

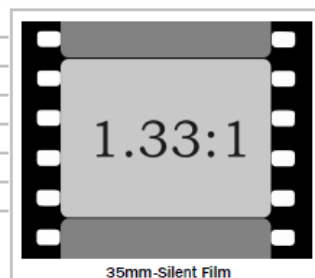
Film Format Guide

From, www.dvdlog.de

Silent Film

Years:	1893 - ca. 1932
Aspect Ratio:	1.33:1
Camera & Projection Lens:	spherical
Full Aperture Size:	0.980" x 0.735" (24.9 x 18.7 mm)
Used Aperture Size:	0.980" x 0.735" (24.9 x 18.7 mm)
Running Speed:	16 - 24 Frames per Second
Sound:	none

35mm silent film has its roots in the early Kinetoscope-experiments of Thomas Edison, who already used a film strip around 1890 which was nearly identical to the 35mm-filmstock in use today and despite some competition became a worldwide standard.

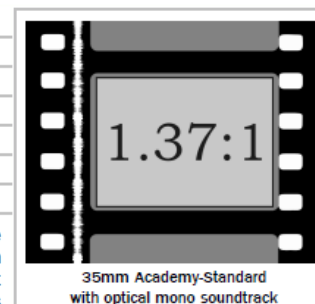


The frame of the early silent movies had a height of four sprocket holes and the whole exposed frame was usually projected. The running speed was variable, because early movie cameras had no motors and were powered by a hand crank. This resulted in speeds between 16 and 25 frames per second, so that many movies from this period look strange today, because they are being shown at too high speeds. Today during restorations of silent movies it is often ensured that the correct running speed is used.

Academy-Standard

Years:	1932 - 1952 (sometimes until today)
Aspect Ratio:	1.37:1
Camera & Projection Lens:	spherical
Full Aperture Size:	0.864" x 0.630" (21.9 x 16.0 mm)
Used Aperture Size:	0.825" x 0.602" (21.0 x 15.3 mm)
Speed:	24 Frames per Second
Sound:	Analog Optical Mono

With the introduction of optical sound at the end of the 1920s the size of the movie frame had to be modified to include the soundtrack on the film strip. Early talkies put the optical soundtrack simply on the left side of the frame, which resulted in a nearly square picture with an aspect ratio of about 1.19:1. To compensate for this, the height of the frame was reduced and an aspect ratio of 1.37:1 was created.



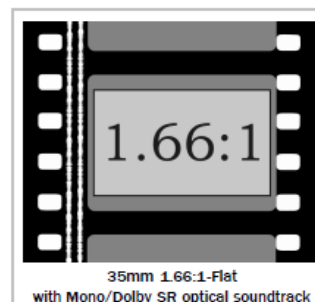
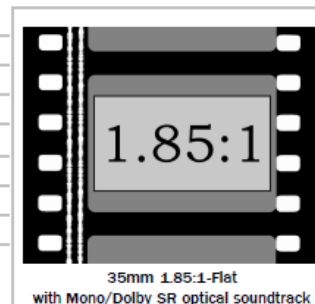
The wider format also provided more space between the individual frames, so that splices were less visible. The modified format was standardized by the American Academy of Motion Picture Arts and Sciences in 1932, but had already been in use since about 1928. The Academy Standard had been used for nearly all movies produced between 1932 and 1952 until the breakthrough of the many widescreen-formats and is still sometimes in use today for artistic reasons.

Flat Widescreen

Years:	since 1953
Aspect Ratio:	1.66:1 - 1.85:1
Camera & Projection Lens:	spherical
Full Aperture Size:	0.864" x 0.630" (21.9 x 16.0 mm)
Used Aperture Size 1.66:1:	0.825" x 0.491" (21.0 x 12.7 mm)
Used Aperture Size 1.85:1:	0.825" x 0.446" (21.0 x 11.3 mm)
Speed:	24 Frames per Second
Sound:	Analog Optical (Mono/Dolby Surround) and/or Dolby Digital, DTS, SDDS

With the surprising success of Cinerama in 1952 all movie studios were under huge pressure to develop their own movie formats for an image as wide as possible. The easiest and cheapest method was to crop the 1.37:1-frame of the Academy-Standard on the top and bottom and project the resulting wider image on a larger screen. While 20th Century Fox used the anamorphic CinemaScope process, other studios hesitated to make costly investments and chose to use these "flat" formats. Paramount experimented with 1.66:1 as early as 1953, MGM and Disney tried 1.75:1 and other studios followed with 1.85:1, which later became the american standard for flat widescreen formats. In Europe 1.66:1 was mostly used, but has also been succeeded by 1.85:1 since the 1970s.

During production usually the whole 1.37:1-negative is exposed, but the image composition is already arranged for a wider aspect ratio, making sure that the unused parts on the top and bottom of the frame are free of unwanted objects like microphones or cables. The "matte" is inserted during postproduction or sometimes left off altogether, so that the cropping only occurs during projection ("soft matte"). Occasionally the matte is inserted directly in the camera during shooting ("hard matte") and is already present on the negative, but sometimes even finished release prints have an aspect ratio of 1.37:1 with instructions for the projectionist to use a certain matte when showing the movie. The digital intermediate technique makes this a rare occasion today, because a digitally edited movie is usually rendered only in its target aspect ratio and can only be printed back to film as hard-matted.



CINEMASCOPE

Years	1953 - 1967
Aspect Ratio	2.55:1 / 2.35:1
Camera & Projection Lens:	Anamorphic 2x
Full Aperture Size:	0.937" x 0.735" (23.8 x 18.7 mm) / 0.868" x 0.735" (22.0 x 18.7 mm)
Used Aperture Size:	0.912" x 0.715" (23.2 x 18.2 mm) / 0.839" x 0.700" (21.3 x 17.9 mm)
Speed:	24 Frames per Second
Sound:	Analog Optical Mono and/or 4-Track-Magnetic

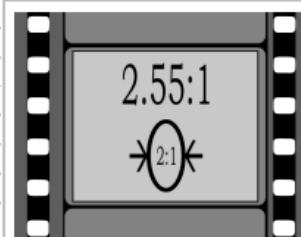
When Cinerama made the big motion picture corporations go into panic mode in 1952, 20th Century Fox bought the Anamorphoscope process from the French inventor Henri Chrétien, who had already patented his hypergonar lenses in the 1920s. The first movie shot with these new lenses was *The Robe*, whose production had already begun in the Academy Ratio, but was started over in favour of CinemaScope. With the exception of Paramount, who used VistaVision, nearly all big studios licensed the CinemaScope-process from Fox in the following years.

CinemaScope is based on the principle of anamorphic film, which squeezes the picture horizontally by a factor of 2:1 during the exposure with a special lens and expands it with a similar lens during projection. This results in an aspect ratio of 2.66:1, which was reduced to 2.55:1 in the early CinemaScope-version by adding magnetic soundtracks on the sides of the frame. The early Cinemascope-prints also had smaller, nearly square sprocket holes called "fox holes" to accommodate the four magnetic soundtracks on the film strip. When an optical soundtrack was added, the aspect ratio was reduced to 2.35:1 and on demand of the other studios cheaper prints only with optical sound and normal sprocket holes were allowed.

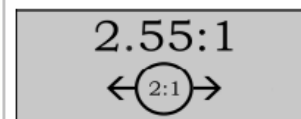
Early CinemaScope had some drawbacks. The worst was an imperfection in the lenses made by Bausch & Lomb, which had problems with deep focus and distortion. This mainly showed up on close-ups, which were entirely avoided on early CinemaScope productions to work around the so-called "CinemaScope Mumps". Bad projection quality, high grain and pale colours were some points of criticism, which were mainly caused by imperfect optics and bad film stock. This however only showed up on the release prints and not the negatives, so it was possible to make better prints after a few years, when the problems had been fixed.

In 1955 20th Century Fox tried to compete with the large-negative 65/70mm-formats and developed CinemaScope 55, which used a 55mm wide negative with a huge, eight sprocket holes high frame anamorphically squeezed in the 2:1 ratio. Shot with modified 70mm-cameras, the originally planned 55mm-release prints were never made because there was no way to project them - instead 35mm-CinemaScope-reduction prints with an aspect ratio of 2.55:1 were made from the 55mm-negative. With *The King and I* and *Carousel* only two movies were filmed in this process, afterwards it was given up by Fox because of the complicated lens systems in favour of Todd-AO, in which the studio bought a share. In the early 1960s Fox made 70mm prints of *The King and I* advertising them under the name Grandeur 70, while 35mm-prints were released as CinemaScope 55.

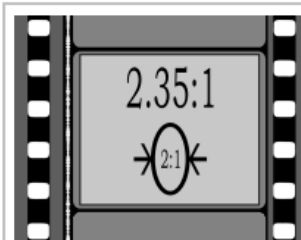
Under different names like Franscope, Tohoscope or Ultrascope and others CinemaScope-compatible anamorphic film processes were used in many countries, because 20th Century Fox owned the patent on their own Bausch & Lomb lenses, but not on the general process. Since 1957 the old CinemaScope camera lenses have slowly been replaced by improved models manufactured by Panavision, who became the market leader in the 1960s. 20th Century Fox continued to use their own CinemaScope-lenses until 1967, when the studio also switched to Panavision equipment. Although today CinemaScope itself is not in use anymore, the name has become a synonym for all anamorphic film processes and is sometimes used by 20th Century Fox as a trademark for nostalgic reasons.



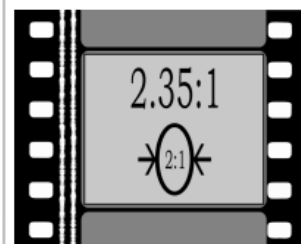
35mm 2.55:1-CinemaScope
with 4-Track-Magnetic Soundtrack



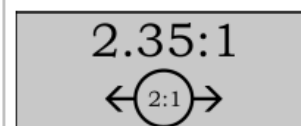
35mm 2.55:1-CinemaScope
Projected Image



35mm 2.35:1-CinemaScope
with 4-Track-Magnetic Soundtrack



35mm 2.35:1-CinemaScope
with optical Mono Soundtrack

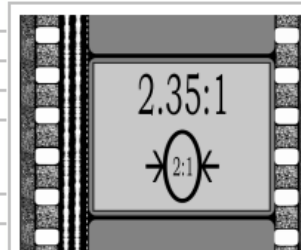


35mm 2.35:1-CinemaScope
Projected Image

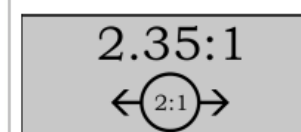
PANAVISION

Years:	since 1957
Aspect Ratio	2.35:1 / 2.39:1
Camera & Projection Lens:	anamorphic 2x
Full Aperture Size:	0.864" x 0.732" (21.9 x 18.5 mm)
Used Aperture Size:	1957: 0.839" x 0.715" (21.4 x 18.1 mm) = 2,346:1 1970: 0.838" x 0.700" (21.3 x 17.8 mm) = 2,394:1 1992: 0.825" x 0.690" (20.9 x 17.5 mm) = 2,391:1
Speed:	24 Frames per Second
Sound:	Analog Optical (Mono/DolbySR) and/or Dolby Digital, DTS, SDDS Digitalton

Panavision was founded in 1953 by Robert Gottschalk with five partners, when the camera shop owner found out that Bausch & Lomb had problems fulfilling the high demand of their CinemaScope projection lenses. Gottschalk and his Partners William Mann and Walter Wallin improved the lens system and introduced the *Super Pantar* lens in 1954, which enabled the seamless adjustment between flat and anamorphic projection. Later this lens was replaced by the even more improved *Ultra Pantar*, and the *Micro Pantar* could be mounted into a film printer to convert anamorphic prints to flat versions - an enormous advantage for the movie studios, who often shot their early CinemaScope movies with a second camera in Academy-Standard, because not all cinemas had been equipped for widescreen projection yet.



35mm-Panavision
with Optical, Dolby Digital, DTS and SDDS



35mm-Panavision
Projected Image

It took a few years, but in 1958 Robert Gottschalk and his partners managed to solve the problem of CinemaScope-mumps, the distortions in close-ups shot with anamorphic lenses. The result was the Auto Pantar camera lens, which got popular very quickly and was soon used by nearly all studios - except 20th Century Fox, who stuck with their own CinemaScope lenses. In the late 1950s CinemaScope became nearly obsolete and almost all movies in anamorphic processes were shot with lenses made by Panavision. Even 20th Century Fox had given up their own CinemaScope lenses in 1967 and used Panavision equipment since then.

In the Mid-1960s Panavision also entered the movie camera business, after they had bought MGMs camera department and improved the standard camera of the movie industry, the Mitchell BNC. At this point the company business model was changed: lenses and cameras were not sold anymore, but were only available for hire to guarantee a consistent quality of the equipment. In the late 1960s the first lenses for spherical 1.85:1 photography were available and 1972 Panavision revolutionized the film industry with its lightweight and quiet Panaflex 35mm-camera. Today Panavision is one of the biggest camera- and lens-manufacturer and even managed to make the jump into the age of digital filmmaking.

The Panavision film format has seemingly changed over the years, because the screen ratios of movies shot in this process often vary between 2.35:1 and 2.40:1. It was actually only the screen height that had been reduced to mask splices on the top or bottom of the frame. While the whole frame was being exposed, only the recommended size of the projected picture was changed. At the introduction of the process in 1957 the frame had an aspect ratio of 2.346:1, in 1970 the height was reduced to 2.394:1 and in 1992 to 2.391:1. The difference between 2.35:1 and 2.40:1 is however so small that it is no big issue especially on video transfers and usually depends on the individual framing of the movie. Aspect ratios between 2.30:1 and 2.40:1 are absolutely normal on video transfers of CinemaScope and Panavision movies.

In the credits Panavision usually stands for the brand name of the cameras and lenses used. "Filmed in Panavision" means the movie was shot with anamorphic lenses, while "Filmed with Panavision Cameras and Lenses" means that the movie was shot "flat", but with Panavision equipment.

VISTAVISION

Years:	1954-1961
Negative Aspect Ratio:	1.50:1
Full and Used Negative Aperture Size:	1.496" x 0.992" (37.9 x 25.1 mm) / 1.418" x 0.772" (36.0 x 19.61 mm)
Aspect Ratio & Aperture Size on Prints:	1.66:1 - 1.85:1 / 0.825" x 0.446" (20.9 x 11.3 mm)
Camera & Projection Lens:	spherical
Speed:	24 Frames per Second
Sound:	Analog Optical Mono

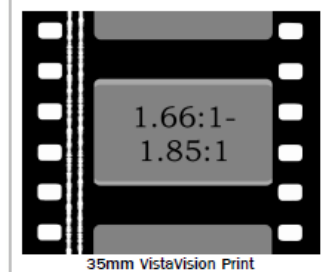
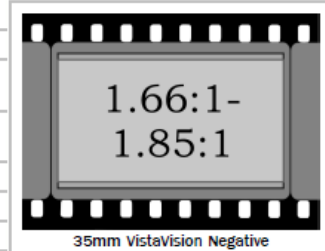
VistaVision was Paramount's answer to CinemaScope, because the studio wanted to have its own widescreen-process and not be dependent on 20th Century Fox. The format was introduced in 1953 with the shooting of *White Christmas* and was until the end of the 1950s a favourite process for big productions, and was even used by Alfred Hitchcock on some of his movies.

VistaVision used regular 35mm stock, which traveled horizontally through the specially-built cameras. The negative frame was eight perforations wide and had the same size as a normal 24x36 photo frame. The larger frame had a distinct advantage over other formats because of the higher resolution of the camera negative. The prints were made from an extraction area of a variable aspect ratio between 1.66:1 and 1.85:1 from the 1.5:1 negative, which was rotated, resized and copied onto a regular 35mm-strip that could be shown on any standard projector like a regular flat print. Because of the much larger negative even the 35mm-reduction prints had a much better image quality than other 35mm productions.

For special occasions prints were sometimes made in the horizontal VistaVision-process, but the projection was very problematic because the film had to run twice as fast through a modified projector. 70mm prints were theoretically possible, but were never made because Paramount was not interested in the 70mm process and the technical equipment was not yet available. Only in the 1990s during the restoration of *Vertigo* 70mm was used to make a preservation print of the large-format VistaVision negative.

The heyday of VistaVision came to an end in the late 1950s, because the process was very costly and cumbersome in comparison to CinemaScope and Panavision. Because of its high resolution and larger image area, special-effects producers in the 70s, 80s and 90s revived the VistaVision format to make optical effects of a very high quality, even if the target format was only 35mm. With the emergence of computer-generated effects the need for a high resolution negative in effects work diminished and is only very occasionally used today.

As with other processes using large format negatives, it is still difficult to make good video transfers of VistaVision movies today. Often a 35mm reduction copy is used, but in some rare cases transfers are made directly from the original negative or a horizontal VistaVision-print, which results in a fantastic quality that is nearly impossible to achieve with 35mm.



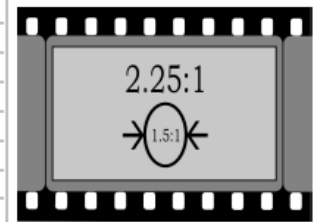
Years:	1957-1985
Negative Aspect Ratio:	2.25:1
Full Negative Aperture Size:	1.496" x 0.992" (37.9 x 25.1 mm)
Used Negative Aperture Size:	1.420" x 0.850" (36.0 x 21.5 mm)
Camera Lens:	anamorphic 1.5x
Projection Lens:	anamorphic 2x (35mm) / spherical (70mm)
Speed:	24 Frames per Second
Sound:	Analog Optical Mono and/or 4-Track Magnetic (35mm), 6-Track-Magnetic (70mm)

In the 1950s Technicolor wanted a piece of the widescreen cake too and developed together with Delft, a company from Holland, the Delrama camera lens, which was combined with a VistaVision-type camera. The negative frame on the horizontally running film strip was the size of a 35mm photographic frame and had the aspect ratio of 1.5:1, which was further squeezed with an anamorphic lens by the factor 1.5:1, creating an usable ratio of 2.25:1.

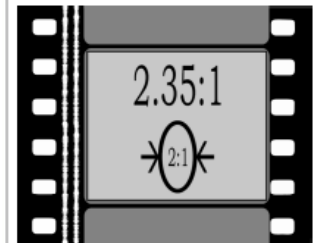
Like VistaVision the frame was rotated and printed to regular 35mm stock, but the 2.25:1 negative was extracted to a 2.35:1 frame by reducing and squeezing it further to a CinemaScope-compatible factor of 2:1. 70mm was also intended as a target format, which involved unsqueezing the negative with the Delrama-lens and printing it to 70mm stock. The quality of the 35mm reduction had a great advantage over CinemaScope, and even 70mm prints had nearly the same good quality as productions with 65mm negatives. When 70mm prints were made, the trademark Super Technirama 70 was used, otherwise the process was just called Technirama.

Although Technirama was very expensive because of the high cost of film material, more than fifty movies between 1957 and 1968 were made in the process, among them Stanley Kubrick's *Spartacus*, the comedies *The Grass is Greener* and *The Pink Panther* and Disney's animated movie *Sleeping Beauty*. Since the 1970s Technirama has seldom been used as a production format, because the quality of regular 35mm stock had much improved and a large-format negative was only needed on special occasions. Technirama was the only film process in the 1950s and 1960s being used to make 70mm prints from a 35mm negative.

Today only few Technirama movies are preserved in their source formats and usually 35mm reduction prints are used for video transfers - only in some cases, like *Spartacus*, the 35mm-horizontal negative has been used for a film-based restoration.



Technirama Negative with 1.5x-Squeeze



Technirama 35mm Print with Optical Sound
(compatible with CinemaScope/Panavision)



Technirama 70mm-Print with Magnetic Sound
(compatible with Super Panavision 70)

& SuperScope 235

Years:	1954-1957
Negative Aspect Ratio:	1.33:1
Negative Aperture Size:	0.980" x 0.735" (2.49 x 1.86 cm)
Print Aspect Ratio & Aperture Size:	2.00:1 - 0.715" x 0.715" (18.2 x 18.2 mm) 2.35:1 - 0.838" x 0.700" (21.2 x 17.7 mm)
Camera Lens:	spherical
Projection Lens:	anamorphic 2x
Speed:	24 Frames per Second
Sound:	Analog Optical Mono

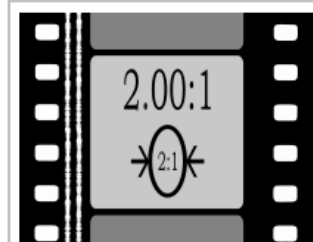


SuperScope Negative

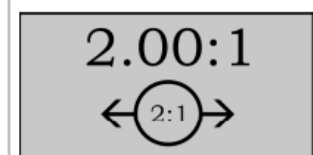
SuperScope began as an invention of Joseph and Irving Tushinsky, who experimented in 1954 with methods to convert flat material to a CinemaScope-like format. With their Tushinsky lens, an adaptor for optical printers, all non-anamorphic processes could be copied like that, but most major studios were not interested in the idea.

Ordered by RKO, the Tushinsky brothers developed the SuperScope process as a cheap alternative to CinemaScope. The whole silent frame of the negative was exposed, but only a middle area with an aspect ratio of 2:1 was used. In the Technicolor labs this part was then squeezed with the Tushinsky lens by a factor of 2:1 like the CinemaScope process, but because of the different aspect ratio a SuperScope print had an exactly square frame which sat in the middle of the filmstrip, leaving a part on the right side unused. This was a huge design error, which caused problems on projectors, which were not calibrated for the offset in the frame position. Another problem was the somewhat worse quality in comparison to other processes, because only a small part of the usable room on the negative was utilized and the film grain became more noticeable.

Between 1955 and 1958 SuperScope was used only on very few movies and sometimes a movie shot in 1.37:1 was printed in the 2:1-format. When RKO realized that the 2:1 aspect ratio didn't have a future, the target format was made compatible to CinemaScope by reducing the image height to the 2.35:1 standard, calling the result SuperScope 235. The quality also improved in spite of the even smaller negative, because the printing technique could deliver better results and sometimes even surpassed early CinemaScope productions, which had their own problems with sharpness due to imperfect lenses.



SuperScope Print with centered Image



SuperScope Projected Image

The demise of RKO in 1958 also meant the end of SuperScope, only Warner shot a couple of movies at the end of the 1950s in the renamed WarnerScope process. In the beginning of the 1980s SuperScope 235 was resurrected as the Super35 process.

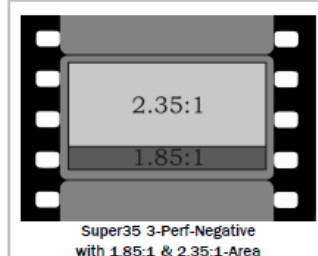
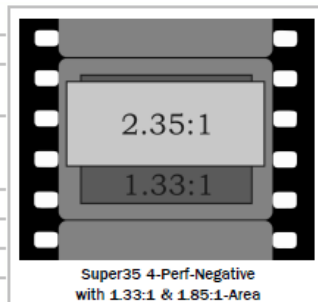
Super 35

Years:	since 1982
Negative Aspect Ratio:	1.33:1
Negative Full Aperture Size:	4-Perf 0.980" x 0.735" (24,9 x 18,7 mm) 3-Perf 0.980" x 0.580" (24,9 x 14,7 mm)
Negative Used Aperture Size:	1.33:1-Area: 0.800" x 0.600" (20,3 x 15,2 mm) 1.85:1-Area: 0.925" x 0.500" (24,1 x 12,7 mm) 2.35:1-Area: 0.925" x 0.393" (24,1 x 9,98 mm)
Print Aspect Ratio:	Like Flat Widescreen (1.85:1) or Panavision (2.35:1)
Speed	24 Frames per Second
Sound:	Analog Optical (Mono/DolbySR) and/or Dolby Digital, DTS, SDDS

After SuperScope had not been in use since the end of the 1950s, the SuperScope 235 version was once again used for the shooting of the music documentary Dance Craze and under the name Super Techniscope 1984 for Greystoke, the first time for a major Hollywood production. Since the end of the 1980s most camera manufactures offer this process as Super 35, which was used by many filmmakers for the advantage to shoot in the 2.35:1 aspect ratio with spherical lenses and to make largely lossless 1.33:1 fullscreen versions for video transfers.

Like SuperScope and Techniscope Super35 is only a production format, from which no direct projection prints are made. Compared to SuperScope the widescreen frame is not extracted from the middle of the negative, but from the top two-thirds. The 1.33:1-version loses a bit horizontally, but gains more on the bottom of the frame. During the shooting the framing is ideally done so that none of the two formats lose important parts of the image.

There's however no guarantee that the fullframe version is as good as the widescreen framing, because special-effects are usually done only for the widescreen frame and have to be pan&scanned in the fullscreen version. To save money sometimes the Super35 negative is reduced to a height of only three sprocket holes, which uses about 25% less film and eliminates the possibility of a 1.33:1 fullscreen version, while working fine for TV productions in 16:9 or HDTV, because an image between 1.78:1 and 2.35:1 can easily be extracted. Because of the still high demand of 1.33:1 fullscreen versions this is rarely used on big movie productions, but has become the standard for TV-series, where fullscreen versions are being made by pan&scanning the 1.78:1 picture.



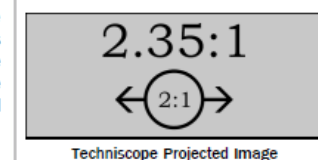
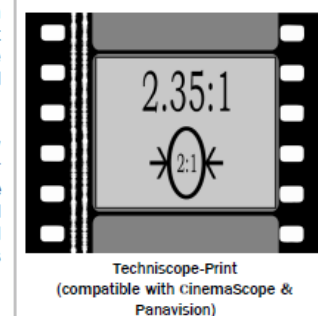
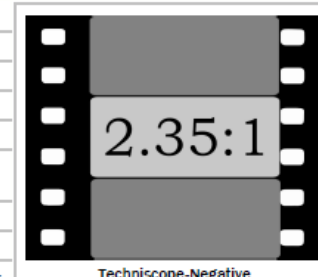
Techniscope

Years:	since 1960
Aspect Ratio:	2.35:1
Camera Lens:	spherical
Projection Lens:	anamorphic 2x
Negative Aperture Size:	0.868" x 0.373" (22,1 x 9,47 mm)
Print Aperture Size & Aspect Ratio:	like CinemaScope & Panavision
Speed:	24 Frames per Second
Sound:	Analog Optical Mono

Techniscope is a variant of SuperScope, which was developed in 1960 by the Italian branch of Technicolor and uses a frame dimension of 2.35:1 without using anamorphic lenses during shooting. In contrast to SuperScope, Techniscope doesn't expose the whole negative and modifies the frame height from four to two sprocket holes (2-perf), reducing the film consumption by half. For projection the frame is enlarged to an anamorphic standard format, which is fully compatible to CinemaScope and Panavision and can be shown on all projectors equipped for these processes.

Techniscope has the great advantage of using a 2.35:1-format with spherical lenses, which especially in the 1960s were technically less problematic than scope optics and meant much more flexibility for cinematographers. Disadvantages were the reduced size of the film negative and the additional dupe step, resulting in increased film grain and inferior sharpness, which could be minimized by good laboratory work. One of the greatest advocates of Techniscope was Sergio Leone, who shot nearly all his movies in this format and impressively demonstrated the advantages of the system with his extreme wide-angle shots and close-ups.

Today Techniscope is not in use anymore, because it has been replaced by the similar, but technically more advanced Super35 process. The restoration of Techniscope movies is often problematic, because the conversion of the 2-perf-negatives to the projection print needs special equipment, which has become very rare. During the restoration of the Sergio Leone western movies MGM first copied the negative into a 4-perf-format, while other studios like Paramount with Leones Once upon a time in the West used a direct digital scan of the 2-perf-version, which however produced only a digital master and not a new print.





Years:	1952-1962
Aspect Ratio	2.65:1 (3 x 0.89:1)
Camera & Projection Lens:	spherical
Full Aperture Size:	3 x 0.996" x 1.116" (25.3 x 28.3 mm)
Used Aperture Size:	3 x 0.985" x 1.088" (25.0 x 27.6 cm)
Speed:	24 Frames per Second
Sound:	7-Track Magnetic Soundtrack on a separate 35mm-strip

In the 1930s Fred Waller, an engineer at Paramount, experimented with an armada of eleven cameras to assemble an image as wide and vivid as possible by using several strips of film together. During world war two he built the "Waller Gunnery Trainer", a film- and projection-system with five 16mm cameras.



After the war he began to develop his Vitarama-system, which used three 35mm-cameras and a curved screen. Together with sound technician Hazard E. Reeves he also developed a seven-channel stereo soundsystem with five speakers behind the screen and two in the auditorium. They were joined by Lowell Thomas, who became president of their new company Cinerama Productions, which introduced the first demonstration movie for the Cinerama-system in 1952, starting the widescreen revolution.

Cinerama was shot with a huge camera, actually consisting of three separate 35mm-units which were accommodated in a soundproof case. The image on each of the three film strips was six instead of four sprocket holes high. Problematic were the intersections between the three projected images, which were minimized by a special shutter between the Projection Lenses. The three separate pictures were projected onto a twenty meter wide concave screen, which had an angle of view of 146°. The soundtrack was partially recorded with five or more microphones live on the set and was stored on a fourth 35mm-strip with magnetic coating, which held the seven soundtracks.

The conversion of a cinema for Cinerama projection cost up to 75000 dollars, and only later when the process began to decline, cinemas would be built especially for Cinerama exhibitions. Between 1952 and 1959 only seven travel documentaries were produced, which were even for today's standards very impressive. In 1962 two last feature films were shot in 3-strip Cinerama: the western epos *How the West was Won* and *The Wonderful World of the Brothers Grimm*.

In spite of the great success of these movies the process proved unprofitable, because the production costs were high and the technical aspects were difficult to handle. Cinerama began to be superseded by other large-format single strip systems, but for some time the name Cinerama was used for 70mm productions in Super or Ultra Panavision 70 when they were projected on the special curved screens of the Cinerama-equipped cinemas - among them movies like Stanley Kubrick's *2001: A Space Odyssey* and many others.

Cinerama also had competition: Cinemiracle was based on a very similar process, but only one travelogue called *Windjammer* was shot in it. More successful was the Russian process Kinopanorama, which was developed in 1956 and was nearly identical to Cinerama. It was mainly used on documentaries and only occasionally on feature films. At the beginning of the 1990s Kinopanorama was revived by an Australian company which restored the Russian 3 strip features, but also produced new movies in the process.

Today there are three preserved Cinerama-venues in Seattle, Los Angeles and in Bradford, UK. These cinemas are the only ones in the world, which can show Cinerama in its original 3-projector configuration; in addition many 70mm productions are being shown. Warner Bros., the new owner of *How the West was Won* even produced new Cinerama prints of the movie, which are regularly shown in these cinemas.

Unfortunately today there are no reasonably good video transfers of the Cinerama productions. *How the West was won* is the only Cinerama movie available on DVD, but it was sourced from an ancient laserdisc transfer of a 35mm reduction print, which only shows a fraction of the original image. Warner says the studio has been working for years on a solution to make Cinerama possible for the home cinema market, but up to now this has not produced any results mainly because of the high costs and the bad conditions of the source material.



Years:	1955-1970
Aspect Ratio:	2.20:1 (on 70mm)
Camera & Projection Lens:	spherical
Negative Aperture Size:	2.072" x 0.906" (52.6 x 23.0 mm)
Print Aperture Size:	1.912" x 0.870" (48.5 x 22.1 mm)
Speed	30 or 24 Frames per Second
Sound:	6-Track Magnetic Stereo

In 1952 Broadway producer Mike Todd was involved in the Cinerama-company, but wanted to develop a way to make the 3-strip-process cheaper by using only one camera with one film strip. After the big success of Cinerama he sold his shares of the process and went to the American Optical Company, then the biggest manufacturer of cameras and lenses in the USA, to develop his idea. As early as 1920 there were experiments with film gauges up to 70mm wide, and Mike Todd had purchased some of the 25 year-old 65mm cameras manufactured by Mitchell.

The system devised by Todd's own company and American Optical consisted of these old 65mm cameras fitted with a set of four newly developed lenses, which captured angles of 128, 64, 48 and 37 degrees, very close to Cinerama's maximum 146° field of view. The film ran not at the usual 24 frames per second, but at 30 to minimize flickering on the huge screens. While there were early experiments with 70mm film, only Todd-AO combined the wide gauge with special lenses and the 6-channel magnetic soundtrack - it really was "Cinerama outa one Hole", as Mike Todd had imagined it.



65mm Todd-AO Negative

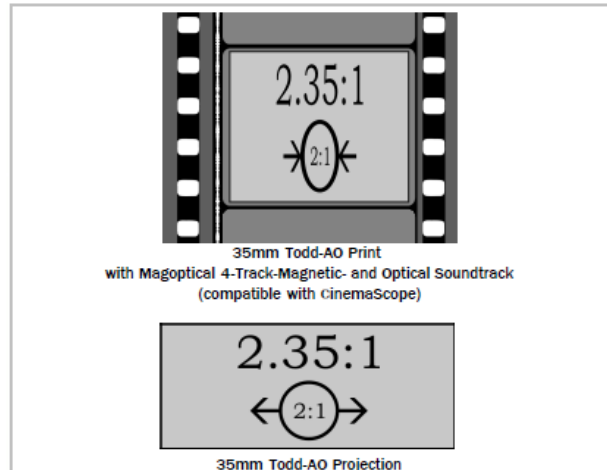


70mm Todd-AO Print with 6-Track Magnetic Soundtrack



The utilized 65mm negative film strip actually had the same dimensions as the 70mm projection print, which had 2.5mm added on each side to accommodate the magnetic soundtracks. The negative was usually fully exposed between the sprocket holes and had a native aspect ratio of 2.29:1. The whole image was not copied onto the prints, because part of it was used by two of the six magnetic tracks, producing an aspect ratio of 2.21:1, later becoming the standard for spherical 70mm processes.

To ensure compatibility for cinemas without 70mm projection capability, a 35mm CinemaScope version could be produced. Because the 'Scope image was wider than the 70mm-frame, the negativ was slightly horizontally cropped by copying only an area of 1.912" x 0.816" - the resulting print was fully compatible with CinemaScope and Panavision. Because Todd-AO originally ran at 30 fps, the first productions using the process were simultaneously shot in 24 fps to make CinemaScope-compatible prints possible.



The first Todd-AO movie was the musical *Oklahoma*, which was filmed in Todd-AO and CinemaScope simultaneously, while the even more elaborate adaptation of Jules Vernes' *Around the World in 80 Days* was shot twice on 65mm in 24 and 30 frames per second. This was later abandoned in favour of shooting in 24 fps only to reduce the already enormous costs of the film stock. The 70mm versions were only shown at roadshow events in specially equipped cinemas with enormous curved screens and six-channel stereo sound - a luxury which became rare at the end of the 1960s.

Between 1955 and 1970 about 20 movies were shot in Todd-AO, but at the end of the 1950s competition appeared from Super Panavision, which only differed in the camera lenses used and only few Todd-AO-Productions used the full range of the special lenses. In 1966 Todd-AO tried to rescue its market share once more with the 70mm alternative Dimension-150 by inventing another new lens system which had a maximum field of view of 150 degrees. But John Huston's *The Bible* and Franklin J. Schaffner's *Patton* were the only two movies shot under this banner, which could not establish itself against the competition. There were only few cinemas specially equipped to project Dimension-150 and the directors only sparingly used the wide angle lenses like they did with the predecessor Todd-AO.

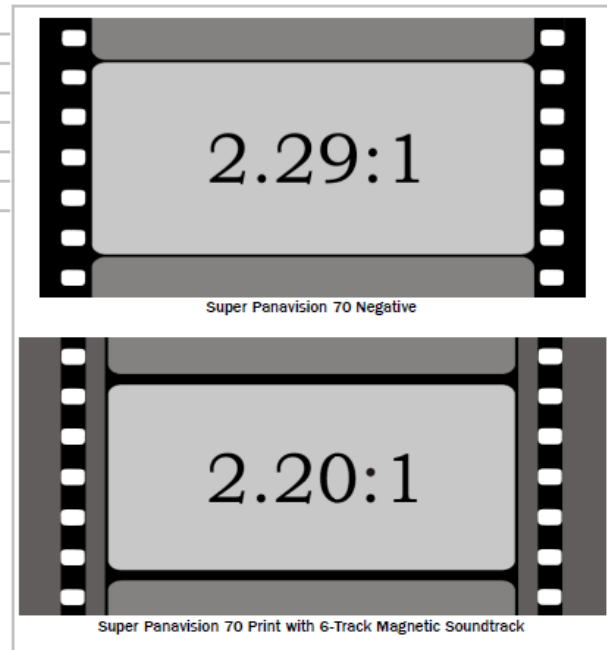
This was however not the end of the company, because in the 1960s Todd-AO already sold CinemaScope-compatible camera lenses, which led to some 35mm-movies with the label "Filmed in Todd-AO 35". Some of these movies were even blown up to 70mm to take advantage of the 6-track-magnetic soundtrack and were advertised as "Filmed in Todd-AO", even if they were not originally shot on a 65mm negative. Today Todd-AO as a company hasn't got much to do anymore with its former business, but became very successful and popular with its postproduction and sound studio services.

SUPER PANAVISION 70

Years:	since 1959
Aspect Ratio:	2.20:1 (on 70mm)
Camera & Projection Lens:	spherical
Negative Aperture Size:	2.072" x 0.906" (52,6 x 23,0 mm)
Print Aperture Size:	1.912" x 0.870" (48,5 x 22,1 mm)
Speed:	24 Frames per Second
Sound:	6-Track Magnetic Stereo

When Robert Gottschalk developed the anamorphic MGM Camera 65-System in 1956, the spherical 70mm technique was still in the hands of Todd AO. But after the success at MGM Panavision began to work on its own system for regular 65/70mm-film, which was introduced in 1959 as Super Panavision 70. On the film strip the process was identical to Todd-AO, but Panavision had developed a completely new lens system, which had many advantages over the expensive and inflexible lenses of the competitors. This made Super Panavision the market leader during the 1960s and even managed to continue the tradition of the Roadshow-exhibitions until the beginning of the 1970s.

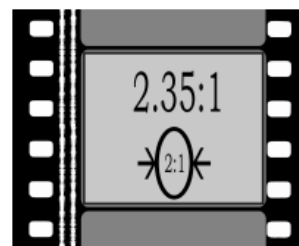
Between 1959 and 1970 14 movies were produced in Super Panavision 70, including big successes like *My Fair Lady*, *West Side Story* and *2001: A Space Odyssey*. Sometimes *Super Panavision 70* was advertised as "Presented in 70mm Cinerama", which meant that a 70mm-print would be projected on the same giant curved screen which was originally made for the 3-strip Cinerama system. In the 1970 the very costly 70mm process was rarely used for feature films, but sometimes for special effects. One of the last big Super Panavision 70 productions, made in the format for technical reasons, was 1982's *Tron*.



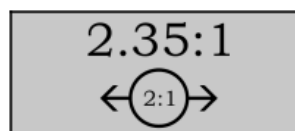
SUPER-PANAVISION 70

In the 1980s 70mm film was mainly used to make blowups from 35mm Panavision productions to take advantage of the better 6-track-magnetic sound. Because of the high costs 65mm filming only very occasionally took place. In spite of this Panavision introduced a new range of 65mm cameras under the label Panavision System 65 and Panavision 70 in the 1990s, but only few cinemas could still project 70mm and the attempted revival of the process failed. The last movies shot in 65mm were Ron Howard's *Far and Away* and Kenneth Branagh's adaptation of *Hamlet*.

Video transfers of 65/70mm material were problematic for a long time, because there was no reliable equipment which could produce a transfer with adequate quality. For many DVDs the transfer of a movie shot in a 70mm process was achieved through a 35mm-scope-reduction, which did not necessarily mean a loss in quality and often looked better than a transfer made directly from a 70mm source. Only in the last few years have some studios made direct 70mm transfers on newly developed equipment with some degree of success, but the quality wasn't always better than similar transfers from 35mm reductions.



35mm Super Panavision 70 Reduction Print
with optical Mono Soundtrack
(compatible CinemaScope/Panavision)



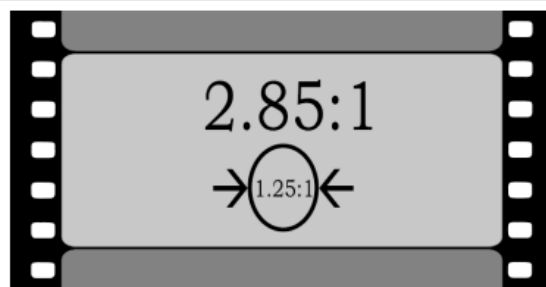
35mm Todd-AO Projection

ULTRA-PANAVISION 70 & MGM Camera 65

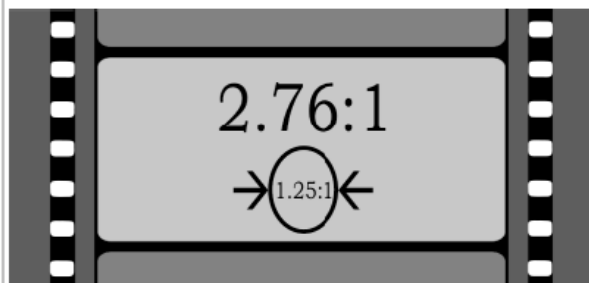
Years:	since 1957
Aspect Ratio:	2.76:1
Camera & Projection Lens:	anamorphic 1.25x
Full Aperture Size:	2.072" x 0.906" (52.63 x 23.01 mm)
Used Aperture Size:	1.912" x 0.870" (48.56 x 22.10 mm)
35mm Used Aperture Size:	1.619" x 0.865" (41.12 x 21.97 mm)
Sound:	6-Track Magnetic Stereo (70mm) 4-Track Magnetic Stereo and/or optical Mono (35mm Magoptical)

In the 1930s MGM had already produced a few movies in an early 70mm process, whose cameras more than 25 years later were used for an alternative to CinemaScope. Although MGM together with 20th Century Fox had used CinemaScope from the beginning, the studio had been working simultaneously on an own widescreen process. In 1953 John Arnold, the head of MGM's camera department, developed a prototype of a process called Arnoldscope, which used a 35mm film strip running horizontally instead of vertically through the camera, producing a negative ten sprocket holes wide. This process was never used to shoot a movie, but was later resurrected as VistaVision. MGM instead went to Panavision and its president Robert Gottschalk.

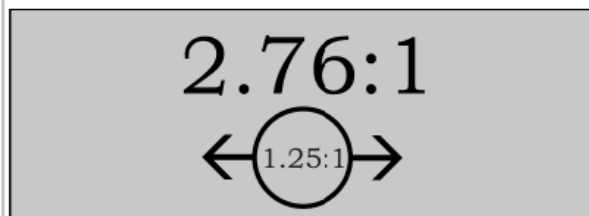
Up to that point Panavision had success with selling CinemaScope-compatible Projection Lenses, which were in high demand, but had not yet produced camera lenses. Together with the studio the company developed MGM Camera 65 and the Super Pantar lens, which squeezed the frame of the 65mm-negative by a factor of 1.25, making an especially wide image with an aspect ratio of 2.76:1 possible, topping even Cinerama's 2.65:1 ratio. In principle MGM and Panavision had added an anamorphic lens to the Todd-AO process to produce a very wide image for the giant curved screens of the large roadshow cinemas. The cameras used originated from MGM's early 70mm experiments in the 1930s and were converted by their manufacturer Mitchell to take 65mm stock.



65mm Negative with 1.25:1 horizontal Squeeze



70mm-Print with 1.25:1 horizontal Squeeze and 6-Track Magnetic Soundtracks



Ultra Panavision Projected Image

ULTRA-PANAVISION 70 & MGM Camera 65

A second goal beside the 70mm roadshow presentation was the production of CinemaScope-compatible 35mm-prints in especially good quality, so a movie could be shown in as many cinemas as possible independent of the format. MGM was aware of the problems Todd-AO had with the different running speeds of 24 and 30 frames per second and wanted to avoid shooting a movie twice to ensure compatibility with all cinemas.

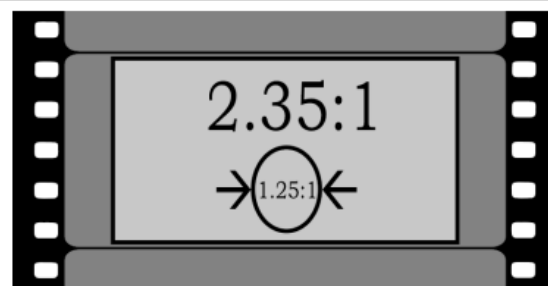
The first MGM Camera 65-production was meant to be the biblical epos *Ben-Hur*, but the new process was ready much earlier. In 1957 the studio put the Civil War romance *Raintree County* in front of the schedule to test the process with a less expensive production. In the end no 70mm prints were made of *Raintree County*, the movie was released only in 35mm CinemaScope - not because of technical problems, but because all 70mm-capable cinemas were already showing *Around the World in 80 Days*, the only other 70mm-production at that time. MGM saw no chance of *Raintree County* seriously competing against it.

The second production in the new process made film history - William Wyler's adaption of *Ben-Hur* won a torrent of eleven Academy Awards and is still one of the most impressive movies of its time. The 70mm roadshow prints of *Ben-Hur* had the full aspect ratio of the 2.76:1 negative, but were rarely shown at their full width - most roadshow-venues limited the projection to a ratio of about 2.5:1 to take advantage of the entire screens.

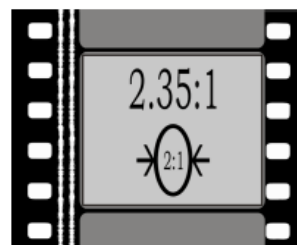
After or parallel to the roadshow exhibition 35mm prints were made for the general release. The first 35mm prints were made with an aspect ratio of 2.55:1 by adding black bars to the top and bottom of the image within the scope-frame, but later prints were made in the full 2.35:1 ratio by showing only a middle portion of the full image. Usually the image was composed during the shooting of a movie so that nothing important happens outside the constraints of the 2.35:1/2.55:1-area.

At the beginning of the 1960s MGM had to sell its camera department to Panavision to make up for the costly flop of *Mutiny on the Bounty*. MGM Camera 65 was renamed to Ultra Panavision 70, a name which had been proposed by Robert Gottschalk from the beginning. With the development of better lenses and cameras six movies until 1966 were filmed in this process, which sometimes was advertised as 70mm-Cinerama.

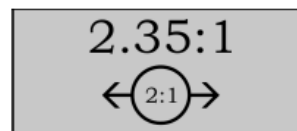
As with other 65mm systems, video transfers from Ultra Panavision movies were usually made by doing a transfer from a 35mm reduction print, because there were no acceptable methods of transferring directly from 65mm. Unlike Todd-AO and Super Panavision 70, only the considerably smaller 35mm extraction area could be transferred, like MGM did with *The Hallelujah Trail*. Warner managed to release *Ben Hur* and *Mutiny on the Bounty*, two of its biggest Ultra Panavision 70 productions, in their original aspect ratio taken from the 65mm-negatives in very good quality.



65mm Ultra Panavision Negative with 35mm Extraction Area



35mm Ultra Panavision Reduction Print
(compatible with CinemaScope/Panavision)



35mm Ultra Panavision Projected Image

16mm

Years:	since 1923
Aspect Ratio:	1.33:1
Camera & Projection Lens:	Spherical
Full Aperture Size:	0.404" x 0.295" (10.3 x 7.5 mm)
Used Aperture Size:	0.373" x 0.272" (9.5 x 6.9 mm)
Speed:	24 Frames per Second
Sound:	Silent or Analog Optical Mono

16mm film was first introduced by Kodak in 1923 as an affordable alternative to 35mm for amateur filmmakers, but was largely ignored by professionals because of quality issues. The goal was to allow amateurs to shoot their own films and to rent or buy prints from the Kodascope Library, where reduction copies from 35mm movies were made available. With the invention of film sound 16mm got its own optical soundtrack and in 1935 the first 16mm colour stock was available.

The width of the film strip was set to 16mm instead of 17.5mm, so that amateurs weren't able to slice the extremely flammable 35mm nitrate stock in half. While 35mm stock was only available as the dangerous nitrate film until the mid-1950s, 16mm had always used acetate 'safety' film.. 16mm silent film originally had sprocket holes on both sides of the frame, but one side was left off to make room for the optical soundtrack when film sound was introduced.



16mm Silent Film

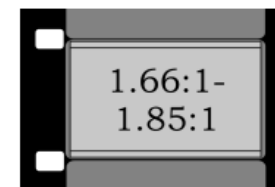


16mm Sound Film
with optical Soundtrack

During the 1930s 16mm began to establish itself as the ideal medium for educational movies and was often used during World War Two because the cameras were lightweight and easy to use compared to 35mm equipment. In the 1940s 16mm began to be used by news reporters and by 1950 for some television productions. Before the introduction of videotape recording 16mm was used heavily in the USA to time-shift tv programming from the east to the west coast using 16mm kinescope recordings, which were sent by courier to other stations. In England many tv productions used 16mm film on location, because early video cameras were too heavy to transport. 16mm was also very popular with news reporters and was used by German TV stations until the mid-1980s.

Super 16

Years:	since 1969
Aspect Ratio:	1.66:1 - 1.85:1
Camera & Projection Lens:	spherical
Full Aspect Ratio	0.488" x 0.295" (12.4 x 7.5 mm)
Used Aspect Ratio:	1.66:1 - 0.468" x 0.282" (11.9 x 7.2 mm) 1.85:1 - 0.468" x 0.253" (11.9 x 6.4 mm)
Speed:	24 Frames per Second
Sound:	None (only on 35mm prints)



Super16 Negative
with 35mm extraction area

Super 16 was developed at the end of the 1960s by the Swedish cinematographer Rune Ericson, who extended the 16mm frame to one side by using the space which had been reserved for the soundtrack or the second row of sprocket holes on normal 16mm stock. By using a larger frame with the aspect ratio of 1.66:1, the quality of a 35mm blowup had been significantly improved over regular 16mm stock. Super16 is not a projection format, but on some occasions projectors were modified to show Super16 stock for watching dailies during film productions.