

John Passmore

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Super 16mm

Super 16mm film is one of a myriad of film formats developed since the beginning of motion picture technology in the late 19th century. Invented around 1970, it quickly became the top choice for low-budget filmmakers who needed quality enlargements for 35mm theatrical release. For professional cinematographers working today, Super 16mm remains one of the only viable low budget film alternatives to 35mm. The advent of HDTV with its increased image quality has also made Super 16mm an attractive choice for television producers. And while the introduction of better quality digital video technology has threatened the use of film generally, Super 16mm seems to have secured a place among filmmakers and television cinematographers as a beloved format whose survival will be secure for at least a few more years. Before explaining the current state of Super 16mm, however, it is important to detail how the format arose from the limitations and frustrations filmmakers and cinematographers had with the standard 16mm format.

Standard 16mm began as safety film, composed of an acetate base and used mostly for amateur film production. Nitrate, the original base for 35mm motion picture film, was highly flammable and considered dangerous for untrained filmmakers. Although manufacturing of acetate-based film began as early as 1909 for 35mm, it was

not until 1923 when Kodak introduced the first 16mm cameras, projectors, and film stock, that the format and base became popular.¹

As the formulas for acetate-based 16mm film were refined, the stock became stronger and picture quality improved. 16mm eventually became popular not only for amateur film but for documentary, industrial, instructional, and art-house productions. Television producers also began using 16mm.² 16mm was a good format for television because television has the same aspect ratio as standard 16mm. 16mm equipment was much lighter and cheaper than 35mm and it was easy to use on location shooting; its portability was good for fast, tight production schedules.

However, there were problems with 16mm. Although it was suitable for television and non-theatrical releases, it was still relatively undesirable for the major motion picture market. Until the mid-1950s the Academy of Motion Pictures standardized aspect ratio for 35mm film projection was 1:1.33 (vertical to horizontal). But after some confusion with varying ratios for 35mm in the 50s and 60s (the 'wide screen' revolution), the film industry eventually settled on a 1:1.85 ratio in the US and Asia and a 1:1.66 ratio in most European countries.³

Because production companies had to blow-up regular 16mm (1:1.33) to 35mm (1.66:1 or 1.85:1) for theatre projection, they had to not only enlarge the picture but also significantly crop the top and bottom of the image. As these widescreen ratios became standardized, filmmakers wanted 16mm to adapt; they needed to create an affordable 16mm format that would have wide-screen capabilities.⁴

In 1963, while working at Cineservice in Hollywood, Adrian Mosser began to experiment with enlarging the exposure area of 16mm film. Mosser found that by

enlarging the camera aperture to include the soundtrack area of the film, the aspect ratio could increase from the typical 1:1.33 of regular 16mm to 1: 1.65. Ferde Grofe, jr. was also working at Cineservice, Inc at the time and in the November 1970 issue of *American Cinematographer*, he describes his and Mosser's experiments with this newly expanded 16mm format:.

It all started for me in May of 1969 when, in the course of a conversation with Adrian, the discussion turned to the hows of improving the quality of blow-ups from 16mm to 35mm. Adrian mentioned a theory of his dating back to 1963 which involved shooting with an expanded aperture onto 16mm single-perforation stock.⁵

Grofe explains that these conversations led to the development of the first wide-format 16 mm cameras. He was excited to use these cameras for a CBS television series whose production had recently been secured by Grofe and Mosser's company. According to Grofe, he and Mosser kept secret these developments for fear the distributors would not accept this new format. To avoid the impression they were using lower quality 16mm film instead of standard 35mm, they named their new film "Super 22". Their first project to use Super 22, "Ride the Tiger", began production in January 1970.⁶

Although, Grofe and Mosser encountered a few technical glitches with their new camera, Grofe claims they were the first successful team to create and use a wide-screen 16mm format camera. "And so Super 22 was born." Grofe states, "In effect, Super-16, if you like, but cloaked under an alias to avoid prejudice."⁷

Grofe's November 1970 article must have been a direct reaction to an earlier article by Rune Ericson, wherein he claims to have invented the Super 16mm format. And although Grofe does not explicitly mention Ericson in his article, he does blame the magazine for exposing the secret invention of Mosser and Grofe. "As a matter of fact," Grofe writes, "our Super-22 would still have been our own private secret, if *American Cinematographer* hadn't spilled the beans about Super-16."⁸

The Swedish cinematographer Rune Ericson wrote his article in the June 1970 issue of *American Cinematographer*. He describes drilling out the aperture of his Éclair NPR 16mm camera to make it 2mm wider; this enlargement exposed the soundtrack area of the single-perforated 16mm film, allowing for a wider 1:1.66 film ratio. To prevent scratches on the film, Ericson also made minor adjustments where the soundtrack area of the film normally rode within the camera. Rune also had to change lenses because most standard 16mm lenses would not cover the larger area of the Super 16mm frame. With this jury-rigged camera, Rune was able to shoot the first feature film in Super 16mm, "Lyckliga Skitar."⁹

In his article in 1970, Rune wrote that he had worked solely with 35mm film before he made the Super 16mm conversion. Before his 16mm camera modification, he had considered the blow-up of regular 16mm to 35mm unsuitable for professional filmmaking. He also said that 35mm cinematographers typically used a camera operator to hold the camera; that way the cinematographer could better control the light while working in the studio. However, for a cinematographer working with a lightweight Super 16mm camera on location, he could operate his own camera. Although Ericson believed Super 16mm was not a replacement for 35mm, he thought it was a huge step forward for

budget conscious productions that required a lightweight flexible camera with high quality image capabilities.¹⁰

In the beginning, Super 16mm cameras were simply modified regular 16mm cameras. In 1970, the transformation of a traditional 16mm camera was only available to ambitious handymen. Although drilling out the aperture, re-centering the lens, and filing down the soundtrack side flanges of the sprockets were relatively simple steps, a certain amount of care and precision were required. Hand-tooled modifications still go on today, but as early as 1970, camera companies like Eclair were converting cameras for their customers. Shortly after 1970, companies such as ACL, Bolex, Aaton, Arriflex, and Auricon were selling straight-from-factory conversions of their regular 16mm cameras; customers could buy cameras with interchangeable parts, easily switching between regular 16mm and Super 16mm.¹¹ Although Super 16mm-only cameras are made today, many companies still manufacture 16mm/Super 16mm conversion cameras.

Despite the general excitement surrounding these new cameras in the early 70s, the quality of film stock was proving difficult. At the time, Eastman Ektachrome 7252 and Eastman color negative 7254 were commonly used but considered too slow (25-50 ASA) and were too grainy for release-quality 35mm blowups. Fortuitously, when Eastman released a new stock in 1973, 7247, filmmakers finally had what they needed to produce film close to the quality of 35mm in a 16mm format.¹²

After Rune Ericson and others began to convert their regular 16mm cameras and use them widely, they realized there was another problem: no equipment had been developed for viewing or editing the new format. Super 16mm was a system that required not only a modified camera, but also modified laboratory, editing and projection

equipment.¹³ KEM and Steenbeck began to modify their editing consoles and projection companies started milling out the apertures on their cameras. Camera lenses were problematic too; standard 16mm lenses would not fit Super 16mm film, so cinematographers had to retrofit 35mm lenses. Eventually, companies like Canon started to develop Super 16 specific lenses. However, even after several years of professional use, Super 16mm did not exist in the eyes of the major standard forming agencies. By 1972, neither SMPTE nor ANSI had a dimensional definition for Super 16.¹⁴ This lack of standardization certainly slowed the incentive of companies to accept and manufacture new products.

Despite its rocky road to acceptance, Super 16 advocates pressed on. However, it probably wasn't a hard sell; the format offered the mobility and cost-effectiveness that 35mm could not. And although many cinematographers felt they were giving up a certain amount of picture quality with Super 16, others liked the gritty reality of the film on 35mm projection. So much so, in fact, that award winning artists like Mike Figgis prefer the format to 35mm and use it exclusively. Figgis, talking about *Leaving Las Vegas* (1995)

Technical advances give us fast stock and fast lenses...we can virtually shoot in the dark if we wanted to, with no light at all. And nobody does that. It's very hard when you are making a studio picture because they want clarity, but personally I like it dirty...it's how I like films to look. A little bit of grain; a little bit soft, not out of focus, just soft. Not quite as forgiving as 35mm, not quite as unrelenting.¹⁵

During the 1982 filming of *Come Back to the Five and Dime, Jimmy Dean, Jimmy Dean*, Robert Altman also explained why he preferred using Super 16mm over 35mm

I think there is an added quality when we blow up to 35mm. With all the good lenses now available...When you shoot in 16mm and blow up, you get a certain effect...When I finish this and blow it up to 35mm, I promise you, nobody in the world is going to know that it wasn't 35. I'm very happy with it.¹⁶

Many cinematographers working today echo the words of Figgis and Altman.¹⁷ Not only have cameras and lenses improved greatly over the last 30 years but film stock has gotten better. The wider exposure latitude of Kodak's new Vision2 stocks, for example, enables the recording of subtle details in shadow and light without the grain usually associated with Super 16mm.

Also, with the introduction of DI or digital intermediate technology, filmmakers can often fix problems with color on the exposed negative after shooting is finished. Ryan Paul, the cinematographer for the *Sundance* television network series, *Admissions*, says that using Super 16mm not only saves time, but with new DI technology, he is able to smooth out any rough edges caused by bright natural light.¹⁸

Indeed, many filmmakers using Super 16 enjoy its distinctive visual quality and try to stay as true as they can to the original exposed negative, but having DI technology gives them a certain piece of mind in post-production. Cinematographer Amy Vincent talks about color correcting her film *Hustle & Flow*. The film had been shot on Super 16mm then scanned and converted into digital files using an Imagica 2K scanner.

We could isolate anything in any shot, put a window around it and manipulate just that part of the image to make it darker or brighter, and also alter color or contrast... There are so many amazing tools at your disposal in the DI suite.¹⁹

Digital scanning and color correcting technologies are a couple of reasons why Super 16mm is still around today: cinematographers are able to utilize Super 16mm to achieve the gritty quality of film; they can shoot from the hip with lightweight Super 16mm cameras; and they can also scan the film to capitalize on recent advances in the digital realm.

Another reason Super 16mm is still a viable recording format today is the emergence of HDTV. Unlike standard television, with its nearly square aspect ratio of 4:3, HDTV has an aspect ratio of 16:9 (1:1.77), virtually the same as Super 16mm (1:1.66).²⁰ Because Super 16mm is a film format, many producers today also consider it future proof. That is to say, film is a standard worldwide, has been around for over 100 years, and is a proven archival format.

A white paper published by The Arri Group in 2006, discusses the “Long Term Archivability” and “Global Standard” of Super 16mm.

Programs produced on film today will retain their value tomorrow, disregarding the constant changes in electronic video formats. Film shot today can be transferred to whatever new electronic standards will reign in years to come.

Similarly, footage shot decades ago can be transferred to HD now, and look as if it were shot yesterday... now that we are drowning in a world of competing and conflicting SD and HD video and data standards, this [Super 16mm] is a unique advantage.²¹

There are also certain cost advantages for television companies using Super 16mm. Instead of buying all new DV camera equipment that is likely to be obsolete in the near future, production houses can convert their regular 16mm cameras with relatively little cost. That being said, there are costs associated with Super 16mm not associated with digital video, mainly the transfer of sound and image to digital files.

It is hard to tell how long the current love affair with Super 16mm will last, however. Certainly, when Rune Ericson and other pioneering cinematographers developed the format in the late 60s and early 70s, it offered many advantages. Compared with regular 16mm, Super 16mm could be blown up to 35mm with much less grain. Because of the increased width of Super 16mm it quickly became a low budget alternative to 35mm. Super 16mm cameras were lighter and more mobile than 35mm cameras and cinematographers could shoot from the hip with out sacrificing quality. Cinematographer Oliver Bokelberg explains

The mobility of the camera is amazing. You can use smaller equipment, move faster and get shots that might have been practical. There's an advantage to being able to catch something on the sly. When something magical happens, you have the ability to capture it. With smaller equipment, you can maintain a certain intimacy.²²

Regular 16mm cameras could be converted to shoot both Super 16mm and regular 16mm, and 16mm film was much cheaper than 35mm. However, the advent of electronic and digital video technology seemed to usher in the demise of Super 16mm. By the late 1980s, electronic video recording was widely used by television and in recent years DV

technology has greatly improved, challenging the value of film as a theatrical release format.

Although there are many die-hard film fans that like the intrinsic qualities of film, Paul Wheeler, the author of *High Definition Cinematography*, believes HD technology since 2000 has far surpassed the image quality film has to offer. “Forgive me if you this a sacrilege, but the process of recording moving images on film is far from perfect. It is very good, until the year 2000, when it was the only medium that could successfully suspend our disbelief in a large cinema. Then came HD.”²³

Wheeler argues that HD is a perfect origination and post-production medium. Unlike Super 16mm, HD does not have to be scanned into digital files and HD can be output into almost any delivery format: cinema, HDTV, web casting, and digital phones. All these conversions can be easily achieved with no loss in quality.²⁴ This ease of conversion also translates into big cost savings for producers. Cinemas are also beginning to install state-of-the-art digital projectors that can show images that have never been anything but HD; this development eliminates the current necessity of transfer to 35mm film for theatrical release.

Wheeler also addresses the idea of future proofing. Although he concedes that raw HD tape stock does not last as long as film, for a little extra money extending the life of HD tape is relatively easy. The cost for preserving film, however, is much higher. The cost of making a clone of an HD tape is relatively little, whereas full copy resolution from a film can be expensive.²⁵

There are other archival considerations at play with Super 16mm. Most archives do not have the equipment to playback Super 16mm film. Steenbecks have to be

modified and without precise adjustments to regular 16mm editing consoles, operators run the risk of scratching the film. For preservation purposes, digitally scanning film can be expensive. Also, the many production elements (35mm blow-up internegative, 35mm duplicating positive, work print, Super 16mm negative original, release prints, and soundtrack) can be confusing to catalog and keep track of. It seems that commercial film and television production will use Super 16mm as long as filmmakers prefer film as a format. However, the increasingly good image quality of HD camera technology and decreasing costs of that technology seems to be ushering in a new era of moving image production.

Annotated Bibliography

Academy of Motion Picture Arts and Sciences. "Academy Presents Award of Commendation to Rune Ericson."

<http://www.oscars.org/press/pressreleases/2002/02.01.22.html>

A press release by the Academy of Motion Picture Arts and Sciences.

Arnold & Richter Cine Technik. "The Beauty of 16." April 07, 2006

<http://www.arri.com/entry/416.htm>

Arri, a motion picture equipment company that manufactures Super 16mm cameras, produced this white paper. This is a state-of-the-format report posted on their website, ostensibly meant to help sell their camera equipment. It offers some good insights on how the industry currently views Super 16mm.

Ascher, Steven, and Edward Pincus. *The Filmmaker's Handbook: a comprehensive guide for the digital age* New York, N.Y.: Plume, 1999.

The Filmmaker's Handbook is a comprehensive guide to the gear and hardware of film and video. The introduction has several good illustrations, showing the inner workings of film projectors and cameras, comparisons of aspect ratios, film formats and blowing Super 16mm up to 35mm.

Ericson, Rune. "Shooting the First Feature in 'Super-16'." *American Cinematographer*, June 1970, pp. 520-523.

Rune Ericson's first hand account about how he shot the first feature film in Super 16mm. He talks about the technical problems with converting regular 16mm cameras to Super 16mm cameras and some of the challenges with lenses and lighting.

Enticknap, Leo. *Moving Image Technology: from zoetrope to digital*. Great Britain: Wallflower Press. 2005

Enticknap's book is a comprehensive overview of the history and theory of moving image technology. He explains the beginnings of film history through video and television. The book is detailed and well researched.

Fisher, Bob. *Film & Video*. "Sweet Super 16."

<http://www.studiodaily.com/filmandvideo/technique/craft/f/shooting/4340.html>

An interview with cinematographer Ryan Paul, where he describes his experiences with Super 16mm, new Kodak film stock, and the advantages of using digital intermediates in the post-production environment.

Fisher, Bob. *MovieMaker: Magazine*. "Super 16 Renaissance Keeps Growing."

http://www.moviemaker.com/articles/print/Super_16_renaissance_keeps_growing_2906

Another article by Fischer where he talks with the makers of *Hustle & Flow*. There is some good discussion about the DI process and how Super 16mm integrates well with computer technology; nowadays filmmakers can take advantage of the quality of film by utilize the editing capabilities of the digital world.

Grofe, Ferde, jr. *American Cinematographer*. "Super 16 by any other name..."

November 1970. pp. 1100-1101.

Grofe's first hand account of how he and Adrian Mosser developed Super 16mm camera and shot the first television series using the new format.

Kodak. "Making Dreams Come True: A Super 16mm Renaissance."

<http://www.kodak.com/country/US/en/motion/newsletters/onFilm/summer2003/makingDreamsP.shtml>

This article from Kodak's on-line newsletter contains interviews with independent cinematographers working with Super 16mm today. They describe their experiences using the new Kodak film stocks for Super 16mm.

Lightman, Herb, and Michael Duvall. "Altman Shoots Super-16." *American Cinematographer*, September 1982, pp. 889-891

An interview with Robert Altman, nearly 10 years after Super 16mm began to be used. He discusses his preference for Super 16mm and how new technology has made it an even more attractive option for low-budget filmmakers.

Lightman, Herb A. "Super 16 – A State-of-the Art Report." *SMPTE* vol. 82: 457-459. June 1973.

SMPTE published a very useful journal addressing technical issues confronting technologists in the moving picture industry. This report details the different aspects filmmakers need to consider before converting their cameras to Super 16mm. There are sections on lenses, film stocks, and laboratory and editing processes for Super 16mm.

Marylandfilm.com

<http://www.marylandfilms.com/16mm-super16-ultra16-compared.html>

Marylandfilm.com is an independent film and acting news blog covering the mid-Atlantic region. It has a good chart comparing regular 16mm, Super 16mm, and Ultra 16mm. It lists the advantages and disadvantages each format has for the independent filmmaker.

McInnis, Kathleen. *MovieMaker: Magazine*. "Mike Figgis, Taking a Shot in the Dark."

http://www.moviemaker.com/articles/item/mike_figgis_taking_a_shot_in_the_dark_3147

McInnis writes a good article with interview of independent filmmaker Mike Figgis and his use of Super 16mm. He makes a strong case for the format in 1995 and espouses the aesthetic quality of film.

Patterson, Richard. "Blow-up: 16mm to 35mm and More About Super-16." *American Cinematographer*. June 1970 pp. 524-565

Patterson's article has a description of the blow-up process of 16mm to 35mm as well as history of Adrian Mosser's experiments with Super 16mm.

Ryan, Rod. *American Cinematographer Manual*. 7th ed. Hollywood : American Society of Cinematographers. 1993.

This manual is the definitive reference work for cinematographers. It contains a concise description of Super 16mm as a format and some good illustrations.

Sassone, Richard. "The Emergence of Super-16." *Filmmaker's Newsletter*. September 1972. pp. 24-29

Sassone's article has several good illustrations of Super 16mm to 35mm blow-up. There is also a good history of how Super 16mm was discovered as well as an interview with Bob Megginson, a DP and editor who shares his experiences with Super 16mm.

Swanberg, Lars. "Super 16 – A Technical Note." *SMPTE*. October 1970. vol. 79: 931-1121.

The first SMPTE article on Super 16mm which was elaborated on later by the journal in 1973.

Wheeler, Paul. *High Definition Cinematography*. Great Britain: Focal Press. 2007.

A recent publication, Wheeler makes the case for HD technology over film. He lays out factors such as cost for production and image quality. There are detailed descriptions of digital cameras at the end of the book.

Wilson, Anton. *Cinema Workshop*. USA: A.S.C. Press. 1983

Anton's book is an easy to use, well-organized concise publication that details the various aspects of film and video. The "Format" section of the book does a good job of explaining Super 16mm and contains detailed illustrations of the format specifications.

Appendix A

A Partial List of Film and Television Shot on Super 16mm

Babel (film)	Mentor (film)
The Ballad of Jack and Rose	A Mighty Wind
Best in Show (film)	Monsoon Wedding
Bloody Sunday (TV film)	The Motorcycle Diaries (film)
The Brown Bunny	Neil Young: Heart of Gold
Dave Chappelle's Block Party	Old Joy
The Daytrippers	Prefontaine (film)
The Devil and Daniel Johnston	Primer (film)
The Devil's Rejects	The Queen (film)
Dog Soldiers (film)	Saw (2003 film)
Faces (film)	She's Gotta Have It
For Your Consideration (film)	Sketches of Frank Gehry
From Dusk Till Dawn	The Squid and the Whale
Half Nelson (film)	Thirteen (film)
Hamlet (2000 film)	This Is Spinal Tap
The Hills Have Eyes (1977 film)	Trailer Park Boys: The Movie
Hustle & Flow	Vera Drake
An Inconvenient Truth	Waiting for Guffman
Jackass: The Movie	Wendigo (film)
The Last King of Scotland (film)	
Leaving Las Vegas	
Leprechaun: In the Hood	
Lock, Stock and Two Smoking Barrels	
March of the Penguins	

Source: http://en.wikipedia.org/wiki/Category:Films_shot_in_Super_16. (Most films on list have been corroborated by other sources.)

Appendix B

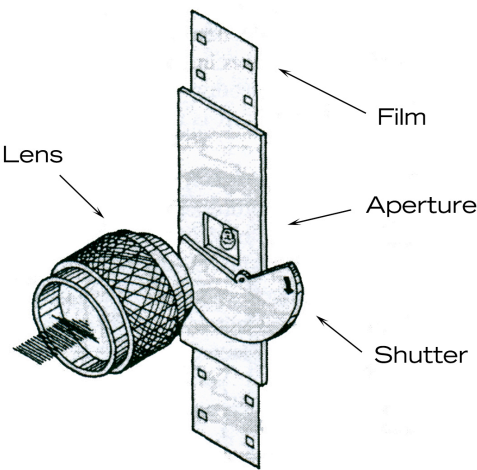


figure 1.1 Making Super 16mm cameras in the beginning required filing down the aperture opening in the camera. This allowed for a greater exposure area. (illustration - *The Filmmaker's Handbook*, p 3)

FIGURE 51—Regular 16 versus Super 16				
Regular 16mm	Aspect Ratio	Dimensions	Area	%Waste
	1.37:1	.404 x .295	.119	0
	1.66:1	.404 x .243	0.98	18%
	1.85:1	.404 x .218	.088	26%
Super 16	Aspect Ratio	Dimensions	Area	%GREATER AREA THAN REG. 16mm
	1.66:1	.488 x .295	.144	47%
	1.85:1	.488 x .263	0.128	46%

figure 1.2 The chart above compares aspect ratios, dimensions, area, and %waste between regular 16 and super 16 film. (illustration - *American Cinematographer* November 1970, p 1102)

Appendix B cont.

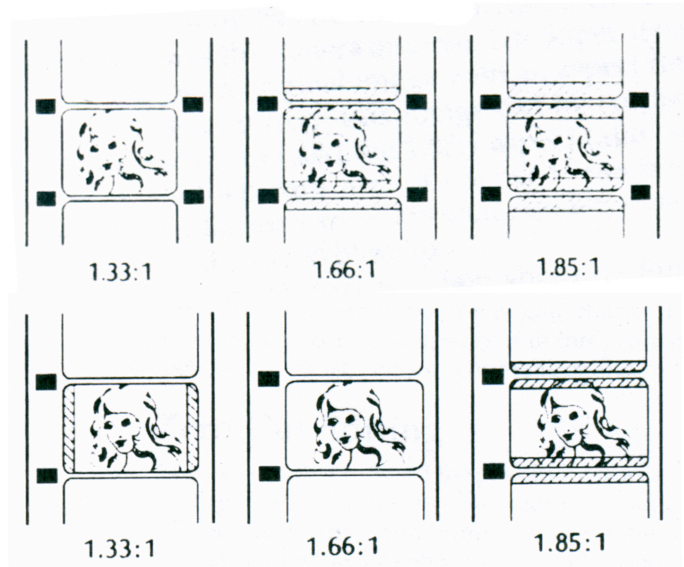


figure 1.3 The top illustration shows the cropping that occurs with regular 16mm, the bottom with super 16mm. (illustration - *American Cinematographer Manual*, p 531)

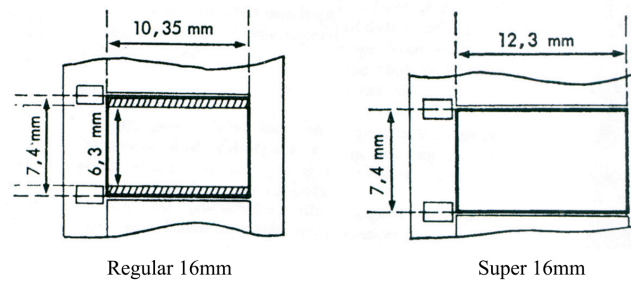


figure 1.4 A SMPTE illustration showing the effective picture areas of regular 16 and super 16. (illustration - *SMPTE vol. 82: 457-459. June 1973*)

¹ Enticknap, Leo, *Moving Image Technology* (Great Britain: Wallflower Press, 2005), 20.

² Ibid. 174,176. The format was used regularly in television until magnetic video tape recording superseded film. Electronic video recording had been in use as early as the 1950s, but it only became economically viable in the early 1970s and then was only widely used by television in the late 1980s onward.

³ ibid. 65

⁴ Please see appendix B for various explanatory explanations.

⁵ *American Cinematographer*, November 1970, 1101

⁶ ibid

⁷ ibid

⁸ ibid. Aside from this single account by Grofe in the November 1970 issue of *American Cinematographer*, I was unable to find any other information on a format called *Super-22*. However, different articles do mention Mosser (never Grofe) experimenting with an expanded 16mm format as early as 1963. And although the June 1970 issue of *American Cinematographer* has a lengthy article on Mosser's 16mm blowup process and experiments with Super 16mm, the majority of later articles I located blithely credit Rune Ericson as the sole inventor of Super 16mm cameras. Most likely, both Ericson and Mosser had come up with the idea of an expanded 16mm film format simultaneously, but Ericson seems to have won out in the 'great man' theory of film history. The Academy of Motion Picture Arts and Sciences presented an Award of Commendation to Ericson for his work in Super 16mm in 2002.

⁹ *American Cinematographer*, June 1970, 521

¹⁰ ibid

¹¹ Lightman, Herb A. "Super 16 – A State-of-the Art Report." *SMPTE* vol. 82: 457-459. June 1973

¹² Ibid

¹³ Ryan, Rod. *American Cinematographer Manual*. 7th ed. Hollywood : American Society of Cinematographers. 1993.

¹⁴ *Filmmakers Newsletter*, September 1972, 28

¹⁵ McInnis, Kathleen. *MovieMaker: Magazine*. "Mike Figgis, Taking a Shot in the Dark."

http://www.moviemaker.com/articles/item/mike_figgis_taking_a_shot_in_the_dark_3147

¹⁶ Lightman, Herb. "Altman Shoots Super-16." *American Cinematographer*, September 1982, 890

¹⁷ For a partial list of film and television shot in Super 16mm see Appendix A.

¹⁸ Fisher, Bob. *Film & Video*. "Sweet Super 16."

<http://www.studiodaily.com/filmandvideo/technique/craft/f/shooting/4340.html>

¹⁹ Fisher, Bob. *MovieMaker: Magazine*. "Super 16 Renaissance Keeps Growing."

http://www.moviemaker.com/articles/print/Super_16_renaissance_keeps_growing_2906

²⁰ Throughout this paper, I have been using height to width ratios. However, I have never seen HD or standard TV described any other way than width to height. So I am keeping the ratios 16:9 and 4:3 width to height.

²¹ Arnold & Richter Cine Technik. "The Beauty of 16." April 07, 2006

<http://www.arri.com/entry/416.htm>

²² Kodak. "Making Dreams Come True: A Super 16mm Renaissance."

<http://www.kodak.com/country/US/en/motion/newsletters/onFilm/summer2003/makingDreamsP.shtml>

²³ Wheeler, Paul. *High Definition Cinema*. (Great Britain: MPG Books, 2007), 3.

²⁴ Ibid. 4

²⁵ Ibid. 21