Leica R-Lenses

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Chapter 1: 50 mm and 60 mm lenses

__ LEICA SUMMICRON-R 50 mm f/2
__ LEICA MACRO-ELMARIT-R 60 mm f/2.8
__ LEICA SUMMILUX-R 50 mm f/1.4

From 1925 to 1950, the lens with a focal length of 50mm was the most used standard lens. Much has been written about the diagonal of the film format being the dsetermining value for its definition as the 'standard lens'. The length of the diagonal of the 35mm-format is 43mm (to be precise: 43.27mm) and therefore this should actually be its focal length. In fact any focal length from 43 to 58mm has been used for the standard lens. More importnat from my point of view are the perspective and angle of view that one gets with a 50mm lens. When Prof. Berek was calculating the first 50mm lens for the new Leica format as it was known in those days, he was without doubt searching for a balanced compromise between useability, speed, depth-of-field, and optical performance. In addition, the lens should exploit all capabilities of the somewhat unorthodox image size that Barnack had chosen. The aspect ratio of 2:3 (1: 1.5) was known from the then ubiquitous 6x9cm print size, but most paper sizes had an aspect ratio between 1:1.25 und 1:1.38. The "golden section", i.e. the ideal proportion as used by painters, had an aspect ratio of 1:1.62, slightly more than Barnack's format.

__Artistic considerations

The Leica was intentionally designed as a camera to be used in an upright posiion and in front of the eye. The maximum viewing angle of humans is limited to 140 degrees in the vertical direction and 200 degrees in the horizontal position. And this ratio (1:1.43) is quite close to the ratio of the Barnack negative size. What you can intuitively observe with your eyes, can be captured almost identically on the negative. A small trick: when you observe the scene with squinted eyes you will see a blurred picture, but the outlines of subjects and their distribution over the image area can be detected with ease. This helps to find a good or interesting composition. The viewing angle of 47 degrees and the perspective (meaning the relationship between the size of the depicted objects at the different distances) of the 50mm lens supports the correct reproduction of the intuitive observations on the final print. The first generation of Leica photographers almost exclusively employed the 50mm lens, evan after the introduction of interchangeable lenses. And with this lens, often stopped down to 1:8, photographic masterpieces have been created. A picture originates between the ears, but one needs an instrument that can capture the scene on film exactly as it was experienced. The '50mm' has much more potential than is often believed.

In recent times it has gotten a bit quiet around the normal lens. You will quite often hear that the focal length 35mm represents the natural perspective in a more pleasing way. In part this is just a matter of taste or opinion. Every picture has a main motive and some environment surrounding the subject. Or in other words: a foreground and a background. In photographic composition the size relation between main subject and background is quite important. If you look closely at pictures, you will often find that the picture taken with a 35mm lens is a bit tense and intrusive, because of the prominent position of the main subject in the focus of attention.
The '50mm' is a bit more balanced in its representaion of bakground and foreground and the size relations are often harmoniously proportioned. Both perspectives are valid and one needs to understand the subtle visual differences, as this helps you to make the right decision for the selection of a lens.

__Optical considerations

The optical evolution normally proceeds in a smooth and orderly way, but sometimes we note an unexpected jump. The first theories about aberrations were developed by mathematicians and practical experience was gathered by makers of telescopes and microscopes. It is therefore logical that maximum resolution is a very important quality criterion. You will not be happy when the distinct spot in the sky is not a star but a double star! The optical designers tried to correct the aberrations in such a way that the resulting image point (the spot) was as small as possible. Often this meant that the small spot was surrounded by a larger area of halo or flare that reduced contrast. In those days that was the least of problems. Already in 1936, Dr. Fricke, Leitz Wetzlar, argued that edge sharpness was more important than resolution. MTF measurements were not yet invented, but his discourse pointed in that direction. In the fifties, TV became a commodity. There was considerable research to match the quality of the TV image to that of the 8mm movie format. The TV image however is restricted to 625 lines in the vertical direction and more resolution cannot be realized than is possible with these TV screen limitations.(this is identical to the current dicussion about pixel size and number in comparison to film emulsions. History repeats itself!).

Dr. Schade was the first person who discovered that an improvement in contrast was the cause of a visually enhanced sharpness impression, even with identical or lower resolution. This knowledge, first employed in the TV design in America, has been adopted by Dr. Mandler, Leitz-Midland, when he designed the first Summicron-R 50mm f/2, introduced in 1964 together with the new Leicaflex. This lens had a very high contrast and image quality judged by the then accepted standards. The high level of contrast was coupled in a smart way to a high level of resolution and for a long period, because of its excellence in terms of the micro-contrast at the limit of useable resolution, this lens served as the reference lens for tests of film emulsions. If you are engaged in collecting Leica lenses, this one should be in your collection as a significant milestone in lens design. Since then, Leica designers have always been engaged in optimizing, which is not the same as maximizing, contrast and resolution at full aperture.

__Aberrations

You can imagine that a scene is made up of many small patches with different brightness. Their distribution is the basis for a good composition and may be used to find an interesting composition. At the moment we are only interested in the fact that the lens should reproduce these brightness spots faithfully. Even the smallest image point must have some extension and therefore a certain amount of energy as the light quanta are themselves energy particles. The light rays of on object point fall on the surface of a lens and are refracted by the spherical form of the surface to form an image point as small as possible. These image points on the negative are very small (typically 0.005mm in diameter). If you look at such a point very closely, you will note that it consists of a very small bright core where most of the light rays are focused, and a larger circle around the core where the rest of the rays will fall. This is a rim caused by flare. If we have a very small core and a large area around the core, we have maximum resolution but contrast will be very low. You can reduce the circle of flare around the core, with the effect that more rays will be concentrated in that core, but we now need a larger area for more rays. Now contrast is at optimum, but resolution is slightly less (see illustration below).

The designer has clearly some influence on the shape and composition of this image point. He/she can try to find a certain compromise between between both extremes and nudge the design in a certain direction. The residual aberrations that are always present, because of the fact that the optical errors cannot be reduced to zero, will influence the final image quality. Object points that are on or close to the optical axis will be represented as circular image points and are relatively easy to correct. That is why a good image quality in the center of the image field is not so difficult to achieve provided you restrict yourself to small apertures. When the maximum aperture is quite large, say f/2 or f/1.4, it is no longer a simple task to get good quality in the center. If you go to positions away from the axis, the distance from image point to optical axis (image height) will increase and the rays will fall obliquely on the image plane (angle of entrance). Now we will encounter new types of aberrations like astigmatism and coma that are quite difficult to correct. And some of these aberrations will, depending on image height and entrance angle, increase disproportionally in magnitude. As an example we may use spherical aberration. If we increase the aperture from f/2.8 to f/1.4, the magnitude of error increases ninefold.

To complicate matters, we know that we can only correct a lens optimally for a certain distance or magification. Mostly we use the infinity distance as the reference, but for macro lenses another distance should be selected. The image quality cannot be evenly distributed over all distances, over the whole image field and at all apertures. And the wider the aperture, the more difficult it will be to find a satisfactory balance of error correction. And finally we have to face the chromatic aberrations. It is well-known that every color is refracted in an optical system by a different amount (dispersion). This means that every color (red, blue, green and so on) will have its own optimal sharpness plane and that all colors will be seen with differences in sharpness. This so called longitudinal chromatic aberration must be taken into consideration when you are searching for a compromise between highest contrast and resolution of small textural details.

These facts may illustrate that any lens is always a compromise solution between many and often conflicting characteristics decided upon by humans. Even the best computer program can produce only numerical indications for this balancing. At the end of the day the optical designer has to make the final decisions. The three standard lenses in the Leica R-system therefore offer a different set of capabilities and performances.

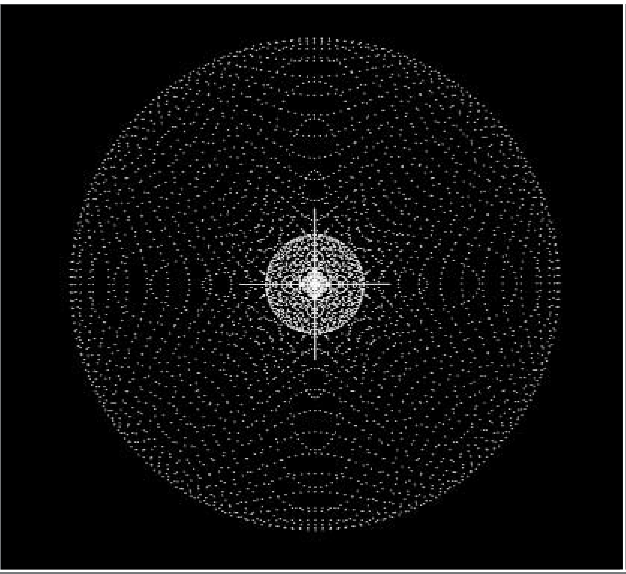


Image point A

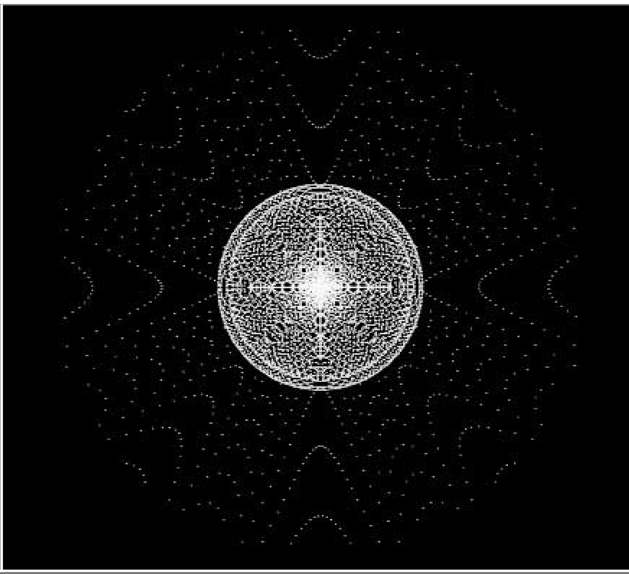


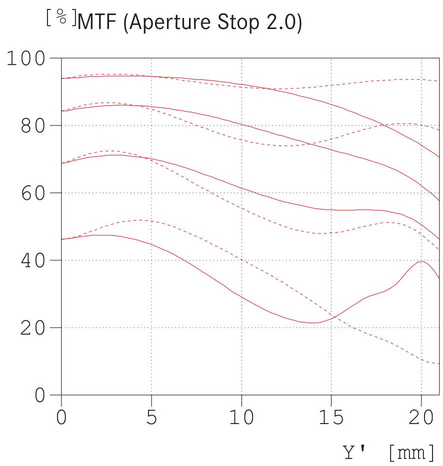
Image point B

__Three standard lenses

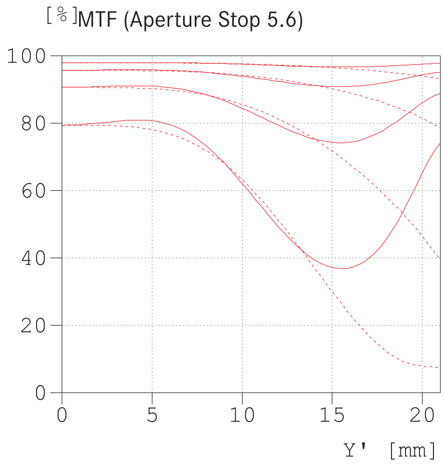
At this moment there are three lenses in the lens line-up that may be designated as standard or normal lenses:the Summilux-R 50mm f/1.4 (1998), the Summicron-R 50mm f/2 (1976) and the Macro-Elmarit-R 60mm f/2.8 (1972). There are good reasons to classify this last lens as a special lens for macro purposes. I would rather see this one as a very interesting standard lens with some remarkable properties.

__ LEICA SUMMICRON-R 50 mm f/2

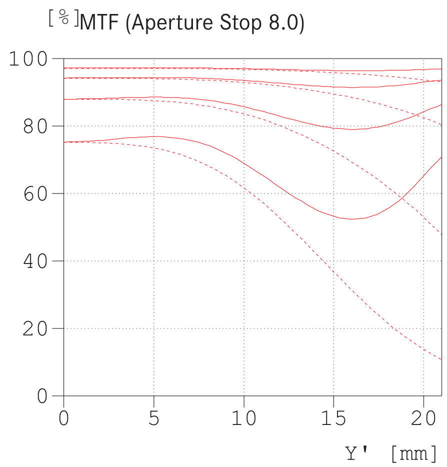
The current Summicron-R is almost identical in optical construction with its counterpart in the M-system. It is one of the two or three best standard lenses in the world. The predecessor from 1964 was balanced for high contrast at wide openings. The disadvantage of the design was a slight shift of focus when stopping down, that resulted in the best sharpness zone shifting from center to a zone outside of the center. The current version is a bit less contrasty at full aperture, but performs better when stopping down, and its image quality is more evenly distributed over the whole image area. Stopped down to f/4 the lens already delivers its best performance. Over an image area with a diameter of 24mm excellent quality can be seen. Brilliance, edge sharpness and resolution smoothly work together to create images with crisp rendition and almost a 3-dimensional effect. Most objects are 3-dimensional and should, when projected onto a flat plane (paper or screen), keep these properties.
Image quality falls off towards the corners, i.e. if the image quality across the whole negative area is really crucial, one should consider the Macro-Elmarit-R 60mm f/2.8.
Wide open the 5 Lp/mm are not yet at optimum position. This can be detected in the slight softness of delineations of main subject outlines. The curve itself is a bit wavy. At an image height of 12mm the line is split in two different lines for the tangential and sagital image plane. This behaviour often indicates the presence of astigmatism (horizonatal and vertical lines are sharp in different positions of the image plane) and coma.



The fact that the curve turns upwards in the corners indicates the influence of vignetting. Especially the curve for 20 Lp/mm (third group of lines in the diagram) is responsible for the somewhat soft definition of the finer image details in the outer areas of the negative.



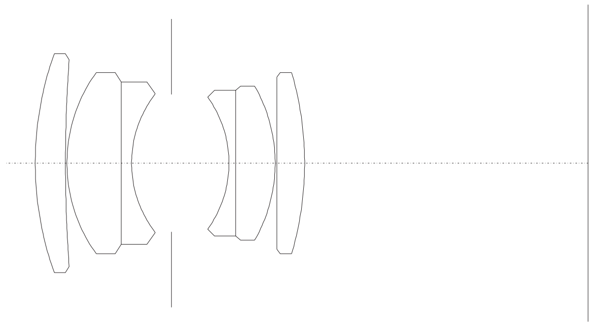
At f/5.6 the performance is outstanding. The line for 40 Lp/mm is now as good as that for10 Lp/mm wide open. The higher the contrast at 40 Lp/mm, the higher the clarity of the fine image details. The line for 5 Lp/mm is completely level now. The fact that the outer zones do not improve in the same way at the higher frequencies indicates the presence of residual aberrations.



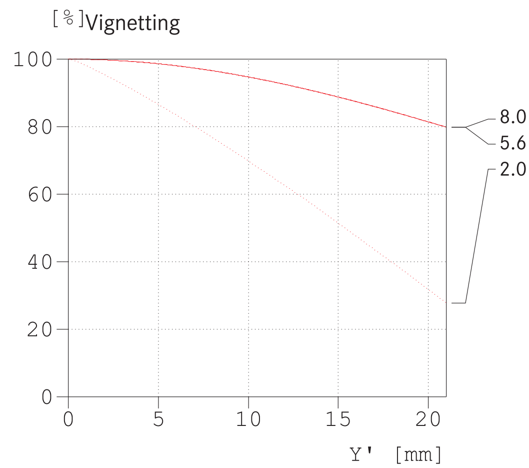
At f/8 you will detect a slight drop in the curve for 5 Lp/mm, as can be seen in the other curves too. This small loss of contrast indicates the influence of diffraction that starts to have effect at this small diamter of the aperture opening. Small differences should not be over-emphasized. Every lens has a tolerance range of 5% in the values of the curves. This is true for all MTF-graphs.

The Summicron-R 50mm f/2 offers outstanding image quality that can hardly be improved as long as one sticks to the six elements normally employed.

In complicated light conditions (contre-jour or backlighting,

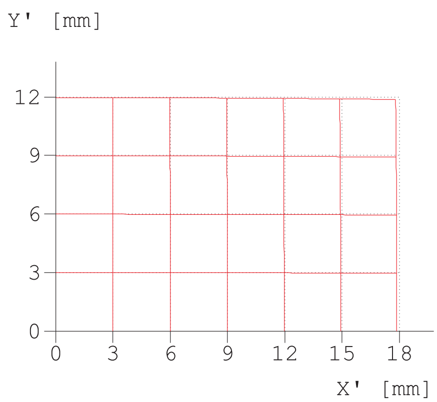


strong light sources that fall obliquely on the lens surface, extreme differences in subject contrast, that produce flare in the shadowy parts and specular highlights) this excellent performance is preserved. Flare and secondary reflections are minimal. Specifically with slides that can render a larger contrast range, this performance shows in really deep black shadow areas. A bit typical for the Summicron design is the occurrence of a hazy patch of light in the center of the image in situations where a large and bright backgound is part of the scene and can act as a light box. In this situation a small change of position can correct this phenomenon.



Vignetting at the edges is visible with almost two stops at full aperture. Vignetting is not so easy to analyse as seems to be the case.With a motive that has a uniform and medium bright illumination, you will see the vignetting quite clearly. With a very bright or dark background or when there are many details in the picture, it is not so easy to detect.

Effective Distortion



Distortion is visible with 1% at the dges of the image area. At an image height of 12mm (the top border of the negative in normal horizontal position) the distortion is hardly detectable. The general rule says that distortion above 1 to 2% will be seen, as straight lines then visibly become slightly curved.

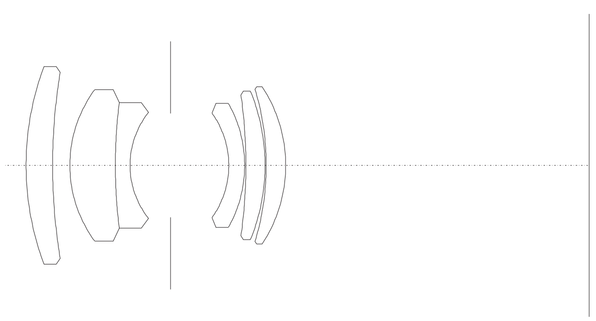
Leica lenses are always calculated according Barnack's famous motto: small negatives, large pictures. It is in fact a pity to to restrict yourself to color pictures on a small print. Leica images should be printed at least on A4 (24x30cm) or projected with larger magnifications. It is only then that the performance of Leica lenses can be appreciated. It is clear that fine detail is only visible when the magnification is above the threshold of human perception. Small details with a size of 0.01mm or 0.005mm on the negative need a resolution of 50 to 100 Lp/mm with good micro-contrast. In normal conditions and at a distance of 25cm the eye can discern about 3 to 6 Lp/mm. This means we need an enlargement between 8x and 32x to see the detail in the negative.

	Eye 3 Lp/mm	Eye 6 Lp/mm
Negative 50 Lp/mm	16x	8x
Negative 100 Lp/mm	32x	16x

At smaller print magnifications and print sizes we are unable to see the many details present in the subject and captured by our Leica lenses. The joy and pleasure in using Leica lenses could be enhanced when we exploit the quality to the full. The 50mm lens with an aperture of f/2 can be employed universally and its full aperture can be used without restrictions. You should always strive to use the highest possible shutter speed. The old rule of thumb that the reciprocal of the focal length is the speed limit for handheld photogrpahy is not a very smart one. With a 50mm lens that would imply 1/60 of a second, which is evidently too slow to counter the self-excited vibration of the body (heart beat). The smaller details and especially the edge sharpness will be disturbed. The overall impression of the image is soft.
There is hardly a subject that cannot be photographed with good effect with a 50mm lens. The palette of possibilties runs from landscape to portrait, from still life to reportage. And in photographic style there are no restrictions: dynamical or constructed, spontaneous or reflective, every approch is possible. You can do more with a 50mm than is often assumed. And as noted in the introduction, the perspective is natural and relaxed. Artistically the 50mm is a challenge to use. The 35mm format with its 1:1.5 aspect ratio is a bit to wide for most compositions. You need to carefully position the main subjects and secondary subjects in a good foreground-background realtion to get a fine composition.

__ LEICA MACRO-ELMARIT-R 60 mm f/2.8

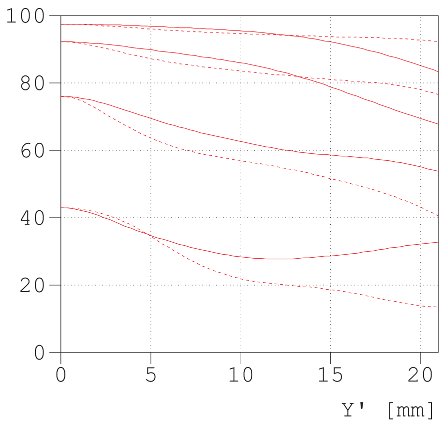
It is often an advantage to use a lens with an aperture that is as large as possible, as with the Summilux-R. The added value of such a lens should be carefully considered. Depth-of-field is very small and when you enlarge, the depth-of-field is reduced again. The tables for the depth-of-field are based on a circle of confusion of 0.033mm, which is too large in many situations for critical work.



Here a trick can help: if you wish to enlarge or project substantially larger, you can find the real depth-of-field according to this rule: Aperture on the lens used is f/8. The depth-of-field is now read off the table at the f/4 line for big enlargements and at the f/5.6 linefor smaller enlargements. This rule works also for the close-up capabilities of the Macro-Elmarit-R 60mm f/2.8.

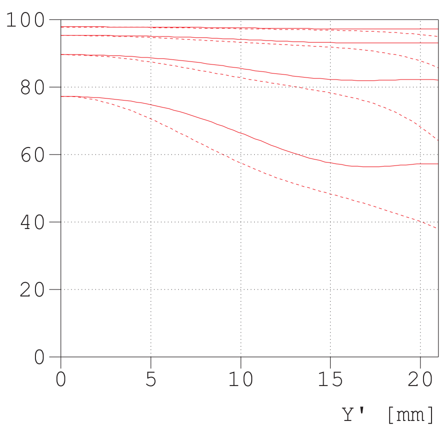
This lens is often characterized as a true macro lens. You should see this designation in a wider perspective. The 'Macro' in the designation does not imply that the lens is calculated for very close distances and high magnifications. The macro range is normally described as the magnification range from 1:1.0 to 1:50.0 or with distances from 1000mm to 10mm. Actually, the Macro-Elmarit should be designated as a close-range Elmarit. Normally a lens is calculated for optical infinity, that is a distance equal to 500 to 1000 x the focal length. It is logical that at closer distances the optical performance will drop a bit, as the aberrations are not corrected fully in this range. Partly you can compensate by stopping down. And you will often read the recommendation to stop down the lens when you are at close range with your lens to improve the image quality. True macroscopic lenses are designed for one optimum (small) magnification or distance range. The Macro-Elmarit-R has been designed and corrected for the medium distances in order to provide for excellent performance at infinity. The diagrams show quite good MTF values at the infinity position and especially at medium apertures the performance is better than with the Summicron-R.

[%]MTF (Aperture Stop 2.8)



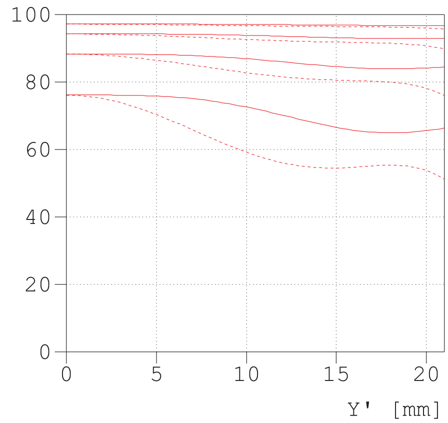
At aperture f/2.8 the line for 5 Lp/mm is already located quite high and straight. The 10 and 20 Lp/mm are on the low side and you will note that medium fine detail will be outlined with faintly soft edges.

[%]MTF (Aperture Stop 5.6)



At aperture f/5.6 the correction of the aberrations is excellent. The 5 and 10 Lp/mm are very high and indicate very high contrast and good resolution. The 40 Lp/mm curve drops a bit from center to corner. But one should be careful here. These very small image details are not so sensitive to small differences in contrast as the subject outlines.

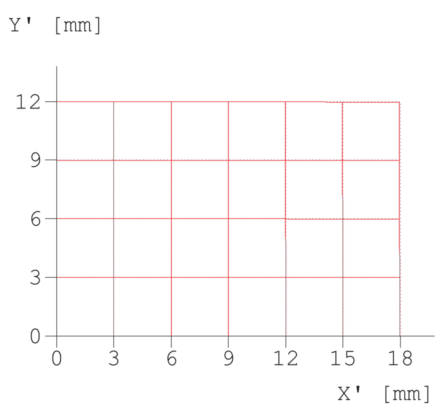
[%]MTF (Aperture Stop 8.0)



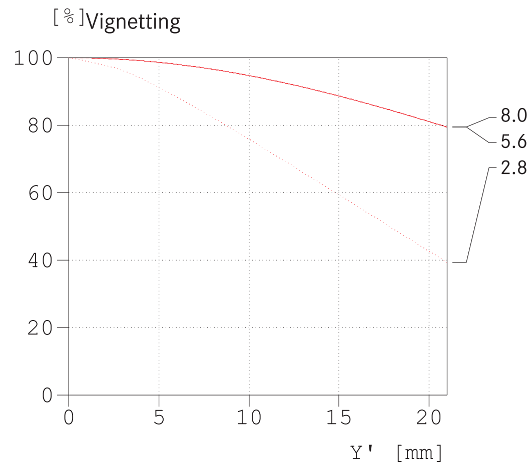
At aperture f/8 you will see (as with the Summicron-R 50mm f/2) the effect of diffraction. The contrast drops a bit. Again a remark: these effects can be calculated and shown in a diagram: it is not so easy to detect this in real photographic practice.

The Macro-Elmarit-R 60mm f/2.8 has no distortion and the performance is equally good from center to edge.

Effective Distortion



easily recognized. Flare cannot be detected and vignetting is quite small .



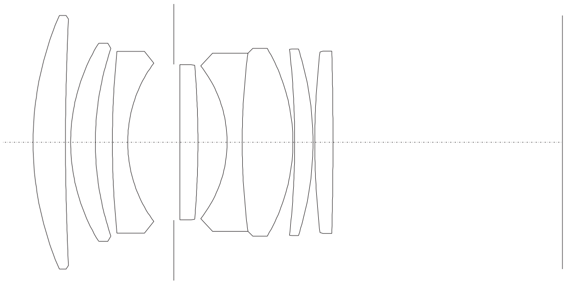
If you are looking for a standard lens that delivers superior performance at medium apertures and distances, then the Macro-Elmarit-R is frst choice. This quality can be exploited best when using a tripod or working with high shutter speeds. And (often overlooked) the subject matter must have those fine textural details, after all, the lens cannot capture what is not available. In the close-up range, between 70cm and 20cm, there is a fascinating world to explore, if you are open-eyed and wish to see new patterns in ordinary subjects. In this range the optical quality is outstandingly good. A small drop in contrast cannot be avoided, but can be accepted as the textural details are already captured quite clearly. Objects with a considerable depth should be photographed with quite small apertures and whenever possible with some backlighting to preserve the sense of depth. At a magnification of 1:10 the depth-of-field at f/5.6 is a mere 4cm. It is advantageous that the unsharpness gradient is quite smooth: unsharp detail will retain its shape and can be easily recognized. Flare cannot be detected and vignetting is quite small .

The diagram shows a smooth curve, which helps to lessen the effect of vignetting. If absolutely even illumination is required, an aperture of smaller than f/5.6 should be used where the limit of natural vignetting is reached.

The big advantage of this type of lens is the possibility to change quickly and smoothly from close-up to medium distances. Detail pictures and overviews can be made in one sweep from infinity to magnification 1:2. The slightly smaller angle of view of 39 degrees (compared to 47 degrees with the 50mm) assists in isolating the main subject. The Macro-Elmarit-R is a general purpose lens and can be used with all subjects and most photographic conditions. It is not a true reportage lens, as the long focusing movement is a bit slow when you need to go from close-up to long distance. But in all situations where the documentary and meditative style of photography is selected, this lens is the best choice.

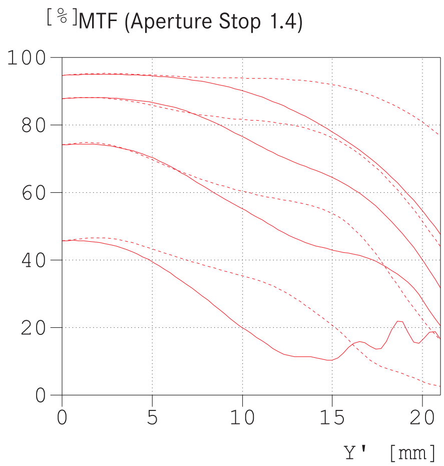
__ LEICA SUMMILUX-R 50 mm f/1.4

The jump from 2.8 to 1.4 brings a fourfold increase in the amount of light energy that travels through the optical system. And some aberrations grow in magnitude by a factor of nine. Specifically the spherical aberration and the chromatic variation of spherical aberration and coma are nasty funspoilers. You can not eliminate these errors, only compensate them with other aberrations. That is why a truly outstanding 1.4-lens is so difficult to design.



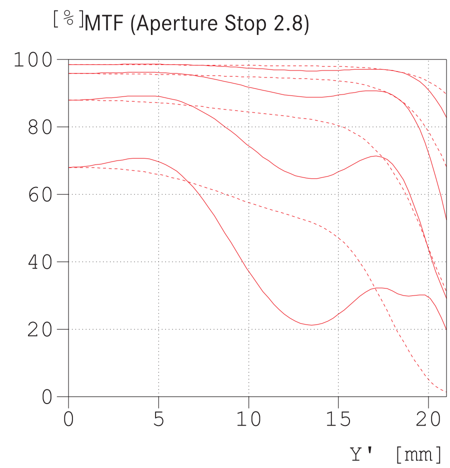
The first version of the Summilux-R 50mm f/1.4 from 1970 had commendable performance and was as good as the rest of the competition. It was not better though, and one should reflect on the fact that in those days a 1.4-lens was a must for every manufacturer in the front rank of optical design. Wide open the image was soft and with low contrast. Stopped down the quality improved, but the lens never reached the performance level of the Summicron-R. Specifically the quality in the outer zonal areas was not very good even at f/4.

The new design from 1998 with 8 elements solved these problems and more! At aperture f/1.4 the performance is very close to that of the Summicron-R at f/2. I write ‘almost’ as the lens shows a very faint softness under critical inspection and large magnifications. The curves for 5 and 10 Lp/mm are located a bit low and this signifies a lower overall contrast and a softness at the edges of subject outlines. The maximum resolution is not yet at its best at this aperture. You can discover this under test conditions, but generally it makes no sense to test a 1.4 lens wide open for best resolution. You will not use this lens at maximum aperture to make high resolution pictures. A more relevant practical comparison is the one I made when, during a two week holiday, I used both the Summicron-R at aperture f/2 and the Summilux-R at aperture f/1.4 and f/2. During the projection of the slides it was often impossible to identify which lens was used for the pictures. We may state that for most picture taking situations the Summilux-R performs as well as the Summicron-R at when both are set at aperture f/2 the Summilux is a tad better. At aperture f/1.4 the vignetting is identical to that of the Summicron-R at f/2.

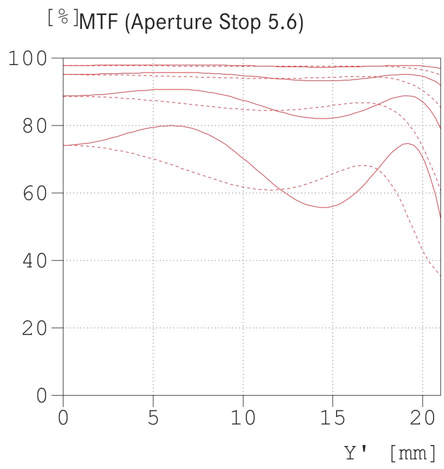


It is really fun to use this lens at aprture f/1.4. The bright image on the finder screen allows for fast and secure focusing and the resulting pictures have a special charm and character. With aperture f/1.4 under-exposure is not so very critical as the light gathering power allows the main subject detail in the shadows to have clean outlines and the specular highlights to be cleanly delineated. The fine textural details in the main subject (where the sharpness plane is located) show clarity, the colors are saturated without being on the dark side. The sum of all these characteristics creates pictures with the famous Leica look.

Flare in high contrast situations is very minor, but whenever possible, the built-in lens hood is a must. Tricky lighting can spoil the day. The big surprise with the Summilux-R is the remarkably high image quality when stopping down. This is not an obvious result. You buy a lens not only for its wide open performance, but want to use it also at smaller apertures with equally good or better results. Especially the improvement of the performance in the area outside the center of the image is very high.

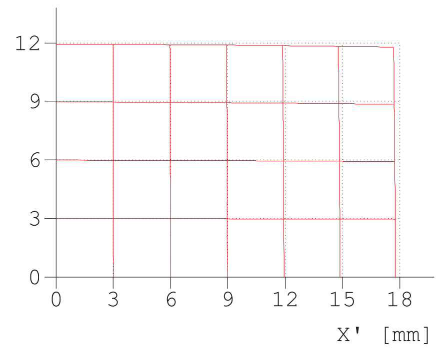


At aperture f/2.8 the Summilux-R equals the Summicron at aperture f/5.6. Especially the location of the curve for 5 Lp/mm indicates a very high image contrast. Very fine details in the edges are still weak and blurred. Look at the curve for 40 Lp/mm beyond an image height of 15mm. The rapid increase in performance when stopping down indicates a low level of residual aberrations, specifically the chromatic aberrations.
At f/5.6 the Summilux is so good that you need the best films to realize the image potential.



The curves for 5, 10 and 20 Lp/mm are almost flat, close together, and high in the diagram. The small undulation in the curve for 40 Lp/mm is not so important in this case. You can be very happy with this performance potential. An ideal lens is not (yet) possible. The excellent performance wide open is accompanied by some distortion.

Effective Distortion



Close to 2% is still an impressive value, but one will see this clearly as straight lines as the edges become a bit curved. You should reflect on this behaviour when selecting your subject matter. I am not aware of a better 50mm f/1.4 lens than this one, within and without the Leica domain. There are very few lenses in the same performance league, but the Leica lens has the advantages of better mechanical engineering and precision in manufacture. Especially here, where you expect and demand top quality, the accuracy of manufacture may be quite significant. Stopped down this lens delivers outstandingly good image quality and wide open the performance is excellent, even in absolute terms. If you are aware of the great challenges that have to be taken up by the designers to create a lens with such high performance, you feel impressed by the result.

__Summary

The Summilux-R 50mm f/1.4most versatile and offers the best allround performance and improves upon the Summicron-R 50mm f/2 at smaller apertures. Ana dditional advantage of the Summilux is its good performance at the wider apertures. If you want accurate reproduction of a wide range of subjects, also in the close focusing range, the Macro-Elmarit-R 60mm f/2.8 is the best choice. The Summicron-R 50mm f/2 offers many of the characteristics of both these lenses in a compact and well-handling shape, but has to take second place in the specialized disciplines of its companions.