D.O. Industries, Inc.

FUJINON LENSES

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1 Basic Knowledge

Large format cameras have many advantages over those of smaller formats. Among them is the ability to adjust depth of field, to control perspective using the cameras' movements (tilts and swings), and a larger negative size allowing sharper photographs with excellent tonal range.

Consequently, the lenses used with large format cameras offer a wider image circle to correspond to the larger negative size and camera movements.

(1) Angle of Coverage and Image Circle

The image circle is the diameter of the area of light over which the lens can reproduce an image sharply, or in other words, the area which can be used to record the photograph. In small format cameras, if the image circle is adequate to cover the parallel angular line of the film size, the lens can be used without any problem. However, with large format cameras, because there is variation in the degrees of camera movements and film size, it would be inadequate for the lens to merely cover a fixed picture area.

Consequently, the word 'angle of coverage' is the term used to express the section of the picture area which the lens has the capacity to cover. 'Angle of coverage then expresses the parallel angle in relation to the area of light which the lens has the capacity to photograph.

On the other hand, the picture angle is the parallel angle in relation to the film size from the center of the lens.

"Angle of coverage" then, is the term for describing the lens performance which does not vary in relation to the size of the picture area available. It is calculated as Image Circle = tan ω x f (focal length)

Relationship between the Image Circle and the Picture Angle

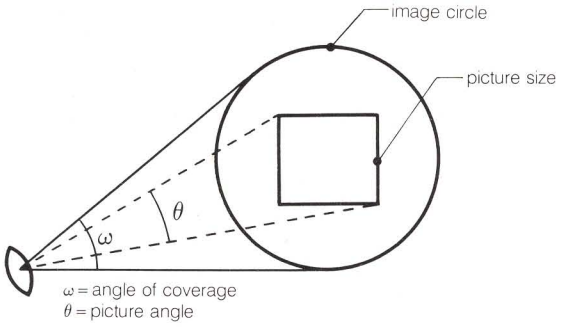


Image Circle = tan.ω × f (focal length)

Ref. 1. The image circle of the Fujinon SWD65 f5.6 is expressed as:
tan 105° × 65 = 169ϕ
2. The image circle of the EBC Fujinon W210 f5.6 is expressed as:
tan 71° × 210 = 300ϕ

(2) Leaf Shutters of Large Format Lenses

Since large format cameras use lenses of various makes, they generally do not come equipped with shutters of their own.

Consequently, since the shutter is limited to the type of shutter which can be used inside of a lens, leaf shutters are generally used.

Types of Leaf Shutters

(A) Mechanical Shutter

This type is generally used in large format cameras, and all parts are mechanically operated. They are usually operated in the following manner:

1. Set the shutter release
2. Check the focus by pressing the focus lever to open the shutter leaves.
3. Close the shutter and press the shutter release button.

(B) Electronic Shutter

Electronic shutters operate in the same manner as mechanical shutters. However with these, the shutter speed is controlled electronically, and for this reason, high precision shutter response is needed, especially for long exposures. They are consequently equipped with long shutter speeds of up to 32 seconds.

(C) Press Shutter

This is a mechanically operated shutter. However, since there is no need to set the shutter release, it offers excellent operability. Unfortunately, these shutters do not have fast shutter speeds and so they are not very effective for photographing fast moving subjects. Also, since the lens cannot be stopped down when the shutter is open, there is a problem with photographing commercial subjects because it is impossible to check the depth of field. For these reasons, its main uses are in photographic equipment (CRT cameras, etc) used in measuring instruments.

The camera manufacturer Wista has taken advantage of the merits of this shutter to develop a camera which opens and closes the shutter blade by linking it up with the holder insert. This is now being sold as the Wista shutter.

Recently, the CVS shutter designed for the Copal View System, entered the market for sale. This shutter operates the blades and controls the timing electronically.

Also, two systems which make exposure metering possible, the Sinar Digital Exposure Meter and the Pronter Auto Lock System are now being sold. Thus, in line with the trend, products offering simplified operation and greater precision are now available.

2 Features and Typical Uses of the Fujinon Lens Series

Type		General Features	Individual Lens/Uses		Types of Shooting
SWD	Super Wide Deluxe	Ultra wide lens designed with 105° angular coverage; large f5.6 maximum aperture; wide coverage circle and short focal length enable shooting in confined areas.	65mm	Shortest focal length for camera movements in 4″×5″ format	Scenery, Architecture, Interiors
			75mm	Focal length corresponds to 1/2 that of the standard picture angle of the 4″×5″ format. Good for interiors of apartments, and other confined areas.	Scenery, Architecture, Interiors, Commercial products
			90mm	The most widely used wide-angle lens for the 4″×5″ format. An essential lens for the photographer because it has wide camera movements for universal application.	Scenery, Architecture, Interiors, Commercial products, Group portraits
SW	Super Wide	Ultra wide angle lens designed with 100° angular coverage; f/8 maximum aperture, provides compactness and value in a wide angle lens.	90mm	Universal application; a good value in a wide angle lens. Offers sharpness and peripheral brightness to the edges of the 4″×5″.	Scenery, Architecture, Interiors, Commercial products, Group portraits
			105mm	A unique focal length for a wide angle lens. Gives a narrower viewpoint when the 90mm is too wide.	Scenery, Architecture, Interiors, Commercial products, Group portraits
			125mm	A Fujinon lens for creative applications. The wide image circle effectively covers 8″×10″ format, makes 4″×5″ format camera movements virtually unlimited.	Scenery, Architecture, Interiors, Commercial products, Group portraits
W	Wide	A versatile series using a new 6-element in 6-group design for perfect corvection on various aberration. Has a wide range of capabilities.	105mm 125mm 135mm	The W-Series features shorter focal length lenses, and a wide image circle; useful for semi-wide angle, compact 4″×5″ applications.	Scenery, Interiors, Commercial products, Group portraits, 6×9 format portraits
			150mm 180mm 210mm 250mm	The most prominent lenses in the W-Series, offering excellent color rendition and sharpness with a wide-image circle. The standard Fujinon lenses to meet 4″×5″ format requirements.	Universally used for Scenery, Commercial products, Portraits, etc.
			300mm 360mm	Long focal length for 4″×5″ photography. Camera movements are sufficient to use as a standard 8″×10″ lens.	Scenery, Commercial products, Portraits
L	Long Focus	Long focus lenses with compact 4-element design at a reasonable price. The image circle is smaller than the wide angle lens. Good for mid-range coverage.	210mm	Compact design makes it more convenient for shooting on location. Its performance equals the 210W lens with the 4″×5″ format when minimum camera movements are required.	Scenery, Commercial products, Portraits
A	Apochromat	Specially designed lenses for close-up and copy work. Outstanding sharpness and perfect correction of color aberrations on blue, green, and red. Its compactness makes it excellent for location work, compensating for loss of lens speed.	180mm 240mm	Excellent for precision close-ups of smaller items such as jewelry, watches, and miniature products. Reproduces minute detail effectively.	Copy, Product, Close-ups, Scenery
T	Telephoto	Long focal length with telephoto design. Requires minimal bellows extension in spite of telephoto length. Especially suitable for field cameras having limited bellows extension.	300mm	An ultra-compact telephoto for use with the #0 shutters. Excellent as a 6×9 format telephoto with Horseman camera.	Scenery, Portraits
			400mm	Typical T-type lens to give a telephoto perspective with the 4″×5″ format. Compact when fitted to the Horseman.	Scenery, Portraits
			600mm	The longest telephoto available for use with the Linhof Technica; gives a dramatic effect with 4″×5″ format.	Scenery, Portraits
SF	Soft-Focus	A high quality soft focus lens with the necessary amount curvature of field aberration for this flattering effect which cannot be provided by soft focus filters. A custom grit provides adjustable soft focus.	180mm	Suitable for 6×9 format shoulder length portraits, or full length portraits with a 4″×5″ format. Soft, flattering effect.	Portraits
			250mm	Excellent portrait lens for 4″×5″ format.	Portraits

Leaf Shutter Categories by Size

In order to provide mounting adaptability and matching to the specific lens sizes, leaf shutters are made available in various sizes. The standards for size are determined by the maximum diameter of the shutter.

The shutters presently available in large format lenses are listed below.

Size	Maximum diameter	Fujinon lens with shutter
#00	18mm	Fujinon·SWD, SW Series
#0	24mm	Fujinon·W105~150 Fujinon·A180, 240 Fujinon·T300
#1	30mm	Fujinon·W180~250 Fujinon·C300, C450 Fujinon·T400, 600 Fujinon·L210 Fujinon·SF180
#3	42mm	Fujinon·W300·360 Fujinon·C600 Fujinon·SF250

(3) Types of Lens Boards

Lens boards are available so that various types of lenses can be fitted to different makes of large format cameras. These lens boards are available in different types, depending on the camera size, its functional capability, and structure. Generally, the following types of lens boards are used.

Board	Size	Camera
View camera board	Large format	Measurements differ depending on the camera. Boards must be customized for the lens in use. (The same board can be used for the Sinar and Horseman L45.)
Linhof board	Medium format	The Linhof Technica Series, and the Wista 45 Series.
Spiegler board	Medium format	Graflex Graphics Series, and the Toyo Super Graphic.
Horseman board	Small format	Horseman Press Series, and Horseman VH, VHR.

Depending on the structure of the camera, there are instances when the shutter release operating lever sometimes gets in the way, the focal length is too long, or the bellows doesn't extend far enough. In these situations, rather than attach the lens directly to the lens board, an adaptor* ring is often used.

* These adaptor rings are not readily available from lens and camera makers.

(4) Types of Shutter Retaining Rings

A shutter retaining ring is used on the back of the shutter in order to use large-format lenses with cameras of different brands, and boards are available for using large-format cameras with lenses of various types and brands. Consequently, the shutter retaining ring is needed to affix the lens to the lens board. The shutter retaining ring is selected on the basis of shutter size (#0, #2, etc.) and is affixed to the shutter when you buy the lens, and the said ring is always attached to the shutter of Fujinon lens.

● Retaining Ring

View cameras, press cameras, and field cameras, almost always feature metal lens boards. These can be attached by the retaining ring provided on Fujinon lenses.

● Washer

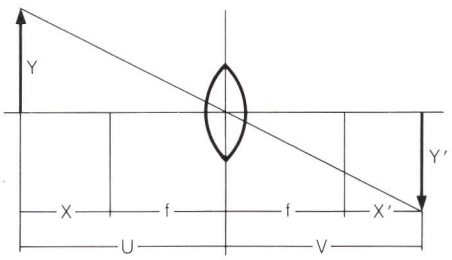
Lenses cannot be mounted onto the wooden lens boards of dark boxes and wooden cameras. To mount the lenses onto wooden lens boards, washers are needed. Washers also differ to match the shutter size as follows.

Washer	Lens
SO, SV — VO	For lenses equipped with Copal #0 shutters.
C1, CV — V1	For lenses equipped with Copal #1 shutter.
C3, SC (CV — V3)	For lenses equipped with Copal #3 shutters. The washer is attached to the Fujinon lens equipped with Copal #3 shutter.

(5) Calculating Lens/Distances (Lens Selection)

There are several factors to consider when selecting a lens; among them are sharpness, color rendition, perspective, contrast, image circle, the individual lens effect, as well as precision operation of the shutter diaphragm, and operating ease. Furthermore, other factors are important as well, such as its ability to be mounted on the camera, and the size of the studio, especially in relation to the working distance. Listed below are some simple formulas for calculating the working distance based on focal length in relation to the bellows extension.

Formula for determining the lens/distance relationship



Y: Size of the subject
Y': Image size on film
M: Magnification Y'/Y
f: Focal length of lens
U: Shooting distance (corresponds to the working distance from the subject to the lens)
V: Image distance (corresponds to the bellows extension for the distance from the film plane to the lens)
X: Difference between shooting distance and focal length
X': The difference between the image distance and the focal length-image distance.

Basic Relationships

$$\frac{Y'}{Y}=M=\frac{v}{u}=\frac{v-f}{f}=\frac{f}{u-f} \quad \cdots\cdots (1)$$

Image Size (Magnification)

$$Y'=\frac{Y\times f}{u-f} \quad \cdots\cdots (2)$$

Shooting Distance

$$u=(\frac{1}{M}=1)\times f=\frac{f\times v}{v-f}=\frac{Y\times v}{Y'} \quad \cdots\cdots (3)$$

$$u=f+x=f+\frac{f^2}{x'} \cdots\cdots (4) \qquad x=\frac{f^2}{x'} \cdots\cdots (5)$$

Lens Focal Length

$$f=\frac{u}{(\frac{1}{M}+1)}=\frac{v}{(M+1)} \quad \cdots\cdots (6)$$

Image Distance

$$v=(M+1)f=\frac{f\times u}{u-f}=M\times u \quad \cdots\cdots (7)$$

$$v=f+x'=f+\frac{f^2}{x} \cdots\cdots (8) \qquad x'=\frac{f^2}{x} \cdots\cdots (9)$$

Example 1

When making a full length portrait with the Fujinon SF 180mm lens, to reproduce the image of a model 170cm tall at 9cm size on the film using a 4″×5″ format, you would use the following calculations.

$$u=(\frac{1}{M}+1)\times f=(\frac{\frac{1}{9cm}}{170cm}+1)\times 18cm$$

$$=(\frac{170cm}{9cm}+1)\times 18cm=358cm\fallingdotseq 360cm$$

Answer: The camera working distance is 3.6m.

Example 2

To reproduce the sideview of an automobile 4.5m in length with a working distance of 10m inside a studio and the subject is 9cm in size on the film using a 4″×5″ format, you would select the focal length of the lens as follows.

$$f=\frac{1}{\frac{1}{M}+1}\times u=\frac{1}{\frac{1}{\frac{Y'}{Y}}+1}\times u=\frac{1}{\frac{Y}{Y'}+1}\times u$$

$$f=\frac{1}{\frac{450cm}{9cm}+1}\times 1000cm$$

$$=\frac{1000cm}{50+1}=19.6cm$$

Answer: f = 180mm lens or shorter

Example 3

If you were photographing jewelry 15mm in size with the Fujinon A180 f/9 lens and you wanted it to have an image size of 2mm on film, you would calculate the required bellows extension as:

$$V=(M+1)\times f=(\frac{Y'}{Y}+1)\times f$$

$$=(\frac{20}{15}+1)\times 180$$

$$=(1.33+1)\times 180$$

$$\fallingdotseq 420mm$$

Answer: The required bellows extension is about 42cm. However, as camera movements are required in many cases, you may need a viewcamera system of which bellows will extend further.

(6) Quick Lens Selection Reference Chart (for shooting distances and magnification selection)

Magnification / Focal Length / Shooting Distance	3	2	1	8/10	6/10	1/2	1/3	1/4	1/5	1/8	1/10	1/15	1/20	1/30	1/50	1/100
50cm	375	334	250	220	188	167	125	100	83	56	45					
80cm	600	534	400	352	300	266	200	160	133	89	73	50				
1m	750	667	500	440	375	333	250	200	167	111	91	63	48			
1.5m		1,000	750	660	563	500	375	300	250	167	136	94	71	48		
2m			1,000	880	750	666	500	400	333	222	182	125	95	65	39	
2.5m				1,100	938	833	625	500	417	278	227	156	119	81	49	25
3m					1,125	999	750	600	500	333	273	188	143	97	59	30
4m						1,332	1,000	800	667	444	364	250	190	129	78	40
5m							1,250	1,000	833	556	455	313	238	161	98	50
6m								1,200	1,000	667	545	375	286	194	118	59
8m									1,334	889	727	500	381	258	157	79
10m										1,111	909	625	476	323	196	99
20m											1,818	1,250	952	645	392	198
30m												1,875	1,429	968	588	297

How to Use the Chart

The number at the intersection of the magnification ratio (at top) and the shooting distance (at left) indicates the required focal length.

Example 1

To photograph a child 150cm tall in a studio with a working distance of 3 meters, and the subject is to have an image size of 10cm on the film with a 4″×5″ format, the lens should be selected as follows:

$$\text{Magnification: } \frac{10}{150}\text{ cm} = \frac{1}{15}$$

Thus, as the chart indicates, 188mm at 1/15 and 3 meters, indicates that a lens up to 180mm at 3 meters would be suitable. The next lens size, a 210mm lens, would require a distance of 3 to 4 meters. The best lens for the above situation would be the EBC Fujinon W180 f5.6 lens.

Example 2

To photograph a 10-meter high, three story house, with an 8″×10″ format at a working distance of 20 meters, the proper focal length would be selected as follows:

$$\text{Magnification: } \frac{20\text{cm}}{10\text{m}} = \frac{20}{1000}\text{ cm} = \frac{1}{50}$$

Thus, as the chart indicates, 392mm at 1/50 and 20m, requires a 360mm focal length lens. If a 450mm lens were selected, a longer shooting distance would be necessary. For this shooting situation, the EBC Fujinon W360 f6.3 lens, or the slightly longer Fujinon C450mm f12.5 could be used (if there is more distance available).

3 General Uses for the Fujinon Lenses (4″ x 5″ format)

Lens		Scenery	Portraits			Products, Foods, Flowers			Architecture, Interiors	Airports
Type	Focal Length		Close-up	Bust	Full-length	Small (watches)	Medium (T.V.)	Large (refrigerators)		
SWD	65	○						△	○	
	75	○					△	△	○	△
	90	○				△	○	○	○	○
SW	90	○				△	○	○	○	○
	105	○				○	○	○	○	○
	125	○				○	○	○	○	○
W	105	○				○				○
	125	○			△	○	○	○	△	○
	135	○			○	○	○	○	○	○
	150	○		△	○	○	○	○	○	○
	180	○	△	○	○	○	○	○	○	○
	210	○	○	○	○	○	○	○	○	○
	250	○	○	○	○	○	○	○	○	○
	300	○	○	△		△	○	○		
	360	○	○				○	○		
L	210	○	○	○	○		○	○		○
	300	○	○	△			○	○		
A	180	○				○	○	△	△	○
	240	○				○	○	△	△	○
	300	○				△	○	○		
	360	○					○	○		
T	300	○	○							
	400	○	○							
	600	○	△							
SF	180		△	○	○					
	250		○	○	○					

○ — Generally used
△ — used in certain situations
Blank — Rarely used except in special cases
* — The above examples are given mainly for the 4″ x 5″ format.

4 Mountability of Fujinon Lenses with Various Cameras

Lens \ Camera		6×9	4×5				5×7	8×10
		Horseman	Linholf Technica	Toyo Field 45A, Wista 45 Series	Speed Graflex	View camera	View camera	View camera
SWD	65	○	○ Note 4	○ Note 6	○	○ Note 6		
	75	○	○ Note 4	○ Note 6	○	○ Note 6	○	
	90		○ Note 4	○	○	○	○	
SW	90		○ Note 4	○	○	○	○	
	105		○	○	○	○	○	
	125					○	○	○ Note 7
W	105	○	○	○	○	○		
	125	○	○	○	○	○		
	135	○	○	○	○	○	○	
	150	○	○	○	○	○	○	
	180	○ Note 1	○	○	○	○	○	
	210	○ Note 1	○	○	○	○	○	○ Note 7
	250	○ Note 1	○	○	○	○	○	○
	300		△	△	△	○	○	○
	360					○	○	○
L	210	○ Note 1	○	○	○	○	○	
	300		△	△	△	○	○	○
T	300	○	○	○	○	○	○	
	400	○ Note 2	○	○	○	○	○	
	600		○ Note 5			○	○	
A	180	○	○	○	○	○	○	
	240	○ Note 3	○	○	○	○	○	○
	300		△	△	△	○	○	○
	360		△			○	○	
SF	180	○ Note 1	○	○	○	○	○	
	250		○	○	○	○	○	○ Note 7

Note 1 — Requires Adaptor Ring for #1 shutter.
Note 2 — A custom Horseman Adaptor Ring is required for close focusing.
Note 3 — #1 Shutter Adaptor Ring is required (will not focus at close range).
Note 4 — Requires a wide board.
Note 5 — Advisable to use an adaptor ring for getting in focus in midrange shooting.
Note 6 — Advisable to use a wide board for rendering adequate camera movements.
Note 7 — Vingetting will occur when shooting at infinity.
△ — Will not focus at close range.

■ Concerning the Camera Brands

- Horseman Press means the Horseman 900 Series and VH, VHR.
- Wista 45 Series: Some of these cameras in this series which will accept an extra long bellows, can be used with lenses having longer focal lengths than indicated on the chart.
- View cameras: Includes the typical view cameras such as the Horseman, Sinar, Toyo View, Linholf, etc., with the features of extension monorail, compatible wide angle bellows, and other systems.

Note: Due to the possibility of specification changes by the various camera manufacturers, be sure to check with the manufacturer before making selections.

5 Relationship of Focal Length and Picture Angle by Picture Formats

▼Format size	Focal length (mm)▲ Picture angle▼	13	15	17	18	19	20	21	24	25	28	30	35	40	45	50	55	58	60	75	80
35mm	Diagonal 43.5	118.3	110.8	103.9	100.8	97.7	94.8	92.0	84.3	82.0	75.7	71.9	63.7	57.1	51.6	47.0	43.2	41.1	39.8	32.3	30.4
	Longer side 36.0	108.3	100.4	93.3	90.0	86.9	84.0	81.2	73.7	71.5	65.5	61.9	54.4	48.5	43.6	39.6	36.2	34.5	33.4	27.0	25.4
	Shorter side 24.0	85.4	77.3	70.4	67.3	64.6	61.9	60.7	53.1	51.3	46.4	43.6	37.9	33.4	29.9	27.0	24.6	23.3	22.6	18.2	17.0
4.5×6	Diagonal 70.0	139.2	133.6	128.2	125.6	123.0	120.5	118.0	111.1	108.9	102.7	98.8	90.0	82.4	75.7	70.0	64.9	62.2	60.5	50.0	47.3
	Longer side 56.0	130.1	123.6	117.5	114.5	111.7	108.9	106.3	98.8	96.5	90.0	86.1	77.3	70.0	63.8	58.5	54.0	51.5	50.0	40.9	38.6
	Shorter side 42.0	116.5	108.9	102.0	98.8	95.7	92.8	90.0	82.4	80.1	73.7	70.0	61.9	55.4	50.0	45.6	41.8	39.8	38.6	31.3	29.4
6×6	Diagonal 79.5	143.8	138.7	133.7	131.3	128.9	126.6	124.3	117.8	115.7	109.7	105.9	97.3	89.6	82.9	77.0	71.7	68.8	67.5	55.8	52.8
6×7	Diagonal 88.0	147.0	142.4	137.8	135.5	133.3	131.1	129.0	122.8	120.8	115.0	111.4	103.0	95.5	88.7	82.7	77.3	74.4	72.5	60.8	57.6
	Longer side 68.0	138.2	132.4	126.9	124.2	121.6	119.1	116.6	109.6	107.3	101.0	97.1	88.3	80.7	74.1	68.4	63.4	60.8	59.0	48.8	46.0
6×9	Diagonal 400.0	150.9	146.6	142.4	140.4	138.4	136.4	134.4	128.7	126.9	121.5	118.1	110.0	77.3	96.0	90.0	84.5	81.5	79.6	67.4	64.0
	Longer side 83.0	145.2	140.3	135.4	133.1	130.8	128.5	126.3	120.0	117.9	112.0	108.3	99.7	92.1	85.4	79.4	74.0	71.1	69.3	57.9	54.8
4×5	Diagonal 155.0	160.9	158.0	155.2	153.8	152.4	151.0	149.6	145.6	144.2	140.3	137.7	131.4	125.4	119.7	114.3	109.3	106.4	104.5	91.9	88.2
	Longer side 121.0	155.7	152.2	148.6	146.9	145.1	143.4	141.7	136.7	135.1	130.3	127.2	119.9	113.1	106.7	100.9	95.5	92.4	90.5	77.8	74.2
	Shorter side 96.0	149.7	145.3	140.9	138.9	136.8	134.8	132.7	126.9	125.0	119.5	116.0	107.8	100.4	93.7	87.7	82.2	79.2	76.8	65.2	61.9
5×7	Diagonal 208.0	165.8	163.6	161.4	160.4	159.3	158.2	157.2	154.0	153.0	150.0	147.8	142.8	137.9	133.2	128.6	124.2	121.7	120.0	108.4	104.9
	Longer side 170.0	162.0	160.0	157.4	156.0	154.8	153.5	152.2	148.5	147.2	143.5	141.1	135.2	129.6	124.2	119.0	114.2	111.4	109.6	97.2	93.5
	Shorter side 120.0	155.5	152.0	148.4	146.6	144.9	143.1	141.4	136.4	134.8	130.0	126.9	119.5	112.6	106.3	100.4	95.0	92.0	90.0	77.3	73.7
8×10	Diagonal 311.0	170.4	169.0	167.5	166.8	166.0	165.3	164.6	162.5	161.7	159.6	158.1	154.6	151.1	147.7	144.3	141.0	139.0	137.8	128.5	125.5
	Longer side 244.0	167.8	165.9	164.1	163.2	162.3	161.4	160.5	157.7	156.8	154.1	152.4	148.0	143.7	139.5	135.4	131.5	129.1	127.6	116.8	113.5
	Shorter side 194.0	164.7	162.4	160.1	158.9	157.8	156.7	155.5	152.2	151.0	147.8	145.6	140.3	135.2	130.2	125.5	120.9	118.2	116.5	104.6	101.0

▼Format size	Focal length (mm)▲ Picture angle▼	85	90	100	105	120	135	150	180	200	210	240	250	300	360	400	500	600	800	1000	1200	1600	2000
35mm	Diagonal 43.5	28.7	27.2	24.5	23.4	20.5	18.3	16.5	13.7	12.4	11.8	10.3	9.9	8.3	6.9	6.2	5.0	4.1	3.1	2.5	2.0	1.6	1.2
	Longer side 36.0	23.9	22.6	20.4	19.4	17.0	15.1	13.7	11.4	10.3	9.8	8.6	8.2	6.9	5.7	5.2	4.1	3.4	2.6	2.1	1.7	1.3	1.0
	Shorter side 24.0	16.0	15.2	14.5	13.0	11.4	10.0	9.2	7.6	6.9	6.5	5.7	5.5	4.6	3.7	2.4	2.7	2.3	1.7	1.4	1.1	0.8	0.7
4.5×6	Diagonal 70.0	45.3	42.5	38.6	36.9	32.5	29.0	26.2	22.0	19.9	18.9	16.6	15.9	13.3	11.1	10.0	8.0	6.7	5.6	4.0	3.3	2.5	2.0
	Longer side 56.0	36.5	34.6	31.3	29.9	26.3	23.4	21.1	17.7	15.9	15.2	13.3	12.8	10.7	8.9	8.0	6.4	5.3	4.0	3.2	2.7	2.0	1.6
	Shorter side 42.0	27.8	26.3	23.7	22.6	19.9	17.7	15.9	13.3	12.0	11.4	10.0	9.6	8.0	6.7	6.0	4.8	4.0	3.0	2.4	2.0	1.5	1.2
6×6	Diagonal 79.5	50.1	47.6	43.3	41.5	36.7	32.8	29.7	24.9	22.5	21.4	18.8	18.0	15.1	12.6	11.4	9.1	7.6	5.7	4.6	3.8	2.8	2.3
6×7	Diagonal 88.0	54.7	52.1	47.5	45.4	40.3	36.1	32.7	27.5	24.8	23.7	20.8	20.0	16.7	13.9	12.6	10.0	8.4	6.3	5.0	4.2	3.2	2.5
	Longer side 68.0	43.6	41.4	37.5	35.9	31.6	28.3	25.5	21.4	19.3	18.4	16.1	15.5	12.9	10.8	9.7	7.8	6.5	4.9	3.9	3.2	2.4	1.9
6×9	Diagonal 100.0	60.9	58.1	53.1	50.9	45.2	40.6	36.9	31.0	28.0	26.8	23.5	22.6	18.9	15.8	14.3	11.4	9.5	7.1	5.7	4.8	3.6	2.9
	Longer side 83.0	52.0	49.5	45.0	43.1	38.1	34.2	30.9	26.0	23.4	22.4	19.6	18.9	15.8	13.1	11.8	9.5	7.9	5.9	4.8	4.0	3.0	2.4
4×5	Diagonal 155.0	84.7	81.5	75.6	72.9	65.7	59.7	54.6	46.6	42.4	40.5	35.8	34.4	29.0	24.3	21.9	17.6	14.7	11.1	8.9	7.4	5.5	4.4
	Longer side 121.0	70.9	67.8	62.3	59.9	53.5	48.3	43.9	37.2	33.7	32.1	28.3	27.2	22.8	19.1	17.2	13.8	11.5	8.6	6.9	5.8	4.3	3.5
	Shorter side 96.0	58.9	56.1	51.3	49.1	43.6	39.1	35.5	29.9	27.0	25.8	22.6	21.7	18.2	15.2	13.7	11.0	9.1	6.9	5.5	4.6	3.4	2.7
5×7	Diagonal 208.0	101.5	98.3	92.2	89.5	81.8	75.2	69.5	60.0	54.9	52.7	46.8	45.2	38.2	32.2	29.1	23.5	19.7	14.8	11.9	9.9	7.4	6.0
	Longer side 170.0	90.0	86.7	80.7	78.0	70.6	64.4	59.1	50.6	46.0	44.1	39.0	37.6	31.6	26.6	24.0	19.3	16.1	12.1	9.7	8.1	6.0	4.9
	Shorter side 120.0	70.4	67.4	61.9	59.5	53.1	47.9	43.6	36.9	33.4	31.9	28.0	27.0	22.6	18.9	17.0	13.7	11.4	8.6	6.9	5.7	4.3	3.4
8×10	Diagonal 311.0	122.7	119.9	114.5	111.9	104.7	98.1	92.0	81.6	75.7	73.0	65.9	63.7	54.8	46.7	42.5	34.5	29.0	22.0	17.7	14.8	11.1	8.9
	Longer side 244.0	110.3	107.2	101.3	98.6	90.9	84.2	78.2	68.3	62.8	60.3	53.9	52.0	44.3	37.4	33.9	27.4	23.0	17.3	13.9	11.6	8.7	7.0
	Shorter side 194.0	97.5	94.3	88.3	85.5	77.9	71.4	65.8	56.6	51.7	49.6	44.0	42.4	35.8	30.2	27.3	21.9	18.4	13.8	11.0	9.2	6.9	5.5

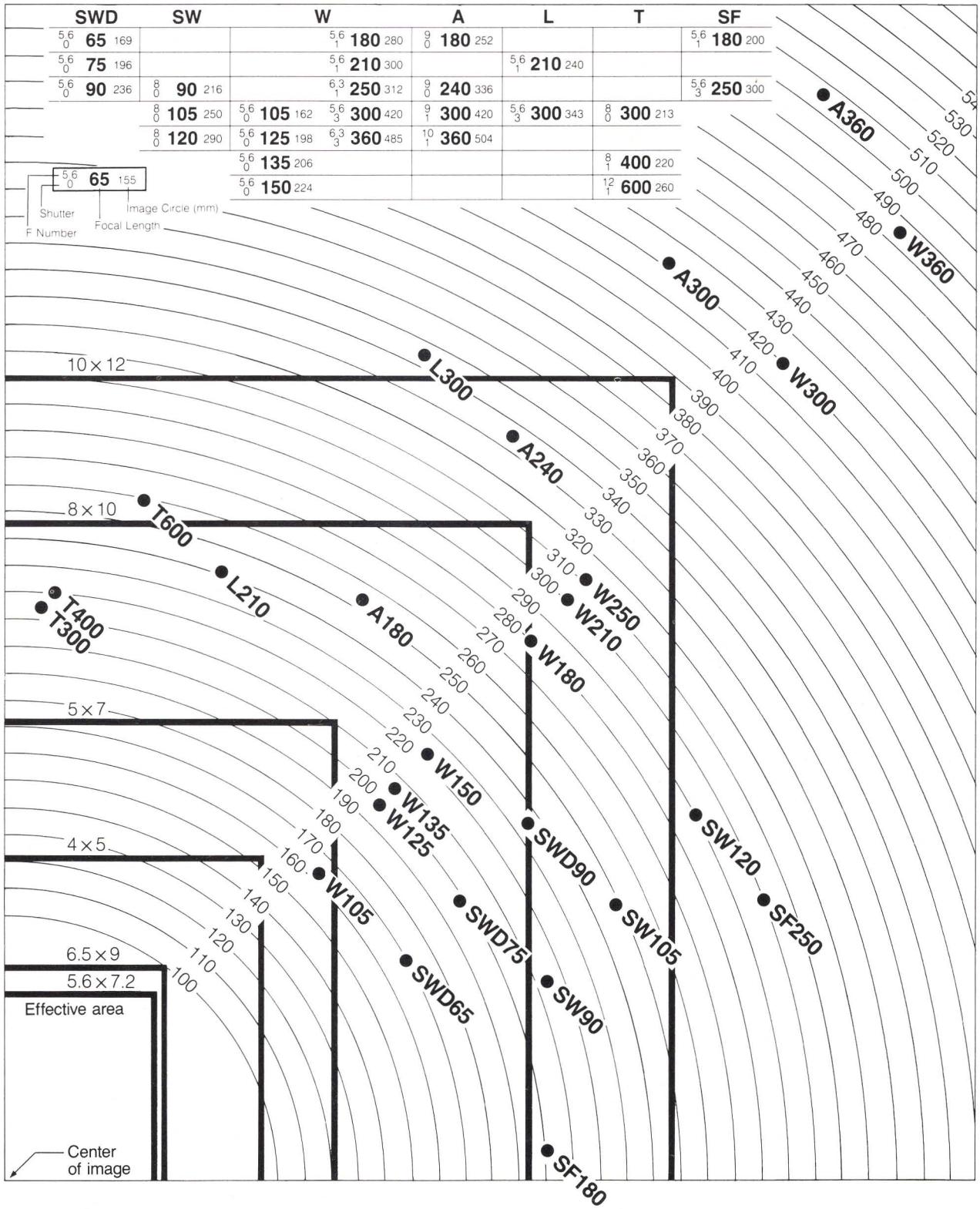
Note 1: Figures in the chart represent degrees (°).

Note 2: The two boundaries for the 6×6 format, and the minimum boundaries for the 6×7 and 6×9 formats are abbreviated on the chart as they are the same for the 4.5×6 format as well.

6 The Image Circle with Fujinon Lenses

SWD	SW	W	A	L	T	SF
5.6 0 **65** 169		5.6 1 **180** 280	9 0 **180** 252			5.6 1 **180** 200
5.6 0 **75** 196		5.6 1 **210** 300		5.6 1 **210** 240		
5.6 0 **90** 236	8 0 **90** 216	6.3 1 **250** 312	9 0 **240** 336			5.6 3 **250** 300
	8 0 **105** 250	5.6 0 **105** 162 5.6 3 **300** 420	9 1 **300** 420	5.6 3 **300** 343	8 0 **300** 213	
	8 0 **120** 290	5.6 0 **125** 198 6.3 3 **360** 485	10 1 **360** 504			
		5.6 0 **135** 206			8 1 **400** 220	
		5.6 0 **150** 224			12 1 **600** 260	

5.6 0 **65** 155
Shutter
F Number
Focal Length
Image Circle (mm)



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