

# PRIMO 70 SERIES



The "Look"



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# SPECS

## Panavision Primo 70 Series

Focal Length		T-Stop	Close Focus	
Primes				
4P24*	24	T2	12"	.30m
4P27	27	T2	14"	.36m
4P35	35	T2	14"	.36m
4P40	40	T2	14"	.36m
4P50	50	T2	16"	.41m
4P65	65	T2	20"	.51m
4P80	80	T2	24"	.61m
4P100	100	T2	30"	.76m
4P125	125	T2	36"	.91m
4P150	150	T2	48"	1.2m
4P200	200	T2.8	48"	1.2m
4P250	250	T2.8	48"	1.2m
Zooms				
4PZW	28-80	T3	33"	8.4m
4PZM	70-185	T3.5	60"	1.5m
4PZT	200-400	T4.5	78"	1.9m

\*4P24 in prototype stage, available early 2015

All front diameters: 4.44" / 112/8mm (except 4PZT which is 4.98" / 126.5mm)

## PRIMO 70 - IMAGE QUALITIES

Cinematography is a technological art, and the description of Primo 70s necessarily combines **subjective** characteristics that attempt to describe the look and feel of the image with **objective** characteristics that can be measured and analyzed.

Let's start with **aesthetic** image qualities a cinematographer might notice at first:

### A TASTE OF 70

While the Primo 70s are designed for 70mm image size, their quality is quite evident with the smaller Super 35 formats of the Arri Alexa, Sony F55 and Phantom 4K Flex, and with intermediate formats like the Red Dragon 6K. Although the Primo 70s offer optical qualities that go far beyond the resolution of these sensors, these lenses can give filmmakers “a taste of 70” with intermediate formats. This taste of 70 is also linked to angle of view and perspective, and we return to this theme in detail at the **end of the third paper**.

### NATURAL SHARPNESS

The Primo 70s are designed for the very demanding high-resolution requirements of large sensors. Many Cinematographers are wary of “too much sharpness”, especially on actors' faces, but after testing the lenses, they may discover the Primo 70s offer an optical clarity that is neither harsh nor “clinical”. The optical fidelity of the Primo 70s is created by contrast and definition from low, medium and high frequency details in the image.

### PRISTINE IMAGE

The Primo 70s offer a clean image without many of the optical aberrations that other lenses have. There is very little color fringing, coma tails, or distortion. The edges are not very different from the center. This lack of aberrations make the image easier on the eye, and feels more natural.

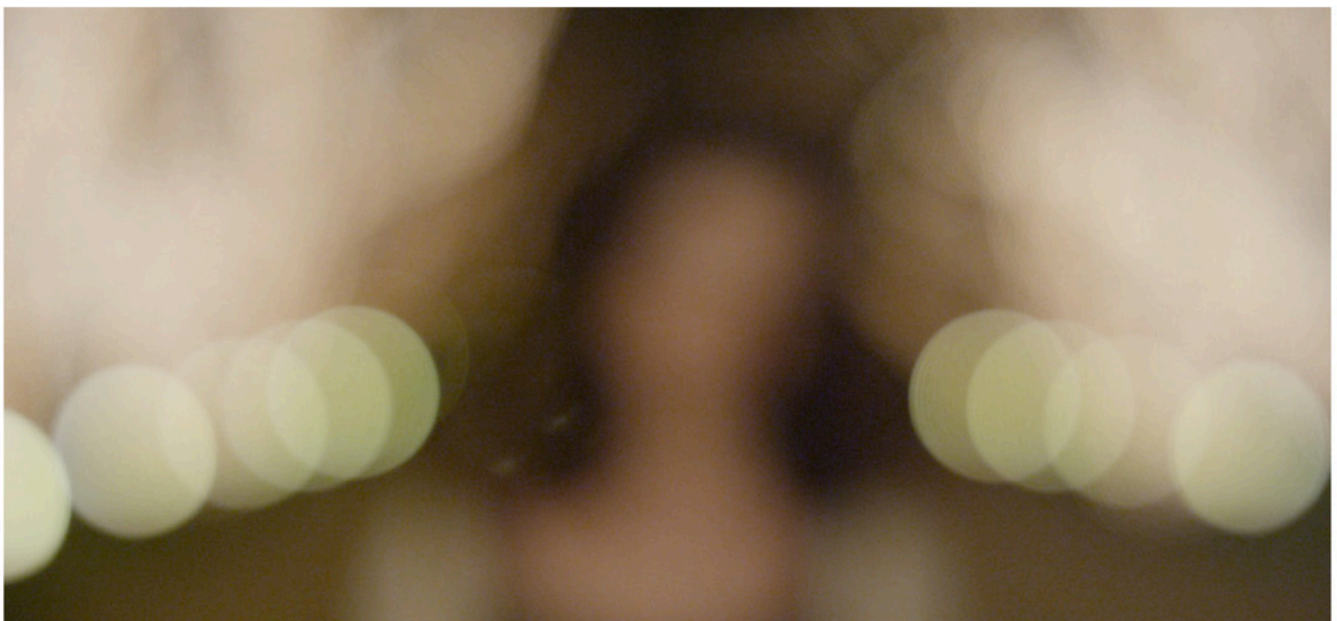
One cinematographer referred to this effect as a “no stress image”. The clean image of the Primo 70s can also allow cinematographers to dig into the **shadows** and pick up details that might be lost in aberrations with other lenses.

### PANAVISION LOOK

The 35mm Primos revolutionized cinema optics in the 1990s, by offering low veiling glare, uniformly matched lenses, faithful color reproduction and sharp images with a gentle focus fall-off. The Primo 70s continue this tradition of innovation and quality for large sensors with state of the art optical materials and designs. They have very few of the chromatic aberrations that can color a lens, and combine both sharpness and roundness.

### OUT OF FOCUS QUALITY

For Panavision lens designers, the out of focus image is as important as the focused one. While the Primo 70s are undeniably sharp, the fall-off from focus is gentle and smooth, with an organic quality to it. **Out of focus highlights** of the Primo 70s remain round, unlike the “cat-eye bokeh” of other lenses, which vignette the pupil.



## PRIMO 70 - TECHNICAL DESIGN

The aesthetic qualities of the lenses listed earlier result from choices in the design and construction of the Primo 70s.

Here are some key **technical** design features.

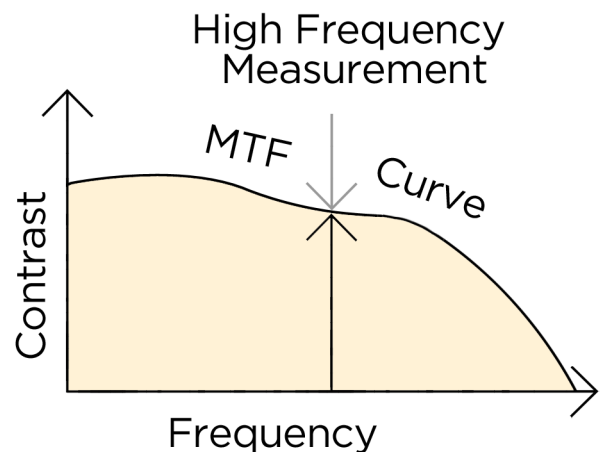
### TECHNICALLY SUPERIOR

The Primo 70 Series lenses are designed to have better technical performance and higher quality than any other existing motion picture lenses, in terms of resolution, colorimetry and illumination across the entire frame.

The Primo 70s MTF numbers for high frequency detail are unequalled, both in the center and at the edges of the frame. But even more important, the large area under the Primo 70 MTF curves denotes a natural sharpness that includes the full range of high and low frequency components.

MTF is not just about the number measured at a high frequency. Perceived sharpness is a function of the area (in beige) underneath the entire MTF curve (see Otto Schade)>

The shape of the “belly” underneath the MTF curve is far more important than the measurement of a single point.



## DESIGNED FOR DIGITAL

The Primo 70s are designed for digital. They won't fit on film cameras: because of their short Flange Depth, they would bump into the shutter. Their design takes into account the low pass and infrared cut-off filters in digital cameras.

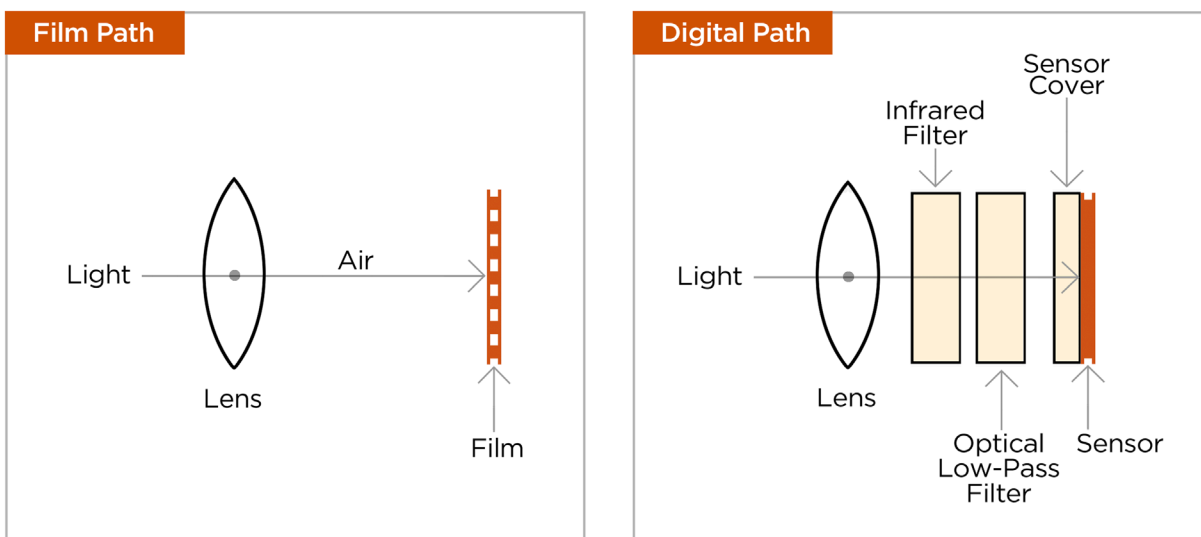
These filters can diminish performance on other lenses, notably:

- On other lenses creating softness on the image edges due to coma and astigmatism, (especially with short focal lengths and apertures wider than T2.8)
- Creating over-correction in the image center, adding spherical aberrations on axis (on all focal lengths)

## THE OPTICAL PATH

The optical path for digital cameras has **additional elements** not present in film cameras. The Primo 70s are designed for an extra 7mm of glass behind the lens of a digital camera to account for:

- Infrared cut-off filter
- Optical low-pass filter
- Sensor cover



## ASPHERIC LENS ELEMENTS

Like the Zeiss Master Primes, Leicas and other contemporary lenses, the Primo 70s include **aspheric** elements. Unlike spherical elements, the contour of these elements changes, and is different for light rays on the edges than for center rays. A single aspheric element can correct errors that would take several spherical elements to correct.

This is one reason the Primo 70s are lighter than 35mm Primos.

## ANOMALOUS DISPERSION GLASS

The Primo 70 design includes elements with anomalous dispersion, which have different **refraction** characteristics than normal glass. This allows for finer correction of chromatic aberrations.

## INTERNAL FOCUS

In a traditional lens like the 35mm Primo, the entire lens head moves with focus. This means that the lens is optimized for a certain distance, with a slight **reduction** in performance at other distances, and in particular at **close focus**.

The Primo 70 floating focus elements allow for very good performance at all distances, including remarkable performance at **close focus**. In addition, the lenses act like very “weak zooms” that change the focal length just enough to **eliminate breathing** (framing change) due to focus change.

## SHORT FLANGE DEPTH

The Flange Depth is the distance between the lens mount and the sensor. Because the Primo 70s are designed for digital cameras, they can utilize a **short** flange depth, and are “closer” to the imaging sensor than traditional motion picture lenses.

The Primo 70 flange distance is a nominal **40mm** to the sensor.

By comparison, the 35mm Panavision flange depth is 57.15mm and the PL flange distance is 52mm.



Traditional PV and PL mounted lenses include a **retro-focus** design to enable the lens to back away from the spinning mirrors of film cameras. The Primo 70 lenses do not face this restriction and can have larger diameter elements closer to the image plane, improving performance.

The short flange depth opened up **new approaches** to Panavision lens designers. The Primo 70s design does not require as much retro-focusing, which makes for more efficient designs, and more compact lenses.

### COMPACT & LIGHT

The Primo lenses are designed to be practical on the film set. The use of aspheric elements allows for a 70mm lens to be the same size as a Primo 35mm, but **lighter**.

### FAST & CONSISTENT T-STOPS

The Primes from 24mm to 100mm open to a fast T2 stop. The 200 and 250mm are T2.8, while the two zooms open up to T3.5 and T4.5.



## COMPATIBLE CAMERAS

Although the Primo 70s are designed for the 70mm format, they are also compatible with some digital cameras with **smaller** sensors. To date Panavision engineers have adapted the Primo 70s to 5 cameras

- **Arri Alexa** (recommended for Open Gate)
- **Phantom Flex4K**
- **Red Dragon** (recommended for 6K mode)
- **Sony F55**
- **Panasonic Varicam 35 (4K)**
- **Phantom 65**

Note that the Sony F65 is not compatible because of its mechanical shutter. This is not a definitive list. Panavision **continues** to look at adapting other cameras to accept the Primo 70s.

The cameras above need 2 modifications before the Primo 70s can be used:

- **Lens mount change**
- **Glass plug Insertion**



Primo 70 lens mounted on a Red Dragon camera

## LENS MOUNT MODIFICATION

To use the Primo 70s with a digital camera like the Dragon, Panavision changes its lens mount to a **PV 70mm mount**. As noted above, the PV 70mm lens mount is designed for a 40mm Focal Flange Depth, shorter than the flange for standard PV and PL mounts.



PV 70mm mount

PV 35mm to PV 70mm adaptor

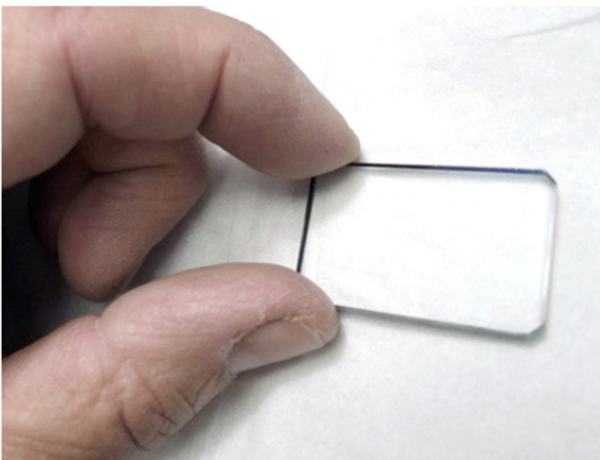
Panavision has developed a **PV 35 to PV 70 adaptor** that will allow you to use 35mm lenses with PV mounts, but this may raise two issues:

- The lens will not **match** the quality of the Primo 70s.
- The lens characteristics may be **altered** by the Glass Plug inserted into the camera.

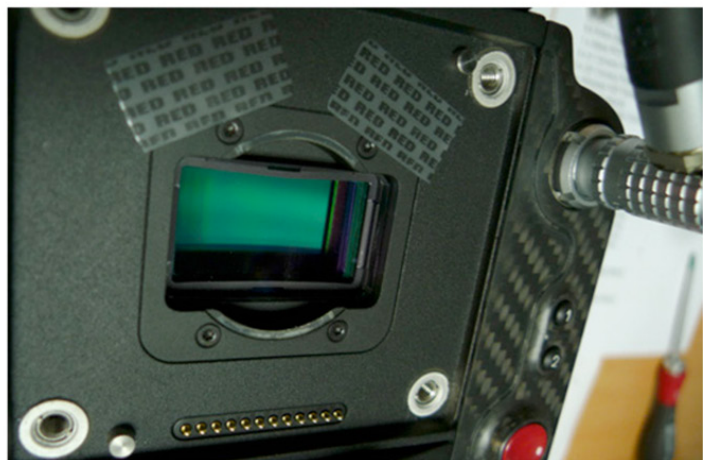
## ADDING A GLASS PLUG

As noted above, digital cameras have an infrared (IR) cut-off filter, an optical low-pass filter (OLPF) and a cover in front of the sensor. The total **thickness** of these behind-the-lens elements varies from camera to camera, and has an effect on the optical path.

The Primo 70s are optimized for a **7mm** thickness of the glass components in a digital camera. When the lenses are mounted on another camera, we may need an additional Glass Plug to obtain an optical path behind the lens equivalent to 7mm. For example, the Red Dragon has roughly 3mm of glass in front of its sensor, so Panavision inserts a 4mm glass plug to get to 7mm.



4mm Glass Plug



Dragon Sensor

The addition of a Glass Plug into a digital camera is not always straightforward, and Panavision engineers are working closely with other camera manufacturers to arrive at the best **optical and mechanical** solutions.

Also, if the filmmakers use lenses other than the Primo 70s on a modified camera, the Glass Plug may alter the **optical characteristics** of these lenses, notably in the corners.

## THE WIDE ANGLE ISSUE

-- See white paper 2 in this series for an explanation of **Crop Factors & Fields of View** --

The Primo 70s are designed for a 70mm sensor, which has a Crop Factor of about 2. So the **widest lens** in the Primo 70 series, the 24mm, has roughly the same Field Of View as a 12mm in Super 35, which is plenty wide.

However when using the Primo 70s with **smaller sensors**, the 24mm may not be wide enough. When shooting 2:39, the 24mm has the same Field Of View as:

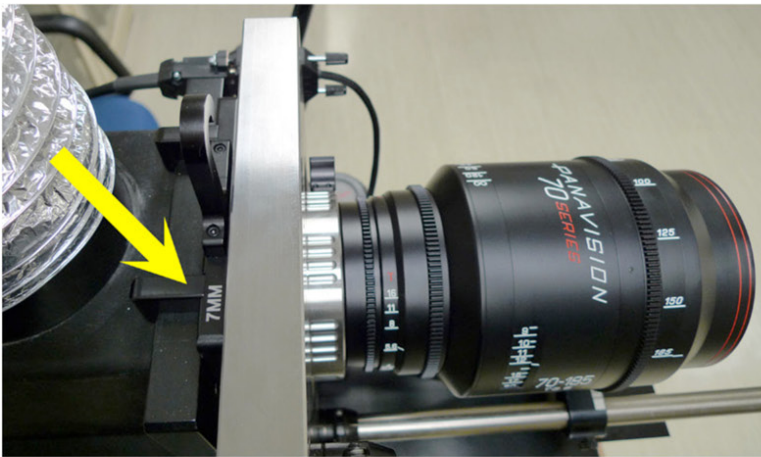
- **19mm on a Dragon 6k**
- **21mm on an Alexa Open Gate.**
- **24mm on a Sony F55, the same as Super 35.**

This may not be a wide enough angle for many filmmakers, who will expect to see lenses with Fields Of View roughly equivalent to that of a 14mm in Super 35. Filmmakers are used to having these **wider focal lengths** in their package, and they're especially useful in **interiors**, when the camera is up against a wall.

If we apply the crop factors for these smaller sensors this implies that we are missing wide lenses with focal lengths around **18 millimeters**. Panavision is working on manufacturing some as soon as possible.

In the meantime, Panavision technicians are assisting filmmakers in selecting and adapting existing lenses to cover the wide end. The difficulty is to find lenses that can intercut with the Primo 70s. The wide-angle lens selection is an **ongoing process**.

APPENDIX. 70mm PROPRIETARY GLASS PLUG FOR PANAVISION PROJECTION



Hooked 7mm glass "plug" inserted behind Primo 70 lens on PV projector system