Jon Fauer, ASC www.fdtimes.com May 2022

FILM AND DIGITAL TIMES

Art, Technique and Technology in Motion Picture Production Worldwide

Cooke S8/i Special Report

Cooke S8/i T1.4 Full Frame Primes

New Cooke S8/i Full Frame Primes arrive in response to requests from cinematographers, camera operators, focus pullers and rental houses for smaller, lighter and faster Full Frame lenses.

Cooke S8/i Primes have a maximum aperture of T1.4. In comparison, Cooke S7/i Full Frame Primes open to T2.0. Not only are S8/i faster, they are also lighter and smaller than most contemporary Cooke lenses. S8/i have a 104 mm front diameter. S7/i have a 110 mm front diameter, as do the 35mm format S4/i and 5/i. It gets even more interesting when you hear that the S8/i series were designed and built using only spherical elements. They do not contain aspheres.

"Work wide open" is a favorite lens mantra. "Don't stop down!" And so, S8/i Primes open up the widely opened T1.4 aperture world for Full Frame / Large Format. Bokeh blossom beautifully: smooth and natural. They are round in the center of frame and take on a cat's eye oval shape when off-axis. All focal lengths exhibit similar symmetrical bokeh shapes at all focus distances.

Spherical elements see to it that you will not see any onion ring artifacts. The only one crying could be a Focus Puller lacking the big sensor lifeline that is the Preston Light Ranger 2, thus assuring sharpness even with a T1.4 four-eyelash depth of field at 100mm, as shown below. Of course, the ever-popular Cooke Look is in full Full Frame parade: a delicious depth of field roll-off and smooth focus fall-off at the periphery, all the better to guide your eye to the object at the center of your attention.

At launch, there are seven S8/i Primes: 25, 32, 40, 50, 75, 100 and 135mm. They all open to T1.4 and all have a 104 mm front diameter. Prices at launch are US $34,650 for 25mm to 100mm S8/i and US $36,100 for the 135mm S8/i. Additional focal lengths are planned: 18, 21, 27, 35, 65, 85 Macro, 180, 250 and 350 mm.

Below: ECU, 4 eyelashes sharp, Cooke S8/i 100mm at T1.4. Bill Bennett, ASC, was the cinematographer and one of the first to try these lenses on *High Desert*. He said, "How they did it—I would love to know— because usually when lenses become

faster, they get bigger. "When they decided not to use aspheres, that could have a lot to do with how the lenses look. When the S8/i Primes are wide open at T1.4, they are especially beautiful."

Raphaël van Oostrum, who was Steadicam Operator on that first production, said, "The new S8/i is, to say at least, a friendlier Cooke lens for Steadicam since its weight and mass, that sit in front of the camera, are considerably less."

Sara van Oostrum was the Director of the short film *The Fishy Chess Move,* frames above and below. Daan Kramer was the Cinematographer and he worked with Cooke S8/i Primes wide open. The look includes smooth skin tones and lustrous bokeh.

See how these Cookes look, here and on the following pages.

Above: Cooke S8/i 100mm at T1.4.
Below: Cooke S8/i 75mm at T1.4.

Cooke S8/i Specifications

Lens	25mm	32mm	40mm	50mm	75mm	100mm	135mm
Aperture	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22
Close Focus from Lens Front	335 mm	460 mm	450 mm	500 mm	585 mm	670 mm	960 mm
	13"	18"	18"	20"	23"	2' 2"	3' 1"
Min. Marked Object Distance	550 mm	650 mm	650 mm	700 mm	800 mm	850 mm	1200 mm
	22"	2' 3"	2' 3"	2' 3"	2' 9"	2' 9"	4'
Length from Front of lens to Lens Mount	162 mm	156.9 mm	159.6 mm	157 mm	156.9 mm	156.9 mm	200 mm
Length from front element apex to Lens Mount	158 mm	143 mm	146 mm	143 mm	143 mm	128 mm	190 mm
Max Front Diameter	104 mm	104 mm	104 mm	104 mm	104 mm	104 mm	104 mm
Angular Rotation from MOD to End Stop	270°	270°	270°	270°	270°	270°	270°
Angular Rotation of Iris Scale	90°	90°	90°	90°	90°	90°	90°
Max. Diag. Angle of View for FF Format	81°	67°	56°	47°	32°	24°	18°
Total Weight	2.47 Kg	2.43 Kg	2.37 Kg	2.16 Kg	2.48 Kg	2.45 Kg	3.24 Kg
Price announced at launch in US $	$34,650	$34,650	$34,650	$34,650	$34,650	$34,650	$36,100

Maximum Image Area Coverage	S8/i primes cover up to a 46.31 mm image circle diagonal ∅, except the 18mm and 21mm which cover to 43.3mm ∅.
Focus Scales	Two Opposing Focus Scales – Dual scales Metric and Imperial. Scales marked from MOD to infinity. In other words, each focus ring is engraved with both Imperial and Metric scales..
Focus Drive Gear	140 teeth 0.8 M
Iris Scales	Two Opposing Linear T-Scales – marked in whole and 1/3 stops.
Iris Drive Gear	134 teeth 0.8 M
Screw-In Front Filter	M105 x 0.75
Optical Design	The S8/i series contain only spherical optical elements. There are no aspheres.
Matching	All S8/i primes are color matched.
Lens Mounts	Titanium PL or LPL mounts with /i Technology contacts
/i Technology	4-pin external Lemo connector and contacts in the lens mount. Lens metadata includes focus and Iris position, focal length, serial number, and individually calibrated lens distortion and shading maps.

Additional Cooke S8/i Focal Lengths

Additional focal lengths are in development:

Lens	18mm	21mm	27mm	35mm	65mm	85mm Macro	180mm	250mm	350mm
Aperture	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22	T1.8-T22	T2.5-22	T2.8-22

Data published in these charts is subject to change.

Above: Cooke S8/i 100mm at T1.4.

Below: Cooke S8/i 50mm at T1.4

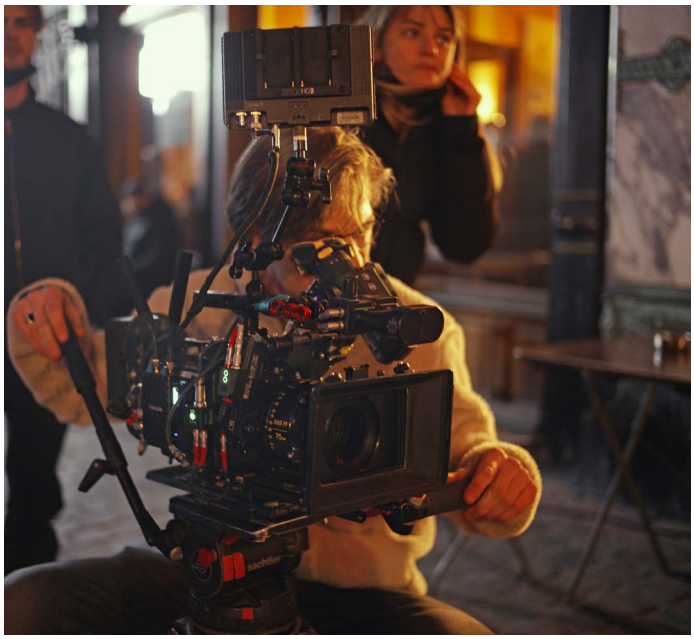
Above: Cooke S8/i 40mm at T1.4.

Below: Cooke S8/i 50mm at T1.4.

Cooke S8/i Full Frame Primes BTS in Brussels

Above: Director Sara van Oostrum with 50mm Cooke S8/i on Optica Magnus FF finder.

Cinematographer Daan Kramer with finder; Director Sara van Oostrum; Art Director Cato van Passel; and Focus Puller Nathan Lederman.



Cinematographer Daan Kramer discussed the backstory:

Camera

We used an ARRI ALEXA Mini LF and shot ARRIRAW Open Gate on *Fishy Chess Move*. The camera and gear came from cinematographer Danny Elsen and Lucky Cameras here in Belgium.

The camera build, handsomely put together by camera assistant/focus puller Nathan Lederman, was unbelievably well balanced and overall was a lovely setup to use. The new Cooke S8/i are light and small, making them great for a more compact camera without having to make sacrifices in the speed of the lens. I can imagine that these small yet mighty lenses would be excellent to use on Steadicam or on Gimbals.

Look

In term of the look, the lenses are familiar to what we've come to expect from Cooke Optics—yet they went above and beyond because they are fast lenses. The focus fall-off is beautiful and has this creamy feel without seeming unnatural. This made it possible for us to really isolate the little boy in our story, to really dive into his imagination. The Full Frame format's look also added an epic feel to the images.

Focus

About focusing wide open at T1.4, Nathan Lederman, the sharp focus puller on the shoot, said, "I mapped all the lenses on my cmotion cPRO PLUS in combination with my Cine RT Ultrasonic rangerfinder."

Story and Style

Sara wrote the script herself. For the past couple of years, she has mostly focused on content with a magical feel and where a child's fantasy comes to life. So, when she heard that she got the assignment to do a showcase film for the new Cooke S8/i, she tried to take this opportunity to further explore. These lenses were ideal for this theme. Sara really wanted to establish a magical realism tone.

The location for *Fishy Chess Move* was in Brussels. It was an early 20th century café built in the Art Nouveau style typical for that period. The location was specifically chosen to fit the warm look and feel that Cooke optics are known for. We also drew a lot of inspiration from Impressionism and the film *Hugo* on which I believe Bob Richardson, ASC also used Cooke lenses—Cooke 5/i.

Cooke S8/i T1.4 on *Fishy Chess Move*

Cooke S8/i T1.4 on *Fishy Chess Move*

Cooke S8/i 100mm

Cooke S8/i 50mm. Actress Anna Khanzhina-Albright. Cinematographer Bill Bennett, ASC said, “It was really cold, with strong winds blowing across the high desert plain, 20 miles northeast of Palmdale California, in the middle of nowhere.

Cooke S8/i 32mm

Bill Bennett, ASC, in the blue jacket to the left of the ARRI ALEXA LF, was the cinematographer. " Kees van Oostrum, ASC, directed. He's in brown trousers, under the black furniture blanket, looking at the monitor. Gaffer: Rodney Charters, ASC. First Camera Assistant: Ambar Capoor. Steadicam Operator: Raphaël van Oostrum, above right.

Above: Kees van Oostrum, ASC, NSC, SBC, AIC, and Chairman of Cooke Optics.

Jon Fauer: Please tell us about your work at Cooke.

Kees van Oostrum: My association with Cooke is interesting. Let me put it this way: first, I'm a cinematographer, always have been and will be. Second is my love for optics, which has been ongoing. Optics have always been of great interest to me. And third, I'm very flattered to have been asked at the time by Les Zellan to become his successor as chairman of Cooke Optics. I accepted that challenge and have enjoyed it very much, because what is better than to come into the Garden of Eden of cine lenses and deal with design and products that might make a difference in the world of cinematographers. I think that I would describe my situation right now as one that is very fortunate and interesting.

What does the job of chairman involve?

It is many different things. I'm approaching it with a certain amount of expertise in the area of lens look. I obviously don't design lenses. At Cooke, that's done by a team of optical and mechanical designers, supported by Iain Neil, the Chief Optics Advisor. But there's a lot to talk about lenses, about what they look like, how they feel. There's also an importance in what are you actually going to build next. What do cinematographers want to see? How is the industry changing? How is the technology of recording those images changing? In a way, most companies are run by technology-oriented people who may not necessarily be sensitive to the likes and dislikes of cinematographers. At best, they listen to cinematographers, but listening and knowing are two different things.

Can you say that yours is partially a role as a product manager who listens to colleagues and then filters those comments to the lens designers? You are also one of the few cinematographers actually working at a lens company.

I don't think product manager is the right description. Andy Buckland is Director of Product Management at Cooke and does exactly that. He and the sales representatives stay in touch with the clientele, which would be cinematographers, and of course the rental houses. I think my dynamic is more like what I said earlier. I love optics. I have a certain opinion about it. I also have a love for the Classic Cooke Speed Panchros, which we cinematographers all talk about ad infinitum. So now I look at the lenses, at the focal lengths, and I say, "Well, we're missing something here, I think, because when you shoot, you need X, Y, Z." So, I would say I'm more the voice of a cinematographer.

You're an advocate, then.

An advocate, or rebel sometimes—because sometimes you have to step up and say, "No, that's not how it works."

How often do you meet with the rest of the team at Cooke?

I probably have about ten Zoom meetings a week with various people. Board meetings are once every month. I meet with the design group every Monday. I talk to Iain Neil about once every day. I've known Iain for 35 years or so, ever since I was starting as a cinematographer. I went to Panavision one day, and Iain had just arrived there. I spent many hours with him in the lens design room because we were always mucking about. Even then, Iain was very engaged with cinematographers in trying to create certain looks. We were at the beginning of the Primo era then. Probably for the first 15 years of my career, I was a Panavision guy. So, there's a long legacy of that. Basically, Iain and I visited frequently up until he left Panavision. And then I lost track of him for a while, because he moved to Switzerland, and started consulting at CW Sonderoptic (now Leitz) and then Cooke. So this was a wonderful, how can you say, re-meeting the Pope after all those years.

You probably picked up right where you left off.

He knows the character of every lens. He knows why you would like something, the potential reason, and things that are not necessarily a design issue. Besides talking about new products at Cooke and developing some of them, we now talk a lot about what is it that ticks in a certain lens. What is the heart of that lens? Why would people like it so much? Or why do I like it so much? What does he think? It's a fascinating conversation every time we broach the subject.

What trends do you see in lenses and looks? For a while, there was a trend of distressed vintage, and now it seems to be shifting again.

I think we want lenses that have a certain feeling and that mean something. It isn't necessarily extreme vintage. That's a choice. Extreme vintage works very well for a commercial, but doesn't always work very well when you do a theatrical feature, when you have multiple cameras going, when you need multiple sets of lenses, and you need a predictability about these lenses because they represent your look.

So, I think that Cooke, being one of the foremost lens builders in the world, must be able to appeal to both crowds. There is a large market that wants a very bespoke look. And there is a huge, rapidly growing market that I would call the high-end professional market. This group wants the stability of a tremendous

Cooke S8/i Full Frame Primes

set of lenses that perform one after the other similarly, as far as the bokeh is concerned, as far as the way of treating highlights is concerned, flaring is concerned, and so on. But at the same time, we want something that is characterful.

That is a problem because lens design has become so technologically driven. It's become almost a computer game and a lot of lenses look so similar. The change of the DP behind the camera will do more than any change of the lens set being used. That doesn't mean all lenses are the same and, speaking as a cinematographer, we may fall in love with a certain lens. It may do well in the lens projection or prep room, but when you shoot a movie, you encounter multiple situations that you couldn't have foreseen. No lens projection tests in the world can ever cover what you encounter in the real world.

So, what happens at the end of a movie, and everybody loves what you did? It was okay and you got beautiful images. But maybe you didn't really like the ultimate look of the lenses. They didn't really respond; they didn't speak to you. That is where we are today, sometimes. We know there are differences in lenses that will influence your work, not only in the camera tests, but also in your journey throughout a whole movie, where you're dealing with situations of contrast and color that you couldn't have foreseen. And suddenly you put a certain lens on the camera, and wow. You fall in love with that look. That's the cinematography approach, as opposed to a technical design approach.

That's an articulate explanation. You talked about the high-end. Do you see it expanding?

Oh, yes. And that's a good introduction to the next, new Cooke S8/i series of Full Frame lenses.

Cooke S8/i Full Frame Primes

I think the S8/i lenses are spectacular. They are fast—T1.4, Full-Frame, smaller, lighter weight, with titanium parts. What is really fascinating is that Iain Neil conceived these lenses without using any aspheric elements—all the way through the entire focal range. That gives the lenses a character that is unique. Opening wide to T1.4 on a non-aspheric lens, you still maintain wonderful focus. It does not just get softer. It creates a different look.

We have the combination of the new glass technology and a designer like Iain who knows how to bend the light in wonderful combinations. It adds an artisan craftsmanship that is very important in making lenses today.

Did you say there are no aspherics, only spherical elements inside?

Yes. The new S8/i Full Frame series are an interesting departure from the S7/i . We went on a quest to have the lenses lighter and smaller. It still features the Cooke look. But you have titanium mounts in the back and various weight-saving design elements. The Cooke design team has done everything to save weight. The S8 lenses just feel a lot easier to handle. You can hold them in one hand. And yes, the lenses are designed without any aspherical elements. This is a novel way constructing modern day optics and is a direct result of working with cinematographers to create a specific look.

Cooke Panchro/i Classic FF Primes

Iain Neil can tell you exactly why. In some ways, these are a less complex lens, and they render differently. That's my feeling.

Evolution of Lens Design and Manufacturing

How is lens design and manufacturing evolving at Cooke?

Lens design has been evolving because we now know more than ever. There are, in the world, a few people, not many, who really understand the craft of building a lens and are able to take the new technology and source new materials and create something that is, in its own way, unique. And then, those lenses must address the likes or dislikes of a cinematographer, a singular artist.

You touched on something else that was interesting about lenses: repeatability.

Vintage lenses were designed in the film era. When you shoot on film, which we both did extensively, you need contrast and resolution. If you don't have contrast, after your negative has gone through all the steps we have now forgotten about—internegative, interpositive, and finally release print—and you see it in the theater, sometimes you are horrified because you lost everything you had gained.

It was important for those lenses to maintain resolution, and the importance of resolution has not changed. For example, I have an uncoated f/2.5 Cooke Speed Graphic lens from 1920s that I have used for some commercials at times. If you flag off all the stray light coming in, and you do not have bright, shiny objects in frame, that lens might look as sharp as a Master Prime. The moment you have a candle in frame, or you have a little sun streak in the background, it starts blooming, and it affects the whole lens. So, in my opinion, the resolution of the lens can be less important than its contrast. And how did we change the contrast? Of course, with exotic glass, coatings, and advanced coating technology along the way.

In the film era, lens manufacturers increased the contrast of their lenses using coatings to create a greater perceived sharpness. As the state of the art advanced, new lenses made film look really good because it was the film itself that had a built-in softness because of the process it went through.

And then we got to digital...

Suddenly we started using those lenses on digital sensors where we don't have that loss. Actually, we increased contrast with the sensor itself. So, a lot of our images started to come back too contrasty, too sharp, too defined. And we wanted to move away from that. We started to use filters again, heavily, as you recall. I'm talking about 10 years ago.

And then we discovered that if you took really old lenses that at full open apertures have all these inherent problems with contrast and with falloff, you got a nice image with the digital sensor. So that started to turn the ship around. And it also started to turn the ship around for lens designers, because when they started to build the newer lenses, they had to really think about what they were going to do about contrast. If you look at some of the better lenses out there now for Full-Frame, the resolution is way up as well, but the contrast is what makes the difference.

So now we go back to vintage lenses. They are interesting, but not for everything or for everybody. The problem with vintage lenses is the mechanics. They're usually very poor, are either worn out or were never good to begin with. So, then you start remounting and rehousing those lenses. Some people do a great job, and others don't do such a great job. You'll find that it's not so easy to build the mechanics around an existing lens, and only a few companies are really good at it. I think that the development of the classic vintage lens is wonderful. It has inspired us, and it also has told us, from a lens manufacturing point of view, that we had to revisit the way we thought about these lenses and went about our business. So that's it.

You have my attention. What's else is coming from Cooke?

Cooke Varotal/i Full Frame Zooms

Full-Frame Panchro/i Classic

We recently introduced the Full-Frame Panchro/i Classic prime lenses. The new Full-Frame Panchro/i Classics will cover a 43.26mm Image circle. The existing Panchro/i Classic 65mm Macro, 75, 100, 135 and 152 mm were designed for Super35, but they nicely cover Full-Frame as well.

I've always loved Cooke Panchro lenses. They've been my favorite go-to lenses at times for a specific look. If you talk about what are among the greatest vintage lenses out there, I think we must include the Speed Panchro [designed by Horace W. Lee in the 1920s]. And celebrating a centennial this year since the first ones were sold in 1921. But they were limited to Super35 until now.

Now we're offering the Speed Panchro look for Full Frame. It is kind of an ode to a classic lens that is specific. It's vintage, but it also is put together with a modern sensibility. The mechanics are much more rugged than the originals. Some of the vintage issues are resolved. The glass in the Classic is the same as the original; there's almost no difference.

The coatings are the same. My cinematographer colleagues might say, "Yeah, but I like the original vintage Panchro's better." So I did extensive tests with original vintage Speed Panchros against our new Panchro/i Classics. The difference in my opinion is negligible. The difference that remains is that the old Speed Panchro's are usually a bit warmer and sometimes tend to be a little bit softer. Why? The fact is that those old lenses are more than 50 years old, and the coatings have disintegrated, become yellow and of course, there's dust in the lens that gives it what I call a classic patina. So I'm looking at being able to give you something to add to the rear of the lens if you want that classic patina. But I tell you, honestly, I yet have to find a vintage Speed Panchro that I couldn't match with the new Panchro/i Classic.

Remember, also, over the years that the vintage Speed Panchro's were built, there were many changes in the manufacturing techniques. That's why, when people remount them, they prefer Series 3, not Series 2, and certainly not Series 1.

What is the maximum aperture? And will you rename the longer focal lengths Full-Frame?

Wide open is still T2.2 through 100mm. The longer focal lengths have not changed, but when we sell a new set, they'll all be called the Panchro/i Classic Full Frames.

Cooke Varotal/i Full Frame zooms

Please tell us more about the new zooms.

Kind of a milestone in my opinion with the introduction this year of the new Cooke Varotal/i Full-Frame zoom lenses: 30-95 mm and 85-215 mm. These are the first two and a wide-angle zoom will come out in the fall this year, approximately in an 18-40 mm range. They will all have a T2.9 maximum aperture.

Varotal: the first 35mm zoom I bought was a Cooke Varotal 20-60. Followed by 20-100, 18-100. Amazing—they were the only zooms at the time that didn't breathe. I loved those Varotals.

Me too. That's the first project I started when I joined Cooke. I said, "We need to provide zoom lenses again." I still have my 18-100 and 25-250 that are both in great shape. I'm not saying that these are the same lenses. The new Varotal's feature a totally new design, are much more advanced and, of course, Full-Frame. The name "Varotal" is a reference to the great zooms that Cooke once built. These new ones are fairly small and lightweight.

Candy Store for the Cinematographer

Jon, do you realize that Cooke Optics is currently manufacturing and offering between spherical and anamorphic and Super35 and Full Frame, one hundred and sixteen different lens options all designed for cinema? That's why I refer to it as the Cooke candy store for the cinematographer.

This has been a fascinating discussion. Congratulations on the new lenses. Thank you.

I'm enjoying what I'm doing. I took a love for lenses from over the last 40 years as a cinematographer and now I can share that with others.

Iain Neil, Cooke Chief Optics Advisor

Above: Iain Neil—lens designer, recipient of multiple Academy Scientific and Technical Awards, ASC associate member, SMPTE and SPIE Fellow, member of AMPAS and Optica—has been working at Cooke Optics for more than 10 years in the role of Chief Optics Advisor. He worked on the S6 series, better known as Super 35 Anamorphic/i Primes. Then came anamorphic zooms and the Full Frame S7/i series. And now S8/i primes. Iain's work at Cooke involved consulting and overseeing the optical design as well as working closely with the engineering team to develop efficient methods to build the lenses, particularly Anamorphics.

Doing an interview with Iain Neil is similar to Vittorio Storaro. Iain begins by asking, "Can I ramble on? Jump in when you want specific questions answered." Vittorio's interviews begin with a long dinner. "Three bottles of wine, no water," he commands. Discussions with Iain are like a graduate course in optics, illuminating and focused. This one could have gone much longer, were it not for the faltering endurance of a laptop battery on a Zoom video call.

Jon Fauer: How did your work on Cooke S8/i Primes begin?

Iain Neil: During the past five or more years, I kept hearing that images produced by digital cameras mostly looked the same, especially with spherical, also known as "flat," lenses. Yes, Anamorphic is different and Speed Panchros are different, but for regular spherical lenses on the majority of the cameras, the words "clinical, sterile look" were heard often. This seemed to be bothering a lot of cinematographers because they wanted to have a look that told the story and went with the movie while still being unique. Thinking about this, I said, "Well, maybe future lenses should be designed so that the images are more film-like, as opposed to digital." The question was how to do it? I started working with aspherical surfaces back in the 1970s for infrared optics. Then we had aspherical surfaces in cine optics around the 1990s. And those types of aspheres, unfortunately, took a direction where the imaging appeared clinical or sterile.

The focus in the past, with film, tended to be mostly about resolution and then contrast. But with digital, you can say there's a limit to the resolution that you need. We only need so much resolution because the camera won't see any more than a certain number of cycles per millimeter. In the old days, and the old days were maybe 15 to 20 years ago, people referred to cine lenses as showing, for example, 200 cycles per millimeter. Well, these days, even with the highest resolution digital cameras available, you're not going to see much more than 100 cycles per millimeter, and that's at the upper limit.

The point is that we don't need to be quite so obsessed with resolution. The key is contrast. In my view, you want to maximize the contrast. So, when the S8/i project began, I said, "We don't really need the aspherical surfaces—they are not magical. With spherical optics, you can design lenses that perform very well—maybe not to super high resolution levels, but certainly sufficient, and quite ample, for digital cameras not just today, but even in 5 or 10 years from now."

Spherical optics can do just as good a job as lenses with aspherical optics. Certainly there are trade-offs: size, weight, cost, supply chain. Many things about spherical optics look more attractive to a lens manufacturer. And the imaging, it turns out, can be made to look quite film-like.

What do you mean by film-like?

It refers to the look from a digital camera that looks more like film. This is the essence of what we were striving to achieve with the new Cooke S8/i lenses. S8/i have optimized aberration correction with the Cooke look built in for digital cameras. You as the cinematographer can establish your own look by adjusting the lighting, filtration, and other things.

Furthermore, in designing spherical lenses, you can produce a near telecentric output of the light rays that is nice for the sensor. It makes the sensor efficient. Remember that Cooke has a long history of making lenses for film, and then film plus digital. But now, we're talking about the new S8/i lenses where the emphasis is on digital, but you can still use them for film and on PL mount Super 35 reflex film cameras. So, we want to minimize lateral color or color fringing, (not on-axis, but around the picture) and reduce it almost to the point where there's none. You can do all this with spherical lenses.

Spherical lenses enabled a modular approach, both optically and mechanically, for the entire set of S8/i lenses. There are 16 focal lengths from 18 mm to 350 mm, the first 7 of which are here now the rest coming later in the year. The entire range, all spherical, all have the same, pleasing look. In other words, it's a matched series. The modular focus arrangement in the lenses and the modular mechanical design of the S8/i high speed lenses—which are T1.4 up to 135mm—means that you are really de-stressing, having less stress in your optical and mechanical design, which makes it, I don't know if the word is easier, but I think you have more chance to realize a good consistent product and a product now that has what I would say is a film-like look.

There are additional reasons for not having aspheres, whether pressed, molded, polished, ground, or other methods. One of them is the alignment, how precise you have to align aspheres, and the fact that over time, you may lose the alignment. So

then you have a servicing issue. The other issue with aspheres, especially when ground and polished, is the possibility of seeing "onion rings," or "tree rings" in the bokeh. It's not always the case, but it can show up. With spherical lenses, you have smooth-looking bokeh, without onion or tree rings.

Another feature of the S8/i lenses is that the control of the optical design is such that the bokeh shape remains the same for all the focal lengths. So, on-axis, you have circular bokeh, and as you go off-axis, you get what looks like a cat's eye. It's not a semi-circle or some unusual shape. The bokeh add to the pleasing look.

I worked on this for several years, looking at several kinds of optical designs. And then Cooke was interested in bringing out a new series of lenses. They had the S4/i, 5/i for Super35 and the S7/i series for Full Frame. But the S7/i are T2. You might say that you don't really need a faster lens. But there's one thing that's been happening lately. Fast lenses are not being used just for low light. It's not like the film days where ASA topped out at 500.

What seems to happen now, even when you shoot in daylight, is you add a lot of ND filtration and you open the lens to maximum aperture. And you're working with Full Frame image size. So, you have a very, very shallow depth of field. And that gets back to the look again.

All of these things go together: imaging, contrast, look, bokeh, shallow depth of field and resolution. How do you balance them? You want them all together, as a package. Then, on top of all this, you have the Cooke look. The Cooke look is, I think, familiar to most people by now. One of the nice results is having very good skin tones. It's very good with people, with actors and actresses. And so, you put all this together, and you do this in a lens series with spherical elements. So, that's the background of the new Cooke S8/i series.

Were you responding to market requests and DP feedback?

Technology advances with lenses. But sometimes I feel as though designers see the new technology and then feel obligated to use it. In this case, I didn't feel that we should follow the technology. We found out what the customers wanted and what was their need.

We hear so much about de-tuning of lenses. And when you de-tune a lens, you're trying to take away some resolution or contrast or something. Here, I am coming at it the opposite way and saying, "Well, how do you tune the lens? How do you tune it for the latest digital imaging technology?" In other words, we started from scratch.

When did this begin?

The project, the concept, the incubation period, was generated over some years. It was Les Zellan, when he was Chairman at Cooke who said, "We want to do this because we should have a new flagship series of Full Frame lenses. Then, once you have the idea or concept, then you have to develop the product. Of course, Cooke has the optical and mechanical design teams, the manufacturing capacity, the testing, the supply chain—they have all these pieces.

Do the S4/i lenses have aspheres?

No, S4/i prime lenses have a slower aperture so have less need for aspheres.

When we talk about the Cooke look, can we say that these new S8/i primes match earlier Cooke primes?

Yes, but the S8/i Cooke look has been somewhat tuned for the digital sensor. The Cooke look has been defined. You interviewed Jon Maxwell a while back. But the Cooke look for digital needs an additional word. That word is "tuned." It has been tuned a little bit to suit the pixel size and what's going on with the digital sensor. If you take an S4/i Cooke lens and put it on a digital camera, it will work very well. I don't want to say there's more or less Cooke look, but I would say the S8/i has been tuned a bit more precisely for digital sensors than it was for film and it is consistent throughout the S8/i lens range. When these lenses were being optically designed, they were done as an entire set, together. It wasn't one focal length, then the next, and the next, with different people doing different things. Everything was co-ordinated, all done in parallel.

Good point, because the S4 series were introduced in 1998. They were equipped with Cooke /i beginning in 2005. Additional focal lengths were added until there were 18 of them by 2012.

You mentioned that the earlier emphasis in the film days was on resolution and they were often trying to achieve 200 line-pairs. But film could not resolve 200 line-pairs. So why were they trying to strive for that?

That's a very interesting question that leads into an avenue with many side roads. When you look at a lens on projection, the human eye and the brain works well looking for resolution, but does not work well looking for contrast. If your reticle has 200 cycles per millimeter test targets or vertical and horizontal bars, or line pairs, the human eye will be looking at that. It will not be looking at, say 40 cycles per millimeter.

And by the way, 40 cycles per millimeter is about 4K for a Super35 size image and about 6K for a 36 x 24mm full frame image size, depending how the pixels are added together. So, 200 cycles is respectively 20K and 30K. Unfortunately, projection these days is not so accurate now in terms of assessing a cine lens for a digital camera.

Why is projection not as good for assessing a cine lens?

First of all, you should not be looking at 200 cycles per millimeter. Ultimately, when you put the lens on the camera, I doubt, unless it's a military or government type application, that you'll be looking at 200 cycles per millimeter. It does make a difference when you're designing, building, assessing, and projection testing. Do you set various parameters of the lens for 200 cycles per millimeter or you do it for maybe 100 cycles per millimeter? It makes a big difference.

There's another thing about digital cameras. Remember with film, the light came out the back of the lens, and it hit the film emulsion. Actually, it hit one layer and then it went through and hit another and another. Now, the light comes out the lens and it goes through an optical low pass filter. Let's just say that it messes around with the light. In fact, it's one of the reasons you don't see 200 cycles per millimeter — because without the OLPF you may get moiré and aliasing.

Also, different from film, the sensor is composed of photosites with micro lenses and filters on each one. You have none of that with film.

When you put your lens on a standard projector, it does not usually simulate the effect of the OLPF, the color filters or the micro lenses on each pixel. All these come into effect when the lens works on the camera itself. If you have an optical low pass filter and you have a very fast T1.4 lens, the OLPF filter may introduce some spherical aberration. And what this means is it will drop the contrast a little bit.

But to play devil's advocate, I'm seeing a trend where some of the camera manufacturers are not using low pass filters anymore. For example, Blackmagic, Leica, Nikon and Canon. But perhaps another reason why the lens manufacturers in the old days were going for a higher resolution was because of the many stages from OCN (Original Camera Negative) to intermediate, interpositive, internegative to a release print that probably bounced around in the projector's gate?

Typically, if you just do a contact print, without the rest of the process, you're going to see somewhere between 60 to 100 cycles per millimeter. If you want to go to 200 cycles, you've got to go to a black and white film stock used for reconnaissance, but you're unlikely to get there with color film.

So, what's the reason why, in the "old days," were they were striving for 200 line pairs?

Marketing.

Wow. So, how would you compare the look of the new FF S8/i T1.4 to the original high speed S35 5/i T1.4 (September 2009) and FF S7/i T2.0 (April 2017) in terms of look?

I think the best way to answer it would be to take an S8/i and say, "Let's stop it down to T2." And then I would say it looks quite similar to the S7/i. Maybe not exactly, but quite similar. The difference would be then at full aperture, wide open, and at full aperture with the S8/i, I believe you will see a more film-like look because of the contrast and resolution balance. I'd say the blend is more modern.

Even though S7/i is only a few years old, already things have moved on. There are changes in the technology and what people want. The S7/i were lenses designed for digital but still thinking about film. It's a bit like the S7/i were giving two points to film and one point to digital. With the S8/i, it's like two points to digital and one to film.

And two points for Harry Potter's Gryffindor and one point for Hufflepuff.

With the 5/i series, it's really the similar story. I don't want to make it sound that this is a firm spec, but they were really designed for film. It doesn't mean you can't use them for digital, but they are earlier designs than S7/i.

Right. The Super35 5/i T1.4 primes were introduced in September 2009, at the same IBC show where the first ARRI cameras code-named ALEXA were launched. Those were indeed early days of digital.

That was the beginning of thinking digital for cine lenses.

I think another advantage of the S8/i series is that they're lighter and smaller, which is a big deal now.

Well, I would say that is very compelling. It is a trend not just with cine optics but with cameras as well. Some of this has been pushed along by drones and gimbals and stabilizers. But the trend is towards a bigger image size: Full Frame. That can make lenses larger, heavier, more complicated, more expensive. I know people say, "Oh, but there's no reflex mirror in these cameras. You can push the lens closer to the sensor." But they're still going to trend larger, heavier.

Cooke has been designing lenses to accommodate a reflex mirror since the S4 was introduced, basically, for ARRI PL mount cameras with a 52mm flange focal depth. And the S8/i actually can still do that. But there was an emphasis here as well to make these lenses more compact and lightweight. The optical designs took that into consideration with the configuration, the structure, and the focus groups. If you only get one focus group moving or one lens element moving, the mechanics are usually simpler than having two or three elements, or two groups of elements, move.

The optical design, following on with the mechanical design, put a lot of emphasis on the size and then the weight. The primary thing was to do with diameter and length. In fact, most of them have a 104mm front diameter and are 157mm long.

Hang on. I remember a discussion at the beginning of the Full Frame wave, and an optical designer named Iain Neil said, "Oh, but they're going to have to be twice as big and twice as heavy." But with the S8/i, you refute that argument, in a good way.

Actually, what happened was I spent about three years doing a feasibility study on my own. I asked, "What can we do with spherical optics these days with the new glass types, using the most modern optical design software? What can we achieve?" The result of that is why I would now say my earlier comment has been revised.

For example, compare the Full Frame S8/i T1.4 front diameter of 104mm to a Super35 S4/i T2 at 110 mm. The slower, older Super35 lens is even bigger than your new Full Frame lens.

Well, yeah, but remember, the S4 was 24 years ago. That is a long time.

What are some of the innovations in design or manufacturing that made it possible to make the S8/i much lighter and smaller?

You do statistical analysis of the tolerances and manufacturing errors. So, you can push the design envelope much further. In the old days, you wouldn't always know what to expect until you finished actually building a lens. The software, design techniques, and modern analysis all mean that you can accurately predict how lenses will perform before you build them.

I assume that the S8/i lenses can be delivered much faster than Cooke traditionally has been able to get lenses to customers?

Yes, they should be. If for no other reason than the lack of aspheres. A lot of other things have changed at Cooke. But if for no other reason, not having aspheres makes a huge difference—it's a large factor. In designing earlier lenses at Cooke, they always said, "See these damned aspheres. They're a bloody nuisance. They're difficult to source. Then we get them, and they're not the right quality. They charge lots of money. We can't get the volume. We can't build enough lenses." So, the word was out, get rid of aspheres.

And that's what got me thinking. The window of opportunity has shrunk from 10 years to 2 or 3. So, if you can't build enough lenses because of aspheres, in three years you'll be overtaken. The market will change: the lenses, the cameras, whatever. So, getting away from aspheres means you can produce more and get it out in a shorter time. That's happening all over in the world. That's how it's now working.

Is there a definable difference between what you call a "film-like look" and "Cooke look?"

No. The film-like look includes the Cooke look. It's combined. As we discussed earlier, the Cooke look got a little bit more precisely tuned for digital sensors because it hadn't been done before. The residual aberration, contrast, resolution, the whole way the image looks, that's blended with the Cooke look. And it's even blended with the fact that the camera has a little bit of filtration with its optical low pass filter.

Someone once said in FDTimes that a lens is a compromise of many things: focal length, speed, size, weight, cost, look. That is always the case. We don't want to make the lens too small, too compact, too lightweight because that could make it very difficult or impossible to build the lens at a reasonable price.

It's a balance, more than a compromise. Blend is perhaps a better word because compromise sounds to me like something made by a committee where nothing's very good, whereas blend sounds as though you've done something good. I think what we did with S8/i is a very good overall blend.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16
22


S8/i FF
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60
40
30
20
50mm

Cooke S8/i Full Frame Primes

Lens	25mm	32mm	40mm	50mm	75mm	100mm	135mm
Aperture	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22	T1.4-T22
Min. Marked Object Distance	550 mm	650 mm	650 mm	700 mm	800 mm	850 mm	1200 mm
	22"	2' 3"	2' 3"	2' 3"	2' 9"	2' 9"	4'
Close Focus from Lens Front	335 mm	460 mm	450 mm	500 mm	585 mm	670 mm	960 mm
	13"	18"	18"	20"	23"	2' 2"	3' 1"
Rotation of Focus Scale to MOD	270°	270°	270°	270°	270°	270°	270°
Rotation of Iris Scale	90°	90°	90°	90°	90°	90°	90°
Max. Diag. Angle of View in FF Format	81°	67°	56°	47°	32°	24°	18°
Length from Front to Lens Mount	162 mm	156.9 mm	159.6 mm	157 mm	156.9 mm	156.9 mm	200 mm
Max Front Diameter	104 mm	104 mm	104 mm	104 mm	104 mm	104 mm	104 mm
Weight	2.47 kg	2.43 kg	2.37 kg	2.16 kg	2.48 kg	2.45 kg	3.24 kg
Maximum Format Coverage Ø	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm

More focal lengths to follow

Focus Scales Two Opposing Focus Scales – Dual scales Metric and Imperial. Scales marked from MOD to infinity.
Focus Drive Gear 140 teeth 0.8 metric module
Iris Scales Two Opposing Linear T-Scales – marked in whole and 1/3 stops.
Iris Drive Gear 134 teeth 0.8 metric module
Screw-in Front Filter M99 x 0.75
Lens Mounts Titanium PL or LPL mounts with /i Technology contacts

Common to this chart and the lens specification charts that follow:

- **Focus Scales** Each focus ring is engraved with both Imperial and Metric scale — you flip the ring around to view the other scale.
- **/i Technology** 4-pin external Lemo connector and contacts in the lens mount. Lens metadata includes focus and Iris position, focal length, serial number, and individually calibrated lens distortion and shading maps.
- **Rotation of Scales** Angular rotation to endstops.
- **Weight** Total weight with lens mount.
- **Image Circle Ø** Term used wherer Maximum Format Coverage does not fit in the chart.

Cooke S7/i Full Frame Primes

Lens	16mm	18mm	21mm	25mm	27mm	32mm	40mm	50mm	65mm	75mm	100mm	135mm	180mm	300mm
Aperture	T2 - T22	T2 - T22	T2 - T22	T2 - T22	T2 - T22	T2 - T22	T2 - T22	T2 - T22	T2 - T22	T2 - T22	T2 - T22	T2 - T22	T2 - T22	T3.3 - T22
Min MOD	400 mm	400 mm	350 mm	350 mm	350 mm	350 mm	450 mm	500 mm	475 mm	475 mm	700 mm	950 mm	1300 mm	2100 mm
	16 in	16 in	14 in	14 in	14 in	14 in	18 in	20 in	19 in	19 in	30 in	39 in	51 in	6'9"
Close focus fr lens front	151 mm	158 mm	109 mm	109 mm	109 mm	109 mm	209 mm	259 mm	234 mm	234 mm	459 mm	709 mm	1050 mm	1790 mm
	6 in	6.2 in	4 in	4 in	4 in	4 in	8 in	10 in	9 in	9 in	18 in	37 in	41 in	69 in
Rotation of Focus Scale	270°	270°	270°	270°	270°	270°	270°	270°	270°	270°	270°	270°	270°	270°
Rotation of Iris Scale	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°
Max. diag. FF angle of view	107°	100°	91°	82°	76°	68°	57°	47°	37°	32°	24°	18°	13.7°	8.6°
Length from Lens Front to Mount	197 mm	200 mm	189 mm	189 mm	189 mm	189 mm	189 mm	189 mm	189 mm	189 mm	189 mm	189 mm	198 mm	256 mm
Max. Front Diameter	136 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm
Weight	4 kg	3.5 kg	3.3 kg	3.3 kg	3.3 kg	3.4 kg	3.5 kg	3.4 kg	3.0 kg	3.0 kg	3.3 kg	3.7 kg	3.6 kg	4.4 kg
Image Circle Ø	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm

Focus scales	Two opposing focus scales – Metric/Imperial. Scales marked from MOD to infinity.
Focus Drive Gear	140 teeth 0.8 metric module, 6 mm wide, 103 mm from image plane.
Iris Scales	Two opposing linear T-scales – marked in whole and third stops.
Iris Drive Gear	134 teeth 0.8 metric module, 4.0mm wide, 81 mm from image plane.
Screw-in Front Filter	M105 x 0.75 for 25mm - 300mm. No filter threads on 16mm, 18mm or 21mm

Cooke Macro 1:1 Full Frame Primes

Lens	60mm	90mm	150mm*
Aperture	T2.5 - T22	T2.5 - T22	T2.5 - T22
Min. MOD Magnification	1:1	1:1	1:1
Close Focus from Lens Front	55 mm	114 mm	172 mm
	2.2 in	4.5 in	6.8 in
Rotation of Focus Scale to MOD	290°	290°	290°
Rotation of Iris Scale	90°	90°	90°
Max. diagonal angle of view in FF format	39°	22°	16°
Length from front of lens to lens mount	159 mm	171 mm	218 mm
Max. front diameter	87 mm	87 mm	87 mm
Weight (with lens mount)	2.3 kg	2.5 kg	3.0 kg
Maximum Format Coverage Ø	46.31 mm	46.31 mm	46.31 mm

* Specifications of 150mm Macro may change

Focus Scales	Two Opposing Focus Scales – Dual scales Metric and Imperial. Scales marked from 1:1 to infinity.
Focus Drive Gear	0.8 metric module
Iris Scales	Two Opposing Linear T-Scales – marked in whole and 1/3 stops.
Iris Drive Gear	0.8 metric module
Screw-in Front Filter	M82 x 0.75

Most Cooke S7/i primes have an M.O.D. (Mininum Object Distance) of roughly 10 times the focal length.

These 3 Cooke Macro/i FF primes have a 1:1 magnification ratio. This means you can focus down to completely fill the Full-Frame (36x24mm or 40x20mm) image area with an object that is 36x24 mm or 40 x 20mm actual size.

Cooke Panchro/i Classic Full Frame Primes

Lens	18mm	21mm	25mm	27mm	32mm	40mm	50mm	65mm Macro	75mm	100mm	135mm	152mm
T-Stop range	T2.2 - T22	T2.2 - T22	T2.2 - T22	T2.2 - T22	T2.2 - T22	T2.2 - T22	T2.2 - T22	T2.4 - T22	T2.2 - T22	T2.6 - T22	T2.8 - T22	T3.0 - T22
Min. MOD	250 mm	300 mm	330 mm	330 mm	350 mm	350 mm	550 mm	325 mm	800 mm	950 mm	850 mm	1100 mm
	10"	11"	13"	13"	13"	13"	20"	13"	30"	36"	2' 9"	3' 6"
Close focus fr lens front	69 mm	103 mm	150 mm	153 mm	165 mm	200 mm	380 mm	114 mm	593 mm	743 mm	655 mm	903 mm
	2.7"	4"	5.9"	6"	6.5"	7.9"	15"	4.5"	23.4	29"	25.8"	36"
Rotation of focus scale	270°	270°	270°	270°	270°	270°	270°	270°	270°	270°	270°	270°
Rotation of iris scale	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°
Max. diag. FF angle of view	102°	92°	82°	78°	68°	57°	47°	36°	32°	25°	18°	16°
Length of Lens Front to Mount	125 mm	127 mm	125 mm	125 mm	110 mm	92 mm	113 mm	197 mm	155 mm	155 mm	167 mm	167 mm
Max. Front Diameter	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm	110 mm
Weight	2.2 kg	1.9 kg	2.0 kg	2.1 kg	1.9 kg	1.5 kg	1.4 kg	2.8 kg	1.8 kg	1.8 kg	2.1 kg	2.1 kg
Illumination Circle	43.3 mm	43.3 mm	43.3 mm	43.3 mm	43.3 mm	43.3 mm	43.3 mm	43.3 mm	43.3 mm	43.3 mm	43.3 mm	43.3 mm

Focus scales	Two opposing focus scales – Metric/Imperial. Scales marked from MOD to infinity.
Focus Drive Gear	140 teeth 0.8 metric module.
Iris Scales	Two opposing linear T-scales – marked in whole and third stops.
Iris Drive Gear	134 teeth 0.8 metric module.
Screw-in Front Filter	M105 x 0.75

Cooke 1.8x Anamorphic/i Full Frame Plus Primes

Lens	32mm	40mm	50mm	75mm	85mm Macro	100mm	135mm	180mm
Aperture	T2.3-T22	T2.3-T22	T2.3-T22	T2.3-T22	T2.8-T22	T2.3-T22	T2.3-T22	T2.3-T22
Min. Marked Object Distance (MOD)	900mm	900mm	850mm	1000mm	500mm	1200mm	1500mm	2000mm
	35"	35"	33"	39"	22"	46"	58"	80"
Close Focus from Lens Front	630mm	630mm	600mm	750mm	181mm	925mm	1166mm	1610mm
	25"	25"	24"	30"	7"	36"	46"	63"
Rotation of Focus Scale to MOD	270°	270°	270°	270°	270°	270°	270°	270°
Rotation of Iris Scale	90°	90°	90°	90°	90°	90°	90°	90°
Max. Diag. Angle of View in FF Format	99°	89°	77°	52°	45°	40°	30°	22°
Length from Front to Lens Mount	206mm	212mm	204mm	206mm	272mm	228mm	271mm	314mm
Maximum Front Diameter	136mm	136mm	110mm	110mm	136mm	110mm	110mm	110mm
Total Weight	4.2 kg	4.4 kg	4.0 kg	3.5 kg	5.2 kg	3.8 kg	5.0 kg	6.2 kg
	9.2 lb	9.7 lb	8.8 lb	7.7 lb	11.4 lb	8.4 lb	11 lb	13.6 lb
Image Circle Ø	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm	46.31 mm

Anamorphic Squeeze 1.8x
Focus scales Two opposing focus scales – Metric/Imperial. Scales marked from MOD to infinity.
Focus Drive Gear 140 teeth 0.8 metric module, 6 mm wide, 103 mm from image plane.
Iris Scales Two opposing linear T-scales – marked in whole and third stops.
Iris Drive Gear 134 teeth 0.8 metric module, 4.0mm wide, 81 mm from image plane.
Lens Mount PL
Versions Cooke 1.8x Anamorphic/i Full Frame Plus Primes come in two versions: regular and SF (Special Flare).

Regular version

SF version

Cooke Varotal/i Full Frame Zooms

Lens	30-95mm	85-215mm
Aperture	T2.9 - T22	T2.9 - T22
Min. Marked Object Distance	800 mm	1500 mm
	2'8"	5'
Close Focus from Lens Front	500 mm	1000 mm
	1'7"	3'3"
Rotation of Focus Scale from MOD to End Stop	280°	280°
Rotation of Zoom Scale	112°	100°
Rotation of Iris Scale	48°	48°
Max. Diagonal Angle of View in FF format (36 x 24 mm)	71.1° at 30 mm	28.6° at 85mm
	27° at 95 mm	11.5° at 215mm
Max. Diagonal Angle of View in S35 format (24.9 x 18.7 mm)	53.1° at 30 mm	20° at 85mm
	18.9° at 95 mm	8° at 215mm
Length from Front to Lens Mount	255 mm	255 mm
Max Front Diameter	114 mm	114 mm
Weight	4 kg	4 kg
	8.8 lb	8.8 lb
Illumination Circle Ø	46.3 mm	46.3 mm

Focus scales Two opposing focus scales – Metric/Imperial. Scales marked from MOD to infinity.
Focus Drive Gear 140 teeth 0.8 metric module, 6 mm wide, 103 mm from image plane.
Iris Scales Two opposing linear T-scales – marked in whole and third stops.
Iris Drive Gear 134 teeth 0.8 metric module, 4.0mm wide, 81 mm from image plane.
Screw-in Front Filter M112.5 x 0.5

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