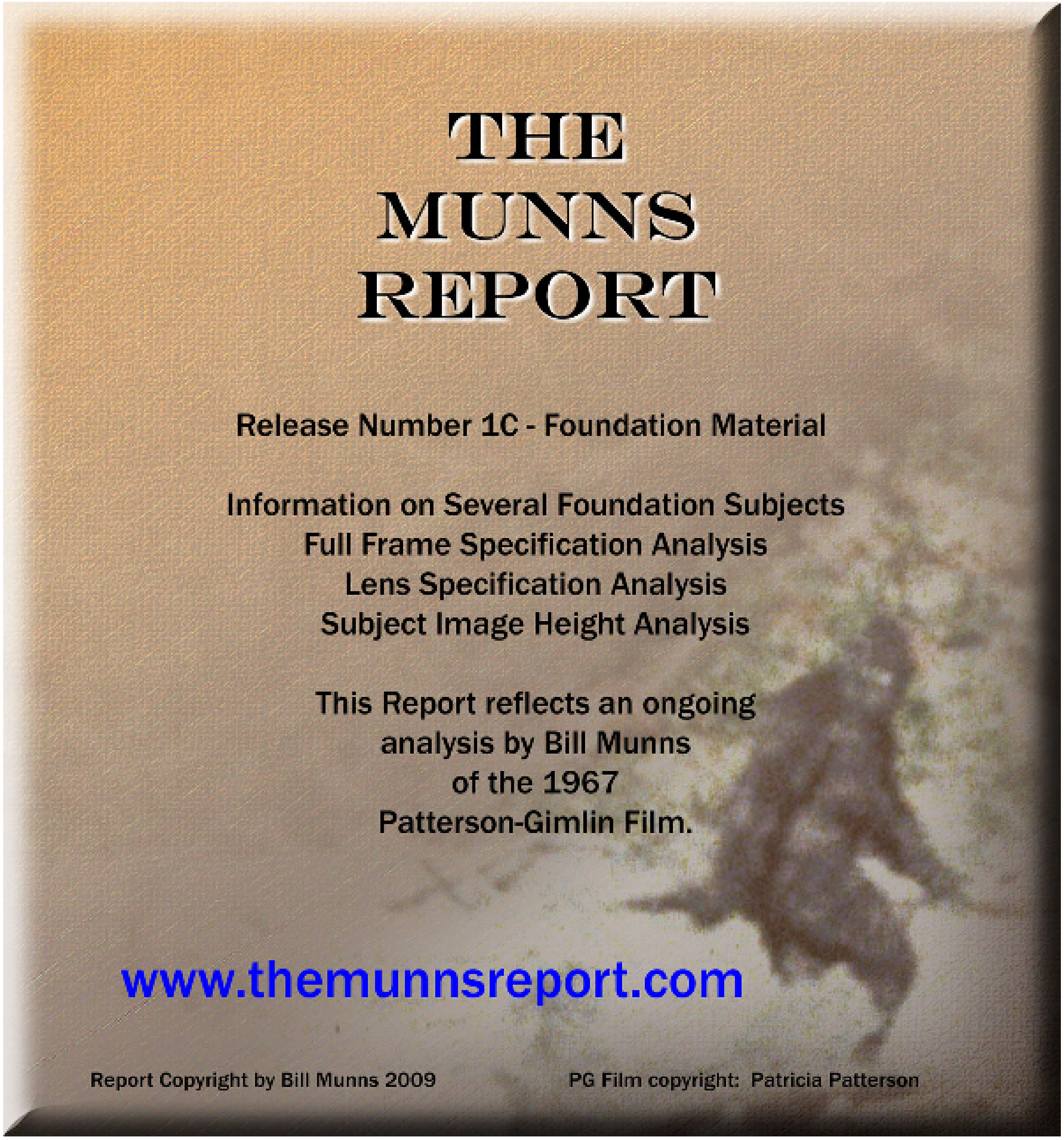


Report Material released July 28, 2009

Full Frame Specification Analysis
Lens Specification Analysis
Subject Image Height Analysis

Full Frame Specification Analysis

PART ONE - Establishing a Full Frame Specification for Subsequent Image Analysis

Because of my film analysis work, as well as the responding analysis of others to the work I presented, a considerable discussion has ensued about what exactly is "Full Frame" or what the dimensional specifications are which can be relied upon for other calculation and analysis.

On thing which I have learned in the time since the first report section release in May, 2009, is that the term "Full Frame" actually is a variable or imprecise term, depending on 16mm camera type. Each camera manufacturer can make their camera gate aperture opening to their own specs, and often included purposeful irregular shapes on one or both frame sides to produce a visible "Camera Identification Mark" in the exposed film, thus allowing a method of identifying the camera merely by inspection of the exposed film (assuming a camera original film).

Also, magazine type cameras for 50' loads of 16mm film, which were popular in the 60's, had their own unique criteria for defining a full frame. The magazine itself has an aperture gate aside from the camera's aperture gate, and the magazine aperture defines the frame vertical height, while the camera aperture defines the frame width and allows for the camera identification mark to imprint on the film stock.

The result of this investigation was to realize the general concept of "true full frame" may have a generic specification, as noted in the ASC Manual (and which I relied on in my first report release material), but actual "full frame" to be used in any image analysis must derive from an actual test on the specific camera used or footage from that camera, so I have had to do a new analysis on what is "true full frame" for the PGF, taken with a Kodak K-100 camera, single lens version, like Patterson actually used for the Bluff Creek footage of the PGF.

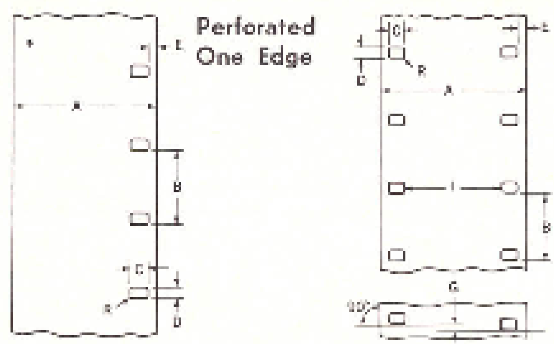
So I have reviewed the issue and spent some time doing simple foundation work to establish a basic PGF Full Frame Image Specification for my subsequent analysis and revisions to my report in the future.

This specification will aid any researchers who in the future may reference the images I have scanned of various film copies, or reference other prior imagery to my scan data for scaling. The unfortunate reality of almost all frame copies and images from the film, prior to my effort, had no reliable dimensional measure which could be referenced and relied upon for such matters as calculating the subject's true height in frame, for use in the optical formula I have referenced throughout my report.

So this foundation material will provide a factual measurement standard for future research.

Foundation Data - The ASC Manual (published by the American Society of Cinematographers), second edition, 1966, provides a diagram (page 287, shown immediately below) and description (page 282 and 283, shown next page) of 16mm film stock dimensions and related specifications. These are ASA (American Standards Association) manufacturing specifications, thus photographic industry standard.

16mm FILM DIMENSIONS



FILM	ASA STAND.	FILM DIMENSIONS (Inches)								
		A	B	C	D	E	G	I	L*	R
16mm, 2R-3000	PH22.5	0.629	0.3000	0.0720	0.0500	0.036	0.001	0.413	30.00	0.010
16mm, 1R-3000	PH22.12	0.629	0.3000	0.0720	0.0500	0.036			30.00	0.010
16mm, 1R-2994	PH22.109	0.628	0.2994	0.0720	0.0500	0.0355			29.94	0.010
16mm, 2R-2994	PH22.110	0.628	0.2994	0.0720	0.0500	0.0355	0.001	0.413	29.94	0.010

*This dimension represents the length of any 100 consecutive perforation intervals.

287 FILM DIMENSIONS

The measurement identified above as "B" is "pitch" (distance from sprocket hole to the next, and thus the pulldown image area where each new frame can be exposed). The ASC Manual notes that there is both a long pitch film stock, with true 0.3000" pref-to-perf (and thus frame to frame distance) and a short pitch (0.2994" perf-to-perf) film stock are made. It does note (copied below) the long pitch stock is more generally used for copy stock and reversal-type camera original stocks which are intended for direct projection. Short Pitch stocks were commonly used for camera original where it is assumed that copies or prints will be made from the camera stock (camera negative stock being the most likely), as of 1966 when this edition was published.

The Kodachrome II stock used by Patterson in 1967 is a reversal film stock, generally intended for consumer use and direct projection, which meets the ASC criteria for a long pitch stock.

However, more current versions (as of 2002, 35 years after the PGF was filmed) of Kodachrome film stock are specifically short pitch, as noted in the most current Kodak spec sheets on these films.

K-40 type 7270 is short pitch (from a March 2002 spec sheet)

K-25 7267 is short pitch

For an understanding of why films were set up with these two different specifications, the following description from the 1966 ASC Manual explains this well.

PITCH

Pitch is the distance from the leading edge of one perforation to the leading edge of the next and is expressed in decimal inches. Motion picture perforations are commonly referred to as having either "long" or "short" pitch.

16mm camera film of a reversal type intended for direct projection is usually supplied in long pitch (3000). 16mm

282

camera film intended for subsequent release printing is generally furnished with short pitch (2994) perforations. When films are being printed, the original camera film and the unexposed printing stock pass over a curved printing sprocket simultaneously for exposure. Since the printing stock is on the outside, the difference in diameter of a few ten thousandths of an inch is accommodated by giving a shorter pitch between the perforations of the film being duplicated.

Most printing or duplicating films, either reversal or positive types are, therefore, supplied in long pitch.

IDENTIFICATION

In referring to a 16mm camera film intended for direct projection the term "PH22.5-1964-2R-3000" is used. The first set of numbers and date refers to the American Standards Association specification sheet for this type of perforation and the date on which it was adopted. "2R" indicates that the film has two rows of perforations, and "3000" indicates the pitch of the perforations as expressed in decimal inches: 0.3000 inch. (Note: ASA frequently revises these standards so it is wise to check if a later spec sheet is available which includes modifications.)

STANDARD 16mm PERFORATIONS

American Standard PH22.5-1964 Dimensions for 16mm Motion Picture Film. Perforated Two Edges — 2R-3000 (Long Pitch). This perforation is used primarily on all 16mm products for both original camera use and duplicating purposes. It is rectangular in shape with fillets in the corners.

American Standard PH22.12-1964 Dimensions for 16mm Motion picture film. Perforated One Edge—1R-3000 (Long Pitch). This perforation is used on original camera films mainly for single-system sound pictures or post magnetic sound recording. Cameras using film perforated to this standard should have a single pull-down claw. Duplicating or printing films intended for sound applications with optical tracks or magnetic striping are also perforated to this standard. Its physical size and shape are identical to 16mm film perforated with two rows.

American Standard PH22.110-1965 Dimensions for 16mm Motion Picture Film. Perforated Two Edges — 2R-2994 (Short Pitch). This perforation is used primarily on professional motion picture films where duplicate prints will be required.

American Standard PH22.109-1965 Dimensions for 16mm Motion Picture Film. Perforated One Edge — 1R-2994 (Short Pitch). Same as above, except one row of perforations.

The relevance of this is a question of exactitude, and critics like to argue for a lack of exactitude as a flaw in a presentation, by looking at ever increasing degrees of precision, or lack of precision, as a way to criticize an analysis.

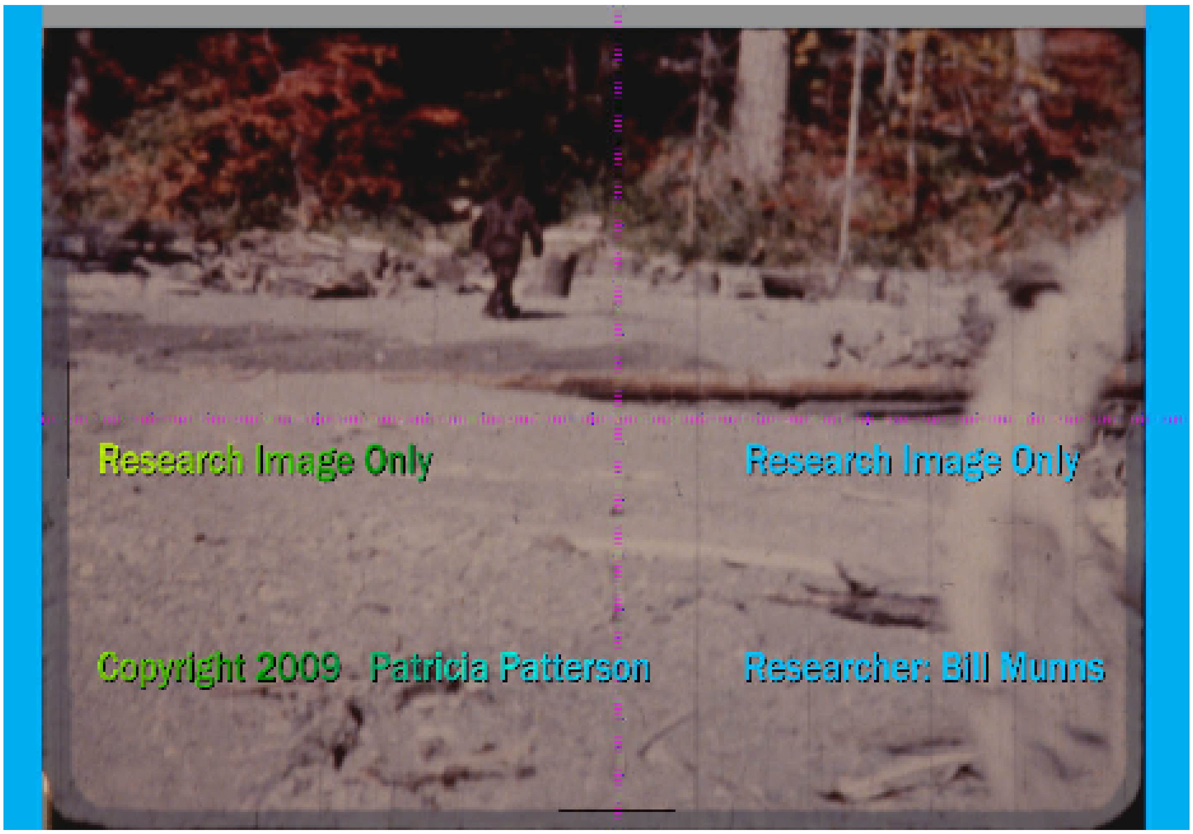
Given the discrepancy between these specifications (short vs long pitch), plus the question of how a copy stock which is stated as long pitch (and the copies I have scanned are thus presumably on long pitch stock) impacts upon the various measurements herein, I will be citing both a short pitch and long pitch specification herein for various discussions.

It should be noted that on this basis, my reliance on the long pitch 0.3000" specification in general, and the assumption of it as the spacing between frames on the PGF camera original would be 0.3000" (example, measured from base line of one frame image to the base line of the next image, the pulldown distance frame to frame), may have an error of -0.2% if subsequent research confirms the old K-II film stock of the 60's was short pitch.

So this report release will acknowledge a 0.2% margin of error based on this issue of film pitch dimension, until such time as all film pitch related issues may be cleared up.

For this analysis, a long pitch, 0.3000" specification will be used for the pulldown distance from baseline of one frame to baseline of the next. For the PGF film I scanned, a true full frame contact print, the image was set up for subsequent measurement by establishing a crop of the scan from true baseline of image frame to the baseline of the next image frame, and then scaling this cropped image to 3000 pixels high, so one pixel represents 0.0001".

This calibration image is shown below, but reduced to accommodate the PDF document. The PGF Image is a 50% blend of the two copies of the same frame, and has the 50% grey border for the cropped version on sides and bottom.



Base Components of my Calibration Image:

Actual size in Photoshop File: 3000 pixels high by 4320 pixels wide.
File Size: 96MB

The grey top margin represents the black unexposed image area between frames in the PGF full frame scan. It is 0.008" in height (short pitch would yield 0.007984")

The Blue Side borders represent the side edges of the PGF full frame image side boundaries.The full frame image width is inside these two blue borders.

The PGF image section has two frames from the same frame number, one from the scan of Mrs. Patterson's archive film copy (scanned on June 25, 2009), which is a full frame contact print, and a second image from a scan of John Green's optically printed copy (scanned on Feb. 1, 2009), one of several copies John possessed, and from a generational copy level not yet determined.

Copy generational level is still under analysis, so no further references will be noted herein to such.

The two versions, representing a true full frame image size, and a cropped optically printed copy size, are shown below. The left half is the true full frame, while the right, with it's conspicuous black borders on side and bottom, represents the cropping caused by the optical printing process.

Establishing a Measure Bar for the Image:

In Photoshop, a measure bar was constructed by a text layer with a lower case "L" (Arial font), so one letter was typed, then two spaces, then a letter, etc. until a group of eleven equally spaced "L" bars were composed. Blue reference dots indicated the 1st and 11th (thus 10 spaces apart) and a blue dot for the midpoint of 5 spaces). This bar was copied and pasted to build a measure bar with easily visible increments of 5, 10, and 50 spaces.

A measure bar from this was assembled with 150 spaces, and rotated 90 degrees to measure top to bottom of the image. The measure was scaled to the full 3000 pixels image height, so that each measure increment was 20 pixels or 0.002" (a short pitch calculation would be each measure increment is 19.96 pixels or 0.001996").

Then a copy of this bar was pasted into a new layer and rotated 90 degrees for a horizontal measure bar identical in scale to the vertical one calibrated to the image vertical scale, the single most reliable measurement.

A second horizontal measure bar was added and joined to the first, to extend the measure beyond the 3000 pixels it originally was when copied from the vertical form.

This resulted in a true measure bar for both horizontal and vertical dimensions of the film in its varied crop forms.

Result:

PAC #1 (Patterson Archive Copy #1), contact printed, measured as follows:

Image height: 0.292" 7.416 mm
Image Width: 0.401" 10.185 mm
Separation black space between image frames 0.008" 0.203mm

JGC (John Green Copy) optically printed and thus cropped, measured as follows:

Image height: 0.285" 7.239 mm
Image Width; 0.385" 9.779 mm
Separation black space between image frames 0.015" (0.008" on top, 0.007" on bottom)

Margin of error of +- 0.5% should be factored in, based on blur of frame image edge on high magnification inspection.

Measures shown below are true size from the Photoshop Source file, for the four edges (top, bottom, left, and right) where the measure bars meet the edge.

Discrepancy of Measurement:

In the NASI Report, which relied on the one previous scan of the PAC (Patterson Archive Copy) of the film, the NASI report lists different numbers for frame width and frame height. This data is shown below:

Each of the 953 frames of the Patterson-Gimlin film were digitized three times, once each through red, green and blue filters. Each of these three colors was digitized using 12 bits (4,096 levels) at the rate of 2,656 pixels horizontally and 1,912 pixels vertically. This provided 36 bits per pixel at a digitization rate of slightly higher than 250 dots per millimeter (approximately 6,350 dots per inch) which was high enough to image the film grain. Each

Table 6: Film Data

	Film Width (mm)	Image Width (mm)	Image Height (mm)	Sprockets, Center-to-Center(mm)
Specification	N/A	10.49	7.605	7.605
Measured	15.75	10.29	7.60	7.568
Deviation	N/A	-2.0%	-0.07%	-0.5%

frame of the Patterson-Gimlin Film yielded a 30,470,144 byte Silicon Graphics (SGI) file composed of a 512 byte header followed by the pixels organized in 3 planes, one for each color. These frame data files were buffered locally on a Silicon Graphics workstation until twenty frames were accumulated which were then written to an 8mm Exabyte tape cartridge in Unix tar format. The twenty frame files were written twice to each tape to minimize the chance of a tape defect rendering a frame inaccessible.

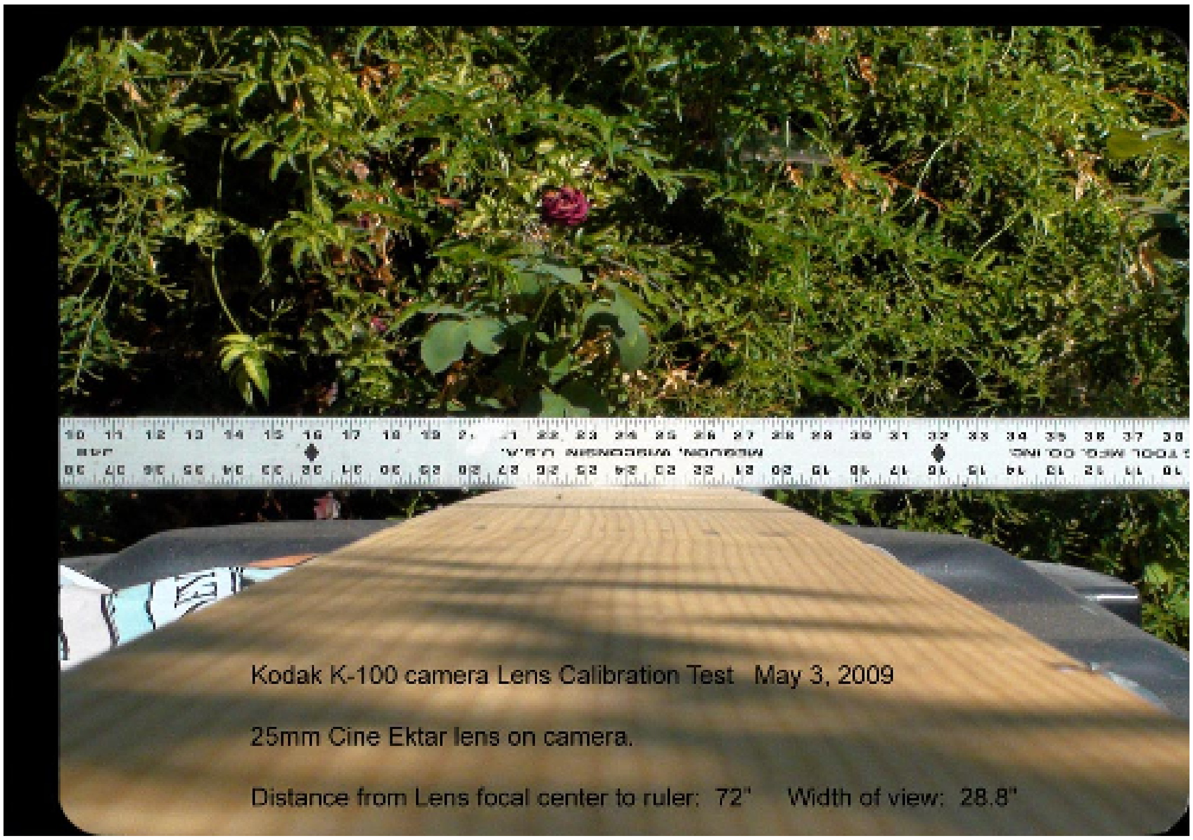
But it also lists a sprocket to sprocket center measure (red dot) which is less than the image height measure (blue dot), and that would mean frame images slightly double expose over each other (which clearly IS NOT present in the film) and there would be no black unexposed separation between frames, (which clearly IS present on the film). Thus inspection of the film verifies that image frame vertical height MUST be smaller than sprocket-to-sprocket center distance, and a black unexposed frame image separation area must also be measured. The combination of image frame height, and frame black separation area height, should total sprocket-to-sprocket distance measured.

On this basis, I cannot determine why the NASI measurements are different, or even how they were determined, and thus I cannot rely upon them for this analysis. I will rely on the methodology and determinations I have noted above from my own research and test analysis.

Lens Specification Analysis

25mm Lens Calibration based on image measure test of May 3, 2009

The scanned test frame, as a basis of this analysis, is below:



Lens Optical Center to Ruler: 72"
Ruler angle to camera centered line of view: 90 degrees
Ruler width: 48"
Ruler visible in film frame: 28.8" total width (Horizontal view)

Calculated HAOV (Horizontal Angle of View): 22.62 degrees.

For a 0.401" film gate aperture width, a 1" lens (25.4mm focal length) will make an angle approximating 22.66 degrees (to the tolerances of my test software computation). A true 25mm (0.984") lens will make an angle of 23.04 degrees on a 0.401" film gate.

Error: 0.17% (assuming Kodak used true 1" or 25.4mm as design spec)

Error: 1.85% (assuming Kodak used true 25mm or 0.984" as design spec)

Discussion of Film Lens and Possible Variations

It has been my contention that the camera filming the PGF does not have a 25mm lens on it. Since this has been announced, there has been some intriguing discussion about this subject. The principle issue is that with a 25mm lens on the K-100 camera Patterson used, the subject being filmed may be well under 5' tall, which essentially contradicts all reports and claims, both real and hoaxed, for the subject seen walking through the scene. Various methods have been suggested by other researchers to modify the input numbers of the optical formula to restore a subject height to about 6' tall. One such modified number is the lens focal length, and the following discussion addresses two claims of modification.

Lens effective focal length - A shorter focal length would affect the optical formula to yield a taller subject, for any given distance, so the idea has been offered that the lens may not have had an effective (true working) focal length of 25mm or 1' (25.4mm), but rather may have had a true effective focal length shorter. Focal length numbers such as 23mm and 22.5mm are some of the numbered argued by other researchers.

This is problematic in two ways. One must either argue for a true lens of correct focal length, which is of that stated specification, or argue for a lens rated and sold with a 25mm specification but to be so off spec as to be falsely advertised.

Considering the first, there is no known lens listed in the 5 pages of Cine Camera Lens known to exist in 1966 and evaluated by the ASC in their Manual chart, page s 236 to 240 . The pages are copied herein in APPENDIX A below (end of this report update).

There are many 25mm lenses listed. Indeed, almost every manufacturer who makes 16mm camera lenses has a 25mm lens in its inventory. But the next step down is a 20mm Baltar, and below that, there are quite a few options between the 20mm and a 15mm Kodak makes for the K-100. But between 25mm and 20mm, there is nothing. So any claim that such a prime (non-zoom) lens exists, with a "C" mount that allows it to fit on a K-100 camera, is an extraordinary claim requiring proof before said lens focal length can even be reasonably considered as an option to discuss, much less to support any proof.

The alternate argument is to claim a 25mm lens is actually off spec by a +- 5% to 10% of rated or advertised focal length compared to actual effective functional focal length. In other words, the argument is that a lens sold and described as a "25mm lens" may actually be a 23mm (or other lesser number) in functional effect. This raises the question of what kind of quality control may be found in movie camera lenses for 16mm cameras.

A lens quality control statement for the Kodak Ektar lenses has not been located so far, but a Kodak slide projector brochure does have an interesting statement about Kodak's level of lens quality. In this brochure, for Kodak's "Ektapro Select" Projector FF Lens series, it states that " Each Lens has individual focal length information accurate to 0.1mm. This means the tolerances on the 93mm lens are a mere +- 0.5mm." The brochure page is shown below.

This results in a lens spec true to rated focal length within a +- 0.537%, or about 1/10th to 1/20th the error range researchers are suggesting the PGF filming Kodak Cine Ektar lens might be off spec.

For a company that has always taken pride in its excellence in the Photographic field, a suggestion that its line of Cine lenses for 16mm film cameras is 10 to 20 times more prone to focal length error than it's slide projector lenses are, does seems to be an extraordinary claim. My testing of one 25mm Cine Ektar lens, noted above, found the lens well within the tolerances of the Kodak Projector lens, indeed even more precise, if anything.

So the argument of a lens being so off spec in actual working focal length should be regarded as an extraordinary claim needing actual proof such a lens exists with such incredibly poor quality control.

Professional Sharpness – introducing a complete new series of projector lenses. Standard lenses of highest quality, in zoom or popular, fixed focal length configurations, or precision lenses of the EKTAPRO SELECT family for your most demanding needs. Both versions offer enhanced convenience due to rack focus.

Enhanced Sharpness

KODAK Slide Projection Lenses are designed for the professional. A choice of specifications to meet all presentation needs and budgets.

KODAK Slide Projection FF Lenses

The cost effective alternative for professional slide presentation: Three fixed focal length lenses are available. They offer single coating with gear rack focussing. Three different zoom lenses provide enhanced flexibility for presentations on the move.

KODAK EKTAPRO SELECT Projection FF Lenses

Brilliant optical quality for the most demanding requirements: multi-coating, metal housing, high contrast and precision manufacture are the characteristics of this series. Each lens has individual focal length information accurate to 0.1 mm.

This means the tolerances on the 93 mm lens are a mere ± 0.5 mm.
All KODAK EKTAPRO SELECT FF Lenses are supplied in plastic system boxes for safe transport and practical storage.

That fact of the matter is that any argument for lens focal lengths less than 25mm (but greater than the 20mm Baltar known), such as in the 24mm, 23mm or 22mm range, is a claim which has no merit until an actual lens is identified that exists to those specifications. Only then can any argument or proof be considered meritorious enough for further scrutiny and a realistic solution to the PGF analysis.

From the standpoint of hypothetical exercises, certainly anyone can consider a "hypothetical lens" for speculative analysis, but such speculative analysis, based on a hypothetical lens, has no weight of proof and certainly does not disprove or refute anything in my report analysis.

Subject Image Height Analysis

One of the more important uses of the frame height measurement (from the first section of this report release) is to determine the film's subject height in frame, as one input number for the classic optical formula I referenced in my main report release, and which is documented in the report website. That is one of three input numbers I am using to make subject height calculations. It is in this respect that the film image measurable height becomes important, and precision of the measurement becomes valuable to this research.

Subject height in frame, as a measurable dimension in fractions of an inch or in mm, is essential for applying the optical formula. But the subject height can be calculated in "height as posed" or "standing height" (which would be the subject's height when standing straight up with full upright posture, not a walking or striding posture). "Height as posed" is to some extent less than standing height, but the extent is subject to considerable debate. Other researchers have used more generous percentages or allowances for expanding "Height as posed" into an estimated standing height, but I find that using a human figure posed to match a frame, and then the same human model straightened up to measure true standing height as being the most reliable method, and the one method I endorse. Using generic computation percentages is far too error prone, because those computations cannot be certified as measuring the same human posture in a walking stride as the film's subject. This methodology I employ does do so, and thus is more reliable.

The method I have used incorporates a human digital model of a body proportion I have previously established as having a good match to the anatomical proportions of the subject figure, including a oddly short lower leg in proportion to upper leg (a low crural index). I have used that same digital model for the three new comparisons I offer herein.

In three frames, two of which have clear view of the subject including a foot or feet, and the classic F352 (which has one knee but no feet seen). We know that the subject is walking away from the camera during this sequence, so we should expect the true standing height to diminish as the frame sequence progresses. So if it is argued that I should scale the subject larger in F352, I would need to scale the subject larger in the other two examples as well, or else we will not have a diminishing height, which would then contradict the fact we can clearly see the subject moving away from camera, a cause for a diminishing image size.

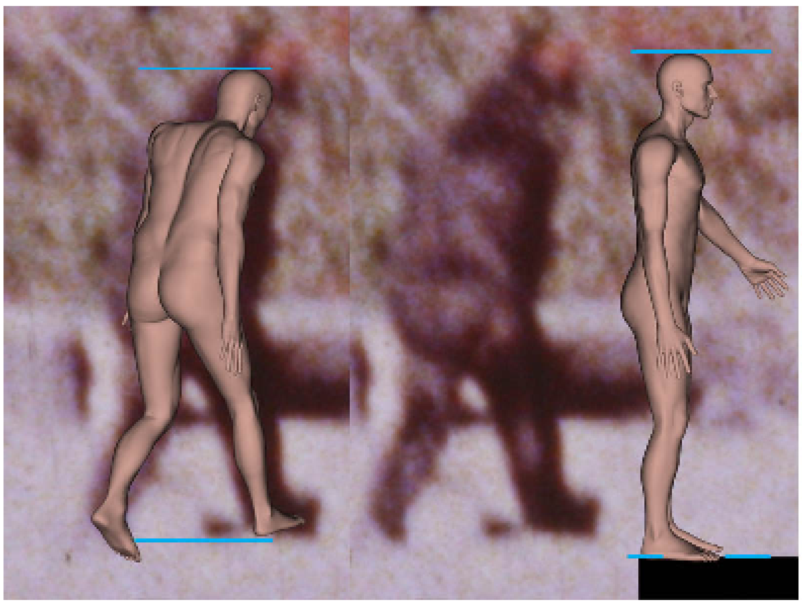
The use of modeling subject height in multiple frames thus allows the rate of height change to be one form of verification of the accuracy of the digital model comparison, a verification which is absent when only one frame is used as the comparison.

Method:

Each film frame was first set up as a true full frame 3000 pixel high source image (including black frame seperation section), similar to the measuring image frame described above. Then, the image was cropped to a 600 x 600 pixel image crop around the subject figure. This insured that the measure of the digital model, in pixels high, had a precise correlation back to the true frame height, and thus a precise percentage for the subject height in frame.

The digital model was posed in DAZ Studio software, using the 600 x 600 pixel crop as a backdrop image. The result was rendered and saved. Then the subject model was rotated to a true profile in place, so it did not scale any larger to the render camera, and the digital model was then "straightened up" to a full upright standing posture. Then it was rendered out and saved.

The three composites, shown below for the three frames, have the digital model posed to replicate the film subject posture, then the digital model standing straight up, and the measurement statistics.



Height in Frame - Analysis 1

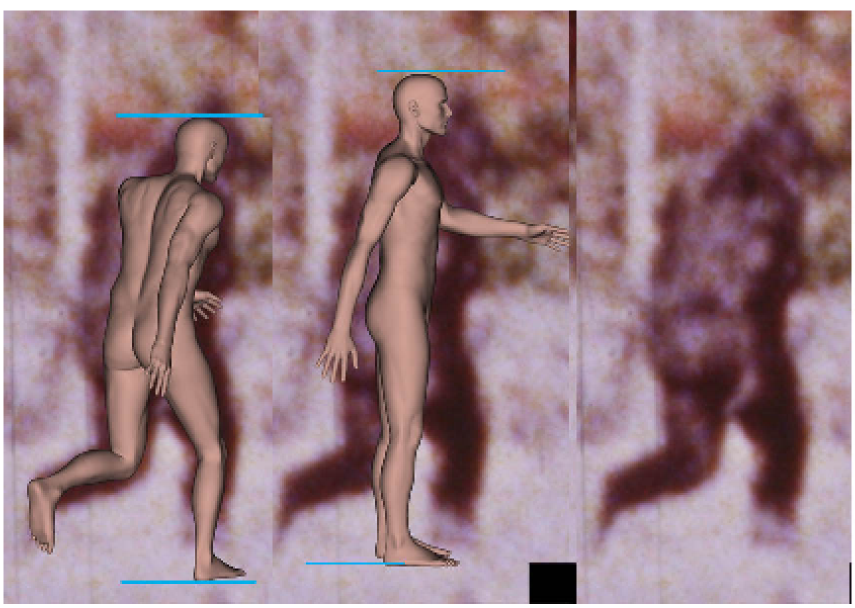
From Frame 287

Height as posed 475 pixels of 3000 pixels frame height
percent of frame height: 15.83%

Height standing straight 507 pixels of 3000 pixels frame
percent of frame height: 16.9%

Change in Height 106.76% (+ 6.76%)

Note:
Standing height is measured half way between the left and right heel elevation, to correct for camera perspective. That would be true height at body midline.



Height in Frame - Analysis 2

From Frame # 311

Height as posed 469 pixels of 3000 pixels frame
percent of frame height: 15.63%

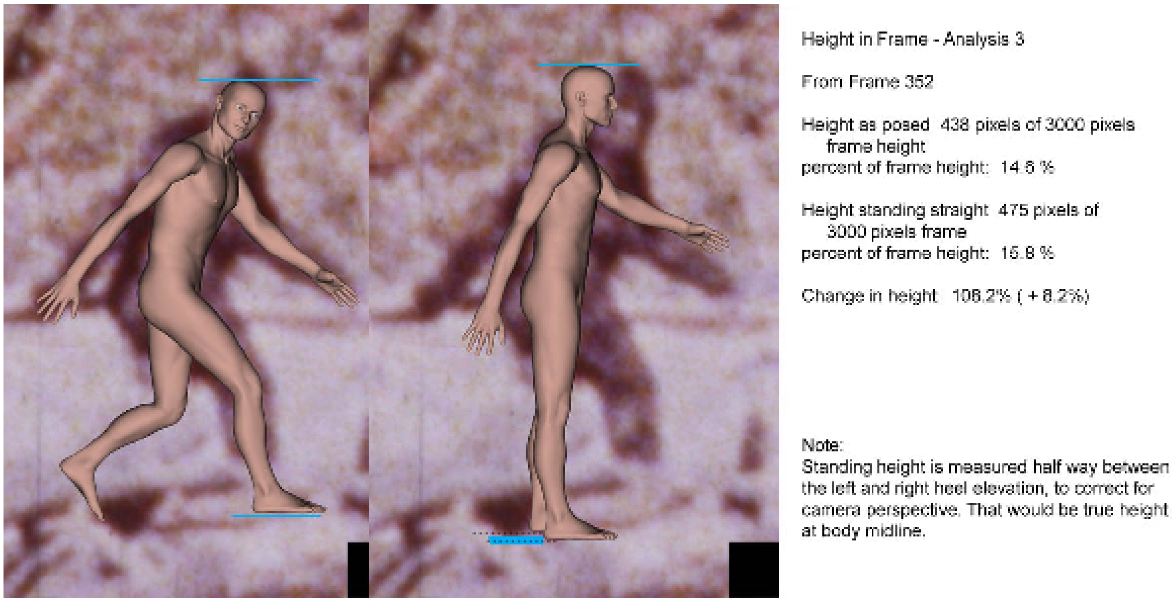
Height standing straight 495 pixels of 3000 pixels frame
percent of frame height: 16.5%

Change in height 105.5% (+5.5%)

Note:
Standing height is measured half way between the left and right heel elevation, to correct for camera perspective. That would be true height at body midline.

Note:

Frame is next one after Cibachrome 310 in sequence.



Blue bars show where the measurements were taken for each height measure, the exact pixels being inside the two blue bars (top and bottom). For standing height, the camera perspective causes the right foot to appear longer, and the left far foot appear shorter, so a midline between the heel base heights was taken as the correct height for the body midline (centered, left to right, and directly below the head).The following statistics are drawn from these three model comparisons:

Standing Height: 507 pixels, to 495 pixels, to 475 pixels, an appropriate diminishing height as subject walks away from camera.

Height as posed fluctuates from height standing up, depending on which part of the walk cycle the frame captures, but the variance is from +5.5% to +8.2%.

Comparing the change in diminishing size to frame, we see that from the first example to the second example is a reduction of height of 02.4%

(from 507 pixels, as 100% to 495 pixels as 97.6%) for 24 frames (0.100% per frame),

and a diminishing of height from the second to third of 4.1% for 41 frames (0.100% per frame).

So we have a rate of diminishing size consistent between the two samples.

So to argue that one particular digital model comparison is wrongly scaled would necessitate comparing how a proposed scaling correction affects this diminishing factor which is validated by the film observation that the subject is, in fact, generally walking away from camera (except briefly in the "look back") and thus must diminish in size (because the camera is stationary at this point, as verified by the fixed scaling of the background landscape objects).

A variable in height calculation is the somewhat pointed head shape of the film subject, and this may increase the calculated subject height by about 0.2 %, in the "as posed" measure, because the head generally tilts down and the back point raises up, but this increase would tend to be less a factor in the standing height, because straightening the head puts the pointed skull more on the back of the head and less on the top. So it has not been factored into this analysis of standing height in frame, but other researchers may choose to argue for a height increase on this basis. But anything more than a claim of increasing height by 0.2% (of total image frame height) would require some well documented illustration and methodology of determination.

Conclusion:

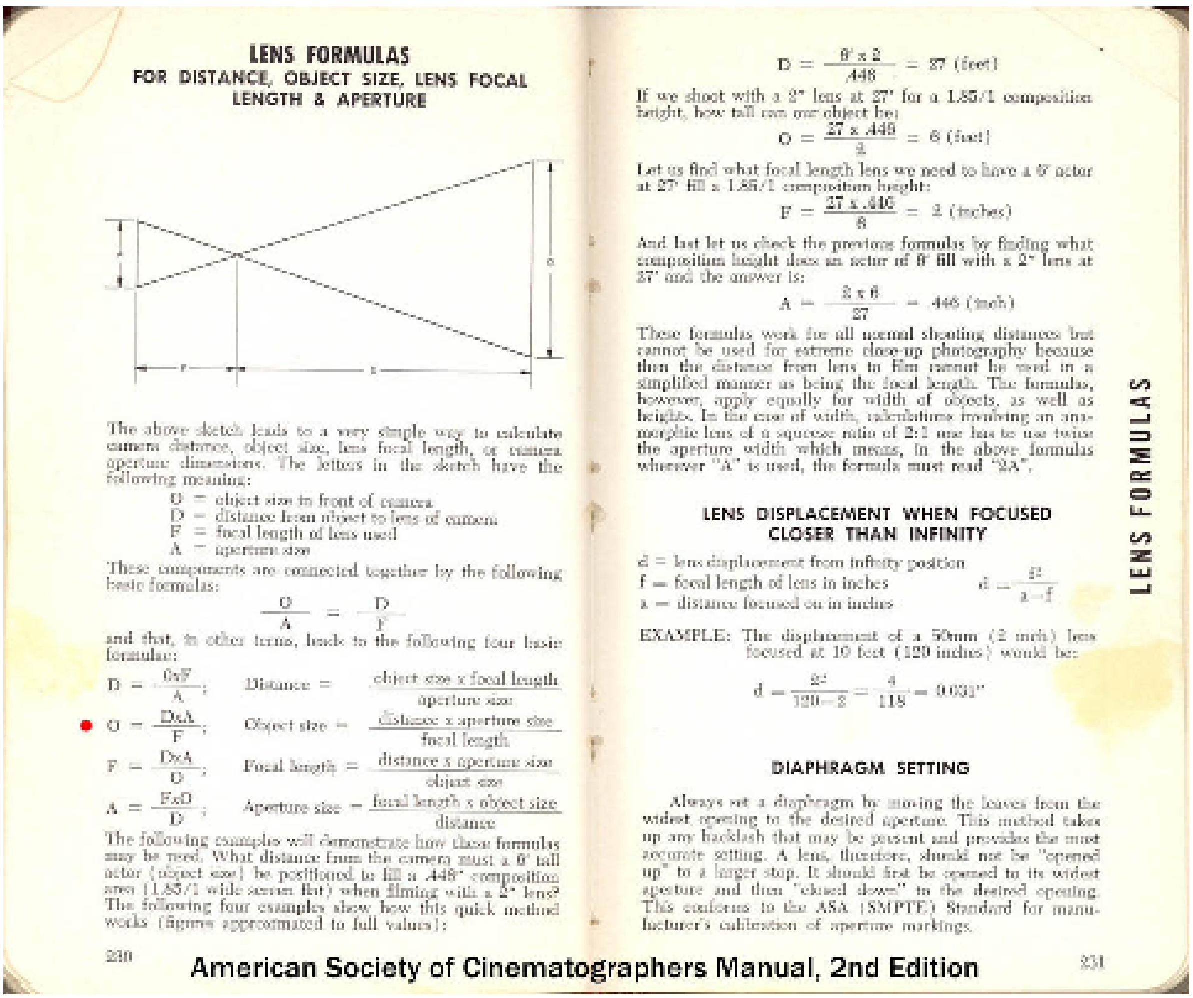
The subject's true standing height in the three example frames, translated into a "subject height in frame", (the "A" value in the optical formula) in true measurable height, as follows:

F287 Subject True (Standing) Height in Frame is 0.0507" 1.284mm

F311 Subject True (Standing) Height in Frame is 0.0495" 1.254mm

F352 Subject True (Standing) Height in Frame is 0.0474" 1.201mm

Reviewing the formula itself, for reference:



LENS FORMULAS
FOR DISTANCE, OBJECT SIZE, LENS FOCAL LENGTH & APERTURE

The above sketch leads to a very simple way to calculate camera distance, object size, lens focal length, or camera aperture dimensions. The letters in the sketch have the following meaning:

O = object size in front of camera
D = distance from object to lens of camera
F = focal length of lens used
A = aperture size

These components are connected together by the following basic formulas:

$$\frac{O}{A} = \frac{D}{F}$$

and that, in other terms, leads to the following four basic formulae:

$D = \frac{OxF}{A}$; Distance = $\frac{\text{object size x focal length}}{\text{aperture size}}$

$O = \frac{DxA}{F}$; Object size = $\frac{\text{distance x aperture size}}{\text{focal length}}$

$F = \frac{DxA}{O}$; Focal length = $\frac{\text{distance x aperture size}}{\text{object size}}$

$A = \frac{FxO}{D}$; Aperture size = $\frac{\text{focal length x object size}}{\text{distance}}$

The following examples will demonstrate how these formulas may be used. What distance from the camera must a 6' tall actor (object size) be positioned to fill a .448" composition area (1.85/1 wide screen flat) when filming with a 2" lens? The following four examples show how this quick method works (figures approximated to full values):

230

$$D = \frac{6' \times 2}{.448} = 27 \text{ (feet)}$$

If we shoot with a 2" lens at 27' for a 1.85/1 composition height, how tall can our object be:

$$O = \frac{27 \times .448}{2} = 6 \text{ (feet)}$$

Let us find what focal length lens we need to have a 6' actor at 27' fill a 1.85/1 composition height:

$$F = \frac{27 \times .446}{6} = 2 \text{ (inches)}$$

And last let us check the previous formulas by finding what composition height does an actor of 6' fill with a 2" lens at 27' and the answer is:

$$A = \frac{2 \times 6}{27} = .446 \text{ (inch)}$$

These formulas work for all normal shooting distances but cannot be used for extreme close-up photography because then the distance from lens to film cannot be used in a simplified manner as being the focal length. The formulas, however, apply equally for width of objects, as well as heights. In the case of width, calculations involving an anamorphic lens of a squeeze ratio of 2:1 one has to use twice the aperture width which means, in the above formulas wherever "A" is used, the formula must read "2A".

LENS DISPLACEMENT WHEN FOCUSED CLOSER THAN INFINITY

d = lens displacement from infinity position
f = focal length of lens in inches
x = distance focused on in inches

$$d = \frac{f^2}{x - f}$$

EXAMPLE: The displacement of a 50mm (2 inch) lens focused at 10 feet (120 inches) would be:

$$d = \frac{2^2}{120-2} = \frac{4}{118} = 0.031"$$

DIAPHRAGM SETTING

Always set a diaphragm by moving the leaves from the widest opening to the desired aperture. This method takes up any backlash that may be present and provides the most accurate setting. A lens, therefore, should not be "opened up" to a larger stop. It should first be opened to its widest aperture and then "closed down" to the desired opening. This conforms to the ASA (SMPTE) Standard for manufacturer's calibration of aperture markings.

LENS FORMULAS

231

American Society of Cinematographers Manual, 2nd Edition

Height Analysis of Subject

If we apply the above F352 subject height standing, 0.0474" and a 25mm (0.984") lens specification (which will yield a slightly taller subject height calculation than the 25.4mm spec would), the following chart shows what subject height we may expect for a given distance from camera to subject in the F352 point of filming.

distance, subject to camera	subject height
90'	4.33'
95'	4.57'
100'	4.81'
105'	5.05'
110'	5.29'
115'	5.39'
120'	5.78'
125'	5.97'

Current investigation of the subject position from camera in relation to a scaled site model puts the subject at less than 105' from camera for F352, **so if a 25mm lens is used on the K-100 camera which took the PGF, then the filmed subject is under 5' tall.**

Arguments of a greater distance (more than 105') are essentially the only way one can responsibly argue for a subject taller than 5', if a 25mm lens is specified on the PGF camera.

It should be noted as well that a 14.5" foot on a 5' tall subject scales to almost 25% or 4 foot lengths, for standing body height. To argue for 5 foot length's for standing height requires a 12" foot, not a 14.5" one.

So this researcher still finds that the prospect of a true 25mm lens on the PGF camera creates far more problems than it solves and thus is not the likely solution to the PGF film. However, attempts to determine subject height must consider actual known lenses of shorter focal length, because an actual lens was on the PGF camera, not a hypothetical lens.

The Lens list follows as Appendix A.

Lens Data Appendix A

Blue dots - 25mm lenses	19 total
Red Dot - 20mm Lens	1 only
Green Dot - Lenses between 15mm and 20mm	8 lenses total

No lenses listed are more than 20mm and less than 25mm.
Zoom Lenses are excluded because a zoom lens could not work on the K-100 camera and allow the photographer to have any viewfinder estimation of the image the lens was taking.

CINE LENS LIST

NAME	16mm	35mm
ANGENIEUX		
10mm f/1.8	X	
15mm f/1.3	X	
25mm f/0.95	X	
25mm f/1.4	X	
25mm f/1.8	X	
50mm f/1.5	X	
75mm f/2.5	X	
100mm f/2.5	X	
150mm f/2.7	X	
14.5mm f/3.5		X
18.5mm f/2.2		X
24mm f/2.2		X
28mm f/1.8		X
32mm f/1.8		X
40mm f/1.8		X
50mm f/0.95		X
75mm f/1.8		X
100mm f/2		X
Zoom Lenses		
17mm to 68mm f/2.2	X	
9.5mm to 95mm f/2.2	X	
12.5mm to 75mm f/2.2		X
12mm to 120mm f/2.2	X	
12mm to 240mm f/3.5 to f/4.8	X	
25mm to 100mm f/2.2	X	X
25mm to 100mm f/3.5	X	X
25mm to 250mm f/3.2 (T 3.9)		X
(with 1.6 ext.: 40 to 400mm)		X
(with 2X Ext.: 50 to 500mm)		X
35mm to 140mm f/3.5	X	X
35mm to 140mm f/2.2	X	X
BAUSCH & LOMB		
BALTARS		
15mm f/2.3 (T 2.5)	X	
17.5mm f/2.3 (T 2.5)	X	

NAME	16mm	35mm
BALTARS (Cont.)		
20mm f/2.3 (T 2.5)	X	
25mm f/2.3 (T 2.5)	X	X
30mm f/2.3 (T 2.5)	X	X
35mm f/2.3 (T 2.5)	X	X
40mm f/2.3 (T 2.5)	X	X
50mm f/2.3 (T 2.5)	X	X
75mm f/2.3 (T 2.5)	X	X
100mm f/2.3 (T 2.5)	X	X
152mm f/2.7 (T 2.8)	X	X
SUPER BALTARS		
20mm T 2.3		X
25mm T 2.3		X
35mm T 2.3		X
50mm T 2.3		X
75mm T 2.3		X
100mm T 2.3		X
150mm T 2.8		X
225mm T 4		X
B&L CINEMASCOPE 35mm Anamorphic (2X squeeze) (2.35/1)	Mount on Mitchell NC & BNC	
40mm f/2.3		
50mm f/2.3		
75mm f/2.8		
100mm f/2.8		
150mm f/3.5		
BERTHIOT		
CINORS		
10mm f/1.9	X	
25mm f/1.4	X	
75mm f/2.5	X	
100mm f/3.5	X	
145mm f/4.5	X	
LYTAR		
25mm f/1.8	X	
PAN CINORS		
Zoom Lenses		
17.5mm to 85mm f/2 (T 2.6)	X	
17.5mm to 85mm f/3.8	X	
28mm to 154mm f/3.8 (T 4.7)		X

236

CINE LENS LIST

NAME	16mm	35mm
BIRNS & SAWYER		
OMNITARS		
125mm f/2.3	X	X
135mm f/2.8	X	X
150mm f/3	X	X
200mm f/3.2	X	X
250mm f/4.5	X	X
300mm f/5	X	X
300mm f/3.5	X	X
400mm f/5.5	X	X
400mm f/5	X	X
400mm f/4.5	X	X
500mm f/5	X	X
500mm f/5	X	X
600mm f/5	X	X
1000mm f/6.3	X	X
1000mm f/4.5	X	X

NOTE: TELEBAR Supplemental Lens fits all B&S Omnitar telephotos from 300mm through 1000mm and extends their effective focal length by 70%. OMNIPODS (Cradles) are available for 300mm to 1000mm lenses, for various cameras.

NAME	16mm	35mm
CENTURY PRECISION OPTICS		
6.5mm f/1.9	X	
25mm f/0.95	X	
50mm f/1.4	X	
75mm f/1.4	X	
100mm f/1.8	X	
150mm f/2.2	X	X
150mm f/2.8	X	
230mm f/3.6	X	
230mm f/2.8	X	X
300mm f/3.2	X	X
300mm f/4.5	X	X
385mm f/4.5	X	X
400mm f/3.2	X	X
500mm f/3.6	X	X
600mm f/4.8	X	X
1000mm f/6.0	X	X

NAME	16mm	35mm
CENTURY (Cont.)		
Zoom Lenses		
12mm to 100mm f/2.5	X	
20mm to 200mm f/3.5	X	
25mm to 250mm f/4	X	
EASTMAN		
CINE EKTARS		
15mm f/2.5	X	
25mm f/1.4	X	
25mm f/1.9	X	
50mm f/1.9	X	
63mm f/2	X	
102mm f/2.7	X	
152mm f/4	X	
ELGEET		
9mm f/1.5	X	
10mm f/1.8	X	
12mm f/1.2	X	
13mm f/1.5	X	
25mm f/1.4	X	
25mm f/1.5	X	
25mm f/1.9	X	
27mm f/0.95	X	
35mm f/2	X	
51mm f/1.5	X	
76mm f/1.9	X	
102mm f/2.7	X	
152mm f/3.8	X	
Zoom Lenses		
20mm to 80mm f/1.8	X	
25mm to 150mm f/3.5	X	
KERN-PAILLARD		
SWITARS		
10mm f/1.6	X	
16mm f/1.6	X	
25mm f/1.4	X	
25mm f/1.5	X	
50mm f/1.4	X	
75mm f/1.9	X	

237

CINE LENS LIST

NAME	16mm	35mm
KERN-PAILLARD (Cont.)		
PIZARS		
26mm f/1.9	X	
50mm f/1.8	X	
MACRO-SWITAR		
50mm f/1.4	X	
MACRO-YVARS		
100mm f/2.8	X	
150mm f/3.3	X	
Zoom Lens		
16mm to 86mm f/2.5	X	
KILFITT		
MAKRO-KILARS		
40mm f/2.8	X	X
90mm f/2.8	X	X
TELE-KILARS		
150mm f/3.5	X	X
300mm f/5.6	X	X
300mm f/4	X	X
FERN-KILARS		
400mm f/4	X	X
600mm f/5.6	X	X
KINOPTIK		
5.7mm f/1.8	X	
9mm f/1.5	X	
9.8mm f/1.8		X
12.5mm f/2.5	X	
14mm f/1.8	X	X
25mm f/2	X	
28mm f/2	X	X
32mm f/1.9	X	X
32mm f/2.8	X	X
35mm f/2	X	X
40mm f/2	X	X
50mm f/2	X	X
75mm f/2	X	X
100mm f/2	X	X
150mm f/2.5	X	X
210mm f/2.8	X	X
300mm f/5.5	X	X
500mm f/5.6	X	X

NAME	35mm
PANAVISION 35	Mount on 35mm Panavision Camera and Mitchell BNC, NC & S35R; Arriflex
AUTO PANATARS	
35mm Anamorphic (2X squeeze) (2.35/1)	
35mm T 3	
40mm T 2.5	
50mm T 2.5	
50mm T 1.2	
75mm T 3	
100mm T 3	
150mm T 3	
200mm T 4	
300mm T 4	
360mm T 4.5	
500mm T 4.5	
750mm T 4.5	
1000mm T 5.6	
MACRO	
55mm T 2.3	
ULTRA WIDE	
25mm T 2.5	
INSERT	
100mm T 3	
PANAFOCAL	
50mm to 95mm T 4	
PANAZOOMS	
40mm to 140mm T 4.5	
80mm to 280mm T 4.5	
35mm to 350mm T 4	
50mm to 500mm T 4.5	
PANAVISION 35	
ARRI PANATARS	35mm Arriflex
35mm Anamorphic (2X squeeze) (2.35/1)	
35mm T 3	
40mm T 3	
50mm T 2.5	
75mm T 2.5	
100mm T 3	
150mm T 4.5	
ARRI TRILENS	35mm Panavision Arriflex
35mm T 3	
40mm T 3	
50mm T 2.5	
75mm T 2.5	
100mm T 4	

CINE LENS LIST

NAME	65mm
SUPER PANAVISION 70	Panavision SC, AC or Hand Held Only
65mm Spherical (no squeeze)	
70mm Release Print (2.21/1)	
SUPER PANATARS	
17mm T 3	
28mm T 3	
37mm T 4.5	
40mm T 3	
50mm T 2.3	
65mm T 2.8	
55mm T 1.4	
75mm T 2.3	
100mm T 2.3	
150mm T 3	
210mm T 3	
300mm T 3	
450mm T 8	
500mm T 5.6	
600mm T 5.6	
1000mm T 6.3	
PANAZOOMS	
90mm to 280mm T 4.5	
50mm to 500mm T 5	
ULTRA PANAVISION 70	Panavision SC, AC or Hand Held Only
65mm Anamorphic (1.25X squeeze)	
70mm Release Print	
APO PANATARS	
35mm T 4.5	
50mm T 2.5	
65mm T 3	
55mm T 1.4	
75mm T 3	
100mm T 3	
150mm T 3	
210mm T 3	
300mm T 3	
PANAZOOM	
90mm to 280mm T 4.5	

NAME	16mm	35mm
RANK-TAYLOR-HOBSON		
SPEED PANCHROS		
18mm f/1.7 (T 2)		X
25mm f/1.8 (T 2.2)		X
32mm f/2 (T 2.3)		X
40mm f/2 (T 2.3)		X
50mm f/2 (T 2.3)		X
75mm f/2 (T 2.3)		X
100mm f/2 (T 2.8)		X
KINETALS		
9mm f/1.9 (T 2)	X	
12.5mm f/1.8 (T 2)	X	
17.5mm f/1.8 (T 2)	X	
25mm f/1.8 (T 2)	X	
37.5mm f/1.8 (T 2)	X	
50mm f/1.8 (T 2)	X	
75mm f/2.0 (T 2.8)	X	
100mm f/2.5 (T 2.8)	X	
150mm f/3.8 (T 4)	X	
SCHNEIDER		
CINEGON		
10mm f/1.8 (T 2)	X	
16mm f/2 (T 2.2)	X	
18mm f/1.8 (T 2)		X
CINE XENON		
25mm f/1.4 (T 2)	X	
28mm f/2 (T 2.2)	X	X
35mm f/2 (T 2.2)	X	X
40mm f/2 (T 2.2)	X	X
50mm f/2 (T 2.2)	X	X
75mm f/2 (T 2.2)	X	X
100mm f/2 (T 2.2)	X	X
Zoom Lens		
16mm to 80mm f/2 (T 2.2)	X	

CINE LENS LIST

NAME	65mm
TODD-AO	Mount on Mitchell BFC or Todd-AO AP-65
65mm Spherical (no squeeze)	
70mm Release Print (2.21/1)	
28mm f/3.2 (T 3.5)	
40mm f/2.8 (T 3)	
50mm f/2 (T 2.3)	
60mm f/2 (T 2.3)	
75mm f/2.8 (T 3)	
100mm f/2.8 (T 3)	
150mm f/2.8 (T 3)	
Zoom Lenses	
60mm to 150mm f/2.8 (T 3)	
100mm to 300mm f/4 (T 4.7)	
ULTRASCOPE	**35mm**
(For 35mm 2X "squeeze" photography.)	Can be fitted to any 35mm camera
40mm f/2	
50mm f/2	
85mm f/2	
135mm f/4	
300mm f/5.6	
400mm f/5.6	
600mm f/5.6	
75mm to 300mm f/5.6 zoom	

NAME	16mm	35mm
3M WOLLENSAK		
CINE RAPTARS		
25mm f/1.4	X	
25mm f/1.5	X	
25mm f/1.9	X	
40mm f/1.5	X	
50mm f/1.5	X	
75mm f/2.8	X	
101mm f/2.5	X	
152mm f/3.8	X	
ZEISS		
DISTAGON		
8mm f/3 (T 2.2)	X	
PLANARS		
16mm f/2 (T 2.2)	X	
25mm f/2 (T 2.2)	X	
32mm f/2 (T 2.2)	X	X
50mm f/2 (T 2.2)	X	X
SONNARS		
85mm f/2	X	X
135mm f/4	X	X
Zoom Lens		
12.5mm to 75mm f/2	X	

OPTICAL ACCESSORIES

SPLIT-FIELD DIOPTER LENSES
Century Precision Industries, Inc.
Samuelson Film Service, Ltd.

Plus diopter lenses cut in half so that near subjects may be photographed sharply on one side of the frame while far subjects are filmed simultaneously on the opposite side. (See: **Extreme Close-up Cinematography** text.)