ALEXA LF & Anamorphic Lenses

White Paper

October 26, 2018

Version History

Version	Author	Change Note
July 27, 2018	Marc Shipman-Mueller	First publication
October 26, 2018	Marc Shipman-Mueller	- Updated with LF SUP 3.0 information - Updated with LF SUP 4.0 information - Added "Panavision Ultra Vista Anamorphic" and "Cooke Anamorphic/i Full Frame Plus" lenses - Added 1.65x and 1.80x de-squeeze text and screenshots - Added "What is a crop factor and how do I calculate it?" - Added " Appendix B: A Brief History of the Anamorphic Process" - Minor textual polishing

Scope

This white paper pertains to using full format and 35 format anamorphic lenses with ALEXA LF cameras.

Please note that menu items, menu item locations and menu screenshots are based on ALEXA LF Software Update Package SUP 4.0 and may differ slightly from other ALEXA LF Software Update Packages. Frameline Composer screenshots are based on FLC version 4.2 and Lens Illumination Guide screenshots are based on LIG version 3.0 and both may differ in future versions.

For more information on the entire ARRI Large Format system, check out www.arri.com/largeformat.

Disclaimer

All efforts have been made to ensure the accuracy of the information, but, as always, we recommend shooting your own test to verify the appropriateness of a given camera/sensor mode/lens combination for the artistic intent of the show.

The online ARRI Lens Illumination Guide (LIG) shows how much illumination there is for each lens listed within a given sensor mode and target aspect ratio. Please note that the LIG only shows illumination and not any other image quality parameters. We strongly recommend shooting a test before making any decision as to the viability of a lens for any sensor mode/target aspect ratio.

Table of Contents

Version History 2
Scope 2
Disclaimer 2
Table of Contents 3
Executive Summary 4
What are Anamorphic Lenses? 5
- Shooting with Spherical Lenses 5
- Shooting with Anamorphic Lenses 5
- Post Production and Theatrical Projection of Anamorphic Images 5

Monitoring and Recording Anamorphic Images with ALEXA LF 6
- Monitoring 6
- Recording 6

ALEXA LF & Anamorphic Lenses without a 4K UHD Mandate 6
ALEXA LF & 2x Anamorphic Lenses with a 4K UHD Mandate 7
Shooting for a 2:1 Deliverable with a 4K UHD Mandate 7
- Photosite Math 7
- Creating a 2880 x 2880 Frameline 7
- Which Anamorphic Lenses cover 2880 x 2880? 8
- Why 2880 x 2880? 9

Shooting for a 2.39:1 Deliverable with a 4K UHD Mandate 9
- Photosite Math 9
- Creating a 3148 x 2636 Frameline 9
- Which Anamorphic Lenses cover 3148 x 2636? 10
- Why 3148 x 2636? 11

First User Story 12
Shooting ALEXA LF to match 35 Format ALEXAs 14
What about Image Extenders and Expanders? 14
How is the Anamorphic Image De-squeezed in Post? 14
What is a crop factor and how do I calculate it? 14
Squeeze or Stretch? 15
What is the Difference between Image Area and Illumination Area? 15
Contact 16
References 16
Appendix A: List of Anamorphic Lenses 17
- Full Frame Anamorphic Lenses 17
- 35 Format Anamorphic Lenses (2.0x) 17
- 35 Format Anamorphic Lenses (1.5x) 18
- 35 Format Anamorphic Lenses (1.3x) 18

Appendix B: A Brief History of the Anamorphic Process 19
- First Documented Occurrence 19
- Henry Chrétien 19
- Hollywood Experimentation 19
- This is Cinerama 19
- Monsieur Chrétien is back 19
- Advantages of Anamorphic Shooting 20
- CinemaScope 20
- Anamorphic Aspect Ratios 20

Executive Summary

The ARRI ALEXA LF and anamorphic lenses are an ideal combination for feature films, TV series and commercials, as the cinematic quality of the large format sensor and ALEXA's best overall image quality further enhance the unique look of anamorphic lenses.

While full frame anamorphic lenses are slowly entering the market, shooting with existing 35 format anamorphic lenses is also possible by using LF Open Gate and cropping the desired area from the image in post production. A number of productions have already been shot this way with great success.

When shooting with 35 format 2x anamorphic lenses for a 2:1 aspect ratio result, Netflix accepts the use of a 2880 x 2880 area on the ALEXA LF sensor. All Master Anamorphic lenses cover this area.

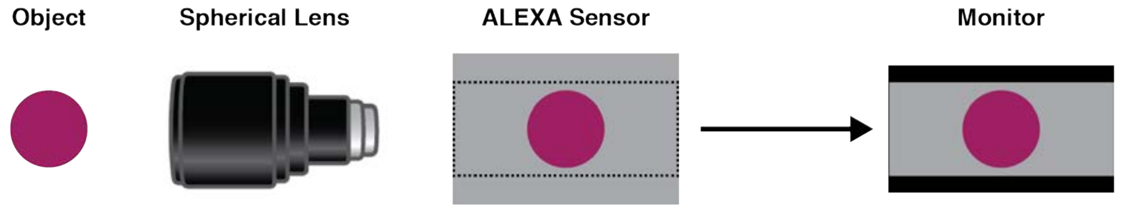
When shooting with 35 format 2x anamorphic lenses for a 2.39:1 aspect ratio result, Netflix accepts the use of a 3148 x 2636 area on the ALEXA LF sensor. Master Anamorphic lenses from 40 mm on cover this area, and the ARRI Anamorphic Ultra Wide Zoom AUWZ 19-36 covers this area from 21 mm on for wide angle shots.

What are Anamorphic Lenses?

Currently two types of lenses are used for professional productions: spherical and anamorphic. While spherical lenses are easier to use, as they do not necessitate special viewing and post production considerations, anamorphic lenses produce a unique widescreen look much appreciated by filmmakers and audiences worldwide.

Shooting with Spherical Lenses

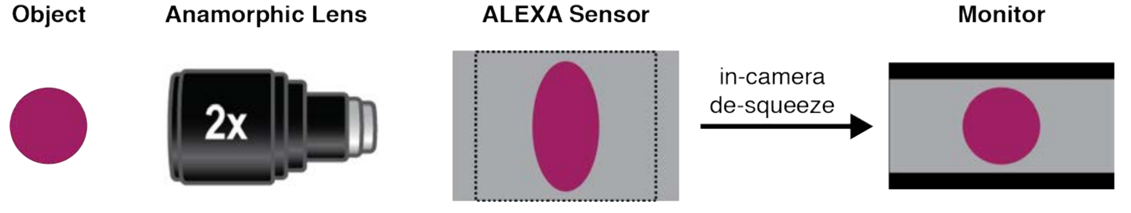
Spherical lenses project an image onto the sensor that maintains the original width to height relationship (also called aspect ratio) of the object in front of the lens. A round object in front of the lens results in the image of a circle on the sensor. This makes monitoring on the set and processing in post production simple.



Shooting with Anamorphic Lenses

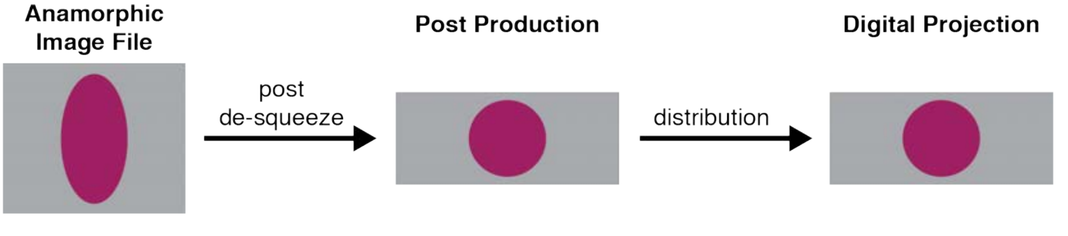
Anamorphic lenses do not maintain the original aspect ratio, but instead squeeze the image. A round object in front of the lens will result in the image of a tall oval on the sensor. Originally, this was done for widescreen movies to enable the use of a larger area on the film negative to reduce film grain.

Most anamorphic lenses squeeze the image by a factor of two, but there are also lenses with other squeeze factors. In order to provide a properly proportioned image to on-set monitoring, ALEXA cameras can "de-squeeze" the image for the electronic viewfinder and monitor outputs.



Post Production and Theatrical Projection of Anamorphic Images

In the film days the image was usually distributed in squeezed form and then de-squeezed by an anamorphic lens on the film projector. However, the DCI specifications, which define the image format for digital projection, only allow for a de-squeezed image being projected by a spherical projection lens. Therefore, in post production the digital image created by anamorphic lenses has to be restored back to its original aspect ratio (de-squeezed), which is also the way it will be projected.

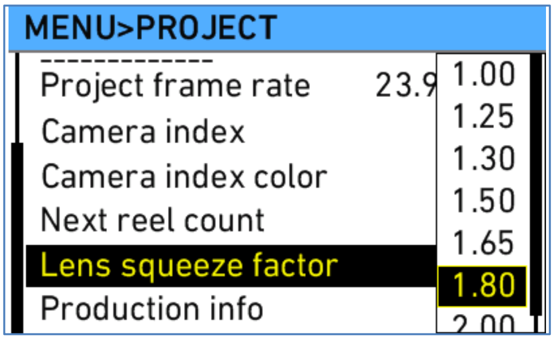


Monitoring and Recording Anamorphic Images with ALEXA LF

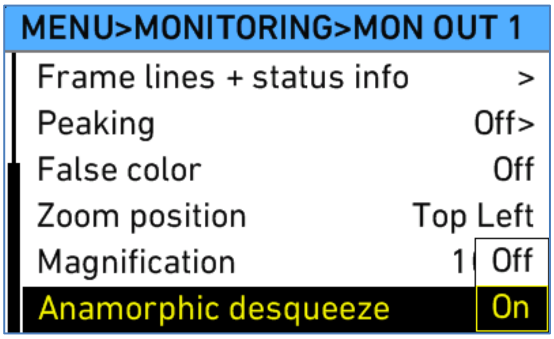
Monitoring

When using anamorphic lenses, viewing an image in the ALEXA LF electronic viewfinder and on the four MON OUTs is easy since the camera can de-squeeze the anamorphic image with one of six de-squeeze factors: 2.00x, 1.80x, 1.65x, 1.50x, 1.30x and 1.25x. These de-squeeze factors cover most currently available anamorphic lenses and are available in all sensor modes. Please see Appendix A for a list of currently availbale FF and 35 format anamorphic lenses for motion picture cameras.

- 1.0 is used for all spherical lenses
- 1.25x is used for Ultra Panavision 70 (aka Ultra Panatar) lenses
- 1.3x is used for Vantage Hawk 65, Hawk 65 Vintage 74, Hawk V-Lite, Hawk V-Lite Vintage 74, Hawk V-Plus and Hawk V-Plus Vintage 74 lenses
- 1.5x is used for P+S Technik Technovision Classic 1.5x anamorphic primes and zooms and ISCORAMA lenses
- 1.65x is used for Panavision Ultra Vista Anamorphic lenses
- 1.80x is used for Cooke Anamorphic/i Full Frame Plus lenses
- 2.0x is the classic CinemaScope format, used by 90% of anamorphic lenses, including Angenieux Optimo Anamorphic Zooms, ARRI Master Anamorphics, Cooke Anamorphics, all Panavision 35 format anamorphics, Vantage Hawk anamorphic lenses and many others.



Choose a lens squeeze factor in the PROJECT menu



Then turn anamorphic de-squeeze on or off independently for EVF and the MON OUTs

Recording

The ALEXA LF records exactly what the anamorphic lens projects onto the sensor, which is the squeezed image. There is no in-camera de-squeeze for the recorded image.

ALEXA LF & Anamorphic Lenses without a 4K UHD Mandate

Shooting without a 4K mandate is the easiest option, as it allows you to adapt the size of the sensor area to the illumination areas of the chosen anamorphic lenses. Set the ALEXA LF sensor mode to LF Open Gate, shoot with any anamorphic lens and then do a crop and de-squeeze in post. The one important issue you should figure out in pre-production (e.g. by shooting a test) is how large the illumination areas of your chosen anamorphic lenses are. This will determine the size of your framelines and the size of the crop in post.

To determine the size of the illumination area for ARRI Master Anamorphic lenses you can look at the online Lens Illumination Guide at:

www.arri.com/camera/alexa/tools/arri_lens_illumination_guide

To create custom framelines for download and insertion into the camera use the Frameline Composer:

www.arri.com/de/camera/alexa/tools/arri_frameline_composer

ALEXA LF & 2x Anamorphic Lenses with a 4K UHD Mandate

Shooting with ALEXA LF and 2x anamorphic lenses for a 4K UHD mandate, as specified by Netflix for instance, is a common requirement. The formats listed below are currently accepted options for achieving aspect ratios between 2:1 and 2.39:1 using anamorphic lenses; they utilize 8.29 million photo-sites on the sensor, which is Netflix's current guidance for anamorphic capture.

Shooting for a 2:1 Deliverable with a 4K UHD Mandate

This section describes shooting with ALEXA LF and 2x anamorphic lenses for a 4K UHD mandate when the intended deliberable has a 2:1 aspect ratio. This is an aspect ratio that is increasingly popular with television series, as it maintains the wide screen feel while utilizing most the screen area of modern smart phones.

Photosite Math

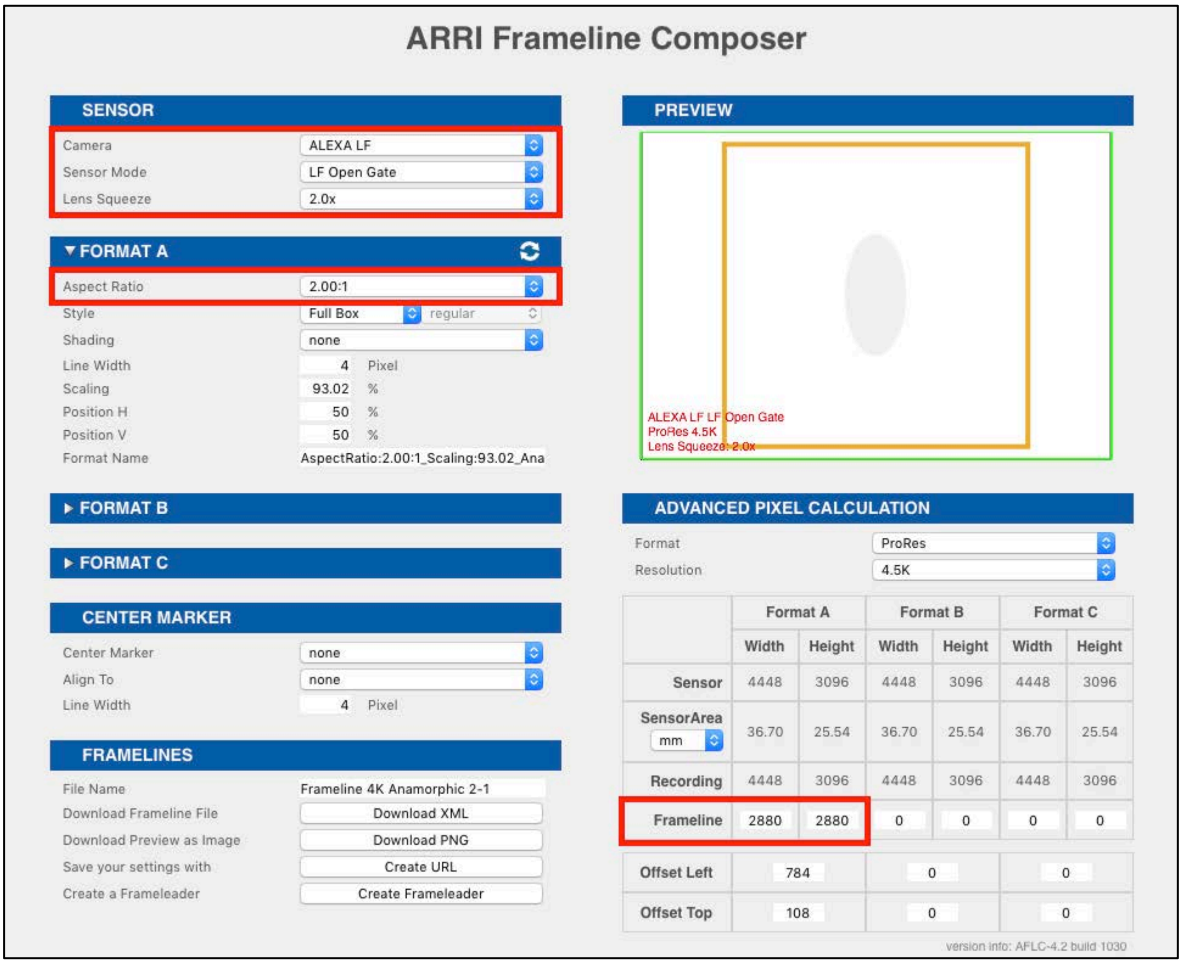
For a 2:1 aspect ratio end result (after de-squeezing in post) you need at least 2880 x 2880 photosites on the ALEXA LF sensor (2880 x 2880 = 8,294,400 = 8.29 Megapixels). Set the ALEXA LF to LF Open Gate sensor mode, as that is the only sensor mode that is tall enough for the 2880 height.

Creating a 2880 x 2880 Frameline

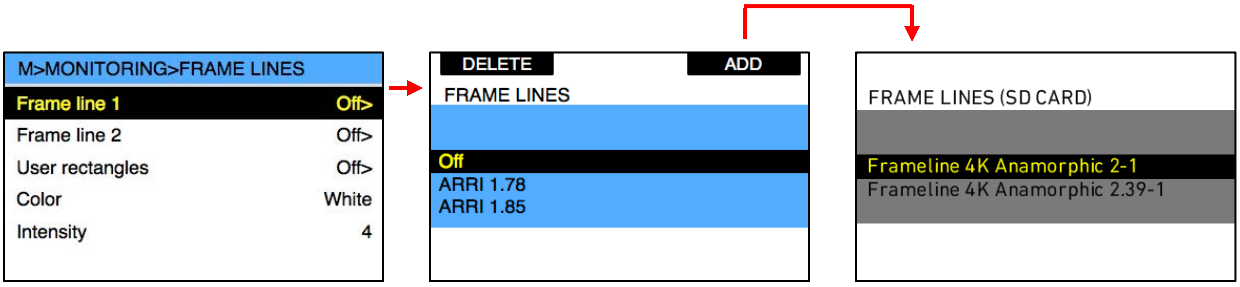
In order to create a basic 2880 x 2880 frameline, go to the ARRI Frameline Composer

www.arri.com/de/camera/alexa/tools/arri_frameline_composer

and enter the values as seen within the red rectangles in the screengrab below. Give your frameline a name (we have named ours "Frameline 4K Anamorphic 2-1"). In the PREVIEW section, the green rectangle is the LF Open Gate sensor mode, and the yellow square is the 2880 x 2880 frameline.



Download that frameline with the "Download XML" button in the lower left, copy it to an SD card and place that SD card into the camera. Then load the frameline into the camera with MENU > MONITORING > FRAME LINES. Don't forget to then select the now loaded custom frameline in MENU > MONITORING > FRAME LINES.



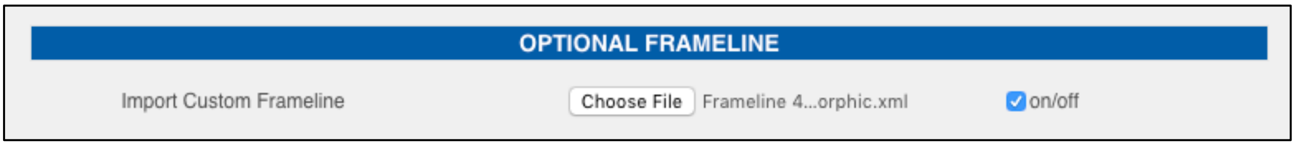
Which Anamorphic Lenses cover 2880 x 2880?

Full Frame Anamorphic Lenses

Any anamorphic lens designed for full frame sensors (36 x 24 mm) will cover 2880 x 2880. Currently these are the P+S Technik Technovision Classic 1.5x anamorphic primes and zooms as well as the Servicevision Scorpiolens Anamorphic 2x primes.

Master Anamorphic Lenses

While the ARRI Master Anamorphic lenses were originally designed to cover the 35 format, all of them have an illumination area large enough to cover 2880 x 2800. To illustrate this, we have loaded our basic 2880 x 2880 frameline into the online Lens Illumination Guide using the "Choose File" button in the "Optional Frameline" section.



Below are screenshots showing the illumination area of the widest (28 mm), a medium focal length (50 mm) and a telephoto (100 mm) ARRI Master Anamorphic lens with the 2880 x 2880 frameline indicated by the yellow square.

Master Anamorphic 28 mm
with 2880 x 2880 Frameline

Master Anamorphic 50 mm
with 2880 x 2880 Frameline

Master Anamorphic 100 mm
with 2880 x 2880 Frameline

<u>Other 35 Format 2x Anamorphic Lenses</u>

For other manufacturers' 35 format 2x anamorphic lenses you will have to shoot a test to see how large their illumination area is.

Why 2880 x 2880?

For finding the best sensor area for shooting ALEXA LF and 2x anamorphic lenses for a 4K UHD mandate when the intended deliberable has a 2:1 aspect ratio, we had four requirements:

1. Use an area on the LF sensor that is as small as possible, so the maximum number of 35 format anamorphic lenses will cover this area.
2. Use an aspect ratio of 1:1 on the sensor. A 2:1 target aspect ratio gets halved in width by a 2x anamorphic lens.
3. Have at least 8.29 Megapixel in that area (horizontal photosites x vertical photosites, mathematically rounded). 2880 x 2880 = 8,294,400 = 8.29 Megapixel.
4. Use only even numbers, since post software has an easier time with even numbers.

2880 x 2880 fulfills all those requirements.

Shooting for a 2.39:1 Deliverable with a 4K UHD Mandate

This section describes shooting with ALEXA LF and 2x anamorphic lenses for a 4K UHD mandate when the intended deliberable has a 2.39:1 aspect ratio. 2.39:1 is the traditional aspect ratio of CinemaScope widescreen movies.

Photosite Math

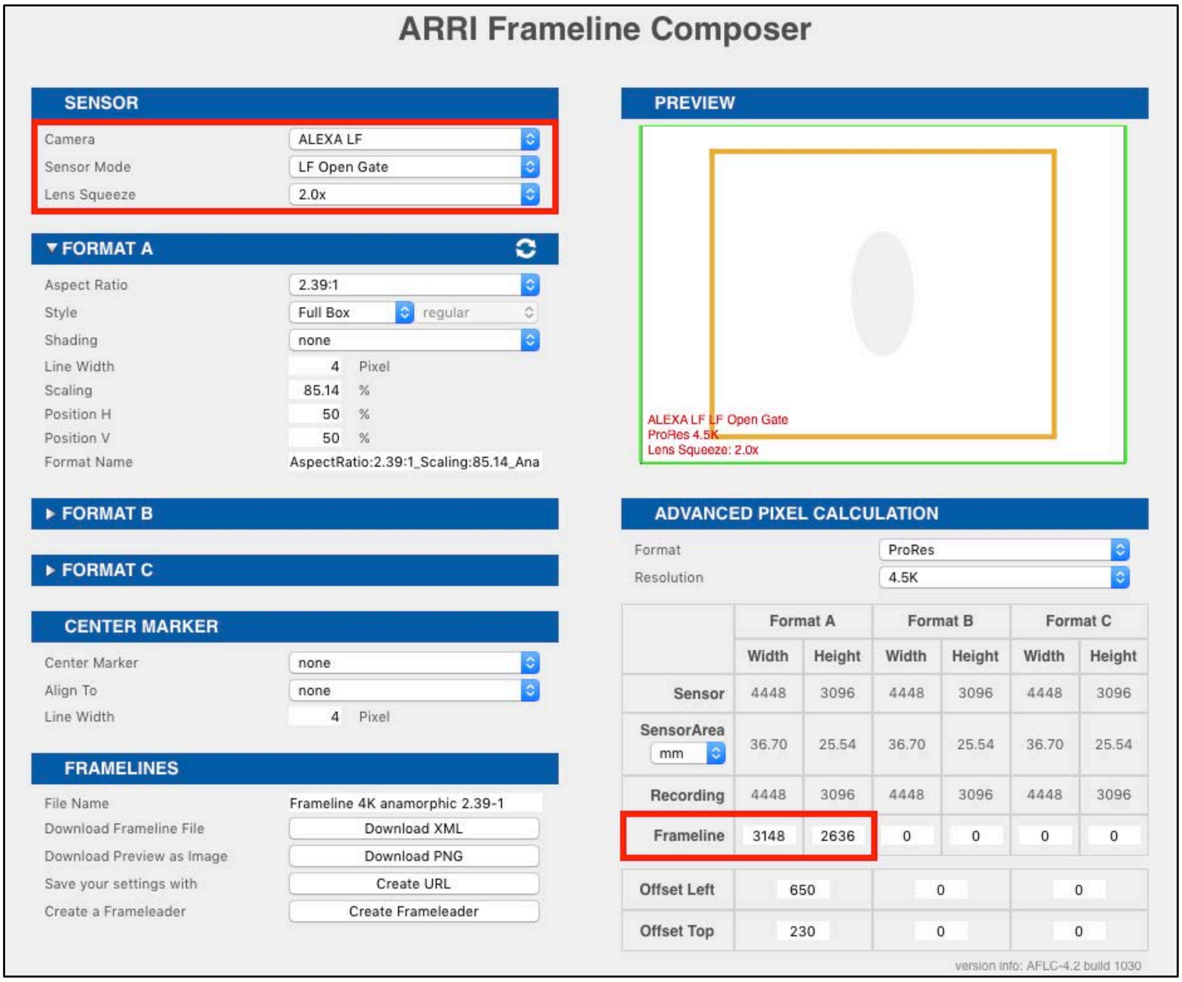
For a 2.39:1 aspect ratio end result (after de-squeezing in post) you need at least 3148 x 2636 photosites on the ALEXA LF sensor (3148 x 2636 = 8,298,128 = 8.30 Megapixel). Set the ALEXA LF to LF Open Gate sensor mode, as that is the only sensor mode that is tall enough for the 2636 height.

Creating a 3148 x 2636 Frameline

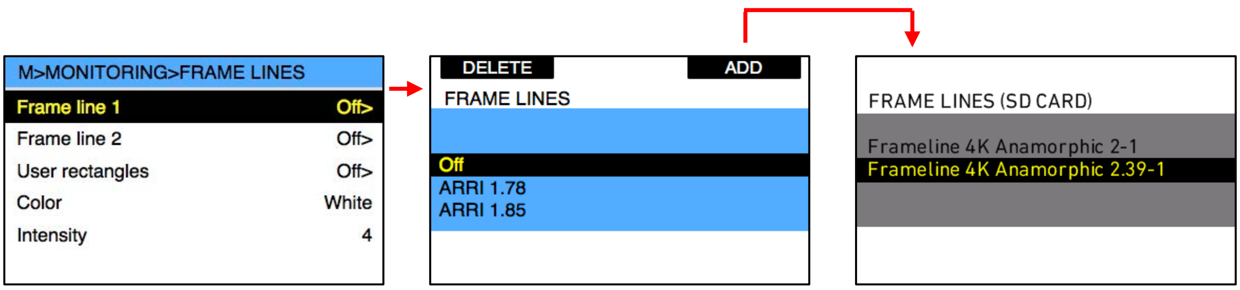
In order to create a basic 3148 x 2636 frameline, go to the ARRI Frameline Composer

www.arri.com/de/camera/alexa/tools/arri_frameline_composer

and enter the values as seen within the red rectangles in the screengrab below. Give your frameline a name (we have named ours "Frameline 4K Anamorphic 2.39-1"). In the PREVIEW section, the green rectangle is the LF Open Gate sensor mode, and the yellow rectangle is the 3148 x 2636 frameline.



Download that frameline with the "Download XML" button in the lower left, copy it to an SD card and place that SD card into the camera. Then load the frameline into the camera with MENU > MONITORING > FRAME LINES. Don't forget to then select the now loaded custom frameline in MENU > MONITORING > FRAME LINES.



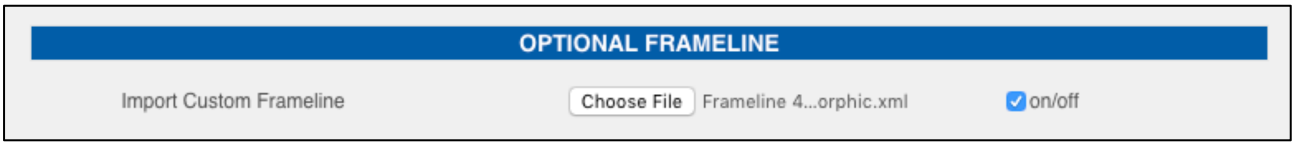
Which Anamorphic Lenses cover 3148 x 2636?

Full Frame Anamorphic Lenses

Any anamorphic lens designed for full frame sensors (36 x 24 mm) will cover 3148 x 2636. Currently these are the P+S Technik Technovision Classic 1.5x anamorphic primes and zooms as well as the Servicevision Scorpiolens Anamorphic 2x primes.

Master Anamorphic Lenses

While the ARRI Master Anamorphic lenses were originally designed to cover the 35 format, they have an illumination area large enough to cover 3148 x 2636 from 40 mm on. To illustrate this, we have loaded our basic 3148 x 2636 frameline into the online Lens Illumination Guide using the "Choose File" button in the "Optional Frameline" section.



Below are screenshots showing the illumination area of the widest lens that just does not cover (35 mm), the widest lens that does cover (40 mm) and a telephoto (100 mm) ARRI Master Anamorphic lens with the 3148 x 2636 frameline indicated by the yellow square. For anamorphic shots wider than 40 mm you can use the ARRI Anamorphic Ultra Wide Zoom AUWZ 19-36, which covers 3148 x 2636 from 21 mm on. The last screenshot shows the AUWZ at 22 mm.

Master Anamorphic 35 mm
with 3148 x 2636 Frameline

Master Anamorphic 40 mm
with 3148 x 2636 Frameline

Master Anamorphic 100 mm
with 3148 x 2636 Frameline

Anamorphic Ultra Wide Angle Zoom AUWZ 19-36
with 3148 x 2636 Frameline

Other 35 Format 2x Anamorphic Lenses

For other manufacturers' 35 format 2x anamorphic lenses you will have to shoot a test to see how large their illumination area is.

Why 3148 x 2636?

For finding the best sensor area for shooting ALEXA LF and 2x anamorphic lenses for a 4K UHD mandate when the intended deliberable has a 2.39:1 aspect ratio, we had four requirements:

1. Use an area on the LF sensor that is as small as possible, so the maximum number of 35 format anamorphic lenses will cover this area.
2. Use an aspect ratio on the sensor that is as close as possible to half the 4K DCI spec (4096 x 1716 = 2.386946387:1). If you deviate too far from the 4K DCI aspect ratio, Resolve will add black lines to your image. Half, because the 2x anamorphic lens squeezes that aspect ratio to half its width.
3. Have at least 8.29 Megapixel in that area (horizontal photosites x vertical photosites, mathematically rounded). 3148 x 2636 = 8,2982,128 = 8.30 Megapixel.
4. Use only even numbers, since post software has an easier time with even numbers.

3148 x 2636 fulfills all those requirements.

First User Story

Cinematographer Mathias Boucard, who is amongst a group of cinematographers that have provided valuable feedback during the draft period of this white paper, has already shot a number of commercials with ARRI Master Anamorphics using a 2880 x 2880 sensor area. He said: "At the moment I shoot a lot of 2:1 aspect ratio with the ALEXA LF and the Master Anamorphics. It's so exciting to be able to use the maximum of the lens, it's like discovering a hidden box with more to see. I love it! ALEXA LF works so well with the Master Anamorphics, using their full image area makes them more organic and curious."

Steadicam operator Aymeric Colas flying the ALEXA LF with Master Anamorphics on the film KOHO. Production company: Division, Director: Fleur Fortuné, Cinematographer: Matias Boucard

Below three screenshots from KOHO, shot for a 2:1 aspect ratio release by cinematographer Matias Boucard with ALEXA LF and Master Anamorphics uisng a 2880 x 2880 sensor area.

Shooting ALEXA LF to match 35 Format ALEXAs

When shooting with 2x anamorphic lenses on 35 format ALEXA cameras, you should use the 6:5 sensor mode. On the ALEXA LF, the LF 16:9 sensor mode (the yellow rectangle in the drawing below) has exactly the same height as the ALEXA 35 format 6:5 sensor mode (the blue rectangle): 2160 photosites. So, if you want to match what a 35 format ALEXA does when shooting in 6:5 sensor mode, set ALEXA LF to LF 16:9 sensor mode, shoot and crop the left and right sides in post.

What about Image Extenders and Expanders?

In our preliminary tests with Master Anamorphic lenses and the Alura extenders we found that the image quality was significantly degraded. We therefore strongly advise against using Master Anamorphic lenses with Alura extenders. For any other lens/extender/expander combination please shoot your own tests.

How is the Anamorphic Image De-squeezed in Post?

Anamorphic lenses optically squeeze the image during capture, and in post the image has to be de-squeezed. However, this is not just a simple process of leaving out lines or duplicating columns; usually the incoming pixel raster from the camera has to be resized horizontally and vertically to fit the target pixel raster of the desired deliverable.

For instance, when a 35 format 6:5 image comes in from a 35 format ALEXA, and the target deliverable is a 4K DCI image, Resolve will do a horizontal and vertical resize in the timeline in one step, to go from 2578 x 2160 (ALEXA 35 format 6:5) to 4096 x 1716 (4K DCI).

What is a crop factor and how do I calculate it?

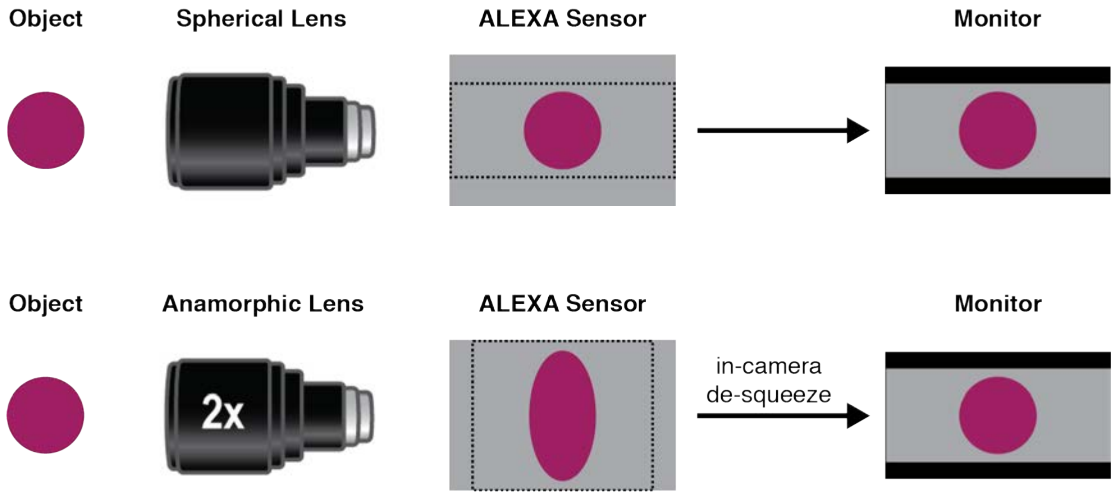
The crop factor is a number used to calculate what focal length lens to use to get the same angle of view for different sensor sizes. Calculating the crop factor for two sensor sizes is relatively easy, assuming both sensors have the same photosite size (all ARRI digital cameras do). The crop factor is the larger horizontal photosite count divided by the smaller horizontal photosite count. So, if we wanted to calculate the crop factor for the ALEXA LF "LF Open Gate" sensor mode and the ALEXA SXT "S35 Open Gate" sensor mode, we would divide 4448 by 3424, which equals 1.3. This means that to get the same angle of view of a 50 mm lens on S35 ALEXA Open Gate, you need a 65 mm lens on LF Open Gate (50 x 1.3 = 65). Or, the other way around, to get the same angle of view of a 65 mm lens on LF Open Gate, you need a 50 mm lens on S35 Open Gate (65 / 1.3 = 50).

Note: for sensors with photosites of different size, simply use the width in mm of the active photosites for calculating the crop factor.

Squeeze or Stretch?

If you do not enjoy persnickety attention to detail and careful use of language, skip the section below.

While creating the graphics for the section "What are Anamorphic Lenses?", we noticed that the statement "Anamorphic lenses [...] squeeze the image." does not seem to be entirely accurate. Take a look at the purple oval on the ALEXA Sensor created by the anamorphic lens in the image below: if it was just "squeezed" in relation to the spherical image, it would maintain its height and show less width. However, this oval maintains its width but is twice as tall. So, technically the image on the sensor is not horizontally squeezed but vertically stretched in comparison to the image created by a spherical lens.



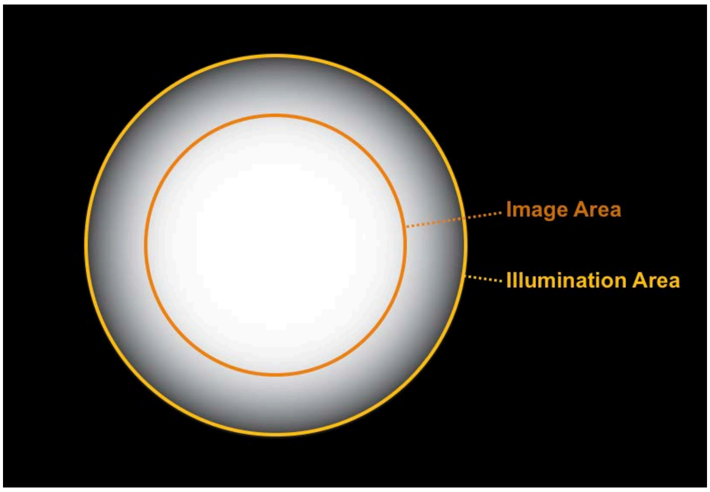
Have we all been using the wrong terminology all these decades? As with so many issues in life, this seems to be a matter of your point of view. As a camera designer, looking at the images on the sensor, the term "stretched" is probably more accurate. But, looking at it from a lens designer's point of view, a traditional anamorphic lens has twice the focal length of a spherical lens (which makes the image twice as tall) and then the image is squeezed horizontally. So, we decided to stick with the traditional terminology of a "squeezed" anamorphic image.

What is the Difference between Image Area and Illumination Area?

You may ask: why image "area"? Did they not just recently talk about image "circle"? True, but while writing this white paper we realized that using the term image "circle" is inaccurate, as anamorphic lenses do not project a circle onto the sensor, but an oval. This is why we have switched to the terms "image area" and "illumination area".

Any lens will project an image with a circular (spherical lenses) or oval (anamorphic lens) shape onto the sensor. Inside this shape is first the image area, which is the area within which the lens' manufacturer guarantees the lens optical quality. However, there is still light outside the image area, all the way out to where there is no more light, which is called the illumination area.

Since the area between the edge of the image area and the edge of the illumination area is of undefined quality, we strongly advise to shoot tests to see if you like what you see there.



The ARRI Lens Illumination Guide shows you the illumination areas for a number of lenses, and we are constantly adding new lenses.

www.arri.com/camera/alexa/tools/arri_lens_illumination_guide

Contact

In case you have questions or recommendations, please contact the ARRI Digital Workflow Solutions group via email: mailto:digitalworkflow@arri.de.

References

- Jay Holben's article *Recent Anamorphic Lenses* on pages 14 through 20 of the May 2018 issue of the American Cinematographer's Magazine gives a great overview of recently introduced anamorphic lenses.
- More Details on anamorphic lenses can be found in Richard Bradbury's online "Motion Picture Lens Database" at tinyurl.com/cinelenses

Appendix A: List of Anamorphic Lenses

This is a list of full frame and 35 format anamorphic lenses for motion picture cameras. Some of the older lenses listed may not have a PL mount, but the rehousing market is so hot right now that it is highly possible they have been retrofitted. Thanks to Wolfgang Bäumler, Richard Bradbury, Natasza Chroscicki, John Duclos and Jay Holben for sharing their fabulous knowledge on anamorphic lenses.

Full Frame Anamorphic Lenses

- Bausch & Lomb Super CinemaScope
- Cooke Anamorphic/i Full Frame Plus (1.80x)
- P+S Technik Technovision Classic 1.5x anamorphic (1.5x)
- Servicevision Scorpiolens Anamorphic 2x primes (2.0x)
- Todd AO
- Panavision Ultra Panavision 70 (aka Ultra Panatar) lenses (1.25x)
- Panavision Ultra Vista Anamorphic (1.65x)
- Vantage Hawk 65 (1.3x) - XPL lens mount!
- Vantage Hawk 65 Vintage 74 (1.3x) - XPL lens mount!

35 Format Anamorphic Lenses (2.0x)

- 2.35 Research (by Joe Dunton)
- Agascope
- Angenieux Optimo
- ARRI ARRISCOPE
- ARRI Master Anamorphics
- Atlas Orion
- Bartley/Kowa (rehoused Kowa Prominar)
- Bartley/Lomo (rehoused Lomo Roundfront)
- Bausch & Lomb CinemaScope
- Cineovision
- CineSel
- Clairmont (Canon, Kowa, Nikkor, Cooke, Angenieux)
- Cooke Anamorphic/i
- Eastern Enterprises (Resleeved Kowa)
- Kowa Cine Prominar
- JDC Cooke Crystal Express
- JDC Cinevision
- Lensworks Rentals Menu anamorphics
- Lomo
- Moviecam/Canon
- NAC
- Nippon Scope
- Optica Elite MK I
- Optica-Elite MKV
- P+S Technik Evolution 2x
- Panavision C Series
- Panavision G Series
- Panavision E Series
- Panavision Primo

- Panavision T Series
- Panavision other (B series, D series, Nikon, Canon, JDC, Close focus, etc.)
- Powerscope
- SATEC Dyaliscope with Cooke Speed Panchro or Kinoptic
- Scanoscope
- Servicevision Scorpiolens 2x
- Technovision Cooke Anamorphics
- Technovision T2.1 Anamorphics (Zeiss T2.1 glass inside)
- Technovision T1.3 Anamorphics (Zeiss or Canon High Speed lenses inside)
- Todd-AO Powerscope
- Toyo Eiki
- Ultrascopes
- Vantage Hawk C-Series
- Vantage Hawk V-Series
- Vantage Hawk V Plus
- Vantage Hawk V Lite
- Vantage Hawk V-Lite Vintage 74
- Vantage Hawk V-Plus Vintage 74
- Vantage Hawk Class-X
- Xelmus

35 Format Anamorphic Lenses (1.5x)

- P+S Technik Technovision Classic 1.5x anamorphic
- ISCORAMA

35 Format Anamorphic Lenses (1.3x)

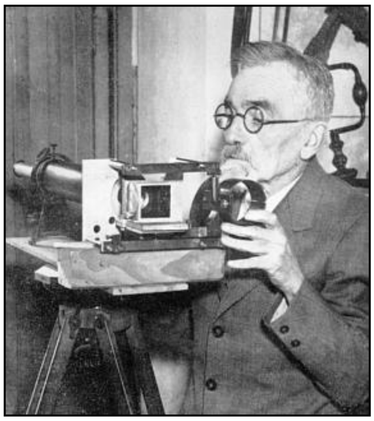
- Vantage Hawk V-Lite
- Vantage Hawk V-Lite Vintage 74
- Vantage Hawk V-Plus
- Vantage Hawk V-Plus Vintage 74

Appendix B: A Brief History of the Anamorphic Process

First Documented Occurrence

While the idea of anamorphic optical distortions can be found very early on in the history of optics, the first documented occurrence that leads to anamorphic lenses as we know them is a 1897 patent by P. Rudolph and E. Abbe. Ernst Abbe was a co-owner of The Carl Zeiss AG and one of the founders of modern optics. However, severe aberrations made anamorphic lenses impractical at that time.

Henry Chrétien

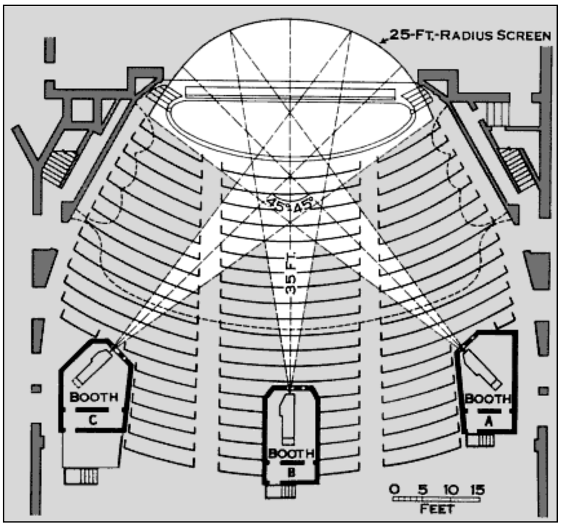


After having used anamorphic lenses for creating a wide angle viewer for military tanks, French inventor Henry Chrétien filed his own patent in 1926 for producing a color film system. He proposed to use anamorphic lenses to optically squeeze the red, green and blue images side by side onto a 35 mm film strip. This idea never led to any commercial success. Neither did his idea of using an anamorphic system for printing the left and right eye of 3D images onto one strip of film. Then he saw Abel Gance's *Napoléon*, which consisted in the original of three side by side screens. While this technically was not a widescreen projection, as mostly different images were shown on the three screens, it convinced Mr. Chrétien of a bright future for widescreen cinema captured with his anamorphic lenses. He attempted to convince the European and US studios of the merit of this idea, but in 1927 he was decades ahead of his time. The prototypes of his *Hypergonar* anamorphic lenses were forgotten for the next 25 years.

Hollywood Experimentation

We jump forward to 1950, a time when the Hollywood studios faced an alarming decline in cinema attendance. It is now assumed that this was caused by two main factors: a new post-war life style with varied recreational opportunities beyond the traditional visit to the cinema, combined with the ascendance of television. In their search for something to differentiate the cinema from television, the Hollywood studios experimented with a number of interesting presentation techniques, ranging from 3D and the misguided *Smell-O-Vision* to a visionary but premature attempt to build an electronic cinema projector (the fascinating and fatefully doomed *Eidophor* project).

This is Cinerama



While there had been experiments with wider aspect ratios and larger film gauges throughout the history of the cinema, a key moment occurred in 1952 when *This is Cinerama* was first projected. This first film in the Cinerama format was shot with a 27 mm lens (approximating the human field of view) and a camera using three strips of 35 mm film. It was presented by simultaneously projecting images from three synchronized 35 mm projectors at 26 fps onto a huge, deeply-curved screen, again trying to emulate the human field of view. The projected image usually had an aspect ratio of 2.65:1, and was accompanied by a seven channel stereo sound system. Equally loved by the public and reviewers, Cinerama was attractive for qualities that the small, 4:3 televisions with their tinny sound system simply could not match: a physically large screen with a wide aspect ratio image and a high fidelity audio system.

Monsieur Chrétien is back

Unfortunately, simultaneously shooting three strips of film was cumbersome and expensive, and the analog film technology at the time never managed to precisely match the colors of all three projected images. Furthermore, converting existing movie theatres to Cinerama would have been prohibitively expensive or impossible. In their search for a more economical way to duplicate the appeal of widescreen cinema, the studios remembered Monsieur Chrétien. Twentieth Century Fox were the first to reach him in Paris. They bought his Hypergonar prototypes, trademarked the whole process as 'CinemaScope' and proceeded to change the shooting of a sword and sandals epic, *The Robe* (1953), which was to become the first film shot in CinemaScope.

Advantages of Anamorphic Shooting

By squeezing a widescreen image onto a standard piece of 35 mm film, the anamorphic process allows for the continued use of existing cameras, post production processes and projectors. Only the taking and projection lenses had to be changed from spherical to anamorphic. Also, converting a movie theatre to CinemaScope was less expensive than a conversion to Cinerama would have been. This gave the studios what they wanted: widescreen at a lower cost. Since then, many movies have been shot using anamorphic lenses, including *How to Marry a Millionaire* (1953), *20,000 Leagues under the Sea* (1954), *Apocalypse Now* (1979), *Blade Runner* (1982), *Chinatown* (1974), *Dances with Wolves* (1990), *Die Hard* (1988), *Indiana Jones* (1984, 1989, 2008), *Jaws* (1975), *Mission Impossible* (1996, 2000), *James Bond* (various), *The Last Samurai* (2003), *The Omen* (1976), *Scarface* (1983), *Star Wars 1, 4, 5, 6* (1977 - 1999), *The Prestige* (2006) and *Star Trek* (2009), just to name a few.

CinemaScope

Since patents for the anamorphic process had already run out by 1952, Twentieth Century Fox trademarked the term 'CinemaScope'. In the beginning, they were also the only ones in possession of anamorphic lenses. The use of their lenses and the CinemaScope trademark, which in the public eye became synonymous with widescreen movies, was linked to licensing fees. This led to the development of other anamorphic lenses and a number of competing widescreen processes, some anamorphic and some spherical, some using 35 mm film and some larger gauges. These competing processes were given more or less creative names including Scanoscope, SuperScope, Techniscope, Arnoldscope (no relations), Vistarama or Thrillarama.

So technically CinemaScope is a Fox trademark rather than a description for the anamorphic process, even though they are often used interchangeably. Sometimes the shortened term 'Scope' is used.

Anamorphic Aspect Ratios

Up until 1952, cinema formats were easy to understand as all mainstream movies and television productions were shot and projected in the aspect ratio of 4:3 (1.33:1). When anamorphic shooting became popular after 1952, a number of aspect ratios were experimented with for anamorphic productions, including 2.66:1 and 2.55:1. The need for reducing costs even further subsequently spawned the spherical widescreen formats of 1.85:1 and 1.66:1. A SMPTE specification for anamorphic projection from 1957 (PH22.106-1957) finally standardized the aperture to 2.35:1. An update in 1970 (PH22.106-1971) changed the aspect ratio to 2.39:1

in order to make splices less noticeable. This aspect ratio of 2.39:1 was confirmed by the most recent revision from August 1993 (SMPTE 195-1993).

Unfortunately, everyone was so used to calling anamorphic films 2.35:1, that many still use that aspect ratio erroneously, even when talking about films shot after 1970. Similarly, 2.40:1 is an incorrect, unfortunate and unnecessary rounding up; a proper rounding up would be 2.4:1. The correct aspect ratio for anamorphic films shot after 1970 is 2.39:1.