

Flat Field Zoom Lens  
Planfeld-Zoom-Objektiv  
Objectif Zoom à Champ Plat  
Objetivo Zoom de Campo Plano

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## Vivitar Series

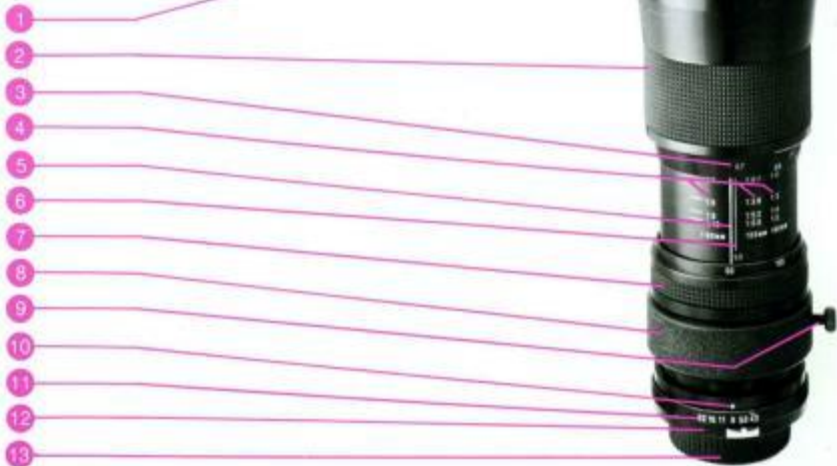


90–180mm f4.5

Owner's Manual  
Gebrauchsanleitung  
Manuel de propriétaire  
Manual del Proprietario

Vivitar Series

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*Your new Vivitar Series 1® 90–180mm Flat-Field Zoom Lens provides four major capabilities in a single optic: a 1:2 magnification ratio, a lens-to-subject distance of nearly 18 inches (45 cm) in the close-focus mode, true zoom design and flat-field characteristics at all aperture openings. Combining a new standard of optical excellence with the rugged reliability required for adverse field conditions, it is uniquely suited for the most critical scientific, biomedical, industrial and commercial applications. The Vivitar 90–180mm Flat-Field Zoom Lens — uncompromising performance for the uncompromising photographer.*

## Getting Acquainted with Your Lens

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- |                                |                                      |
|--------------------------------|--------------------------------------|
| 1 Accessory Thread             | 8 Tripod Mounting Ring               |
| 2 Focusing Ring                | 9 Tripod Mounting Ring Locking Screw |
| 3 Distance Scales              | 10 Aperture Reference Dot            |
| 4 Reproduction Ratio Scales    | 11 Aperture Scales                   |
| 5 Distance Index Line          | 12 Aperture Ring                     |
| 6 Infrared Distance Index Line | 13 Lens Mount                        |
| 7 Zoom Ring                    |                                      |

## Mounting Your Lens

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Mount your Series 1 90–180mm lens according to the lens mounting instructions in your camera Owner's Manual.

## Holding Your Lens

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For maximum stability when hand-holding your camera, place your left hand underneath the lens as shown (see photo "A"). This leaves your other hand free to operate the controls of your camera and assures proper balance and stability.

For any critical copy work, use a tripod to minimize camera movement. Your lens has a locking, Tripod Mounting Ring ⑧ for this purpose.

## Aperture Control

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Your Series 1 lens has Automatic Diaphragm Control. As you turn the Aperture Ring ⑫, the diaphragm remains open at the lens' maximum aperture. When the shutter is released, the lens automatically stops down to your preselected f-stop and instantly reopens after the exposure is completed. To select a specific f-stop:

- 1 — Turn the Aperture Ring ⑫ until desired f-stop aligns with the Aperture Reference Dot ⑩.

The Aperture Ring is equipped with click-stops at each indicated f-stop and at each intermediate half-stop between f5.6 and f16.

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

Canon Mount lenses have an AUTO/MANUAL Lever which must be at the clockwise end of its slot for Automatic Diaphragm Control. In the counterclockwise position, the lens diaphragm opens and closes as the Aperture Ring is turned.

## EE Coupled Lenses

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Canon Mount lenses have a click stop at the "O" marked EE position. The Aperture Ring may be set at and removed from this position in the same manner as selecting a specifically marked f-stop.

## Distance Scales

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There are two numbered Distance Scales ③ engraved on the Focusing Ring ②. The *white numbers* indicate distance in *feet* and the *green numbers*

indicate distance in *meters*. The distance to an object in focus is indicated on these scales at the Distance Index Line ⑤.

## Infrared Photography

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Infrared light does not focus at the same point as visible wavelengths. A special, Infrared Distance Index Line ⑥ has been provided to help you adjust for this difference in wavelength transmission. For infrared photography:

- 1 — Focus on your subject.
- 2 — Note the exact point on the Distance Scale that aligns with the Distance Index Line. Turn the Focusing Ring until that same point aligns with the Infrared Distance Index Line ⑥.

Since infrared radiation is variable by nature, the Infrared Distance Index Line should be regarded as an approximation for focusing.

## Depth of Field

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Depth of field is the area of acceptable sharpness in front of and behind an object-in-focus. For precise depth of field information for selected aperture/focal length/distance combinations, refer to the Depth of Field Charts in the back of this Owner's Manual.

## Zoom Ring

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The Zoom Ring ⑦ controls the lens focal length selection and is marked at specific focal lengths of 90, 105, 135, 150 and 180mm. The cam-operated focusing system maintains focus as you zoom from one focal length to another. It is always advisable to recheck focus after zooming.

## Close-Up Photography

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Your Series 1 90–180mm Flat Field Zoom is an excellent instrument for close-up photographic applications. The 90–180mm has an image reproduction range of 1:4 at 90mm to 1:2 at 180mm, with a minimum working distance of 45 cm (17.7 in.) (subject to front lens element). This increased distance between subject and lens allows you to use a greater variety of illumination techniques on your subject.

The reproduction Ratio Scales ④ provide image reproduction ratios for 90, 135 and 180mm focal lengths (see photo "B"). For any desired image reproduction ratio:

- 1 — Turn Zoom Ring ⑦ to desired focal length.
- 2 — Turn the Focusing Ring ② until the trailing edge of the Ring aligns with the desired reproduction ratio. (See photo "C")

- 3 — Move camera/lens until the subject appears sharpest in the camera viewfinder.

In all close-up applications, the use of a tripod and cable release is recommended to minimize camera movement.

## Caring for Your Lens

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- 1 — It's a good idea to keep a filter (Vivitar Skylight or UV Haze) on your lens at all times. A filter will protect your lens' front element from dust and dirt that can cause scratches.
- 2 — When attaching threaded accessories to your lens, carefully align the accessory with the Accessory Thread ⓘ to prevent damage.
- 3 — After removing the lens from your camera, put both front and rear lens caps on the lens to prevent any foreign particles from entering.
- 4 — Clean your lens with an air brush or can of compressed air (available at your photo dealer). To remove a fingerprint, use lens cleaning solution and a lens cleaning tissue. DO NOT rub your finger, cloth or clothing on the lens surface. Doing so will scratch the lens coating and will affect your photos.



- 5 — Always store your lens in a cool, dry place. In extremely humid climates, EXTRA CARE should be taken when storing your lens. NEVER store your lens in a moisture-retaining enclosure. Let your lens adapt to room temperature before storing. It's a good idea to store your lens with a fresh silica gel packet to prevent moisture from forming on or inside the lens.

## Specifications

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*Optical Construction:* 18 elements in 12 groups

*Zoom Ratio:* 2:1

*Angles of Acceptance:* 27° at 90mm; 13° at 180mm

*Aperture Range:* f4.5 to f22\*

*Minimum Focusing Distance —*

*from Film Plane:* 69 cm (27.2 in.)

*from Front Element:* 45 cm (17.7 in.)

*Maximum Reproduction Ratio:* 1:2 at 180mm

*Weight:* 1.09 kg (38.4 oz.)

*Length at Infinity:* 158 mm (6.2 in.)

*Maximum Barrel Diameter:* 75 mm (3 in.)

*Accessory Size:* 72mm

*Lens Cap Size:* 75mm

*Accessories Included:* Front and rear lens caps

\*f16 on Konica Mount



Specifications subject to change without notice

Depth of Field Tables  
Tiefenschärfetabellen  
Tableaux de profondeur de champ  
Tablas de profundidad de campo



90mm

ft. \ f	4.5	5.6	8	11	16	22
2.5	2.489 ~ 2.511	2.486 ~ 2.514	2.480 ~ 2.520	2.473 ~ 2.528	2.461 ~ 2.541	2.447 ~ 2.557
2.75	2.734 ~ 2.766	2.730 ~ 2.770	2.722 ~ 2.779	2.712 ~ 2.790	2.695 ~ 2.808	2.675 ~ 2.831
3.0	2.979 ~ 3.022	2.974 ~ 3.027	2.963 ~ 3.039	2.949 ~ 3.053	2.927 ~ 3.079	2.901 ~ 3.110
3.5	3.466 ~ 3.535	3.458 ~ 3.543	3.440 ~ 3.562	3.419 ~ 3.586	3.383 ~ 3.628	3.342 ~ 3.679
4.0	3.951 ~ 4.051	3.939 ~ 4.064	3.913 ~ 4.092	3.882 ~ 4.127	3.831 ~ 4.189	3.773 ~ 4.265
5.0	4.912 ~ 5.092	4.891 ~ 5.115	4.845 ~ 5.167	4.790 ~ 5.223	4.702 ~ 5.347	4.601 ~ 5.492
7.0	6.802 ~ 7.212	6.755 ~ 7.266	6.656 ~ 7.387	6.537 ~ 7.544	6.348 ~ 7.824	6.137 ~ 8.193
10.0	9.560 ~ 10.487	9.458 ~ 10.614	9.245 ~ 10.902	8.993 ~ 11.288	8.604 ~ 11.999	8.184 ~ 12.991
15.0	13.962 ~ 16.216	13.731 ~ 16.546	13.253 ~ 17.315	12.703 ~ 18.390	11.887 ~ 20.527	11.044 ~ 23.891
30.0	25.874 ~ 35.758	25.036 ~ 37.526	23.388 ~ 42.080	21.617 ~ 49.647	19.211 ~ 71.113	16.967 ~ 149.403
∞	175.762 ~ ∞	141.380 ~ ∞	99.184 ~ ∞	72.332 ~ ∞	49.956 ~ ∞	36.531 ~ ∞

m \ f	4.5	5.6	8	11	16	22
0.8	0.796 ~ 0.804	0.795 ~ 0.805	0.793 ~ 0.807	0.790 ~ 0.810	0.786 ~ 0.815	0.781 ~ 0.821
0.9	0.894 ~ 0.906	0.892 ~ 0.908	0.889 ~ 0.911	0.885 ~ 0.915	0.879 ~ 0.923	0.871 ~ 0.932
1.0	0.991 ~ 1.009	0.989 ~ 1.011	0.985 ~ 1.016	0.980 ~ 1.022	0.971 ~ 1.032	0.960 ~ 1.045
1.1	1.089 ~ 1.112	1.086 ~ 1.114	1.080 ~ 1.121	1.073 ~ 1.129	1.061 ~ 1.143	1.048 ~ 1.160
1.3	1.282 ~ 1.318	1.278 ~ 1.323	1.269 ~ 1.333	1.257 ~ 1.346	1.239 ~ 1.369	1.218 ~ 1.397
1.5	1.474 ~ 1.527	1.468 ~ 1.534	1.455 ~ 1.549	1.439 ~ 1.568	1.413 ~ 1.601	1.383 ~ 1.644
2.0	1.948 ~ 2.055	1.936 ~ 2.069	1.910 ~ 2.101	1.876 ~ 2.141	1.828 ~ 2.213	1.772 ~ 2.307
3.0	2.870 ~ 3.143	2.841 ~ 3.180	2.778 ~ 3.265	2.703 ~ 3.378	2.588 ~ 3.586	3.464 ~ 3.875
5.0	4.620 ~ 5.453	4.536 ~ 5.577	4.364 ~ 5.869	4.166 ~ 6.282	3.877 ~ 7.124	3.580 ~ 8.505
10.0	8.504 ~ 12.145	8.260 ~ 12.823	7.625 ~ 14.605	7.008 ~ 17.694	6.180 ~ 27.434	5.419 ~ 82.429
∞	53.572 ~ ∞	42.093 ~ ∞	30.231 ~ ∞	22.047 ~ ∞	15.227 ~ ∞	11.135 ~ ∞

105mm

ft. \ f	4.5	5.6	8	11	16	22
2.5	2.492 ~ 2.508	2.490 ~ 2.510	2.486 ~ 2.515	2.486 ~ 2.520	2.472 ~ 2.529	2.461 ~ 2.541
2.75	2.738 ~ 2.762	2.736 ~ 2.765	2.730 ~ 2.771	2.722 ~ 2.779	2.710 ~ 2.792	2.695 ~ 2.808
3.0	2.985 ~ 3.016	2.981 ~ 3.020	2.973 ~ 3.028	2.963 ~ 3.039	2.946 ~ 3.057	2.927 ~ 3.079
3.5	3.475 ~ 3.525	3.469 ~ 3.532	3.456 ~ 3.545	3.440 ~ 3.563	3.414 ~ 3.592	3.383 ~ 3.629
4.0	4.964 ~ 4.037	3.955 ~ 4.046	3.936 ~ 4.067	3.913 ~ 4.092	3.875 ~ 4.136	3.831 ~ 4.190
5.0	4.935 ~ 5.067	4.919 ~ 5.084	4.886 ~ 5.121	4.844 ~ 5.168	4.778 ~ 5.249	4.700 ~ 5.351
7.0	6.853 ~ 7.154	6.819 ~ 7.193	6.744 ~ 7.279	6.653 ~ 7.391	6.508 ~ 7.585	6.344 ~ 7.834
10.0	9.673 ~ 10.353	9.597 ~ 10.443	9.434 ~ 10.647	9.239 ~ 10.913	8.934 ~ 11.390	8.595 ~ 12.026
15.0	14.223 ~ 15.874	14.046 ~ 16.104	13.675 ~ 16.631	13.239 ~ 17.344	12.575 ~ 18.685	11.687 ~ 20.612
30.0	26.854 ~ 34.023	26.185 ~ 35.179	24.837 ~ 38.004	23.341 ~ 42.262	21.223 ~ 52.033	19.153 ~ 72.230
∞	239.103 ~ ∞	192.290 ~ ∞	134.838 ~ ∞	98.277 ~ ∞	67.811 ~ ∞	49.531 ~ ∞

m \ f	4.6	5.6	8	11	16	22
0.8	0.797 ~ 0.803	0.796 ~ 0.804	0.795 ~ 0.805	0.793 ~ 0.807	0.790 ~ 0.811	0.786 ~ 0.815
0.9	0.896 ~ 0.905	0.894 ~ 0.906	0.892 ~ 0.908	0.889 ~ 0.911	0.884 ~ 0.916	0.879 ~ 0.923
1.0	0.994 ~ 1.006	0.992 ~ 1.008	0.989 ~ 1.011	0.985 ~ 1.016	0.978 ~ 1.023	0.971 ~ 1.032
1.1	1.092 ~ 1.108	1.090 ~ 1.111	1.085 ~ 1.115	1.082 ~ 1.121	1.071 ~ 1.131	1.061 ~ 1.143
1.3	1.287 ~ 1.313	1.284 ~ 1.317	1.277 ~ 1.324	1.268 ~ 1.334	1.255 ~ 1.350	1.239 ~ 1.369
1.5	1.481 ~ 1.520	1.476 ~ 1.525	1.467 ~ 1.535	1.454 ~ 1.549	1.435 ~ 1.573	1.412 ~ 1.602
2.0	1.962 ~ 2.040	1.952 ~ 2.050	1.933 ~ 2.073	1.909 ~ 2.102	1.871 ~ 2.152	1.827 ~ 2.216
3.0	2.904 ~ 3.104	2.881 ~ 3.130	2.833 ~ 3.190	2.776 ~ 3.268	2.686 ~ 3.408	2.585 ~ 3.594
5.0	4.715 ~ 5.325	4.650 ~ 5.411	4.516 ~ 5.609	4.358 ~ 5.880	4.120 ~ 6.397	3.869 ~ 7.158
10.0	8.856 ~ 11.491	8.616 ~ 11.928	8.137 ~ 13.010	7.610 ~ 14.681	6.872 ~ 18.709	6.160 ~ 28.001
∞	72.879 ~ ∞	58.610 ~ ∞	41.099 ~ ∞	29.955 ~ ∞	20.669 ~ ∞	15.097 ~ ∞

135mm

ft. \ f	4.5	5.6	8	11	16	22
<b>2.5</b>	2.495 ~ 2.505	2.494 ~ 2.506	2.492 ~ 2.508	2.489 ~ 2.512	2.483 ~ 2.517	2.477 ~ 5.524
<b>2.75</b>	2.743 ~ 2.757	2.742 ~ 2.759	2.738 ~ 2.762	2.734 ~ 2.767	2.726 ~ 2.775	2.717 ~ 2.784
<b>3.0</b>	2.991 ~ 3.009	2.989 ~ 3.012	2.984 ~ 3.017	2.978 ~ 3.023	2.968 ~ 3.033	2.956 ~ 3.046
<b>3.5</b>	3.485 ~ 3.515	3.482 ~ 3.519	3.474 ~ 3.527	3.464 ~ 3.537	3.448 ~ 3.555	3.429 ~ 3.576
<b>4.0</b>	3.978 ~ 4.022	3.973 ~ 4.028	3.961 ~ 4.040	3.947 ~ 4.055	3.924 ~ 4.080	3.896 ~ 4.112
<b>5.0</b>	4.961 ~ 5.042	4.951 ~ 5.050	4.930 ~ 5.072	4.905 ~ 5.100	4.863 ~ 5.147	4.814 ~ 5.205
<b>7.0</b>	6.911 ~ 7.092	6.889 ~ 7.115	6.843 ~ 7.166	6.786 ~ 7.231	6.694 ~ 7.342	6.587 ~ 7.480
<b>10.0</b>	9.799 ~ 10.210	9.752 ~ 10.263	9.649 ~ 10.381	9.525 ~ 10.532	9.325 ~ 10.795	9.097 ~ 11.131
<b>15.0</b>	14.519 ~ 15.516	14.406 ~ 15.848	14.167 ~ 15.945	13.880 ~ 16.333	13.428 ~ 17.027	12.926 ~ 17.947
<b>30.0</b>	28.012 ~ 32.313	27.566 ~ 32.935	26.642 ~ 34.380	25.574 ~ 36.382	23.978 ~ 40.310	22.317 ~ 46.352
<b>∞</b>	394.438 ~ ∞	317.150 ~ ∞	222.297 ~ ∞	161.935 ~ ∞	111.635 ~ ∞	81.455 ~ ∞

m \ f	4.5	5.6	8	11	16	22
<b>0.8</b>	0.798 ~ 0.802	0.798 ~ 0.802	0.797 ~ 0.803	0.796 ~ 0.804	0.794 ~ 0.806	0.792 ~ 0.809
<b>0.9</b>	0.897 ~ 0.903	0.897 ~ 0.903	0.895 ~ 0.905	0.894 ~ 0.907	0.891 ~ 0.910	0.887 ~ 0.913
<b>1.0</b>	0.996 ~ 1.004	0.995 ~ 1.005	0.993 ~ 1.007	0.991 ~ 1.009	0.987 ~ 1.014	0.982 ~ 1.019
<b>1.1</b>	1.095 ~ 1.105	1.094 ~ 1.106	1.091 ~ 1.109	1.088 ~ 1.112	1.083 ~ 1.118	1.076 ~ 1.125
<b>1.3</b>	1.292 ~ 1.308	1.290 ~ 1.310	1.286 ~ 1.314	1.281 ~ 1.320	1.272 ~ 1.329	1.262 ~ 1.341
<b>1.5</b>	1.488 ~ 1.512	1.486 ~ 1.515	1.480 ~ 1.521	1.472 ~ 1.529	1.460 ~ 1.543	1.446 ~ 1.560
<b>2.0</b>	1.977 ~ 2.024	1.971 ~ 2.030	1.959 ~ 2.043	1.944 ~ 2.060	1.920 ~ 2.089	1.891 ~ 2.125
<b>3.0</b>	2.941 ~ 3.062	2.927 ~ 3.077	2.897 ~ 3.112	2.860 ~ 3.156	2.801 ~ 3.234	2.734 ~ 3.332
<b>5.0</b>	4.823 ~ 5.191	4.782 ~ 5.240	4.694 ~ 5.351	4.590 ~ 5.497	4.426 ~ 5.759	4.246 ~ 6.111
<b>10.0</b>	9.277 ~ 10.858	9.116 ~ 11.088	8.783 ~ 11.632	8.401 ~ 12.393	7.836 ~ 13.918	7.254 ~ 16.346
<b>∞</b>	120.225 ~ ∞	96.667 ~ ∞	67.756 ~ ∞	49.358 ~ ∞	34.026 ~ ∞	23.827 ~ ∞

150mm

ft. \ f	4.5	5.6	8	11	16	22
2.5	2.496 ~ 2.504	2.495 ~ 2.505	2.493 ~ 2.507	2.491 ~ 2.509	2.487 ~ 2.513	2.482 ~ 2.519
2.75	2.745 ~ 2.755	2.743 ~ 2.757	2.740 ~ 2.760	2.737 ~ 2.763	2.731 ~ 2.770	2.724 ~ 2.777
3.0	2.993 ~ 3.007	2.991 ~ 3.009	2.987 ~ 3.013	2.982 ~ 3.018	2.974 ~ 3.027	2.965 ~ 3.037
3.5	3.488 ~ 3.512	3.485 ~ 3.515	3.479 ~ 3.522	3.471 ~ 3.530	3.458 ~ 3.544	3.443 ~ 3.561
4.0	3.982 ~ 4.081	3.978 ~ 4.022	3.969 ~ 4.032	3.957 ~ 4.044	3.938 ~ 4.065	3.916 ~ 4.090
5.0	4.968 ~ 5.032	4.960 ~ 5.041	4.944 ~ 5.058	4.923 ~ 5.080	4.889 ~ 5.118	4.849 ~ 5.164
7.0	6.927 ~ 7.074	6.910 ~ 7.093	6.872 ~ 7.134	6.826 ~ 7.185	6.750 ~ 7.274	6.662 ~ 7.383
10.0	9.837 ~ 10.170	9.798 ~ 10.212	9.714 ~ 10.306	9.612 ~ 10.427	9.446 ~ 10.634	9.256 ~ 10.896
15.0	14.608 ~ 15.416	14.516 ~ 15.521	14.318 ~ 15.757	14.080 ~ 16.062	13.701 ~ 16.500	13.274 ~ 17.300
30.0	28.370 ~ 31.848	27.998 ~ 32.335	27.221 ~ 33.453	26.311 ~ 34.968	24.927 ~ 37.836	23.455 ~ 41.991
∞	486.799 ~ ∞	391.395 ~ ∞	274.307 ~ ∞	199.798 ~ ∞	137.706 ~ ∞	100.452 ~ ∞

m \ f	4.5	5.6	8	11	16	22
0.8	0.799 ~ 0.801	0.798 ~ 0.802	0.798 ~ 0.802	0.797 ~ 0.803	0.795 ~ 0.805	0.733 ~ 0.807
0.9	0.898 ~ 0.902	0.897 ~ 0.903	0.896 ~ 0.904	0.895 ~ 0.905	0.893 ~ 0.908	0.890 ~ 0.911
1.0	1.003 ~ 0.997	0.996 ~ 1.004	0.995 ~ 1.005	0.993 ~ 1.007	0.989 ~ 1.011	0.986 ~ 1.015
1.1	1.096 ~ 1.104	1.095 ~ 1.105	1.093 ~ 1.107	1.090 ~ 1.110	1.086 ~ 1.115	1.081 ~ 1.120
1.3	1.294 ~ 1.307	1.292 ~ 1.308	1.289 ~ 1.312	1.284 ~ 1.316	1.278 ~ 1.324	1.270 ~ 1.333
1.5	1.491 ~ 1.510	1.488 ~ 1.512	1.483 ~ 1.517	1.477 ~ 1.524	1.467 ~ 1.535	1.456 ~ 1.548
2.0	1.981 ~ 2.019	1.976 ~ 2.024	1.967 ~ 2.035	1.954 ~ 2.048	1.934 ~ 2.071	1.911 ~ 2.100
3.0	2.952 ~ 3.050	2.941 ~ 3.062	2.916 ~ 3.090	2.886 ~ 3.125	2.837 ~ 3.186	2.781 ~ 3.263
5.0	4.856 ~ 5.154	4.822 ~ 5.193	4.750 ~ 5.281	4.663 ~ 5.395	4.525 ~ 5.597	4.371 ~ 5.863
10.0	9.405 ~ 10.681	9.270 ~ 10.862	8.990 ~ 11.280	8.663 ~ 11.852	8.170 ~ 12.950	7.651 ~ 14.579
∞	148.376 ~ ∞	119.297 ~ ∞	83.609 ~ ∞	60.898 ~ ∞	41.973 ~ ∞	30.618 ~ ∞

180mm

ft. \ f	4.5	5.6	8	11	16	22
2.5	2.497 ~ 2.503	2.497 ~ 2.503	2.495 ~ 2.505	2.494 ~ 2.506	2.491 ~ 2.509	2.488 ~ 2.513
2.75	2.746 ~ 2.754	2.745 ~ 2.755	2.743 ~ 2.757	2.741 ~ 2.759	2.737 ~ 2.764	2.732 ~ 2.769
3.0	2.995 ~ 3.005	2.994 ~ 3.006	2.991 ~ 3.009	2.988 ~ 3.013	2.982 ~ 3.019	2.975 ~ 3.026
3.5	3.492 ~ 3.509	3.489 ~ 3.511	3.485 ~ 3.515	3.479 ~ 3.521	3.470 ~ 3.531	3.459 ~ 3.543
4.0	3.987 ~ 4.013	3.984 ~ 4.016	3.978 ~ 4.023	3.970 ~ 4.031	3.956 ~ 4.046	3.940 ~ 4.063
5.0	4.977 ~ 5.023	4.972 ~ 5.029	4.960 ~ 5.041	4.945 ~ 5.047	4.920 ~ 5.084	4.891 ~ 5.116
7.0	6.948 ~ 7.053	6.935 ~ 7.066	6.908 ~ 7.095	6.874 ~ 7.132	6.819 ~ 7.194	6.754 ~ 7.270
10.0	9.883 ~ 10.121	9.854 ~ 10.151	9.793 ~ 10.218	9.718 ~ 10.302	9.596 ~ 10.446	9.455 ~ 10.626
15.0	4.717 ~ 15.296	14.649 ~ 15.370	14.504 ~ 15.535	14.328 ~ 15.746	14.044 ~ 16.113	13.719 ~ 16.579
30.0	28.810 ~ 31.301	28.534 ~ 31.637	27.950 ~ 32.397	27.255 ~ 33.402	26.174 ~ 35.230	24.990 ~ 37.721
∞	678.167 ~ ∞	545.231 ~ ∞	382.082 ~ ∞	278.260 ~ ∞	191.742 ~ ∞	139.832 ~ ∞

m \ f	4.5	5.6	8	11	16	22
0.8	0.799 ~ 0.801	0.799 ~ 0.801	0.798 ~ 0.802	0.798 ~ 0.802	0.797 ~ 0.803	0.795 ~ 0.805
0.9	0.899 ~ 0.901	0.898 ~ 0.902	0.897 ~ 0.903	0.896 ~ 0.904	0.895 ~ 0.905	0.893 ~ 0.907
1.0	0.998 ~ 1.002	0.997 ~ 1.003	0.996 ~ 1.004	0.995 ~ 1.005	0.993 ~ 1.008	0.990 ~ 1.011
1.1	1.097 ~ 1.103	1.096 ~ 1.104	1.095 ~ 1.105	1.093 ~ 1.107	1.090 ~ 1.110	1.086 ~ 1.114
1.3	1.295 ~ 1.305	1.294 ~ 1.306	1.292 ~ 1.308	1.289 ~ 1.311	1.284 ~ 1.317	1.278 ~ 1.323
1.5	1.493 ~ 1.507	1.492 ~ 1.508	1.488 ~ 1.512	1.484 ~ 1.517	1.477 ~ 1.524	1.468 ~ 1.534
2.0	1.986 ~ 2.014	1.983 ~ 2.017	1.976 ~ 2.025	1.967 ~ 2.034	1.953 ~ 2.050	1.936 ~ 2.070
3.0	2.965 ~ 3.036	2.957 ~ 3.044	2.939 ~ 3.064	2.917 ~ 3.089	2.881 ~ 3.131	2.839 ~ 3.184
5.0	4.896 ~ 5.109	4.871 ~ 5.137	4.818 ~ 5.198	4.753 ~ 5.277	4.649 ~ 5.414	4.532 ~ 5.590
10.0	9.566 ~ 10.480	9.466 ~ 10.605	9.254 ~ 10.887	9.003 ~ 11.263	8.615 ~ 11.953	8.193 ~ 12.907
∞	206.705 ~ ∞	166.186 ~ ∞	116.459 ~ ∞	84.814 ~ ∞	58.443 ~ ∞	42.621 ~ ∞





A



B



C

Vivitar Series

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