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# FILM DIGITAL TIMES

Art, Technique, and Technology in Motion Picture Production Worldwide

## FUJIFILM Report & Factory Tour

*Woman with a Basket of Flowers*  
Pierre-August Renoir, 1895  
Woodone Museum of Art, Japan  
(reformatted to fit this cover from  
original 127.3 x 40 cm oil on canvas)



# FUJINON MK 18-55 T2.9 Cine Zoom Lens



Hideyuki Kasai with new Fujinon MK 18-55 zoom in secret equipment room at BSC Expo 2017 on February 4th.

It often begins this way. There's a handshake or signature of non disclosure. Secrecy is sworn. A secluded space awaits. At BSC Expo 2017, the setting felt like a spy story, private truffle transaction, or rare art viewing.

In a hitherto undisclosed secure location (the equipment closet of their exhibition booth), FUJIFILM executives took the wraps off an exciting new zoom lens that had previously been hinted in hushed tones at an earlier meeting. That was at InterBEE 2016 with Keitaro So, Takatsugu Osari and Takuya Noguchi in a hush-hush whisper room so quiet you could almost hear the ticking of our Apple Watches. "We would like you to visit our Fujifilm factory where our new lens is being manufactured," Keitaro-san said. "It's a factory and advanced process the likes of which you have never seen before." Fujifilm executives in Japan and the US approved and organized and that is why I was flying to Tokyo on Feb. 26, 2017.

The new FUJINON MK 18-55 T2.9 Cine Lens was officially presented on Wednesday, February 22 in Hollywood. It is an affordable, lightweight, compact, E-mount zoom lens intended for the rapidly growing independent owner-

# FUJINON MK 18-55 T2.9 Cine Zoom Lens



operator market. This is a new area for Fujinon, whose HK Premiers are the pinnacle of their 35mm cine zoom line. ZK Cabrios are the handheld compact zoom family members with removable servo handgrips. The XK Cabrio 20-120 is a “slower” but longer PL-mount cine zoom and was Fujinon’s first foray into affordable zoom lenses.

The MK 18-55 T2.9 is the first in a new series of Fujinon affordable E-mount zooms. (MK 50-135 T2.9 comes next.) MK zooms only comes in E-mount at the moment (18mm flange focal depth) and represent a growing affirmation of a lens interface that was introduced by Sony. A Fujifilm X-mount version comes later this year.

Users can attach the MK 18-55 zoom onto Sony FS5, FS7, FS7 II, FS100, and FS700 cine cameras as well as Sony still cameras like the a7 series and a6500. I expect there will be more to come.

What we’re seeing is an evolution of the affordable, aspirational DSLR cine market whose independent content creators are increasingly asking for more. MORE? As Oliver Twist would have said were he a DP, “Please sir, we want more—more affordable, less breathing, parfocal, straight tracking, no ramping, 0.8M gearing.” (Parfocal maintains focus throughout the zoom range. Breathing looks like a slightly annoying zoom when you’re focusing. Tracking keeps the center of the frame centered throughout the zoom.)

The MK focus scale is helpfully marked in both Metric and Imperial. You don’t have to swap focus barrels to go from meters to feet. This is a purely mechanical zoom lens. It’s not your father’s ENG lens repurposed for cine. It’s totally opto-mechanical. There are no electronic controls to get in the way. Auto and servo controls are absent. Of course, you can add lens motors to mesh with the industry-standard 0.8M focus, iris and zoom gears for wireless control and I’m sure someone will come up with aftermarket handgrip controls. But meanwhile, this is a quintessential, archetypal documentary style zoom lens.

It reminds me of classic 16mm documentary cine zooms and is about the same size and weight. Lest anyone whine about lack of lens markings on the camera right side, remember that you always solved this in the past with a strip of white tape and a Sharpie Fine Point Marker.

The front diameter is a mere 85 mm and has 82mm threads for a front screw-in filter. There’s a Macro button for close focus to 1 ft 2.9 in / 0.38 m. You don’t need shims; a thumbscrew enables flange focal depth adjustment. (Once set, tape the barrel to avoid accidentally moving it.) Accessories include a lens support foot and rectangular lens shade.

The MK 18-55 begins shipping in March. As mentioned, it’s the first in a series. The MK 50-135, should ship this July.

# Fujinon MK 18-55 T2.9 and 50-135 T2.9 Zooms



# Fujinon MK 18-55 T2.9 and 50-135 T2.9 Zooms



MK 50-135 with lens support foot

While the 18-55 T2.9 will probably be the go-to lens for handheld, aerials, POV and establishing shots, Fujinon's MK 50-135 T2.9 takes over for close-ups, portraits, and long lens scenes.

Why the need for two lenses when Cabrio 19-90 or 20-120 have greater range?

A great deal of thought went into the concept of both MK lenses. Lens design is always a grand bargain—a delicate balance of size, weight, speed, resolution and cost. In this case, to reduce weight and size, yet keep a fast maximum aperture of T2.9 for both lenses, it would not have been practical to attempt all these things in one lens.

Why only E-mount? Fujinon optical designers said that the short, 18 mm flange focal depth facilitated the lighter, smaller, faster design. I can hear my phone ringing as rival optical designers call to refute this—nevertheless, the MK lenses are indeed some of the faster-lighter-smaller-sharper zooms out there.

X Mount versions of the 18-55 mm and 50-135 mm MK zooms for the Fujifilm X Series digital cameras with APS-C sensors are being developed and should be seen by the end of this year. Information about the X Mount lenses will be provided as soon as more details are confirmed, but it's in Fujifilm's roadmap online: [tinyurl.com/fujinon](http://tinyurl.com/fujinon)

A few days of tests showed excellent optical quality, lack of distortion or aberrations, and splendid resolution with the Sony FS7 II.

Focus, iris and zoom barrels on both MK lenses line up—so there's no need to move lens motors or follow focus position when swapping from 18-55 to 50-135. The front diameter of both lenses is the same—85 mm.

Even though the lens barrels are quite skinny, they have a traditionally long degree of rotation. Focus rotation is a generous 200°. Zoom is 90° and Iris is 60°.

The weight of each lens is 2 lb 2 oz (980 g) and length is 8.1 in (206.3 mm).

Image coverage is 28.5 mm diagonal, which in Super35 16:9 format is 13.97 x 24.84 mm.

There are 9 iris blades providing an aperture range of T2.9 - T22, with a completely closed position as well.

Price is around \$3,799 for the MK 18-55.

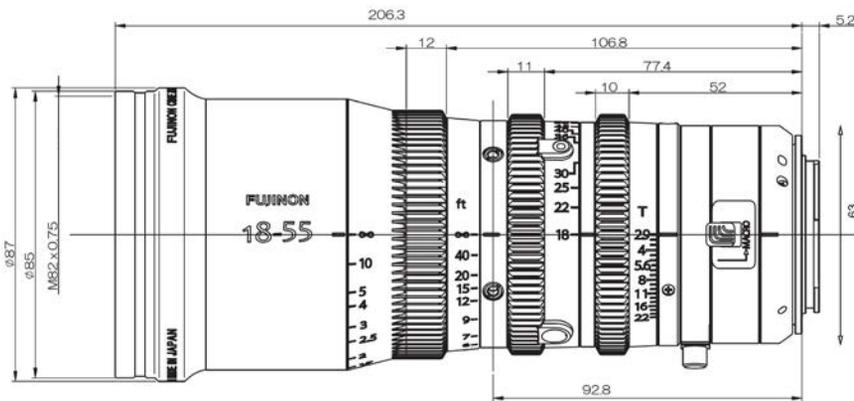
# Fujinon MK 18-55

Fujinon MK E-mount is mechanical only, there are no lens data contacts

Note: on the Sony FS7 II, rotate the E-mount locking ring counter-clockwise to lock



Sony FS7 II



## Fujinon MK 18-55 T2.9 and 50-135 T2.9 Specs

Lens Name	FUJINON MK 18-55 T2.9	FUJINON MK 50-135 T2.9 (for Summer 2017)
Focal Length	18-55 mm (3x zoom ratio)	50-135 mm (3x zoom ratio)
Maximum Aperture F-Stop	f2.75	f2.75
Aperture Range in T-Stops	T2.9-T22, closed	T2.9-T22, closed
Mount	E-mount (18.0 mm flange focal depth)	E-mount (18.0 mm flange focal depth)
Flange Focal Depth (in air)	18 mm (mechanically adjustable $\pm 0.2$ mm)	18 mm (mechanically adjustable $\pm 0.2$ mm)
Image Size (16:9)	13.97 x 24.84 mm	13.97 x 24.84 mm
Image Diagonal	28.5 mm diagonal	28.5 mm diagonal
MOD (Minimum Object Distance)	0.85 m / 2 ft	1.2 m / 3 ft 11 in
MOD in Macro Mode (at wide end)	0.38 m / 1 ft 2.9 in	0.85 m / 2 ft 9 in
Front Filter Diameter	82 mm	82 mm
Front Diameter	85 mm	85 mm
Length	206.3 mm / 8.1 in	206.3 mm / 8.1 in
Weight (approx)	980 g / 34.6 oz	980 g / 34.6 oz
Focus Barrel Rotation	200°	200°
Zoom Barrel Rotation	90°	90°
Iris Barrel Rotation	60°	60°
Iris Blades	9	9
Gear Pitch of Focus, Iris, Zoom Barrels	0.8 M	0.8 M

# Fujifilm Omiya Headquarters



Fujifilm headquarters in Omiya, Saitama Prefecture, north of Tokyo

Fujifilm headquarters is a half-hour train ride north of Tokyo Station, in the city of Omiya. It's a short cab ride through busy streets that aren't much different from Tokyo.

In a bright conference room overlooking the vast Fujifilm campus, a team of engineers, designers, product and project managers had gathered to provide an in-depth review of the latest products and answer many questions.

## X-Series APS-C and GFX Medium Format

### Jon Fauers: Why did you leapfrog from X-Series to Medium Format, without offering a Full Frame Camera?

Fujifilm: Medium format has always been a dream for photographers. It has been a professional format, favored for advertising, fashion and high-end work. We wanted to offer an aspirational product that might democratize medium format photography, with superb image quality.

By making it mirrorless, we could design it in a more compact form factor. In fact, the GFX is about the same size and weight as a typical full frame DSLR. Yet the image is 1.7 times larger.

### What other advantages did mirrorless design offer?

Another great advantage is the lack of shutter shake. When you have a large glass mirror opening and closing to make an exposure, the camera can be subjected to a significant amount of shutter shake which can result in a softer, blurrier image. We have conducted many tests confirming this.

### You have designed a new set of lenses for the GFX?

They are lighter and smaller than typical medium format lenses because of the short flange focal depth of 26.7 mm and a large lens mount diameter of 65 mm. The image quality is excellent.

**Your Fujifilm X-T2 has been very well received for both stills and cine. Huffington Post wrote, "The mirrorless Fujifilm X-T2 shows that Fujifilm...is in the mainstream and has taken on the best mirrorless and DSLR cameras. With 4K video, excellent photo quality, and pro level features, the X-T2 is not just good, it is actually fun to use for both photos and video.**

Thank you. Shall we discuss the MK zoom?



Mock-ups of the 18-55's internal elements, sub-assemblies and molded composite lens barrel—for demonstration purposes: not the actual parts.

# Fujifilm MK Zooms and GFX Medium Format



Fujinon 18-55 lens designers, engineers, planners, product managers. Left to right in dark suits: Takatsugu Osari and Takuya Noguchi, who were the wonderful guides on this adventure.

## MK Zoom Lenses

### What is the concept and design philosophy of the MK zooms?

They are intended for the larger, and rapidly growing, Emerging Independent Content Creator market—usually a single cinematographer operating alone or with a small crew. They are affordable, but there's no compromise in quality. MK lenses.

### Why so few PL mount lenses for this segment?

Because they find PL lenses are larger, heavier and more expensive. As you know, we make a large selection of PL mount zooms in our XK, ZK and HK series. But, for example, an XK 6x20 zoom costs around \$18,00 and weighs 2.4 kg and is 239 mm long. That can be 3 to 4 times more expensive than the camera used by this market segment.

### What did you see as the problems with DSLR lenses?

Quite a few: focus shift, iris click, lack of 0.8M gears, breathing, optical axis shift on zoom, narrow focus rotation. These lenses were designed for shooting stills, not cine.

### Then the MK zoom concept addresses these issues?

It's the dawn of a new era for the emerging production market. The MK lens is intended for that market. It resolves the conflicts between the cinema and DSLR lenses.

### Why the name MK?

Good question. M for Movie, Manual, Mobility, Marvelous, Multiple-use! Also, perhaps it can be said that in Video you "take the shot." In stills, you "take" a photograph. But in movies, you "make" a film. You are a film maker. So MK.

### Thank you very much.

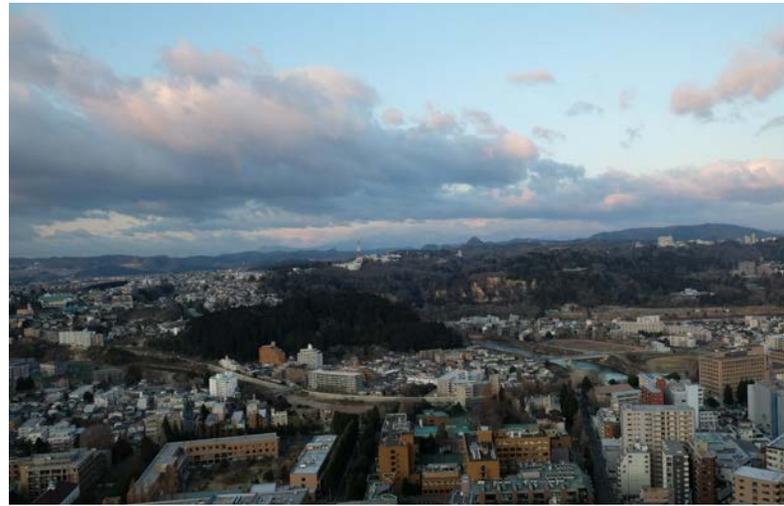
Right: Lunch at Ippudo in Sendai. Ippudo began as a 10-seat shop in 1985. Today it's rated among the best ramen shops in the world. There are more than 70 worldwide, including two in New York. Lines can be long for Ippudo in New York. Instead, book a flight on ANA between NY and Tokyo. They serve Ippudo ramen and ANA service is stellar.



The following morning we boarded the Shinkansen at Omiya Station for a one-hour ride north to Sendai and then a visit to the Fujifilm Factory in Taiwa where MK zoom lenses, GFX Medium Format Cameras and X-T2 Cameras are made.



# Sendai



Sendai is the capital of Miyagi Prefecture, in the Tōhoku region of Japan. With a population of around 1 million, it is the largest city north of Tokyo. The epicenter of the magnitude 9.0 earthquake on March 11, 2011—the most powerful ever in Japan—was 80 miles east of Sendai. The tsunami travelled up to 6 miles inland.

In 1600, Date Masamune (1567–1636) began construction of Sendai Castle on a hilltop overlooking the town. Masamune was a Daimyō (feudal samurai lord), with a fearsome helmet and only one eye. He was known as Dokuganryū — “one-eyed dragon”. Ken Watanabe played the part of Masamune in the 1987 NHK series *Dokuganryū Masamune*.

The year 1600 was also the year when English navigator William Adams’ Dutch ship *Liefde* was wrecked on the southern coast of Japan. James Clavell’s novel *Shogun* and the TV series shot by Andrew Laszlo, ASC are based on Adams’ adventures and Tokugawa’s interest in Western shipbuilding and navigation.

The Shogun was not the only one interested in ships and the West. Lord Date Masamune supervised the construction of a European-style galleon named *Date Maru* (later called *San Juan Bautista*). It was completed in 45 days by 4,300 workers. In 1613, Masamune’s Samurai retainer Hasekura Tsunenaga, with a crew and entourage of 180, sailed from Japan to Acapulco. They crossed Mexico by land, continuing as a smaller group onboard Spanish ships via Cuba and then to Spain, France and finally Italy. The main goal was to establish trade with Europe and relations with the Pope in Rome. At least five members of the expedition stayed in Seville and 600 of their descendants, with the surname Japon (Japan), remain in Spain today. Tsunenaga again to pick up the remainder of his crew, sailed to the Philippines and finally home to Japan.



Above, left:  
Daimyo (Lord) Date Masamune

*Hasekura Tsunenaga in Rome*  
by Claude Deruet, 1615, oil  
Galleria Borghese, Rome  
also attributed to Archita Ricci  
Tokyo National Museum

*Pope Paul V*  
Sendai City Museum  
oil on canvas  
76.5 x 61.0 cm



# Fujifilm Taiwa Factory



Fujinon 18-55 zooms are built here: at the Fujifilm Taiwa Factory, 34 km north of Sendai, in the foothills between Mount Izumigatake and the Pacific.



Hiroki Takatsuki, Engineering Manager; Shigeki Chiba, Engineering General Manager; Hideya Suganami, General Manager of Taiwa Factory.



Conveniently, Fujifilm's Medium Format GFX camera is also built here and one is pulled off the assembly line to take photos for this article.



Equally convenient, Fujifilm's superb APS-C format X-T2 camera is also made here and several are provided as we suit up and enter Taiwa Factory's enormous clean room.



The reason for such cleanliness? It was explained that customers expect perfection and would complain bitterly if a new lens came with particles of lint or dust inside. It wouldn't be detrimental optically, but it does diminish the consumer experience.

## Building Fujinon MK 18-55 Zooms



How does FDT manage to get inside various companies' highly sensitive chambers of secrets? Like set etiquette, there are several important factory-visit commandments, thou-shalt-nots, and don't-because. Thou shalt not trip over anything or break stuff. Don't slow down the assembly line. Don't ask dumb questions. Don't take pictures of things they tell you not to. Submit all photos for review lest you accidentally photograph a particularly proprietary process or part.

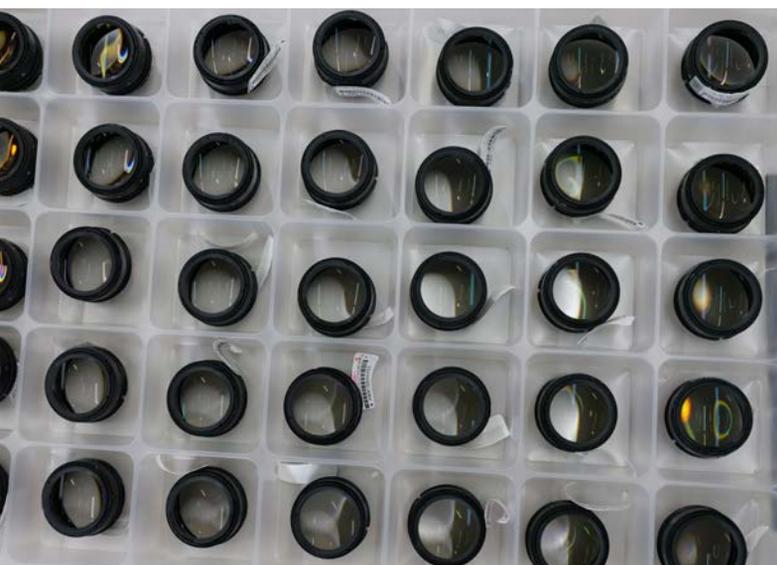
I have a weakness. Whenever a factory manager rhetorically asks whether I'd like to learn how to work on a lens or build something, I eagerly agree—thus breaking rule number 3 (“Thou shalt not bring their manufacturing process to a screeching halt.”) As seen above, the lensmeister lady is instructing in the art of MK zoom inspection and watching in horror or chortling in disbelief. But we're getting ahead of the story. Let's see how the expert team at Fujifilm Taiwa puts together MK 18-55 zoom lenses.



# Prepping Fujinon MK 18-55 Assembly

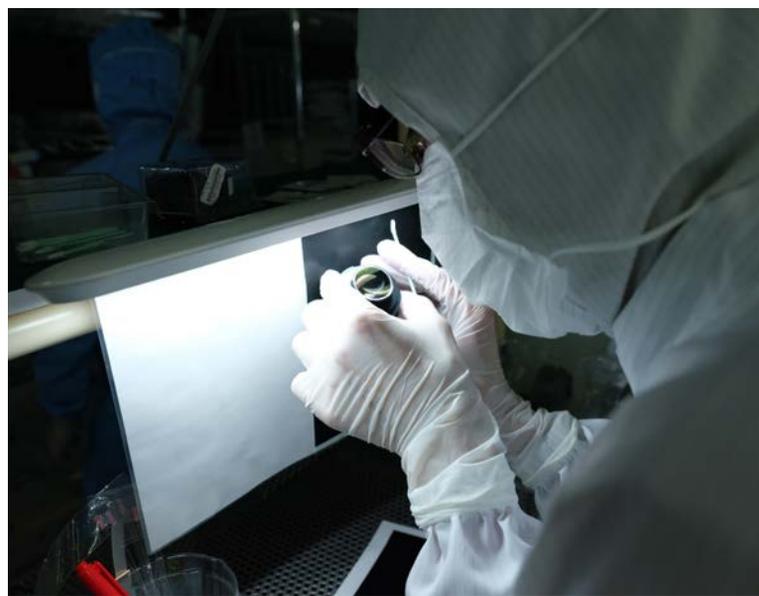


More than 1,000 people work in the vast Fujifilm Taiwa Factory, assembling X-series and GFX cameras, components and other products. A new, dedicated area has been set up for a highly skilled team to build Fujinon MK lenses. The process begins as the various components are gathered, cleaned and checked. Above left: E-mounts. Above right: the distinctive green rear ring.



There are 22 optical elements in 17 groups within the MK 18-55. 8 of the elements are ED glass for high optical performance

Elements are cleaned against both white and black backgrounds. A black background makes white dust more visible. White helps see black.



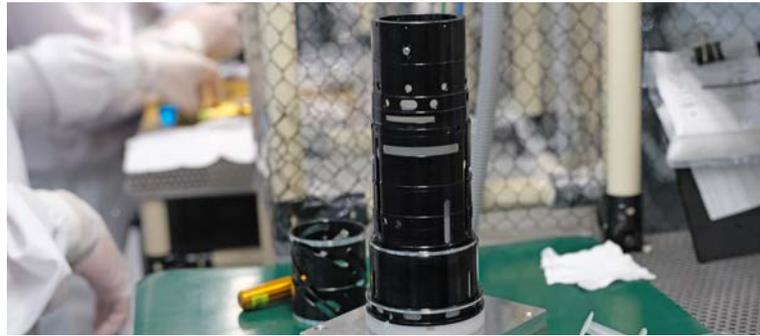
# MK 18-55 Barrel and Sub Assemblies



Now it gets really interesting. The philosophy of the MK lenses is affordability for independent productions. To keep the cost down and the manufacturing yield high, Fujinon has combined techniques from their experience in high-yield manufacturing (still cameras and lenses) and high-precision, high-end lens crafting. The trick seems to be their use of molded, composite lens barrels and mechanical sub-assemblies. Traditionally, these components have been milled on CNC machines from metal. Advantages of composites include speed of manufacturing, resistance to temperature variations in the field, and advanced structural possibilities.



Cam channels in a sub-assembly



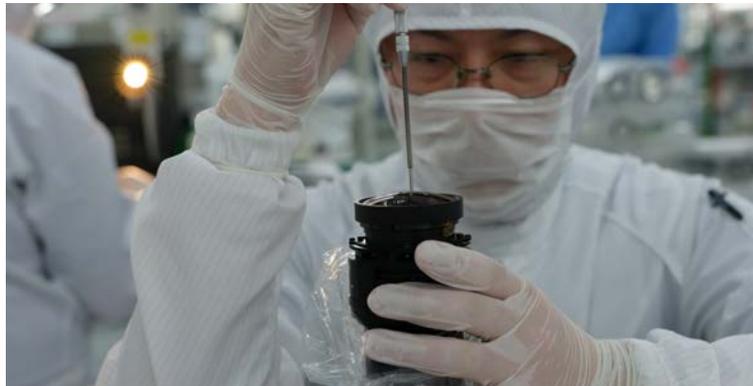
Barrel and sub-assembly



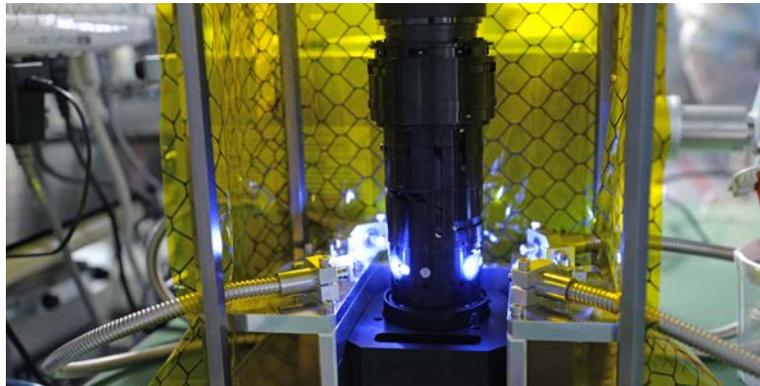
Optical elements are installed into barrel



Optical elements are secured in their housings with high-strength cement



Optical elements are bonded then cured with UV. If your dentist has used a composite filling in your teeth, it's a similar, robust process.



# Final Assembly MK 18-55



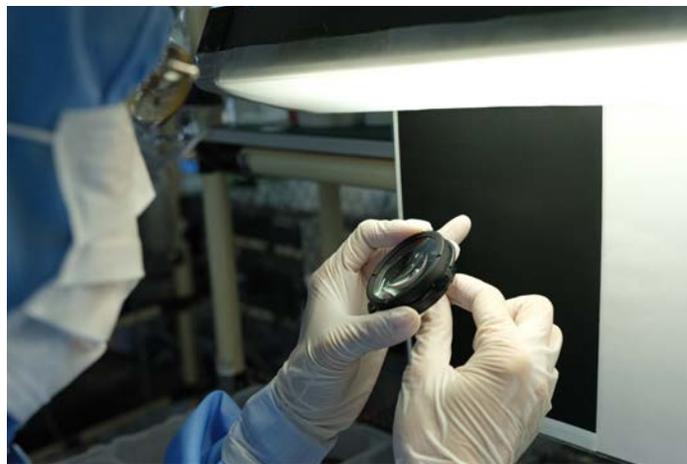
# MK 18-55 Final QC, Packing and Shipping



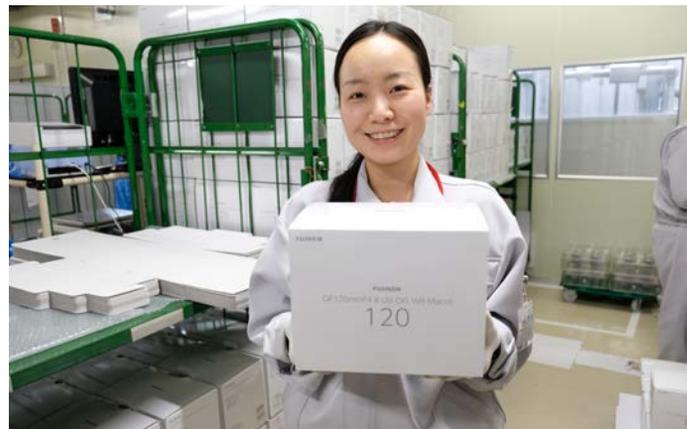
# Fujifilm X-T2 Manufacturing at Taiwa Factory



# Fujifilm GFX Camera and FX Lens Manufacturing at Taiwa Factory



# GFX final assembly



# FUJIFILM GFX 50S Mirrorless Medium Format Camera System

A Fujifilm Medium Format GFX camera with GF lenses took most of the factory photos in this article with: GF32-64mmF4 R LM WR, GF120mmF4 R LM OIS WR Macro and GF63mmF2.8 R WR lenses. The new G format, GFX system uses a 32.9 x 43.8 mm 51.4 MP CMOS sensor. That's an area about 1.7x larger than 35mm Full Frame. The GFX can window the image to various aspect ratios, including 4:3 (default), 3:2, 1:1, 4:5, 6:7 and 6:17—familiar large and medium format film camera formats. Tethered shooting is supported.

The GFX is lightweight and compact. The body is smaller than many DSLR APS-C cameras. (5.8 x 3.7 x 3.6" / 147.5 x 94.2 x 91.4 mm (WxHxD - without viewfinder). It is made of magnesium alloy and weighs about 43 ounces with a Fujinon GF63mmF2.8 R WR lens. The X Series design philosophy shows up here—with helpful mechanical buttons and dials. A joystick at the rear easily relocates focus position. The 3.69M dot organic EL electronic viewfinder can be removed. An must-have accessory EVF-TL1 EVF tilt adapter (sold separately) allows the finder to be tilted to 90° vertically and swung ±45°. The 3.2 inch, 2.36M dot panel rear monitor has touchscreen control of the menu, focusing points and image playback. The LCD screen tilts in three directions.

The new Fujifilm GFX medium format camera supports Full HD recording at 29.97p/25p/24p/23.98p. Film Simulation modes are available both for still and video. The new G Mount has a flange focal distance of 26.7 mm. The Fujinon GF lenses have an aperture ring with click-stops for A (Automatic) and C (Command) which enables aperture adjustments by using the Command Dial on the camera body. Each lens is dust and weather resistant.



Above: JWF with GFX taken by X-T2. Below: Photo taken with GFX and GF120 at 3200 ISO, f/7.1 @ 1/550 sec.



GF63mmF2.8 R WR



GF32-64mmF4 R LM WR

# FUJIFILM X-T2 Mirrorless APS-C Camera System

The other half the photos in this article were taken by Takatsugu Osari, Takuya Noguchi and me using an abundance of Fujifilm X-T2 cameras and lenses, including the XF18-55mmF2.8-4 R LM OIS zoom and XF35mmF1.4 R (the “God” lens.)

FUJIFILM’s X-T2 is their top-of-the-line mirrorless APS-C format digital camera. It is light, small, splash-resistant and has blazingly fast autofocus and records 4K video. The classic design offers ISO, shutter speed and exposure compensation dials on top—thoughtful features that are much easier and faster to use than diving deep into menus. My favorite control is the joystick at the rear of the camera, similar to the one on Fujifilm’s GFX, to position the autofocus window area anywhere in frame.

The X-T2 has a 15.6 x 23.6 mm 24.3 MP APS-C sensor. The design avoids an OLPF (low-pass filter) and the images are superb. UHD 3840x2160 video can be recorded to an internal SDXC card. In a nod to Fujifilm’s heritage as a motion picture and still film manufacturer, 15 film simulation modes are available. The body is lightweight and rugged. It is made of magnesium alloy, with weather-proofing at 63 points for resistance to dust and moisture. There are more than 25 Fujifilm X Series X-mount prime and zoom lenses that fit the X-T2.



Takatsugu Osari with X-T2

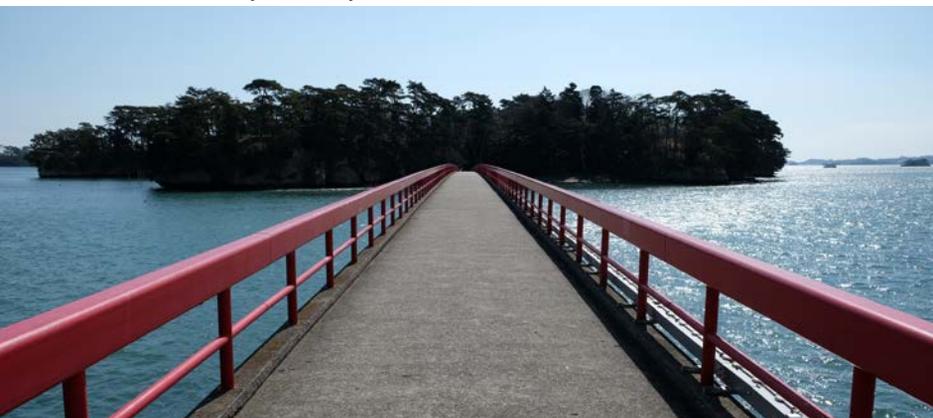


Photo of GFX taken with X-T2, XF18-55mm at 640 ISO, f/4.5 @ 1/50

# Matsushima



Matsushima Bay is dotted with 260 islands. It is known as one of the three most scenic places in Japan. Apparently “one-eyed dragon” Date Masamune agreed. From Sendai to Matsushima, the feudal lord and his Samurai could be there in a couple of hours on horseback. Today, it’s a fifty-minute ride north from Sendai station.



Matsushima is famous for its oysters—steamed or grilled in the shell at counters along the main street—or as a sublime deep-fried delicacy at the Taritsuan Oyster Restaurant (below), with its breathtaking view of the harbor.



Zuigan-ji Temple (above and left) was founded in 828 and rebuilt in 1604 by Date Masamune. It was damaged by the 2011 earthquake and tsunami — one of the largest natural disasters in history. The tidal wave reached 133 feet high in Miyako to the north. Matsushima was buffered a bit by the islands in the bay and the wave in town was about 10 feet high.



# The Next Shot is in the Glass



There's a famous saying on film sets when the last shot of the day is about to begin: "The next shot is in the glass."

It was, therefore, fitting to head for the hills above Fujifilm's Taiwa facility after our visit and see another interesting manufacturing process that requires an equal amount of skill and art: the Nikka Sendai Distillery. On this particular day, it was shrouded in fog and there was a light dusting of snow.

Masataka Taketsuru (1894–1979) is known as the "father of Japanese Whisky." He came from a family that had been brewing sake since 1733 and was raised to appreciate the painstaking, fine art of the process. However, Scotch whisky captured his imagination. In December 1918, he sailed to Scotland to continue his studies in organic chemistry at the University of Glasgow. By 1919 he was working as an apprentice at various Scotch whisky distilleries. In 1920, he married Jessie Roberta "Rita" Cowan and they moved to Japan later that year. He established Dai Nippon Kajzu in 1934 on the island of Hokkaido. The company was later renamed Nikka.

Whisky making, it seems, is not dissimilar to the art of making fine cine lenses. It begins, like glass, as a relatively raw material. Barley is added to water, the starch is converted to sugar, dried, ground, fermented, and distilled. The result is an undrinkable, clear liquid that is 68% alcohol and awful. The flavor and character of the whisky, like the character of the lens, comes from a complex combination of things: flavor of the barrels, the residue of rum or sherry or previous runs of whisky in those barrels, chemistry, physics, taste and art. Just like lens making.



Nikka Whisky Miyagikyo Sendai Distillery, built in 1969. The company was founded in 1934



Above: Masataka Taketsuru in London, 1919.

Below: Taketsuru with his wife Jessie Roberta ("Rita") Cowan

