70-210mm f3.5 Macro Focusing Zoom Lens

Vivitar Series 1

Owner's Manual

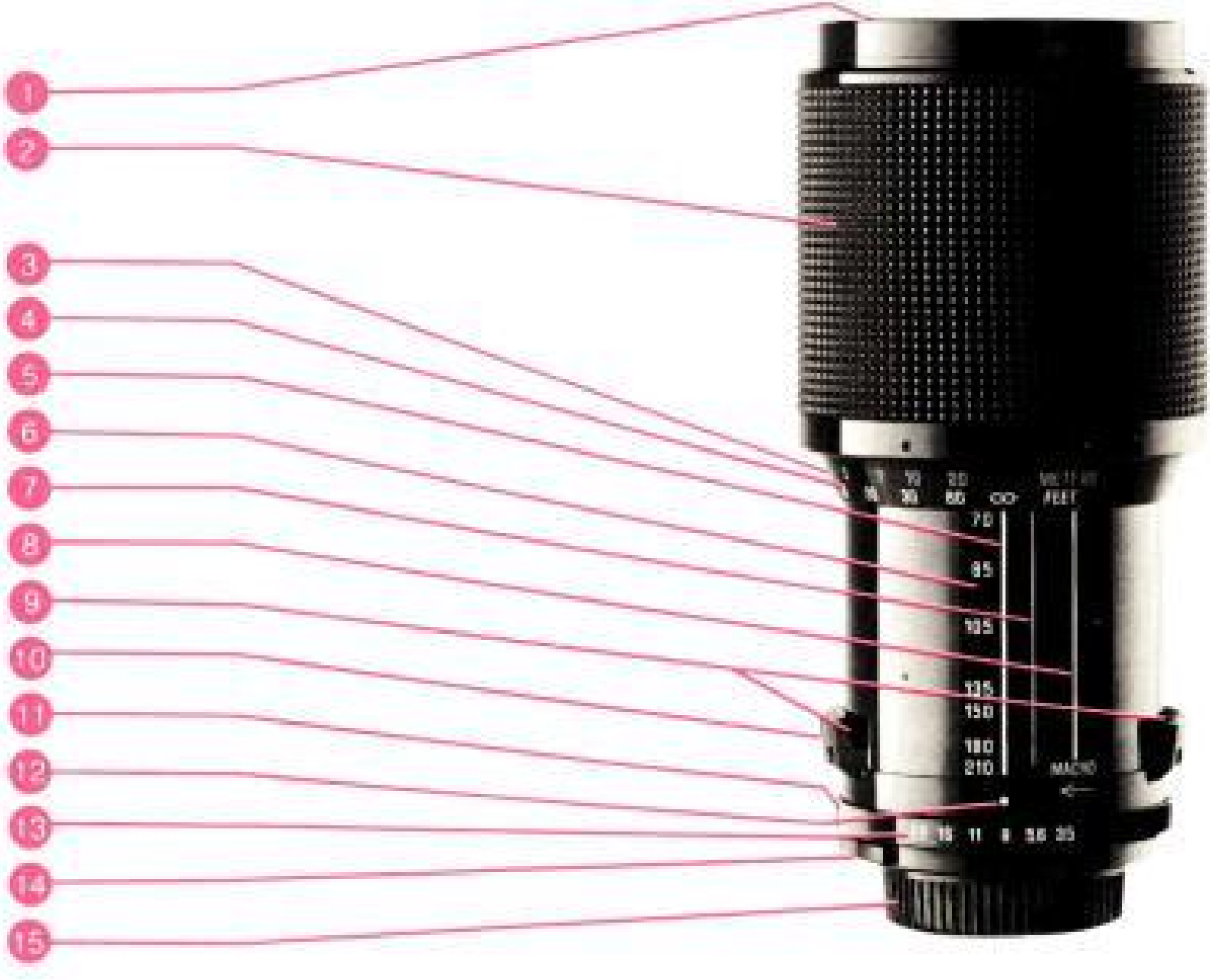
Before you use your lens –

When changing from Macro operation to Zoom operation or from Zoom operation to Macro operation, the Zoom Focus Ring of your lens MUST BE SET TO THE 210mm POSITION.

INCORRECT

CORRECT

For best results, please read this Owner's Manual carefully!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FEET
MACRO

Your new Vivitar Series 1™ Macro Focusing Zoom Lens is part of an entirely new lens system, unique in concept and created to meet the challenge of tomorrow's photographer today. Its versatility is unlimited. As a telephoto lens, its remarkable "one-touch" zoom and focus control lets you choose any focal length between 70mm and 210mm for exact framing at the moment of exposure. A simple turn of the wrist and your Series 1 Zoom becomes a Macro lens allowing you to explore the exciting world of close-up photography. To you, the photographer, this means total creative expression in nearly every photographic situation without ever removing the lens from your camera. And the Vivitar name is your assurance of superb computer-designed optics and the utmost in optical and mechanical reliability.

Getting Acquainted With Your Lens

1. Filter Thread
2. Zoom/Focus Ring
3. Macro Focus Reference Mark
4. Distance Scales
5. Distance Index Line
6. Focal Length Scale
7. Infrared Index Line
8. Macro Index Line
9. Zoom/Macro Selector Switch
10. Selector Switch Lock Button
11. Aperture Ring
12. Aperture Index Point
13. Aperture Scale
14. Auto/Manual Switch*
15. Lens Mount

*Universal Thread Mount Lenses only.

Mounting Your Lens

Your Vivitar Macro Focusing Zoom has been designed to mount on your camera with the simplicity and ease of your normal lens. However, because it is longer than your normal lens, special care should be taken when aligning it to the camera.

For the best results, slide the Zoom/Focus Ring ② to the 70mm position on the Focal Length Scale ⑥ and grasp the lens firmly around the lens barrel as shown in photo A. This will enable you to achieve better balance during the mounting procedure.

Holding Your Lens

When using your lens it is best to support the camera/lens combination by placing your left hand underneath the lens as shown in photo B. This leaves your other hand free to operate the controls of your camera and assures proper balance and stability.

Aperture Control

The automatic diaphragm operation of your lens allows you to focus and compose your picture with the diaphragm at maximum aperture or "wide open." When shooting, the diaphragm will automatically stop down to the pre-

selected aperture at the moment of exposure and immediately re-open as the exposure is completed.

NOTE: Universal Thread Mount lenses have an Auto/Manual Switch (see photo C) which must be set in the "A" (Auto) position for Automatic Diaphragm Control. In the "M" (Manual) position, the diaphragm opens and closes as the Aperture Ring is turned.

Canon Mount lenses have an Auto/Manual lever (photo D) which must be set at the clockwise end of its slot for Automatic Diaphragm Control. With the lever in the counter-clockwise end of its slot, the lens diaphragm opens and closes as the Aperture Ring is turned.

EE Coupled Lenses

Some cameras (such as the Konica Autoreflex series) automatically determine the correct aperture for a given photographic situation when a specific shutter speed is selected. For a lens to operate automatically with these cameras it must be coupled to the camera's EE mechanism.

Vivitar Series 1 lenses designed with EE coupling mechanisms differ from other lenses as follows:

1. Aperture Scale—Since cameras with EE mechanisms work automatically to f/16 only, the aperture range of the EE coupled Vivitar Series 1 Lens goes to f/16 only.

2. EE Lock Button—To ensure that the lens is not accidentally removed from EE operation, the Aperture Ring locks with a positive click when placed in the "EE" position. When you wish to set aperture manually, press the EE Lock Button to move the Aperture Ring from the "EE" position (see photo E).

Zoom Operation

To set your lens for Zoom operation

1. Slide the Zoom/Focus Ring ② towards the Lens Mount ⑮ until it stops at the 210mm position on the Focal Length Scale ⑥.
2. Press the Selector Switch Lock Button ⑩ and turn the Zoom/Macro Selector Switch ⑨ clockwise until the Distance Index Line ⑤ is opposite the Aperture Index Point ⑫. (See photo F).

CAUTION: Always make sure the Zoom/Focus Ring is at the 210mm position *before* changing from Macro to Zoom operation. Do not force—lens will shift modes easily when set in the proper position.

Focusing and Zoom Control

Your Vivitar Macro Focusing Zoom Lens provides a "one-touch" focus and zoom system that lets you focus and compose your picture quickly and easily. Focusing and zooming are both controlled by the Zoom/Focus Ring as follows:

1. To focus, turn the Zoom/Focus Ring until your subject appears sharpest in the camera viewfinder.
2. To zoom from one focal length to another, slide the Zoom/Focus Ring along the lens barrel to the desired position. The Focal Length Scale (6) is conveniently marked with the major focal lengths for easy reference.
3. Since zooming may cause you to turn the Zoom/Focus Ring slightly, it's always a good idea to re-focus at the focal length you will be using.

Distance Scales

Your lens has two Distance Scales (4) which give you the distance from the subject in focus to the film plane. The white numbers denote this distance in feet while those in green represent distance in meters.

Distance Index Line

The Distance Index Line (5) is the reference point for the correct focus position of your lens. Reading the number of feet or meters indicated on the Distance Scales opposite this line allows you to estimate the distance from the subject in focus to the film plane.

Infrared Index Line

Your lens has an Infrared Index Line (7) engraved in red on your lens barrel for use with infrared film. When using infrared film focus normally on your subject, select the zoom position you prefer, and read the distance on the

Distance Scales as indicated opposite the Distance Index Line.

Without changing the zoom position, turn the Zoom/Focus Ring ② to the right until the distance reading is opposite the Infrared Index Line. Your lens will then be focused for average infrared photography. *NOTE** Infrared radiation is variable by nature and therefore the Infrared Index Line should be used as an approximation only.

Depth of Field

Depth of field is the area in acceptable sharpness in front of and behind the subject in focus. This depth is determined by the aperture you have selected and the distance from the subject in focus to the film plane. As you get closer to your subject, or as you open your lens (e.g. from f22 to f3.5), the depth of field becomes shallower (f3.5 is shown in photo G). By stopping your lens down (e.g. f3.5 to f22) or getting farther away from your subject, this depth of field or zone of acceptable sharpness can be increased (f22 is shown in photo H).

Another factor in determining depth of field is the focal length at which you are shooting. As a rule, the longer the focal length of a lens the shallower the zone of acceptable sharpness becomes. Therefore, as you change the focal length of your Vivitar Macro Focusing Zoom from 70mm to 210mm, the depth of field becomes shallower. You can compensate for this by stopping your lens down. However, a shallow depth of field can add creative impact to your

pictures by providing you with pleasing out-of-focus foregrounds or backgrounds.

Depth of Field Preview

Pressing your camera's Depth of Field Preview Button stops down the lens diaphragm to your pre-selected aperture. This allows you to see the depth of field in the viewfinder prior to taking a picture.

NOTE: On Universal Thread Mount lenses, the Auto/Manual Switch may be used for previewing depth of field. This is done by moving the switch to the "M" (Manual) position.

Depth of Field Tables

If you need more precise depth of field information than can be obtained by looking through your camera's viewfinder, check the Depth of Field Tables in the back of this manual. These give you precise information for select focal length/aperture combinations.

Macro Operation

To set your lens for Macro operation:

1. Slide the Zoom/Focus Ring ② towards the Lens Mount ⑮ until it stops at the 210mm position on the Focal Length Scale ⑥.

2. Press the Selector Switch Lock Button ⑩ and turn the Zoom/Macro Selector Switch ⑨ counter-clockwise until the Macro Index Line ⑧ is opposite the Aperture Index Point ⑫ (see photo I).

CAUTION: Always make sure the Zoom/Focus Ring is at the 210mm position *before* changing from Zoom to Macro operation. Do not force—lens will shift modes easily when set in the proper position.

Magnification

The remarkable Macro feature of your Vivitar Series 1 Macro Focusing Zoom lets you take pictures at magnifications up to approximately one-half times life size—without the need for lens extension devices or other supplementary close-up equipment.

The concept behind this unique macro focusing feature is quite basic. Magnification is defined as the ratio of the distance from the optical center of a lens to the film (lens-to-film distance) over the distance from the optical center of a lens to the subject (lens-to-subject distance). As the lens-to-film distance increases, magnification increases and you are able to focus closer to your subject.

$$\text{Magnification} = \frac{\text{lens-to-film distance}}{\text{lens-to-subject distance}}$$

In Macro operation, your Vivitar Series 1 Lens incorporates moving elements that change the position of the optical center of the lens. As you slide the

Zoom/Focus Ring away from the camera body, the lens-to-film distance increases allowing you to achieve a higher magnification. As you slide it towards the camera body, the lens-to-film distance is reduced and magnification decreases.

Macro Focusing

For optimum results in Macro operation, turn the Zoom/Focus Ring ② to the right until the Macro Focus Reference Mark ③ is opposite the Macro Index Line ⑧. Keep the Zoom Focus Ring in this position as you slide it along the lens barrel to change magnification and/or focus.

If your picture does not require a fixed magnification, slide the Zoom/Focus Ring along the Macro Index Line until the subject appears sharpest in your camera's viewfinder. If you wish a larger image size, move the entire camera/lens combination closer to your subject and adjust the Zoom Focus Ring accordingly.

If your picture requires a fixed magnification, set the Zoom/Focus Ring to the desired position and focus by moving the entire camera/lens combination back and forth until the subject appears sharpest in your camera viewfinder. The following table provides magnification information at the various positions along the lens barrel and is indexed in terms of the Focal Length Scale ⑥ for easy reference.

MAGNIFICATION SCALE

Lens set at Macro Mode	Field Size Diagonal	Object Distance from Front Element	Magnification
70 mm	95 mm	77.5 mm	1:2.2
85 mm	150 mm	210 mm	1:3.5
105 mm	280 mm	620 mm	1:6.5
135 mm	470 mm	1560 mm	1:11

Depth of Field in Macrophotography

In close-up photography, depth of field is directly related to magnification and aperture.

As magnification increases, depth of field decreases drastically. In most cases, you are working with a zone of acceptable sharpness that measures in inches and fractions of inches, particularly at higher magnification. Since depth of field increases as the aperture becomes smaller (e.g. from f3.5 to f22), you can compensate somewhat for this shallow depth of field by stopping your lens down as far as lighting conditions will allow.

If inadequate conditions prevent you from stopping your lens down for satisfactory depth of field, add supplementary artificial lighting or adjust your shutter speed until the proper exposure can be obtained. If this is not possible, make sure you focus carefully on your subject and position in a way that great depth of field is not critical to a good photograph. For example, if you place an elongated subject on a plane parallel to the film plane (as shown in photo J), the need for great depth of field is virtually eliminated. If the subject is not placed parallel to the film plane (as shown in photo K), greater depth of field is needed for the entire subject to be in focus.

Helpful Hints

1. *Always* make sure the Zoom/Focus Ring ② is at the 210mm position on the Focal Length Scale when changing from Zoom to Macro operation or from Macro to Zoom operation. This will prevent any possibility of damage to your lens.
2. Because exposure in close-up photography is critical to getting the best possible picture, it's a good idea to shoot several pictures of the same subject varying the exposure slightly. This method, called "bracketing," involves shooting the pictures at the f-stop indicated by your TTL meter, underexposing by ½ to 1 f-stop and overexposing by ½ to 1 f-stop. The results will be well worth the few pennies it may add to your film cost.

3. In Macro operation, always try to use a tripod or other stable platform when shooting at higher magnifications to assure that slight movements do not degrade the picture quality. If, for some reason, a stable platform cannot be used, take the picture at the fastest possible shutter speed lighting conditions will allow.
4. In Macro operation, it's always a good idea to use a cable release to trigger the shutter of your camera. Even the slight movement caused by your hand depressing the shutter release can affect the quality of pictures taken at high magnification. If your camera has a self-timer, you can use it to prevent this movement if a cable release is not available.

Taking Care of Your Lens

1. It's a good idea to keep a filter (such as UV filter) on your lens at all times. This not only improves photographs, but also protects the front lens element from scratches.
2. When attaching threaded accessories (filters, etc.) to your lens, carefully align the accessory with the Filter Thread ① to prevent damage.
3. Keep your lens dust free by making sure both front and rear lens caps are in place when it's not in use.

4. Clean your lens with an air brush, anti-static brush or wipe it lightly with a camel-hair brush or lens tissue. In EXTREME cases, use a clean, soft cotton cloth moistened with denatured alcohol. *Never rub the lens surface with your finger, clothing or any other abrasive material.* Cleaning your lens in this way will scratch the lens coating and can cause damage to the element surface.
5. Always store your lens in a cool, dry place. It's a good idea to store it with the silica gel packet supplied, especially during wet or humid weather. A lens case with a silica gel packet provides a handy means of storage and gives excellent protection for your lens.

Specifications

Focal Length: 70mm–210mm
Minimum Focal Length of Macro: 54mm
Optical Construction: 15 elements/10 groups
Aperture Range: f3.5–f22 (EE coupled lens to f16 only)
Angle of Acceptance: 34° at 70mm; 12° at 210mm
Zoom Ratio: 3:1
Maximum Magnification in Macro: 1:2.2
Minimum Focusing Distance From Film Plane in Zoom: 6 ft. 6½ in. (2 m)
Minimum Focusing Distance From Front Element in Macro: 3 in. (80 mm)
Maximum Barrel Diameter: 3 1/16 in. (77.8 mm)
Length at Infinity: 6⅛ in. (157.5 mm)
Weight: 31 oz. (879 g)
Accessory Size: 67 mm
Accessories Included: Front and rear lens caps

Specifications subject to change without notice. Lengths and weights may vary slightly depending on lens mount.

Depth of Field Tables

70mm

ft \ f	3.5	5.6	8	11	16	22
7	6.7 ~ 7.2	6.6 ~ 7.4	6.5 ~ 7.5	6.3 ~ 7.7	6.1 ~ 8.2	5.8 ~ 8.7
8	7.7 ~ 8.3	7.5 ~ 8.5	7.3 ~ 8.7	7.1 ~ 9.0	6.8 ~ 9.6	6.5 ~ 10.5
9	8.6 ~ 9.4	8.4 ~ 9.6	8.2 ~ 10.0	7.9 ~ 10.4	7.5 ~ 11.2	7.1 ~ 12.4
10	9.5 ~ 10.5	9.3 ~ 10.8	9.0 ~ 11.2	8.6 ~ 11.8	8.2 ~ 12.9	7.6 ~ 14.6
12	11.3 ~ 12.7	10.9 ~ 13.3	10.5 ~ 13.9	10.0 ~ 14.9	9.4 ~ 16.7	8.7 ~ 19.8
15	13.8 ~ 16.3	13.3 ~ 17.2	12.7 ~ 18.4	12.0 ~ 20.0	11.0 ~ 23.8	10.0 ~ 30.8
20	18.0 ~ 22.5	17.0 ~ 24.3	15.9 ~ 26.8	14.8 ~ 30.8	13.3 ~ 41.1	11.8 ~ 69.1
30	25.5 ~ 36.2	23.5 ~ 41.4	21.5 ~ 49.7	19.5 ~ 66.2	16.8 ~ 151	14.5 ~ ∞
60	44.1 ~ 93.4	38.2 ~ 141	33.1 ~ 339	28.3 ~ ∞	23.0 ~ ∞	18.7 ~ ∞
∞	163 ~ ∞	102 ~ ∞	71.4 ~ ∞	52.1 ~ ∞	36.0 ~ ∞	26.3 ~ ∞

m \ f	3.5	5.6	8	11	16	22
2.0	1.922 ~ 2.085	1.879 ~ 2.140	1.831 ~ 2.206	1.776 ~ 2.296	1.691 ~ 2.464	1.600 ~ 2.704
2.5	2.376 ~ 2.639	2.308 ~ 2.730	2.234 ~ 2.843	2.150 ~ 2.999	2.023 ~ 3.303	1.890 ~ 3.765
3.0	2.820 ~ 3.206	2.722 ~ 3.345	2.619 ~ 3.520	2.501 ~ 3.767	2.327 ~ 4.272	2.150 ~ 5.099
4.0	3.678 ~ 4.386	3.510 ~ 4.657	3.336 ~ 5.013	3.143 ~ 5.544	2.867 ~ 6.746	2.597 ~ 9.150
5.0	4.501 ~ 5.628	4.248 ~ 6.090	3.992 ~ 6.723	3.714 ~ 7.732	3.331 ~ 10.339	2.967 ~ 17.489
7.0	6.045 ~ 8.323	5.590 ~ 9.393	5.149 ~ 11.021	4.689 ~ 14.086	4.085 ~ 26.433	3.543 ~ 0.000
10.0	8.141 ~ 12.985	7.328 ~ 15.836	6.580 ~ 21.172	5.839 ~ 36.712	4.922 ~ ∞	4.148 ~ ∞
20.0	13.668 ~ 37.479	11.496 ~ 79.261	9.735 ~ ∞	8.177 ~ ∞	6.466 ~ ∞	5.178 ~ ∞
∞	42.564 ~ ∞	26.655 ~ ∞	18.701 ~ ∞	13.639 ~ ∞	9.421 ~ ∞	6.890 ~ ∞

85mm

m \ f	3.5	5.6	8	11	16	22
7	6.8 ~ 7.1	6.7 ~ 7.2	6.6 ~ 7.3	6.5 ~ 7.5	6.3 ~ 7.8	6.1 ~ 8.1
8	7.8 ~ 8.2	7.6 ~ 8.3	7.5 ~ 8.5	7.4 ~ 8.7	7.1 ~ 9.1	6.8 ~ 9.6
9	8.7 ~ 9.2	8.5 ~ 9.4	8.4 ~ 9.6	8.2 ~ 9.9	7.8 ~ 10.4	7.5 ~ 11.2
10	9.6 ~ 10.3	9.5 ~ 10.5	9.2 ~ 10.8	9.0 ~ 11.2	8.6 ~ 11.9	8.2 ~ 12.8
12	11.5 ~ 12.5	11.2 ~ 12.9	10.9 ~ 13.3	10.5 ~ 13.9	10.0 ~ 15.0	9.4 ~ 16.6
15	14.2 ~ 15.9	13.7 ~ 16.5	13.2 ~ 17.2	12.7 ~ 18.3	11.9 ~ 20.3	11.0 ~ 23.5
20	18.5 ~ 21.7	17.7 ~ 22.8	16.9 ~ 24.4	16.0 ~ 26.6	14.7 ~ 31.5	13.4 ~ 40.3
30	26.7 ~ 34.2	25.0 ~ 37.3	23.4 ~ 41.8	21.6 ~ 49.1	19.2 ~ 69.5	17.0 ~ 140
60	47.7 ~ 80.3	42.5 ~ 101	37.9 ~ 144	33.3 ~ 310	27.8 ~ ∞	23.2 ~ ∞
∞	227 ~ ∞	142 ~ ∞	99.8 ~ ∞	72.7 ~ ∞	50.2 ~ ∞	36.6 ~ ∞

m \ f	3.5	5.6	8	11	16	22
2.0	1,948 ~ 2,055	1,919 ~ 2,089	1,886 ~ 2,130	1,847 ~ 2,184	1,786 ~ 2,281	1,718 ~ 2,410
2.5	2,417 ~ 2,590	2,369 ~ 2,647	2,318 ~ 2,716	2,257 ~ 2,808	2,162 ~ 2,976	2,060 ~ 3,209
3.0	2,878 ~ 3,134	2,809 ~ 3,220	2,736 ~ 3,326	2,649 ~ 3,468	2,516 ~ 3,736	2,375 ~ 4,121
4.0	3,779 ~ 4,249	3,659 ~ 4,415	3,531 ~ 4,622	3,383 ~ 4,911	3,164 ~ 5,486	2,907 ~ 6,392
5.0	4,654 ~ 5,404	4,469 ~ 5,680	4,276 ~ 6,034	4,058 ~ 6,546	3,741 ~ 7,632	3,423 ~ 9,550
7.0	6,328 ~ 7,837	5,985 ~ 8,445	5,637 ~ 9,270	5,256 ~ 10,566	4,727 ~ 13,803	4,222 ~ 21,933
10.0	8,665 ~ 11,832	8,025 ~ 13,301	7,403 ~ 15,509	6,751 ~ 19,590	5,892 ~ 35,065	5,117 ~ 798,522
20.0	15,227 ~ 29,203	13,327 ~ 40,409	11,669 ~ 72,165	10,104 ~ 5337,601	8,267 ~ ∞	6,797 ~ ∞
∞	62,724 ~ ∞	39,267 ~ ∞	27,538 ~ ∞	20,074 ~ ∞	13,854 ~ ∞	10,123 ~ ∞

105mm

H \ f	3.5	5.6	8	11	16	22
7	6.9 ~ 7.1	6.8 ~ 7.2	6.8 ~ 7.2	6.7 ~ 7.3	6.6 ~ 7.5	6.4 ~ 7.7
8	7.9 ~ 8.1	7.8 ~ 8.2	7.7 ~ 8.3	7.6 ~ 8.5	7.4 ~ 8.7	7.2 ~ 9.0
9	8.8 ~ 9.2	8.7 ~ 9.3	8.6 ~ 9.4	8.5 ~ 9.6	8.2 ~ 9.9	8.0 ~ 10.3
10	9.7 ~ 10.2	9.6 ~ 10.3	9.4 ~ 10.5	9.3 ~ 10.8	9.0 ~ 11.2	8.7 ~ 11.7
12	11.5 ~ 12.3	11.4 ~ 12.5	11.2 ~ 12.8	11.0 ~ 13.2	10.6 ~ 13.8	10.1 ~ 14.7
15	14.4 ~ 15.5	14.1 ~ 15.9	13.8 ~ 16.4	13.4 ~ 17.0	12.8 ~ 18.1	12.1 ~ 19.7
20	19.0 ~ 21.1	18.4 ~ 21.8	17.8 ~ 22.7	17.1 ~ 23.9	16.1 ~ 26.3	15.1 ~ 29.9
30	27.7 ~ 32.6	26.5 ~ 34.4	25.3 ~ 36.8	23.9 ~ 40.3	21.9 ~ 47.9	19.9 ~ 62.1
60	51.2 ~ 71.9	47.1 ~ 81.9	43.2 ~ 97.4	39.2 ~ 128	33.9 ~ 257	29.3 ~ ∞
∞	344 ~ ∞	215 ~ ∞	151 ~ ∞	110 ~ ∞	75.7 ~ ∞	55.3 ~ ∞

m \ f	3.5	5.6	8	11	16	22
2.0	1.967 ~ 2.034	1.948 ~ 2.055	1.927 ~ 2.079	1.901 ~ 2.111	1.860 ~ 2.166	1.813 ~ 2.237
2.5	2.447 ~ 2.556	2.416 ~ 2.591	2.382 ~ 2.632	2.340 ~ 2.686	2.275 ~ 2.780	2.202 ~ 2.904
3.0	2.921 ~ 3.084	2.876 ~ 3.136	2.826 ~ 3.199	2.766 ~ 3.281	2.673 ~ 3.428	2.569 ~ 3.625
4.0	3.856 ~ 4.156	3.774 ~ 4.257	3.685 ~ 4.377	3.581 ~ 4.539	3.419 ~ 4.839	3.245 ~ 5.257
5.0	4.771 ~ 5.253	4.645 ~ 5.418	4.508 ~ 5.620	4.348 ~ 5.896	4.108 ~ 6.424	3.853 ~ 7.204
7.0	6.549 ~ 7.520	6.307 ~ 7.871	6.051 ~ 8.317	5.760 ~ 8.954	5.335 ~ 10.269	4.904 ~ 12.487
10.0	9.090 ~ 11.118	8.620 ~ 11.921	8.141 ~ 12.997	7.614 ~ 14.655	6.876 ~ 18.638	6.164 ~ 27.754
20.0	16.602 ~ 25.176	15.071 ~ 29.822	13.638 ~ 37.823	12.193 ~ 57.006	10.371 ~ 378.877	8.804 ~ ∞
∞	95.665 ~ ∞	59.869 ~ ∞	41.972 ~ ∞	30.582 ~ ∞	21.091 ~ ∞	15.397 ~ ∞

135mm

f / R	3.5	5.6	8	11	16	22
7	6.9 ~ 7.1	6.9 ~ 7.1	6.9 ~ 7.1	6.8 ~ 7.2	6.7 ~ 7.3	6.6 ~ 7.4
8	7.9 ~ 8.1	7.9 ~ 8.1	7.8 ~ 8.2	7.7 ~ 8.3	7.6 ~ 8.4	7.5 ~ 8.6
9	8.9 ~ 9.1	8.8 ~ 9.2	8.8 ~ 9.3	8.7 ~ 9.4	8.5 ~ 9.5	8.4 ~ 9.8
10	9.9 ~ 10.1	9.8 ~ 10.2	9.7 ~ 10.3	9.6 ~ 10.5	9.4 ~ 10.7	9.2 ~ 11.0
12	11.7 ~ 12.2	11.6 ~ 12.3	11.5 ~ 12.5	11.3 ~ 12.7	11.1 ~ 13.0	10.8 ~ 13.5
15	14.6 ~ 15.3	14.4 ~ 15.5	14.2 ~ 15.8	14.0 ~ 16.1	13.5 ~ 16.7	13.1 ~ 17.5
20	19.3 ~ 20.6	19.0 ~ 21.0	18.6 ~ 21.5	18.2 ~ 22.2	17.4 ~ 23.3	16.7 ~ 24.9
30	28.6 ~ 31.5	27.8 ~ 32.5	26.9 ~ 33.7	26.0 ~ 35.4	24.5 ~ 38.7	22.9 ~ 43.5
60	54.4 ~ 66.7	51.5 ~ 71.6	48.6 ~ 78.1	45.4 ~ 88.2	41.0 ~ 113	36.7 ~ 169
∞	570 ~ ∞	357 ~ ∞	250 ~ ∞	182 ~ ∞	125 ~ ∞	91.4 ~ ∞

f / m	3.5	5.6	8	11	16	22
2,0	1.962 ~ 2.019	1.971 ~ 2.030	1.958 ~ 2.044	1.943 ~ 2.061	1.919 ~ 2.090	1.891 ~ 2.126
2,5	2.469 ~ 2.532	2.451 ~ 2.551	2.431 ~ 2.574	2.406 ~ 2.603	2.366 ~ 2.652	2.320 ~ 2.715
3,5	2.954 ~ 3.048	2.927 ~ 3.077	2.897 ~ 3.112	2.860 ~ 3.156	2.801 ~ 3.233	2.734 ~ 3.331
4,0	3.914 ~ 4.090	3.865 ~ 4.146	3.810 ~ 4.212	3.743 ~ 4.298	3.638 ~ 4.450	3.519 ~ 4.648
5,0	4.863 ~ 5.145	4.784 ~ 5.238	4.697 ~ 5.347	4.594 ~ 5.491	4.431 ~ 5.749	4.252 ~ 6.095
7,0	6.725 ~ 7.299	6.571 ~ 7.492	6.403 ~ 7.726	6.205 ~ 8.041	5.903 ~ 8.628	5.579 ~ 9.462
10,0	9.435 ~ 10.639	9.127 ~ 11.064	8.799 ~ 11.595	8.421 ~ 12.338	7.862 ~ 13.817	7.284 ~ 16.154
20,0	17.807 ~ 22.819	16.711 ~ 24.934	15.615 ~ 27.894	14.435 ~ 32.771	12.825 ~ 46.321	11.319 ~ 92.426
∞	158.062 ~ ∞	98.890 ~ ∞	69.304 ~ ∞	50.477 ~ ∞	34.768 ~ ∞	25.374 ~ ∞

150mm

ft \ f	3.5	5.6	8	11	16	22
7	7.0 ~ 7.1	6.9 ~ 7.1	6.9 ~ 7.1	6.9 ~ 7.1	6.8 ~ 7.2	6.7 ~ 7.3
8	7.9 ~ 8.1	7.9 ~ 8.1	7.9 ~ 8.1	7.8 ~ 8.2	7.7 ~ 8.3	7.6 ~ 8.4
9	8.9 ~ 9.1	8.9 ~ 9.1	8.8 ~ 9.2	8.7 ~ 9.3	8.6 ~ 9.4	8.5 ~ 9.6
10	9.9 ~ 10.1	9.9 ~ 10.2	9.8 ~ 10.3	9.7 ~ 10.3	9.5 ~ 10.6	9.3 ~ 10.8
12	11.8 ~ 12.1	11.7 ~ 12.2	11.6 ~ 12.4	11.4 ~ 12.5	11.2 ~ 12.8	11.0 ~ 13.1
15	14.7 ~ 15.2	14.5 ~ 15.4	14.4 ~ 15.6	14.1 ~ 15.9	13.8 ~ 16.3	13.4 ~ 16.9
20	19.5 ~ 20.5	19.2 ~ 20.8	18.9 ~ 21.2	18.5 ~ 21.7	17.9 ~ 22.6	17.3 ~ 23.8
30	28.8 ~ 31.2	28.2 ~ 32.0	27.5 ~ 32.9	26.6 ~ 34.2	25.4 ~ 36.5	24.0 ~ 40.0
60	55.4 ~ 65.3	53.0 ~ 69.0	50.5 ~ 73.8	47.6 ~ 80.9	43.6 ~ 96.3	39.6 ~ 125
∞	706 ~ ∞	441 ~ ∞	309 ~ ∞	225 ~ ∞	155 ~ ∞	113 ~ ∞

m \ f	3.5	5.6	8	11	16	22
2.0	1,986 ~ 2,015	1,977 ~ 2,024	1,968 ~ 2,034	1,956 ~ 2,047	1,936 ~ 2,069	1,914 ~ 2,096
2.5	2,476 ~ 2,525	2,461 ~ 2,540	2,445 ~ 2,557	2,426 ~ 2,580	2,394 ~ 2,618	2,356 ~ 2,666
3.0	2,963 ~ 3,038	2,942 ~ 3,061	2,918 ~ 3,086	2,888 ~ 3,122	2,841 ~ 3,181	2,786 ~ 3,255
4.0	3,931 ~ 4,071	3,891 ~ 4,115	3,847 ~ 4,167	3,793 ~ 4,234	3,706 ~ 4,350	3,607 ~ 4,499
5.0	4,890 ~ 5,116	4,826 ~ 5,188	4,755 ~ 5,273	4,670 ~ 5,384	4,535 ~ 5,581	4,383 ~ 5,838
7.0	6,776 ~ 7,238	6,651 ~ 7,390	6,512 ~ 7,571	6,347 ~ 7,811	6,091 ~ 8,248	5,811 ~ 8,845
10.0	9,540 ~ 10,508	9,285 ~ 10,839	9,010 ~ 11,245	8,688 ~ 11,798	8,203 ~ 12,857	7,689 ~ 14,416
20.0	18,191 ~ 22,216	17,257 ~ 23,802	16,302 ~ 25,922	15,250 ~ 29,177	13,773 ~ 36,934	12,346 ~ 54,361
∞	195,105 ~ ∞	122,053 ~ ∞	85,528 ~ ∞	62,284 ~ ∞	42,914 ~ ∞	31,292 ~ ∞

180mm

ft \ f	3.5	5.6	8	11	16	22
7	7.0 ~ 7.0	6.9 ~ 7.1	6.9 ~ 7.1	6.9 ~ 7.1	6.9 ~ 7.2	6.8 ~ 7.2
8	8.0 ~ 8.1	7.9 ~ 8.1	7.9 ~ 8.1	7.9 ~ 8.2	7.8 ~ 8.2	7.7 ~ 8.3
9	8.9 ~ 9.1	8.9 ~ 9.1	8.9 ~ 9.1	8.8 ~ 9.2	8.7 ~ 9.3	8.6 ~ 9.4
10	9.9 ~ 10.1	9.9 ~ 10.1	9.8 ~ 10.2	9.8 ~ 10.3	9.7 ~ 10.4	9.5 ~ 10.5
12	11.9 ~ 12.1	11.8 ~ 12.2	11.7 ~ 12.3	11.6 ~ 12.4	11.5 ~ 12.6	11.3 ~ 12.8
15	14.8 ~ 15.2	14.7 ~ 15.3	14.6 ~ 15.5	14.4 ~ 15.6	14.2 ~ 15.9	13.9 ~ 16.3
20	19.6 ~ 20.3	19.4 ~ 20.6	19.2 ~ 20.8	18.9 ~ 21.2	18.5 ~ 21.8	18.0 ~ 22.5
30	29.1 ~ 30.8	28.7 ~ 31.3	28.2 ~ 32.0	27.6 ~ 32.8	26.6 ~ 34.3	25.5 ~ 36.3
60	56.7 ~ 63.6	54.9 ~ 66.0	53.0 ~ 69.0	50.8 ~ 73.2	47.5 ~ 81.5	44.1 ~ 94.3
∞	1038 ~ ∞	630 ~ ∞	442 ~ ∞	322 ~ ∞	221 ~ ∞	161 ~ ∞

m \ f	3.5	5.6	8	11	16	22
2.0	1.991 ~ 2.009	1.985 ~ 2.015	1.979 ~ 2.021	1.971 ~ 2.030	1.959 ~ 2.043	1.944 ~ 2.060
2.5	2.484 ~ 2.516	2.475 ~ 2.526	2.464 ~ 2.537	2.451 ~ 2.551	2.429 ~ 2.576	2.404 ~ 2.605
3.0	2.976 ~ 3.025	2.961 ~ 3.040	2.945 ~ 3.057	2.925 ~ 3.079	2.893 ~ 3.117	2.855 ~ 3.164
4.0	3.954 ~ 4.048	3.927 ~ 4.077	3.895 ~ 4.110	3.858 ~ 4.154	3.798 ~ 4.228	3.728 ~ 4.321
5.0	4.925 ~ 5.078	4.881 ~ 5.126	4.832 ~ 5.181	4.772 ~ 5.253	4.675 ~ 5.378	4.565 ~ 5.536
7.0	6.847 ~ 7.161	6.758 ~ 7.261	6.660 ~ 7.379	6.541 ~ 7.532	6.353 ~ 7.804	6.142 ~ 8.158
10.0	9.680 ~ 10.343	9.498 ~ 10.560	9.299 ~ 10.821	9.061 ~ 11.166	8.693 ~ 11.795	8.289 ~ 12.653
20.0	18.715 ~ 21.478	18.022 ~ 22.477	17.291 ~ 23.741	16.459 ~ 25.539	15.239 ~ 29.242	14.000 ~ 35.432
∞	280.880 ~ ∞	175.685 ~ ∞	123.088 ~ ∞	89.617 ~ ∞	61.724 ~ ∞	44.989 ~ ∞

210mm

ft \ f	3.5	5.6	8	11	16	22
7	7.0 ~ 7.0	7.0 ~ 7.0	6.9 ~ 7.1	6.9 ~ 7.1	6.9 ~ 7.1	6.8 ~ 7.2
8	8.0 ~ 8.0	7.9 ~ 8.1	7.9 ~ 8.1	7.9 ~ 8.1	7.8 ~ 8.2	7.8 ~ 8.2
9	9.0 ~ 9.5	8.9 ~ 9.1	8.9 ~ 9.1	8.9 ~ 9.2	8.8 ~ 9.2	8.7 ~ 9.3
10	9.9 ~ 10.1	9.9 ~ 10.1	9.9 ~ 10.1	9.8 ~ 10.2	9.7 ~ 10.3	9.6 ~ 10.4
12	11.9 ~ 12.1	11.9 ~ 12.2	11.8 ~ 12.2	11.7 ~ 12.3	11.6 ~ 12.4	11.5 ~ 12.6
15	14.9 ~ 15.2	14.8 ~ 15.2	14.7 ~ 15.4	14.5 ~ 15.5	14.3 ~ 15.7	14.1 ~ 16.0
20	19.7 ~ 20.3	19.6 ~ 20.5	19.4 ~ 20.7	19.2 ~ 20.9	18.8 ~ 21.4	18.4 ~ 21.9
30	29.3 ~ 30.6	28.9 ~ 31.0	28.5 ~ 31.5	28.0 ~ 32.2	27.3 ~ 33.3	26.4 ~ 34.7
60	57.4 ~ 62.8	55.9 ~ 64.6	54.3 ~ 66.8	52.5 ~ 69.8	49.7 ~ 75.5	46.8 ~ 83.8
∞	1288 ~ ∞	806 ~ ∞	565 ~ ∞	411 ~ ∞	283 ~ ∞	206 ~ ∞

m \ f	3.5	5.6	8	11	16	22
2.0	1.994 ~ 2.006	1.990 ~ 2.010	1.986 ~ 2.014	1.981 ~ 2.020	1.972 ~ 2.029	1.962 ~ 2.040
2.5	2.489 ~ 2.511	2.483 ~ 2.518	2.475 ~ 2.525	2.466 ~ 2.535	2.451 ~ 2.551	2.433 ~ 2.571
3.0	2.983 ~ 3.017	2.973 ~ 3.028	2.962 ~ 3.040	2.947 ~ 3.055	2.924 ~ 3.081	2.897 ~ 3.112
4.0	3.967 ~ 4.034	3.948 ~ 4.054	3.926 ~ 4.078	3.899 ~ 4.108	3.854 ~ 4.159	3.803 ~ 4.222
5.0	4.946 ~ 5.055	4.914 ~ 5.089	4.879 ~ 5.128	4.835 ~ 5.178	4.763 ~ 5.264	4.681 ~ 5.371
7.0	6.889 ~ 7.115	6.824 ~ 7.186	6.751 ~ 7.269	6.663 ~ 7.376	6.521 ~ 7.561	6.359 ~ 7.797
10.0	9.766 ~ 10.246	9.631 ~ 10.400	9.481 ~ 10.582	9.301 ~ 10.819	9.016 ~ 11.239	8.697 ~ 11.791
20.0	19.045 ~ 21.058	18.516 ~ 21.750	17.946 ~ 22.599	17.283 ~ 23.761	16.283 ~ 25.993	15.229 ~ 29.310
∞	382.238 ~ ∞	239.057 ~ ∞	167.466 ~ ∞	121.908 ~ ∞	83.943 ~ ∞	61.165 ~ ∞

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Vivitar Series

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