3D Frequently Asked Questions

Compiled for the 3-D mailing list

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3D Frequently Asked Questions

1 Introduction

1.1 The 3D mailing list

The 3D mailing list is a group of individuals who discuss 3D photography and closely allied subjects via electronic mail. An article posted to the group will literally be read by and get responses from a world-wide audience. This list of frequently asked questions about 3D has been compiled from discussions on the 3D mailing list, and other sources. Whenever possible, credit has been given to the sources used.

To subscribe to the 3D mailing list, send email to "listserv@lbl.gov", with the text "subscribe photo-3D *your name*" in the body of the email. An email introduction to the group will be returned to you. To report errors in this document or to suggest additions or changes, email to "Joel.Alpers@FtCollinsCO.NCR.COM" with the appropriate information.

1.2 Archives of articles in the 3-D mailing list[1]

You can obtain back issues of the 3d mailing list from an on-line server by e-mailing a request to the server address: listserv@vmd.cso.uiuc.edu In the e-mail text place your server commands. To get a file, put the command "get" in front of the two word file names. The names of the files for the 3d mailing list are currently "3d-photo" following by a space and then the string "logyymm" where "yymm" is replaced by the year and month. Send the following command to get the November archives:

```
get 3d-photo log8911
```

You may also obtain these same back issues and archives via FTP to host vmd.cso.uiuc.edu (128.174.5.98). Use the userid of "anonymous"; no password is required. Then CD to "listserv.193" to access the archives. To select the files of interest, form the filename WITH a dot (".") between the above two words on the FTP "get" command.

1.3 3D Basics

3D photography duplicates the way we view a 3D object or scene by taking a pair of photographs separated by a distance equal to the separation between a typical person's eyes. The two pictures then have a viewpoint similar to the view seen by the left and right eye. These images, if directed to the left and right eyes, are fused by the brain into a single image with the appearance of depth. Perhaps the most well-known example of this is the View-Master many of us have played with as children (of all ages).

2 Useful References

Reference books and materials recommended by the members of the 3D mailing list include:

Table 1: Useful references for stereo photography

Reference	Authors	ISBN #	Comments
Reel 3D Commonly Asked Questions	Reel 3D Enterprises, Inc.	n/a	Although many of these questions are covered here, this is a good list of common questions and their answers. You may get a copy by requesting a Reel 3D catalog (see *Suppliers* section for address)

1. Thanks to Chris Sherman for the info and Kevin Skelton for telling me about it!

Table 1: Useful references for stereo photography

Reference	Authors	ISBN #	Comments
The World of 3-D	Jacob G. Ferwerda	?	
Optics in Photography	Rudolf Kingslake	0-8194-0763-1	"The best technical book for the general audience" - John Bercovitz
Back-issues of the Reel 3D Newsletter (1978, 1979, 1980)	Compiled by David Stark and Susan Pinsky		Available as bound reprints from Reel 3D Enterprises in sets for each year.

3 Suppliers

Table 2: Suppliers of 3D equipment

Name	Address/Phone	Comments
Reel 3-D	P.O. Box 2368 Culver City, CA, 90231 (310) 837-2368 (310) 558-1653 FAX (orders only)	Large line of 3d slide mounts, slide and print viewers, reference materials, View-Master, cameras, equipment, etc.
3D mail list of suppliers	maintained by Tim Klein	An excellent and very comprehensive list of suppliers of 3D equipment and services. This list (in ASCII format) may be obtained by anonymous ftp from csg.lbl.gov (128.3.112.84).

4 Processing / Mounting

The following labs currently do processing and mounting of 3D slides. If you do you own mounting, you may find it useful to take your film to a convenient local lab and mark:

"Process only - do not cut - do not mount"

Table 3: Labs providing processing/mounting of 3D slides

Lab Name	Address	Comments
Qualex		
(Reel 3D list)		Reel 3D maintains a list in their catalog.

5 3D formats

5.1 Film Formats[2]

Several formats are currently in use for 3D photography, as shown in the following table:

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2. Sources: Reel 3D catalog, members of 3D mailing list

Note: All dimensions in mm unless otherwise noted.

Table 4: Common 3D film and mounting formats

Format Name	Film Dimensions	Exposures on roll of:		Slide Mounts		Comments
		135-20	135-36	Opening Size	Mount Size	
View-Master	12 x 13	37	69	10 x 11	3 17/32" (90mm) diameter circle holding 7 pairs	
Nimslo / Nishika	24 x 18	10	18	22 x 16	1 5/8" x 4"	4 side-by-side half frame images. Slide mounts hold 2 of the 4. Designed for special lenticular print
Half Frame	24 x 18, side-by-side on a 35mm frame	20	36		n/a	Typically produced by a beam-splitter arrangement
Realist	24 x 23	16	29	23 x 21.7	1 5/8" x 4"	Normal (7' stereo window)
				23.6 x 21.4	1 5/8" x 4"	Aluminum normal mount
				23 x 21	1 5/8" x 4"	Medium (4' stereo window)
				23 x 19.6	1 5/8" x 4"	Close-up (2 1/2' stereo window)
European	24 x 30	?	21	23.5 x 28	1 5/8" x 4"	
Twin 35mm	24 x 36	10	18	23 x 35	2" x 2"	Pair of standard 35mm slide mounts
				23 x 33	2" x 4 1/2"	Reel 3D "full frame" mount
Twin 2 1/4"	Mamiya - 56 x 56 Fuji 6x7 - 54.4 x 67.1 6cm x 6cm, 6cm x 7cm	n/a	n/a	n/a	n/a	from 120 or 220 rollfilm
Twin 4x5	3 3/4" x 4 3/4"	n/a	n/a	n/a	n/a	from 4x5 sheet film

5.2 Prints for viewing

The negative sizes for print films correspond to the film sizes in the previous section. Most common viewers used for prints accept print sizes of $3^1/_2$" x 5" or 4" x 6". Some older (commonly called "antique" or "parlor" viewers) take a cardboard holder (holding both left and right images) which is $3^1/_2$" x 7".

6 Free Viewing Stereo Pairs

Free viewing of stereo pairs refers to viewing two photos, drawings, etc. to see a 3D effect without using a viewing device to assist the eyes in "fusing" the two images together. Two basic methods may be used:

6.1 Parallel viewing

Pairs of stereo images for parallel viewing have the left image placed on the left side, and the right image on the right. To view, "defocus" your eyes in a manner similar to day-dreaming. After a time you will begin to see "double" images. If you begin to concentrate on the images in the center of your view, you should be able to get them to merge into a single 3D image.

6.2 Cross-eyed viewing[3]

Pairs of stereo images intended for cross-eyed viewing have the image intended for the left eye on the right side, and the right eye on the left side. To view a picture in stereo, display it in its entirety and cross your eyes so that the two halves of the image merge. It is often helpful to over-cross the eyes and let them relax somewhat until the scenes merge into a stereo view. Concentrate your attention on some prominent feature of the scene, preferably in the distance, and get these to merge first. Once full merging takes place you will be able to move your eyes around the scene at will.

Don't be discouraged if you don't achieve the stereo effect easily. Some people have more trouble than others, but cross-viewing is a skill than nearly everyone can learn. If you are new

to the technique, don't overdo it. Crossing the eyes tires muscles that are not used to being treated that way. Take frequent breaks until you have built up muscle strength through this unusual exercise. (You will not hurt your eyes in the process.)

(Note: I first learned to parallel free-view images, and had become quite quick at it by the time I first tried to cross-eye view an image. As a result, I had considerable trouble - I found that an aid which helped me was to use a pencil or other object held a short distance in front of the stereo pair. By focusing on this, I was able to get my eyes to cross at approximately the right angle - ed.)

6.3 Sample 3D images

If you have trouble finding images to practice on, or if you just want to look at some, check out the color GIF image files Duane Starcher has collected. They are available by anonymous ftp from morgan.ucs.mun.ca (134.153.2.99) in the directory "/pub/stereo". These are cross-eyed view images.

3. Thanks to Duane Starcher for this excellent description!

7 Stereo Cameras

7.1 Currently Manufactured

The cameras in Table 5 are currently available new.

Note: Costs are approximate, for information only.

7.2 Available used

The cameras in Table 6 are no longer available new. Many can be found in the used market, however. Possible sources to check are camera stores carrying used equipment, photography swap meets, flea markets, or the listings in *Shutterbug* magazine. Many of these cameras are circa 1950.

7.3 Custom Cameras

Custom 3D cameras are usually produced by the creative merging of two production cameras (usually 35mm). Some of the members of the 3D mailing list appear fluent in this rather drastic activity. More information will be put here as I find out who they are!

Table 5: Stereo Cameras currently available new

Model	Format	Approx Cost	Lenses	Focusing	Shutter Speeds	Sync.Flash	Film Counter	Double Exp		Features
								Prevent	Capable	
FED (Camera)	European	$450	38mm, f/2.8		$^1/_{30}$ - $^1/_{500}$, B	Y				Russian made. Fully automatic exposure
(Kit)										Includes camera, projector, slide mounts, viewer.
ImageTech										
Loreo	Half Frame	$120		fixed focus						Relies on print film lattitude - two aperatures ("Mr. Sun" and "Flash"). Includes viewer for $3^1/_2$ x 5 prints.
Nishika	Nimslo / Nishika	$200								

Table 6: Stereo Cameras no longer manufactured, available used

Model	Format	Estimated #[a] Manufactured	Lenses	Focusing	Shutter Speeds	Sync.Flash	Film Counter	Double Exp		Features
								Prevent	Capable	
Belplasca	European	8,000								
Busch Verascope F40	European		40mm f/3.5	rangefinder	1s - 1/250, T, B	Y	Y	Y	Y	Coupled film / shutter cocking. Stereo or single frame
Challenger Stereo	Realist		35mm f/3.5	manual	1/10 - 1/100, T, B	Y				focusing scale
Delta Stereo	Realist			fixed focus	1/25 - 1/100, B	Y				coupled film/shutter, single frame capable.
Edixa Stereo IA	Realist		35mm f/3.5	manual	1/25 - 1/200	Y		Y		coupled film/shutter
IB	Realist		35mm f/3.5	manual	1/10 - 1/200, B	Y		Y		
IIA	Realist		35mm f/3.5	rangefinder	1/10 - 1/200, B	Y		Y		self timer
IIIA	Realist		35mm f/3.5	rangefinder	1/10 - 1/300, B	Y		Y		self timer, exposure meter
Iloca I	European									
II	Realist	30,000	35mm f/3.5	manual	1s - 1/300, B	Y	Y	Y	-	self timer, Depth of field scale
Rapid	Realist	10,000								
Kin-Dar	Realist	6,000	35mm f/3.5	rangefinder	1/10 - 1/200, B	Y	Y			Depth of field scale, flash exposure scale
Kodak Stereo	Realist	110,000	35mm f/3.5		1/25 - 1/200, B	Y				bubble level in viewfinder
Nimslo	Nimslo/Nishika		30mm f/5.6 (4 lenses)	fixed focus	1/30 - 1/500	Y				fully automatic
Owla	Realist	1,000								
Revere 33	Realist	30,000	35mm f/3.5	rangefinder	1/2 - 1/200, T,B	Y		Y	Y	coupled film/shutter cocking, viewfinder parallax adjustment, bubble level.
Stere-All	Realist	6,000	35mm f/3.5	fixed focus?	1/50 fixed, M	Y	Y	Y		
Stereo Graphic	Realist	15,000	35mm f/4	manual	1/50 fixed, B	Y		Y		
Stereo Realist ST41	Realist	130,000	35mm f/3.5	rangefinder	1s - 1/150, T, B	Y				focusing scale, Depth of Field scale
ST42	Realist		35mm f/2.8	rangefinder	1s - 1/200, T, B	Y				same as ST41
ST44	Realist		35mm f/3.5	rangefinder	1/25 - 1/200, B	Y		Y		focusing scale
TDK Stereo Colorist I	Realist		35mm f/3.5	manual	1/10 - 1/200, B	Y	Y	Y		3 ft min focus
Stereo Colorist II	Realist		35mm f/3.5	rangefinder	1/10 - 1/200, B	Y	Y	Y		

Table 6: Stereo Cameras no longer manufactured, available used

Model	Format	Estimated #[a] Manufactured	Lenses	Focusing	Shutter Speeds	Sync.Flash	Film Counter	Double Exp		Features
								Prevent	Capable	
Stereo Vivid	Realist	20,000	35mm f/3.5	rangefinder	$^1/_{10}$ - $^1/_{100}$, B,M,F	Y		Y	Y	$2^1/_2$ ft min focus, DOF scale, coupled film/shutter, bubble level, continuously variable shutter spd
View-Master Personal	View-Master		25mm f/3.5	fixed focus	$^1/_{10}$ - $^1/_{100}$, B	Y				
Mark II	View-Master									
Wollensak Model 10	Realist	5,000	35mm f/2.7	rangefinder	$^1/_2$ - $^1/_{300}$, B	Y		Y		
Wirgen	Realist	5,000								
Videon I	Realist	1,000								
II	Realist	1,000								

a. Estimates of number of cameras manufactured are generally made by surveys of serial numbers of cameras owned by collectors / club members. They are estimates only, and in some cases may be somewhat optimistic.

7.4 Other Techniques

7.4.1 Twin Camera

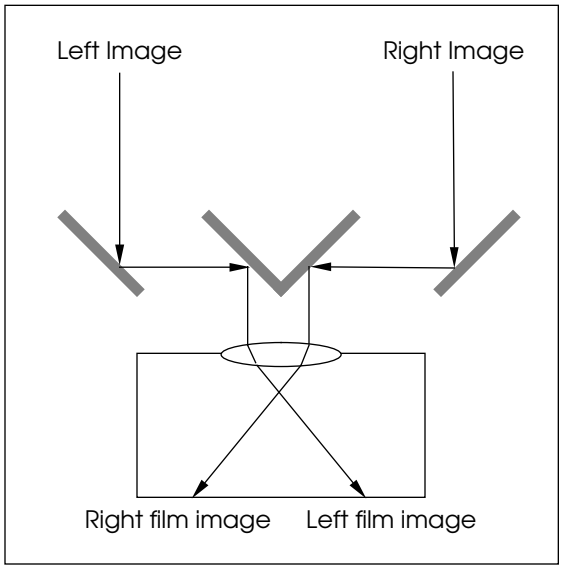
This technique uses two "identical" cameras mounted on a firm support (These are available from the suppliers, or you may build your own), and some means of synchronizing the shutters on the two cameras (see the section entitled *Shutter / Flash Synchronization*). Because of the lens-to-lens separation required, this method is not generally good for close-up photos.

7.4.2 Slide Bar

This technique involves using a purchased or constructed slide bar and a single camera to make both exposures. The author has used an aluminmum plate with the edges folded to make a support against which the camera can rest, with a ruler glued to the back to determine the amount of image separation. The drawback to this technique is that the subject must be stationary between the two exposures. In spite of this, I have taken numerous successful landscape stereo pairs this way.

7.4.3 Beam Splitters[4]

This system involves a system of mirrors or prisms which fit in front of the normal lens of an SLR, and "split" the film into a left and right version. A model using mirrors operates like this:



A similar arrangement is built into a viewer used to view either the slides or prints produces. (The images may also be free-viewed, cross-eyed method). Equipment currently available new using this principle includes a 35mm attachment made by Pentax (which can be used with any SLR which has 49 or 52 mm filter threads on the lens - two different Pentax models), and the Loreo camera.

8 The Stereo Window

4. Much of this material taken from an article by David Starkman in *Reel 3D News*, Volume 1, No. 3

9 Projection

Basically, projection of 3D slides involves:

1. Use of a dual-lens projector, or two single-lens projectors
2. Polarized filters over each projection lens are aligned at right angles
3. Use an aluminum or lenticular screen, not a white one.
4. Polarized glasses are worn which match the alignment of the projector lens polarizing filters.

10 Close-up Photography

11 Photomicrography

12 Astrophotography

NOTE: There was recently a discussion on astrophotography, but unfortunately I do not have any of the articles saved. If someone could forward me copies or summarize, I will include the information here.

13 HyperStereo[5]

Hyperstereo refers to using a larger than normal base, or separation between the lenses taking the left and right images. Usually this is obtained by using either two cameras widely separated, or by separate shots made by the same camera tens or even hundreds of feet apart. This can effectively give a stereo effect to distant objects which would not normally display much.

When shooting a hyperstereo pair, you should bear the following in mind:

5. As a *guideline*, use a separation of approximately $^{1}/_{50}$ of the distance to your main subject.
6. Try to take both photos from the same "level" - avoid vertical changes between photos.
7. Unlike normal stereo, avoid foreground objects as much as possible - they can be very distracting
8. You will need some method to synchronize the framing of the two images. Use registration marks in the viewfinder, objects at the edge of the frame, etc. to adjust both images within the viewfinder.
9. You may find it useful to switch to manual exposure to make sure both exposures are the same.
10. David suggests this for mountain scenes, city scenes taken from opposite sides of a tall building.

14 Shutter / Flash Synchronization[6]

This topic applies to twin-camera setups, and refers to the difficulty of synchronizing the shutter mechanisms of two separate cameras. This is especially critical when using flash, due to the extremely short duration of

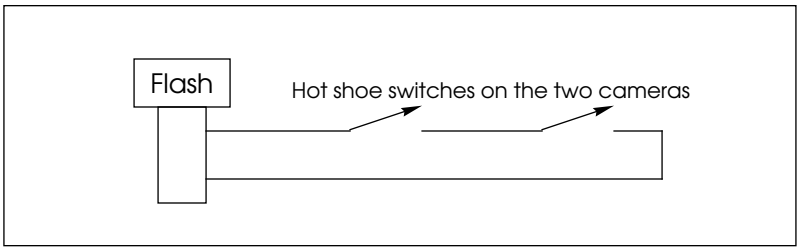
5. *Hyperstereo* by David Starkman, *Reel 3D News*, Volume 1, No. 6.
6. Much of this paraphrased from Alexander Klein, <100041.212@COMPUSERVE.COM>, and John Bercovitz.

typical flash units. Shutters on both cameras must be completely open when the flash occurs. Methods of addressing this include:

Table 7: Shutter Synchronization Methods

Method	Advantages	Disadvantages	Comments
Dual Cable Release	Inexpensive	Poor synchronization	The button must be pushed quickly to get reasonable sync (some hit the button). Sync may not be good enough to use flash
Spring-loaded			
Air-pressure	Good for SLR's up to several feet apart		
Solenoids	Most accurate of mechanical solutions		Suggest use of a storage scope for adjustment
Electrical	Good synchronization		For cameras with electrically-activated shutter

For flash synchronization, the following method has been tried with a camera with electric cable release (specifically the Minolta X-700)[7]



This has the effect of ANDing the two camera hot shoe switches, causing the flash to not fire until both shutters are closed. Kevin cautions: "It was a little tricky getting the wires right, and I got zapped a few times because I forgot that the outer connections of cameras' pc-jacks are already connected via the bodies and aluminum plate they're mounted on".

15 Special Effects

15.1 Time Exposures

A recent discussion on the 3D mailing list suggested that interesting stereo effects can be had by "painting with light", using a long time exposure in a dark setting, while a person moves a sparkler, flashlight, or other light source in a 3D pattern in front of the camera. If desired, a flash may be fired sometime during the exposure to freeze a picture of the person doing the movement. The light trails will come out in 3D.

*** Anyone care to recommend a starting point for the exposure?

7. Credits to Dave Horn, John Bercovitz, and Kevin Skelton

16 Stereo Clubs / Associations / Periodicals

Table 8: Stereo Clubs / Associations / Periodicals

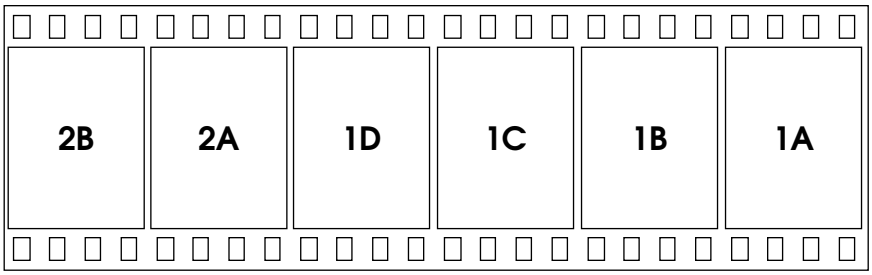
Name	Address	Publication
National Stereoscopic Association	P.O. Box 14811 Columbus, Ohio 43214	Stereo World
Stereo Club of Southern California	????	3-D NEws
International Stereoscopic Union	ISU P.O. Box 19-119 Hamilton, New Zealand <100041.212@CompuServe.COM>	magazine published quarterly.
View-Master / Tru-Vue Collectors Association	V.T.C.A Box 47891 Minneapolis, MN 55447 USA	_ReView_ (newsletter)

Appendix A: Film Image Format

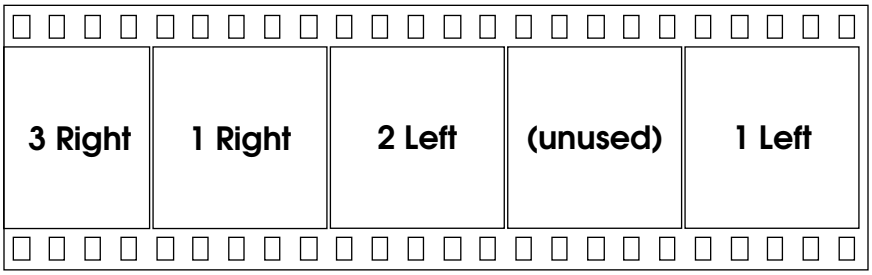
This appendix gives the placement on film of several 3D formats. These appear actual size in the original print of this FAQ. The same length of film is shown in all cases for comparison purposes, even though this does not always allow an even number of frames to be shown (i.e. the Realist and European formats)

A.1 View-Master

A.2 Nimslo / Nishika - 4 sprocket

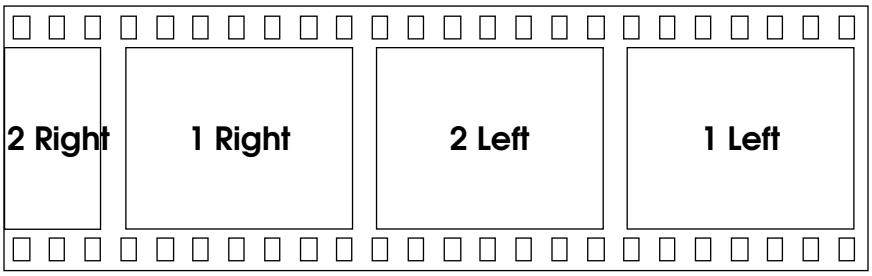


A.3 Realist - 5 sprocket



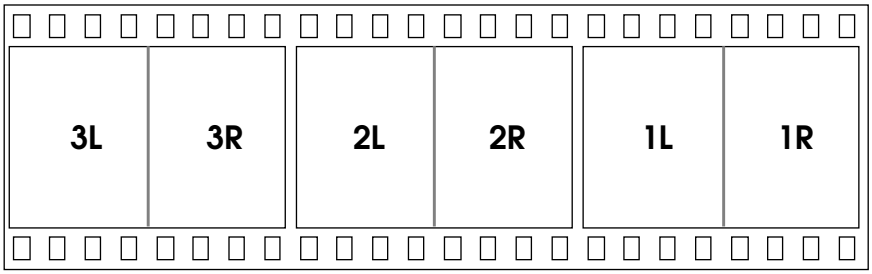
In this format, the film advances two frames for each exposure. This results in an unused exposure at the beginning and end of the film. The extended film sequence is 1L-unused-2L-1R-3L-4R-4L-3R- etc.

A.4 European - 7 sprocket

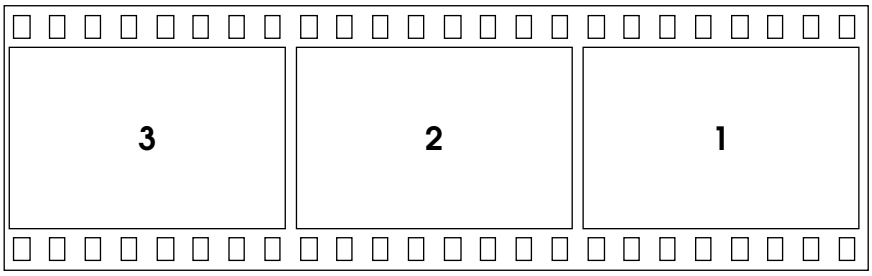


This pattern requires the camera to advance first one frame, then three frames - the extended sequence on film is 1L2L1R2R - 3L4L3R4R - 5L6L5R6R - etc.

A.5 Half-Frame - side-by-side on 8 sprocket



A.6 Standard 35mm - 8 sprocket



Appendix B: Quotable Quotes

"Get some of those 3D glasses and put them on. Get enough pairs to make it up to, say, 10 or 12 D."

Comedian Steven Wright

"A man can give a very close friend advice about the choice of a wife, or cigarettes - but, if he values that friendship, will never offer advice about the choice of an auto, or a camera."

Herbert C. McKay, on the choice of format for 3D photography.