Jon Fauer ASC www.fdtimes.com ZEISS Special Report - June 2018

FILM AND DIGITAL TIMES

ZEISS SUPREME PRIMES

The Supremes

Everyone has heard The Supremes.

"Where Did Our Love Go" (1964), "Baby Love" (1964)
"Stop! In The Name of Love" (1965), "I Hear a Symphony" (1965)
"You Keep Me Hangin' On" (1966), "Reflections" (1967)

Rolling Stone said it best:

"With 12 #1 pop singles, numerous gold recordings, sold-out concerts, and regular television appearances, the Supremes were not only the most commercially successful female group of the '60s but among the top 5 pop/rock/soul acts of that decade.

"Diana Ross, Mary Wilson, and Florence Ballard comprised Motown's flagship group, Berry Gordy Jr.'s pop music crossover group that paved the way from rock radio hits and package bus tours to Las Vegas showrooms and Royal Command Performances.

"Fronted by Diana Ross during their peak years, they epitomized the classic Motown sound and the label's sophisticated style. Beautiful, musically versatile, and unique, the original Supremes were America's sweethearts, setting standards and records that no group has yet equaled.

"Diana Ross, Mary Wilson, and Florence Ballard met while each was living in Detroit's Brewster housing project. They began singing together in their teens. While still in high school, they became the Primettes. In January 1961, Berry Gordy signed the group to Motown and suggested that they change their name. Ballard suggested the Supremes."

Photo of Supremes by Michael Ochs Archives, Getty Images

Supreme

Supreme

Supreme is a trendy skate culture fashion brand. The first Supreme store opened in 1994 on Lafayette Street in New York City. It had a large central area that was easy for skaters to ride in and look at the merchandise arranged around the perimeter. The original staff were local neighborhood kids, skaters and artists.

Supreme now has 11 locations worldwide: 1 in Los Angeles, London and Paris, 2 in New York and 6 in Japan.

They make shoes, clothing, accessories and skateboards. Products often sell out within seconds of being introduced and there is a jaw-dropping secondary speculative market with Supreme T-shirts going for more than $1,300 each.

In 1995, Supreme released a skateboarding promo video called "A Love Supreme." In 2014, they released a first full-length skate video called "cherry."

In 2017, Louis Vuitton announced a collaboration with Supreme.

Supreme copywriters write, "Over 24 years, Supreme has expanded from its New York City origins into a global community working with artists, photographers, designers, musicians, filmmakers and writers who defied conventions and contributed to its unique identity and attitude."

ZEISS Supremes

And now we have new Supremes. ZEISS Supreme Primes.

Full Frame

ZEISS Supreme Primes cover an image area up to 46.3 mm diagonal. They are incredibly small, lightweight and fast. The focus barrel has a unique, advanced square helical thread that is as smooth as cams and even more rugged. There are 13 lenses planned so far.

Lens Mounts

ZEISS Supreme Primes have a user-interchangeable lens mount system. Like the CP.2, CP.3 and CZ.2 lenses, it is quite simple to swap mounts in the field. The mount can be exchanged by the user, rental house, DP or the camera assistant.

Initially, the Supreme Primes will come with PL lens mounts. ARRI's new LPL mount and Canon EF mount will also be supported.

Lens Metadata

The lens mounts will communicate Cooke /i, and ZEISS Xtended Data to the camera. A new concept is that the EF mount can communicate with the camera. It essentially translates the /i data into EF data. So you will be able to see aperture and focus settings in an EF-equipped camera's viewfinder.

Delivery and Price

Delivery of the Supreme Primes begins in June with the initial core set of 5 focal lengths: from 25, 29, 35, 50, 85—all T1.5. The 100 mm will arrive in December 2018. The 65 mm should deliver in spring of 2019, followed by the 21 mm in summer, and the 135 and 150 mm later that year. The 15, 18 and 200 mm will be released in 2020.

Approximate price will be 90,000€ (US $112,500) for the initial set of 6 lenses (25, 29, 35, 50, 85 and 100 mm). That works out to about 15,000€ (US $18,750) per lens.

ZEISS Supreme Primes

Lens	Release	Aperture	Close focus	Length	Front Diameter	Weight	AoV FF	AoV S35
15 mm	2020	T1.8 to T22	0.35 m / 14"		114 mm / 4.5"		100°	79.4°
18 mm	2020	T1.5 to T22	0.35 m / 14"		114 mm / 4.5"		90°	69.3°
21 mm	Q2 / 2019	T1.5 to T22	0.35 m / 14"	119 mm / 4.7"	95 mm / 3.7"		79.5°	59.8°
25 mm	May 2018	T1.5 to T22	0.26 m / 10"	119 mm / 4.7"	95 mm / 3.7"	1.42 kg / 3.13 lb	70.8°	52.3°
29 mm	May 2018	T1.5 to T22	0.33 m / 13"	121 mm / 4.8"	95 mm / 3.7"	1.61 kg / 3.55 lb	64°	46.8°
35 mm	May 2018	T1.5 to T22	0.32 m / 13"	119 mm / 4.7"	95 mm / 3.7"	1.40 kg / 3.09 lb	55°	39.6°
50 mm	May 2018	T1.5 to T22	0.45 m / 18"	119 mm / 4.7"	95 mm / 3.7"	1.22 kg / 2.69 lb	39°	27.5°
65 mm	Q2 / 2019	T1.5 to T22	0.6 m / 2'	121 mm / 4.8"	95 mm / 3.7"	1.63 kg / 3.59 lb	30.5°	21.3°
85 mm	May 2018	T1.5 to T22	0.84 m / 2'9"	119 mm / 4.7"	95 mm / 3.7"	1.42 kg / 3.13 lb	24°	16.7°
100 mm	Dec 2018	T1.5 to T22	1.1 m / 3'9"	119 mm / 4.7"	95 mm / 3.7"		20,4°	14,2°
135 mm	Aug 2019	T1.5 to T22	1.35 m / 4'5"	160 mm / 6.3"	114 mm / 4.5"		15.6°	10.9°
150 mm	Q4 / 2019	T1.8 to T22	1.5 m / 4'11"	160 mm / 6.3"	114 mm / 4.5"		13.7°	9.5°
200 mm	2020	T2.1 to T22	2 m / 6'7"		114 mm / 4.5"		10.3°	7.1°

Image diagonal: 46.3 mm Focus Barrel Rotation: 300° AoV = Angle of View Initial Set shown in Gray Rows

ZEISS Supremes

Core Set of Supreme Primes (Full Frame) Ready in May 2018

Lens	Ready	Aperture	Close focus	Length	Front ∅	Weight	AoV FF	AoV S35
25 mm	May 2018	T1.5 - T22	0.26 m / 10''	119 mm / 4.7''	95 mm / 3.7''	1.42 kg / 3.13 lb	70.8°	52.3°
29 mm	May 2018	T1.5 - T22	0.33 m / 13''	121 mm / 4.8''	95 mm / 3.7''	1.61 kg / 3.55 lb	64°	46.8°
35 mm	May 2018	T1.5 - T22	0.32 m / 13''	119 mm / 4.7''	95 mm / 3.7''	1.40 kg / 3.09 lb	55°	39.6°
50 mm	May 2018	T1.5 - T22	0.45 m / 18''	119 mm / 4.7''	95 mm / 3.7''	1.22 kg / 2.69 lb	39°	27.5°
85 mm	May 2018	T1.5 - T22	0.84 m / 2'9''	119 mm / 4.7''	95 mm / 3.7''	1.42 kg / 3.13 lb	24°	16.7°

ZEISS Full Frame Supreme Primes

Akira Sako, JSC on ZEISS Supreme Primes

Location stills and text by Arato Ogura

In early April 2018, Akira Sako, JSC and crew tested Supreme Primes in the mountain area of Shimane prefecture, western Japan. Their short film was about the people, art and craft behind *Iwami Kagura*, a regional traditional art performed at shrines to give thanks and pray for good health and a bountiful harvest. The Kagura performances are popular as entertainment, with sound and smoke effects helping audiences, even little children, to better understand the story.

FDT: Tell us about the film.

Akira SAKO JSC : In early March, I was approached by ZEISS, asking me to shoot a short film using their new cinema lenses. They did not tell me the details then, but just mentioned the lenses were large format, high speed and high resolution. ZEISS said they were contacting several DPs around the world to make a diverse collection of films, and I felt honored to be chosen as a representative of Japan.

Why did you choose this traditional subject?

When I accepted the offer to shoot a short film, I learned that the film would be screened at Cine Gear and also on the web to be seen worldwide. So I decided to pick something cultural and historic in Japan, and came up with an idea to highlight the arts and crafts around *Iwami Kagura*—which is actually the origin of the famous Kabuki performances. I aimed to show cinematically how the handcrafted masks and costumes are made, and also illustrate how the performances are passed down to younger generations.

Tell us about the equipment setup.

For lenses, I had 2 sets of production model ZEISS Supreme Primes, each set consisting of 25, 29, 35, 50 and 85 mm focal lengths. These SP primes are amazingly well balanced lenses in terms of size and optical performance, and I loved the fact they can go very close to the subject without using diopters —especially the 25mm and 29mm. Using fast, wide angle lenses close-up with large format cameras was a fresh experience, and I totally enjoyed it.

Our Camera Assistants liked the Supreme Primes because they are smaller than other full frame primes. Also, the eXtended lens data readout made the focus pullers' lives a bit easier.

I have used ARRI cameras all though my career, but for this project I tried 2 brand new Sony VENICE cameras. In April, all the VENICE cameras in Japan were locked to 24p and EI 500 because of the firmware, but luckily Sony helped by installing beta firmware so I could try shooting at EI 2500 and EI 10,000. I also wished to shoot at higher frame rates, but it was explained that there was no chance to use 60p or higher before their next major firmware updates.

For lighting, I got the help from my long-time buddy Hiro Kase from Fuji Media Technology. His team created beautiful atmospheric lighting at each location, such as the one seen in the mask craftsman's atelier. As I did not want to make the film a documentary, I asked him to experiment with dramatic lighting to emphasize the image. He used several ARRISUN 1.8Kw heads as window keys, and also Kino Celebs and ARRI Skypanels for fill and also to create dramatic lighting inside the shrine.

How was it like to shoot a brand new Full Format camera with a new generation of Full Format lenses?

From the film days, I always wanted to shoot on a larger format, such as 65mm. I love that special feeling of depth captured on large format. For this reason, Full Format cameras and lenses get me one step closer to my ideal image.

When shooting film or digital on Super35 format, I often go for Anamorphic lenses so I can achieve a very wide angle of view. But, in order to capture fine details of a wide landscape and deliver that feeling to audiences, I stop down to T8, T11 or even smaller to get everything sharp. However using such small T-stops was difficult on film, especially in low light, and also quite a challenge even on modern digital sensors.

But with SONY VENICE, I was quite comfortable to work at EI 2500 at dusk and dawn, and this was a great revelation in terms of T-stop choices. I also must mention that we used the VENICE's built-in ND filters a lot. It's a very convenient and dust-free way of changing filters, and I think every serious camera should have these built-in like the VENICE.

To me, large format and fast lenses are not about shallow depth of field—in fact the opposite—its about having the freedom of using higher T-stops, emphasizing small details in the frame and creating the real "depth" in the picture. Of course, there is no question about the benefit of having T1.5, but it is the freedom to use any T-stop between T1.5 and T22 that really appeals to me. I remember in the old days when I stopped down to T16 or smaller, the image quality quickly dropped, and as a cinematographer I needed to know the character of each lens as to its usable T-stop ranges.

But the ZEISS Supreme Primes are very sharp, as we all expect from ZEISS. Having that resolving power in a compact 95mm diameter barrel and still cover FF+ is simply amazing. Together with VENICE's high ISO and built-in ND filters, I enjoyed thinking about when and what T-stop of Supreme Primes I should use to tell the story in the most effective way, and not worry about the image quality at all.

"Tsunageru" (meaning succession and inheritance) is a short film directed and photographed by Akira Sako, JSC.

Equipment: Sony Business Solutions, NAC Rental, Video Service.

Camera: SONY VENICE.

Lenses: ZEISS Supreme Prime (SP) 25mm, 29mm, 35mm, 50mm, 85mm.

Lighting: ARRISUN, ARRI Skypanel, Kinflo Celeb, Kobold DW, ETC Source Four.

Paul Cameron, ASC on ZEISS Supreme Primes

Paul Cameron, ASC on ZEISS Supreme Primes

I spoke with Paul Cameron after he completed his short film using Supreme Primes. The conversation lasted more than an hour and it is all fascinating. However, it would take up another 40 pages of this edition, and since most readers will be carrying this edition around Cine Gear, I will spare aching backs and publish it in a future edition.

JON FAUER: You were one of the lucky ones to be first to try the new Supreme Primes.

PAUL CAMERON: I just recently shot a promo and a short film for ZEISS with the Supremes. With the five existing core set lenses that they have. And I shot it on a Sony VENICE supplied by Keslow Camera. We captured 6K, Full Frame, 2.39:1.

Laura Stabilini, my wife, directed the short. It's about a day in the life of a young mother who is in the process of bringing her son back to the boy's estranged father. And it intercuts with the dad and follows the day in the life of both**.**

JON FAUER: Please describe the sensibility about spherical Large Format that you like.

PAUL CAMERON: It feels more like photography to me. The depth of field feels more natural. I think we've just seen the opposite over the last decade: wide open, overly sharp and overly shallow depth of field movies. We kind of lost some of our craft in terms of the psychology of depth of field and managing it consciously. The whole reality of Large Format shooting is con-trolling depth of field.

So you're managing the out of focus characteristics of a close up and then matching that to a wider medium shot?

Exactly. I narrowing the depth of field on a a couple lines of a scene. I like super shallow to really isolate a character on a couple of cuts. Suddenly, two stops more open which is what I used to do on anamorphic all the time. It's kind of an old school approach. But I think cinematographers should think about depth of field instead of just l put it on 1250 and shoot it wide open, here we go.

What were your impressions of the lenses?

We had no rehearsals and two 10-hour days. We had a 12-year-old kid in every shot. It was a kind of guerilla style. But, my focus puller, Thomas Barrios, once he got the rhythm of these lenses, was very happy with them. The focus scales are done well. Your 2-foot to 10-foot cary pull of an actor is intuitive.

There's minimal breathing. By nature of them being Large For-mat lenses, they just seem more natural. You just feel the shift in focus. he engineering is quite incredible. They're beautiful lenses. There was no drop off in density. Just a clean, beautiful lens. I'm always looking for a lens that renders a face very well. They have a very authentic personality. It just feels very authentic to me. They're a very elegant, creamy, beautiful set of lenses. I think I'm going to buy a set.

Production stills by Danna Kinsky.

Christian Bannert - Vice President Development & Manufacturing

Christian Bannert is Vice President, Development & Manufacturing, Consumer Products at ZEISS. Photographed with Supreme Prime 85mm at T1.5.

JON FAUER: ZEISS introduced Full Frame Compact Primes at a time when the format barely existed in cinema.

CHRISTIAN BANNERT: We had a feeling that Full Frame would enter the cinema market. Of course, since we do not make cameras, so it was kind of a bet. Our Compact Primes addressed that--Full Frame still cameras capable of shooting video, but not dedicated cine cameras. Everybody was talking about a shift from Super 35 to Full Frame at the high end. Everybody was guessing. It was like the chicken and egg dilemma. Who's first? But we were sure what happens in the photo industry will also apply to the cinema industry. It took a bit longer than we expected. However, now in 2018, it looks like we finally arrived. So we're more than happy to introduce the Full Format Supreme Primes.

And then we decided to just do it because you can use a Full Format lens for a Super35 anyway. It's an investment that you can use also for many years to come.

Why were you convinced it would happen?

Several reasons. One is from the artistic approach. Shallow depth of field gives you more opportunities. You have more opportunities with Full Frame.

The other reason is that the cine camera manufacturers might see an opportunity in lowering the Full Format sensor costs.

What is the differentiator in the future? I'm not really sure whether it's still the pixel race or the dynamic range of the sensors. They're becoming more similar. It's a guess, but if you look at smartphones, we started with 2 Megapixels and went up to 13 MP and more. Now the technology is changing. You see two or even three cameras in a smartphone. You can see the clever combination of black and white, a tele lens and a wide lens. If you make a clever combinations, it looks like you have a zoom lens. You have a higher resolution because you add some information from the black and white into the color picture. With good software, you can achieve great images. You could not achieve this by just adding more pixels to a single sensor.

How does this relate to cine?

Let's wait and see. I think we need to have a deeper look. Resolution is one thing. 2K is history and now we have 4K. Maybe 8K. And dynamic has always been a very important issue, even more than pure resolution. To be creative with Full Format, I think it is more than just resolution. It's about the artistic feeling and the color and the tones. Therefore, I could imagine that the pure hardware sensor is not so important in the future as is it might have been at the beginning in the digital area.

Does ZEISS have a philosophy on how lenses should be designed and look? Is there an overall theme?

Yes, there is. We try to provide an almost natural window on reality, with fewer effects and artifacts. It starts with distortion and color. Our over-arching philosophy is to provide a lens that frees the artist, the cinematographer, to add effects and looks rather than "baking" those artifacts into the design.

We listened to customers who said that some of our lenses have been clinical or too sharp. Actually, our new Supreme Primes are as sharp, if not sharper than, previous lenses. However, even though they are sharp, they also have beautiful skin tones and a gentle focus fall-off. This is the result of the decades we have been making cinema lenses, balancing high resolution and forgiving depth of field and smooth skin tones. We don't want to force a look upon

the user. We're trying to give cinematographers the greatest creative freedom with light and depth, using filters, atmosphere, composition and all the artistic tools available for beautiful images.

How did you start at ZEISS?

I started as a mechanical designer. Then I was project leader and mechanical designer for the Ultra Primes. At that time, the Super Speeds and Standards had the focus ring at the back. The iris ring was at the front of the lens, but the actual iris leaves were at the back. I don't know why it was so. It might have been a legacy of when the cameras had blimps and you had rabbit ears on the focus ring. But everybody was complaining. We changed this for the first time, as far as I remember, with the Ultra Primes.

The Ultra Primes were a break-through for us. It was a way to compete with Panavision. Today we have 16 Ultra Primes, from the 8mm T2.8 Rectilinear to 180 T1.9.

After the success of Ultra Primes, we were convinced, together with ARRI, that a new set of high speed lenses would be appreciated by users. That's why we decided to make the Master Primes.

Most ZEISS Cine lenses were done with ARRI. Why did you go out on your own with the Supremes?

ARRI and ZEISS both stand for high quality and reliability. Both companies have been working very well and successfully together for over 80 years.

As part of a joint effort with ZEISS in terms of design and development, ARRI launched the Master Anamorphic, Master Prime and Ultra Prime lens families. We received an excellent response from our customers. We are delighted about this success. ARRI will continue to offer these products and the service that goes with them.

The partnership is not exclusive: ARRI and ZEISS have both pursued their own projects concurrently. ARRI teamed up with other partners to develop the Alura Zooms and the ARRI Signature Primes. ZEISS launched the Compact Primes, Cinema Zooms and the Lightweight Zoom on its own. The ZEISS Supreme Primes are another lens range that ZEISS is pursuing independently.

ZEISS and ARRI will, of course, continue to pursue joint projects together.

As a result, now ARRI have their Signature Primes. And we are introducing our Supreme Primes. But let me repeat: we will still work together with ARRI. Maybe in the future we'll do another new project together again. It really depends on the market.

Choice is an excellent thing. What about Supreme Zooms to go along with your Supreme Primes?

We already have our Full Frame Cinema Zooms. We think they are an excellent match.

These are the lenses formerly known as Compact Zooms: 15-30mm, 28-80mm and 70-200mm? They were ahead of their time—Full Frame, all T2.9.

I think the Cinema Zooms are becoming more popular now that users are asking for Full Frame zooms and discover what they are.

ZEISS Full Format Cinema Zooms CZ.2

ZEISS CZ.2 (Full Frame)

Lens	Aperture	MOD [1]	Length [2]	Front Ø	Wgt
15-30mm	T 2.9 to T 22	0.55m 1'10"	252mm 9.92"	114mm 4.5"	2.6kg 5.7lb
28-80mm	T 2.9 to T 22	0.83 m 2'8"	196mm 7.72"	95mm 3.7"	2.5kg 5.5lb
70-200mm	T 2.9 to T 22	1.52 m 5'	250mm 9.84"	95mm 3.7"	2.8kg 6.2lb

[1] Close focus distance (MOD) is measured from the image plane
[2] Front to PL mount flange

CZ.2 Equivalent Field of View for FF vs S35

CZ.2 lenses used in Full Frame (36x24 mm)	Equivalent focal lengths for same field of view in Super35 (24x18 mm)
CZ.2 15 mm – 30 mm	9.8 mm – 19.6 mm
CZ.2 28 mm – 80 mm	18.3 mm – 52.3 mm
CZ.2 70 mm – 200 mm	45.7 mm – 130.7 mm

Calculated using the crop factor between both sensors. For example, with Sony VENICE, there is a 1.5x crop factor between its Large Format (36.1 mm wide) sensor and a Super35 Sony F55 (24 mm wide) sensor.

Christophe Casenave - Product Manager

Christophe Casenave is the ZEISS Product Manager for Cinema Lenses. He is responsible for planning new products and marketing existing lenses. His job involves talking with cinematographers, rental houses, customers, and users. He constantly analyzes what's missing in the market, what cinematographers aspire to have and what new technologies would be useful. Photographed with 85mm Supreme Prime.

JON FAUER: You were in charge of planning the ZEISS Supreme lenses. When was the first spark of that idea?

CHRISTOPHE CASENAVE: It began with a lot of discussions we had with different people. You for example. But also with many other cinematographers, assistants, rental houses and dealers. That was three years ago. Full Frame was still not really here. The only Full Frame cinema camera was the RED 8K VV, introduced in April 2015. They were not delivering very many, but this camera did something that everyone started to think about. (ARRI Alexa 65 had been introduced in September 2014, but it was rental-only, and at 54.12 x 25.59 mm, was larger than Full Frame 36 x 24 mm.)

But ZEISS Compact Primes had been around since April 2009.

We made these Full Frame lenses for completely different users: cross-over DSLR-video shooters, owner-operators, for corporate or lower budget films. Then we looked into what to do next at the high end. At the time, we made a bet on Full Frame. Based on the feedback I received, it came very clear what was missing. I would not call it an Ultra Prime or Master Prime Full Frame lens, but rather a lens series with high quality, affordability, and reliability—all combined in the Full Frame format.

How would you describe the "look" of the Supremes?

Gentle sharpness. We insisted on a look that is versatile and flexible. It's not a vintage lens. It's not a specialized look. We do not dictate a look to the cinematographers. We make a lens to the best of our abilities so that all possibilities are open. It allows you to have sharpness where you need it, but has also has very smooth skin tones and textures.

Take us along a timeline of the design process: optical, mechanical, production.

The most important thing is the optical design. It is an area where I, as product manager, get very involved. Optical designers are normally people who like physics and perfection. Without resistance, they will design a perfect lens, but maybe it will not provide the kind of images that cinematographers like to have.

It's a very interesting part of the project because you know

approximately what you want to achieve and, in your head, you see images. Cinematographers are able talk about a look, an image, a feeling. But you need to translate these artistic concepts into numbers and mathematical formulas. You need to take what the DP wants and explain it by quantifying the amount of contrast, micro contrast and distortion as numerical values.

Who is the translator from DP-speak to lens designer language?

Basically that's me, with the help of some of our engineers who have years of experience shooting with all kinds of lenses. I try to find out what DPs like by discussing different topics with them. Based on experience, I try to translate those concepts into numbers that will result in the kind of images that we agree upon. Then the optical designer will use these numbers to develop an assembly of different lens elements, and the lens is conceived.

Are you a physicist?

I studied physics and I'm an engineer. Even if I am not a developer, I understand, a bit, the things that optical designers do. I can read the formulas and I can imagine how, if we have a certain value, we might get a certain kind of image.

This is fascinating. How do you translate a DP's verbal and artistic terms into a lens design? For example, what does it mean when a DP says, "Oh, I like a vintage look?"

I have a theory about vintage lenses. It's relevant for all the manufacturers because the techniques have been improved so much in the past few years that almost anybody could make a perfect lens. The difference is that in the past no one was deliberately designing vintage lenses. They did the best they could at that time, building what we nowadays call vintage. Now, we not only have to do the best we can, but we also have to consider the artistic ingredients.

In the film days, lens makers were always trying to go better and sharper because the film was bouncing around in the gate, in the contact printer and again in projection.

Today, we take care to provide looks that are beautiful. Getting back to the question of how we translate a cinematographer's aspirations into lens design—it depends on a number of things. Is it chromatic aberration? Is it just sharpness or low sharpness or where do you get sharpness in this lens? Or is it distortion? Some might say an old ZEISS Super Speed has a vintage look but others might find them too sharp. Personally I don't think they are so vintage. The old Kowas, I would say, are really vintage. They have quite a lot of chromatic and spherical aberration. They are soft. Same with the Canon K-35.

The ZEISS Super Speeds have a nice characteristic of looking a little soft when you open them to full aperture. But when you close them down a bit, they will be very sharp. If you defined the mathematics of this, you would see that the MTF at T1.3 would be a bit lower. So you get less contrast, but as soon as you close down, you notice how the MTF shoots up to almost 100 percent.

Master Primes are completely different. They are very sharp, even at T1.3. Some people love them, but some say they are too sharp or the transition from in-focus to out-of-focus is abrupt. So, with Supreme Primes, we try to keep the sharpness, but make a nicer transition.

We wanted to give the DP more flexibility. To soften the image, you can use filters, nets or diffusion. But when you need to have it sharp, then you can have it sharp. We worked hard on the Supreme Primes to achieve the sharpness of the Master Primes, but on the other hand, to have a more smooth fall-off. We made the transitions between the areas in-focus and out-of-focus, between the sharp and the un-sharp parts, much smoother.

How do you achieve that?

The optical designers worked on having a wider zone of sharpness. It's not a sudden change from sharp to soft.

But the depth of field of a Master Prime is visually (maybe not mathematically in the DoF tables) much shallower than, let's say, an Ultra Prime at the same T-stop.

Yes. But the Depth of Field of a Master Prime is not only shallower, it's also how fast it goes out of focus. All the people who tried the Supreme Primes said that the fall-off was much smoother, much gentler. This is good when you consider that DPs confront actors' and actresses' faces 80 percent of the time, so [laugh] clearly this helps a lot—because eyelashes are sharp, but the face is silky smooth.

Supreme Primes are also a bit more forgiving for the camera assistants. This is a big issue now with the larger format. Full Format depth of field is normally shallower than S35 for the same angle of view at the same distance and aperture. For camera assistants, the job gets harder and harder. Having a smoother fall-off helps a lot.

The second area where we paid a lot of attention was chromatic aberration. If you look at some old lenses, they have huge chromatic aberration, with red edges that are not pretty. The Supreme Primes are well corrected. Some people may like red edges in the picture, but then the image can appear harsh. I find it more disturbing. Eliminating chromatic aberration was something very important for us.

In summary, the Supreme Primes look how?

The Supreme Primes are not vintage. They are sharp. But forgiving. The transition from sharp to un-sharp is smooth. They have very pleasing skin tones. They are lenses with artistic competence.

Is this a first time for ZEISS?

Some optical designers would have made the lens even sharper and more of a demonstration of physics prowess, but we all worked very hard to move in the direction of making an artistically beautiful lens set.

Earlier, we were talking about the timeline. Please continue the journey.

We had the optical design. We integrated XD (eXtended Data) metadata technology. Then we worked on the mechanical designs with an emphasis on the ergonomics. It was very important to have the same smooth focusing as we have on the Master Primes. This is what we are known for and we didn't want to make any sacrifices.

We are also known for a high level of reliability. On top of that, we wanted to have the Supremes smaller than Master Primes. This required a completely new technology for the inner mechanics. If we had used the same technology as the Master Primes, then everything would have been much bigger. We've seen that camera systems are getting smaller and people want to use those smaller cameras. Cameras are no longer restricted to a dolly, tripod or crane. Camera operators are working with Steadicam, stabilizers, rigs, gimbals, handheld, sometimes passing the camera from one person to another. And we wanted to support this with light weight and small size.

So, our optical designers had to refrain from using too many optical elements. Our mechanical designers had to find a completely new ways of supporting these elements inside the lens. It took a significant amount of time. A good thing was that our colleague, Helmut Lenhof, had been working on this technology for more than five years, even before the Supreme Primes. We already had a big part of the puzzle ready to make the lenses lighter and smaller.

Is it the same helical thread technology that Helmut showed me last year on the CP.3?

The basic technological principle is similar. What you saw last year was a much more basic version made for the CP.3. For the Supreme Primes, the precision is much higher and the tolerances much tighter. I like to say that the most expensive things are often not visible. We had to step up the precision of all the parts inside the lens in order to achieve the constraints of the larger and more demanding optics. The mechanics and optics work together.

Then we started building pre-prototypes and last year, prototypes. At ZEISS, we are passionate about the consistency of quality. The process from concept to product takes a very long time because making five prototypes by hand is one thing, but then our engineers put those prototypes through a huge battery of tests. We want to ensure that each lens comes out of production at the same quality level. We don't accept any variation.

Do you shoot tests with these prototypes?

Yes. Of course. Optically, the prototypes are usually fine. But, there's a big difference between producing five prototypes where the engineer assembles all the components and takes one week to adjust everything compared to getting the same quality with mass production.

After the prototypes, what happens next?

We do a pre-production run of about 50 lenses. The idea is to have the lenses built on a production line where the technicians can also learn how to assemble them. That way, we can see if everything is working well. That's where we find out if certain things might be too complex to produce or if there is any risk of variation within the production. We don't accept any variation between one cinema lens and the next one. This is the stage at which we can correct things. Finally, if everything is going well, we start with production.

Where do you grind and polish the lens elements?

We work a lot with our sister company, Carl Zeiss Jena, about 360 km northeast of here. They can produce and polish virtually any type of lens element, including aspheric elements. They are even able to supply some of the sub-assemblies.

How did you come up with the name "Supreme?"

It was a very long discussion with my colleague Isabel Winter. We wanted a name that was easy to remember and also that reflects what the cinematographer should be. It's not the lens that's supreme. It's the DP.

You wanted to keep it in the ZEISS family of greatness like Super, Ultra, Master and now Supreme?

Not really. It was based more on a gut feeling. We wanted to find a name that describes the DP and not the product itself. Let's say that we wanted to express the respect that we, poor scientific people, have for artists. For us, they are Supreme! By September 2017, we finally had the name.

Talk about how you see eXtended data being used with the new Supremes.

I think the Supreme Primes will be the sweet spot for eXtended data. They integrate well with visual effects and CGI. You can also trim the look (distortion, shading) electronically. Until now, when you knew that your film had a lot of CGI integration, you needed to shoot distortion mapping grids for post-production. Now you don't need to shoot grids anymore. Post-production gets all the metadata and pre-calculated distortion mapping information. The VFX artists can use these distortion maps to correct or calculate for compositing, match-moving and so on. Post-production becomes much easier.

At the moment, Supreme Primes with eXtended data can remove distortion (or add more) and adjust shading. What else?

We plan to be able to electronically remove the very small amount of breathing that some of the lenses have.

What an exciting journey. And here you are, three years later, launching the Supreme Primes.

Before starting this project, I did a long study about what people wanted to see from ZEISS. It was quite interesting because what they think about our lenses most is reliability. Camera crews rely on ZEISS knowing they will not be stuck somewhere in the desert with a lens that is broken or whose focus scale is off in very hot or cold weather. We build on the trust that our equipment is really solid and reliable. We are engineers. The artists are the cinematographers, but they don't need an artistic product that doesn't work. That is what we want to provide: lenses you can trust.

So here we are now, in production on the Supreme Primes – and actually a bit ahead of schedule.

Josef Stöhr - Project Manager

Josef Stöhr is the Project Manager of the Supreme Primes. Photgraphed with 85mm Supreme Prime.

JON FAUER: What is the difference between a product manager and a Project Manager?

JOSEF STÖHR: Christophe Casenave once described it well: the Product Manager says what needs to be done and the Project Manager figures out how can we do it.

At what point did you decide they were going to be T1.5?

In the concept phase, at the very beginning.

What would have happened if you said, "Come on guys, that's going to be way too difficult or we can't make it that small?"

That's why we have the concept phase. The good thing here is we have many years of experience working together. We can agree on these parameters quickly. When the concept comes close to being finalized, I start drawing up a timeline and planning schedule.

You deal with the suppliers and delivery schedules as well?

Yes. I am in very close contact with the suppliers and all team members. We all meet at the beginning of each workday to discuss our progress and to define the next steps. Then I update our schedule and notes in an Excel file for everyone on the team.

By the way, I am working with additional teams on parallel projects at the same time, for example, Milvus and Otus still lenses, and CP.3.

How many designers worked on the Supremes?

Around five optical and five mechanical designers.

François Truffaut said that shooting a movie was like a stagecoach ride in the Wild West. At first you hope for a nice ride. Then you just hope to reach your destination." Is it like that when designing a lens, where at some point you get worried that it's going to take longer than you thought or may be more difficult?

Sometimes it is that way. That's why it's very important to plan very carefully at the beginning.

Did the Supremes go according to plan?

Yes. I guess we have the experience and doing lots of simulation beforehand helps. We calculate the tolerances of the lens elements in advance and exclude concepts that cannot be built later on. Furthermore, from the beginning, we include the manufacturing, electronic, testing and service teams.

Servicing the lens easily and quickly is also important. Rental houses do not want any downtime. If a front element is broken on location, they'd like to replace it immediately.

One thing actually was not planned at the beginning. The feedback from customers was so positive that we had to recalculate for increased sales. This necessitated investing in another high-precision machine to increase capacity for milling the focus barrels.

With this additional production capacity, we hope to have a

delivery time of four weeks between the time a customer orders a lens and it is delivered.

Seriously? That quickly?

Yes. Even if the orders are doubled, it should work. This means that once we ordered the new machine, we had to inform all the suppliers to double their quantities.

How do you get the suppliers to double their output?

We discuss and negotiate. Remember, however, most of our suppliers are based nearby in our local region, which I would call Precision Valley—just as you have your Silicon Valley.

Whose initial idea was it to develop Supremes?

It was Christophe's idea, but also the DPs and rental houses he talked with. That idea was nurtured by an entire team, more than 50 people, which includes assembly. It has been a wonderful team and an exciting project. I think, for the Supreme Primes, we built up a very good team.

We brought the idea to Winfried Scherle. He believed in following instinct, guided by gut feelings. He had similar faith in Full Frame. When the concept was presented, he said, "Why should we not do it?"

Was it risky embarking on this project?

That's also a task of a Project Manager—to keep the costs under control. When we started, I had to calculate the development costs and then work on the business plan. We even established the prices in the concept phase.

At this point, Christophe Casenave interrupted: Josef is very humble. You are talking to "Mr. I Deliver on Date at Cost Promised." Three years ago, he projected delivery in August 2018. Here he is, delivering three months early and at the costs he determined.

Josef, your job sounds like the Production Manager on a film—the person they pay to worry.

I guess I learned doing precision engineering at Mercedes and Nokia. When a product is launched worldwide, you have to deliver it on time. You cannot say that you'll deliver it two weeks later.

One of your designers once said that introducing new lenses is almost like attending a movie premiere. On the date it's released, you are probably hoping it will be accepted by cinematographers and will be a success. Are you nervous?

Of course. A Project Manager is always nervous.

But now that we are close to releasing this first set of five lenses, everything is working pretty much as we planned. So, I'm not so nervous anymore.

The large portraits (gentle sharpness — sharp eyes and smooth skin tones) in this article were photographed with Supreme Prime lenses on a Sony α9 Full Frame camera using a Vocas PL to E-mount Adapter.

Sandro Förster, Director of R&D

Sandro Förster is ZEISS Senior Director of Product Development, responsible for the R&D department, pre-development and main development of camera and cine lenses.

JON FAUER: Take us through the process of developing the Supreme Primes from the beginning.

SANDRO FÖRSTER: We have several phases and several milestones. One of our biggest tasks is to write down the requirement specifications and then run in one direction. We want to be very sure what the goal is, what kind of lens the customers want. The Product Manager is responsible for deeply understanding the customer's needs and we are responsible to transfer these ideas into a realistic specifications that are also manufacturable at reasonable costs, as light as possible, with the desired optical qualities.

We decide on the real essence of what is necessary for the lens and write the requirement specifications in a book. [Sandro holds up a book with more than 50 pages.] We tried to make it shorter.

Is it written in scientific terms or in broad generalities?

It is a kind of science to transfer DPs' thoughts about a nice and beautiful look into technical values as to geometrical aberrations and so on.

Interesting. So, you're almost like a translation service?

This is very difficult because you can't measure beautiful images. You see it in the results. But the work is done before. We start with pre-development where we try to reduce risk in the main phase. We start with the optical designers. Then we find out what is really possible in terms of size, resolution, aperture and front diameter.

The optical design is very hard work because there are so many parameters you can change: what kind of glass, how many, radius, distance between the elements? In the end it's a very high dimensional mathematical problem you have to solve. We have experts to do this. They have a lot of experience and also special programs. There are some commercial programs, like Code 5 or ZMax. Here at Zeiss, we have the advantage, because we are a big company with 27,000 employees, of having the chance to develop our own optical program. It's called "Oase," which means Oasis.

Optical design is searching for the solution to a problem where you don't even know if the solution exists.

Sometimes it is a mathematical problem with more than 200 dimensions.

The next step is simulation. We have special programs to simulate stray light, ghosting and flares. For instance, what happens if you have a strong headlights from a car in front of you? It illuminates the lens at night. What kinds of reflections and flares do you see? And then you decide which coating is meaningful for each surface. You also have to consider mechanical parts, because you can also get ghosting from mechanical parts. These days, HDR is very important, so reducing stray light is essential. We have an expert in ghosting and stray light simulation.

Really? You have a flare expert? Dr. Flare and Dr. Bokeh?

Some call him Dr. Ghost. You'll talk with him tomorrow.

When we finish the simulation phase, we start mechanical design. But to be honest, mechanical design starts earlier, because it's an interaction between the optical and the mechanical. You have to hold the lens elements inside the barrel. Tolerances are very important because you want every lens in the series to behave the same way. The complete system is then described as a CAD model. At this point, we order the components, the lens elements and the metal parts. And then we have to wait a little bit, because it takes a while to do tooling and prepare the lenses. After several weeks or sometimes months, we get the parts and prototyping begins

We build prototypes to see the results—not to see mistakes but to reduce the number of issues that may come up later. This is the goal of front-loading simulation: do simulation as much as possible in the early phases, then you save time and budget during production.

Do you ever discover things when you make the prototype that you implement in the manufacturing?

The prototype is a verification of the design phase. It's not the case that we try to design something, then build it, see how it looks and then decide if it is usable or not. But sometimes we see flares or other imperfections. Sometimes we can simply make mistakes. And we don't want to give these mistakes to the customer. Therefore, it's very useful to do prototypes and test them for image quality and consistency of specifications. We ensure that we don't have a change of image quality, bokeh, sharpness or quality of skin tones.

Do you go out and shoot real life test images as well?

It's the next step. If the prototype meets our specifications and passes the environmental and reliability tests, we hand over the first prototypes to the product manager and he tests the lens by himself, and, of course, with cinematographers. We get feedback. Hopefully the feedback is the same as in the beginning where the cinematographers described their dreams and aspirations. It's a wonderful thing if they say, "I would love to be able to have a lens like this." Even better is when, after one and a half years, Christophe can say, "Here it is. I have a little surprise for you. I hope this is the lens you had in mind."

It sounds as stressful as opening night of a movie.

We are usually convinced that the lens we are making is good, and we had feedback from the cinematographers from the beginning where they wrote down the specifications. But in the end, there is always a little bit of mental stress. Our team members are all passionate about making pictures, if not cinematography, then stills. And we all love to go to the movies.

Dr. Benjamin Völker (Dr. Ghost) Optical Simulation

Benjamin Völker is a member of the ZEISS the optical design team doing optical simulations. (Photographed with Supreme Prime 85mm, flared and ghosted by iPhone LED shining into lens.

JON FAUER: So, you're Ghost. Or do you prefer Dr. Flare?

BENJAMIN VÖLKER: Dr. Stray Light.

Dr. Strange, tell us about your optical simulations.

My job is to take care of all the unwanted light. Optical designers try to find an optical formula that brings you the best-looking picture on the image sensor. They live in a very ideal world in which all the light just hits the front lens, goes through all the elements without any reflections or stray incidents on the mechanical inside of the lens, and then just hits the sensor. But it's not an ideal world. And I take care of everything else that can happen—and, believe me, a lot can happen inside a lens.

And then you try to reduce stray light and artifacts?

Based on the kind of stray light we have, we take different steps in the development process. The first step is to find the optical formula, which I do together with the optical designer, and then I take care of all the ghosts.

What exactly is a ghost—an optical ghost?

A ghost is a reflection between two optical surfaces. It's seen as a double image. You can reduce it with coatings or by changing the optical formula.

What is narcissism—optical, not presidential?

Narcissism is a double image between the image center and the glass elements. The most severe come from light reflecting from the image sensor onto the rear element. It depends on the kind of camera you have, but we've seen reflection values between two and almost 10 percent. And this is really a lot compared to an optical surface, which is at its highest is .5 percent.

How do you reduce the reflection from the sensor?

We have two strategies. If you have a really focused ghost, then you try to change the curvature of the lens element or the glass type. You never change that for one single element. You always have to change the whole thing, because it still needs to focus the usable light. The other strategy is to put a good coating on.

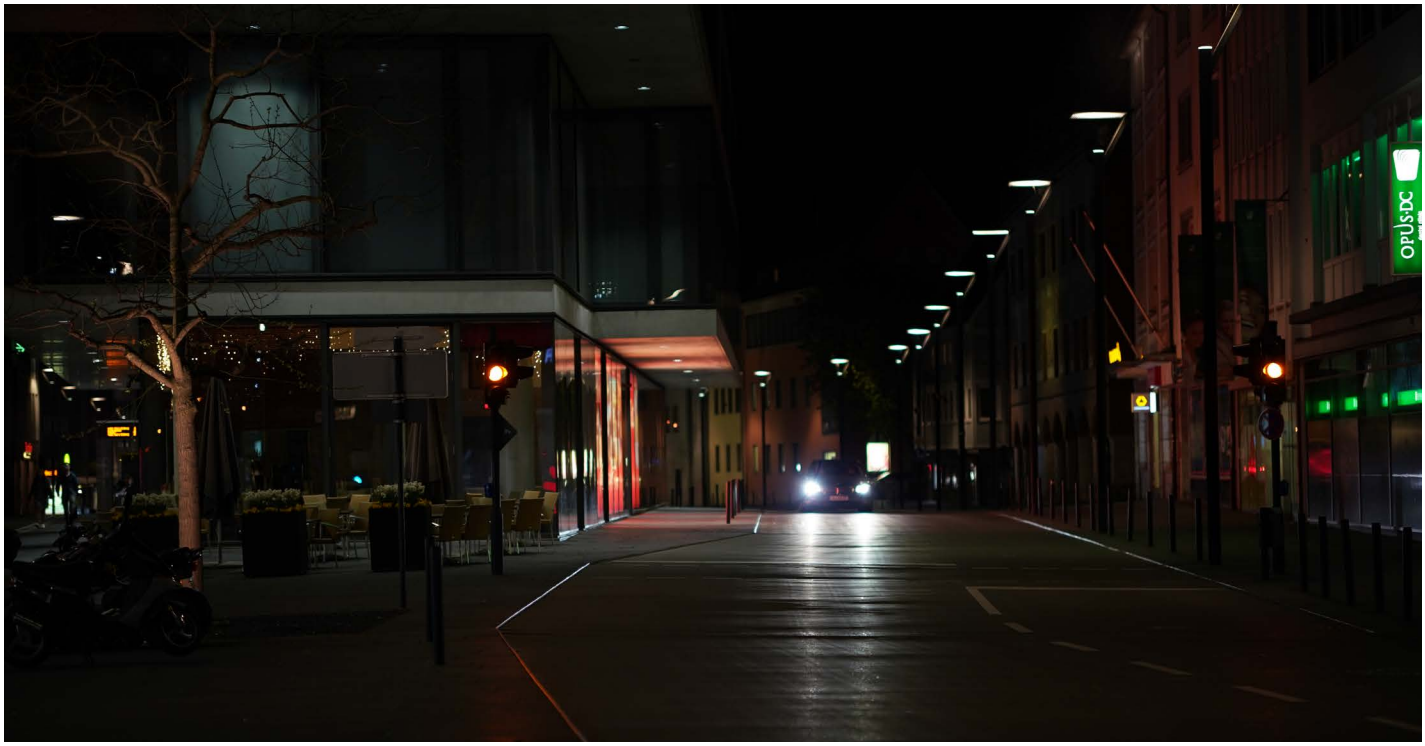
What about flares? I heard you're the guy who goes out at night shooting headlights. *(photo: next page.)*

Yes, I'm the one. I would like to ask you a question. How would you define the difference between ghost and flare? You DPs have a really complicated vocabulary for naming for all the stray light. Everyone uses a different name.

Is ghost a double image from an internal reflection? And a flare is from an external light source like the sun or a light.

Okay. That's interesting, because I have a different point of view. I think of three or four kinds of stray light. One is what we just talked about, what I call ghost. Ghost, for me, is a double reflection between optical surfaces—a mild reflection. Today we consider double reflections. But in the future, as cameras get more sensitive, it might be necessary to also consider quadruple reflections.

But ghosts and flares for me are the same thing, because it doesn't really matter if the light source is in field or out of field—as long as the light reaches the sensor by a double bounce. Narcissism for me is the same as ghost. From a simulation point of view, this



is the easy one to take care of. You have a defined light ray going in. You have a reflection. You can calculate that as well. You have another reflection and you have a defined place where the light reaches the sensor. It is very easy to calculate because in the simulation you always know the next surface that the light ray will hit. It can only hit the optical elements.

Can it hit the inside of the lens and then bounce off the barrel?

That would be the other kind of stray light that I'm considering. For the ghost simulation, this is all covered with just two or four reflections between optical elements. It is called Snell's Law. This is easy and very quick to calculate. From a calculating point of view, the more interesting simulation is stray light from mechanical parts, which we call scattering.

Scattering can be more tricky. Light goes through the optical elements and hits the mechanical interior of the lens, and then the light gets scattered. In which direction, you can't say. In the worst case, light scatters in a full half sphere. If you want to calculate that, you have one ray going in, hitting a mechanical surface, and then you have to generate 10,000 rays bouncing out from there in every direction. You see that as internal barrel flare where dark shadow areas become foggy and black becomes milky.

You probably hear a lot of DPs talking about how they often love flares. You probably hate them.

I love photography and cinematography. I do it in my spare time as well, keeping in mind that with flares, I always lose information.

So, basically, you're trying to get rid of the flares to have the best possible image. I'm getting the feeling that the design philosophy at ZEISS is that if somebody wants flares, they can use filters, aim small lights into the lens, shoot through plexi rods, or add flares in in post with Davinci Resolve flare plugins.

Dynamic range suffers with flares. If you take a picture into the sun, you see two or three really focused ghost images. These are not the ones that kill your dynamic range. It's the 500 others that go in there. If you consider a lens like the Supreme Prime 29mm, for example, just do the math. There are 16 optical elements inside, but there may be 530 ghosts in there all at the same time. Shooting into the sun, you maybe see the top 10, because they are focused. But it's the 520 remaining ghosts that are the ones killing your dynamic range, lowering your contrast.

And when you simulate, do you also take pictures, like still pictures and then introduce ghosts on those real life pictures?

We take pictures in the lab and see how close we come. And we come really close. So, photograph simulation, I really would say we are now able to predict the complete look on the actual prototype and with a I say 95 percent chance of it looks exactly like that on the actual prototype later.

Talk about car headlights, because in almost every movie, there's always a shot of the car at night coming towards the camera. So, I assume that you also tune the lens to handle those nicely so, it doesn't milk out the whole image and so on?

Yes. The thing is to control them. We reduce them, but we can't bring it to zero. It's physics: there always will be a remaining reflection from every element. We get better with better coatings. It won't be zero unless you pay a huge amount of money. Another thing I do is to get the same look throughout the family of lenses.

When you talk about the look of the Supreme Primes, what words would you use to describe how they look? Some have called it "Gentle sharpness."

I would agree with it. I had the privilege to test most of them outside the lab, on location. We calculated the design. We tested the real prototypes. Because the ghosting calculation has a lot of parameters going on, it can look different for every lighting con-

dition you can think of, at different apertures, for different light sources, different focal length and so on. So, normally I take home the prototype and take a lot of pictures with still cameras and a PL adapter—like you're doing.

In terms of sharpness, I really like the color rendering. This has something to do with the coatings we use. In terms of color rendering, we go for a neutral look. This is what I personally like most in post-production, because you then can do anything you want. You can make the image a little warmer or cooler. We developed the coatings for reducing the reflectivity, but we also tried to mix and match the coatings on all the elements so that the overall transmission gets as neutral as possible.

What other words could we use to describe the Supremes besides gentle sharpness? Tame your ghosts?

Repeatable and reproducible.

What kind of tests did you do for the Supremes?

I try to provoke the ghosts. With backlight.

Often, you need extreme lighting sets, directly against the sun. Sunset is a good example. I try to do the most severe things you can do in terms of flares. I look for something really dark that is not illuminated. All the light comes from behind, with a black object with fine detail on it, and all the stray sunlight is entering our Supreme Prime lens and hitting the mechanical barrels and housings.

Will you be heartbroken when DPs ask for uncoated Supremes?

No, but they should remember they would lose a lot of light – up to several stops. Also, you would have to keep the lens in the dark, because without any coating, sunlight damages the front element.

Benjamin with an uncoated lens (top) and coated lens (bottom). Ghosts courtesy of iPhone LED shining into lens.

It would become gray over there over some weeks. People talk about uncoated, but often there is some kind of coating, but it's just coated differently.

As a photographer myself, I think a lot about look. And then I go back to our lab and try to quantify stray light and ghosting as numbers. Sometimes we fail, because it's very complicated to put real numbers on it. We can define ghosts as a point or an arc or a rainbow. But maybe you don't like the ghosts as rainbows so much, but would prefer one color. We do simulations of the image as it will look later on, with the prototype. We do simulations for different apertures, photo distances, light source positions, and we compare. We try to get it as consistent as possible so that you don't take the 29mm, have a huge ghost in the corner, then take the 35mm, and it looks completely different. In the range of the possible, we try to average. And we do that by looking at pictures. You need experience, because a wide angle lens has a totally different ghosting behavior than a tele lens. And then you have to ask, "Is it good or bad. Could it be better?"

It's funny how we DPs have a vocabulary that's quite different from yours. You were a great translator. I learned that look is to a large degree spherical and chromatic aberration, and flares are not flares, they're ghosts.

This is instructive for both of us. I see why it makes sense for you to difference it between ghost and flare. For you, a ghost is a reflection within the lens that you can't do anything about. A flare is something that you can try to fix yourself, like flagging the light.

Thanks for an illuminating discussion, Dr. Ghostbuster.

Uwe Weber, Karl-Heinz Rösner - Mechanical Design

Uwe Weber (above) is Manager of Mechanical Design at ZEISS. Karl-Heinz Rösner (above, next page) is a ZEISS Mechanical Designer.

JON FAUER: Which ZEISS lenses did you develop?

KARL-HEINZ RÖSNER: Many. I have been working at ZEISS for 28 years. I designed a lot of lenses for cine as well photo application. I made a lot of lenses for Contax and Hasselblad. The first Cine lens I did was the 10-100 zoom for 16mm.

UWE WEBER: I was the one who turned it into an 11-110 for Super16 by making some internal changes. After that, I worked on many lenses, including the Master Primes. I was honored to receive an Academy Sci-Tech Award in 2012 in Hollywood for that.

Walk us through the Supremes' mechanical design process.

UWE WEBER: We always create a family of lenses and it starts with an idea. We are in touch with the optical designers from the beginning. We work out whether the lenses are able to be built, whether they fit well together as a set of lenses. We try to have the same outer appearance of the lenses, with almost the same length and front diameter, and with lens gear rings at the same position. We start with the mechanical design of the housing, of the mechanics around the focus drives. This has to be started very early, because sometimes it takes a lot of time—sometimes up to two years.

How were you able to make such a small front diameter?

A wide angle lens will have its front element close to the front of the lens. So we need to incorporate a design where the barrel gives the front element some protection from being scratched. Even the 25mm Supreme has a 95mm front diameter. The longer lenses have front elements that a recessed further from the front.

In the very beginning, did somebody say, "We want to have a 95mm front diameter?"

Yes. That was one of the requirements, from the very beginning.

It appears that the focus is not guided by a cam, but it's smoother than most helical focus threads. Can you tell us more?

It's a special, rectangular thread inside. When you remember lenses with helical threads, like the old ZEISS Super Speeds and Standards and even Ultra Prime lenses, we always had the problem that the torque got stiffer at colder temperatures. The threads were tapered on those lenses. We wanted to avoid that.

At the same time, we wanted a large inner volume to get the big

optical elements inside. When you look at a wider focal length, the front elements are big. The rest of the inner lens elements are relatively smaller. And, when you have a big front lens element, you also have a big iris inside of the lens. So, instead of having threads that come to a point, the helical coils of the focus mechanism are rectangular.

It's still a helical focus mechanism?

It's still done on a turning machine, but with special tools. It takes some time to machine them, but we get very good surface qualities and geometry. It's precise down to micron levels. When you compare other designs where curves are inside, you have to mill the curves and the surfaces on the curves are a little bit more rough.

And do you still use grease inside?

Yes, there is grease inside. The question was to find something that works over the whole lifetime of the lens. The surface quality is like a mirror when you have it without grease. You can even have a smooth focus movement without any grease, but we add it because it adds the extra smooth feel that customers want. Because of this combination and the grease we are using, the Supremes work very well at low temperatures.

What is the reason for the non-linear aperture?

It takes up less space inside. We have this in other lens designs—the Master Anamorphics, for example. The most important reason is that it provides much more precision where you need it. Between T1.5 and T4, the throw is much longer than on MP where the scale is linear, and this is exactly where you want it.

Thomas Steinich - Optical Design

Thomas Steinich has been an Optical Designer at ZEISS since 2006. He worked on the team doing the Master Anamorphics.

JON FAUER: Tell us about the optical design of the Supreme Primes.

THOMAS STEINICH: It was an interesting and long way to get here. It always starts with the Product Manager coming in and talking about some ideas he has in mind what we should do. What it should look like. What we think the market wants to have.

And what did he say? The market wants Full Frame?

Definitely. The market wants a completely new series of Full Frame lenses for high-end cinema. At the beginning, you start with some rough designs. You start doing some focal lengths and looking into how could it look. Can we reach the goals that we want to have? We have a lot of discussions. It's a process where you start quite rough with very basic designs and you go into more and more and more details. And at the end, you have to put it all together.

Of course, when we do a series of lenses, we want all focal lengths to have similar performance. We have to look in parallel during the design process. That's what we do.

Hypothetically, what happens if the Product Managers asks for a front diameter of 95mm and then you do your calculations and you find that's really difficult to do and a 100mm would work much better. Do you then go back and forth and discuss?

Yes. We work out the specifications of size, length and weight. Then we have discussions. Most of the time we finally succeed to get to the specs that are requested.

We talked a lot about how we DP's try to articulate how a look or a lens should be: impressionistic, soft, flary, vintage. How do you optical designers translate those ideas into formulas?

That's the big task for the optical designer. DPs are verbalizing what the picture should look like. The optical designer must translate those words into math. The calculations need to come to that conclusion. We have a big advantage here in our department because we have a special optical design software that is proprietary to ZEISS. We have special algorithms that are closely related to cinema applications. So it's actually a little bit easier for us to translate these ideas into numbers.

You push a button for the Supreme look?

That would be fun. But, we can simulate a whole picture. And this is something which is really very useful. Because when you have an optical design and you talk to users, it's not such a good idea to talk with lots of diagrams and lots of numbers. You have to show them what the picture looks like.

You actually take real photographs and then you simulate how it's going to look?

I prepare a series of pictures. They show contrast, resolution and other characteristics. And then we compare those real photographs with our computer simulations.

How would you describe to a DP how the Supreme Primes look?

The basic concept of the Supreme Prime look is to have the best of everything. Really good contrast and resolution in the plane where you're really in sharp focus. And a very smooth and symmetrical focus fall-off in both near and far directions. When you do a portrait, you have really sharp pupils but the skin is soft in front and in back. It's not such a good idea to have the complete image creamy or soft. So this is the basic idea that we try to achieve.

How do you achieve the very smooth skin tones with the Supremes?

We want to avoid different colors of focus, longitudinal color aberration in the back and front focus areas. If we reduce these color aberrations with special materials and lots of design work, we can have the same color over the complete depth of field. This helps to get the same skin tones over a certain range. And this is one big thing that was not easy to achieve over the complete series of lenses. But this was a goal that we had in mind and we achieved it. Another way of putting it is that the depth of field is more relaxed, more forgiving.

How do you deal with flares and reflections in your designs?

We can trace the rays that cause the reflections that you see in the image. We see where they come from. Which surface of the lens. Which angle. We can simulate the coatings on the lenses. We have a really special tool that not only analyze these ghosts, we have also opportunities to control them. For example if we have one narcissism or ghost that is in the middle of the image and I don't want it there, I want it on the edge, I can have our system change radii and put these reflections somewhere else. This is not possible in commercial packages. It is something quite special that is part of our design software.

Explain your design group's philosophy.

The basic idea is to make the best lens we can. A great lens can always look great. If you want aberrations, you always have possibilities of adjusting the image with smoke, special lighting, diffusion, filters or anything else the cinematographer wants to add to the get the desired artistic impression. But if you have a lens that is not sharp, it's never sharp. You can't do anything to improve it. The information is lost. It's not there. So this is not what we want to have. We want to have it sharp where it should be sharp and with nice fall off. And that's the basic idea.

Gebhard Müller, Manager of the test lab at ZEISS checking lens performance and contrast with a "black hole" device.

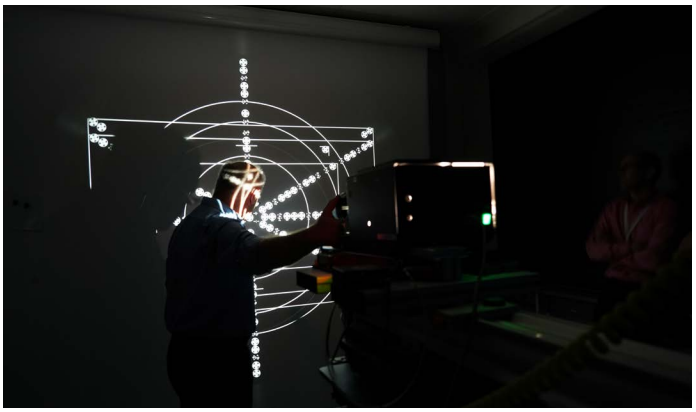
GEBHARD MÜLLER: The lab consists of up to 13 persons. One job is to do the Supreme Prime electronics and develop the firmware for eXtended Data. We also do the prototyping. All prototypes are assembled here in my laboratory.

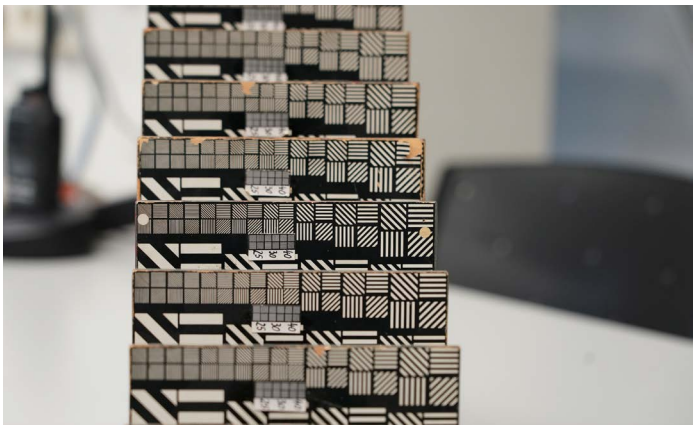
After we built the Supreme Prime prototypes, we began the qualification phase—testing them to be sure they lived up to their specifications. The next step is application testing, with the lenses on real cameras, shooting under real and simulated conditions. We want to take it through the entire workflow to see how image quality holds up every step of the way.

Finally, we develop all the test equipment used here and in our service centers. The extended metadata, with information about distortion and shading, along with regular lens data (aperture, focus, etc) are linked together with timecode to be recorded in camera or externally by companies like Ambient.

Gebhard Müller with Andreas Jung, Developer of electronic hardware and firmware for the Supreme Primes.

We do a complete qualification of the lenses and to do that, we use a lot of equipment to check each and every parameter that is specified. We project the lenses to test geometry, distortion, resolution, contrast, depth of field. We put them on machines that rotate the focus and iris rings up to 200,000 of turns to ensure that the electronics and mechanics are stable over the whole lifetime of the lens.

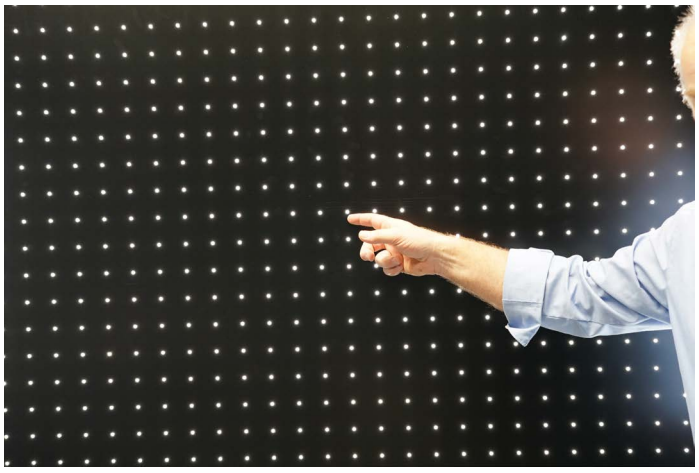


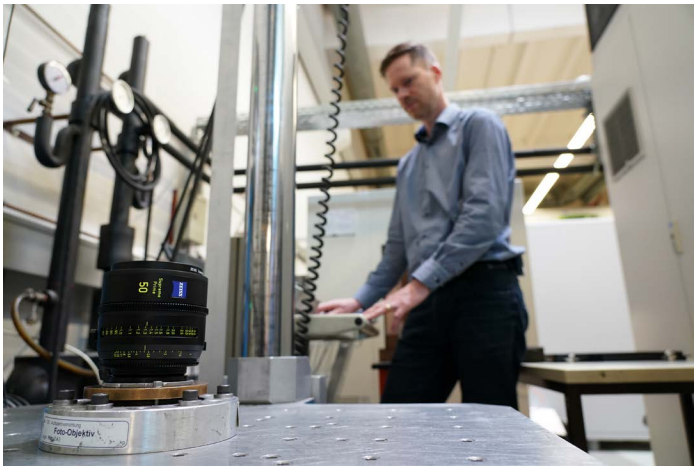


Gebhard Müller - Testing

GEBHARD MÜLLER (continued): Three-dimensional shadow-boxes give us a lot more information than ordinary printed lens charts. And they are a lot of fun to put together.

We have developed a lot of specialized devices that allow us to check lens elements inside of the lens holders or to align complete optical systems inside of the barrel. As a result, we have a very controlled way established for assembling the lenses, step by step. After the lens is completed, then a final alignment is done using a K8 machine or a K9 machine or other suitable devices.

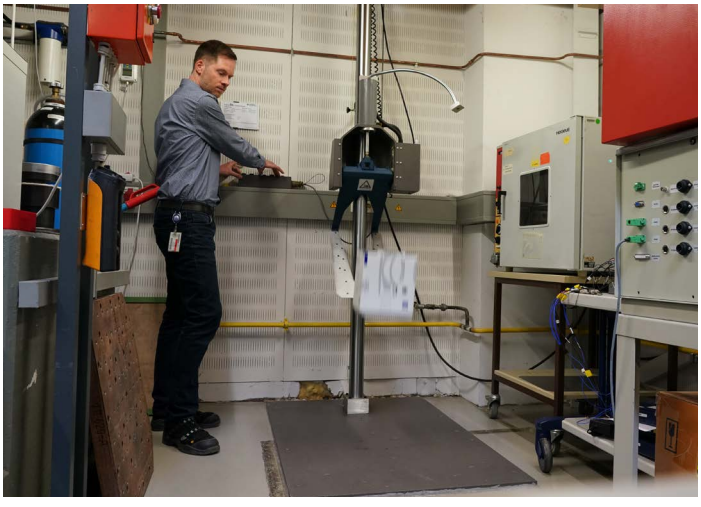




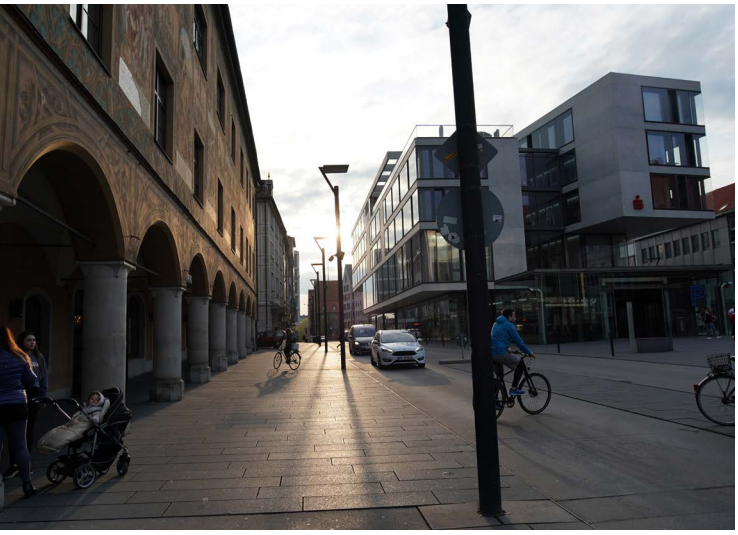
Vibration test, above. Camera truck to pavement liftgate drop test.

The result is that we have a very low variation in the performance over the whole series production. This is always what we are aiming for. There is very little difference between the lens design on the paper, which is calculated, and the actual performance that we measure with our test program. This means that no lens which leaves the company without meeting our specifications.

Suited up at 40 below zero to test Supremes.



Supreme Field Trip to Ulm



Christophe and Isabel decided it was time to test Supremes on location and we set off to Ulm, 75 km south of Oberkochen.

Albert Einstein was born here. Ulm cathedral has the tallest steeple in the world, which may be why it seems to be eternally under renovation. A river flows through Ulm—the Danube, on its way 2,700 km to the Black Sea.

We tested wide angles (nice geometry), depth of field, architectural photography and food (in-season white asparagus and freshly-caught Ulm trout.) All photos on these two pages captured with Supreme Primes on a Sony α9 with PL to E-mount adapter.

Testing Supreme Primes wide open at T1.5 in Zur Forelle, Ulm on the Danube. Above, ZEISS Marketing Manager Isabel Winter. Below, Christophe Casenave.

Josef Kohnle, Camera Lens Assembly

Josef Kohnle (above, right) is Senior Director of Operations at ZEISS, managing camera lens assembly.

JON FAUER: You're the busy man in charge of building Supreme Primes?

JOSEF KOHNLE: Yes. I'm responsible for logistics and the supply chain--to get materials here and assemble the lenses. 95 percent of the glass and all the mechanical parts come from ZEISS or from companies nearby in Germany. This gives us a great degree of control over the supply chain. That's how it works with very sophisticated products like the Supremes. If there's a problem, it's easy to drive 30-40 kilometers to meet with the suppliers and talk with them face-to-face about how to improve things.

That seems unique to Germany for suppliers to be so close.

It's an important difference. In the cine industry, volume is relatively small. We do not mass-produce quantities in the thousands, as we do for still photography lenses. We are in the hundreds and have to be very precise. It's an advantage to have sources nearby.

When did you first start working on the Supremes?

We started serial production in November 2017. But planning began about a year ago. The first thing we did was to set up precision mechanical machining for the new focus mechanism. The threads are a new concept. We worked on that for almost a year to get it really precise.

Then we started to plan our workspace and assemble the assembly line. We built a first batch of lenses. We worked together with the R&D and engineering teams discussing how the assembly line could be built to assemble the Supremes precisely and quickly. I think we went through seven or eight different iterations.

After four or five weeks, we had the line running. We use the Japanese Kanban system of lean, just-in time manufacturing. It's like in a supermarket. Our assembly technicians have boxes of parts in front of them at their workstations. When a box of parts is empty, the logistics person takes that empty box down to our supply room to refill it. The other box at the workstation has enough parts until the new box returns. If you go to a supermarket and buy milk, you always want to have fresh milk. If there's no milk, you go to the next supermarket.

That's what we learned from Toyota in Japan. It's called lean logistics.

How long does it take to assemble a Supreme Prime?

At the moment, on average it takes one to two days to build a Supreme Prime. We will add technicians and the time will shorten as we ramp up production.

Take us through the Supreme Prime assembly process.

There are two phases. First, you have a barrel that's mechanical and you put it together piece by piece. Then you fill the barrel up with lens elements. Each element has been blacked (painted black) around the edges with a special formula. We try to produce a "black hole" that minimizes reflections from the inside barrel surface to the edges. The lens is measured on our K8 MTF measurement machine to check diameter, centering and geometry. Each lens is individually adjusted. Each focus scale is individu-

ally determined and identified by letters (AA, BB, CC, etc) and engraved specifically for that lens. The final checks are done on our K9 machine.

How do you adjust the lenses?

With screws from the outside and with shims. Every lens has a little bit of variation. Our goal is precision across the set, for every individual lens. The elements are spherical, aspherical and some are glued together. We have a large R&D department that develops special glues that are optimized for various combinations of glass.

There's another big advantage in what we are doing compared to mass production. We work on each lens, one at a time.

Are you able to find enough skilled technicians and do you have a training program?

Yes, we have a training program. We are in a rural region, but we attract enough people. ZEISS has a good reputation as a friendly place to work, so that's attractive. Sometimes we recruit from outside. Every year, I go to the various departments within ZEISS where they have been training apprentices for three years. For example, we have a couple of technicians doing lens assembly who were previously working in our service department.

Does one person assemble the entire lens?

It depends. Our lines are in U-shapes. If the technicians need more experience, we start them by doing step one. When they are able to do step one, they go on to step two. And so on. If everybody's qualified, and, for example, we are building 20 Supremes a day, there is a chance that twenty people could each be doing the whole process. Or they could hand the lens off at step three to another colleague.

Do you have meetings where suggestions can be made?

Daily. We meet every morning at 8:15 with the teams from assembly, from the supply chain and from sales. If the sales people tell us we need 40 lenses that day, the supply team will bring us 40 Kanban cards. Each card represents an individual lens and we fill it out with information, for example, that a 50mm Supreme Prime needs a focus scale in feet with an LPL mount and another 85mm Supreme Prime requires a metric focus scale and a PL mount. That way, we know the plan for that day. Ideally, by that evening, we have checked off those 40 cards, and 40 completed lenses are ready to go. If there were problems the day before, we discuss them at the morning meeting. Usually, problems can be solved that day.

Are Supreme Prime lenses difficult to build?

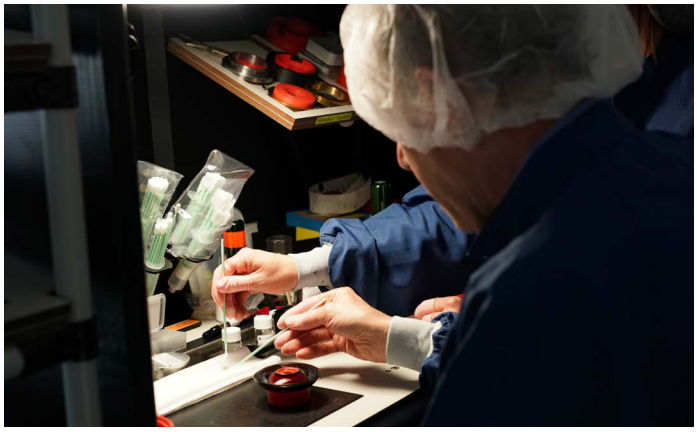
They are built in the same large clean room where we assemble Ultra Primes, Master Primes and Master Anamorphics. These are all precise, sophisticated lenses. We take the best qualified people. It takes a minimum of six months to a year of training. The technicians cleaning the optical elements have spent up to 18 months for qualification.

Just for cleaning?

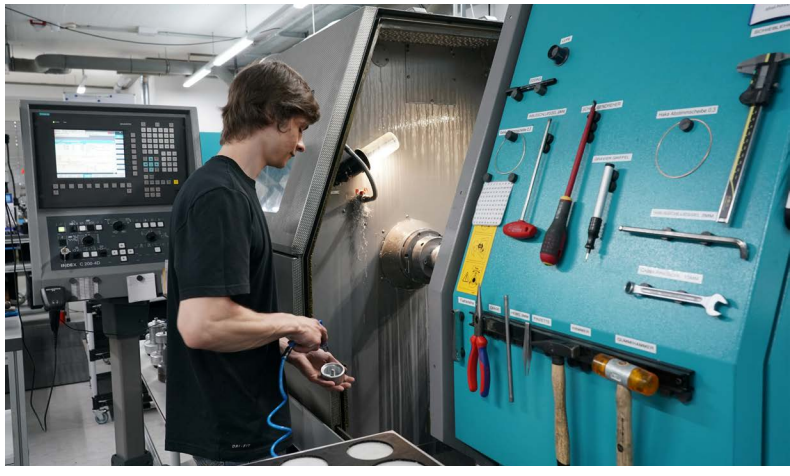
You might think it's an easy job. But to do it well, you have to visualize the complete lens which consists of a lot of different elements inside. A good technician can look into the completed lens and detect which element a speck of dust or imperfection is on. They can even tell you whether the blemish is on the back side or the front side of an element. A really good technician will even know what kind of material is the glass element is, because we have 130 different glass types. For each glass type, there's a different method of cleaning using many different liquids. Some glass types and coatings are very sensitive to various types of fluids.

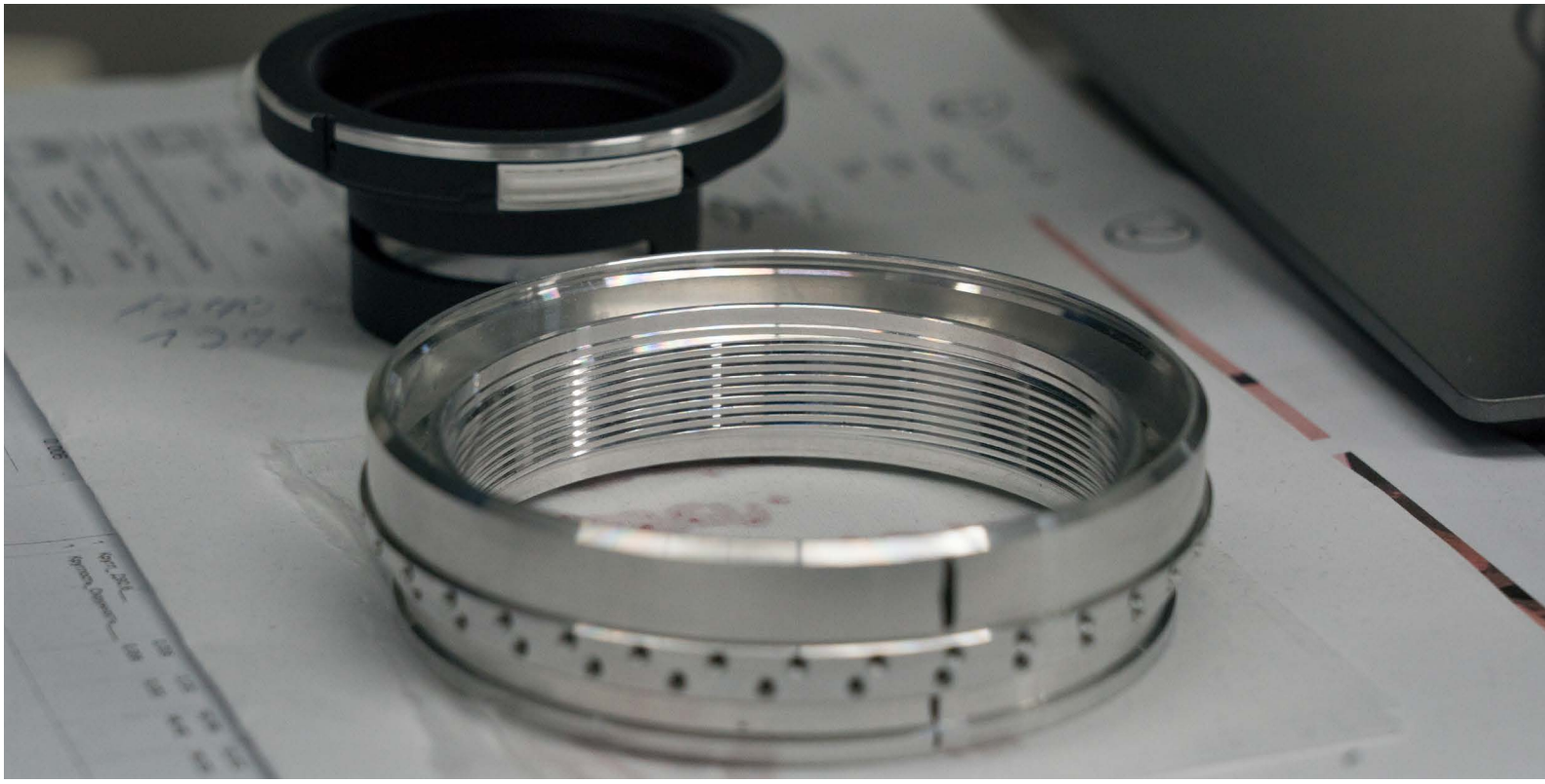
At this point, to prove the point, Josef led me into the vast clean room where ZEISS Supreme Prime lenses are assembled. He sat me down at a workbench and challenged me to clean a lens element. Despite years of cleaning lenses on location, often responding to the cry that there were more fingerprints on our lens than in the files of the FBI, and having endured a few lens-cleaning Olympics, I am embarrassed to say that I did not pass the ZEISS lens-cleaning qualification test. Josef had proved his point.

On the following pagees, join us on a tour and let's see how Supreme Primes are built.



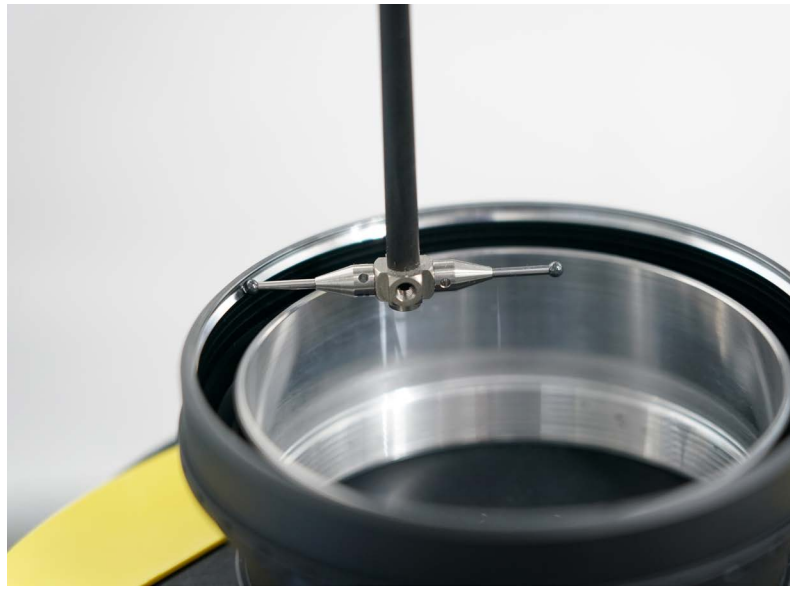
Inside the innovative focus mechanism: rectangular helical threads, precision CNC machining and advanced materials for smooth moves.





Inner and outer rings of focus mechanism.

Measuring to micron tolerances.



Lens Assembly

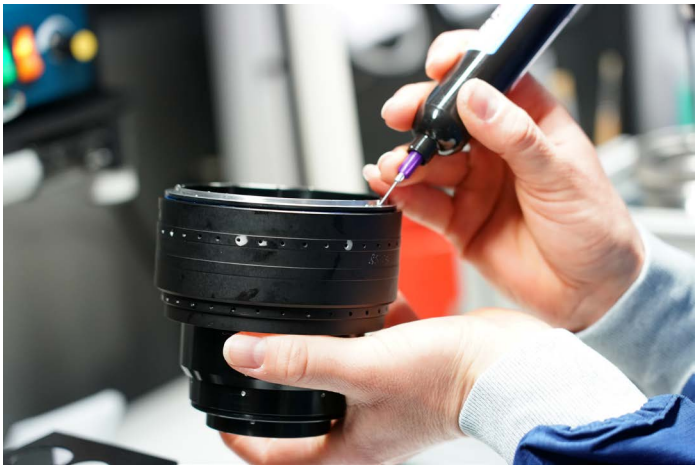
Let's build some Supreme Prime lenses. After suiting up, we enter large clean room, walking past Master Prime, Ultra Prime, CP.3, Cinema Zoom and other lens assembly stations. We arrive at one of the Supreme Prime U-shaped work areas.

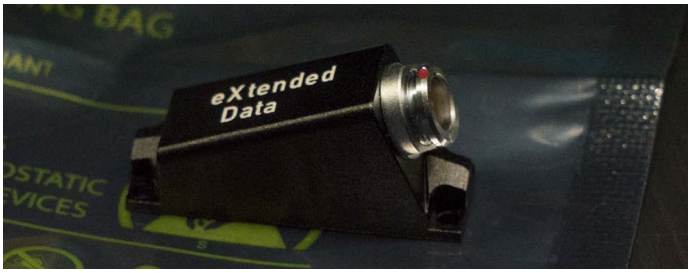
Lens Assembly

As Josef discussed in his interview, it's a Kanban Supermarket system. The logistics team fills up boxes with parts for each workstation.

Here's a Supreme Prime workstation with the main sub-assemblies.

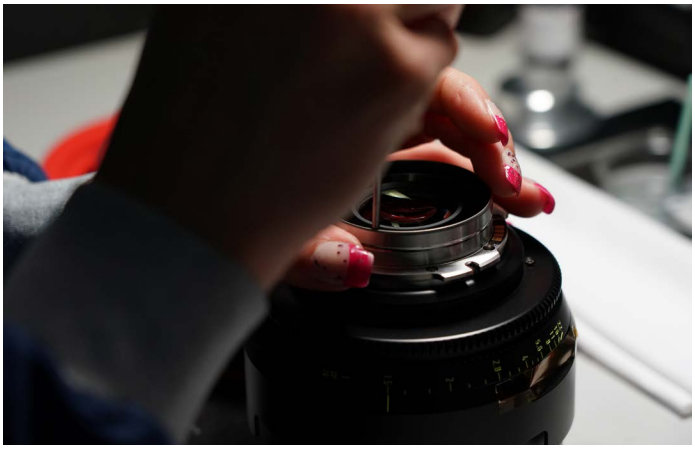
Below: Electronics board for eXtended Data.



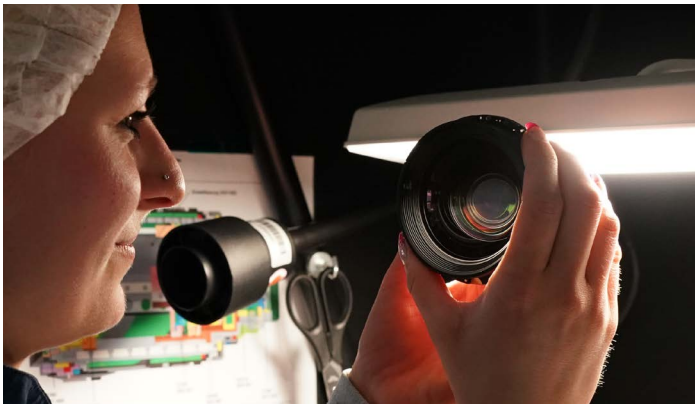


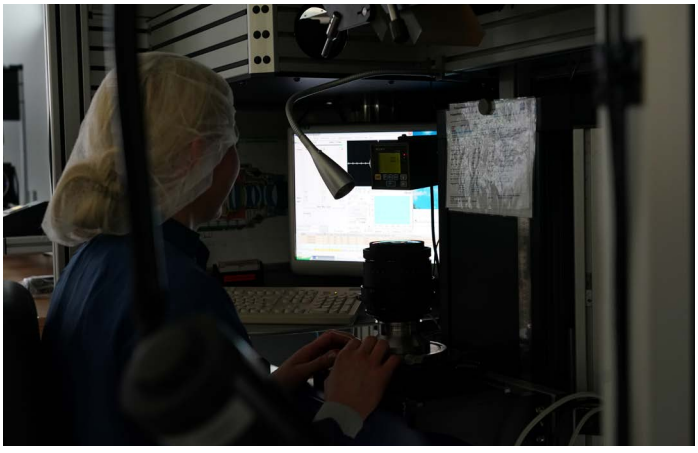
Lens Assembly

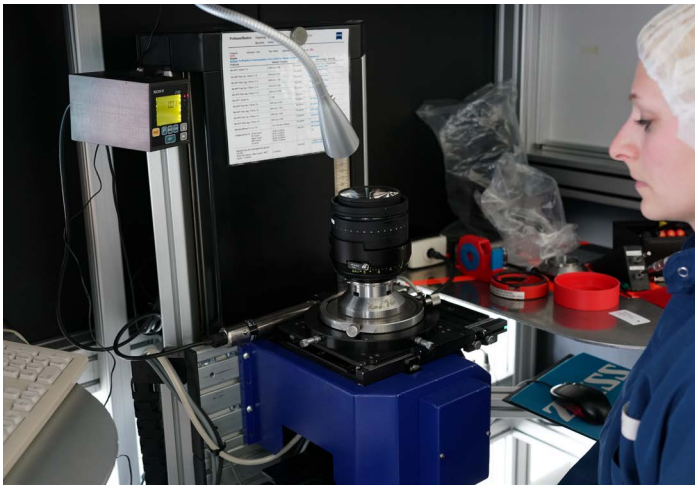
Lens Assembly



I suspect there is a secret sisterhood of manicures among lens technicians worldwide—in Germany, UK, France, Japan, USA...



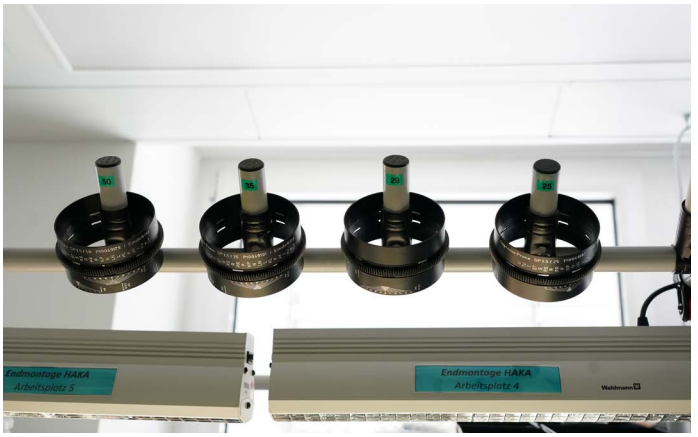




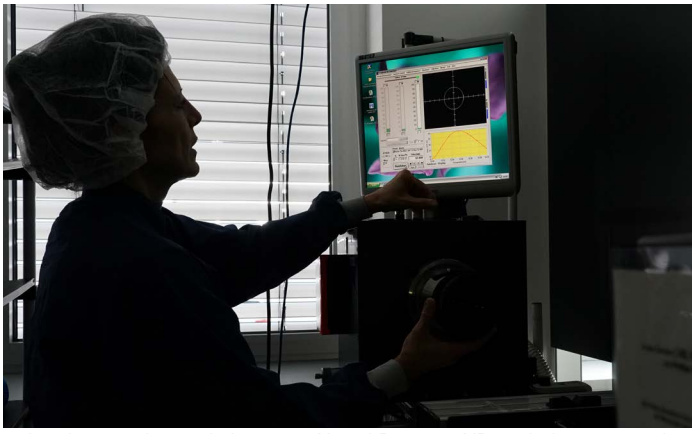
Checking lens on K8, above, and centering, at right.

Supreme Primes - Focus Scales

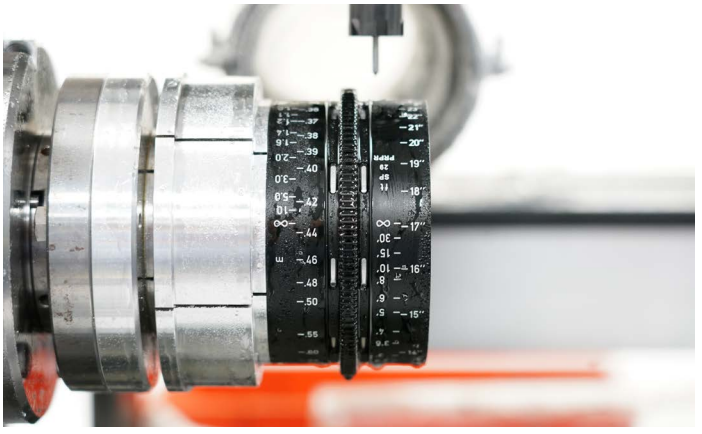
Each lens is checked on a ZEISS K9.



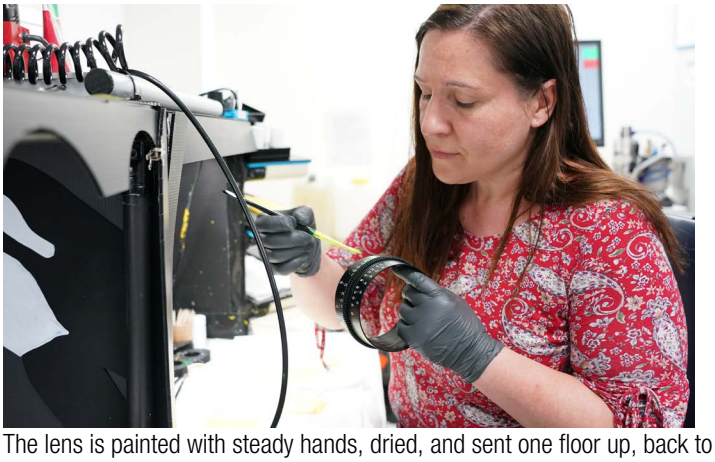
A test focus scale is selected for each focal length



The lens is focused and the shows which scale is appropriate. In this example, the sharpest image is between N and P, so an NP scale is requested.



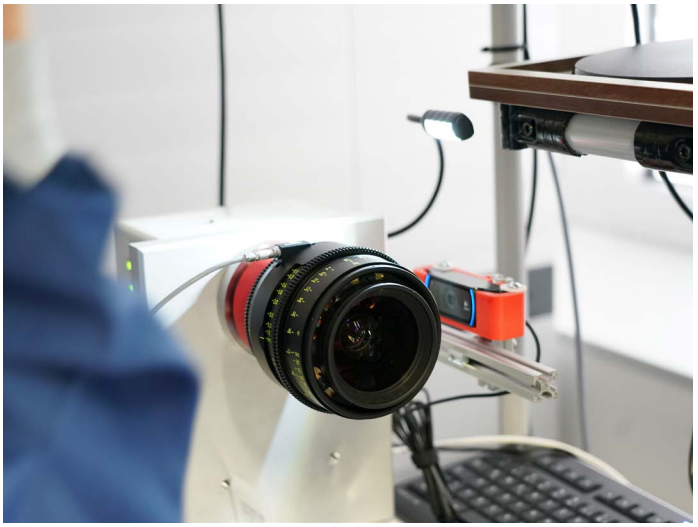
The order goes in to the engraving department, and an NP scale is made immediately. Notice that one focus ring has both feet and meters.



The lens is painted with steady hands, dried, and sent one floor up, back to the assembly department — to be fitted on the lens.

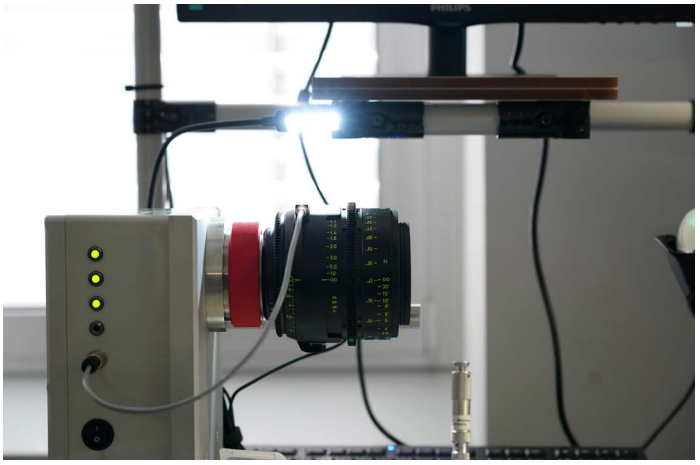
Lens Assembly

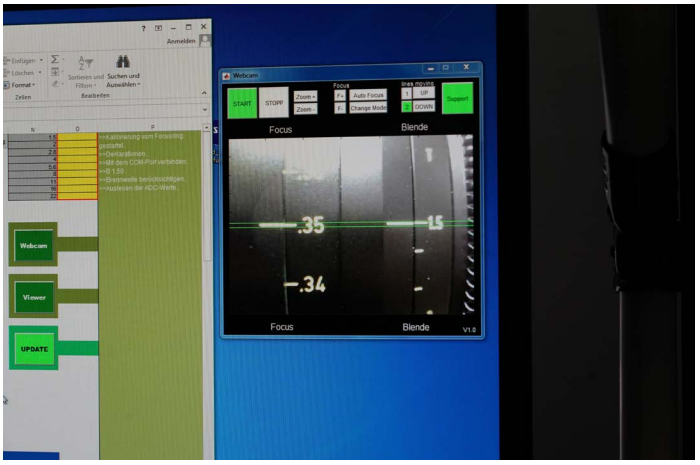
Engraved and painted focus and iris rings, witness marks and lens labeling.



The newly engraved rings are mounted to the lens and checked

Focus and iris marked are checked against the XD metadata





Rainer Dolderer (right) is Head of Repair Service at ZEISS. Simon Sommer is the ZEISS Service Trainer.

JON FAUER: Where are the ZEISS service facilities worldwide?

RAINER DOLDERER: We are based at ZEISS headquarters here in Oberkochen, Germany. We service more than 500 lenses a year. Authorized ZEISS service for the U.S. and South America service is done by AbelCine, with offices in Burbank and New York. It's NAC in Tokyo and ARRI China in Beijing. We all have K8 and K9 test equipment and the same tools that our assembly teams use.

Do you give feedback to the manufacturing department?

RAINER: During the repair process, if we see patterns of optical or mechanical damage, we will contact our development department with issues that the customer had and suggestions on how to fix them. A lot of things we learn in service are implemented in the next generations of lenses. It's very important to have this information to improve the new lenses.

How does a rental house change a Supreme Prime focus scale from feet to meters? And how do they adjust the flange focal depth?

RAINER: You get shim sets and you can adjust the depth the same way as other ZEISS lenses. Changing from feet to meters is easy: each lens has the focus scales engraved on the same ring. You simply flip the ring over.

Simon, tell us how you train technicians to repair the Supremes.

SIMON SOMMER: We can invite people here to do the training for Supreme Primes or I often travel to rental houses around the world. We also have training sessions with our partners like AbelCine or ARRI.

A class, typically, is about 10 to 15 people. We begin with a selection of lenses on the table. I point out differences between a Supreme and other lenses, and what makes the design special. We discuss image quality and I do a demonstration of lens projection. We go to the K8 machine and measure MTF.

The participants get an understanding of how we do the lens service here at ZEISS, what kind of parts they need and what tools to use. It's also very important for them to give customer support very quickly. If somebody has a problem in the field, the lens usually goes back to the rental house. But for further service, the lens goes back to one of the authorized service stations. One of the most important things our classes teach is which technical support the rentals can do by themselves, and when they have to send the lenses back to our service centers.

Do you charge for the training classes? And, what special procedures and tools do rental houses need to service the Supremes?

SIMON: Yes, people pay for the classes. We have a special holding tool to remove the rear group. You need a tool for the inner moving group that fits into the thread. Aligning image quality can be done visually on the projector, because you have to move two elements in front for center and field adjustment. Those are the three most important aspects that you have to look at to do service on this.

How often will you have services classes about the Supremes?

SIMON: As often as they like. Probably once a month, either here or at their facilities.

I have a feeling you will be getting many frequent flyer miles in the coming months.

ZEISS Service Office HQ in Oberkochen.

Servicing a Supreme

Classroom is set up for service training session.

Simon Sommer servicing a Supreme Prime.

Simon removes the front assembly with front element.

Focus mechanism inside lens barrel.

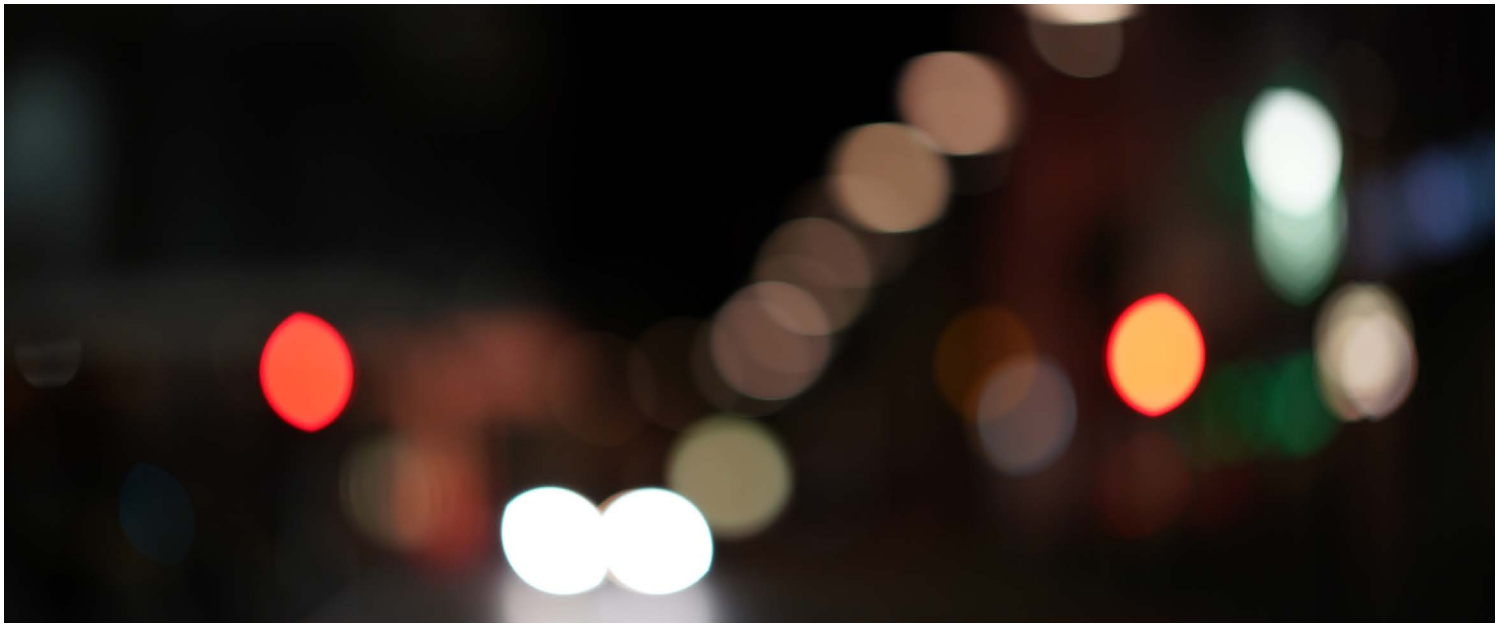
Focus ring removed.

ZEISS K8 workstation in foreground.

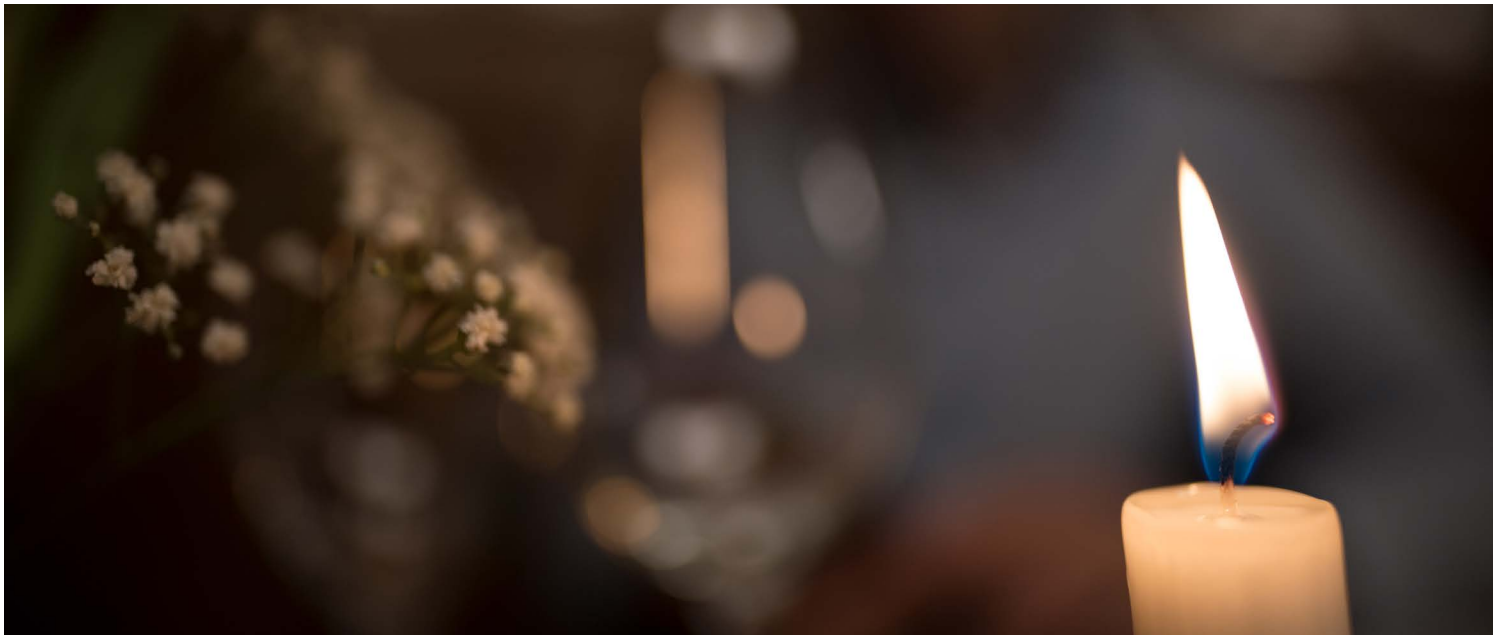
Servicing the Supreme Prime's eXtended Data connector.

Connector removed, revealing electronics board beneath.

ZEISS Supreme Framegrabs



ZEISS Supreme Framegrabs



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ZEISS Supreme Prime Special Report
by Jon Fauer

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