



Leica R-Lenses

by Erwin Puts

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Chapter 2: 80 mm and 100 mm lenses

- LEICA SUMMILUX-R 80 mm f/1.4
- LEICA APO-SUMMICRON-R 90 mm f/2 ASPH.
- LEICA APO-MACRO-ELMARIT 100 mm f/2.8



In older textbooks about photographic techniques there is much space devoted to the choice of a lens. At first one should buy a 50mm lens and use it for an extended period of time. Having learned the language of photography, one is prepared, and only then, to buy a second lens. The 90mm lens, or as it was called when focal lengths were measured in centimeters, the 9cm lens, was the next step. Having bought this lens and after studying the laws of perspective, one was ready for a wide angle lens. And finally a 135mm telelens could be considered. The first Leicaflex was introduced with only four focal lengths (35-50-90-135) and this was done on purpose. Much of what was known in the past, is still valid today. Lenses are like persons. Only after a long period of companionship, the true character can be seen and appreciated. A 90mm lens is a more versatile tool than can be gleaned from the usual catalog description (useful for landscapes, architecture, snapshots, animals). The 'ninety' is a lens that enables you to really investigate the Leica style of photography. If you look at many pictures, you will discover that often the image works overloaded as so many parts of the image ask for attention. A ninety millimeter lens forces the photographer to a selective choice of subject matter and thus to exploit the space provided by the quite small negative format to its best. Selective enlargement should be avoided as much as possible, as any additional magnification will degrade the optimum image quality. In this sense the 90mm is an excellent teacher

__Artistic reflections

The natural perspective is one where the viewing angle in natural space is identical to the angle of view when looking at the picture. The eye has a viewing angle that is close that of a fish-eye lens, but in practice the field of vision is much narrower. Fundamental requirement for the correct perspective demands that the eye should be positioned at the same location as the entrance pupil of the lens. There is a simple equation that tells you that the viewing distance (e) for the correct perspective should be the focal length of the lens (f) times the negative enlargement (v). As a formula: $e = f \text{ times } v$. If you make a picture with a 50mm lens and wish to look at the negative directly, your eye should also be 50mm from the negative. But the minimum distance of distinct vision is 250mm and so the negative must be enlarged 5 times. We need a 5x magnifying glass to see the picture with the correct perspective. Or you should enlarge the negative 5 times to a print to a size of 13x18cm. The well known picture format of 10x15cm requires a 4 x enlargement and is too small. It implies that you will look at the picture with an extended space perception. You look at the picture with a wide angle perspective so to speak. When a format of 13x18cm is used and the picture is made with a 50mm lens, then this 5 times enlargement will provide for a correct and natural perspective. The picture format of 13x18cm has a diagonal with a length of 222mm and that is quite close to the minimum distance of distinct vision of 250mm. The angle of

view is now about 50 degrees and this corresponds to the angle of view of a 50mm lens (45 - 47 degrees). But this minimum distance is very often quite uncomfortable in many situations. You may not be able to view the whole picture at once without moving your eyes and the distance of 250mm is quite short, if you are above 20 years old. Many studies have found that the most comfortable viewing distance is twice the value of the minimum distance. If you want to keep the natural perspective, you need a lens with a focal length that is twice the value of the diagonal of the negative format, thus $2 \times 111\text{mm}$. A focal length of 86mm, then would be the ideal lens. This somewhat surprising conclusion can be supported by the following observations. The focal length of 90mm is often described as the best for portraiture. This is true, but why? Let us make a head and shoulder portrait at a distance of 2 meter with a 100mm lens, and enlarge this negative to a print size of 13x18cm. The formula tells us that we need to look at the picture from a distance of $5 \times 100\text{mm}$, or 50cm. If we now take the same picture with a 50mm lens at one meter distance, the viewing distance should be 25cm. But we look at the portrait often at a distance from 50cm as this is more comfortable. Then we look at the portrait with a wide angle perspective and the impact of the image will be different from that taken with the 100mm lens.

Perspective is independent from the focal length. If we photograph a subject from the same position with a 28mm lens and a 300mm lens, the perspective is not changed, only the rate of magnification. We can verify this, when we enlarge the 28mm picture ten times. Let us now compare both pictures and we see that they are both identical in size and perspective (depth cues). The vertical angle of view of the 28mm lens is 46 degrees and that of the 300mm lens is 4.6 degrees. The viewing distance for the enlargement of the negative with the 28mm lens is 28cm (10 times 2,8cm) and for the (not enlarged) picture with the 300mm lens it is 30cm (1 times 30cm). If we take pictures with lenses of different focal lengths at different distances to keep the size of the main subject at equal size, the perspective will change of course. The perspective formula tells that the perspective impression is only then a natural one, if the viewing angle of the camera in space is the same as the viewing angle of the eye at the picture. You can ensure this when you carefully adjust these three important aspects: enlargement factor, viewing distance and focal length. This is true also when you project slides. The choice of the focal length should always take into consideration the expected enlargement factor and the normal viewing distance. It cannot be a coincidence that the 90mm lens was very popular with experienced photographers. And Leica has always offered a wide selection of 90mm lenses, carefully tuned to different tasks. It might be a fine exercise to use the 90mm exclusively for one month and enlarge all pictures to a size of 13x18cm. The viewing distance should be about 50cm. Then you really get used to the correct perspective. A portrait taking with a 90mm has a 'flatter' perspective that is 'flattering' for the sitter.

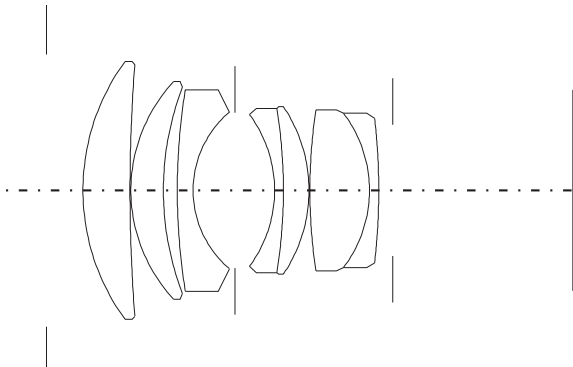
__Optical considerations

Within the R-System we have three lenses with a focal length between 80 and 100mm. Every lens has its special use and character. We will look at first at the optical properties. Almost every high speed lens with focal lengths from 35 to 100mm are derived from either the Sonnar or Biotar basic form. The number of lens elements ranges from 5 to 8. With this amount of options the optical designer has an abundance of choices.

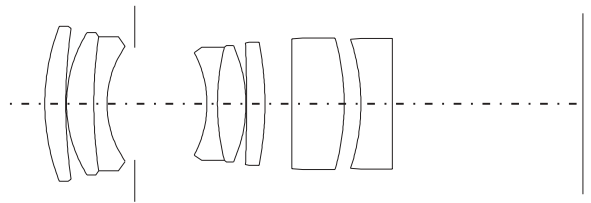
Basically the following options exist:

- split a lens in two single lenses (distribution of refractive powers)
- create a single lens as a compound of two lenses
- change the refractive index of the glass types
- use aspherical surfaces
- split a compound element in two separate elements
- use glass types with anomalous dispersion

The optical designer can use all of these options in any combination to design a lens that delivers optimum performance according to his set of standards.



The Summilux-R 1:1.4/80mm (from 1980) has the construction we already know from the Summilux-M 1.4/50 from 1961. Three single lenses before the aperture and two compound lens groups behind the aperture. Leitz used two versions of this design: the last group is constructed as a compound doublet or as two separate single elements. For high speed lenses the compound version is better suited, if this group is designed as a new achromat. It is in fact remarkable how well this design has served the demands of generations of users. Even from today's elevated demands we can evaluate the performance as outstandingly good. With some effort you may detect in the design the vestiges of a Double-Gauss lens.



A true Double-Gauss design we find in the Apo-Macro-Elmarit-R 1:2.8/100mm. Here we have a six element construction with two separate thick elements at the rear end. As with the 60mm macro lens, the computation is designed for universal usage. When focusing the lens, the whole front lens with six elements moves and the rear group is stationary. The apochromatic correction is very important when slides or negatives need to be magnified substantially. The disturbing color fringes are eliminated, because of the reduction of the secondary spectrum. The apochromatic correction is often restricted to the long focus lenses as the chromatic errors grow proportionally with the focal length. It was a remarkable decision by Leitz to employ this correction type in a lens with a focal length of 100mm. The optical qualities have not been surpassed to this date, although we have some others who are quite close in performance. With the 100mm lens, you can take pictures at a magnification of 1:2 without supplementary tools and still keep some distance from the subject. The image quality is equally high at close ups and at infinity. The special construction with the two thick rear lenses is partly responsible for this behavior. The use of special glasses with anomalous dispersion helped the apochromatic correction substantially. The optical design has been optimized for the specified task, especially the homogeneous quality level over the whole distance range. The first version of the Apo-Macro-Elmarit-R 1:2.8/100mm used a mount with a double thread, later changed to a single thread, as the previous mechanism created a less smooth movement. (from serial number 3469285)

The first Summicron-R 1:2/90mm has been introduced in 1970 and has held the flag for this classical focal length during 30 years. It is a five element design from the Midland optical construction department. It has some reminiscence to the Sonnar design. The system is nose heavy as most elements are in front of the aperture. The performance is good, but the Summilux-R is as good and has twice the speed to illuminate the negative area.

The Summicron-R 1:2/90mm displays the typical veil of soft flare over the whole image at full aperture, that is the characteristic of almost every high speed lens of the older generation. The typical use of the 90mm as a portrait lens could serve as an explanation and defense of this behavior. The soft reproduction of image details and subject outlines created a more friendly image of most faces of the sitters. But one did the 90mm lens an injustice as it restricted its potential universal use.

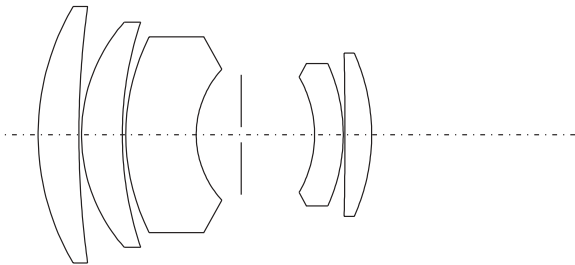
The current Apo-Summicron-R 1:2/90mm ASPH (2002) raised the level of optical quality substantially. The size is very compact and almost equal to that of the current Summilux-R 1:1.4/50mm. Based on size it can be classified as a standard lens. The optical quality is superb and a revelation. The aspherical surface is grinded by CNC-equipment in a lengthy and elaborate way. Grinding and finishing takes many hours per element and is so time consuming because of the many inspections and checks during the manufacture. If a lens is manufactured with such accuracy, you need a very careful assembly. The Leica-typical construction with metal parts of exact dimensionality is a necessary condition for a high quality

product. This aspherical surface with a large diameter and complex shape has to be assembled with utmost care to ensure that the theoretical capabilities can be practically available. The optical construction shows a five single elements, and the first surface of the third lens has the aspherical shape. True mastery can be seen in this elegant design. Some time ago one needed seven or eight lens elements and could not get this high performance. The low number of elements, the choice of glasses for transparency and color transmission, the effective type of coating, all work together to provide the remarkably clear and crisp rendition. The image quality is very, even at full aperture and veiling glare and secondary reflections are absent. If you take pictures with the sun, directly shining into the front lens, some aperture reflections can not be avoided.

This layout may be indicative for new designs from Solms. The classical design with seven or eight elements may be in its final stage. The current demands have become too high, especially in relation to the new method of digital capture.

___Three lenses of medium focal length

These three lenses do not only differ in their effect on perspective but also in their performance at full aperture. Everyone of these lenses could be described as a general purpose lens, with exception of the special macro facilities of the Apo-Macro-Elmarit. The angles of view are close together with 30, 27 and 25 degrees. In reality the differences are bigger. If we take a picture of a person and a face in vertical format, the subject distances are as seen in the table below.



	Person 1.76 Meter	Face 50 cm
Summilux-R 80 mm f/1.4	6.57 Meter	1.86 Meter
Apo-Summicron-R 90 mm f/2 ASPH.	7.33 Meter	2.08 Meter
Apo-Macro-Elmarit-R 100 mm f/2.8	7.93 Meter	2.25 Meter

At these distances the image size of the person is always the same, but the background is clearly different and has its pictorial effect on the subject. For formatfilling figure photography, the 100mm is a bit uncomfortable as the distance to the person is quite large and here the 80 or 90 are better suited. The most important selection criterion is the performance wide open. In the next table I have compared the three lenses in this respect.

	Aperture 1,4	Aperture 2,0	Aperture 2,8
Summilux-R 80 mm f/1.4	Medium contrast, some flare. In the center good resolution, in the outer zones medium resolution, some astigmatism is visible.	Medium contrast, low flare. In the center very good resolution, in the outer zones good resolution, some astigmatism is visible.	High contrast. In the center very good resolution, in the outer zones good resolution with some softness, astigmatism is very faint.
Apo-Summicron-R 90 mm f/2 ASPH.		High contrast, very high edge sharpness, high resolution from center to edge.	Very high contrast, very high edge sharpness, very high resolution from center to edge.
Apo-Macro-Elmarit-R 100 mm f/2.8			Very high contrast, high edge sharpness, very high resolution from center to edge.

This evaluation is based on very severe conditions. The testslides were enlarged to a size of 2.40 meter, that is a magnification of 66 times. Under these conditions, even the minutest error can be seen, especially as the observer is close to the screen, where he should not be to be honest! The Summilux-R shows some characteristics, that are not visible at all at smaller magnifications. From aperture 2.8 all three may be considered equal in image quality. The performance of the Summilux is in absolute terms excellent and should be related to the very high speed. It is not always the case that a very high speed lens can be compared favorably to a dedicated macro lens of stunning performance. The MTF graphs are very informative for the appreciation of optical performance. These graphs show the maximum resolution of 40 Lp/mm. That is more than needed for most picture assignments. The new Digital Back for the R8/9 has a theoretical resolution of 75 Lp/mm. It is interesting to know if these lenses meet the requirements.

The Summilux-R reaches at full aperture a value of 100 Lp/mm in the center of the image and 40 to 50 Lp/mm in the outer zones. The edge is weak with 16-25 Lp/mm. At aperture 2 these values may be raised by +10 Lp/mm and at 2.8 we have a center resolution of above 100 Lp/mm and in the outer zones above 70 Lp/mm. The Apo-Summicron-R ASPH at full aperture has a value of above 100 Lp/mm over the full image area, excepting the corners where we still have a stunning 50

Lp/mm. On the optical axis we even see more than 150 Lp/mm. From 2.8 we have a uniform resolution of more than 100 Lp/mm with the edge now at 80 Lp/mm. The Apo-Macro-Elmarit-R has the same values as the 90mm lens at aperture 2.8.

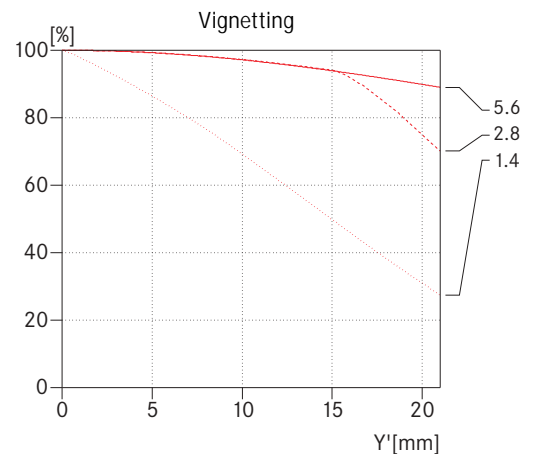
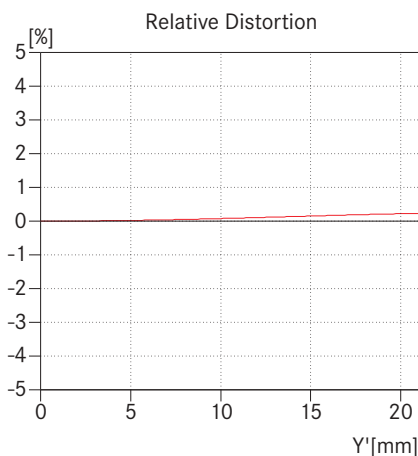
Overall we may declare that all three lenses can exploit the high resolution of the future digital back and they even have some reserve capacity.



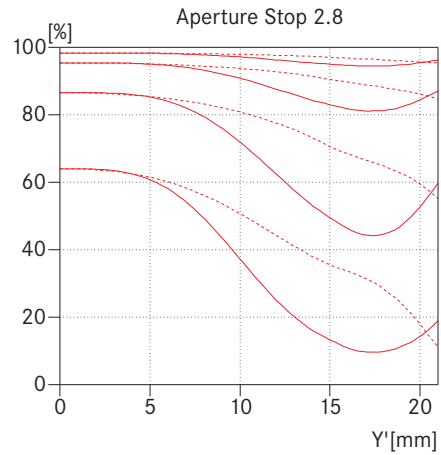
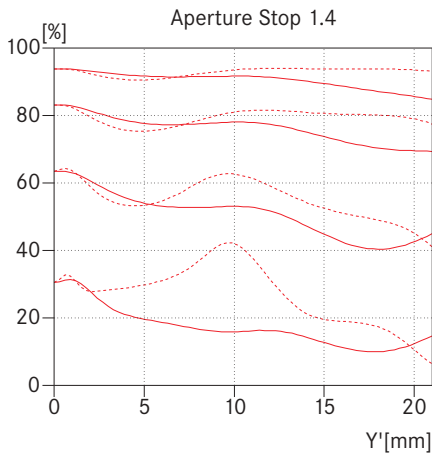
— LEICA SUMMILUX-R 80 mm f/1.4

With 700 grams the Summilux-R has somewhat less weight than the Apo-Macro-Elmarit-R. The discussion whether mass does support the stability of the lens will presumably never end. But a high mass also asks energy from the photographer to support the weight and this may counteract the stabilizing effect of mass. You need to hold the lens immobile for a longer period. The Summilux-R has been classified as a ultra-high speed reportage lens. The brightness of the focusing screen is very high, indeed and the focusing is fast and accurate. The speed of focusing can be improved when you pre-focus at the anticipated distance and move the camera slightly to and from the subject for fine tuning, without larger focusing movements. The true focus snaps into position on the bright screen.

Distortion is surprisingly low with only 0.2% and is even suitable for architectural photography.



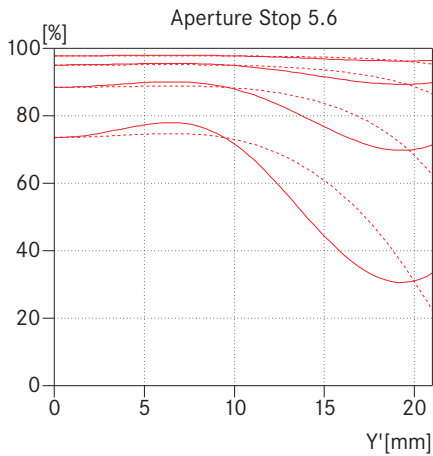
Vignetting is relatively high with 2.5 stops as a measured value. In practical use, these values should be treated with some caution. Even landscape pictures with clear sky show only a slight darkening in the corners.



At aperture 1.4 the overall contrast is medium, as can be seen from the graph, where the low frequencies are below 95%. The important 20 Lp/mm are clearly defined with 60% in the center and 40% in the outer zones. The edge sharpness is a bit soft as can be seen from the low position of the line for the 40Lp/mm. High contrast scenes with many light sources and deep shadow areas are reproduced with a slight veil of softness, but quite low halo around bright spots. You will use the wide aperture of 1.4 to capture scenes in low light situations that are interesting, moving or informative-documentary in character. For this kind of photography, the Summilux is eminently suited. The performance wide open is better than can be captured on modern high speed emulsions. Stopped down to 1:2 the overall contrast improves visibly, as internal reflections are effectively reduced.

Aperture 2.8 again improves contrast and now performance in the center is very high. In the outer zones the quality lags a bit behind, but for this type of photography that is not so important. Here you should look at the 20 Lp/mm as the guiding line.





Aperture 5.6 can be regarded as the optimum. The edges stay a bit soft in the definition, but you need a high magnification to discern this. In the center of the image where the main subject or action is being located, very fine textures are reproduced with crispness.

The MTF graphs should be studied with some caution. You can overrate the values that are displayed. I have made comparison pictures with all three lenses at all apertures on ISO100 slide film. The distinctive differences as described above, can be seen only when the magnification is 20 times or more. You should also take care of your photographic technique. Wrong focusing distance and a slight movement of the camera create more loss in the picture quality than the inherent optical characteristics. The unsharpness gradient is quite pleasing and adds to the impression of depth and space. Specular highlights are reproduced with finely nuanced hues and that again improves the plasticity of the image.

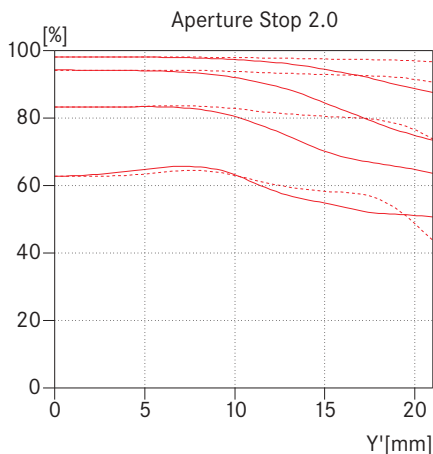


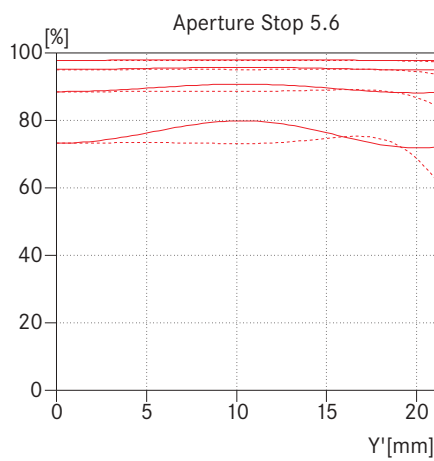
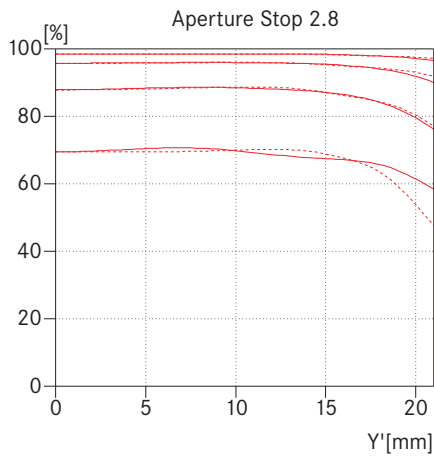


__ LEICA APO-SUMMICRON-R 90 mm f/2 ASPH.

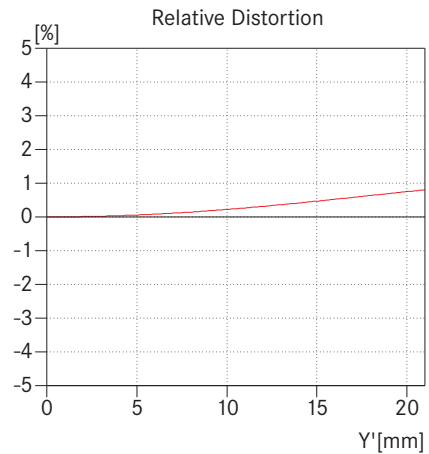
Since Photokina 2002 the R-photographer can deploy an optical crown jewel. Every lens line from every manufacture is built up from lenses with differing characteristics, performance levels and deployment possibilities. There is not one manufacturer where all lenses exhibit identically high performance. The rule is still valid that a lens has to be designed with a large set of requirements that are often conflicting and every designer has his own ideas about what should be the best solution for a given task. Anyway, sometimes we have a lens that is very difficult to fault and seems to show a very happy synthesis of requirements. The Apo-Summicron-R 1:2/90mm ASPH is such a lens. It is really difficult to criticize this lens.

At full aperture the performance is already as good as that of the Apo-Macro-Elmarit-R 1:2.8/100mm at aperture 2.8. For an aperture of 1:2 this is a most remarkable feat. More important perhaps is the transparency of the colors and the clarity of the details. Extremely fine details are reproduced with very good crispness from center to edge. The 40 Lp/mm have an average contrast value of 60%, and there is no trace of astigmatism or coma in the outer zones. The previous version of the Summicron 90mm had a contrast of 30% for the same 40 Lp/mm. A doubling of the contrast of the fine textural details is more than just visible: it is a new experience for high speed lenses. Stopped down the performance improves only slightly.



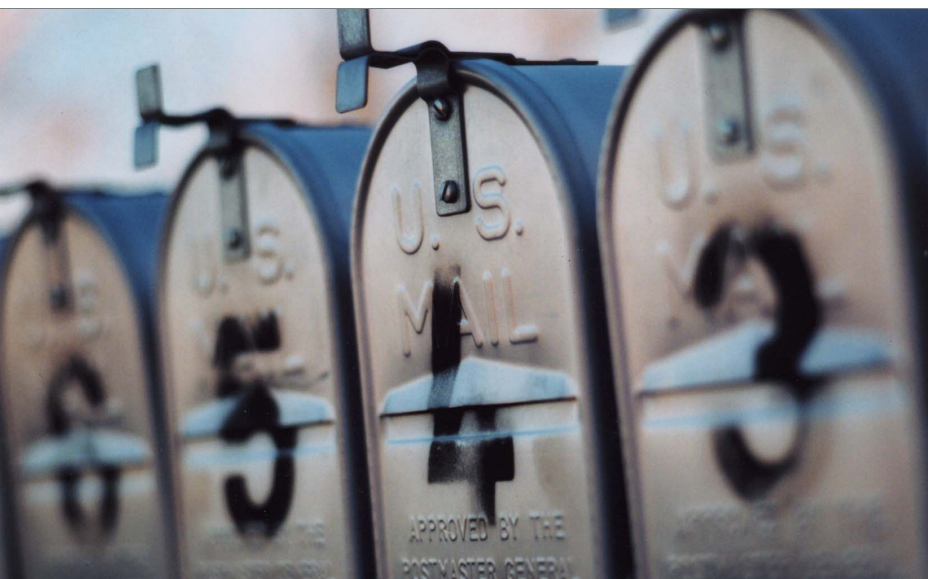


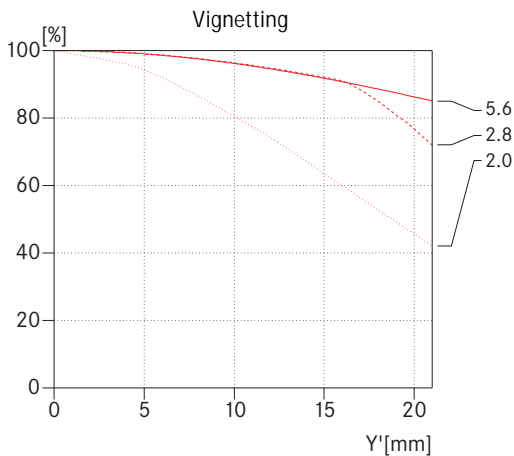
and the extreme edge rays are blocked. If you look carefully, you may see the result of the diffraction at aperture 5.6: the overall contrast for the 5Lp/mm is slightly reduced compared to the values at 2.8.



Distortion is low with 1% but may be visible on critical inspection and suitable subjects. The Summilux is better here.

The graphs for 2.8 and 5.6 indicate an improvement for the 20Lp/m and the 40Lp/mm, but the jumps are quite small. Compare the jumps in performance of the Summilux. The residual aberrations of the Apo-Summicron are already so low at full aperture that stopping down only improves the depth of field. At smaller apertures the internal reflections are reduced





Vignetting amounts to 2 stops wide open, but can already be neglected at 2.8, and is even lower than that of the Apo-Macro-Elamrit at 2.8. The apochromatic correction is effective from aperture 1:2 and can be seen from the non-existent color fringes at high contrast edges. Still the correction is not perfect. At very steep black-white borders (and color-white or color/black borders) a very small color fringe can be detected, but only just and in high magnification. The unsharpness gradient is not as smooth as can be seen with the Summilux 80mm. Some veiling glare can be detected in strong back light and large areas of sky that work as a light box. At distances below 1.5 meter the definition of very fine structures softens a bit at the wider apertures. Stopping down to 5.6 will save the day. Using the Apo-Extender-R 2x, you get a very fine 4/180mm lens, that should be stopped down to smaller apertures at distances below 2.5 meter for best quality.

These remarks should not be interpreted as nitpicking. As a tester you simply stumble across some limits, how far off they may be, and these should be noted. The Apo-Summicron-R 1:2/90mm ASPH is a superb lens in any sense of objectivity, that breaks all previous limitations. With a weight of 520 grams and a small size it may be seen as the ideal standard lens.

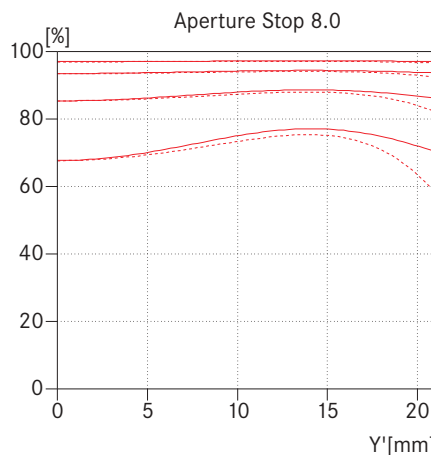
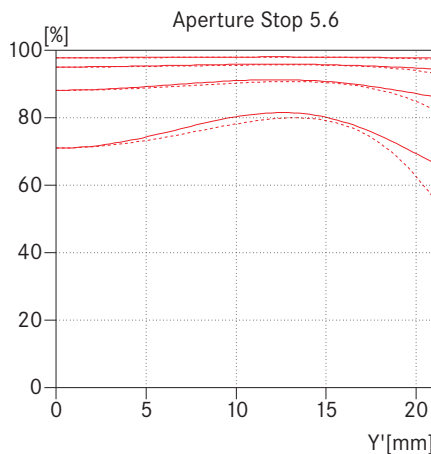
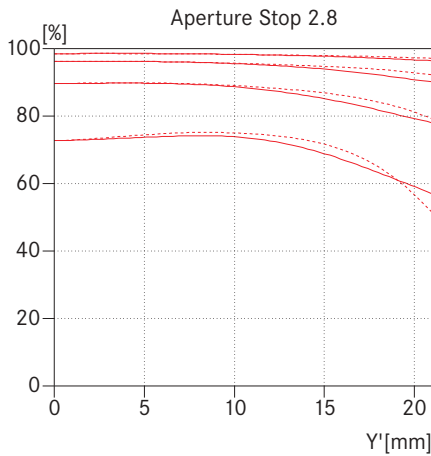


__ LEICA APO-MACRO-ELMARIT-R 100 mm f/2.8

There are persons who always seem to operate at maximum efficiency, show a uniform performance, never get angry and never say never. Such persons you meet only once in a lifetime. You may be jealous of such a person. Some lenses have this character too. The Apo-Macro-Elmarit-R 1:2.8/100mm is such a lens. In direct comparison to the Apo-Summicron-R 1:2/90mm

ASPH, the maximum aperture is slower by a stop, the performance over the entire distance range uniformly high. These parameters define the choice. If the near focusing range (1 meter to 20cm) is not important, the Apo-Summicron-R is the better choice (better ergonomics, less weight and more speed).

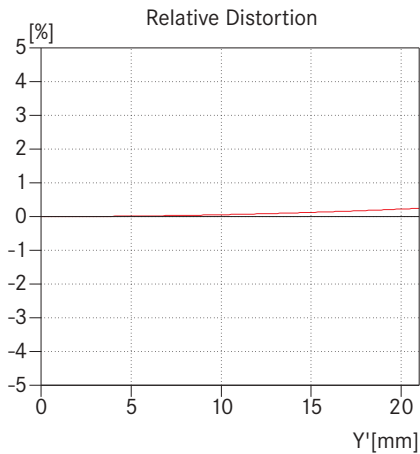




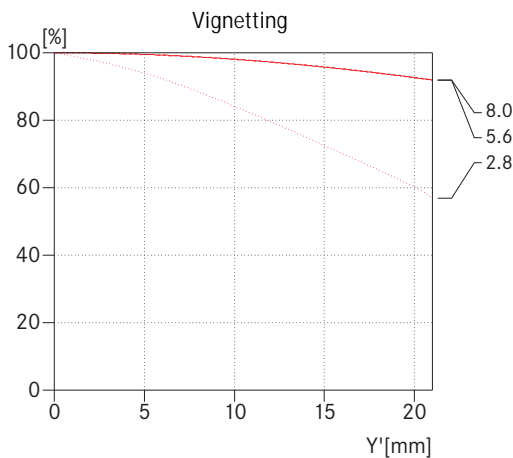
At aperture 2.8 the performance is uniformly high: high contrast and clarity of details are even better than what you expect from medium format systems and this verdict indicates the preferred domain of the 100mm. On tripod and with carefully selected emulsions, the R-System reaches distinctive studio quality. The MTF graphs indicate the performance potential. The 5,10 and 20 Lp/mm are at all apertures equally high. At 5.6 you note the unavoidable effect of diffraction. Only the best lenses can 'suffer' from diffraction at this aperture. The 40 Lp/mm, responsible for the reproduction of the fine details and the crispness of the subject outlines, show an interesting shape of the curve. At apertures of 5.6 and 8 the shape bulges out a bit. This is the result of some focus shift. When you stop down a lens, the rays at the edges are blocked and the plane of best focus shifts a little bit. Often this shift will be compensated with a correction state that plays out third and fifth degree spherical aberration. But then contrast drops a bit too at full aperture.

The Apo-Macro-Elmarit-R has hardly any spherical aberration and already a high contrast at full aperture. Then you will see a slight focus shift more easily. You should also look at the design with the two thick single lenses at the rear. The front group (six elements) moves in relation to the rear group (two elements). This is not the same mechanism as with zoomlenses, but a kind of internal focus mechanism. This is also responsible for a slight reduction of focal length at the 1:1 macro position: the focal length is here 92mm. You will hardly notice it.

The Apo-Macro-Elmarit-R is one of the very few lenses that performs at its best already at full aperture and does not improve on stopping down.



The distortion is close to zero, and the lens can be used with good effect for architecture and reproduction.



Vignetting is low with a drop of 0.7 stops. My comparison pictures indicate that in practical use the difference in light fall off between one and two stops is less important visually than the numbers seem to indicate. The apochromatic correction has been described in the Summicrons section and the same applies here too. Without supplementary equipment the Apo-Macro-Elmarit-R reaches a magnification of 1:2. With the Elpro lens it is possible to get to 1:1. This lens has been calculated specifically for the Apo-Macro-Elmarit-R. Still one will see a slight drop in contrast at the wider apertures and when maximum magnification is required you could stop down to the middle and smaller apertures.

The Apo-Extender-2 creates a focal length of 200mm and an aperture of 5.6. This is fine for emergency situations, but the relatively small aperture will not give much pleasure. You sometimes can read the statement that the Apo-Macro-Elmarit-R is too sharp for portraiture. I do not share this view. The superb image quality already at 2.8 allows for a clear definition of the finest modulation of color hues and brightness differences on film. This aperture has limited depth of field and both effects work together to create images with high realism and good depth impression. Paul Wolff and Renger-Patch would love to use this lens!



__To summarize

These three lenses are on the one hand very similar and on the other hand represent very different worlds, optically and in practical use. The best optical performance we find with the Apo-Summicron-R 1:2/90mm ASPH. If the close focusing ability is not important, this should be the first choice, as the 90mm focal length gives the most natural perspective and forces one to concentrate on the photographic language. The performance at 1:2 boosts the available-light photography with current high speed films. The photographer who needs or wants to make documentary and emotional pictures at very wide apertures and expects excellent quality in all lighting situations and at smaller apertures should look at the Summilux-R 1:1.4/80mm. Versatile usability, outstanding performance at all apertures and distances till 1:1 are the specifics of the Apo-Macro-Elmarit-R 1:2.8/100mm. It has not the best ergonomics, but has excellent built-quality and is capable of amazingly good pictures when using a tripod and medium speed films.