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**MASTER'S THESIS**

# PROBLEMATICS OF ASPECT RATIO

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## ABSTRACT

The purpose of this thesis is to explore the different dimensions of aspect ratio and to demonstrate the importance of it in the process of filmmaking. By exploring its history and how it has changed until the present, this text intends to give cinematographers as well as filmmakers, an understanding of the factors that are involved in this attribute of film and how it had been approached.

Each aspect ratio has its own characteristics, advantages and limitations that, depending on the intention of the filmmaker and the cinematographer, could enhance the storytelling. By producing a particular visual identity for the film, the use of aspect ratio could also produce a better experience for the audience.



## ABSTRAKT

Smyslem této práce je prozkoumat rozdílné dimenze poměru stran tzv. aspect ratio a ukázat jeho význam v procesu filmování. Zkoumáním historie jeho užívání a změn, které u něj proběhly od počátku až po současnost se tento text snaží podat kameramanům a filmařům vysvětlení faktorů, které jsou v tomto filmovém atributu začleněny a také to, jak k němu bylo celkově přistupováno.

Každý poměr stran má svůj jedinečný charakter, výhody a omezení, které mohou v závislosti na záměru režiséra a kameramana spoluvyprávět příběh. Tím, že vytváří specifickou obrazovou identitu filmu, umožňuje zvolený poměr stran předat divákům hlubší zkušenost.

**CONTENT**

# INTRODUCTION

Since cinema was created, there have been multiple facts which have influenced the size of its frame, and subsequently, its aesthetics and narratives. The use of the ratio of the screen had given film different approaches and has changed the perception of the viewer towards it. Just as canvas gives the painter the space to create, the aspect ratio gives the filmmaker the frame to express.

According to the film critic James Monaco,[1] "aspect ratio" is the proportional relationship between the width and height of the projected image. It is dependent on the shape and size of the aperture of the camera (and of the projector) as well as on the type of lenses used and the size of the negative. It could be expressed by two numbers separated by a colon like 4:3 or by using the x symbol: 4x3, or as a decimal such as: 1.33:1. Without considering how big the size of the image is,

> *x:y* aspect ratio the width is divided into *x* units of equal length and the height are measured using this same length unit, the height will be measured to be *y* units…The values *x* and *y* do not represent actual width and height but, rather, the "relation" between width and height. As an example, 8:5, 16:10 and 1.6:1 are the same aspect ratio.[2]

The aim of this thesis is to explore the different dimensions of aspect ratio to demonstrate the importance that it has in filmmaking. By exploring its history and how it has changed till the present, this text intends to give cinematographers as well as to filmmakers, an understanding of the factors that are involved in this characteristic of film and how it can be approached. Throughout the history of film, and of technology evolution, there have been different variations of the size of the projected image, from the 1:33 of Edison's Kinetoscope till 2:67 used in *Ben Hur,* and beyond. Each aspect ratio has its own characteristics, pros and cons that, depending on the intention of the filmmaker and the cinematographer, could enhance the storytelling. By producing a particular visual identity for the film, the use of aspect ratio could also produce a better experience for the audience.

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[1] James. Monaco and David Lindroth, How to Read a Film: The World of Movies, Media, and Multimedia: Language, History, Theory, 3rd ed. (New York: Oxford University Press, 2000).
[2] Wikipedia (Wikimedia Foundation, 2016), s.v "CinemaScope" accessed December 30, 2015, 2016, https://en.wikipedia.org/wiki/Aspect_ratio_%28image%29

## I. The evolution of aspect ratio

To understand how the concept of aspect ratio is applied to filmmaking, it is necessary to take a look at the history of film and its technological development. This chapter will explore how aspect ratio were approached since the beginning of cinema until the late years of the 20th century, a period of time that had an important influence on the way that filmmaking is happening in the present.

Before the first films appeared with the Thomas Alba Edison Kinetoscope and the Cinematographe of the Lumiere brothers, and other mechanism to reproduce movement, it is significant to point out that the reason why those machines were able to photograph different amount of pictures in specific time periods, is mainly because the physical support of this image was the film roll created by George Eastman in 1889[3]. He experimented for three years with a formula he found in a British journal to make gelatin emulsion. By 1880, he had not only invented a dry plate formula, but had patented a machine for preparing large numbers of the plates. Then, he continued his work by searching photo-sensible materials that can be lighter and more flexible than glass supports.

With the passing of years, between 1884 and 1885 with W. H. Walker as a partner, Eastman invented a holder for a roll of picture-carrying gelatin layer coated paper as photo-sensible support with not entirely satisfactory results. The materials were not stable and the paper can break easily and its projection has a limited sharpness. In 1889, Eastman realized that the dry-gelatino-bromide emulsion could be coated onto a clear base that Hannibal Goodwin invented - a nitrocellulose film base in 1887 which was the first transparent flexible film. Nevertheless, Eastman's was the first major company to mass-produce these components.[4]

Meanwhile the development of kinetoscope was starting around the same time:

[3] "Photography," 2016, accessed July 23, 2016, http://www.kodak.com/ek/us/en/corp/aboutus/heritage/photography/default.htm.
[4] Mees, C. E. Kenneth (1961). *From Dry Plates to Ektachrome Film: A Story of Photographic Research*. Ziff-Davis Publishing. pp. 15–16. Quoted by Wikipedia (Wikimedia Foundation, 2016), s.v "35 mm film" accessed May 12, 2016, https://en.wikipedia.org/wiki/35_mm_film.

> A breakthrough came with the launch of photographic quality celluloid by John Carbutt. In June of 1889 the Edison Laboratory ordered 12 Carbutt film sheets - each sheet measuring twenty by fifty inches. After much experimentation the cylinder device was clearly at a dead end and with the results produced proving successful but highly impractical, Dickson and Edison turned their attention to film.[5]

The Kinetoscope, which was first shown at the Brooklyn Institute of Arts and Sciences on 9 May 1893 was a film loop system intended for one-person viewing. First Eastman and then, from April 1893 into 1896, New York's Blair Camera Co. supplied Edison with film stock. At first, Blair would supply only 40 mm (1-9/16 in) film stock that would be trimmed and perforated at the Edison lab to create 1-⅜ inch (34.925 mm) gauge filmstrips. Then at some point between 1894 or 1895, Blair began sending stock to Edison that was cut exactly to specification and with 4 perforations high.[6] Nevertheless the patent register of his design of 35 mm motion picture film forced his filmmaking competitors to use 68 mm film that used friction feed instead of sprocket holes to move the film through the camera. Then in 1902, a court judgment invalidated Edison's claim, so then it was allowed that any producer or distributer could use the Edison 35 mm film design without license.

From this point, it is possible to talk about aspect ratio, a characteristic that perhaps was not considered with enough importance at the time when film was born, but was crucial for the development of cinematographic technology and aesthetics. Certainly, the size of the negative determined the space where the image is captured, and the 35 mm became popular as it was used in the kinetoscope as well as in the *Cinématographe*, which were considered the most popular systems to film in and project throughout this period. During this time, film stock was usually supplied unperforated and had to be punched by the filmmaker to fulfill the standards that their equipment required. For instance, the *Cinématographe* of the Lumière Brothers used a single circular perforation on each side of the frame towards the middle of the horizontal axis.

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[5] "EarlyCinema.Com," accessed January 29, 2016, http://www.earlycinema.com/technology/kinetoscope.html.

[6] John Fullerton; Astrid Söderbergh-Widding (June 2000). Moving images: from Edison to the webcam. John Libbey & Co Ltd. p. 3. ISBN 978-1-86462-054-2. Quoted by Wikipedia https://en.wikipedia.org/wiki/35_mm_film

As a matter of fact, the invention of the film roll and its possibilities to capture movement images inspired many people around the world to experiment and create their own cameras. During the first years of cinema, many formats of film appeared as many camera manufacturers appeared, so that different sizes of film showed up too. Therefore, there were problems of compatibility to screen movies from different places around the world, because there were a wide amount of formats and brands. For instance, it was not possible to show something filmed in 38 mm on a projector of 17.5 mm and vice versa. So that, it was required to group a wider amount of filmmakers and camera manufacturers and keep filming under a standard that could fit into as many possibilities were possible.

Certainly, since the creation of the motion pictures, there have been multiple materials, cameras and formats that have produced different aspect ratios. (Figure 1) Therefore, the compatibility between those systems was a difficulty for the distribution of the films along the world, so that it became necessary to introduce a standard which supported the most common necessities of the filmmakers, producers, and distributors.

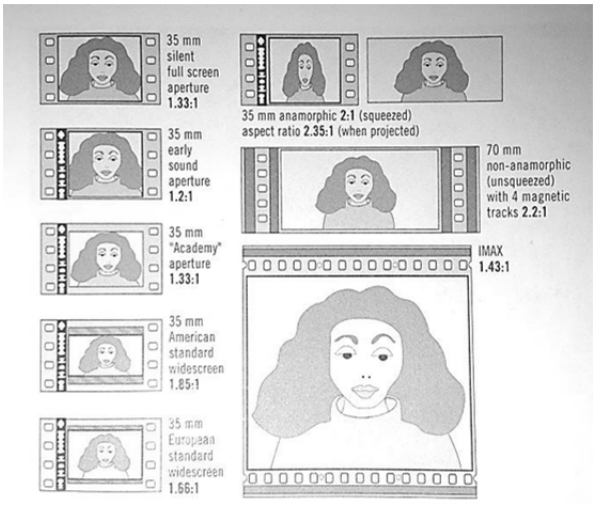


**Figure 1:** To see a list wider list of aspect ratios please see the attached #1

In the year 1908, the Motion Picture Patents Company was formed, a trust established by Edison in which Eastman was also part of it. And by 1909, the “Edison’s” format which was the first dominant standard, would became the “official” standard, 35

mm gauge (figure 2), with the 4 perforations and 1.33 aspect ratio. In the words of film historian Paul C. Spehr:

> The early acceptance of 35 mm as a standard had momentous impact on the development and spread of cinema. The standard gauge made it possible for films to be shown in every country of the world… It provided a uniform, reliable and predictable format for production, distribution and exhibition of movies, facilitating the rapid spread and acceptance of the movies as a world-wide device for entertainment and communication.[7]

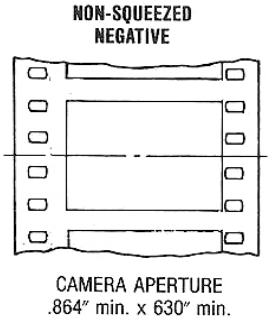


**Figure 2**

The film format was introduced into still photography as early as 1913 (the Tourist Multiple) but became popular with the launch of the Leica camera, created by Oskar Barnack in 1925.[8]

At the beginning, the films had no sound so the size of the image had a square aspect ratio defined as 1.33 or 4:3. The space between the two rows of film perforation was used completely in each frame, defined by this gauge 24.89 mm by 18.67 mm or 0.980 in by 0.735 in. Between 1926 and 1927, when the first features were released, Warner Bros "was using synchronized phonograph discs (sound-on-disc). Fox placed the soundtrack in an optical record directly on the film (sound-on-film) on a strip between the sprocket holes and the image frame".[9] This technological advance changed the aspect ratio, by making slightly taller the image; "however the studios had the common

[7] John Fullerton; Astrid Söderbergh-Widding (June 2000). Moving images: from Edison to the webcam. John Libbey & Co Ltd. p. 3. ISBN 978-1-86462-054-2. Quoted by Wikipedia (Wikimedia Foundation, 2016), s.v "35 mm film" accessed May 12, 2016, https://en.wikipedia.org/wiki/35_mm_film.

[8] Scheerer, Theo M, F Bradley, F. Scheerer, and J. Makovec. The Leica, the Leicaflex, and Their Systems. London: Fountain, 1970.

[9] Dibbets, Karel. "The Introduction of Sound". *The Oxford History of World Cinema*. Oxford University Press: Oxford, 1996. https://en.wikipedia.org/wiki/35_mm_film

attempt to reduce the image back to a 1.33:1 ratio by decreasing the projector aperture." [10] So the size remains. Furthermore, each cinema theater chain had its own designated house ratio. So that, in November 1929, the major USA film studios created the Society of Motion Picture Engineers (SMPE) and agreed on the first standards which would be set for the new sound-on-film motion pictures, by decreasing the size and defining in 20.3 mm cm x 15.2 mm or 0.800 in x 0.600 in so they could keep the 1.33 aspect ratio.

After this, on May 9, 1932 the Academy of Motion Picture Arts and Sciences (AMPAS) considered further alterations to the 1929 standard. Various dimensions were submitted, and in order to make room for the sound track, the image should be masked off on the top and the bottom, and also the projector aperture standard size changed. The camera aperture became 22 mm by 16 mm (0.866 in by 0.630 in), and the projected image used an aperture plate gauge of 0.825 in × 0.600 (21.0 mm × 15.2 mm), yielding an aspect ratio of 1.375 (closer to 1.33) which was dubbed the "Academy Ratio" (Figure 3) and it remained the standard in Hollywood productions for almost twenty years.

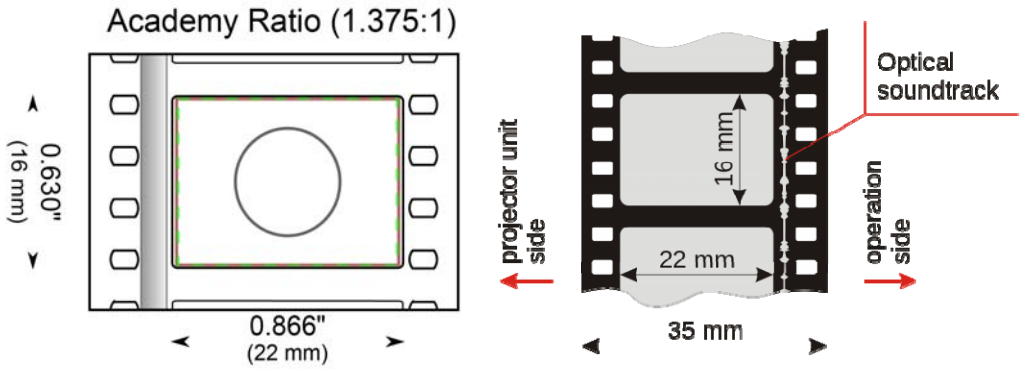


**Figure 3**

It is necessary to remark that Academic Aspect Ratio is not created in the film camera, which has continued to use the 1.33 aspect ratio of Edison's full frame silent aperture gate for 4 perforation spherical filming. Rather, it is created when the optical soundtrack and frame lines are added in the married print.

[10] Ibíd.

Meanwhile, film had emerged as the necessity of communication and the interest of many individuals and some companies to reproduce images and broadcast it, resulting in different experiments and researches that allowed the invention of Television. It was in 1928 while John Baird broadcast for the first time a television image from London, England to New York, United States, when General Electric introduced a television set with 3" x 4" screen, keeping the aspect ratio that was approved by the SMPE and AMPAS. This selection of aspect ratio would provide television the facility to have compatibility with the existent systems of image reproduction.

In addition, it is worth noticing, as it was mentioned before, that 35 mm was not the only gauge that existed during the early years of cinema. But this text is focused on the most popular formats as they influenced the current aspect ratios that are used in the industry of cinema and television. Therefore, it is also convenient to mention the appearance of the 16 mm negative as it was the film gauge that kept the aspect ratio of 1.37 per 1 to height 1.37:1, which became popular for many filmmakers not only for its low cost, but also because of its technical and visual characteristics, which were determining factors in the development of television.

The 16 mm negative was introduced by Eastman Kodak, the company of George Eastman, in 1923, as an economical option for amateur filmmakers, presented in a pack that had camera, projector, tripod, screen and splicer. This new gauge received great acceptance among home consumers. However, it also became popular in the production of educational films with the addition of optical sound and color. By 1935, it got a great boost, used in different purposes as governmental, business, medical, industrial films and mainly during the World War II, because of its costs and portability against the 35 mm. 16 mm became the most commonly used material for news and magazine television programs.

In the end of the 1960's the Swedish cinematographer Rune Ericson create a variant for 16 mm called Super 16 mm, Super 16, or 16 mm Type W, (Figure 4) which

uses a single-sprocket film, so that it was possible to have an expanded picture area of 7.41 mm by 12.52 mm with a wider aspect ratio of 1.66:1

> "Super 16 cameras are usually 16 mm cameras that have had the film gate and ground glass in the viewfinder modified for the wider frame. Since Super 16 takes up the space originally reserved for the soundtrack, films shot in this format can be enlarged by optical printing to 35 mm for projection. However, with the recent development of digital intermediate workflows, it is now possible to digitally enlarge to 35 mm with virtually no quality loss (given a high quality digital scan), or alternatively to use high-quality video equipment for the original image capture... In 2009, German lens manufacturer Vantage introduced a series of anamorphic lenses under its HAWK brand. These provided a 1.3x squeeze factor (as opposed to the standard 2x) specifically for the Super 16 format. These lenses let camera operators use the entire Super 16 frame for 2.35:1 widescreen photography."[11]

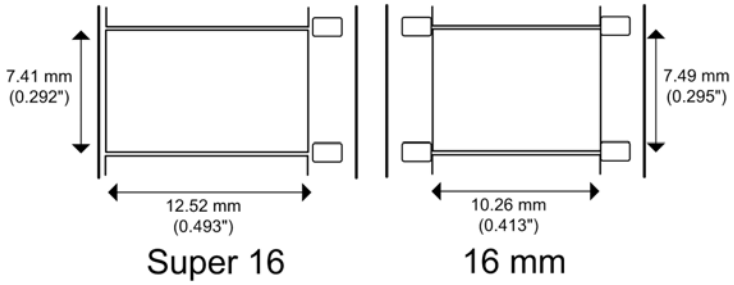


**Figure 4**

While the technological changes and evolutions of film and television were happening, there were other inventions that appeared and influenced indirectly the aspect ratio of film. According to John Hartley[12], the expansion of the home refrigerator market during the 30's and its evolution from being a luxury to becoming a common appliance inside the houses changed the cultural perception of the industries toward people who "changed their uses of time, space, food, and semiosis."[13] Refrigerators allowed people to spend more time at home because it was not necessary to go out for supplies every day. The idea of an economic platform and cultural form in television was developed in the USA in the 1940s to provide programming as entertainment,

[11] "16 Mm Film," Wikipedia, , accessed August 22, 2016, https://en.wikipedia.org/wiki/16_mm_film.
[12] John Hartley, The Uses of Television (London: Routledge, 2002).
[13] Ibíd.

rather than just news, and conditions to keep the people inside their houses, expanding their domestic consumer needs.

> For TV to happen the consumers had to be at home. To be at home, they need two things: Capital investment in the home to sustain their activities there; An Ideology of domesticity which would maintain their pleasures there, rather than in the street, pub, cinema, music-hall or even in brothels or communism. For the above conditions to be met in practice, every home had to have a refrigerator.[14]

Since people had found a new option of entertainment on television, gathering families inside their houses, the audiences who went to see movies in theaters were decreasing. Film industry that had shot on 35 mm in the Academy ratio from 1932 to 1952 was forced to offer something different that attracted the audiences used to the experience of watching movies in 4:3 aspect ratio; a fact that already was happening with TV and influenced film composition.

Regardless of the widescreen aspect ratios existing at the beginning of film history, the widescreen "revolution" was about to happen in the 1950's as a response to the demand of the cinemas to bring spectators into their projections rooms. On September 30, 1952, the Cinerama appeared, by offering a wider screen and surrounding sound experience to the audience in the theater. The idea of this format was to give the spectator the impression of reality in which they can see as much as the corner of their eyes. "Cinerama was presented to the public as a theatrical event, with reserved seating and printed programs, and audience members often dressed in their best attire for the evening." [15]

Contrary to the Academic Aspect Ratio that was dominant in the production at almost all of the film studios, there were other options to get a different ratio using the standard film size of 35 mm. One of these was achieved by masking the top and the bottom of the frame; providing the most common "flat" widescreens ratios 1.66 in Europe and 1.85 in USA. "Masking however means that a much smaller portion of the available

[14] Ibíd Pág 99.
[15] Wikipedia (Wikimedia Foundation, 2016), s.v "Cinerama" accessed March 29, 2016, https://en.wikipedia.org/wiki/Cinerama

film frame is used, resulting in diminished quality of the projected image. In the 1.85 ratio, 36 percent of the total frame area is wasted"[16] The other method of achieving a widescreen ratio is the anamorphic process, which became popular in the middle of the decade of the 50's with the "Cinemascope". The professor Henri Chrétien invented the "Anamorphoscope in the 1920's as a device which used Hypergonars system, a special lens that distorted the image in just one direction in order to provide a wider angle of view. At the beginning, this was used for military use, but in 1927 Claude Autant-Lara used this in his film *Construire un feu*. In the same year, André Debrie and Abel Gance developed the Polyvision system which used three projectors which would be very similar to the Cinerama which was invented later.

The anamorphic lens squeezes a wide image into the regular frame dimensions of the film and then de-squeezes the image during projection to provide an image with the proper proportions. "The standard squeeze ratio for the most common anamorphic systems (First Cinemascope now Panavision) is 2:1 – that is, a subject will appear in the squeezed frame to be half as wide as it is in reality. The height of the subject is unchanged" The anamorphic process obtained a projected image aspect ratio between 2.55 and 2.66 at its beginning but then it was standardized into 2.35 to make space for an optical soundtrack.

The beginning of the widescreen revolution could be considered with the appearance of Cinerama. Cinerama was based on the multi-camera / multi-projector system (Figure 5) invented by Fred Waller with the military purpose of making a combat training simulator for Bomber Gunners in the World War II[17].

[16] James. Monaco and David Lindroth, How to Read a Film: The World of Movies, Media, and Multimedia: Language, History, Theory, 3rd ed. (New York: Oxford University Press, 2000). 108
[17] "The Changing Shape of Cinema: The History of Aspect Ratio," 2016, accessed July 6, 2016, http://filmmakeriq.com/lessons/the-changing-shape-of-cinema-the-history-of-aspect-ratio/.

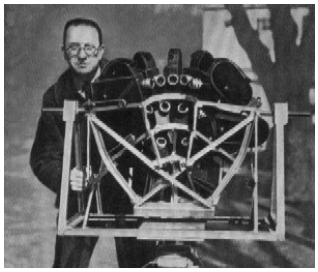

**Figure 5,** Fred Waller and the Multicamera system.

Cinerama used three 35mm cameras shooting 27mm lenses so as to approximate the angle of vision of the human eye, mounted at 48 degrees to each other in one unit. A single rotating shutter in front of the lenses assured simultaneous exposure on all cameras, and it was filmed at 26 frames per second.

Cinerama film capture was projected in a curved screen using three projectors running at 26 frames per second and boasting a 7 track stereoscopic surround sound system. The projection screen (Figure 6) "is made of hundreds of individual vertical strips of standard perforated screen material, each about 7⁄8 inch (~22 mm) wide, with each strip angled to face the audience, so as to prevent light scattered from one end of the deeply curved screen from reflecting across the screen and washing out the image on the opposite end" [18]

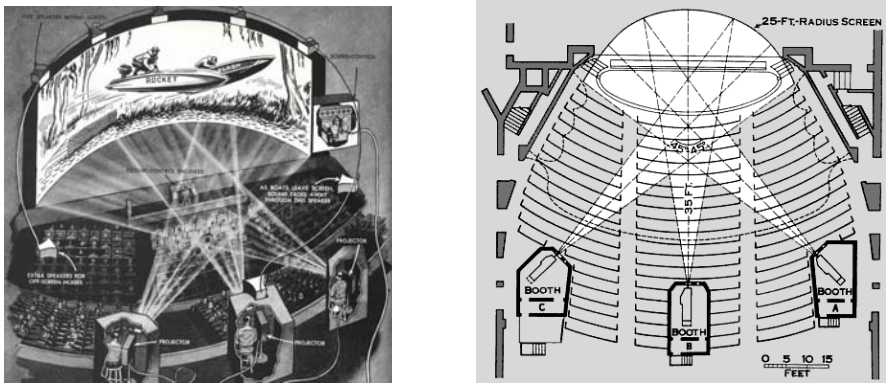


**Figure 6**

Nevertheless, to shoot and synchronize the three cameras and projectors had many drawbacks, it was expensive to shoot as well as to project it. Furthermore, it was only possible to have one focal length that should be wide. Also, making a close-up was

[18] Ibíd.

limited by the noticeable bend at the joins. Besides when two actors appeared looking at each other, they seemed to look past each other, particularly when there were shot by different cameras, so each actor should be alone in each take when they were talking. However, Cinerama became popular and made a lot of money, the films with dramatic stories were few, for instance in 1962 the only two dramatic films appeared shot in Cinerama, *The Brothers Grimm* and *How the West was Won*. The others films were made to recreate an experience for the viewer more than acting.

With Cinerama, the studios realized that the widescreen experience got a great acceptance from the audience, and that changing the aspect ratio of the films would make the difference. Eight months after Cinerama appeared; Paramount studio released what is considered[19] the first break to the 1.37:1 Academic Aspect Ratio, *Shane*, (1953). The film was photographed conventionally, but was screened with the top and bottom cropped to achieve a 1.66:1 (Figure 7) aspect ratio. Theatres had to change their standard and used new larger screens, as it happened with the 30 foot screen of the Radio City Music Hall which was replaced by a 50 foot screen, to sell the "new" wide screen concept to the public. Furthermore, this change in the aspect ratio also offers the audience a better quality in sound with a three channel stereophonic sound track, on a separate magnetic film. However, by masking off a portion of the frame to create wider images, the film grain is enlarged as well, and the image quality is reduced. [20]

**Figure 7**

Paramount established 1.66:1 for their conventionally cropped widescreen presentations. Major theatres in large markets also ran *Shane* with interlocked three-channel stereo sound on a separate magnetic film. Other studios followed suite with

[19] Hart, Martin. "Early Wide Screen Ratios." 1997. Accessed April 12, 2016. http://www.widescreenmuseum.com/widescreen/evolution.htm.
[20] Ibíd.

their biggest productions, including many in 3-D, in 1953. “By using a different sized aperture plate and wider lens, a normal Academy ratio film could be soft matted to this or any other aspect ratio”[21]. A great quantity of theaters in America had installed wide screens; nevertheless, because a smaller portion of the image was being used and magnification was increased the images seemed to be softer and with more grain. So that, some studios tried to compensate for this effect by shooting with full aperture gate, even bigger than the Academy Aperture and then they reduced the image in the optical printer. This process was the predecessor of Super 35 format which also uses a 1.85:1 aspect ratio, but uses one-third more of the frame area than a standard 1.85:1 matted into a 1.33:1 Aspect ratio.

20th Century Fox was concerned about the impact of the wide screen phenomenon happening with Cinerama, but wanted to create a cheaper system that did not require changing the screens of the theaters. To do so, they required their ”optical company Baush & Lomb to made a prototype “anamorphoser” (later shortened to "anamorphic")”[22] Meanwhile Professor Henri Chrétien’s patent for its Hypergonar lens system had expired. He was contacted by Fox studios who bought the rights of his technique so they could develop the CinemaScope wide screen technique.

By using 2x1 anamorphic lenses the images were squeezed into the traditional 4 perforation 35 mm negative (Figure 8 and 9) and then dilated in the projection by the use of anamorphic lenses as well. This process established at its beginning an aspect ratio of 2.66:1. The first feature made with this technique was *The Robe* in 1953 which “originally committed to Technicolor Three-Strip origination, was halted so that the film could be changed to a CinemaScope production (using Eastmancolor, but processed by Technicolor)”.

[21] Wikipedia (Wikimedia Foundation, 2016), s.v “VistaVision” accessed august 1, 2016, https://en.wikipedia.org/wiki/VistaVision.
[22] Wikipedia (Wikimedia Foundation, 2016), s.v “CinemaScope” accessed March 29, 2016, https://en.wikipedia.org/wiki/CinemaScope.

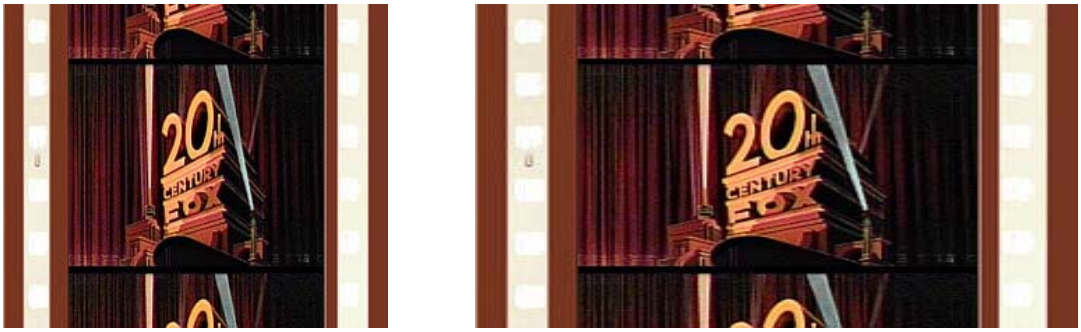

**Figure 8** Left: negative with the squeezed image. Right: de-squeezed image on the projection

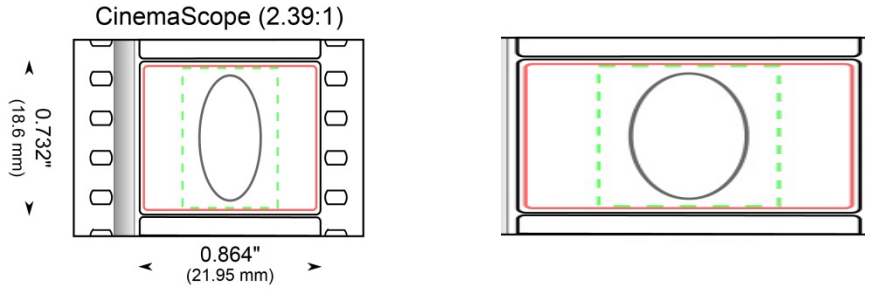


**Figure 9:** Left: negative with the squeezed image. Right: de-squeezed image on the projection

The use of anamorphic lenses was easier to shoot than Cinerama, and did not require huge investments from the projection theaters. "Twentieth-Century Fox attempted to make this the standard widescreen format and pressured other studios and cinema owners to convert to this gauge."[23] MGM, United Artist, Disney, Columbia and Warner wanted a widescreen format that could replicate the "Cinerama" experience and after an initial competition and haggling they adopted CinemaScope in their film productions.

However, Paramount Pictures opposed Fox, as a result of their internal ethics of not supporting a competing studio. Besides, they were not satisfied with the fact that the anamorphic system had not offered a better quality of the image; Paramount engineers complained that Cinemascope suffered from graininess, had reduced depth of field and an aspect ratio that offered much in width but little in height.[24]

[23] Peter Ward, Picture Composition for Film and Television (Boston: Focal Press, 2002). 95
[24] Torkell Saetervadet, The Advanced Projection Manual: Presenting Films in a Modern Projection Environment (Oslo: Federation internationale des archives du film, 2006).

Therefore, Paramount came up with the VistaVision format (Figure 10). Motivated by the Hill-Alberini pre-war widescreen process Panoramico Alberini. “This process is based on standard 35mm film travelling through the camera horizontally with a film frame covering eight perforations instead of the usual four. The camera aperture dimensions are 25.32mm x 37.39mm (an aspect ratio of 1.48:1).”[25] This process in which the camera were turned on its side “to achieve a wide image with an eight-sprocket hole pull down, (more precisely, a “pull-across”).”[26] The frame then was double the dimension of a 35mm frame and used all the image area available, avoiding the use of anamorphic lenses.

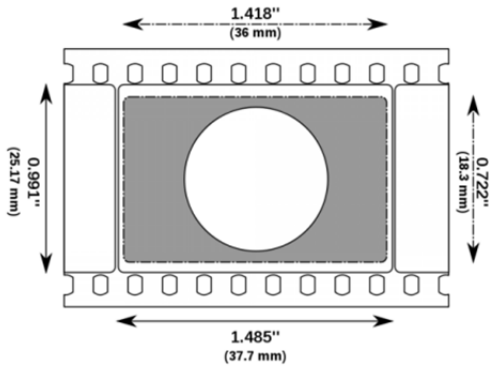


**Figure 10**

From the Paramount VistaVision (Figure 11) system, its negative was able to do various types of prints on the 35 mm projected print with diverse aspect ratios “varying from 2:1, 1.85:1, 1.66:1 to 1.33:1 … They claimed that height was as important as width of screen”[27] so their prints had much smaller visible grain. The first movie made with this system was *White Christmas* in 1954 and this format is associated with many films made by Alfred Hitchkock like *To Catch a Thief, North by Northwest* and *Vertigo*. CinemaScope and VistaVision also had a clear rivalry about the technical conditions that each system required, while the first one requires a lens system, VistaVision had to use a specific configuration on the camera construction, therefore different editing tables, as it could be appreciated in the advertisement poster of the two production companies (Figure 12) “At left is actress Marla English with a wooden mockup of the yet to be

[25] Ibid Saetervadet. 85
[26] James. Monaco and David Lindroth, How to Read a Film: The World of Movies, Media, and Multimedia: Language, History, Theory, 3rd ed. (New York: Oxford University Press, 2000).112
[27] Peter Ward, Picture Composition for Film and Television (Boston: Focal Press, 2002). 95

completed Mitchell Elephant Ear VistaVision camera. At right, a bit more recognizable superstar Marilyn Monroe fondles a CinemaScope projection adapter lens."[28]

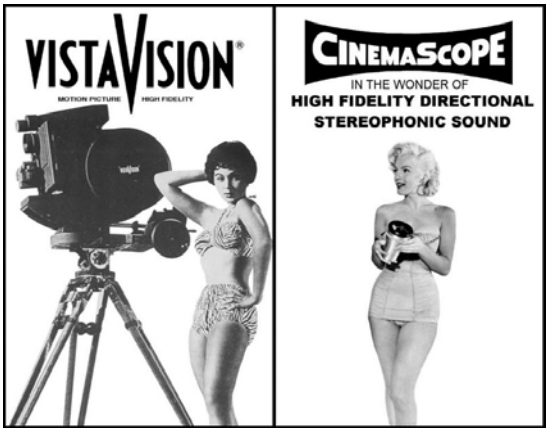


Figure 11

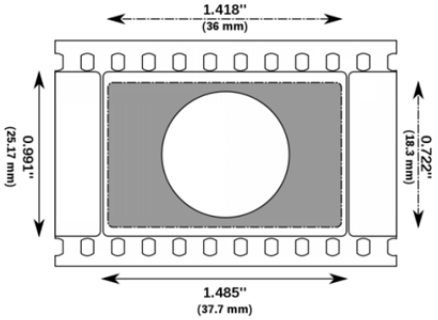


Figure 12

According to Ward, with the Cinemascope system, Fox demanded cinemas to re-equip with new projectors and a new screen that they patented, (The Magic Mirror screen which offered a brighter image) and a complex magnetic track stereo sound system. However, most of the cinema owners omitted the sound requirements. Regardless of the effort by Fox to influence those changes, they had to return to the standard sprocket holes and keep an aspect ratio of 2.35:1 and the release print had a combined optical and mechanic sound track. "Other widescreen formats followed, including CinemaScope 55 shooting on 56.625 mm negative but projected using 35 mm prints. Although it was sharper on the large screens, the audience was not generally aware of the difference. CinemaScope as a format finished at Fox in 1967."[29]

During the 50's, different widescreen formats emerged such as Superscope, Technirama, Cinemiracle, Vistarama, etc, using 35 mm. Nonetheless, film became bigger, with Todd AO – developed by a former Cinerama associate and Broadway Producer Mike Todd, along with American Optical Company. They used a 65 mm negative to film and 70mm prints that allowed accommodating sound tracks. "This process allowed four lenses to be used – 128, 64, 48, 37° so that standard storytelling

[28] Hart, Martin. "Early Wide Screen Ratios." 1997. Accessed June 11, 2016. http://www.widescreenmuseum.com/widescreen/shootout2.htm
[29] Peter Ward, Picture Composition for Film and Television (Boston: Focal Press, 2002). 96

technique could be employed through a range of shot size and camera movement."[30] Later, a small company that originally worked with CinemaScope, Panavision, in order to "reduce anamorphic camera distortion used a pair of prisms that could be moved in relation to each other to alter the anamorphic horizontal expansion factor. Therefore, cinema projectionists could adjust to accommodate any film with compression squeeze ratios from x1:1 to x2."[31]

Widescreen processes like MGM Camera 65, Super Panavision 70 mm, Super Technirama 70 demanded that many theater cinemas re-equip to be able to project 70 mm film. This gauge became "synonymous with image quality even when, to save production costs, some producers used 35 mm to shoot and then print up to 70 mm for release." [32] By the late 50s, Panavision started to replace cinemascope. They developed and acquired new camera formats and systems. The MGM 65 became Panavision's Super Panavision 70, except it used spherical lenses with an aspect ratio of 2.20. It can be appreciated in films such as *Lawrence of Arabia* in 1962, cinematographed by Freddie Young. The inconvenience with this process was that 70 mm stock was expensive.

As it is mentioned above, while some new film systems were appearing, some studios were trying to get cheaper solutions to achieve widescreen formats as it happened with Paramount masking or cropping the standard 35 mm Academy frame to get a wider aspect ratio. One of the implications that it had, was the fact that these images were smaller, therefore they had short focal length, and when they were projected had less resolution. However, it became popular for being inexpensive and simple, and in the cinema design and technology expert Saetervadet's words "Today, cropped widescreen is by far the dominant film format for theatrical 35mm film projection."

[30] Peter Ward, Picture Composition for Film and Television (Boston: Focal Press, 2002). 96
[31] Ibíd. 96
[32] "The Changing Shape of Cinema: The History of Aspect Ratio," 2016, accessed July 6, 2016, http://filmmakeriq.com/lessons/the-changing-shape-of-cinema-the-history-of-aspect-ratio/

In Russia and most European countries, the 1.66:1 aspect ratio was adopted as standard, in some part not only for political, economic or practical reasons, but also for quality reasons, because less cropping could achieve a better image quality. It had aperture dimension for projection of 12.6mm x 20.9mm. Meanwhile in the U.S.A after 1.85:1 aspect ratio were introduced in the VistaVision process, studios like Columbia and Universal International consented to use this format excluding some of their 3-D films. "The aperture dimensions are 11.3mm x 20.9mm… Disney/Buena Vista preferred the 1.75:1 ratio and has stayed with this format ever since. The aperture dimensions are 11.9 x 20.9mm. MGM also supported 1.75:1"[33] The significance of the 1.75:1 format might increase as it is almost identical to the television 16:9 or 1.78:1 aspect ratio, which will be considered later. For Saetervadet, the 1.85:1 perhaps will be replaced by the 1.78:1 or 1-75:1 as it happened with the 1.66:1 that currently is used very rarely.

To sum up about the different aspect ratios that were used in the early years of the widescreen from 1953 to 1960, it is possible to say that most probably Hollywood studios for their movies used the following aspect ratios:[34]

| Studio | Aspect Ratio |
|---|---|
| Columbia: | 1.85:1 |
| Disney: | 1.75:1 |
| MGM: 1.75:1 | 1.75:1 |
| Paramount: | 1.66:1 |
| RKO: 1.66:1 | 1.66:1 |
| Universal International: | 1.85:1 or 2:1 |

Approximately between 1960 and 1990, most of the Hollywood productions had as their first choice 1.85:1 since most studios were using it for wide flat screens. Even if the film was intended for 1.66:1 aspect ratio, the filmmakers were conscious that in the U.S.A, it would be projected in 1.85:1. According to Monaco, the 1:85 aspect ratio was adopted as an standard in USA and is referred to as American Standard Widescreen. The author of this text also found out that 1:85 sometimes could be called Academy aspect ratio, but this is confusion derivate from the Academic Aspect Ratio 1:33 which is related to the Academy aperture gauge on camera. Usually when a cinematographer

[33] Ibid Saetervadet, 92
[34] Ibid Saetervadet, 96

wants to shoot at 1:85, he/she uses the full aperture of the gauge, which has the Academy Aperture that the image is composed for, and subsequently cropped in the projection to achieve the 1:85 flat wide aspect ratio.

Around the decade of the 1960's, the Vistavision system was gradually disappearing. The cost of the materials and the new technologies changed the way of filmmaking. Using steadycams, or shooting in small locations was not possible because of the size of the cameras. Shooting with them was not practical, given how limited was their mobility. (Figure 13) Besides, the quantity of film used in the 8 perforations was more than in 4- perforations, which means more material, more cost, plus the special editing tables and facilities that studios and projections rooms should have. All of these extra-expenses and the innovation and appearance of new devices like Panavision systems set aside the VistaVision. However, its possibility of being projected on flat screens keeping a wide aspect ratio set a period of time in which many of the great movies of the studios were shot in this system.

Nowadays, there remain many sizes but the most common aspect ratios are the Academy Flat (1.85:1) and Anamorphic Scope (2.35:1). 1.66:1 and 2.20:1 (70 mm) ratios are also used (Figure 14). "Composition is often planned, when shooting, so that the release print can be accommodated on different aspect ratio display screens without seriously compromising information or the integrity of the image"[35]

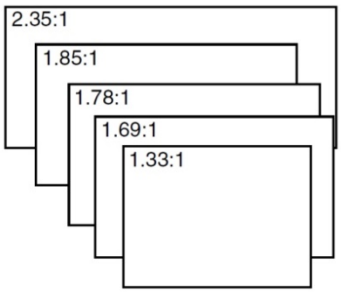


**Figure 13: Left:** VistaVision Camera on the set of Alfred Hitchcok's movie The man who knew too much"

**Figure 14: Right:** Different aspect ratios.

[35] Ibíd, Ward.

## II. Technological and aesthetics characteristics of the aspect ratio

According to theorist Peter Ward[36], the aspect ratio on television or film has an important impact on the composition of a shot. The shape of the frame depends on the source where the movie is made and screened. "Framing for a specific aspect ratio is an inherent part of a production's identity."[37] The choices of the director and cinematographer about capturing the image results in showing different elements and hiding others, all in order to fulfill an aesthetical purpose. What the spectator sees on the screen should be the same as its creators saw. Nowadays there is a wide range of aspect ratios that filmmakers can choose from. It is important to underline the aesthetical options that these different aspect rations can give to the movies.

Composition is defined by Ward as "arranging all the visual elements in the frame in a way that makes the image a satisfactory and a complete whole. Integration of the image is obtained by the positioning of mass, colour and light in the most pleasing arrangement." Nevertheless the concept of satisfactory or pleasing is a matter of discussion considering that it is a subjective topic that depends of other factors. For the arrangement of the visual elements, it is important to understand the differences of the framing in different aspect ratios, because each of them provides a particular approach to the image and the subjects that appears within the frame.

For instance, in the Kinetoscope, Dickson, who was Edison's assistant and was in charge of choosing a film strip that "provided an image sufficient quality at minimal cost"[38] had also to decide between using the horizontal format of landscape or the vertical of portraits used in paints and photography. Furthermore, instead of selecting a size of 1 inch per 1 inch, he preferred to have 1 inch per ¾ inch in order to have more frames in the strip and this decision determined the way how the first movies were made. So then, it is possible to affirm that once the aspect ratio of 1.33 became standardized the approach to the mise en scene was closer to tableau, as Ward says,

[36] Peter Ward, Picture Composition for Film and Television (Boston: Focal Press, 2002).
[37] Ward, 91
[38] Belton, quoted by Ward. 93

The Hollywood's visual style has its roots in the silent era. In the years from 1906 to 1915 or so, filmmakers in various countries refined a "tableau" cinema based in long takes. Usually the characters were arranged in a horizontal line across the frame, but sometimes the blocking moved them diagonally into the distance.[39]

**Figure 15** The abyss 1910

**Figure 16:** Carmen 1915

In the silent movies, which used the 1.33: aspect ratio, according to Bordwell[40] the close ups were an issue. Producers, actors and directors demanded close ups because they could add production values like movement of camera as well as showing the emotions of the characters. But when many different actors appeared in one scene, there was not the possibility to show all of them at the same time in close up. Cuts broke the scene and showed it with different camera angles; also most of the positions of actors were facing the camera in a horizontal axis (Figure 15). Even when two actors were facing each other "their bodies tended to be pivoted somewhat to the viewer."[41] (Figure 16) Far ahead in the 1940's, for example with films by Orson Welles and the cinematographer Gregg Toland, it was possible to see different uses of the perspective in the image as well as positions of camera that could produce different effects towards the composition and the perception of the images. The variation on the positions of actors in the foreground and the background as well as other elements like lights, shadows, props, etc. created a different sensation towards the images that appears in this 1.33:1 frame. (Figure 17)

Even some authors like Bordwell just talk about Hollywood cinema, but it is also necessary to point out that in Europe, different filmmakers were exploring different ways

[39] David Bordwell, Poetics of Cinema (London, United Kingdom: Routledge, 2007). 295
[40] Ibid
[41] Ibid

to frame and used the film to experiment and discover new aesthetics. A good example of this is German Expressionism[42], with movies like *Nosferatu* of Wilhelm Murnau or *The Cabinet of Dr Caligari* of Wiene. (Figure 18). In these movies, the use of different perspectives and non-conventional compositions created a new language that inspired films which were made after.

**Figure 17:** Citizen Kane 1941

**Figure 18:** Cabinet of Dr. Caligari 1920

Paraphrasing Bordwell, directors began experimenting with a mise en scene in the 1930s and early 1940s, coming back to the "tableau" positions of actors but with the elements on the foreground closer, making it bigger. They started to deal with the fact that all elements in the composition cannot be completely in focus, especially when the foreground was too close to camera. No matter how much light was added and how much they tried to close the diaphragm, it was not enough (Figure 19). The use of diagonals became more important and it also provided production values. Big spaces could be shown using diagonals and the vanishing point on the perspective of images to enhance the storytelling because using these would substitute in some occasions for the use of establishing shots. (Figure 20)

[42] German Expressionism was an aesthetic movement of filmmaking that started in the 1920's as opposition of the conventionalisms of western filmmaking. To understand more about this movement is recommended to read the following article: Darsa, Alissa. *"Art House: An Introduction to German Expressionist Films"*: https://news.artnet.com/market/art-house-an-introduction-to-german-expressionist-films-32845 December 26, 2013. Recovered August 2016

**Figure 19** The man who knew too much 1934

**Figure 20:** My-Darling-Clementine 1946

Without a doubt, filmmakers during the era of the 1.33:1 aspect ratio explored different ways to compose the image. Hollywood remains for many authors as a starting point to analyze how mainstream films were made, and how the variations of this industry were developing over time. The different aesthetic movements in film in other countries occurred in a way as a response to this establishment, with the purpose of setting a different point of view. However, the use of different aspects ratios were used massively until the big studios of Hollywood started to implement the wide aspect ratio in their movies.

The widescreen in 50's appeared as an answer for the demand to bring spectators to cinemas. The television broadcasting had adopted 1.33:1 aspect ratio as its standard so the chance of giving a new experience to the audience was successful and opened the opportunity to filmmakers to find a new approach towards the aesthetics both in framing and the mise-en-scene. The idea of covering more space in the horizontal plane produced the facilities to show great landscapes and big locations for instance, but also produce different interpretation regarding the position of the actors. In 1:33 aspect ratio, it was possible to show a couple talking closely in a medium shot. Doing it in a wider aspect ratio like in cinemascope however, there could be two issues; if the actors were placed at the center of the frame, as it was done before, the frame could look empty in the sides and quite awkward, or if the actors were placed with a gap between them, the gap usually should be filled by props and this gap can be interpreted by the audience as a separation or lack of intimacy (Figure 21). Furthermore, Bordwell affirms that "having taken away the deep-space schemas of the previous decade, Scope also made the traditional planar arrangements look embarrassingly artificial"

**Figure 21** East of eden, 1955 The space between the characters could give the impression that exists a barrier between them

When the format of CinemasScope appeared, the Fox established a series of rules to be used with the new aspect ratio that had born. But some filmmakers like the art director Gene Allen, who worked closely with the Director George Cukor, said ""Fox had given us this whole list of rules, like lining up your actors in a straight row, because of perspective problems, focus problems, and all. Well, Cukor said, "I don't know how the hell to direct people in a row. Nobody stands in rows.""[43] (Figure 22).

**Figure 22:** Hell and High Water 1954. To show different actors at the same time directors used to place them in front of camera filling the space, this arrangement is criticized by Director Cukor because it seems to be unnatural positions regardless the rules established by Fox.

The use of the aesthetic resources that Cinemascope was taking from the movies previous to its appearance seemed to limit the cutting rates, limit camera movements, and forbid deep focus and close-ups. Some filmmakers followed the rules given by Fox, but many directors did not. They tried to avoid close-ups because it sometimes looked too big for the screen, Bordwell for instance, believes that a close-up of a face in Cinemascope could not show the whole face like it was possible with 1:33 aspect ratio (figure 23).

[43] Allen, Quoted in Ronald Haver, *A Star Is Born: The Making of the 1954 Movie and Its 1983 Restoration* (New York: Knopf, 1988), 133. Quoted by Bordwell, 300.

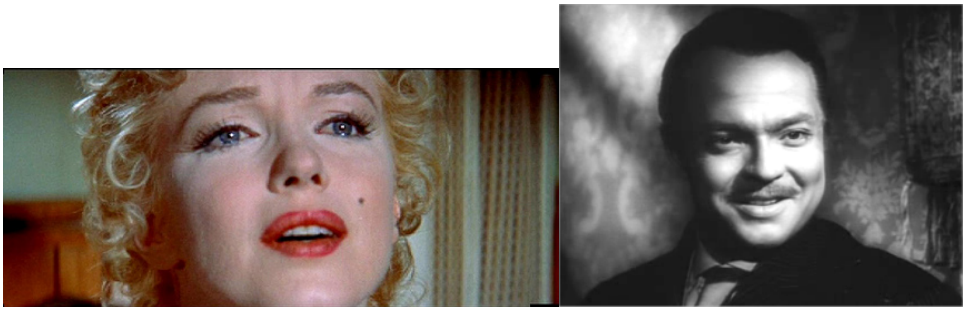

**Figure 23:** Left: Close up of Marilyn Monroe in Bus Stop (1956) to keep her eyes and mouth inside the frame was necessary to crop her face or make wider the shot. While in Citizen Kane (1941) a face can appear without cutting and occupy the majority of the frame

Also, anamorphic lenses had the problem of distortions at the edges, which pushed some directors to place the characters in the center of the frame, and put some elements in the borders that attempted to direct the attention towards the center. Likewise, because the horizontals got deformed, some filmmakers tried to "shoot rectilinear solids from a ¾ angle which makes the distortions of parallel lines less apparent and also creates a deeper space, though not all of it might be used for dramatic purposes (Figure 24)"[44] However, nowadays the anamorphic lenses has less aberration which allows characters to be placed in either the right or left part of the frame without a significant distortion. This means, it is possible to use the empty space of the frame to suggest that what is outside the frame is also important.

**Figure 24**: Left: Helen of troy (1956) distortion on the borers and vertical objects of the image. Right: American Phsyco (2000) The verticals of the image look straight and the character is placed slightly at right part of frame and is possible to see the background with detail as it is.

CinemaScope and VistaVision could be considered the main precursors of widescreen, as their aesthetic characteristics set the basis of the main aspects ratios that are used nowadays, 1.85:1 and 2.35:1. Therefore, it is necessary to point out their main characteristics and differences. Mainly VistaVision used spherical lenses and CinemaScope used anamorphic lenses, which produced special images because of the

[44] Ibid Bordwell, 303

construction of the lens. An image that has anamorphic lenses can be recognized because of its particular attributes.

Squeeze factor; the cylindrical element that is contained within the lens squeezes the image and projects it into the film or sensor with a compression on its longer dimension (Figure 25). The most common factors are 2.0X and 1.3X. The last one is more common, used in small sensors with a 16:9 aspect ratio, while 2.0 is used with full gate aperture or full size of the sensor, which means the captured image is twice as big than in a normal spherical lens. This also means that the Focal Length is different. In other words, using a 50 mm anamorphic lens in its horizontal plane, the image is wider, which means, that in order to achieve the same size image in a spherical lens, it would be necessary to use a 25 mm lens. This attribute of lens implies that the Depth of Field is affected, for instance, using the 2.0X Anamorphic lens 50 mm with its 25 mm focal length in the horizontal plane, compared with a spherical lens using same T/stop and focus distance, one you will see approximately a 4x difference in depth of field. In other words, "if the depth of field for the 50 mm is 2 inches, it will be 8 inches for the 25mm lens"[45]

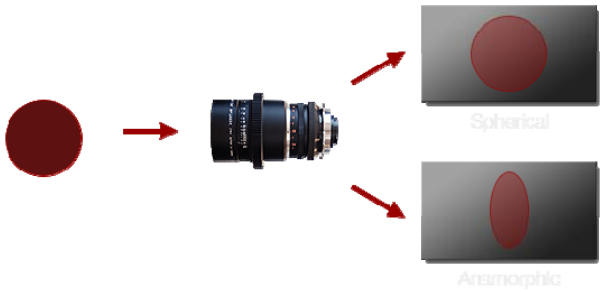


**Figure 25:**[46] Difference between the Spherical lens and Anamorphic lens, the image that is projected on the spherical does not have changes while (Above) the anamorphic (bottom) is compressed in the horizontal field.

Another characteristic of the anamorphic lens is the bokeh and flare shape. The first one looks ellipsoidal (Figure 26) and the second one, depending on the lens manufacturer and model can create a different color but always will look wider in its horizontal plane (figure 27). These two characteristics gives anamorphic images a particular aesthetics that cannot be achieved

[45] Jon Maxwell, *"The Aesthetic Role of Depth of Field in Anamorphic Cinematography"*. Film and Digital Times. June 2014
[46] "Understanding Anamorphic Lenses," 2016, accessed August 12, 2016, http://www.red.com/learn/red-101/anamorphic-lenses.

with spherical lenses. In a way those attributes could be used to give a particular identity to the film

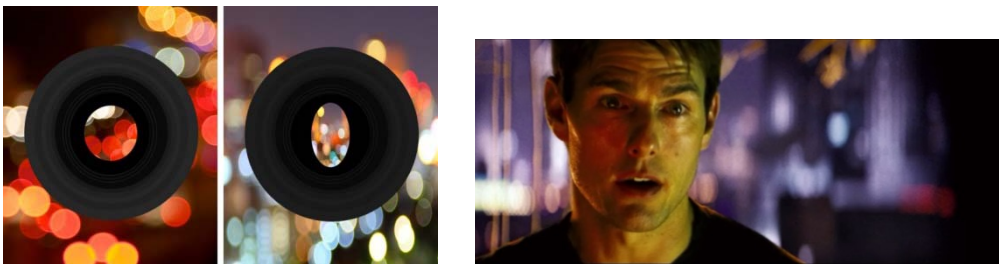

**Figure 26:** Left Spherical lens bokeh center: Anamorphic lens. Right: Still from Mission Impossible 3, shooted with anamorphic lens.

**Figure 27**: Star Trek, Flare shape of anamorphic image.

Furthermore, anamorphic aspect ratio of 2.35:1 has different advantages, for instance the use or greater space of the negative area, compared between 1.85:1. It results "in finer grain, better opticals, and an increase in apparent sharpness (apparent because while a similar image photographed in 1.85 will be sharper, the increase in grain and greater magnification actually make it appear less sharp)"[47]. This dissimilarity is more visible after going through the dupe negatives. It is approximately closer to the human field of vision, as well as it is more compatible with 70mm, not only for a blow-up but also because the aspect ratio can fit entirely into the 70mm print frame. There is also the facility that in interiors, the ceilings become unnoticed, so that gives the cinematographer the opportunity of having more space for placing lamps.

On the other hand, one of the disadvantages that this format could have is when it should be reduced to a smaller aspect ratio, because it requires a compromise from the author as the image would not being as they planned. So that, there are three options to reduce but each of it has limitations; the use of letterbox can be a solution for

[47] Rob Hummel, "Pros and Cons of 1.85, 2.35 and Super 35 Film Formats," in American cinematographer manual 9th Ed. Vol. I, ed. Asc Stephen H Burum, by ASC and Stephen H Burum (Hollywood, CA: American Cinematographer, 2007).

watching the whole image but that means the full size of the screen will be not used. So the other option could be pan and scan, an alternative with panning towards the most important action on the frame and omitting some information of the frame. But this technique has the disadvantage of omitting information for the audience, which means in many cases that the place in which the action occurs is not visible at all and the lack of information could mislead the understanding of the image. Another option is to expand the image, which means a greater part of it will not appear on the screen, therefore ignored by the public.

Moreover, anamorphic lenses are more expensive than spherical and it use could also increase the production costs. Certainly there is more space visible on the sides so that set and locations should be big or full enough to look real on camera. Furthermore if there will be necessary extras or compositions in visual effects, it is necessary to fill more space as well.

Certainly, the 1.85:1 can offer different advantages and disadvantages; a wider image with a cheaper price than anamorphic. Shooting with spherical lenses does not require using special accessories on the camera like the viewfinder and also does not need a special flat table for the editing. Moreover, it is not necessary to have special lenses or screens for the projection.

Also, some members of the American Association of Cinematographers like Rob Hummel, said that 1.85 does not require bigger sets like with 2.35 because the borders are not so visible. Despite his opinion, it is relevant to notice that, with either 1.85 or 2.35, the size of the location could be the same, depending on the framing and the composition of the picture could be necessary to build or set the location in a way that could require a great amount of money or work to do it.

Additionally, is important to consider that the bigger space in the vertical field demand the cinematographer to be more careful with framing to avoid showing the edges of the decoration, roofs, lighting equipment or microphones. Furthermore, the greater depth of field that could be achieved with spherical lenses might require showing

more space of the set that will appear on the screen even with more detail. One of the disadvantages of the 1.85 is that it uses on the negative a smaller area which makes it grainier than anamorphic; this effect could be more visible after going through dupe negatives.

Even if at the beginning, there were some issues to get used to the new aspect ratios, the widescreen offered some advantages over its previous format. For instance, the standard over the shoulder framings could be replaced by shot/reverse-shot giving a major time on the length of each shot during the editing. Bordwell affirms that close-ups could appear as rare but were not forbidden. On the contrary, when the close-ups avoided situating the character in the center, the empty space, no matter if this space is at left or right of the frame, implied something else off-screen, that the character is looking at. In addition, the empty spaces between characters were used to support the stories because it turned into an expressive effect. Bordwell points out that the most common case is the effect of emotional separation, "In *Rebel without a Cause (1955)* as James Dean watches Natalie Wood, a lateral camera movement follows her: the shot "gives us an insight into Dean's experience while at the same time remaining completely natural and unforced"[48].

Some directors tried to underline certain elements in the image by framing different elements of the shot in a way that it could isolate the characters or the objects that are important for a specific take. It means the use of elements that appear in the frame, such as props or set pieces, could be cut in a way that it is not necessary to show them completely. The space could also be shot in a way to create an image with visual rhythm. When directors emphasized shapes, color contrasts and other pictorial values, the result became closer to an abstract configuration of elements. For Bordwell, the movie *Picnic* is quite notorious for its use of depth in the compositions, like in the scenes inside or outside the Midwestern grain elevators (Figure 28).

[48] David Bordwell, The Velvet Light Trap (review of Cinema No. 21, 1993) (n.p.: University of Texas Press, 1993).Perkins, Film as Film,24

**Figure 28** Picnic 1955

Additionally, one of the other advantages that wider aspect ratio brought to cinema, was the facility to have long takes. Earlier directors and editors believed that extensive cutting could be confusing in the widescreens. The director Preminger for instance "was able to shoot lengths around twenty-four seconds and the film *Carmen Jones* had a take of thirty-five seconds" affirms Bordell[49]. On the other hand, the critic and director Éric Rohmer[50] affirms that wider aspect ratio allows better matches in the montage. A cut from a close-up to a long shot works smoothly, so there is no necessity to change the angle of the camera at all.

However, critics such as André Bazin, had ambiguous appreciations towards wider aspect ratios. For instance, about CineScope, Bazin remarks that regarding the montage, it does not give to the film a new range of stylistic possibilities. From his point of view, the ability of cutting the scenes by introducing different shots to show a sequence are against the main aim that film should have. The film should be composed of long takes because editing modifies the reproduction of the reality. It was well known for him that the wider size seems closer to the angle of view that humans have and it was one of the reasons that he found that widescreens could have the possibility to be closer to the reproduction of the reality. The cinema's ability to expose elements of phenomenal reality were enhanced in the Hollywood films because the new format gave more expressive resources to the mise-en-scene while it kept the standards of style.

Bordwell points out that director Otto Preminger was successful in understanding the advantages of a wide aspect ratio. The author takes *River of No Return* (1954) cinematographed by Joseph LaShelle to support the argument that with no dialogue, the viewer can see all that Preminger wanted to show. The director was able to show his

[49] Ibid 24
[50] Quoted by Bordwell in David Bordwell, The Velvet Light Trap (review of Cinema No. 21, 1993) (n.p.: University of Texas Press, 1993).Perkins, Film as Film,24

narrative and the evolution of the characters using the visual resources of the frame. Actors, camera movement, camera angle, were used to satisfy the demand for the utmost clarity, precision and conciseness in the playing. Film critic Perkins affirms "Hitchcock tells stories as if he knows how they end; Preminger gives the impression of witnessing them as they unfold." [51]

However Bazin's positions towards the wider aspect ratio, according to Bordwell, Bazin's opinions were relegated to a stylist's perception, so his theory became a reference in categorizing the films. If a film was called "Bazinian," it was because of its use of long takes and deep-focus. Its mise-en-scene was also used as a contrast to the "Eisensteinian" montage. Bazin´s criteria for a good film depended on the metaphysical and moral values that the film can have; if the film could offer a different criteria of "classical art-harmony, naturalness, subtlety, and unobtrusive control," it could be considered as a *good film*. However, mise en scene criticism in England, France, and the United States, succeeded to a great degree in imposing its reading of Bazin." [52]

Authors like Barr, opposite to Bazin's opinions, remarked that CinemaScope brought tools that allowed the evolution of the film language. With CinemaScope, it was possible to have the presence of characters, objects figures and landscapes at the same time in the frame. Furthermore, the use of details in the montage should enhance the montage in a nuance of emphasis. So that, a director should use the composition to enhance the narrative and not flaunt the ratio itself, which means, the viewer should perceive the gradations of characters' interaction and not jump around the whole image looking for what is important to see. For instance, is possible to place elements and actors in the different planes of the image, actors moving from the background, towards the middle plane and coming to the foreground. This can be showed by racking focus. This option can help the directors to improve their mise en scene because is possible to place different actors or actions along the frame and direct the attention of the viewer towards the planes of the image

[51] Perkins, Film as Film, 130 Quoted by Bordwell.
[52] Borwell, Ibid. 19

Regardless of the different opinions given by these authors, it is possible to say that the exploitation of the widescreen and its aesthetic resources to enhance the storytelling depended on the approach of directors and cinematographers. The critique from *Cahiers du Cinema* made by Jacques Rivette said:

> The director will learn how he can sometimes claim the whole surface of the screen, mobilize it with his own enthusiasm, play a game that is both closed and infinite—or how he can shift the poles of the story to their opposites, create zones of silence, areas of immobility, the provoking hiatus, the skillful break. Quickly wearying of chandeliers and vases brought into the edges of the image for the "balance" of the close-ups, he will discover the beauty of the void, of free, open spaces swept by the wind.[53]

Another possibility that CinemaScope brought to cinema was the enlargement of the human body, much like Cinerama had enabled the reproduction of great landscapes. The ability to expand the image of the person, contrary to Cinerama's interest in landscapes, gave the opportunity to the audience to see their favorite actors on the screen in giant size, which was also another change in aesthetics brought about by the wide ratios. Advertisements promised the possibility for the audience to appreciate the full bodies of celebrities like Marilyn Monroe or Lauren Bacall on the complete screen. The curved screen and the curves of the female actress were the hook to bring audience to the movies. Therefore, the shots in which the iconic actress appeared had to show their body in such a way that it could have harmony with the format of the screen. According to Rogers, "Fox consistently maximized the size of the star's image in its CinemaScope films by featuring her in a reclining position"[54] (Figure 29)

The full body shot, with mainly with the actress lying down horizontally became popular. In complicity with the press, the idea of scrutinizing the bodies of the celebrities called many spectators to the cinemas. Even the opportunity to show them in stereoscopic 3D was advertised as giving the audience a chance to see their stars floating over them. However, the big screens had to face the issue that to enlarge the size of the actors, their flaws could be more evident. The earlier films for the widescreens wanted to present clearly their difference and give reasons why the

[53] Rivette quoted by David Bordwell, Poetics of Cinema (London, United Kingdom: Routledge, 2007).309
[54] Ariel Rogers "Smothered in Baked Alaska" The Anxious Appeal of Widescreen Cinema

experience of the cinema had to change. In order to prove their difference, the films started with a prologue in the Academic Aspect Ratio, and then they changed to the wider aspect ratio to emphasize the differences. This phenomen happened not only in Cinerama movies, such as *The Robe*, and others Cinemascope movies, but also in movies like *Around the World in 80 Days,* which was made in Todd-AO process.

It iss important to clarify that showing the bodies of the actors along the whole length of the screen was but one tendency. The cinematographer could have the freedom to show the celebrities in different approaches. For instance, a panning along the bodies of the character would make the body look even bigger and could show more detail to the spectator. It was a matter of choosing what would enhance the film best. Given the size of the screen on which the film would be projected.

**Figure 29:** How to marry a millionaire – 1953 Shot of Marilyn Monroe full body with no necessity of panning.

Another aesthetic use explored by some filmmakers was the fractured screen, a process which consisted in fragmenting the screen and positioning different shots within the frame, separated usually by dark masks, often used to show the simultaneously of the actions occurring in the movie. (Figure 30)

**Figure 30:** Boston Strangler – 1968 Use of multiple screens.

Dr. Harper Cossar, Ph.D. in Communication (Moving Image Studies), affirms that multi-image panels born in the late decade of the 60's and presented in the movies from 1968 *The Boston Strangler* cinematographed by Richard H. Kline and *The Thomas Crown Affair* cinematographed by Haskell Wexler were the most preponderant movies that used this technique as an aesthetic tool to enhance the storytelling. Both Marshal Deutelbaum (2003) and Bordwell claim that widescreen framing can be managed in a better way by "dividing its width into imaginary thirds or quarters, and then composing into imaginary thirds or quarters and then composing horizontally by segment"[55] Both of the aforementioned films coincidentally were crime dramas and divided the frame into geometric fragments of visual spaces. In the *Boston Strangler,* its director Richard Fleisher used this technique in different ways. One was to emphasize the mental disorders of the main character, and the other was to confuse the audience, like when the face of the killer was not shown in order to keep the suspense. Cossar affirms that both filmmakers used the wide aspect ratio by dividing up its geometric options instead of concentrating on its great width and these multi-image films opened the doors for new forms of widescreen experimentation.

Contrary to Preminger's approach of making the viewer scan the frame to locate the relevant information, Fleisher's multi-panel approach divided the frame in a way that can be managed with the purpose of the storytelling. As the production and visual designer Fred Hardman noted, Fleisher was conscious about the widescreen aspect ratio's capability to "lose" a viewer's interest in horizontal compositions… "He (Fleischer) doesn't like the anamorphic aspect ratio with its wide, narrow frame"[56] As mentioned before, when it was necessary to tell an intimate story between two people, the space that surrounded or separated them was not necessary. The interest of fragmenting the screen was the consequence of the idea that compares painting with the frame. For Fleisher, the picture should not match the frame. It is the frame that should match the image.

[55] Harper Cossar and Visiting Instructor Harper Cossar, Letterboxed the Evolution of Widescreen Cinema (United States: University Press of Kentucky, 2010).
[56] Harper Cossar and Visiting Instructor Harper Cossar, Letterboxed the Evolution of Widescreen Cinema (United States: University Press of Kentucky, 2010).

The process of shooting for multi-panel framing was complex and demanded more precise planning. The *Boston Strangler's* was a successful example of how to create a different framing into an established gauge. The multi-image process breaks with standard filmmaking methods as well as the continuity-editing practices. Furthermore, the habit of viewers to watch and read a horizontal image on the widescreen was interrupted by an option to see how different images appeared in the vertical plane. (Figure 31)

**Figure 31:** Boston Strangler, Vertical screens to show different victims and situations simultaneously.

On the other hand, *The Thomas Crown Affair* by Norman Jewison is a movie that uses the resource of multiple screens not because it was planned from the beginning, but because it had to be done. Its director and editor were having problems to fit material into the running time they needed for the movie, so by using multiple-image sequences, the actions could be shown simultaneously and the running-time of the film were reduced as well as its cuts. (Figure 32) It is worth mentioning, despite the fact that Jewison's reasons were accidental and against the aesthetics for multi-panels established by Fleischer, both movies show that it was possible to use multiple panels within the widescreens, even though the aspect ratio changed.

*Boston Stranger* had a 2.35:1 aspect ratio of CinemaScope while *Thomas Crown Affair* used the 1.85:1 aspect ratio of Panavision frame. Moreover, according to the authors of the mentioned movies, the partition of the frame had its own values, which means that for the aspect ratio of 2.35:1 the filmmakers realized that more than twelve images within the frame was improbable, while in ratio of 1.85:1, it was possible to fit fifty-four images (Figure 33). This high quantity of images was criticized because in some moments the resource was not used for narrative purposes. The Jewison film was well perceived by the audience; its use of the multiple image became an attraction.

**Figure 32:** Thomas Crown Affair - 1968

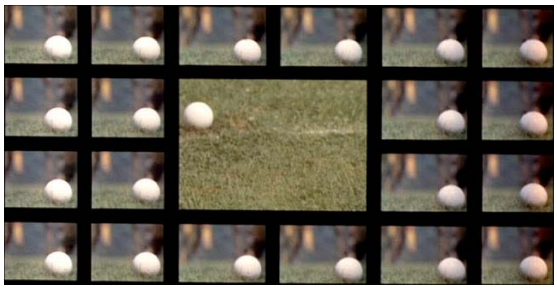

**Figure 33:** Thomas Crown Affair - 1968

To sum up, some filmmakers used the compositional potential of the wider aspect ratio in different ways; they divided the screen into different grids, each grid has a different shot of the same sequence, being aware that the image that would be projected in the cinema would be the same they framed. Nevertheless, their compositions were changed later when panned and scanned or cropped to fit into the 4:3 aspect ratio of the television broadcast. Regardless of the critics and fears that some filmmakers and theorists had when widescreen appeared, and despite the "too much to look at" critique, the new shape of the screen allowed filmmakers to explore different compositions that became an advantage for the creation of images with rich visual complexity.

For instance, Ward notes that in *Lawrence of Arabia* (1962) cinematographed by Freddie Young there is a scene where the desert appears and takes the whole frame to show two camel riders galloping towards each other from opposite sides of the screen. For him, Ward, this shot achieves the spectacular potential of the widescreen cinema. However, widescreen composition, once the technology allowed it, went back to Academy format conventions "with complex camera movement, staging to provide lines of force across or into the background and eye line glances to counterweigh the composition. Lighting, focus zone, actor position and setting directed the spectator's attention to the dominant subject/s of the shot."[57]

Another item to consider is the approach that the cinematographer had to have towards the framing on films which used the wide aspect ratios, when the films would be cropped or masked at its projection. Paramount wanted the format to be universal so

[57] Ward- pag 108

they suggested using the 1.85:1 aspect ratio but the projectionists had the option to choose what they wanted. In these cases, the viewfinder in the camera indicated the various safe zones for composition, so as far as the framing remained into those areas the image would not have any inconvenience at the projection. This freedom that the studio promoted demanded that the cinematographer had to make compromises and compose according to the multiple aspect ratios or accept a probable loss of the control of its frame. Besides, it also meant that many of the cinematographers framed in a way that composed for 1.85:1 but took care not to show microphones, lights or part of the backstage on the top and bottom so that if the aspect ratio of the movie would change, there would not be undesirable objects in the frame. In other words, if the Director of photography (DOP) knew that a film would be screened in horizontal film projection, perhaps he/she could ignore objects that appeared within the 1:66:1 area, while if the film would end in a vertical film projection, the cinematographer should prefer to frame for the safe zone of 1.66:1 instead of using the 1.96:1 or 1.85:1.

Ground glass inside the camera serves as a framing reference for a desire aspect ratio. Usually, most of the films are shot with full-frame and later masked during projection to have a widescreen aspect ratio. It is important for the cinematographer and the camera operator to be able to see the boundaries of the desired aspect ratio they want to use, for this aim is necessary to use different replaceable ground glasses. In order to warrantee the correct projection of the aspect ratio and for later postprouction is necessary to shot a frame leader, “a method of showing lab/transfer house where the specific film aspect ratio will be placed on the film. The lab then knows the exact size and position of the format on the film negative.” [58] Is advisable to shot the frame leader in digital cameras as well

Aspect ratio has been used as a narrative tool as well. A clear example is in the recent movie *Mommy* directed by Xavier Nolan and cinematographed by André Turpin, that tell the story of a woman who is raising alone her son who has some mental problems that makes him violent. The film starts with a 1:1 aspect ratio, but in some moments it changes to 1.85:1 to support the different emotions which the characters

[58] Rental, ARRI. "Formats and Frameleaders." Download Formats and Frameleaders. Accessed August 22, 2016. http://www.arrirental.com/download/pdf_frameleader.html.

have. On using a square aspect ratio, Nolan said, "I know a lot of people are saying, 'Oh, 1:1, how pretentious," admits Dolan. "But for me, it seems a more humble and private format, a little more fitting to these lives we're diving into."[59] Nolan also remarks that using a narrow frame was able to imprison his characters but when he widened the film he wanted to underline the moment when the character and the story became hopeful, so the sensation of wellness was enhanced. One of the sequences in which the variation of aspect ratio happened was when Steve the son seems to overcoming his violence problems and started to ride his skateboard (Figure 34) in the words of the director "I knew going in that I wanted one moment where the frame would break open and for the character to break free… We loved it so much we ended up doing it twice."[60]

**Figure 34**: *Mommy* (2015) Stills from the sequence where Steve (main character) widened the aspect ratio while shows he is getting over his problems.

[59] Chris O'Falt, "Why Xavier Dolan's 'Mommy' Was Shot as a Perfect Square," The Hollywood reporterJanuary 8, 2015, accessed August 6, 2016, http://www.hollywoodreporter.com/news/why-xavier-dolans-mommy-was-756857
[60] Ibid.

## III. Perception of the public towards widescreens projections

The new sizes of screens in the cinemas promoted the idea that the viewers would have a completely different experience than they had with the previous cinema of 1:33.1 aspect ratio. The widescreen and its size promoted the idea of stimulating the viewer's peripheral vision, because its size can simulate the illusion of depth. The screens became bigger and produced the sensation of surrounding the audience with a viewing experience that was closer to real-life vision because the great size of the screen made the viewers to move their eyes around the screen to see the different parts of the screen. Systems like Cinerama with its 2.77:1 aspect ratio claimed that its audience would enjoy the coverage of 146° in the horizontal field of view and 55° in the vertical; distances very close to the human vision of 165° degree in the horizontal field and 65° degree in vertical angles.[61] This change in perception created the illusion of immersion into the images, which explains why the first movies on the new widescreens, instead of presenting stories, showed different landscapes and situations like going on a roller-coaster or visiting a must see place like the Niagara Falls. The idea was to promote a physical experience, to create the illusion in the audience that they participated in the actions that were projected, like a ride with a gondolier in Venice.

According to Ward, the curved screens duplicated the peripheral vision, enhancing the visual experience. For instance, in the Cinerama's aspect ratio of 2.77:1 many of the audience were less aware about the edges of the horizontal frame. Contrary to the visual approach of the Standard Academy ratio movie, the Cinerama audience was seated so the screen covered their field of view.

> Human vision uses a series of small eye motions called saccadic eye movement to scan 5–358 of their field of view. The Cinerama screen, covering 1468, meant the audience's visual attention was scattered across the screen. This duplicated the experience in reality of scanning across a panoramic view. Unlike the Academy ratio movie, the audience's attention (unless you were sitting in the front seats), was not focused on a single framed image. [62]

[61] Rogers, Ariel Smothered in Baked Alaska" The Anxious Appeal of Widescreen Cinema
[62] Ibid Ward. 95

The immersion concept of big screens required adjustments in the projections rooms. Increasing the size of the screen made the theater change their shape. The large theaters became wider. For instance, the screen at the Broadway Theater where Cinerama made its first appearance had a measure of approximately 20 meters wide by 7 meters high, almost six times bigger than the average of screens before 1953, 5 or 6 meters wide by 4 or 4.30 meters high. With the screen of the Roxy Theater in New York, where the film *The Robe* in Cinemascope was released, it was 20 meters wide by 7.7 meters high.[63] As mentioned before, the bigger size of the screen produced the effect that the people could not see the entire screen, so their eyes had to move around the screen. This was also produced not only because of the bigger size or the curvature, but also because the "theater owners were instructed to move the new screen in front of the eye-catching prosceniums of yesteryear, allowing it to extend from wall to wall at the front of the theater"[64]

Furthermore, sound had an important role in the immersion effect. Cinerama for instance introduced a Hi-Fi stereophonic audio system of seven tracks with five speakers behind the screen plus two surround speakers on the projection room. On the other hand, Fox with its Cinemascope introduced a four-track magnetic sound attached within the print. Later, Cinemascope had to change its aspect ratio from 2.55:1 to the 2.35:1 because of the high price of magnetic sound prints, the limited number of playback systems[65] and the special conditions that magnetic sound require, like de-magnetized projector, which "encouraged the introduction of optical sound to Cinemascope print"[66] This change on the sound could be made by using a standard optical monophonic track that also allowed standard perforations or the "optical sound track were added to a four-track magnetic print"[67] also called MagOptical print, which at

[63] Ibid Rogers
[64] Rogers suggested to See "CinemaScope Technical Bulletin for Theatre Supply Dealers," no. 1: 3, Publicity—General, folder, box 106, Sponable Collection.
[65] The Fox Company with the aim to have a bigger image changed the size of the perforations on the prints which demands the projection rooms should have the special equipment to deal with this material, as well as the editing tables and splicers.
[66] Torkell Saetervadet, The Advanced Projection Manual: Presenting Films in a Modern Projection Environment (Oslo: Federation internationale des archives du film, 2006).
[67] Ibid Saetervadet

its beginning has utilized the foxhole but with the passing of time, used the standards perforations.

One of the important facts to point out is that the perception of the movie depends on where the viewer sees it from, that means, depending on where the viewer sits, he or she will have a different approach towards the immersing effects of the widescreen. Certainly being closer to the screen makes the experience different in terms of appreciating the frame the eyes rather than the path of a viewer in the center or in the further seats.

The shape of the screen also influenced the size of the theater, from long saloons where the first Academic aspect ratio was screened to the wider and big cinemas when the big formats appears. Nowadays the cinemas have become smaller with different stereophonic sound systems of surrounding and the variety of aspect ratios can be handled by the projector itself. According to Saetervadetl, modern cinemas' design that have the TXH approval[68] preferably have a minimum angle of coverage in the horizontal plane of 36° in the rear row and maximum horizontal viewing angle coverage of 90° on the front row. (Figure 35)

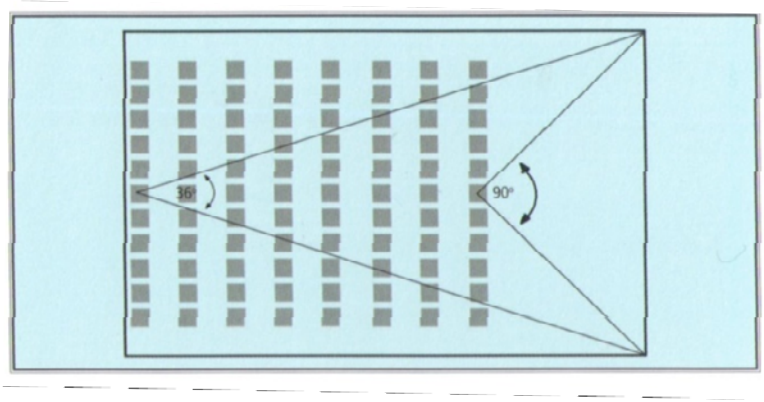


**Figure 35**[69]

[68] THX approval is a certificate that guarantee the Cinemas who have it are able to "provide standards and best practices for architectural design, acoustics, sound isolation and audio-visual equipment performance." http://www.thx.com/professional/cinema-certification/thx-certified-cinemas/ Recovered (July 2016)

[69] Ibid Saetervadet

While it is true that many cinemas transformed their structure in order to have a curved widescreen, there were others that did not do it; one of the reasons that could explain it, besides the economical ones, was the appearance of the alternative given by Paramount with the VistaVision format. For instance, with the horizontal 35 mm VistaVision format, it was required the use of their own projectors in which the projection print was cropped to allow the optical sound track and its loss of space explains why even if the projector aperture had an aspect ratio of 1.96:1 the image shown had an aspect ratio of 1:85:1. (Figure 36) This specific format was exclusive for some movies and was only screened in the most prestigious theaters. Nevertheless, according to Saetervadet, this format of projection is “virtually extinct”. It also must be remembered that Horizontal VistaVision prints was not able to project 1.66:1 aspect ratio because of the space of the optical sound track and the area on the opposite side of it.

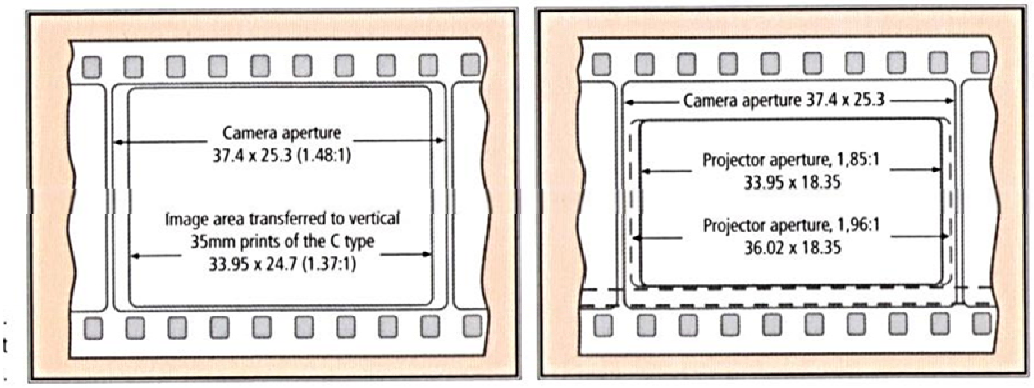


**Figure 36 Left:** VistaVision camera dimensions. Right VistaVision horizontal print dimensions[70]

The vertical full-height image on 35mm prints for anamorphic systems of Vistavision were cropped sideways to the 1.66:1 aspect ratio and then were printed in a reduction “through 1.5x anamorphics within the absolute limits of 35mm frames (18.8mm x 20.9mm). When projected through 1.5x anamorphics, the original image proportions of 1.66:1 were regained and could be cropped to any ratio up to 2:1.”[71]

[70] Ibid Saetervadet
[71] Ibid Saetervadet

On the other hand, the vertical 35 mm prints that were optimized for maximum 1.85:1 aspect ratio are considered relevant for the projection in flat screens because it was versatile, had a great definition and compatibility with other projection system. It means the 1.85:1 aperture plate allows seeing the same parts of the image that could be seen when the horizontal VistaVision print was projected. Furthermore, it gave the opportunity to be screened in aspect ratio of 1.66:1, with the only difference that it could reveal more of the image at the top and at the bottom of the frame. Besides, this aspect ratio had a great compatibility with many projection systems for the reason that Paramount wanted to have a gauge that could be screened in the theaters that did not convert into widescreen.

## IV. Television and aspect ratio

In film, the selection of the aspect ratio produces extensive debates and depends on multiple facts. Likewise, in television, the aspect ratio is influenced by different facts, such as bandwidth, line structure and resolution.

According to Ward, the quality of the screen depends on internal and external factors. External factors include the reflections or ambient light on the surface of the screen, the size of the screen and the distance at which it is viewed. Unlike film, where the image consists of light reflected on a screen, television emits light itself. The viewing distance and the size of the display screen will be one factor in how much detail is noticeable in a televised image. "Because of the regulation of television transmissions, the design of the system (e.g., number of lines, interlace, etc.) and the permitted bandwidth, the detail (sharpness) of the broadcasted picture will be affected. Bandwidth will determine how much fine detail can be transmitted."[72]

In the 1920s and the early 1930's, different systems of creating an electronic picture could have been developed, but similar to Dickinson deciding on the aspect ratio of the 35 mm film, engineers and researchers such as "Philo T. Farnsworth and Vladimir Zworykin in the USA and Blumlein & McGee in England, devised a television signal that varied in detail but was similar in principle"[73]

> On the 2nd of November 1936, the British Broadcasting Corporation started the first television service alternating between the 240 line Baird system and the 405 line Marconi/EMI system. In February 1937 the Baird transmissions were discontinued. Circular faced cathode ray tubes were used as television display screens and it was thought, that the maximum area of the tube face could only be used, if the aspect ratio of the television image were 5:4. On the 3rd of April 1950, the BBC changed the screen shape to a 4:3 image, which coincided with the Academy film ratio. It was ironic that this shared film and television standard aspect ratio would only last three years before

[72] Ibid Ward, 97
[73] Ibid 97

> CinemaScope was launched in 1953 with an aspect ratio of 2.66:1. It would take nearly 50 years, until television changed its screen shape to 16:9 widescreen.[74]

Later in 1968 in Japan, the research laboratories of the Nippon Hoso Kyokai (NHK) investigated the predilections of the viewers regarding size and aspect ratio, finding a predilection in choosing wider aspect ratios rather than 4:3. Based on the average of viewing distance, which was "2–2.5 m, which suggested an ideal screen size of between 1 m x 60 cm and 1.5 m x 90 cm… and with high quality stereo sound, the viewer involvement was increased."[75] By 1980, NHK proved that they could broadcast a 1125 line picture on a system of 60 Hz and provide a support for a worldwide standard for HDTV. However, the 60 Hz was not compatible with the PAL/SECAM field rate of 50 Hz and the NTSC 59.94 Hz. Although the NHK initiated to broadcast HDTV by satellite for about an hour per day in PAL/SECAM countries, the format 1126/60 was rejected because it would be difficult to convert to the PAL/SECAM systems. This situation happened in USA with the NTSC system as well. But according to Ward, one of the main reasons for that, was the industry's concern that a world standard originated by NHK would leave the Japanese manufacturers in a privileged position on the world equipment supplies. Ward remarks that at an international standards meeting in Dubrovnik, in that time part of Yugoslavia, in May 1986, the conference voted to delay the decision until 1990. Throughout the next years, the discussions about which format to adopt were held under influenced by how parties wanted to protect and promote their own broadcasting industry and television services.

The appearance of 16:9 aspect ratio is due to the quest for a universal standard, based on the fact that 35 mm and 16 mm can be screened in almost every country around the world because they fulfill some standards of compatibility that television systems do not have. The broadcasting industries and manufacturers of professional and domestic television equipment needed to find a single standard format that could be converted to all other formats with the minimum of degradation. Therefore, a 1080 line, progressive scan picture with a frame rate of 60 Hz (1080P/24) were selected as the

[74] Ibid 98
[75] Ibid 98

most likely format to be adopted as a world production standard. This will not be transmitted, but will be the 'master' originating format."[76]

Furthermore, Television committees which assumed the shape of the screen should be wide for the HDTV. They did not easily agree about the proportions of the display. Although the research made by Dr. Takashi at NHK founded that most of viewers preferred a 5:3 or 15:9 aspect ratio, in 1984 in USA, the Advanced Television Systems Committee (ATSC) approved the 16:9 or 1.77:1 aspect ratio based on Dr. Kerns Powers' suggestion to the Society of Motion Picture and Television Engineers (SMPTE).

For Dr. Kerns, using 1.77:1 aspect ratio was the best solution because it fits between 1.66:1 and 1:85:1 aspect ratio, and at the same time simulcasts different aspect ratios with less compromises than the standard 4:3. Moreover, it can let the television program makers a new standard of aspect ratio which could be broadcasted in 4:3 screens as well. To broadcasting 16:9 it is necessary to take considerable precautions on the framing, which means using marks in the view finder to position the objects within the frame, according to the both systems of aspect ratio that are going to be broadcasted. This way, it wasn't necessary to produce two aspect ratios during the transition from analogue to digital television.

It's valid to remind that the opinion of the members of the American Society of Cinematographers (ASC) were not listened, from a creative perspective, "either recomposing or letterboxing 35 mm anamorphic (2.35:1) or unsqueezed 70 mm format (2.2:1) film would require unacceptable artistic compromises"[77] to fit into the 1.77 aspect ratio. "ASC felt that 2:1 was an acceptable compromise between artistic purity and commercial realism"[78] but manufacturers have the last word. Therefore, it's possible to say that commercial reasons seem to be more powerful than aesthetics.

[76] Ibid, Ward 99
[77] Ibid, Ward 100
[78] Ibid, Ward 100

One interesting way to describe what many cinematographers felt at the moment when 16:9 aspect ratio was set, can be seen in the following anonymous message that the ASC sent to the SMPTE:

> The logic of picking something right in the middle between 1.66 and 1.85 may make sense from a mathematical standpoint, and carry international goodwill, but . . . in the real world . . . It's like saying that if you want to build kitchen appliances and sell them in the US and UK, you should build them to run on 165 volts, because that's halfway between 110 and 220.

On the other hand, the new aspect ratio of the HDTV allows to visualize various aspect ratios by accommodating them into the displays, in order to do it there are different options. One, and the most accurate to see the image in its "totality", is the letterboxing, which consists in adjusting the film on the center of the display and filling the remaining parts with black bands, in case the images are wider than 1.77:1. Most common letterboxing is visible on the top and bottom for wide aspect ratio and on the left and right parts of the display for the 4:3 aspect ratio images, the main advantage of letterboxing is that it avoids the process of Pan Scan or cropping the image when it is broadcasted.

This refusing attitude towards 16:9 aspect ratio is comprehensible from the point of view of many filmmakers, because its proportion did not solve completely the compatibility issues that the difference between aspect ratios on film and television had have along the history. For instance, wider aspect ratios like CinemaScope can be broadcasted without cropping the image or pan and scan, but it will be letterboxed which means its size will be reduced and the display would not be fully exploited.

Another option to broadcast different aspect ratios could be by cropping or expanding the image to fit any shape of the displays, but this process has the disadvantage, that it could decrease both the resolution of the image and/or the information which the frame contains. There are some countries that prefer to use 14:9 aspect ratio to decrease the impact of broadcasting wide products in 4:3 receivers. That also implies the cinematographer should be aware about which aspect ratio the program will be transmitted. Therefore, if the framing remains into the safe zones of the

viewfinder, the final image would be affected in smaller proportions when the aspect ratio varies.

Ward reminds to be aware about the fact that framing for television should be tighter than in film, because the size of the display is smaller, so the image needs to be big enough on the screen, to stand out on the human field of view. It is therefore preferable to eliminate some information around the characters and show just the essential, rather than use wider compositions with many details that can mislead the audience's perception on the television. However, with the appearance of bigger displays over the 42 inches, the HDTV can manage to have wider shots with enough quality and the use of tight shots can be reduced.

In circumstances where the cameraman has to shoot for different aspect ratios it is advisable to be aware about the following information, mainly in the actual period of transition between analog and digital television: When productions need to be screened in 16:9 and the cameras are 4:3 is convenient to increase the headroom because the top and bottom of the frame will be cropped. In addition, if it is known that the production will be shot with 16:9 cameras, but it still will be broadcasted for smaller aspect ratios, it might occur an "inhibition to use the full potential of the 16:9 shape, because the composition has to be all things to all viewers at the same time. It must fit the 14:9 shape but also satisfy the 4:3 viewer. Therefore it is difficult to know when the full potential of the widescreen shape can be utilized"[79]

Another issue about composition on widescreen television is to shoot faces, when the script requires the speaker and the listener to be in the same time on frame. This situation could look, in words of Ward, as a mixture of over the-shoulder, medium close-ups and close-ups. "The shots tighter than MCU can be difficult to frame for 16:9 and the tendency is to continually tighten to lose the 'space' around the ears." [80] However, when the shot has an interview and is necessary to see both the interviewer and the interviewed, it is recommended to frame them not too tight in order to avoid leaving out the interviewer. The solution here is to have and over-the-shoulder two shot, being

[79] Ibid Ward 115
[80] Ibid Ward 115

aware of the reverse shot to keep the continuity in the body postures, illusion of physical separation between characters, and angles of camera.

Composing for 16:9 has the advantage that, when the content of the image has sports, live events of interaction between people and the location; the increase of the quality of the image allows seeing more detail in the wider shots and for composition purposes the framing allows to show less sky or ground. Sometimes it might happen that the cameraman has a good composition in the 16:9 aspect ratio while framing two or more characters closer to the safe zone of the 14:9. But for the smaller ratio, the image tends to look strange, so that some cameraman tend to zoom out and make the frame wider in order to accommodate the characters. However, this movement, which seems to be imperceptible for the smaller aspect ratio, could be noticeable in the wider. In this specific case, according to Ward, it is better to loosen the shot, because no matter that in 14:9 the image looks acceptable, in the 16:9 a small variation will appear, with no particular reason whatsoever.

Other issue concerning the variation of the aspect ratio and the wide screens, is when it is necessary to insert 4:3 or vertical images into a 16:9. This situation is most commonly seen when one needs to include archive material or cellphone videos into actual programs. One of the options that can be used is to letterboxing on the sides. However, the main problem with this insertion of videos is that the variation between those images with letterbox and those without, can be distractive for the 16:9. One of the solutions could be expanding the image in the post-production process to make it fit into 14:9, which means the frame will lose variable proportions of top or bottom of the 4:3 image. But in shots, in which the objects are situated on the limits of the borders, it could be tricky to do this process because the information that the picture is transmitting could disappear. Therefore, another solution that can be considered more appropriate, as several television programs opt to do it, is to expand and to blurr the image or to add motion graphics in the background and in the foreground of the video in its original aspect ratio. (Figure 37)


**Figure 37 Two different programs from the same news channel show the same video, one with motion graphics and cropped (left) and the other with the expanded image with blur on the background (right)** [81]

At present, television has to deal with different platforms like internet or cellphones. These platforms are changing the aspect ratios; internet broadcast of videos is making the necessary changes to fulfill the standards of the HDTV aspect ratios. However, displays like tablets or smartphones are opening the possibility of vertical aspect ratio, keeping the 16:9 but becoming 9:16. This vertical format is also used for special purposes mainly for advertisement billboards or informative videos in public places like airports or mall centers. (Figure 38)

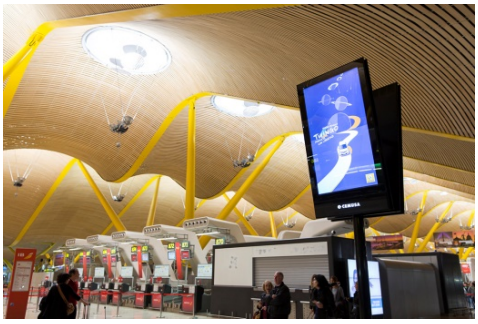

**Figure 38 –** Spanish Airport with vertical Panasonic Display**.**[82]

Regardless of those new technologies and new displays, the predominance of the horizontal wide displays will remain for a long time. The television broadcasting is still on the process to assimilate the technological change of the HDTV and presents,

[81] CNN emisions at 10 am and 3 pm at June 11, 2016. Available in http://edition.cnn.com/2016/06/10/us/dallas-love-field-shooting/index.html and https://www.youtube.com/watch?v=Y7IMITtVeF4 (recovered at august 2016.)
[82]Digital AV magazine, “Aena moderniza las instalaciones publicitarias de los aeropuertos españoles con pantallas de Panasonic” Available in http://www.digitalavmagazine.com/2015/02/18/aena-moderniza-las-instalaciones-publicitarias-de-los-aeropuertos-espanoles-con-pantallas-de-panasonic/ (Recovered in August 2016)

sometimes, problems regarding the interpretation of the artistic, aesthetic and narrative values that aspect ratio has in films. Recently Netflix U.K., a platform of streaming video on-demand changed the aspect ratio of the movie *Mommy*, mentioned above (Please refer to page 44), and expand the frame to fill the screen, this change provoked the complains of many viewers and even a public letter, written by the Director, Xavier Nolan,[83] in which he demanded his movie to be respected and broadcasted in the way he made it. After the pressure, Netflix had to rectify and correct the aspect ratio. (Figure 39)

**Figure 39 –** On the left the Netflix extended image, on the right the shot with the original aspect ratio (See page XX)**.**

According to Ward, Director and cameraman are the only ones who know the original image because they are the ones working with it. Meanwhile, the final display of this image is "in the hands of commerce whose visual dead eye only takes into consideration stars and action, except, of course, when the screen shape is promoted to sell more cinema tickets or to urge consumers to buy new TV receivers."[84]

[83] The content of this letter can be seen in the following link:
https://twitter.com/XDolan/status/684025871867473925/photo/1
[84] Ibid, Ward, 122

## V. Present and nearly future

Today, technological advances on digital images tend to move to wider screens. The sizes of the displays have been growing significantly; the HDTV, which is not implemented around the whole world yet, is also not the best resolution available. New and bigger resolutions have been appearing. The so called beyond high definition technologies or Ultra High Definition (UHD), seem to be the main concern of some manufactures, clearly with the aim of creating systems for the digital film industry and television as well. Most of the camera equipment was destined for covering the 16:9 aspect ratio. However, since high definition appeared, the introduction of bigger sensors allowed to increase the gauge of the cameras, offering systems of 2k, 4k, 6k and 8k. For instance, according to the announcement of NHK at the International Broadcasting Convention celebrated in Amsterdam in 2013, it will be possible to broadcast i 8k resolution in public television by the year 2020, and this year coincides with the 2020 Tokio Olympic Games.

One of the advantages that higher resolution cameras bring to the aspect ratio is that digital cameras are not stuck in the 16:9, conversely the wider sensors give the opportunity to be closer to the sizes that film has. 4K cameras and beyond allow the use of anamorphic lenses and all their potential, so that it's possible to create images with 2.35:1 aspect ratio without compromising the quality of the image. It means that to achieve wider aspect ratio, it is not necessary to cropp the image that much. And even more, there are camera systems like the Alexa 65, Red Weapon 8k, or Ikegami SHK-810, that allow bigger resolution as well as bigger aspect ratios that can be compared with the 65 mm or 70 mm films.

However, 8K resolution is not fully developed yet. Systems like 4k with sensors that can keep a native aspect ratio of 4:3 can be used with anamorphic lenses and have a similar effect of squeezing and unsqueezing the image to get the aesthetical characteristics of this technique. Basically, most of digital sensors have a higher aspect ratio than 35 mm film, so that spherical lenses regularly record enough wide images with minimal cropping or not cropping at all. Using an anamorphic lens sometimes produces

a needlessly high aspect ratio and the sides of the image are not used as well as the horizontal resolution is reduced. That means, that anamorphic lenses just improve image quality when a "higher aspect ratio is needed than (the one) captured by the digital sensor. However, unless the required aspect ratio is unusually large, cropping the image vertically will often preserve more pixels."[85]

For example with a full frame camera like Red Dragon, with a resolution of 6144x3160 which has an aspect ratio of 1.94:1, to achieve a 2.39:1 aspect ratio there would be two options, one by cropping the top and bottom which means to use only 81% of the pixels or to use a 2x anamorphic lens, in that "case the sides of the frame would need to be cropped and only 61% of the pixels would be preserved. One could potentially utilize a less common 1.3X anamorphic lens and preserve 95% of the pixels," but the effect is so subtle that it might not justify its use.

**Figure** 40 Left: Standard digital widescreen. Right: Anamorphic digital Screen.[86]

When the recorded image with anamorphic lenses in digital camera is de-squeezed in the post-production process to achieve the 2.39:1 aspect ratio, the pixels get expanded as well, but the quality loss is almost imperceptible for the viewers, because the image is usually recorded in bigger resolution than the one that will be projected.

[85] "Understanding Anamorphic Lenses," 2016, accessed August 12, 2016, http://www.red.com/learn/red-101/anamorphic-lenses.
[86] Note: Above examples depict the RED DRAGON® digital sensor with 2.39:1 widescreen images. Ibid.

# CONCLUSIONS

Throughout the history of film, the evolution of the shape of screens has been interrelated with economic factors. With the implementation of sizes and standards for film, the introduction of the widescreen cinema, the latest solutions for broadcasting television and the appearance of digital cinema, companies, manufactures and studios have being trying to find solutions that fit into their financial purposes. Still, filmmakers, and especially cinematographers, have found the way to adjust their craft and evolve alongside the new demands of film.

Each existent aspect ratio has its own characteristics, advantages and limitations, and current technology provides a great variety of formats that could enhance the storytelling and produce a particular visual identity for the film, according to the intentions of the filmmaker. The artistic intention of the filmmaker should guide decisions about the selected aspect ratio. The approach to the location, the mise en scene and the composition should be made according to the main idea of the film. For instance, when it is required to shoot an intimate story in which the character's mind or internal conflict is more important than the surroundings, it is common to use smaller aspect ratios; or framing the wider aspect ratio in a way that the subject looks compressed into the image. The idea is to generate the sensation of being in a reduced space either by selecting the aspect ratio or through the composition, in such a way so that spectator could focus his or her attention on the character.

Even so, how to frame in each aspect ratio seems to be a never ending discussion because framing is a subjective decision that depends on many factors. It is important to understand why and how the initial aspect ratio of the movie should be selected, because this choice will affect the visual components of the film and the audience's approach towards it. For example, it would make more sense to select an aspect ratio of 1.77 if the production will be broadcast on HDTV, and the interaction between characters and the location is not the main topic on the movie. While if the main distribution of the film would be in cinema theaters, it is better to use a wider aspect ratio. Furthermore, if the movie would have significant interaction between actors

and space, the mise en scene requires different positions of the elements within the frame, which leads to changes between the depth of field throughout the shoot, and in such cases, it would be better to use 2.35. But if this film should be distributed in HDTV and to Cinemas at the same time, perhaps it would be better to use 1.85, then cinematographer would not have make a compromise which a composition which should work with both, because it would keep the characteristically wide angle that is used in widescreens cinema and in its transfer to 1.77, the loss of the parts of the frame at the bottom and top of the image, will not be significant at all, in case the image will not be letterboxed.

Unfortunately, it has been shown that commercial reasons tend to have more influence than intellectual regarding the control of the correct aspect ratio which would guarantee that the spectators would see the same image as the creators intended. An ideal projection or broadcasting system should allow the audience to see the image without any crops, expansions or aspect ratio different than the frame selected by its author. Framing to numerous aspect ratios at the same time can decrease the production values of a film, the composition will be compromised and this will affect negatively the aesthetics of the film, moreover, viewers could miss important information of it. Instead of being rewarded with a screen that is used in its entirety, the film experience could be spoiled with a smaller image.

Cinematographer and camera operator have the option to check their aspect ratio in the viewfinder; either by the ground glass for film cameras or by the markers inside the viewfinder for digital cameras, both options serves as framing reference for a desire aspect ratio. To warrantee the final product will have the aspect ratio with the correct framing the cinematographer must shot a frame leader, so that the in the post-production process could know the exact size and position of the image.

Definitely framing for 2.35 and 1.85 is not the most advisable option because to go from 2.35 to the 1.85 means a loss of information if the image is cropped or panned and scanned. While if letterbox is used, the size would be smaller, which means the surrounding effect of the size of the screen would change. On the other hand, with 1.85 to 2.35 blow–up, there is a loss in the quality of the film, because the grain will be

expanded. Moreover, it will have two black lines on the sides, which usually can be covered in the projection room by dark curtains, and so, a minor issue.

The nearest future comes with wider and bigger displays, which have better resolution, as well as high quality televisions and home entertainment devices, which somewhat offers the audience the sensation of immersion within the image, which was a concept already presented to the public in the 1950's and still remains in the cinema theaters. Going to the cinema offers to the audience a big screen that is not possible to find in their homes, and surrounding sound systems which increase the sensation of being inside the situation projected on the screen. So, it is possible to affirm that the experience offered in the cinema is not reproducible for customer use at home yet. The size of the image is not big enough to fill the visual field of the spectator, the peripheral vision in a home will notice different elements rather than just the display, so that, in the cinema the peripheral vision will be working for the projected image and together with the stereophonic sound the viewer will get an unique experience. (Peripheral vision moving together with panning sound) Nonetheless, new personal devices and displays could include different approaches to the image through different aspect ratios, therefore opening the possibilities to create new aesthetics, possibly with vertical displays, which even could be as small as a cellphone.

As a matter of fact, the use of aspect ratio should be incorporated into aesthetic approaches towards filmmaking or television production. It should be the task of the authors to enhance their work despite technological reasons, which should use it as a tool to explore and express their craft within the frame. The choice of a particular aspect ratio would respond to the necessities of each story. Now the question that remains is how will productions look once the transition between Standard television and HDTV finish? How will filmmaking and theatrical cinema aspect ratios and coexist with television standard, if the displays become bigger? Are we going to have a new period of wider aspect ratios in the digital era? In any case, it is important for the authors to demand that their choice of aspect ratio is respected, since their choice was made to support the stories' ideas and should not be ignored by film and television industries and manufacturers.

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| Format | Creator | Est. | First known work | Negative gauge | Negative A/R[1] | Gate dims | Negative pulldown | Negative lenses | Projection gauge | Projection A/R[1] | Projection dims | Projection lenses |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chronophotographe**[2] | Étienne-Jules Marey | 1888 | motion analysis studies | 90 mm | 1.00 | 3.543" x 3.543" | unperforated | spherical | | | | |
| **Paperfilm**[3] | Louis Le Prince | 1888 | Roundhay Garden Scene | 54 mm or 63.5 mm | 1.00 | | perforated | spherical | 54 mm or 63.5 mm | 1.00 | | spherical |
| Chronophotographic | Wm. Friese-Greene | 1889 | | 54 mm | | | irregular perfs | spherical | | | | |
| Kinesigraph | Wordsworth Donisthorpe | 1889 | view of Trafalgar Square | 68 mm | 1.00? | | unperforated | spherical | | | | |
| Kinetoscope cylinder | Wm. Dickson & T. Edison | 1889 or 1890 | Monkeyshines, No. 1 | strip rolled around a cylinder | | | unperforated | spherical | strip rolled around a cylinder | | | spherical |
| Kinetoscope horizontal | Wm. Dickson & William Heise | 1891 | Dickson Greeting | 19 mm | | | 1 perf, 1 side, horizontal | spherical | 19 mm, horizontal | | | spherical |
| Silent film standard | Wm. Dickson & T. Edison | 1892 | Blacksmith Scene | 35 mm | 1.33 | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 35 mm | 1.33 | 0.931" x 0.698" | spherical |
| Bioskop | Max Skladanowsky | 1892 | footage of Emil Skladanowsky | 54 mm | | | unperforated (camera); 4 perf, 2 sides | spherical | 54 mm (two strips interleaved) | | | spherical |
| **Acres 70**[4] | Birt Acres | 1894 | The Henley Royal Regatta of 1894 | 70 mm | 1.38 | 2.750" x 2.000" | | spherical | 70 mm | | | spherical |
| **Eidoloscope**[5] | Woodville Latham | 1895 | Griffo-Barnett Prize Fight | 51 mm | 1.85 | 1.457" x 0.787" | 4 perf, 2 sides | spherical | 51 mm | 1.85 | | spherical |
| Cinematographe | Lumière Brothers | 1895 | La Sortie des Usines Lumiere | 35 mm | 1.33 | 0.980" x 0.735" | 1 perf, 2 sides (rounded) | spherical | 35 mm | 1.33 | | spherical |
| Biograph | Herman Casler | 1895 | *Sparring Contest at Canastota* | 68 mm | 1.35 | 2.625" x 1.938" | 1 perf, 2 sides (punched in-camera) | spherical | 68 mm | | | spherical |
| Joly-Normandin | Henri Joly | 1895 | | 60 mm | | | 5 perf, 2 sides | spherical | 60 mm | | | spherical |
| Biographe | Demeny-Gaumont | 1896 | | 60 mm | 1.40 | 1.750" x. 1.250" | unperforated | spherical | 60 mm | 1.40 | | spherical |
| Chronophotographe | Demeny-Gaumont | 1896 | | 60 mm | 1.40 | 1.750" x. 1.250" | 4 perf, 2 sides | spherical | 60 mm | 1.40 | | spherical |
| Sivan-Dalphin | Casimir Sivan and E. Dalphin | 1896 | | 38 mm | | | 2 perf, 2 sides | spherical | 38 mm | | | spherical |
| Veriscope | Enoch Rector | 1897 | The Corbett-Fitzsimmons Fight | 63 mm | 1.66 | 1.875" x 1.125" | 5 perf, 2 sides | spherical | 63 mm | | | spherical |
| Viventoscope | Thomas Henry Blair | 1897 | | 48 mm | 1.50 | 1.500" x 1.000" | 1 perf? | spherical | 48 mm | | | spherical |
| Birtac | Birt Acres | 1898 | unknown (amateur format) | 17.5 mm | | | 2 perf, 1 side | spherical | 17.5 mm | | | spherical |
| Biokam | T. C. Hepworth | 1899 | unknown (amateur format) | 17.5 mm | 1.60 | 0.630" x 0.394" | 1 perf, center | spherical | 17.5 mm | | | spherical |
| Prestwich 13 mm | John Alfred Prestwich | 1899 | unknown (amateur format) | 13 mm | | | | spherical | 13 mm | | | spherical |
| Mirograph | Reulos, Goudeau & Co | 1900 | unknown (amateur format) | 21 mm | | | 1 notch, 2 sides | spherical | 21 mm | | | spherical |
| Lumiere Wide | Lumière Brothers | 1900 | | 75 mm | 1.33 | 2.362" x 1.772" | 8 perf, 2 sides | spherical | 75 mm | 1.33 | | spherical |
| Cinéorama | R. Grimoin-Sanson | 1900 | Cinéorama | 70 mm x 10 cameras (360°) | | | 4 perf? | spherical | 70 mm x 10 projectors (360°) | | | spherical |
| La Petite (Hughes) | W.C. Hughes | 1900 | unknown (amateur format) | 17.5 mm | 1.60 | 0.630" x 0.394" | 1 perf, center (smaller and less rectangular than | spherical | 17.5 mm | | | spherical |
| Pocket Chrono | Gaumont Demeny | 1900 | unknown (amateur format) | 15 mm | | | 1 perf, center | spherical | 15 mm | | | spherical |
| Vitak | William Wardell | 1902 | unknown (amateur format) | no standard | no standard | no standard | 1 perf, center | spherical | 11 mm | | | spherical |
| Home Kinetoscope | Edison | 1912 | unknown (amateur format) | no standard | no standard | no standard | no standard | spherical | 22 mm, 2 perf (on frameline between frame | 1.5 | 0.236" x 0.157" (three frames across width) | spherical |
| Pathe Kok | Pathé | 1912 | unknown (amateur format) | 28 mm | 1.36 | 0.748" x 0.551" | 3 perf on one side, 1 perf on the other | spherical | 28 mm | | | spherical |
| Duoscope | Alexander F. Victor | 1912 | unknown (amateur format) | 17.5 mm | | | 2 perfs, center | spherical | 17.5 mm | | | spherical |
| **Panoramico**[4] | Filoteo Alberini | 1914 | Il sacco di Roma | 70 mm | 2.52 | | 5 perf, 2 sides | spherical | 70 mm | | | spherical |
| Split Duplex | Duplex Corporation | 1915 | | 35 mm | 1.33 | 0.980" x 0.735" | 4 perf, 2 sides (shooting) | spherical | 35 mm | 1.87 | 0.735" x 0.394" | spherical (split image 90° rotated) |
| 11 mm | (American) | 1916 | unknown (amateur format) | 11 mm | | | 1 perf, center | spherical | 11 mm | | | spherical |

Wikipedia (Wikimedia Foundation, 2016), s.v “List of film formats” accessed May 11, 2016, https://en.wikipedia.org/wiki/List_of_film_formats.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movette | Movette Camera Company | 1917 | unknown (amateur format) | 17.5 mm | | | 2 perfs, 2 sides (rounded) | spherical | 17.5 mm | | | spherical |
| 28 mm safety standard | Alexander Victor | 1918 | unknown (amateur format) | 28 mm | 1.36 | 0.748" x 0.551" | 3 perf, 2 sides | spherical | 28 mm | | | spherical |
| Clou | (Austrian) | 1920 | unknown (amateur format) | 17.5 mm | | | 2 perf, 2 sides | spherical | 17.5 mm | | | spherical |
| 26 mm | (French) | 1920 | unknown (amateur format) | 26 mm | | | 1 perf, 1 side | spherical | 26 mm | | | spherical |
| 9.5 mm | Pathé | 1922 | unknown (amateur format) | 9.5 mm | 1.31 | 0.335" x 0.256" | 1 perf, center | spherical | 9.5 mm | 1.31 | 0.315" x 0.242" | spherical |
| Phonofilm | Lee De Forest | 1922 | *Barking Dog* and *Flying Jenny Airplane* | 35 mm | 1.33 | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 35 mm | 1.17 | 0.826" x 0.708" | spherical |
| **Widescope**[6] | John D. Elms & George W. Bingham | 1922 | | 35 mm x 2 (both in same camera) | 1.33 x 2 negatives | 0.980" x 0.735" | 4 perf, 2 sides | spherical (one lens per strip) | 35 mm x 2 projectors | 2.66 | 0.931" x 0.698" | spherical |
| Cinebloc | Ozaphan | 1922 | unknown (amateur format) | 22 mm | | | 2 perf, 2 sides | spherical | 22 mm | | | spherical |
| **Tri-Ergon soundfilm**[6] | Tri-Ergon | 1922 | | 35 mm | 1.33 | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 42 mm | 1.33 | 0.931" x 0.698" | spherical |
| **16 mm**[7] | Eastman Kodak | 1923 | unknown (amateur format) | 16 mm | 1.37 | 0.404" x 0.295" | 1 perf, 1 or 2 sides | spherical | 16 mm | 1.37 | 0.378" x 0.276" | spherical |
| Duplex | G.J. Bradley | 1923 | unknown (amateur format) | 11 mm | | | 2 perf, 2 sides (rounded) | spherical | 11.5 mm | | | spherical |
| Alberini-Hill | Corrado Cerqua | 1924 | | 35 mm | 1.66 | 1.575" x 0.945" (curved) | 10 perf, 2 sides, horizontal | spherical, on 65° revolving | 35 mm | | | spherical |
| Cinelux | Ozaphan | 1924 | unknown (amateur format) | 24 mm | | | | spherical | 24 mm | | | spherical |
| 48 mm | J.H. Powrie | 1924 | | 48 mm | 1.32 | 1.969" x 1.496" | horizontal | spherical | 35 mm | 1.33 | 0.931" x 0.698" | spherical |
| **Natural Vision**[8] | George K. Spoor & P. John Berggren | 1925 | Niagara Falls and Rollercoaster Ride | 63.5 mm | 1.84 | 2.060" x 1.120" | 6 perf, 2 sides, 20 frame/s | spherical | 63.5 mm | 2.00 | | spherical |
| 13 mm | (French) | 1925 | unknown (amateur format) | 13 mm | | | 4 perf, center | spherical | 13 mm | | | spherical |
| 18 mm | (Russian) | 1925 | unknown (amateur format) | 18 mm | | | 1 perf, 2 sides | spherical | 18 mm | | | spherical |
| Pathe Rural | Pathé | 1926 | unknown (amateur format) | 17.5 mm | 1.35 (silent); 1.30 | 0.516" x 0.382" (silent); | 1 perf, 2 sides | spherical | 17.5 mm | 1.33 (silent); 1.26 (sound) | 0.472" x 0.354" (silent); 0.445" x 0.343" (sound) | spherical |
| **Widevision**[6] | John D. Elms & George W. Bingham | 1926 | Natural Vision Pictures | 57 mm | | | 5 perf, 2 sides | spherical | 57 mm | | | spherical |
| **Magnascope**[4] | Lorenzo del Riccio | 1926 | Old Ironsides | 35 mm | 1.33 | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 35 mm | 1.33 | 0.931" x 0.698" | spherical (selected scenes |
| **Fox Movietone** | F. H. Owens, T. Case, Tri-Ergon | 1927 | Sunrise | 35 mm | 1.33 | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 35 mm | 1.17 | 0.826" x 0.708" | spherical |
| **Polyvision**[9] | Abel Gance | 1927 | Napoléon | 35 mm x 3 cameras | 1.33 x 3 negatives | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 35 mm x 3 projectors | 4.00 | 0.931" x 0.698" | spherical |
| Hypergonar | Henri Chrétien | 1927 | Pour construire un feu | 35 mm | 2.66 | 0.980" x 0.735" | 4 perf, 2 sides | 2x anamorphic | 35 mm | 2.66 | 0.931" x 0.698" | 2x anamorphic |
| **Magnafilm**[10] | Lorenzo del Riccio | 1929 | You're in the Army Now | 56 mm | 2.19 | 1.620" x 0.740" | 4 perf, 2 sides | spherical | 56 mm | 2.00 | | spherical |
| **Fox Grandeur**[10] | Fox Film Corporation | 1929 | Fox Grandeur News and Fox Movietone Follies | 70 mm | 2.07 | 1.890" x 0.913" | 4 perf, 2 sides, 20 frame/s (before 1930) | spherical | 70 mm | 2.00 | 1.768" x 0.885" | spherical |
| **Fearless Super Pictures**[11] | Ralph G. Fear | 1929 | | 35 mm | 2.27 | 1.813" x 0.800" | 10 perfs, 2 sides, horizontal | spherical | 35 mm, horizontal | | | spherical |
| **Fearless Super-Film / Magnifilm / Fox Vitascope**[12] | Ralph G. Fear | 1930 | Kismet | 65 mm | 2.00 | 1.811" x 0.906" | 5 perf, 2 sides | spherical | 65 mm | 2.05 | 1.772" x 0.866" | spherical |
| **Realife**[11] | MGM | 1930 | Billy the Kid | 70 mm | 2.07 | 1.890" x 0.913" | 4 perf, 2 sides | spherical | 35 mm | 1.75 | 0.904" x 0.517" | spherical |
| **50 mm**[13] | Fox Film Corporation & SMPE | 1930 | | 50 mm | 1.80 | 1.325" x 0.735" | | spherical | 50 mm | 1.80 | 1.305" x 0.725" | spherical |
| 17 mm sound | (French) | 1930 | unknown (amateur format) | 17 mm | | | 1 perf, 1 side | spherical | 17 mm | | | spherical |
| Giant Expanding Pictures | George Palmer | 1930 | | 35 mm | 1.33 | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 35 mm | 1.17 | 0.826" x 0.708" | spherical (with a special |
| Kodel Kemco Homovie | Clarence Ogden | 1931 | unknown (amateur format) | 16 mm | | 4 sequential images per frame | 1 perf, 2 sides | spherical | 16 mm | | | spherical |
| **Academy format**[14] | AMPAS | 1932 | | 35 mm | 1.375 (commonly | 0.868″ × 0.631″ | 4 perf, 2 sides | spherical | 35 mm | 1.37 | 0.825″ × 0.600″ | spherical |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 mm | Eastman Kodak | 1932 | unknown (amateur format) | 16 mm | 1.32 | 0.192" x 0.145" | 1 perf, 1 side (using 16 mm film with twice as | spherical | 8 mm | 1.33 | 0.172" x 0.129" | spherical |
| **Straight 8** | Bell & Howell | 1935 | unknown (amateur format) | 8 mm | 1.32 | 0.192" x 0.145" | 1 perf, 1 side | spherical | 8 mm | 1.33 | 0.172" x 0.129" | spherical |
| Vitarama | Fred Waller | 1939 | | 16 mm x 11 cameras | 1.37 x 11 negatives | 0.404" x 0.295" | 1 perf, 2 sides | spherical | 16 mm x 11 projectors | hemispherical view | 0.378" x 0.276" | spherical |
| Waller Flexible Gunnery Trainer | Fred Waller | 1943 | US Air Force interactive training exercise | 35 mm x 5 cameras | 1.37 x 5 negatives | 0.866" x 0.630" | 4 perf, 2 sides | spherical | 35 mm x 5 projectors | hemispherical view | 0.825" x 0.602" | spherical |
| **Cinerama**[15] | Fred Waller | 1952 | This is Cinerama | 35 mm x 3 cameras | 2.59 (3 x negatives) | 0.996" x 1.116" | 6 perf, 2 sides at 26 frame/s | spherical | 35 mm x 3 projectors, with 6 perf | 2.59, with 146° curved screen | 0.985" x 1.088" | spherical |
| **Matted 1.66**[14] | Paramount | 1953 | Shane | 35 mm | 1.37 | 0.866" x 0.630" | 4 perf, 2 sides | spherical | 35 mm | 1.66 | 0.825" x 0.497" | spherical |
| **Matted 1.85**[14] | Universal | 1953 | Thunder Bay | 35 mm | 1.37 | 0.866" x 0.630" | 4 perf, 2 sides | spherical | 35 mm | 1.85 | 0.825" x 0.446" | spherical |
| Matted 1.75 | MGM | 1953 | Arena | 35 mm | 1.37 | 0.866" x 0.630" | 4 perf, 2 sides | spherical | 35 mm | 1.75 | 0.825" x 0.471" | spherical |
| **Cinemascope**[16] | 20th Century Fox | 1953 | The Robe | 35 mm | 2.55 (1953–57); 2.35 | 0.937" x 0.735" (1953–57); | 4 perf, 2 sides | 2x anamorphic | 35 mm | 2.55 (1953–57); 2.35 | 0.912" x 0.715" (1953–57); 0.839" x 0.715" (1957–67) | 2x anamorphic |
| **Arnoldscope**[17] | John Arnold | 1953 | | 35 mm | | | 10 perf, 2 sides, horizontal | spherical | | | | |
| **VistaVision**[18] | Paramount | 1954 | White Christmas | 35 mm | 1.51 | 1.495" x 0.991" | 8 perf, 2 sides, horizontal | spherical | 35 mm, 4 perf, vertical | 1.85 | 0.825" x 0.446" | spherical |
| **VistaVision Large Area**[18][19] | Paramount | 1954 | White Christmas | 35 mm | 1.51 | 1.495" x 0.991" | 8 perf, 2 sides, horizontal | spherical | 35 mm, 8 perf, horizontal | 1.96 | 1.418" x 0.723" | spherical |
| **Superscope**[20] | Tushinsky Brothers | 1954 | Vera Cruz | 35 mm | 1.33 | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 35 mm | 2.00 | 0.715" x 0.715" | 2x anamorphic |
| **Circarama**[21] | Disney | 1955 | A Tour of the West | 16 mm x 11 cameras | 1.37 x 11 negative | 0.404" x 0.295" | 1 perf, 2 sides | spherical | 16 mm x 11 projectors | 360° | 0.378" x 0.276" | spherical |
| **Todd-AO**[22][23] | Michael Todd | 1955 | Oklahoma | 65 mm | 2.29 | 2.072" x 0.906" | 5 perfs, 2 sides, at 30 frame/s | spherical | 70 mm | 2.21, with 120° curved screen | 1.912" x 0.870" | spherical |
| **CinemaScope 55**[24] | 20th Century Fox | 1955 | Carousel | 55 mm | 2.55 | 1.824" x 1.430" | 8 perfs, 2 sides | 2x anamorphic | 35 mm | 2.55 | 0.912" x 0.715" | 2x anamorphic |
| **9.5 Duplex**[25] | Pathé Fréres | 1955 | ? | 9.5 mm | 1.51 | 4.1 mm x 6.2 mm | 2 central perforations in a 9.5mm film | spherical | 4.75 mm | | | spherical, rotated 90° |
| **8 mm Panoramic**[26] | Dimaphot, Paris | 1955 | ? | 16 mm | 1.5 | 5 mm x 7.5 mm | 1 perf, 2 sides | spherical | 8 mm | | | spherical, rotated 90° |
| **Emel Panoscope**[27] | Emel, Paris | 1955 | ? | 16 mm | 2.7 | 3.5 mm x 9.6 mm | 2 perf, 2 sides | spherical | 16 mm | | | spherical |
| **Technirama**[28] | Technicolor | 1956 | The Monte Carlo Story | 35 mm | 2.26 | 1.496" x 0.992" | 8 perf, 2 sides, horizontally | 1.5x anamorphic | 35 mm, 4 perf vertical | 2.35 | 0.839" x 0.715" | 2x anamorphic |
| **Technirama Large Area**[28] | Technicolor | 1956 | The Monte Carlo Story | 35 mm | 2.26 | 1.496" x 0.992" | 8 perf, 2 sides, horizontally | 1.5x anamorphic | 35 mm, 8 perf horizontal | 2.42 | 1.421" x 0.881" | 1.5x anamorphic |
| **Dynamic Frame**[29] | Glenn Alvey | 1956 | The Door in the Wall | 35 mm | 1.3, 1.6, and 2.5 | variable aperture plates | 8 perf, 2 sides, horizontally | spherical | 35 mm, 4 perf, vertical | 1.3, 1.5, and 2.5 | | spherical |
| **Superscope 235**[20] | Superscope Inc. | 1956 | Run for the Sun | 35 mm | 1.33 | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 35 mm | 2.35 | 0.839" x 0.715" | 2x anamorphic |
| **Thrillarama**[30] | Albert H. Reynolds | 1956 | Thrillarama Adventure | 35 mm x 2 cameras | 1.78 x 2 negatives | | 3 perf, 2 sides? | spherical | 35 mm x 2 projectors | 3.55, with a curved screen | | spherical |
| **Magirama**[9] | Abel Gance | 1956 | Magirama | 35 mm x 3 cameras (sides bounced off | 1.33 x 3 negatives | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 35 mm x 3 projectors (sides bounced | 4.00 | 0.931" x 0.698" | spherical |
| MGM Camera 65 | Panavision | 1957 | Raintree County | 65 mm | 2.76 | 2.072" x 0.906" | 5 perf, 2 sides | 1.25x anamorphic | 70 mm | 2.76 | 1.912" x 0.870" | 1.25x anamorphic |
| **Ultra Panavision**[31] | Panavision | 1962 | Mutiny on the Bounty | 65 mm | 2.76 | 2.072" x 0.906" | 5 perf, 2 sides | 1.25x anamorphic | 70 mm | 2.76 | 1.912" x 0.870" | 1.25x anamorphic |
| **Cinestage**[32] | Mike Todd | 1957 | Around the World in 80 Days | 65 mm | 2.29 | 2.072" x 0.906" | 5 perfs, 2 sides | spherical | 35 mm (1 mm shaved off for UK prints) | 2.12 | 0.912" x 0.675" | 1.567x anamorphic |
| Rank VistaVision | J. Arthur Rank Organization | 1957 | | 35 mm | 1.51 | 1.495" x 0.991" | 8 perf, 2 sides, horizontally | spherical | 35 mm, 4 perf, vertical | 1.82 | 0.825" x 0.602" | 1.33x anamorphic |
| **Modern anamorphic**[33] | Panavision | 1958 | The Female Animal | 35 mm | 2.37 | 0.866" x 0.732" | 4 perf, 2 sides | 2x anamorphic | 35 mm | 2.35 (1957–70); 2.39 | 0.839" x 0.715" (1957–70); 0.838" x 0.7" (1970–93); 0.825" x 0.690" | 2x anamorphic |
| **Kinopanorama**[34] | NIKFI | 1958 | Great Is My Country | 35 mm x 3 cameras | 0.91 x 3 negatives | 1.014" x 1.116" | 6 perf, 2 sides, at 25 frame/s | spherical | 35 mm x 3 projectors | 2.72 | 0.985" x 1.088" | spherical |
| **70 mm**[22][35] | American Optical Company | 1958 | South Pacific | 65 mm | 2.28 | 2.066" x 0.906" | 5 perfs, 2 sides | spherical | 70 mm | 2.21 | 1.912" x 0.87" | spherical |
| **Cinemiracle**[36] | National Theatres | 1958 | Windjammer | 35 mm x 3 cameras (sides bounced off | 0.89 x 3 negatives | 0.996" x 1.116" | 6 perf, 2 sides at 26 frame/s | spherical | 35 mm x 3 projectors (sides bounced | 2.59, with 120° curved screen | 0.985" x 1.088" | spherical |
| **Super Technirama**[28] | Technicolor | 1959 | Sleeping Beauty | 35 mm | 2.26 | 1.496" x 0.992" | 8 perf, 2 sides, horizontally | 1.5x anamorphic | 70 mm | 2.21 | 1.912" x 0.816" | spherical |
| **Smith-Carney** | Rowe F. Carney Jr. and Tom F | | Missouri | | | 0.839" x | | spherical x | | | three sub-frames projected to | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Smith-Carney System**[37] | Rowe E. Carney Jr. and Tom F. Smith | 1959 | Missouri travelogue | 35 mm | 4.69 | 0.370" (bottom | 4 perf, 2 sides | spherical x 3 | 35 mm | 4.69 | three sub-frames projected to one 180° image | spherical x 3 |
| **Circular Kinopanorama / Circlorama**[38] | E. Goldovsky | 1959 | The Path of Spring | 35 mm x 11 cameras | 1.37 x 11 negative | 0.866" x 0.630" | 4 perf, 2 sides | spherical | 35 mm x 11 projectors | 360° | 0.825" x 0.602" | spherical |
| **Varioscope**[39] | Jan Jacobsen | 1959 | Flying Clipper | 65 mm | 2.28 | 2.066" x 0.906" | 5 perfs, 2 sides | spherical | 70 mm | variable framing run through | 1.912" x 0.87" | spherical |
| **Quadravision**[40] | Ford Motor Company | 1959 | *Design for Suburban Living* showtent | ? mm x 4 cameras | ? x 4 negatives | | | spherical | ? mm x 4 projectors | ? (4 images in 2x2 configuration) | | spherical |
| **Techniscope**[41] | Technicolor | 1960 | The Pharaoh's Woman | 35 mm | 2.33 | 0.868" x 0.373" | 2 perf, 2 sides | spherical | 35 mm | 2.39 | 0.838" x 0.7" | 2x anamorphic |
| **Wonderama (Arc 120)**[42] | Leon W. Wells | 1960 | Honeymoon | no standard | no standard | no standard | no standard | no standard | 35 mm | 2.50 with a 120° curved screen | 0.931" x 0.698", with two half-images turned 90° and placed side-by-side | spherical x 2 |
| **Cine System 3**[43][44] | Eric Berndt | 1960 | USAF and NASA usage | 3 mm | | | 1 perf, centered | spherical | | | | |
| **Grandeur 70**[45] | 20th Century Fox | 1961 | The King and I (re-release) | 55 mm | 2.55 | 1.824" x 1.430" | 8 perfs, 2 sides | 2x anamorphic | 70 mm | 2.21 | 1.912" x 0.87" | spherical |
| **Cinerama 360**[42] | Cinerama Corporation | 1962 | Journey to the Stars | 65 mm | 1.00 (circle) | 2.25" diameter circular | 10 perf, 2 sides | fisheye | 70 mm | 1.00 (circle) | 2.25" diameter circular image | spherical |
| Super 8 | Eastman Kodak | 1965 | unknown (amateur format) | 8 mm | 1.48 | 0.245" x 0.166" | 1 perf, 1 side | spherical | 8 mm | 1.36 | 0.215" x 0.158" | spherical |
| **Real Sound**[46] | Kenner | 1965 | | no standard | no standard | no standard | 1 perf, 1 side | spherical | 11.5 mm | 1.33 | 0.172" x 0.129" | spherical |
| **Double Super 8**[47] | Eastman Kodak | 1965 | unknown (amateur format) | 16 mm | 1.48 | 0.245" x 0.166" | 1 perf, 1 side (using 16 mm film with twice as | spherical | 8 mm | 1.36 | 0.215" x 0.158" | spherical |
| **Single-8**[48] | Fujifilm | 1966 | unknown (amateur format) | 8 mm | 1.36 | 0.224" x 0.164" | 1 perf, 1 side | spherical | 8 mm | 1.35 | 0.213" x 0.157" | spherical |
| **Dimension 150**[49] | American Optical Company | 1966 | The Bible: In the Beginning | 65 mm | 2.28 | 2.066" x 0.906" | 5 perfs, 2 sides | spherical | 70 mm | 2.21, with 150° curved screen | 1.912" x 0.87", optically curved to compensate for the screen | spherical |
| **Circle Vision 360**[38] | Disney | 1967 | America the Beautiful | 35 mm x 9 cameras | 1.37 x 9 negatives | 0.866" x 0.630" | 4 perf, 2 sides | spherical | 35 mm x 9 projectors | 360° | 0.825" x 0.602" | spherical |
| **8.75 mm**[50] | Shanghai Film Projection Equipment Factory | 1968 | unknown (amateur format) | | | | 1 perf | spherical | 8.75 mm | | | spherical |
| Astrovision[51] | Goto Optical | 1969 | | 65 mm | | | 10 perf, 2 sides | spherical or fish-eye | 70 mm | | | fish-eye (dome projection) |
| **IMAX**[52] | IMAX Corporation | 1970 | Tiger Child | 70 mm | 1.34 | 2.772" x 2.072" | 15 perf, 2 sides, horizontally | spherical | 70 mm, horizontal | 1.31 | 2.692" x 2.056" | spherical |
| **Super 16 mm film**[7] | Rune Ericson | 1970 | Blushing Charlie | 16 mm | 1.66 | 0.493" x 0.292" | 1 perf, 1 side | spherical | no standard, but often blown up to 35 | no standard | 0.463" x 0.279" (full frame); 0.463" x 0.251" (framed for 1.85) | spherical |
| **Pik-a-Movie**[53] | Leon W. Wells | 1972 | | no standard | no standard | no standard | no standard | no standard | 70 mm, horizontal, 1 perf, 2 sides | 1.48 | 0.245" x 0.166", 12 rows high, underneath 12 rows of optical sound | spherical |
| **OMNIMAX**[54] | IMAX Corporation | 1973 | Garden Isle | 70 mm | 1.34 | 2.772" x 2.072" | 15 perf, 2 sides, horizontally | special fish-eye lenses optically | 70 mm, horizontal | 1.31 | 2.692" x 2.056" | spherical, projected elliptically on |
| **8/70 (Dynavision, Iwerks 870)**[55] | Dynavision | 1973? | | 65 mm | 1.37 | 2.031" x 1.484" | 8 perf, 2 sides, 24 or 30 frame/s | spherical | 70 mm | 1.34 | 1.913" x 1.431" | spherical |
| **Showscan**[56] | Douglas Trumbull | 1978 | Night of Dreams | 65 mm | 2.28 | 2.066" x 0.906" | 5 perfs, 2 sides, at 60 frame/s | spherical | 70 mm, at 60 frame/s | 2.21 | 1.912" x 0.87" | spherical |
| **Polavision**[57] | Polaroid Corporation | 1978 | unknown (amateur format) | 8 mm | 1.48 | 0.245" x 0.166" | 1 perf, 1 side | spherical | 8 mm | 1.36 | 0.215" x 0.158" | spherical |
| **Cinema 180**[58] | Omni Films | 1979 | Crazy Wheels | 65 mm | 2.28 | 2.066" x 0.906" | 5 perfs, 2 sides, 30 frame/s | fisheye | 70 mm | 180°, on a dome | 1.912" x 0.87" | fisheye |
| **Super 35**[59] | Joe Dunton | 1982 | Dance Craze | 35 mm | 1.33 | 0.980" x 0.735" | 4 perf, 2 sides | spherical | 35 mm | no standard | no standard | no standard |
| **Circle Vision 200**[60] | Disney | 1982 | Impressions de France | 35 mm x 5 cameras | 1.37 x 5 negatives | 0.866" x 0.630" | 4 perf, 2 sides | spherical | 35 mm x 5 projectors | 6.85, on a 200° screen | 0.825" x 0.602" | spherical |
| **Swissorama 360 / Imagine 360**[61] | Ernst A. Heiniger | 1984 | Impressions of Switzerland | 65 mm | 360° | 1.91" (outer edge), | 10 perf, 2 sides | 360° x 35° extreme fisheye | 70 mm | 360° | | 360° x 35° extreme fisheye |
| **Super Duper 8 / Max 8 / Super 8B**[62][63] | Mitch Perkins & Greg Miller | mid-1980s | Sleep Always (2002) | 8 mm | 1.51 | 0.250" x 0.166" | 1 perf, 1 side | spherical | 8 mm | no standard | no standard | spherical |
| **3-perf**[64] | Rune Ericson | 1987 | Pirates of the Lake | 35 mm | 1.79 | 0.980" x 0.546" | 3 perf, 2 sides | spherical | 35 mm | no standard | no standard | no standard |
| **Super VistaVision**[65] | Paramount | 1989 | The Ten Commandments (re-release) | 35 mm | 1.51 | 1.495" x 0.991" | 8 perf, 2 sides, horizontal | spherical | 70 mm | 2.21 | 1.912" x 0.87" | spherical |
| **Kinoton HDFS**[66] | Kinoton | 1990 | | no standard | no standard | no standard | no standard | no standard | 35 mm | 2.00 | 0.931" x 0.698" | 1.5x anamorphic |
| **IMAX Magic Carpet**[67] | IMAX Corporation | 1990 | Flowers in the Sky | 70 mm x 2 cameras | 1.34 | 2.772" x 2.072" | 15 perf, 2 sides, horizontally | spherical | 70 mm, horizontal x 2 projectors | 1.31 x 2 screens (one in front, one | 2.692" x 2.056" | spherical |
| **Iwerksphere**[68] | Iwerks | 1991 | | 65 mm | 1.37 | 2.031" x 1.484" | 8 perf, 2 sides, 24 or 30 frame/s | fisheye | 70 mm | 1.34 | 1.913" x 1.431" | fisheye |
| **IMAX HD**[69] | IMAX Corporation | 1992 | Asteroid Adventure | 70 mm | 1.34 | 2.772" x 2.072" | 15 perf, 2 sides, horizontally, 48 | spherical | 70 mm, horizontal | 1.31 | 2.692" x 2.056" | spherical |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Adventure | | | | frame/s | | horizontal | | | |
| **Hexiplex** [70] | (Australian) | 1992 | Expo '92 demo | 35 mm x 6 cameras | 1.37 x 6 negatives | 0.866" x 0.630" | 4 perf, 2 sides | spherical | 35 mm x 6 projectors | 360°, with rotating screens and | 0.825" x 0.602" | spherical |
| **Ultra Toruscope** [71] | Mac McCarney | 1992 | | 35 mm x 3 cameras | 1.37 x 3 negatives | 0.866" x 0.630" | 4 perf, 2 sides, at 30 frame/s | spherical | 70 mm x 3 projectors, at 30 frame/s | 360° | 1.912" x 0.87" | spherical |
| **Imagination FX 7012** [13] | Geo-Odyssey | 1992? | | 35 mm | 2.08 | 2.040" x 0.980" | 12 perf, 2 sides, horizontal | spherical | 70 mm | 2.21 | 1.912" x 0.87" | spherical |
| **Univisium** [72] | Vittorio Storaro | 1998 | Tango | 35 mm | 2.00 | 0.945" x 0.472" | 3 perf, 2 sides at 25 frame/s | spherical | 35 mm | 2.00 | | spherical |
| **Maxivision** [73] | Dean Goodhill | 1999 | | 35 mm | 1.79 | 0.980" x 0.546" | 3 perf, 2 sides | spherical | 35 mm, 3 perf | 1.85 | | spherical |
| **Maxivision 48** [73] | Dean Goodhill | 1999 | | 35 mm | 1.79 | 0.980" x 0.546" | 3 perf, 2 sides, 48 frame/s | spherical | 35 mm, 3 perf, 48 frame/s | 1.85 | | spherical |
| **Super Dimension 70** [74] | Robert Weisgerber | 1999 | | 65 mm | 2.28 | 2.066" x 0.906" | 5 perfs, 2 sides, at 48 frame/s | spherical | 70 mm, at 48 frame/s | 2.21 | 1.912" x 0.87" | spherical |
| **FuturVision 360** [51] | | | | 65 mm | 1.52 | 2.066" x 0.906" | 5 perfs, 2 sides, 30 frame/s | 1.5x vertical anamorphic | 70 mm | 1.47 | 1.912" x 0.87" | 1.5x vertical anamorphic |
| **Mini-Max** [75] | Vistascope | | | 35 mm | 2.66 | | 2 perf, 2 sides, 30 frame/s | spherical | 35 mm | 2.66 | | spherical |
| **MotionMaster** [76] | Omni Films | | | 65 mm | 2.28 | 2.066" x 0.906" | 5 perfs, 2 sides, 30 frame/s | spherical | 70 mm | 2.21, on a curved screen | 1.912" x 0.87" | spherical |
| **Row-film** [77] | R. Thun | | | 35 mm | | 20 rows of images wide | | spherical | | | | spherical |
| **Septorama** [51] | | | | ? mm x 7 cameras | 1.33 x 7 negatives | | | spherical | ? mm x 7 projectors | hemispherical view | | spherical |
| **Single Cinerama** [78] | Fred Waller | | | 35 mm | | curved gate | 16 perf, 2 sides, horizontal | spherical | 35 mm, horizontal | curved screen | | spherical |
| **Soviet 10** [79] | | | | 65 mm | | | 10 perf, 2 sides | 2x anamorphic | 70 mm | 2.09 | 1.890" x 1.811" | 2x anamorphic |
| **Vario-35** [79] | | | | 35 mm | | | | spherical | 35 mm | variable framing run through | 0.835" x 0.713" (full); 0.835" x 0.453" (1.84); 0.709" x 0.524" (1.35); 0.614" x 0.614" (1.00); | spherical |
| **Vario-35A** [79] | | | | 35 mm | | | | | 35 mm | variable framing run through | 0.835" x 0.713" | variable anamorphic (2x for 2.35; |
| **Vario-70** [79] | | | | 65 mm | | | 10 perfs, 2 sides | spherical | 70 mm | variable framing run through | 1.890" x 1.811" (full); 1.890" x 0.803" (2.35); 1.673" x 0.906" (1.85); 1.441" x 1.051" (1.37); | spherical |
| **Format** | **Creator** | **Est.** | **First known work** | **Negative gauge** | Negative A/R[1] | **Gate dims** | **Negative pulldown** | **Negative lenses** | **Projection gauge** | Proj. A/R[1] | **Projection dims** | **Projectio** |