Medium Format Lens Tests

Below are the results of some tests of medium format (6x6cm, 6x7cm, and 6x9cm) film camera lenses. The best way to test a lens would be to use an MTF measurement setup like the Zeiss K8, but since this is not an option for me, I made test chart images and evaluated negatives with a microscope. Of course, one has to keep in mind that all these tests test the whole system, from focusing to development procedures. To get any meaningful data on one component of this system like the lens, one needs to be very diligent in keeping everything else as constant as possible. Possible error sources range from focusing errors, rangefinder alignment, parallelism of the object, lens, and film planes, shutter vibration, to development temperature and agitation. In addition, numbers from different test setups should not be compared. Medium format roll film cameras are especially prone to problems with film flatness, as one can see in some of the results below for older medium format folders where the center has worse resolution than the corners or an intermediate position, likely due to bulging of the film. Another indicator is the resolution number jumping up and down with different f-stops. The bulging of roll film and the possible countermeasures of the camera manufacturers are also something to keep in mind when trying to check focus with a ground glass. Examples are the Super-Ikontas where the film gate opening is in front of the film guide rails, allowing the film to bulge forward, the Certo Six where the pressure plate has a raised rim and a sunk area to allow the film bulge backward, or the Olympus Six that employs spring loaded film tensioners (“film plane corrector”) on both the film spool and the take up spool to keep the film taught. Especially older lenses might also show some focal plane shift upon stopping down due to zonal spherical aberration – a good indicator is a reduced resolution one or two stops down from wide open, e.g. a lower resolution at f/4 compared to f/3.5.

My present test setup is the following: As test object I chose the patterns of the Norman Koren lens test chart (http://www.normankoren.com/Tutorials/MTF5.html) which allows a judgement of performance at two contrast levels, 50% MTF, and 10% MTF. It is different from a pure bar chart, and gives slightly worse results in lp/mm for the 10% MTF than a standard USAF bar chart. The text at the linked web site is worth reading to understand the concept. I printed out 16 of these charts, and mounted them on a stiff 4x8 ft foam board indoors, with one chart in the center, and the remaining ones in pairs for sagittal (radial) and tangential orientation in two corners, edges and at intermediate positions. The “Center”, “Corner”, and “Intermediate” positions used to determine the resolution values are marked in red in fig. 1.

Lighting was by 1500W of halogen lighting. I took these on 120 Kodak TMAX 100 (TMX) or Fuji Acros film at magnifications between 1: 1:28 (6x9cm) to 1:45 (6x6cm) and at an EI of 80, resulting in the following exposures: f/2.8: 1/250s, f/4: 1/125s, f/5.6: 1/60s, f/8: 1/30s, f/11: 1/15s, f16: 1/8s, f/22: ¼s, f/32: ½s. The numbers on Koren's charts are calibrated for 1:50, but since I am trying to fill the negative area, the magnification changes for each film format. After determining the size of the chart (250mm long in reality) on the negative with a caliper, I determine the actual magnification m, listed in the last column of each table, and use that as a correction factor for the numbers on the Koren chart (10, 15, 20, 30, 40, 50….200lp/mm). As an example, if my magnification is 1:40, I have to multiply the numbers read off of the chart by 40/50=0.8. Focusing is done by a combination of the rangefinder (if available) focus, measured distance, a ground glass on the film gate, or the screen for the TLR's.

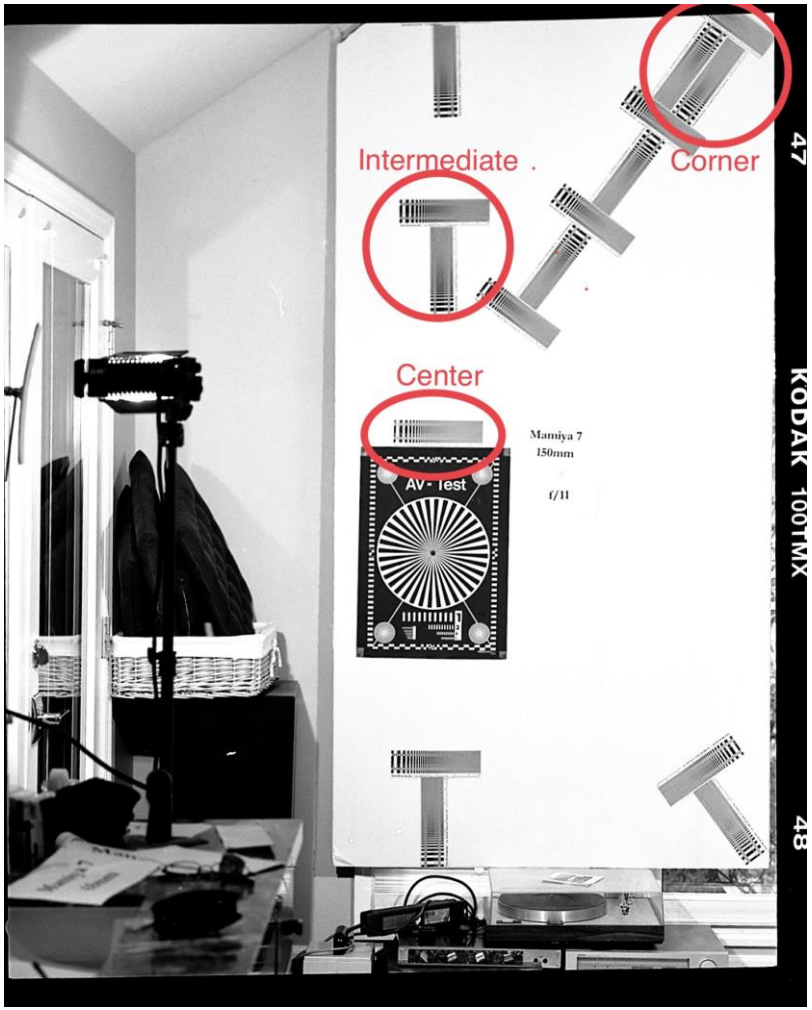

Fig. 1: One of the 6x7cm test negatives showing the setup.

The cameras are mounted on a Gitzo 1325 tripod (no center post). I use a cable release or the self-timer to reduce vibrations to a minimum. I develop the TMX negatives in Kodak TMAX RS 1+9 (from concentrate) and the Fuji Acros negatives in Kodak XTOL 1+1 to N contrast. After drying, the negatives are examined in a microscope at 25x - 50x magnification, and the lp/mm cutoff values for 50% and 10% MTF are noted for each individual chart. As an example, there are 60 numbers for an f/5.6 lens (10 values/aperture x 6 different apertures).

The values in the tables below show the resolution in lp/mm at the stated MTF's, 50% and 10%. A regular bar graph is also part of the test pattern; as a rule of thumb, the lp/mm resolution numbers for the bar graph are about 10% higher than the 10%MTF values.

For interpreting the results it is useful to have some knowledge about the general characteristics of a lens type. As an example, Tessar types, and to a lesser extent Plasmats, tend to have a slump in their MTF curve at about

½ to ¾ of the image height, with a subsequent increase in performance. A comparison with published MTF data, where available, is also helpful in assessing the characteristics. The lenses are at least single coated unless otherwise noted in the remarks column.

6x6cm: Rangefinder Folders (1)

Camera/Lens	f stop		Open		4		5.6		8		11		16		22		32		Remarks
	MTF		50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	
Zeiss Ikon Super Ikonta B 532/16 Carl Zeiss Jena Tessar 8cm *f*/2.8	Center		13	26	13	26	26	44	35	53	44	70	44	79	39	61	-	-	m=0.0228 (1:44) 4/3 Tessar type Front focusing Uncoated Optics design Jan. 1933 by Zeiss Jena
	Corner	sagittal	10	14	14	22	18	31	31	39	35	53	35	61	35	57	-	-	
		tangential	5	10	5	10	11	13	12	14	13	18	18	22	18	26	-	-	
	Intermediate	sagittal	10	13	16	22	26	35	35	48	40	57	44	70	39	61	-	-	
		tangential	10	13	18	26	18	31	22	35	26	39	31	44	31	44	-	-	
Zeiss Ikon Super Ikonta B 532/16 Zeiss-Opton Tessar 80mm *f*/2.8 T	Center		22	34	22	30	17	22	22	34	22	26	30	39	34	60	-	-	m=0.0232 (1:43) 4/3 Tessar type Front focusing Optics design Jan. 1933 by Zeiss Jena Made at Kollmorgen GmbH, Coburg
	Corner	sagittal	17	26	7	10	10	14	15	17	22	30	17	26	36	47	-	-	
		tangential	13	19	13	17	15	17	17	22	22	26	22	34	34	43	-	-	
	Intermediate	sagittal	17	26	17	30	22	34	30	43	43	69	43	60	39	60	-	-	
		tangential	16	22	13	17	19	26	30	43	34	60	34	60	39	60	-	-	
Zeiss Ikon Super Ikonta B 532/16 Zeiss-Opton Tessar 80mm *f*/2.8 T	Center		22	43	20	43	26	34	26	39	30	43	39	60	39	60	-	-	m=0.025 (1:40) 4/3 Tessar type Front focusing Optics redesigned April 1950 (Zeiss Oberkochen)
	Corner	sagittal	17	34	8	13	12	16	22	30	26	39	39	52	39	56	-	-	
		tangential	10	19	6	8	6	8	11	13	14	17	17	30	26	39	-	-	
	Intermediate	sagittal	26	39	22	30	26	34	26	34	30	43	39	60	39	60	-	-	
		tangential	17	26	22	34	26	34	26	34	26	34	34	47	34	52	-	-	
Zeiss Ikon Super Ikonta B 532/16 Zeiss-Opton Tessar 80mm *f*/2.8 T	Center		17	33	21	33	33	50	42	62	42	66	42	71	37	54	-	-	m=0.024 (1:42) 4/3 Tessar type Front focusing Optics redesigned April 1950 (Zeiss Oberkochen)
	Corner	sagittal	15	33	15	21	17	21	21	29	29	46	37	58	33	50	-	-	
		tangential	8	25	12	21	17	25	25	33	29	54	33	50	29	42	-	-	
	Intermediate	sagittal	17	29	21	29	29	42	42	58	42	62	42	58	33	50	-	-	
		tangential	15	17	17	25	25	29	33	50	37	54	42	58	33	46	-	-	
Zeiss Ikon Super-Ikonta III 531/16 Carl Zeiss Tessar 75mm *f*/3.5	Center		26	43	19	43	39	60	39	69	47	78	43	69	34	52	-	-	m=0.023 (1:43) 4/3 Tessar type Front focusing Optics design Oct. 1950 (Zeiss Oberkochen)
	Corner	sagittal	13	26	16	19	16	26	30	60	43	60	39	52	34	52	-	-	
		tangential	16	26	16	19	14	16	17	26	26	34	30	39	30	39	-	-	
	Intermediate	sagittal	13	16	13	17	17	34	22	39	34	60	34	60	34	47	-	-	
		tangential	19	26	16	19	16	22	22	30	34	52	39	60	34	47	-	-	
Certo Certo Six Carl Zeiss Jena Tessar 80mm f/2.8 T	Center		25	37	29	41	29	45	29	41	16	25	25	37	33	49	-	-	m=0.0244 (1:41) 4/3 Tessar type Unit focusing Optics redesigned July 1950 (Zeiss Jena)
	Corner	sagittal	20	27	16	25	20	29	25	33	29	37	33	45	33	45	-	-	
		tangential	16	27	15	25	16	25	25	33	20	29	29	37	25	33	-	-	
	Intermediate	sagittal	20	27	15	16	20	37	25	33	29	37	29	49	33	49	-	-	
		tangential	20	33	33	41	41	57	29	33	20	33	29	49	33	49	-	-	
Balda Super Baldax Enna München Ennit 80mm f/2.8	Center		25	42	33	46	29	37	25	33	29	42	33	58	37	62	-	-	m=0.024 (1:42) 4/3 Tessar type Unit focusing
	Corner	sagittal	17	33	17	25	15	25	25	33	25	33	33	46	33	54	-	-	
		tangential	6	8	6	8	8	10	11	14	12	17	17	23	25	33	-	-	
	Intermediate	sagittal	21	37	17	25	15	17	17	21	25	33	33	42	33	50	-	-	
		tangential	12	17	12	17	12	21	15	21	15	21	17	29	29	37	-	-	

6x6cm: Rangefinder Folders (2)

Camera/Lens	f stop		Open		4		5.6		8		11		16		22		32		Remarks
	MTF		50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	
Mamiya Mamiya 6 Automat 2 Sekor 75mm *f*/3.5	Center		21	29	21	29	25	33	25	37	21	29	33	49	37	53	-	-	m=0.0244 (1:41) 4/3 Tessar type Film plane focusing
	Corner	sagittal	16	21	13	25	15	21	15	25	21	33	33	49	33	45	-	-	
		tangential	25	33	16	29	21	29	25	37	25	40	25	37	29	41	-	-	
	Intermediate	sagittal	16	29	21	25	21	29	29	40	33	49	37	53	33	45	-	-	
		tangential	25	33	21	33	25	33	29	45	33	49	37	56	33	45	-	-	
Fuji Photo Film Super Fujica 6 Fujinar 75mm *f*/3.5	Center		17	21	17	23	17	23	19	24	21	30	30	38	34	51	-	-	m=0.0244 (1:42.4) 4/3 Tessar type Unit focusing
	Corner	sagittal	3	4	3	5	5	7	13	21	15	17	21	30	30	47	-	-	
		tangential	13	17	13	17	9	13	13	17	17	26	21	30	26	34	-	-	
	Intermediate	sagittal	17	21	17	23	21	26	26	30	26	30	30	43	34	51	-	-	
		tangential	17	21	17	23	21	30	21	30	21	26	26	43	34	47	-	-	
Olympus Six RIIb Zuiko F.C. 75mm f/2.8	Center		25	33	21	37	25	29	21	29	25	33	42	58	42	58	33	46	m=0.025 (1:40) 4/3 Tessar type Front focusing
	Corner	sagittal	10	12	6	8	10	12	17	18	21	25	29	42	33	50	29	37	
		tangential	17	25	21	29	25	33	25	33	17	33	21	29	17	29	17	21	
	Intermediate	sagittal	21	29	15	25	21	29	25	42	29	46	33	54	33	50	25	42	
		tangential	8	17	8	10	12	17	17	21	21	29	29	42	33	42	25	37	
Olympus Six RIIa D. Zuiko F.C. 75mm f/3.5	Center		29	46	37	50	37	54	33	50	37	54	42	58	42	58	-	-	m=0.025 (1:40) 4/3 Tessar type Front focusing
	Corner	sagittal	15	25	15	25	15	25	17	29	21	29	29	37	33	46	-	-	
		tangential	12	25	17	25	17	25	29	37	33	42	29	42	29	37	-	-	
	Intermediate	sagittal	21	33	21	25	33	42	42	58	46	66	46	62	42	58	-	-	
		tangential	29	37	33	42	33	50	42	54	42	66	42	58	42	54	-	-	
Barnet Ensign Ensign Autorange 220 Ensar 75mm *f*/4.5	Center		17	25	-	-	20	30	25	42	21	34	30	38	34	42	-	-	m=0.025 (1:40) 4/3 Tessar type Unit focusing
	Corner	sagittal	17	25	-	-	15	21	25	38	30	38	30	42	30	38	-	-	
		tangential	17	21	-	-	13	17	21	34	25	34	25	34	25	34	-	-	
	Intermediate	sagittal	20	25	-	-	17	21	25	38	25	30	30	38	30	42	-	-	
		tangential	20	25	-	-	13	17	30	42	30	42	34	47	38	51	-	-	
Barnet Ensign Ensign Commando Ensar 75mm f/3.5	Center		12	25	16	33	16	25	25	33	33	53	37	62	37	57	29	37	m=0.0236 (1:42) 4/3 Tessar type Film plane focusing uncoated
	Corner	sagittal	5	8	5	8	8	12	8	12	8	12	15	21	29	39	25	29	
		tangential	8	12	5	8	8	12	8	12	8	12	12	16	21	29	16	21	
	Intermediate	sagittal	25	41	29	37	29	37	37	45	41	57	41	57	37	49	25	33	
		tangential	21	33	25	37	29	37	29	41	33	45	33	49	33	41	25	33	
	Center																		
	Corner	sagittal																	
		tangential																	
	Intermediate	sagittal																	
		tangential																	

6x6cm: Rangefinder Folders (3)

Camera/Lens	f stop		Open		4		5.6		8		11		16		22		32		Remarks
	MTF		50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	
КМЗ Искра (KMZ Iskra) Индустар-58 (Industar-58) 75mm f/3.5	Center		16	26	18	35	35	57	35	70	35	53	35	61	39	61	-	-	m=0.0228 (1:44) 4/3 Tessar type Unit focusing
	Corner	sagittal	9	17	9	14	12	18	16	31	16	31	26	35	35	48	-	-	
		tangential	16	26	18	26	22	35	26	39	26	35	22	26	22	26	-	-	
	Intermediate	sagittal	14	18	16	22	22	31	26	35	26	39	26	35	35	53	-	-	
		tangential	22	31	22	26	31	39	39	61	44	57	31	39	35	53	-	-	
Shanghai Camera Seagull 203 S-111-02 75mm f/3.5	Center		28	40	20	40	28	35	32	56	32	56	32	56	32	44	-	-	m=0.0248 (1:40) 3/3 Triplet type Unit focusing
	Corner	sagittal	12	20	10	14	14	20	14	16	16	20	20	32	24	36	-	-	
		tangential	8	12	6	10	10	16	14	24	16	20	20	28	14	24	-	-	
	Intermediate	sagittal	16	32	14	28	16	24	24	32	28	44	32	48	32	40	-	-	
		tangential	12	28	12	20	16	24	20	32	28	40	28	40	28	32	-	-	
	Center																		
	Corner	sagittal																	
		tangential																	
	Intermediate	sagittal																	
		tangential																	
	Center																		
	Corner	sagittal																	
		tangential																	
	Intermediate	sagittal																	
		tangential																	
	Center																		
	Corner	sagittal																	
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	Center																		
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	Center																		
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		tangential																	
	Intermediate	sagittal																	
		tangential																	
	Center																		
	Corner	sagittal																	
		tangential																	
	Intermediate	sagittal																	
		tangential																	

6x6cm: TLR Cameras

Camera/Lens	f stop		Open		4		5.6		8		11		16		22		32		Remarks
	MTF		50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	
Rollei Fototechnik Rolleiflex 2.8 GX HFT Planar 80mm *f*/2.8	Center		27	53	36	63	45	94	49	98	50	89	45	71	36	63	-	-	m=0.022 (1:45) 5/4 Planar type
	Corner	sagittal	27	53	36	63	45	71	45	89	45	76	45	67	36	54	-	-	
		tangential	36	53	31	54	36	58	36	54	36	58	36	58	36	45	-	-	
	Intermediate	sagittal	27	40	36	67	40	80	54	89	45	76	40	71	36	54	-	-	
		tangential	27	49	36	67	40	80	40	80	40	71	36	63	31	54	-	-	
Rollei Fototechnik Rolleiflex 2.8 GX Edition HFT Planar 80mm *f*/2.8	Center		45	80	36	58	45	80	54	80	54	80	40	71	40	58	-	-	
	Corner	sagittal	36	63	45	63	45	76	49	80	54	71	45	67	40	54	-	-	
		tangential	27	45	31	45	36	54	36	54	36	54	40	54	36	45	-	-	
	Intermediate	sagittal	27	40	40	58	36	54	45	67	45	80	54	71	40	54	-	-	
		tangential	36	54	40	63	45	71	54	80	54	76	45	63	36	54	-	-	
Mamiya C 330 S Mamiya-Sekor 55mm *f*/4.5	Center		46	88	-	-	42	79	46	93	51	83	47	74	37	56	-	-	m=0.022 (1:45) 9/7 Retrofocus type
	Corner	sagittal	37	56	-	-	46	65	46	79	56	83	51	74	46	56	-	-	
		tangential	32	42	-	-	37	46	37	56	37	46	37	51	28	46	-	-	
	Intermediate	sagittal	32	46	-	-	32	42	32	56	42	69	37	65	32	51	-	-	
		tangential	32	65	-	-	37	65	37	69	37	65	32	60	32	51	-	-	
Mamiya C 330 S Mamiya-Sekor DS 105mm *f*/3.5	Center		40	70	40	65	50	80	50	80	40	70	40	65	40	60	40	55	m=0.02 (1:50) 5/3 Heliar type
	Corner	sagittal	35	45	25	40	35	45	45	70	40	70	45	70	40	55	40	60	
		tangential	25	40	25	40	30	50	40	55	40	60	40	65	40	50	40	50	
	Intermediate	sagittal	30	45	30	45	35	60	45	70	45	70	45	70	40	60	40	55	
		tangential	25	40	35	45	40	60	40	70	40	60	45	70	40	50	40	55	
Mamiya C 330 S Mamiya-Sekor Super 180mm *f*/4.5	Center		20	40	-	-	50	80	50	85	50	80	45	70	40	60	35	45	m=0.02 (1:50) 5/4 Ernostar type
	Corner	sagittal	35	55	-	-	35	60	40	60	45	70	50	70	40	55	35	45	
		tangential	25	35	-	-	25	40	40	50	35	50	35	50	30	45	30	40	
	Intermediate	sagittal	25	45	-	-	45	80	50	85	45	80	40	65	40	60	30	45	
		tangential	18	25	-	-	40	50	40	65	35	55	40	55	35	55	30	45	

6x7cm: Cosina-Voigtländer / Fuji Rangefinder Cameras

Camera/Lens	f stop		Open		4		5.6		8		11		16		22		32		Remarks
	MTF		50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	
Fuji GF 670/ Fujinon 80mm *f*/3.5	Center		43	64	43	79	57	86	43	64	43	64	36	61	36	50	-	-	m=0.028 (1:35.7) 6/4 Planar type
	Corner	sagittal	29	46	36	43	39	57	36	50	36	50	32	43	29	43	-	-	
		tangential	21	36	29	36	29	39	32	43	29	43	29	39	29	36	-	-	
	Intermediate	sagittal	36	64	29	43	43	71	50	71	43	71	36	61	36	57	-	-	
		tangential	29	43	29	46	36	64	43	71	36	64	32	50	29	43	-	-	
Voigtländer Bessa III 667 Heliar 80mm *f*/3.5	Center		41	64	43	64	43	71	36	57	36	57	36	54	32	50	-	-	
	Corner	sagittal	21	29	21	29	21	36	29	39	36	46	36	50	36	50	-	-	
		tangential	18	25	18	29	18	32	18	32	21	32	29	36	29	32	-	-	
	Intermediate	sagittal	36	57	36	61	36	57	43	71	49	71	43	64	32	46	-	-	
		tangential	36	57	36	64	43	61	43	64	43	64	36	57	36	46	-	-	
Voigtländer Bessa III W 667 Color-Skopar 55mm *f*/4.5	Center		56	96	-	-	56	88	56	96	56	96	48	72	36	56	-	-	m=0.025 (1:40) 10/8 Biogon type
	Corner	sagittal	24	36	-	-	24	28	32	40	36	48	40	56	36	56	-	-	
		tangential	32	40	-	-	32	36	32	44	40	56	40	48	32	40	-	-	
	Intermediate	sagittal	56	88	-	-	48	64	56	88	56	84	48	72	40	56	-	-	
		tangential	40	80	-	-	44	64	56	88	56	80	44	64	36	48	-	-	

6x7cm: Mamiya 7 II

Lens	f stop		Open		4		5.6		8		11		16		22		32		Remarks
	MTF		50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	
43mm L *f*/4.5	Center		67	104	-	-	67	104	67	96	59	81	44	78	33	46	-	-	m=0.027 (1:37) 10/6 Biogon type
	Corner	sagittal	37	67	-	-	41	78	37	59	44	67	44	56	30	48	-	-	
		tangential	30	44	-	-	30	41	33	44	30	41	37	44	26	33	-	-	
	Intermediate	sagittal	33	74	-	-	67	104	61	104	59	89	44	67	30	48	-	-	
		tangential	52	96	-	-	52	96	52	96	52	81	44	67	33	52	-	-	
50mm L *f*/4.5	Center		57	100	-	-	57	86	64	100	57	86	43	71	36	57	-	-	m=0.028 (1:35.7) 10/6 Biogon type
	Corner	sagittal	39	62	-	-	43	57	43	54	43	64	39	57	32	43	-	-	
		tangential	29	46	-	-	36	50	36	50	36	50	32	43	29	39	-	-	
	Intermediate	sagittal	21	36	-	-	43	71	57	75	57	79	39	64	39	50	-	-	
		tangential	36	50	-	-	50	79	46	79	50	79	43	61	36	50	-	-	
65mm L *f*/4	Center		53	98	53	98	45	83	49	91	53	83	53	76	38	61	-	-	m=0.0264 (1:38) 9/5 Biogon type
	Corner	sagittal	38	53	38	53	38	53	38	53	34	61	38	61	38	53	-	-	
		tangential	30	45	30	45	34	45	34	45	38	53	34	53	30	45	-	-	
	Intermediate	sagittal	45	106	45	106	53	106	45	91	45	83	53	76	38	61	-	-	
		tangential	45	98	45	98	53	106	53	83	45	83	45	68	38	61	-	-	
80mm L *f*/4	Center		39	86	39	86	55	102	55	102	47	86	47	78	39	59	-	-	m=0.0256 (1:39) 6/4 Plasmat type
	Corner	sagittal	31	39	31	39	27	35	31	35	35	47	39	63	35	55	-	-	
		tangential	16	23	16	23	14	20	14	20	20	27	31	43	31	43	-	-	
	Intermediate	sagittal	39	55	39	55	47	78	55	86	47	82	43	70	39	55	-	-	
		tangential	31	63	31	63	39	70	47	86	51	82	43	66	39	51	-	-	
150mm L *f*/4.5	Center		45	90	-	-	60	97	60	104	60	82	45	75	37	56	30	45	m=0.0268 (1:37) 6/5 Sonnar/Ernostar type
	Corner	sagittal	45	82	-	-	52	82	52	82	52	82	45	60	34	45	30	37	
		tangential	37	60	-	-	37	56	37	56	45	63	37	52	30	45	30	34	
	Intermediate	sagittal	60	104	-	-	60	90	60	97	52	90	45	75	37	52	30	45	
		tangential	60	97	-	-	52	82	52	97	52	75	45	67	37	52	30	41	
210mm L *f*/8	Center		45	82	-	-	-	-	45	82	52	75	52	67	34	56	30	45	m=0.0268 (1:37) 7/5 (Miniature Plasmat+ negative meniscus)
	Corner	sagittal	34	41	-	-	-	-	34	41	34	52	45	60	34	45	30	41	
		tangential	37	52	-	-	-	-	37	52	37	52	37	49	34	45	30	37	
	Intermediate	sagittal	45	67	-	-	-	-	45	67	52	67	45	60	37	56	30	45	
		tangential	52	90	-	-	-	-	52	90	52	82	45	60	37	56	26	37	

6x9cm: Voigtländer Folders and Rangefinder Folders

Lens	f stop		Open		4		5.6		8		11		16		22		32		Remarks
	MTF		50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	
Voigtländer Bessa Voigtar 10.5cm *f*/6.3	Center		17	31	-	-	-	-	12	33	17	25	19	33	28	50	-	-	m=0.035 (1:28.4) 3/3 Triplet type Front focusing uncoated
	Corner	sagittal	17	28	-	-	-	-	17	33	19	33	28	47	28	44	-	-	
		tangential	14	22	-	-	-	-	12	22	14	22	19	33	22	33	-	-	
	Intermediate	sagittal	11	22	-	-	-	-	14	22	17	22	22	31	25	44	-	-	
		tangential	11	17	-	-	-	-	14	19	14	25	17	25	22	33	-	-	
Voigtländer Bessa Voigtar 11cm *f*/4.5	Center		14	22	-	-	14	22	14	22	12	19	17	33	25	39	-	-	m=0.035 (1:28.4) 3/3 Triplet type Front focusing uncoated
	Corner	sagittal	11	17	-	-	8	9	11	25	17	22	19	28	25	39	-	-	
		tangential	9	10	-	-	7	8	9	11	11	17	14	22	17	28	-	-	
	Intermediate	sagittal	14	22	-	-	17	22	17	28	17	25	22	39	28	50	-	-	
		tangential	12	19	-	-	14	17	14	25	19	25	22	25	22	39	-	-	
Voigtländer Rangefinder Bessa Helomar 10.5cm *f*/3.5	Center		22	44	25	42	20	39	17	25	17	33	31	47	28	47	-	-	m=0.035 (1:28.4) 3/3 Triplet type Unit focusing uncoated
	Corner	sagittal	8	10	10	11	10	12	10	11	14	17	19	25	28	39	-	-	
		tangential	11	33	11	33	12	31	22	33	25	33	28	39	22	33	-	-	
	Intermediate	sagittal	8	22	9	25	14	33	14	25	22	33	31	50	33	44	-	-	
		tangential	19	33	17	28	17	31	28	42	22	33	28	44	33	47	-	-	
Voigtländer Rangefinder Bessa Skopar 10.5cm *f*/3.5	Center		11	22	10	19	11	22	17	33	25	36	25	42	28	44	-	-	m=0.035 (1:28.4) 4/3 Tessar type Unit focusing uncoated
	Corner	sagittal	5	6	5	6	5	6	8	10	9	11	10	12	17	22	-	-	
		tangential	11	17	9	11	8	17	19	25	17	25	11	17	22	28	-	-	
	Intermediate	sagittal	10	11	9	11	11	17	11	22	17	28	22	36	28	47	-	-	
		tangential	11	25	11	22	17	31	19	28	22	33	19	25	25	42	-	-	
Voigtländer Bessa II Color-Skopar 105mm *f*/3.5	Center		11	23	14	28	11	28	23	43	28	51	28	43	23	40	-	-	m=0.035 (1:28.4) 4/3 Tessar type Unit focusing
	Corner	sagittal	20	28	20	28	20	34	28	45	28	40	26	34	23	34	-	-	
		tangential	11	23	14	26	10	11	11	17	11	17	17	23	14	23	-	-	
	Intermediate	sagittal	8	11	8	11	8	11	11	20	20	31	23	34	23	43	-	-	
		tangential	28	45	28	45	28	45	34	51	21	40	34	51	28	43	-	-	
Voigtländer Bessa II Color-Heliar 105mm *f*/3.5	Center		7	8	8	11	8	13	10	14	11	14	11	20	20	34	-	-	m=0.035 (1:28.4) 5/3 Heliar type Unit focusing
	Corner	sagittal	7	8	8	11	8	13	10	14	11	14	11	20	20	34	-	-	
		tangential	23	28	17	26	26	34	26	34	28	40	23	37	23	34	-	-	
	Intermediate	sagittal	10	17	8	11	14	23	14	28	28	45	26	40	23	40	-	-	
		tangential	28	51	26	40	34	57	40	63	34	51	40	57	34	48	-	-	

6x9cm: Rangefinder Folders

Lens	f stop		Open		4		5.6		8		11		16		22		32		Remarks
	MTF		50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10%	50%	10	
Zeiss Ikon Super-Ikonta C 531/2 Tessar 10.5cm *f*/3.5	Center		14	28	17	33	22	36	17	39	19	42	28	44	33	47	31	42	m=0.035 (1:28.4) 4/3 Tessar type Front focusing uncoated
	Corner	sagittal	11	19	14	19	19	25	17	19	19	31	22	36	33	44	33	42	
		tangential	14	22	17	22	17	19	17	31	22	36	22	42	28	39	22	33	
	Intermediate	sagittal	14	28	14	28	19	36	19	44	28	42	28	44	33	55	31	44	
		tangential	17	31	19	36	22	39	33	47	33	50	33	58	33	55	28	42	
КМЗ Москва-5 (KMZ Moskva-5) И-24 (Industar-24)	Center		17	24	17	29	17	24	15	29	19	29	24	39	24	41	24	41	m=0.041 (1:24.3) 4/3 Tessar type Front focusing
	Corner	sagittal	22	24	10	15	7	10	10	17	15	27	19	29	24	34	24	39	
		tangential	9	15	7	10	7	10	7	10	8	12	9	12	12	19	19	32	
	Intermediate	sagittal	15	22	15	19	17	24	15	29	19	39	24	39	27	44	24	39	
		tangential	10	19	12	19	10	17	10	19	12	19	15	19	22	32	24	34	