

WVGA Lens Charts

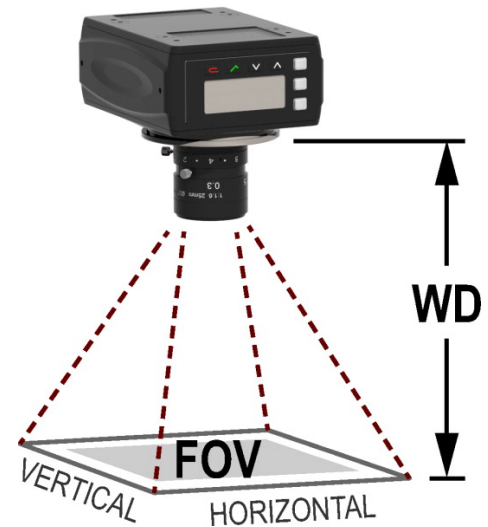
This paper offers information useful for selecting a C-mount lens for the VE Series WVGA smart camera.

Working Distance and Field of View

The two main variables involved when discussing a camera's lens choice are the **Working Distance** and the **Field of View** size. The Working Distance, or WD, is the distance from the camera to the target object. In the case of this collection of lens charts, the Working Distance is measured from the front surface of the threaded lens cover mount. The distance is not measured from the end of the lens because different lenses from different manufacturers, even with the same focal length, can vary in length.

The Field of View, or FOV, is the real world size of the picture the camera takes. This can also be broken down into a horizontal FOV size and a vertical FOV size. Note that the picture taken by a VE Series vision sensor is not square. The imager used in the WVGA VE sensor is 752×480 pixels, making a rectangular image where the vertical FOV is about 64% the size of the horizontal FOV.

The Working Distance and Field of View sizes are related by linear equations determined by the focal length of the lens. Choosing the correct lens for a given application might be a matter of selecting the desired size of the FOV, then seeing which of the options for focal length result in a good fit for camera Working Distance. The situation might also be reversed, where the desired mounting location of the camera is known (and thus the Working Distance is fixed) and the various focal length lenses give a range of FOV sizes to choose from. In all cases, only one of these two variables may be freely selected. The second variable then becomes a function of the first. This is the reason why we offer a broad range of lens focal lengths—to provide as many options as possible to suit different WD/FOV size requirements.



Multiple Manufacturers and Format Size

Banner does not manufacture any C-mount lenses used by our vision sensors. Instead we offer a range of lenses from different suppliers.

Imager Resolution: 752 px (H) $\times$ 480 px (V)
Pixel Size: $5.3 \mu\text{m} \times 5.3 \mu\text{m}$
Image Size: 4.1 mm (H) $\times$ 2.6 mm (V), 4.9 mm (diagonal)

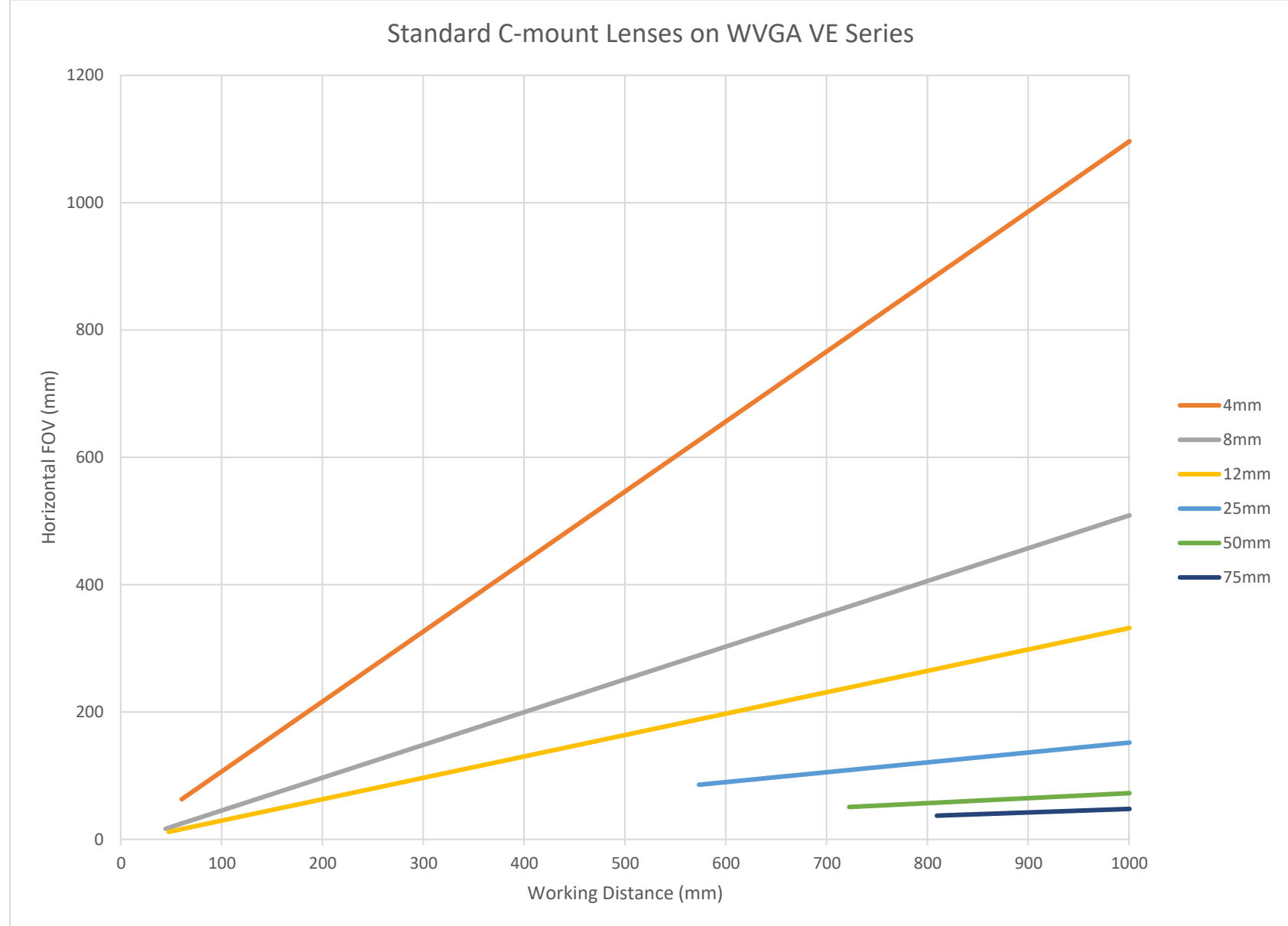
Off the Charts

In the pages that follow, graphical views of the Working Distance versus Horizontal FOV relationships are shown, out to a maximum working distance of 1 meter. These graphs offer a quick and easy way to estimate the FOV size for a given Working Distance and lens focal length. Also provided are two tables with entries out to 1.5 meters. The first shows FOV size as a function of Working Distance and the

second shows Working Distance as a function of FOV size. The mathematical equations that describe the relationship between these two variables are also provided, allowing for calculations beyond what the chart and tables offer.

Each lens has a natural minimum Working Distance. If a camera using this lens were to move closer to the target than this minimum distance, the image would be out of focus and the lens alone would not be able to fix it. This is where extension tubes and shims are used. Extension tubes allow a lens to come into focus at a Working Distance closer than the minimum. The relationship between Working Distance and FOV size remains in effect as extension tubes are added, and so extension tubes are usually used to generate very small FOVs. A microscope is basically a high focal length lens with a large amount of extension tubes applied.

Standard Resolution C-mount Lenses on WVGA VE Series



Standard C-mount Lenses on WVGA VE Series, FOV as a function of WD Chart

WD (mm)	FOV (mm)																	
	4mm			8mm			12mm			25mm			50mm			75mm		
Minimum	61	x	39	16	x	10	11	x	7	85	x	54	51	x	33	37	x	24
	@ 60mm			@ 44mm			@ 47mm			@ 573mm			@ 722mm			@ 809mm		
20																		
40																		
60	63	x	40	25	x	16	16	x	10									
80	85	x	54	35	x	22	23	x	15									
100	107	x	68	46	x	29	30	x	19									
120	129	x	82	56	x	36	36	x	23									
140	151	x	96	66	x	42	43	x	27									
160	173	x	110	76	x	49	50	x	32									
180	195	x	124	87	x	55	56	x	36									
200	217	x	138	97	x	62	63	x	40									
220	239	x	152	107	x	68	70	x	45									
240	261	x	167	118	x	75	77	x	49									
260	283	x	181	128	x	82	83	x	53									
280	305	x	195	138	x	88	90	x	57									
300	327	x	209	148	x	95	97	x	62									
320	349	x	223	159	x	101	103	x	66									
340	371	x	237	169	x	108	110	x	70									
360	393	x	251	179	x	115	117	x	75									
380	415	x	265	190	x	121	124	x	79									
400	437	x	279	200	x	128	130	x	83									
420	459	x	293	210	x	134	137	x	87									
440	481	x	307	221	x	141	144	x	92									
460	503	x	321	231	x	147	151	x	96									
480	525	x	335	241	x	154	157	x	100									
500	547	x	349	251	x	161	164	x	105									
520	569	x	363	262	x	167	171	x	109									
540	591	x	377	272	x	174	177	x	113									
560	613	x	391	282	x	180	184	x	118									
580	635	x	405	293	x	187	191	x	122	87	x	55						
600	657	x	419	303	x	193	198	x	126	90	x	57						
620	679	x	433	313	x	200	204	x	130	93	x	59						
640	701	x	447	324	x	207	211	x	135	96	x	61						
660	723	x	461	334	x	213	218	x	139	99	x	63						
680	745	x	475	344	x	220	224	x	143	102	x	65						
700	767	x	489	354	x	226	231	x	148	105	x	67						
720	789	x	503	365	x	233	238	x	152	109	x	69						
740	811	x	517	375	x	239	245	x	156	112	x	71	52	x	33			
760	833	x	531	385	x	246	251	x	160	115	x	73	54	x	34			
780	855	x	545	396	x	253	258	x	165	118	x	75	55	x	35			
800	877	x	559	406	x	259	265	x	169	121	x	77	57	x	36			
820	899	x	574	416	x	266	271	x	173	124	x	79	59	x	37	38	x	24
840	920	x	588	427	x	272	278	x	178	127	x	81	60	x	38	39	x	25
860	942	x	602	437	x	279	285	x	182	130	x	83	62	x	39	40	x	26
880	964	x	616	447	x	285	292	x	186	133	x	85	63	x	40	41	x	26
900	986	x	630	457	x	292	298	x	190	136	x	87	65	x	41	42	x	27
920	1008	x	644	468	x	299	305	x	195	140	x	89	66	x	42	43	x	28
940	1030	x	658	478	x	305	312	x	199	143	x	91	68	x	43	45	x	28
960	1052	x	672	488	x	312	319	x	203	146	x	93	69	x	44	46	x	29
980	1074	x	686	499	x	318	325	x	208	149	x	95	71	x	45	47	x	30
1000	1096	x	700	509	x	325	332	x	212	152	x	97	73	x	46	48	x	31
1020	1118	x	714	519	x	331	339	x	216	155	x	99	74	x	47	49	x	31
1040	1140	x	728	530	x	338	345	x	220	158	x	101	76	x	48	50	x	32
1060	1162	x	742	540	x	345	352	x	225	161	x	103	77	x	49	51	x	33
1080	1184	x	756	550	x	351	359	x	229	164	x	105	79	x	50	52	x	33
1100	1206	x	770	560	x	358	366	x	233	167	x	107	80	x	51	53	x	34
1120	1228	x	784	571	x	364	372	x	238	171	x	109	82	x	52	54	x	35
1140	1250	x	798	581	x	371	379	x	242	174	x	111	84	x	53	56	x	35
1160	1272	x	812	591	x	377	386	x	246	177	x	113	85	x	54	57	x	36
1180	1294	x	826	602	x	384	392	x	250	180	x	115	87	x	55	58	x	37
1200	1316	x	840	612	x	391	399	x	255	183	x	117	88	x	56	59	x	38
1220	1338	x	854	622	x	397	406	x	259	186	x	119	90	x	57	60	x	38
1240	1360	x	868	633	x	404	413	x	263	189	x	121	91	x	58	61	x	39
1260	1382	x	882	643	x	410	419	x	268	192	x	123	93	x	59	62	x	40
1280	1404	x	896	653	x	417	426	x	272	195	x	125	95	x	60	63	x	40
1300	1426	x	910	663	x	423	433	x	276	198	x	127	96	x	61	64	x	41
1320	1448	x	924	674	x	430	439	x	281	202	x	129	98	x	62	66	x	42
1340	1470	x	938	684	x	437	446	x	285	205	x	131	99	x	63	67	x	43
1360	1492	x	952	694	x	443	453	x	289	208	x	133	101	x	64	68	x	43
1380	1514	x	966	705	x	450	460	x	293	211	x	135	102	x	65	69	x	44
1400	1536	x	981	715	x	456	466	x	298	214	x	137	104	x	66	70	x	45
1420	1558	x	995	725	x	463	473	x	302	217	x	139	105	x	67	71	x	45
1440	1580	x	1009	735	x	469	480	x	306	220	x	141	107	x	68	72	x	46
1460	1602	x	1023	746	x	476	487	x	311	223	x	143	109	x	69	73	x	47
1480	1624	x	1037	756	x	483	493	x	315	226	x	145	110	x	70	74	x	47
1500	1646	x	1051	766	x	489	500	x	319	229	x	146	112	x	71	75	x	48

Standard C-mount Lenses on WVGA VE Series, WD as a function of FOV Chart

			WD (mm)																	
FOV (mm)			4mm			8mm			12mm			25mm			50mm			75mm		
Minimum			61 x 39 @ 60mm		16 x 10 @ 44mm		11 x 7 @ 47mm		85 x 54 @ 573mm		51 x 33 @ 722mm		37 x 24 @ 809mm							
20	x	13			50		72													
40	x	26			89		131						858							
60	x	38			128		191				839		1220							
80	x	51		75	167		250				1094		1582							
100	x	64		94	206		310		665		1350		1943							
120	x	77		112	245		369		794		1605		2305							
140	x	89		130	283		429		923		1861		2667							
160	x	102		148	322		488		1052		2116		3028							
180	x	115		166	361		548		1181		2372		3390							
200	x	128		185	400		607		1310		2627		3752							
220	x	140		203	439		667		1439		2882		4113							
240	x	153		221	478		726		1568		3138		4475							
260	x	166		239	517		786		1697		3393		4837							
280	x	179		257	555		845		1826		3649		5198							
300	x	191		276	594		905		1955		3904		5560							
320	x	204		294	633		964		2084		4160		5922							
340	x	217		312	672		1024		2213		4415		6283							
360	x	230		330	711		1083		2342		4670		6645							
380	x	243		348	750		1143		2471		4926		7007							
400	x	255		367	788		1202		2600		5181		7368							
420	x	268		385	827		1262		2729		5437		7730							
440	x	281		403	866		1322		2858		5692		8092							
460	x	294		421	905		1381		2987		5948		8453							
480	x	306		439	944		1441		3116		6203		8815							
500	x	319		458	983		1500		3245		6458		9177							
520	x	332		476	1022		1560		3374		6714		9538							
540	x	345		494	1060		1619		3503		6969		9900							
560	x	357		512	1099		1679		3632		7225		10262							
580	x	370		530	1138		1738		3761		7480		10623							
600	x	383		548	1177		1798		3890		7736		10985							
620	x	396		567	1216		1857		4019		7991		11347							
640	x	409		585	1255		1917		4148		8246		11708							
660	x	421		603	1293		1976		4277		8502		12070							
680	x	434		621	1332		2036		4406		8757		12432							
700	x	447		639	1371		2095		4536		9013		12793							
720	x	460		658	1410		2155		4665		9268		13155							
740	x	472		676	1449		2214		4794		9524		13517							
760	x	485		694	1488		2274		4923		9779		13878							
780	x	498		712	1526		2333		5052		10034		14240							
800	x	511		730	1565		2393		5181		10290		14602							
820	x	523		749	1604		2452		5310		10545		14963							
840	x	536		767	1643		2512		5439		10801		15325							
860	x	549		785	1682		2572		5568		11056		15687							
880	x	562		803	1721		2631		5697		11312		16048							
900	x	574		821	1760		2691		5826		11567		16410							
920	x	587		840	1798		2750		5955		11822		16772							
940	x	600		858	1837		2810		6084		12078		17133							
960	x	613		876	1876		2869		6213		12333		17495							
980	x	626		894	1915		2929		6342		12589		17857							
1000	x	638		912	1954		2988		6471		12844		18218							
1020	x	651		931	1993		3048		6600		13100		18580							
1040	x	664		949	2031		3107		6729		13355		18942							
1060	x	677		967	2070		3167		6858		13610		19303							
1080	x	689		985	2109		3226		6987		13866		19665							
1100	x	702		1003	2148		3286		7116		14121		20026							
1120	x	715		1021	2187		3345		7245		14377		20388							
1140	x	728		1040	2226		3405		7374		14632		20750							
1160	x	740		1058	2264		3464		7503		14888		21111							
1180	x	753		1076	2303		3524		7632		15143		21473							
1200	x	766		1094	2342		3583		7761		15398		21835							
1220	x	779		1112	2381		3643		7890		15654		22196							
1240	x	791		1131	2420		3702		8019		15909		22558							
1260	x	804		1149	2459		3762		8148		16165		22920							
1280	x	817		1167	2498		3822		8277		16420		23281							
1300	x	830		1185	2536		3881		8406		16676		23643							
1320	x	843		1203	2575		3941		8536		16931		24005							
1340	x	855		1222	2614		4000		8665		17186		24366							
1360	x	868		1240	2653		4060		8794		17442		24728							
1380	x	881		1258	2692		4119		8923		17697		25090							
1400	x	894		1276	2731		4179		9052		17953		25451							
1420	x	906		1294	2769		4238		9181		18208		25813							
1440	x	919		1313	2808		4298		9310		18464		26175							
1460	x	932		1331	2847		4357		9439		18719		26536							
1480	x	945		1349	2886		4417		9568		18974		26898							
1500	x	957		1367	2925		4476		9697		19230		27260							

Standard C-mount Lens equations for VE Series WVGA

H = horizontal FOV size, W = working distance



4 mm lens

Banner model: LCF04 (p/n 68884)

Marshall Electronics model: V-4504ML

1/3-inch format, no filter, fixed iris f/2.5, fits with either the VELC60 or VELC85 lens cover

H(W), mm

$H = 1.099 \times W - 3$ (minimum W ~ 60 mm)

W(H), mm

$W = (H + 3)/1.099$ (minimum H ~ 61 mm)

NOTE: Banner recommends using a 0.25 mm spacer (LEKS)



8 mm lens

Banner model: LCF08 (p/n 57298)

Azure Photonics model: AZURE-0813F

1/2-inch format, no filter, fixed iris f/1.3, fits with either the VELC60 or VELC85 lens cover

H(W), mm

$H = 0.515 \times W - 5.97$ (minimum W ~ 44 mm)

W(H), mm

$W = (H + 5.97)/0.515$ (minimum H ~ 16 mm)



12 mm lens

Banner model: LCF12 (p/n 57299)

Marshall Electronics model: V-4512

1/3-inch format, no filter, fixed iris f/2.0, fits with either the VELC60 or VELC85 lens cover

H(W), mm

$H = 0.336 \times W - 4.04$ (minimum W ~ 47 mm)

W(H), mm

$W = (H + 4.04)/0.336$ (minimum H ~ 11 mm)



25mm lens

Banner model: LCF25R (p/n 68885)

Goyo Optical model: GMG42514C

1-inch format, 37.5 mm filter, min f/1.4, fits with either the VELC60 or VELC85 lens cover

H(W), mm

$H = 0.155 \times W - 3$ (minimum W ~ 573 mm)

W(H), mm

$W = (H + 3)/0.155$ (minimum H ~ 85 mm)



50mm lens

Banner model: LCF50L2R (p/n 68888)

Goyo Optical model: GMG45018MCN

1-inch format, 40.5 mm filter, min f/1.8, requires LHWK-1 set screws

H(W), mm

$H = 0.0783 \times W - 5.693$ (minimum $W \sim 722$ mm)

W(H), mm

$W = (H + 5.693)/0.0783$ (minimum $H \sim 51$ mm)



75mm lens

Banner model: LCF75LR (p/n 70545)

Goyo Optical model: GMG47518MCN

1-inch format, 46 mm filter, min f/1.8, does not fit with a sealed lens cover

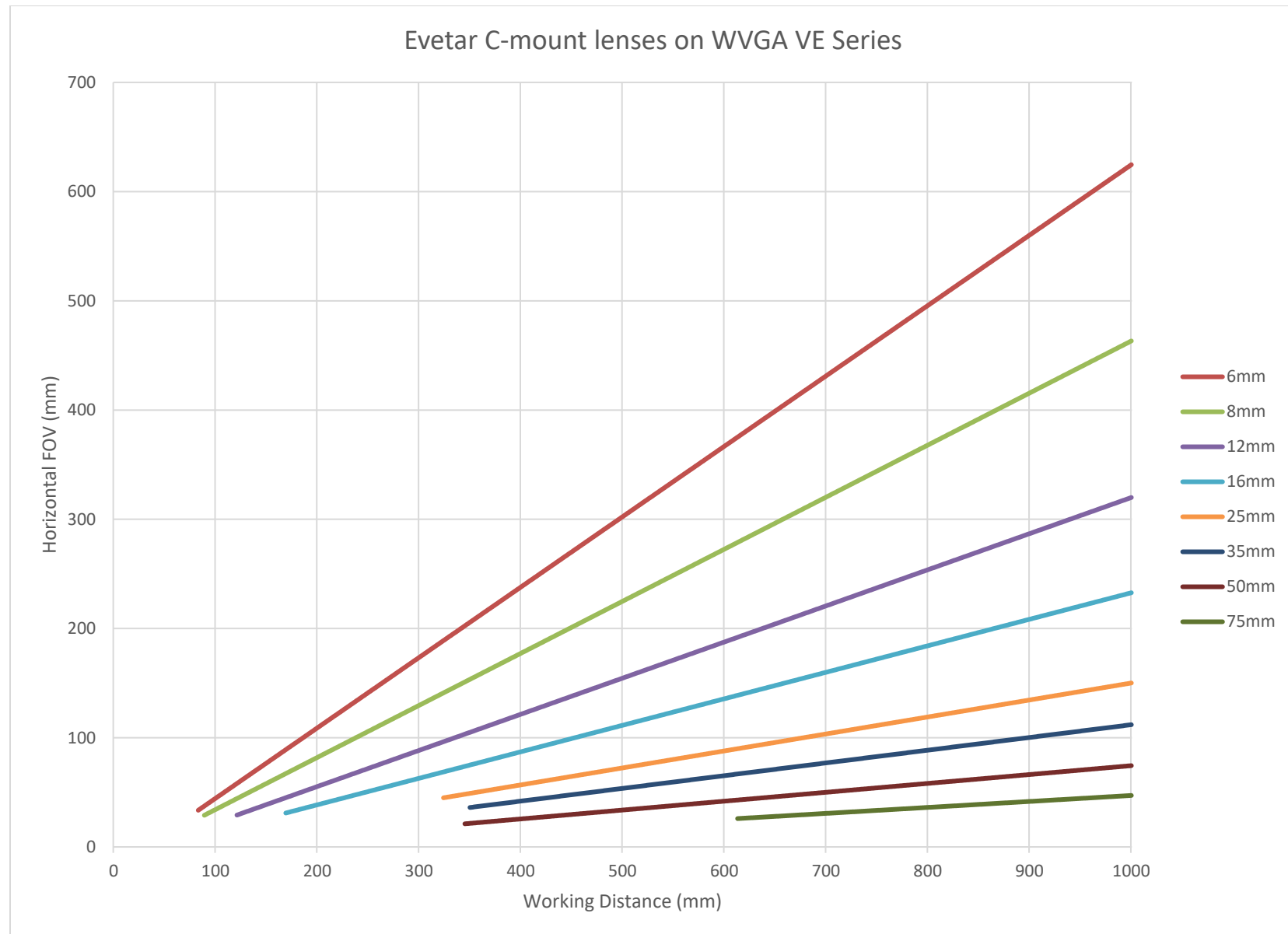
H(W), mm

$H = 0.055 \times W - 7.47$ (minimum $W \sim 809$ mm)

W(H), mm

$W = (H + 7.47)/0.055$ (minimum $H \sim 37$ mm)

Evetar C-mount Lenses on WVGA VE Series



Evetar C-mount Lenses on WVGA VE Series, FOV as a function of WD Chart

WD (mm)	FOV (mm)							
	6mm		8mm		12mm		16mm	
Minimum	34 x 22 @ 83mm		29 x 19 @ 89mm		30 x 19 @ 121mm		31 x 20 @ 169mm	
20								
40								
60								
80	32 x 20							
100	45 x 28		34 x 22					
120	57 x 37		44 x 28		29 x 18			
140	70 x 45		53 x 34		35 x 23			
160	83 x 53		63 x 40		42 x 27			
180	96 x 61		72 x 46		49 x 31	34 x 22		
200	109 x 70		82 x 52		55 x 35	39 x 25		
220	122 x 78		91 x 58		62 x 40	43 x 28		
240	135 x 86		101 x 64		69 x 44	48 x 31		
260	148 x 94		111 x 71		75 x 48	53 x 34		
280	161 x 102		120 x 77		82 x 52	58 x 37		
300	173 x 111		130 x 83		88 x 56	63 x 40		
320	186 x 119		139 x 89		95 x 61	68 x 43		
340	199 x 127		149 x 95		102 x 65	73 x 46	47 x 30	
360	212 x 135		158 x 101		108 x 69	77 x 49	51 x 32	
380	225 x 144		168 x 107		115 x 73	82 x 53	54 x 34	37 x 24
400	238 x 152		177 x 113		121 x 78	87 x 56	57 x 36	40 x 25
420	251 x 160		187 x 119		128 x 82	92 x 59	60 x 38	42 x 27
440	264 x 168		196 x 125		135 x 86	97 x 62	63 x 40	44 x 28
460	277 x 177		206 x 131		141 x 90	102 x 65	66 x 42	47 x 30
480	289 x 185		215 x 137		148 x 94	107 x 68	69 x 44	49 x 31
500	302 x 193		225 x 144		155 x 99	111 x 71	72 x 46	51 x 33
520	315 x 201		234 x 150		161 x 103	116 x 74	75 x 48	54 x 34
540	328 x 209		244 x 156		168 x 107	121 x 77	79 x 50	57 x 36
560	341 x 218		254 x 162		174 x 111	126 x 80	82 x 52	60 x 38
580	354 x 226		263 x 168		181 x 116	131 x 83	85 x 54	63 x 40
600	367 x 234		273 x 174		188 x 120	136 x 87	88 x 56	66 x 42
620	380 x 242		282 x 180		194 x 124	140 x 90	91 x 58	69 x 44
640	393 x 251		292 x 186		201 x 128	145 x 93	94 x 60	72 x 46
660	405 x 259		301 x 192		207 x 132	150 x 96	97 x 62	75 x 48
680	418 x 267		311 x 198		214 x 137	155 x 99	100 x 64	77 x 49
700	431 x 275		320 x 204		221 x 141	160 x 102	103 x 66	80 x 60
720	444 x 284		330 x 211		227 x 145	165 x 105	107 x 68	83 x 63
740	457 x 292		339 x 217		234 x 149	170 x 108	110 x 70	86 x 66
760	470 x 300		349 x 223		241 x 154	174 x 111	113 x 72	89 x 69
780	483 x 308		358 x 229		247 x 158	179 x 114	116 x 74	92 x 72
800	496 x 316		368 x 235		254 x 162	184 x 118	119 x 76	95 x 75
820	509 x 325		377 x 241		260 x 166	189 x 121	122 x 78	98 x 78
840	522 x 333		387 x 247		267 x 170	194 x 124	125 x 80	101 x 81
860	534 x 341		397 x 253		274 x 175	199 x 127	128 x 82	104 x 84
880	547 x 349		406 x 259		280 x 179	204 x 130	131 x 84	107 x 87
900	560 x 358		416 x 265		287 x 183	208 x 133	135 x 86	110 x 90
920	573 x 366		425 x 271		293 x 187	213 x 136	138 x 88	113 x 93
940	586 x 374		435 x 277		300 x 192	218 x 139	141 x 90	116 x 96
960	599 x 382		444 x 284		307 x 196	223 x 142	144 x 92	119 x 99
980	612 x 390		454 x 290		313 x 200	228 x 145	147 x 94	122 x 102
1000	625 x 399		463 x 296		320 x 204	233 x 149	150 x 96	125 x 105
1020	638 x 407		473 x 302		327 x 208	238 x 152	153 x 98	128 x 108
1040	650 x 415		482 x 308		333 x 213	242 x 155	156 x 100	131 x 111
1060	663 x 423		492 x 314		340 x 217	247 x 158	159 x 102	134 x 114
1080	676 x 432		501 x 320		346 x 221	252 x 161	163 x 104	137 x 117
1100	689 x 440		511 x 326		353 x 225	257 x 164	166 x 106	140 x 120
1120	702 x 448		520 x 332		360 x 230	262 x 167	169 x 108	143 x 123
1140	715 x 456		530 x 338		366 x 234	267 x 170	172 x 110	146 x 126
1160	728 x 465		540 x 344		373 x 238	272 x 173	175 x 112	149 x 129
1180	741 x 473		549 x 350		379 x 242	276 x 176	178 x 114	152 x 132
1200	754 x 481		559 x 357		386 x 246	281 x 180	181 x 116	155 x 135
1220	766 x 489		568 x 363		393 x 251	286 x 183	184 x 118	158 x 138
1240	779 x 497		578 x 369		399 x 255	291 x 186	187 x 120	161 x 141
1260	792 x 506		587 x 375		406 x 259	296 x 189	191 x 122	164 x 144
1280	805 x 514		597 x 381		413 x 263	301 x 192	194 x 124	167 x 147
1300	818 x 522		606 x 387		419 x 268	306 x 195	197 x 126	170 x 150
1320	831 x 530		616 x 393		426 x 272	310 x 198	200 x 128	173 x 153
1340	844 x 539		625 x 399		432 x 276	315 x 201	203 x 130	176 x 156
1360	857 x 547		635 x 405		439 x 280	320 x 204	206 x 132	179 x 159
1380	870 x 555		644 x 411		446 x 284	325 x 207	209 x 134	182 x 162
1400	882 x 563		654 x 417		452 x 289	330 x 211	212 x 136	185 x 165
1420	895 x 572		663 x 424		459 x 293	335 x 214	215 x 137	188 x 168
1440	908 x 580		673 x 430		465 x 297	340 x 217	219 x 139	191 x 171
1460	921 x 588		683 x 436		472 x 301	344 x 220	222 x 141	194 x 174
1480	934 x 596		692 x 442		479 x 306	349 x 223	225 x 143	197 x 177
1500	947 x 604		702 x 448		485 x 310	354 x 226	228 x 145	200 x 180

Evetar C-mount Lenses on WVGA VE Series, WD as a function of FOV Chart

		WD (mm)																							
FOV (mm)		6mm			8mm			12mm			16mm			25mm			35mm			50mm			75mm		
		Minimum			29° x 19°			30° x 19°			31° x 20°			45° x 29°			36° x 23°			21° x 13°			26° x 17°		
		@ 83mm			@ 89mm			@ 121mm			@ 169mm			@ 324mm			@ 350mm			@ 345mm			@ 613mm		
20	x	13																							
40	x	26		93		112		154		206						383		577				870			
60	x	38		154		214		288						421		555		823				1235			
80	x	51		196		271		371		549				726		766		1069				1601			
100	x	64		186		238		335		453				678		898		1315				1967			
120	x	77		217		280		396		536				806		1069		1561				2332			
140	x	89		248		322		456		618				935		1241		1807				2698			
160	x	102		279		364		516		700				1064		1413		2053				3064			
180	x	115		310		406		577		783				1192		1584		2299				3429			
200	x	128		341		448		637		865				1321		1756		2545				3795			
220	x	140		372		490		698		948				1450		1927		2791				4161			
240	x	153		403		532		758		1030				1578		2099		3037				4526			
260	x	166		434		574		819		1112				1707		2270		3283				4892			
280	x	179		465		616		879		1195				1835		2442		3529				5257			
300	x	191		496		657		940		1277				1964		2613		3775				5623			
320	x	204		527		699		1000		1360				2093		2785		4021				5989			
340	x	217		558		741		1061		1442				2221		2956		4267				6354			
360	x	230		589		783		1121		1524				2350		3128		4513				6720			
380	x	243		620		825		1182		1607				2478		3299		4759				7086			
400	x	255		651		867		1242		1689				2607		3471		5005				7451			
420	x	268		683		909		1302		1772				2736		3642		5251				7817			
440	x	281		714		951		1363		1854				2864		3814		5497				8182			
460	x	294		745		993		1423		1936				2993		3985		5743				8548			
480	x	306		776		1035		1484		2019				3122		4157		5989				8914			
500	x	319		807		1077		1544		2101				3250		4328		6235				9279			
520	x	332		838		1119		1605		2184				3379		4500		6481				9645			
540	x	345		869		1161		1669		2266				3507		4672		6727				10011			
560	x	357		900		1203		1726		2348				3636		4843		6973				10376			
580	x	370		931		1245		1786		2431				3765		5015		7219				10742			
600	x	383		962		1287		1847		2513				3893		5186		7465				11108			
620	x	396		993		1329		1907		2596				4022		5358		7711				11473			
640	x	409		1024		1371		1968		2678				4151		5529		7957				11839			
660	x	421		1055		1413		2028		2761				4279		5701		8203				12204			
680	x	434		1086		1455		2088		2843				4408		5872		8449				12570			
700	x	447		1117		1497		2149		2925				4536		6044		8695				12936			
720	x	460		1148		1539		2209		3008				4665		6215		8941				13301			
740	x	472		1179		1580		2270		3090				4794		6387		9187				13667			
760	x	485		1210		1622		2330		3173				4922		6558		9433				14033			
780	x	498		1241		1664		2391		3255				5051		6730		9679				14398			
800	x	511		1272		1706		2451		3337				5179		6901		9925				14764			
820	x	523		1303		1748		2512		3420				5308		7073		10171				15129			
840	x	536		1334		1790		2572		3502				5437		7244		10417				15495			
860	x	549		1365		1832		2633		3585				5565		7416		10663				15861			
880	x	562		1396		1874		2693		3667				5694		7587		10909				16226			
900	x	574		1427		1916		2754		3749				5823		7759		11155				16592			
920	x	587		1458		1958		2814		3832				5951		7931		11401				16958			
940	x	600		1489		2000		2874		3914				6080		8102		11647				17323			
960	x	613		1520		2042		2935		3997				6208		8274		11893				17689			
980	x	626		1551		2084		2995		4079				6337		8445		12139				18054			
1000	x	638		1582		2126		3056		4161				6466		8617		12385				18420			
1020	x	651		1613		2168		3116		4244				6594		8788		12631				18786			
1040	x	664		1644		2210		3177		4326				6723		8960		12877				19151			
1060	x	677		1675		2252		3237		4409				6851		9131		13123				19517			
1080	x	689		1706		2294		3298		4491				6980		9303		13369				19883			
1100	x	702		1737		2336		3358		4573				7109		9474		13615				20248			
1120	x	715		1768		2378		3419		4656				7237		9646		13861				20614			
1140	x	728		1799		2420		3479		4738				7366		9817		14107				20980			
1160	x	740		1831		2462		3539		4821				7495		9989		14353				21345			
1180	x	753		1862		2504		3600		4903				7623		10160		14599				21711			
1200	x	766		1893		2545		3660		4985				7752		10332		14845				22076			
1220	x	779		1924		2587		3721		5068				7880		10503		15091				22442			
1240	x	791		1955		2629		3781		5150				8009		10675		15337				22808			
1260	x	804		1986		2671		3842		5233				8138		10846		15583				23173			
1280	x	817		2017		2713		3902		5315				8266		11018		15829				23539			
1300	x	830		2048		2755		3963		5398				8395		11190		16075				23905			
1320	x	843		2079		2797		4023		5480				8524		11361		16321				24270			
1340	x	855		2110		2839		4084		5562				8652		11533		16567				24636			
1360	x	868		2141		2881		4144		5645				8781		11704		16813				25001			
1380	x	881		2172		2923		4205		5727				8909		11876		17059				25367			
1400	x	894		2203		2965		4265		5810				9038		12047		17305				25733			
1420	x	906		2234		3007		4325		5892				9167		12219		17551				26098			
1440	x	919		2265		3049		4385		5974				9296		12394		17797				26464			
1460	x	932		2296		3091		4446		6057				9424		12562		18043				26830			
1480	x	945		2327		3133		4507		6139				9552		12733		18289				27195			
1500	x	957		2358		3175		4567		6222				9681		12905		18535				27561			

Evetar C-mount Lens equations for VE Series WVGA

H = horizontal FOV size, W = working distance



6mm Megapixel lens

Banner model: LCF06LEVMP (p/n 97345)

Evetar model: MV118FM06C

1/1.8-inch format, 34 mm filter, min f/1.6, fits with either the VELC60 or VELC85 lens cover

H(W), mm

$H = 0.645 \times W - 19.947$ (minimum W ~ 83 mm)

W(H), mm

$W = (H + 19.947)/0.645$ (minimum H ~ 34 mm)



8mm Megapixel lens

Banner model: LCF08LEVMP (p/n 97346)

Evetar model: MV118FM08C

1/1.8-inch format, 27 mm filter, min f/1.4, fits with either the VELC60 or VELC85 lens cover

H(W), mm

$H = 0.477 \times W - 13.42$ (minimum W ~ 89 mm)

W(H), mm

$W = (H + 13.42)/0.477$ (minimum H ~ 29 mm)



12mm Megapixel lens

Banner model: LCF12LEVMP (p/n 97347)

Evetar model: MV23FM12C

2/3-inch format, 27 mm filter, min f/1.6, fits with either the VELC60 or VELC85 lens cover

H(W), mm

$H = 0.331 \times W - 10.86$ (minimum W ~ 121 mm)

W(H), mm

$W = (H + 10.86)/0.331$ (minimum H ~ 30 mm)



16mm Megapixel lens

Banner model: LCF16LEVMP (p/n 97348)

Evetar model: MV23FM16CR1

2/3-inch format, 27 mm filter, min f/1.6, fits with either the VELC60 or VELC85 lens cover

H(W), mm

$H = 0.243 \times W - 9.98$ (minimum W ~ 169 mm)

W(H), mm

$W = (H + 9.98)/0.243$ (minimum H ~ 31 mm)



25mm Megapixel lens

Banner model: LCF25LEVMP (p/n 97349)

Evetar model: MV23FM25C

2/3-inch format, 27 mm filter, min f/1.8, fits with either the VELC60 or VELC85 lens cover

H(W), mm

$$H = 0.156 \times W - 5.41 \text{ (minimum } W \sim 324 \text{ mm)}$$

W(H), mm

$$W = (H + 5.41)/0.156 \text{ (minimum } H \sim 45 \text{ mm)}$$



35mm Megapixel lens

Banner model: LCF35LEVMP (p/n 97350)

Evetar model: MV23FM35C

2/3-inch format, 27 mm filter, min f/2.0, fits with either the VELC60 or VELC85 lens cover

H(W), mm

$$H = 0.117 \times W - 4.7 \text{ (minimum } W \sim 350 \text{ mm)}$$

W(H), mm

$$W = (H + 4.7)/0.117 \text{ (minimum } H \sim 36 \text{ mm)}$$



50mm Megapixel lens

Banner model: LCF50LEVMP (p/n 97351)

Evetar model: MV23FM50C

2/3-inch format, 30.5 mm filter, min f/2.6, fits with VELC85 lens cover

H(W), mm

$$H = 0.081 \times W - 6.88 \text{ (minimum } W \sim 345 \text{ mm)}$$

W(H), mm

$$W = (H + 6.88)/0.081 \text{ (minimum } H \sim 21 \text{ mm)}$$



75mm Megapixel lens

Banner model: LCF75LEVMP (p/n 97352)

Evetar model: MV11FM75C

1-inch format, 34 mm filter, min f/2.8, does not fit with a sealed lens cover

H(W), mm

$$H = 0.055 \times W - 7.58 \text{ (minimum } W \sim 613 \text{ mm)}$$

W(H), mm

$$W = (H + 7.58)/0.055 \text{ (minimum } H \sim 26 \text{ mm)}$$