

# Iain Neil on Leica Summilux-C Lenses



Iain Neil is an international, multi-talented optical designer, currently living in Lugano, Switzerland. He was born in Scotland, graduated from Strathclyde University in Glasgow in 1977 with a B.Sc. Honors degree in Applied Physics, awarded Alumnus of the Year in 2003 and made Visiting Professor to the Department of Physics in 2004. Along the way, he won more technical Oscars than anyone else, and has been issued or applied for over 150 worldwide optically-related patents.

His association with Leica goes back over 30 years. He worked for Barr & Stroud Ltd. Scotland (now a division of Thales), as Head of Optical Design. The company had associations with Leitz Wetzlar. He then was employed at Ernst Leitz Canada Ltd. (now Raytheon ELCAN Optical Technologies Ltd.) as Manager, Systems Engineering. Most cinematographers, of course, will remember Iain from his eighteen years at Panavision Inc. as Executive Vice President, Research & Development and Optics, and Chief Technical Officer. At Panavision, his work included the design and development of the Primo series of spherical and anamorphic lenses, video systems, viewfinder optics, HDTV optical systems, compound zoom lenses, and much more.

Iain Neil has known Otto Nemenz for more than 22 years—through his connections at Panavision. When Otto first started in Hollywood he worked in the Panavision lens department, building anamorphic lenses under George Kraemer, who was the optics guru at the time. When Iain started at Panavision, he was sort of taking over from George, who knew Otto very well. After leaving Panavision, Iain moved back to Europe in 2005 and provided optical services from his company ScotOptix. His involvement with the Leica Cine Lens project began in 2007. I spoke with him by phone in Wetzlar recently.

Iain explained, “By 2007, Dr. Kaufmann, Christian Skrein and Otto Nemenz had come to the conclusion that there should be a project to make Prime Cine lenses. They had put the rough specifications together as to what kind of lenses these would be. They had already decided on prime lenses: it was a question of aperture, size, weight, resolution, etc. The general specifications had already been determined. It was market driven, answering the question, ‘What’s the right product for the film and digital market?’ One key aspect was to consider cameras with both film and electronic sensors. It was to design lenses equally good for film or digital. The digital application became more important as time went on.”

When Iain got on board, it was clear the first thing they needed to do was put together a top notch, world class team of experts to develop this kind of product. Leica had never been in the

business of making lenses for cinema cameras. Yes, there had been modifications, but this was a new thing.

When Andreas Kaufmann and Christian Skrein met with him, Iain said, “You’ll need a team of people, not just one person.”

When he heard the specs from Otto and Christian, Iain knew this was going to be extremely demanding—and that they needed a very, very strong team. They assembled a worldwide team, connected by phone, computer, and internet, to design the optics, mechanics and aspects of manufacturing. It was a first class group—they didn’t want to be on the learning curve; they all had to know what they were doing. Iain explained, “When I looked at the speed (T stop had to be fast), the size (had to be small, reduced length and small diameter—compared to what existed at the moment), and feed in the requirements for film and digital, future-proof, good for the next 10-20 years—we had to come up with an optical design that corrects optical aberrations and reduces certain unwanted characteristics. This was not going to be a series of lenses that’s just a mere improvement over what’s been there before. This was a situation that happens every quarter century, where you can make a quantum leap in lens design as opposed to an improvement.

“To do that, we had to start from scratch, asking, ‘How can we meet this target?’ The base set of 8 lenses, from wide angle to long focal length, derive from a single optical design approach and construction. I created a new optical design, which is patent pending, and it covers the whole range of lenses. They all derive from one core optical design which involves using more than one aspherical surface. That’s the key thing.”

Iain was the optical designer. He spent thousands of hours, over a few years, using powerful computers and one of the most advanced lens design programs in the world. He also had to write a lot of additional algorithms and proprietary macro software. After several years, one of the major things they contended with was elimination of color fringing. On film, in the past, minor color fringing was less critical than on current high definition digital, which now has to be well controlled down to the pixel level. Color fringing has to be very carefully controlled: the number of elements in the lens, with different kinds of glass, push things to the limit. These new Leica lenses intended to squeeze in a small space as much glass as possible with virtually no air in between. “This would use up all degrees of freedom,” Iain said.

The next big task was contending with shading, which is the light loss from the center of the lens to its outer edges. If you shoot against a white background or a cloudless blue sky, this shows up as a darkening circle, like vignetting, toward the edges. This can be up to 1 to 3 stops in older lenses. Electronic sensors are more critical in this respect, and the shading cannot be abrupt, suddenly happening at the corner of the picture.

Iain explained, “That was an enormous obstacle, especially for wide angle lenses. We achieved it with very little fall-off across the entire picture. And it had to be controlled for all focus distances. Even with our combination of aspheres, cramming everything into the small space, with our lens design coming together, the level of illumination remained very high.

“The other very big technical aspect, without getting into MTF, is that these lenses were designed to perform extremely well for not only 4K, but also 6K, 8K, and well beyond. Two major

# Iain Neil on Leica, cont'd

things (besides distortion and a few other things) contribute to picture quality when you talk about camera resolution like 2K, 4K and so on. One is contrast and the other is resolution. Most cinematographers do lens tests by looking at a test chart that has black and white bars. You can put up a Baltar, you know, a really old lens from the 1950s, and you can say it's a 4K lens. But there's a difference.

"At whatever the resolution has to be for 4K, when you look at the contrast, how black the black is, how white the white is, for these black and white bars, when you measure it for a Baltar, you might get only 30% contrast. You should get ideally 100%, but the best you might hope for would be around 90% once you design and build the lens. Lenses from 20 years ago, maybe you get 40 or 50%. And this can vary over the picture, from center to edges. The point is, all these lenses are 4K. But then arguments go on over contrast—it's contrasty on axis, but not off...

"First, you've got to resolve your target. For a usable 4K picture, you've got to have high contrast. We are aiming for 6K, 8K with high contrast, and we're looking to set a new standard that will meet film and electronic sensor requirements for the future. This is not a gradual improvement, this is a quantum leap. When you invest in a set of lenses, you want to be sure your investment is future-proof for a good span of time, say at least 10 or more years. We're not in the game of coming out with a new set of lenses and 3 years down the road coming out with something completely different.

"There was one snag. It was a major thing. If you look at the trend in cine lenses in the last 20 years—the barrels got larger. Everyone has lenses that have barrels with a pretty large diameter. The main reason was for focus scale marks and how well spaced apart they were—particularly in the range from 6' to infinity. The scale there normally is a bit compressed, so it's a double whammy. You need a big diameter just to get more marks. So as a result, the lenses became bigger and heavier. If you make them a bit too big, you reach a point where it's even hard to get the lens out of the lens case and you might need three hands to do a lens change. From the user point of view, if it gets too big it almost becomes unmanageable. So if you have these big, heavy lenses in a big, heavy lens case, and you're outside on location, climbing a mountain... there are a lot of practical issues for wanting to make the lenses smaller."

The Leica Summilux-C designers understood this. They had a lens with great optical performance, jammed full of exotic glass, aspherical surfaces, all this great performance, but they now had a lens that was 20% thinner in diameter and 30 to 40% smaller in circumference. The focus scale was once again much smaller and much more difficult to use.

Iain came up with another invention. "I arrived at a unique way of solving, for the customer and the focus puller, a design arrangement using the optics and mechanics, where from 6' to infinity we're using half the available rotation, and from close focus to 6' is the other half of the travel. And that was our new design, which even though the diameter was 20% less, the spacing of the focus marks from 6' to infinity is 60% greater than on most other lenses. To achieve this kind of thing you need very good optics and mechanics, but that's why we put this strong team together. We had much more than a hundred years of combined

experience on this team. The scale is even more expanded than on the largest diameter lenses.

"So that completely changes the direction of cine lens design. In the coming years, everyone will want to do this. And not only did we make the scale expanded, we went one step further. We also made it the same for every lens in the set, between 6' and infinity. The feel is the same from lens to lens in the entire set. The scales are all virtually identical. This is especially handy when you put the lens on a crane with a remote head, so the remote focus scale is the same. This was a unique invention in the package of many new and powerful benefits out of these small, breakthrough lenses.

"We were aware of the 3D trend, but this didn't come up at the beginning. It came up later in the design phase when we realized that 3D was no longer a fad, but that the studios needed something else. Smaller and shorter lenses, with a factor of about two times less weight, and much smaller, are especially suitable for shooting with two cameras on a rig."

In realizing this project, there were three key factors in making the large leap in lens logistics. They needed to know the market. They needed the general specifications: not a luxury car, but a Formula 1 custom racing car. And they had to design new software to do it. Most important, they needed an investor for this long-term project who had to be committed, determined, and believed the goal could be achieved. He had to be willing and able to put money down and stick with it. That was Dr. Andreas Kaufmann.

Iain said, "This is the kind of thing that only happens a few times every century. One of the previous quantum leaps in cine optics was the development of the early cine zoom lenses by Angénieux and Cooke, followed later by the Panavision Primo high end zoom lenses. They were made possible partly by advances in lens coatings and the advent of computers. Remember, before that, lenses weren't coated, so if you had all these lens elements, by the time the light hit the film there wouldn't be any light left at all. The Cooke Triplet was revolutionary in 1893, but it would have taken over 1 million man-hours to design a modern zoom lens back then: that's one man working a million hours, or a million men working one hour. These were positive, breakthrough, disruptive technologies in optics. These were huge events."

The key players were Dr. Andreas Kaufmann, Managing Director of ACM, CW Sonderoptic, Chairman of Leica; Christian Skrein, photographer, filmmaker, collector, longtime friend of Otto Nemenz, President of Otto Nemenz International; and Iain Neil, optical designer.

Iain explained, "Another company might have gotten stuck, or done something not as brand new. Or they would have done what some other companies have done, made conservative lenses that wouldn't be as good or future-proof.

"In addition to all that, to the multiple aspheric surfaces, we've added both a thread in the front for screw-in filters, and at the rear, for net or gel holders. The iris closes all the way down—this is helpful for electronic cinematography. And finally, the proof is in the pudding, as we say. These lenses have exceptional image quality, resolution, contrast, without shading (fall-off). Skin tones have a pleasing, pleasant look. In summary, we tried to balance all of the specifications. The key features balance the market requirements, specifications and technology."