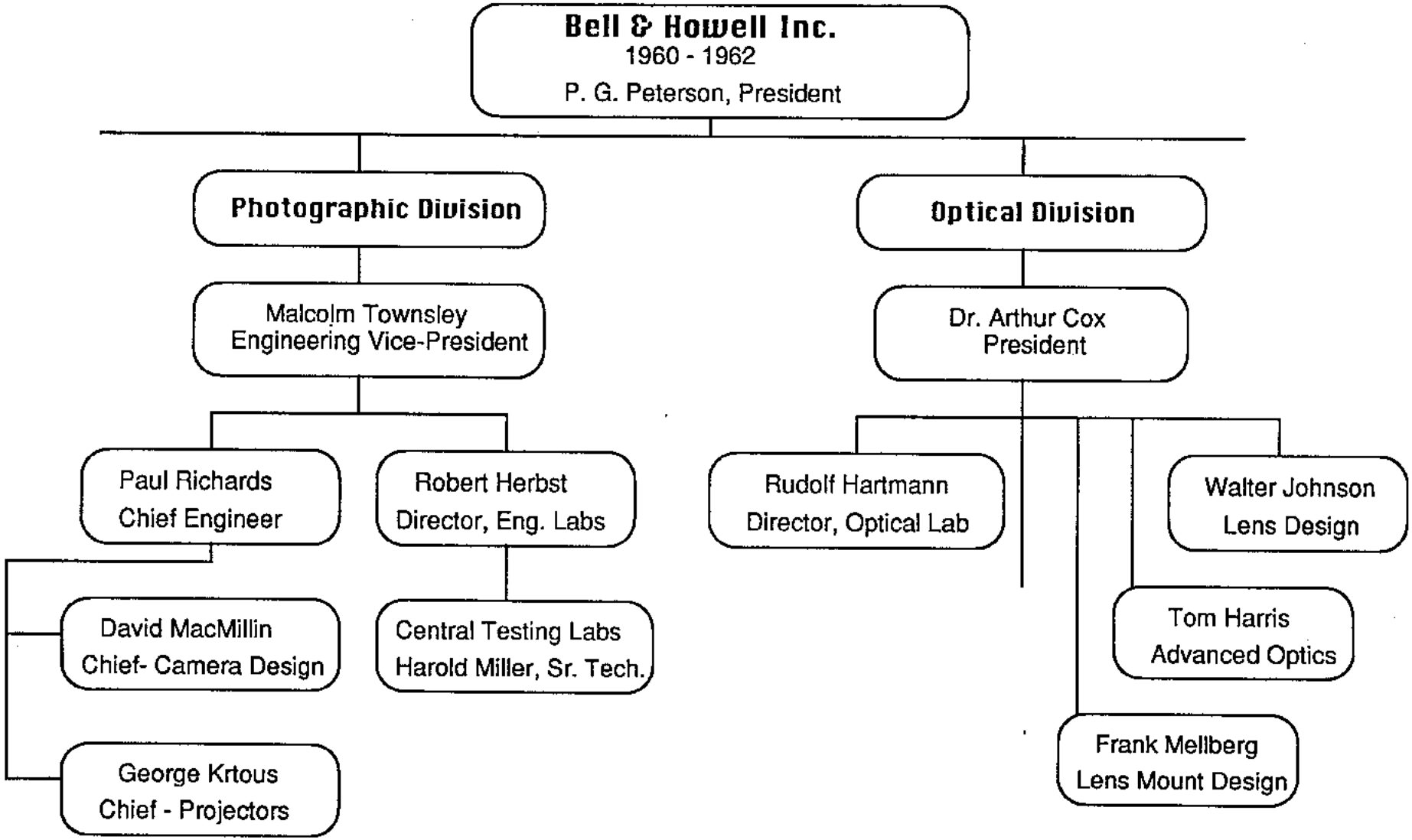

Bell & Howell Inc.
1960 - 1962
P. G. Peterson, President
Photographic Division
Optical Division
Malcolm Townsley
Engineering Vice-President
Dr. Arthur Cox
President
Paul Richards
Chief Engineer
Robert Herbst
Director, Eng. Labs
Rudolf Hartmann
Director, Optical Lab
Walter Johnson
Lens Design
David MacMillin
Chief- Camera Design
Central Testing Labs
Harold Miller, Sr. Tech.
Tom Harris
Advanced Optics
George Krtous
Chief - Projectors
Frank Mellberg
Lens Mount Design

Figure 4-32

Appendix

Sample set of Micro-Densitometer Readings

The samples selected are from Camera No. 1, Exposure Series, with two values selected. The first is equivalent to the auto exposure correct value of about f5.6 and the second is underexposed giving heavier density at about f11 to f16.

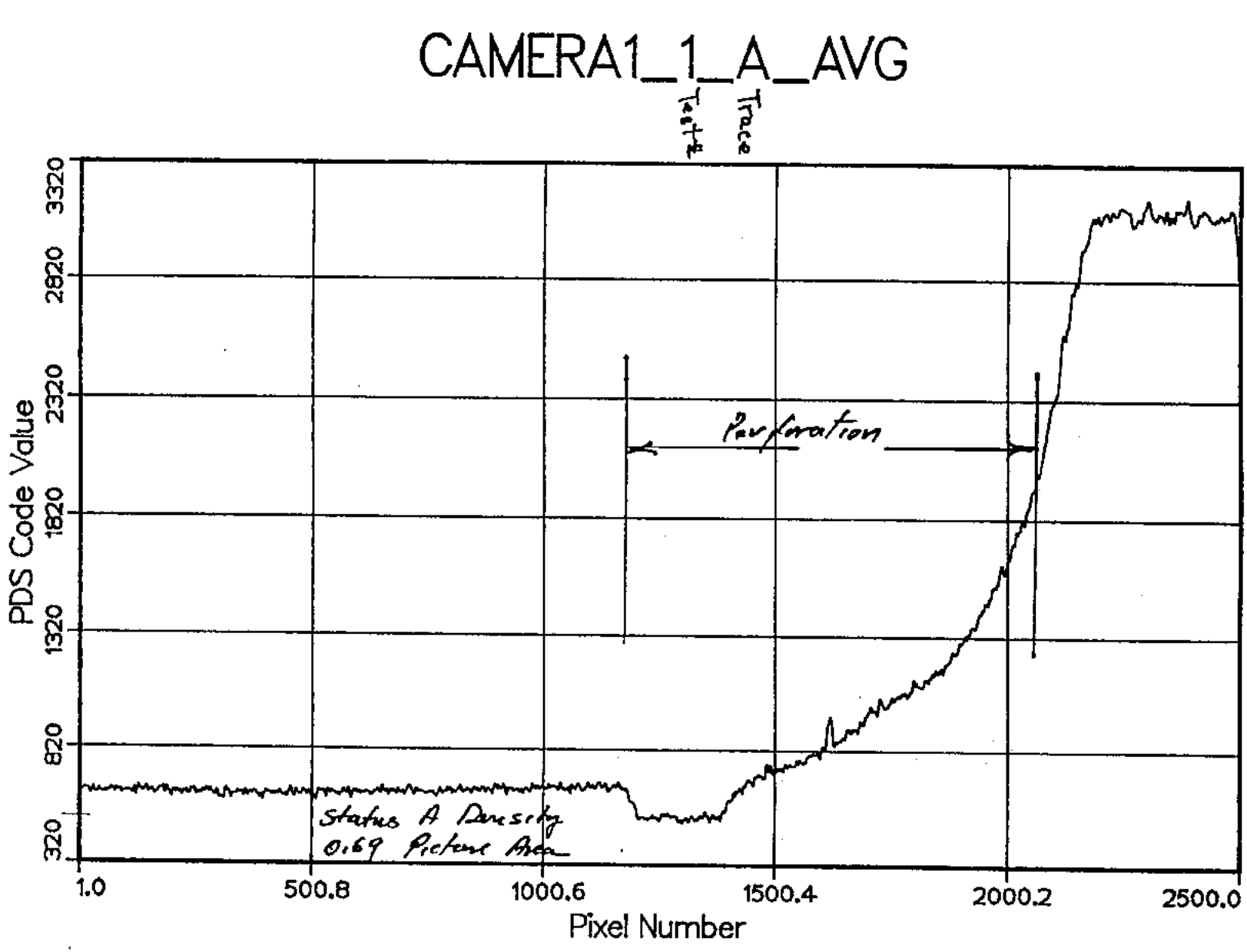
Measured values for density using Status A in the general exposed area was 0.69 for test 1 and 1.34 for test 4. The PDS Code Values translates to about 0.77 and 1.6 optical density units. The multiple exposure area shows a lower density by about 0.2 and 0.3 respectively for the two different density levels. The claw shadow represents an increase in density of about same amount 0.2 and 0.3 density units. An image of the gray wall exposures can be seen as Figure 4-27 in Part 3.

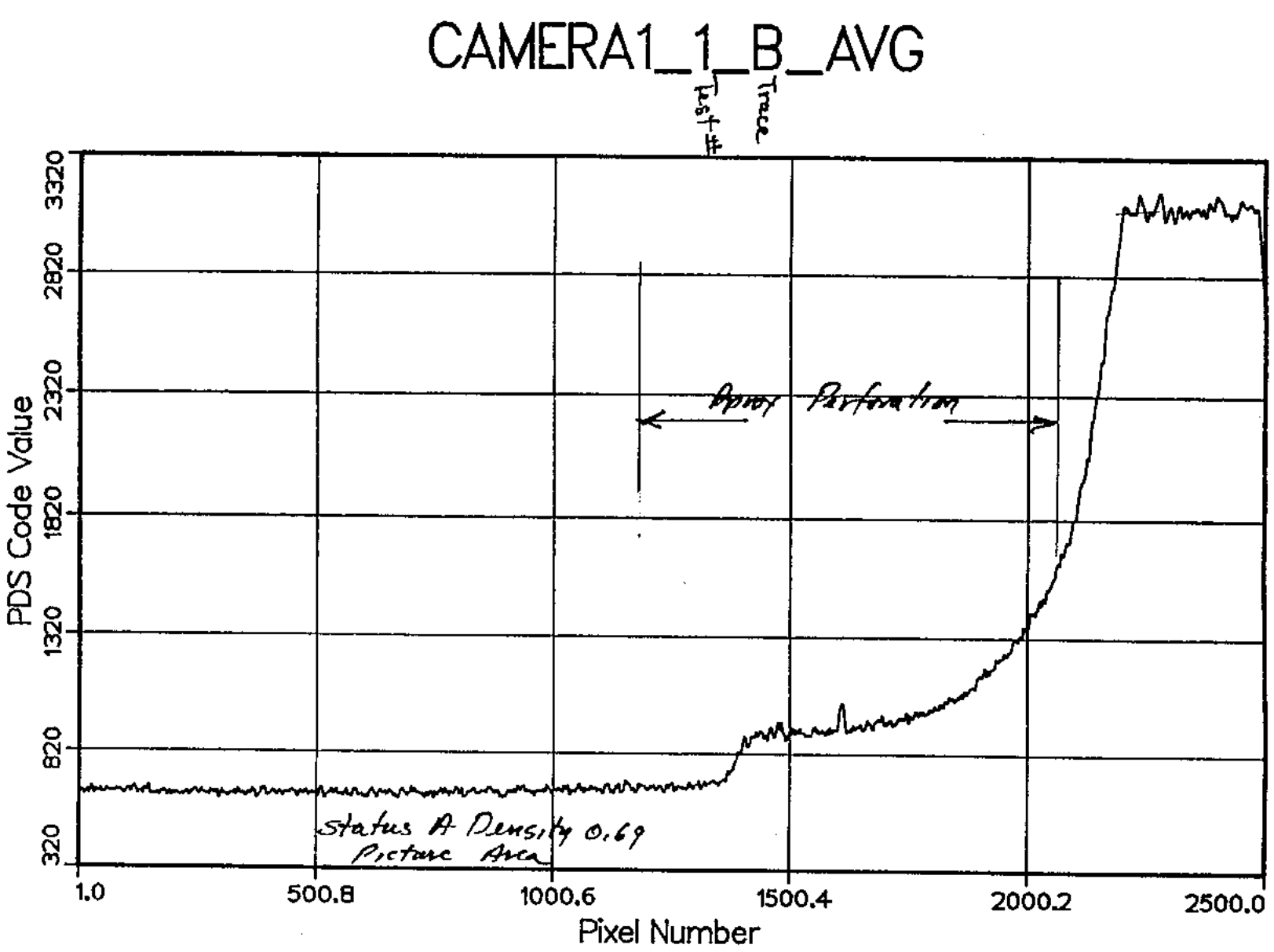
Refer to Figure 4-31 for location of scanned areas.

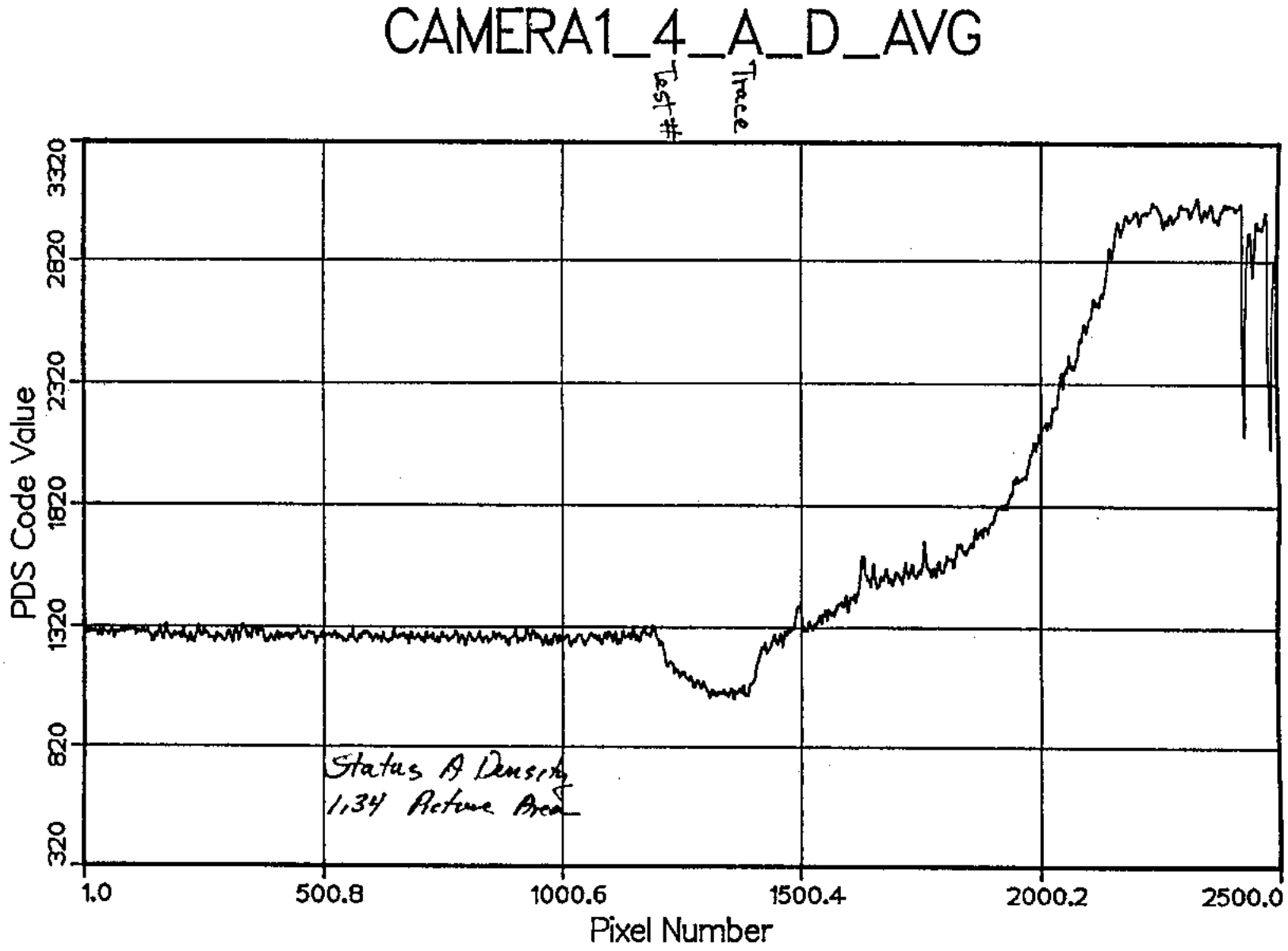
For interpretation - a scale of equivalencies -

For the X-axis, PDS code values can be translated to optical density units by dividing by 800.

For the Y-axis, we can anticipate that the edge of the film is at the right edge of the chart (pixel number 2500). The outside edge of the perforation is at about 2050 pixels and the inside edge of the perforation is about 1170 pixels.


CAMERA1_1_A_AVG
Test#
Trace
PDS Code Value
3320
2820
2320
1820
1320
820
320
Perforation
Status A Density
0.69 Picture Area
1.0
500.8
1000.6
1500.4
2000.2
2500.0
Pixel Number


CAMERA1_1_B_AVG
Test #
Trace
PDS Code Value
3320
2820
2320
1820
1320
820
320
Apron
Perforation
Status A Density 0.69
Picture Area
1.0
500.8
1000.6
1500.4
2000.2
2500.0
Pixel Number


CAMERA1_4_A_D_AVG
Test#
Trace
PDS Code Value
3320
2820
2320
1820
1320
820
320
Status A Density
1.34 Active Area
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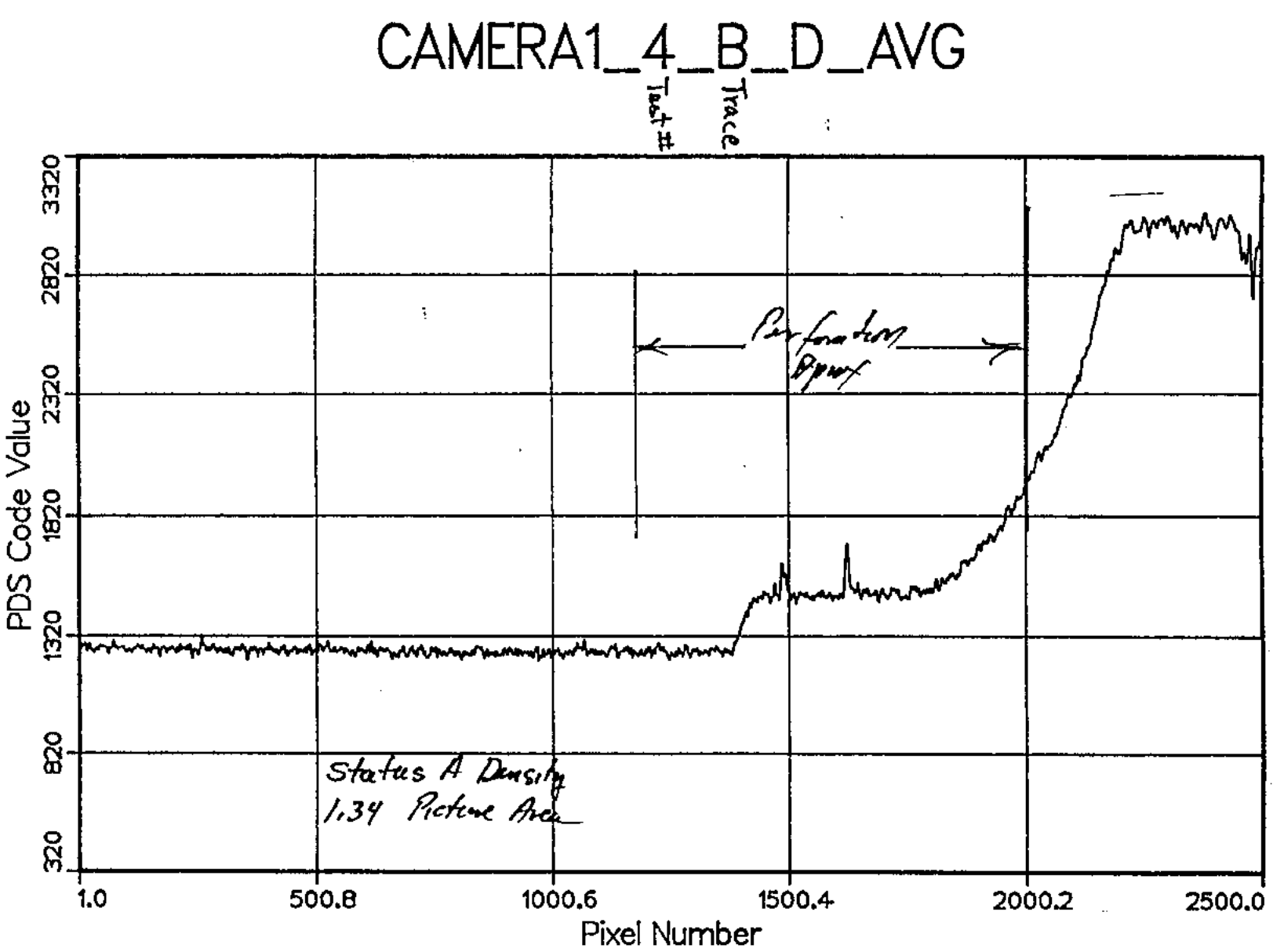
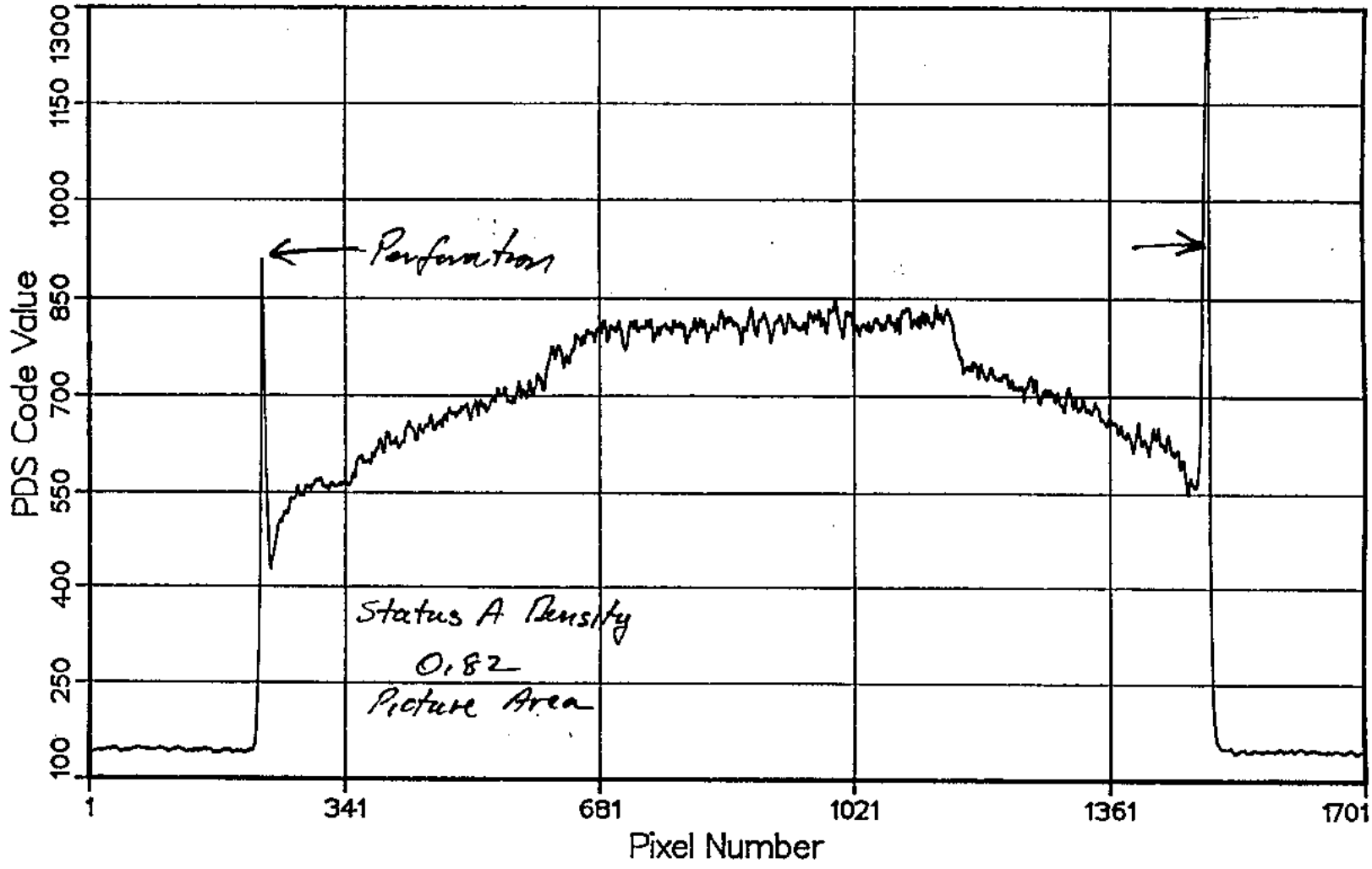
500.8
1000.6
1500.4
2000.2
2500.0
Pixel Number


CAMERA1_4_B_D_AVG
Test #
Trace
Perforation Space
Status A Density
1.34 Picture Area
PDS Code Value
3320
2820
2320
1820
1320
820
320
1.0
500.8
1000.6
1500.4
2000.2
2500.0
Pixel Number

CAMERA3_4_H1_AVG

Transverse Perf to Perf Reading "D"



Subject: Zapruder 8mm Report
Sent: 9/29/98 11:54 AM
Received: 9/29/98 7:59 PM
From: Herb Farmer, hfarmer@usc.edu
To: Rollie Zavada, zavadarc@netacc.net

Hi Rollie...

Your report arrived very promptly and I was able to look it over, enough to recognize that it is extremely detailed, very thorough and should answer any questions that may come up. Also, I can readily understand the need for accuracy.

I did ask Steve Wright who manages our MP Lab to look at it and we concur that on pages 15 and 16 and there is one point which needs correction or clarification. The sample print referenced in Figure 3-8 and its descriptive paragraph was not done on a Model J printer because, although we have several, we do not have one in service at the present time. It actually was printed on a B&H "Model J type mechanism" which is part of a B&H Design 6100 Model AB printer. I call it this because the film path and picture printing sprockets, tension, guide and pressure rollers, and printing aperature width contol, all seem to be the same as in the Model J printers except for refinements over the years. The hand operated light change part is missing as light control is a part of the Model AB light system. The main casting of the printing head was modified in design to add the sound track in addition to the picture image printing capability on the same pass through the mechanism. The drive system is belt coupled as in the Model J but the drive motor is in the pedistal and is designed to allow it to run both at 60fpm and 180fpm. It also came with the margin edge number printing kit installed.

This printer is used regularly for printing B&W positive work print at one controlled exposure without scene to scene timing and at 180fpm. All workprint is printed with the edge number margin light on. I think your conclusions are still correct as I cannot see how printing at the higher speed could affect the appearance of the septum line.

Herb Farmer

Addendum about this particular printer.

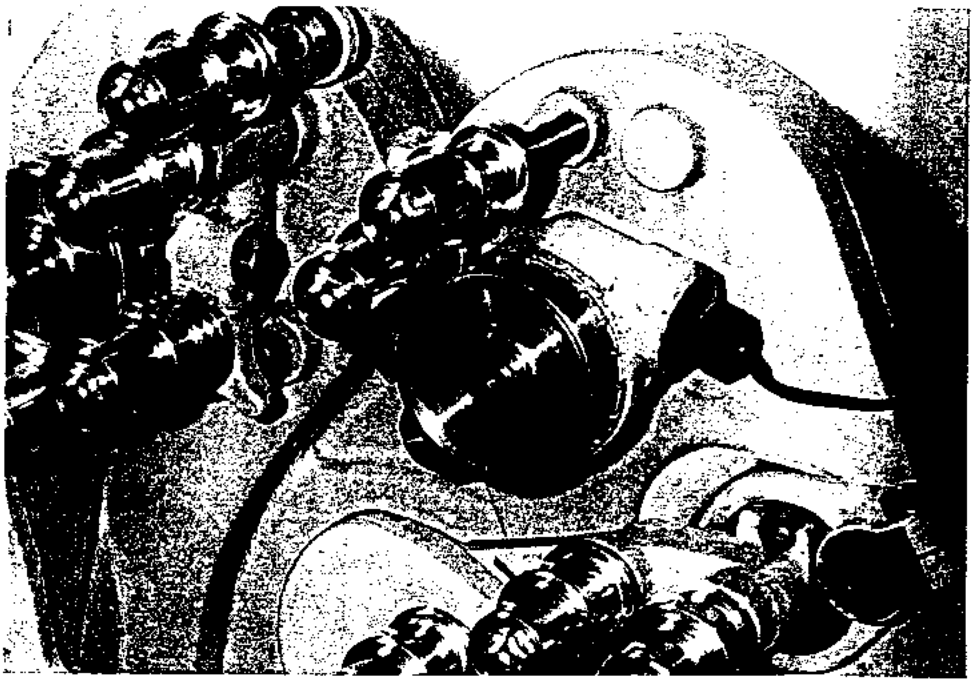
It is my understanding that B&H actually produced and delivered Design 6100 Model AB printers to a few laboratories with the committment that they would be taken back by B&H when a full production model was ready. James Wassell of B&H Professional Products Sales, arranged for USC to have two of these printers from Hollywood Film Company when their new Model 6100 C's were put into service.

Many years later we put one into service and are still using it for B&W positive work print. We have never used the additive color features but use strictly the blue channel at one standard value so that exposure variation in the workprint are obvious to all. The original light beam control system apparently left a great deal to be desired and I recall Ed Reichard of CFI showing and explaining to us the (then) new vane system unit in development which was standard on the Model C from the start.

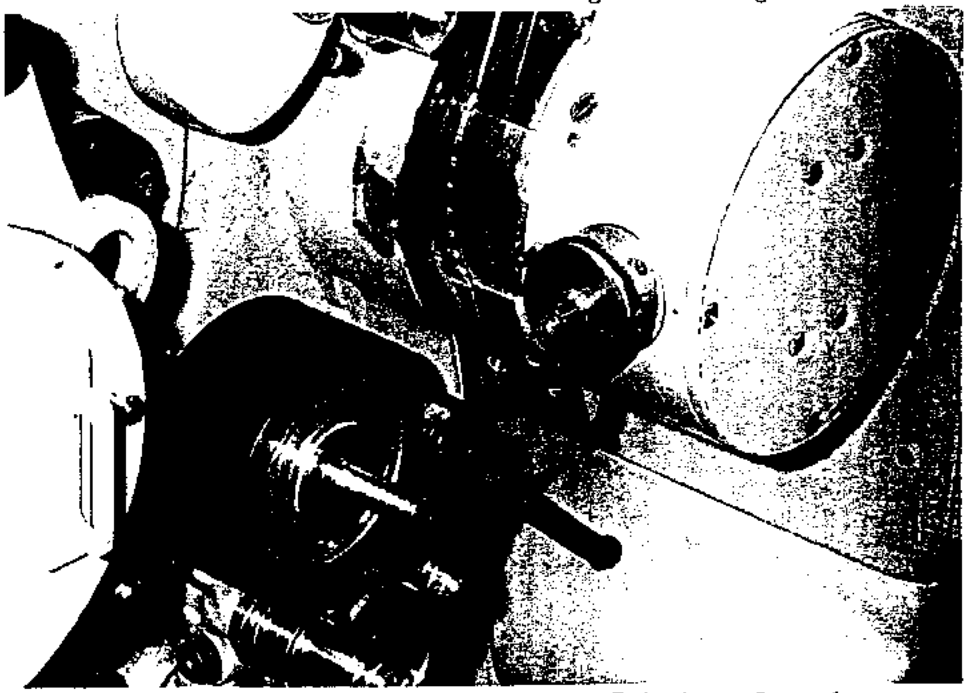
The Design 1600 designation seems to specify an additive type light source and if I were to guess, I suspect there could been a 6100A prototype which would have be the RGB lighting unit and pedistal with a Model J printer mechanisms added directly to it. This then became an AB printer when the printer head was modified to add the whole sound track printing path with the extra supply and takeup provision. This then is the configuration which became the Model C Printer when the whole thing was refined and commercially released. I will get pictures of both the AB and the C mechanisms for you in a few days. HEF

USC Bell & Howell Design 6100 Model AB 16mm Printer

The USC printer is referenced on page 15 of Study 3 accompanying a film clip showing the septum line generated by the Margin Printing Attachment. According to Mr. John Ehrenberg, former Bell & Howell and President of BHP, The 6100 design series Model AB is basically the same transport mechanism as the Model J, with changes primarily in the light source and light controls. Photos supplied by Prof. Farmer show the printer head and the margin printing attachment.



Bell & Howell Model AB Printer Margin Printing Attachment



Bell & Howell Model AB Printer Printing Sprocket