Canon's Challenges


Kasuda
1:3,5 f= 50mm

Canon's roots lie in Kwanon

Kwanon, the Buddhist Goddess of Mercy, was chosen as the name for the first Japanese 35mm focal plane shutter camera. Here is the story of how the Kwanon came to be developed and how it got its name.

A magazine ad for KWANON

The KWANON logo

In the 1930s, the two best 35mm focal plane shutter cameras were made by Leica and Contax. In 1932 the Leica II went on sale, followed the next year by the Contax I. These two cameras were produced in Germany, which boasted the world's finest precision machinery industry at that time, and they immediately became the object of desire of avid camera lovers throughout the world. In the meantime, Japan, with little or no technological power to speak of, was using foreign cameras as models.

At that time, the starting salary of a college graduate in a prestigious company was 70 yen per month, while a D-model Leica with a 50mm f/3.5 lens was priced at 420 yen. In other words, Leica and Contax cameras were far beyond the reach of the average person wanting to purchase a good camera.

At around this time, Goro Yoshida (1900-1993) attempted to build his own (and Japan's first) 35mm focal-plane shutter camera with a rangefinder (a 35mm rangefinder camera), just by taking apart a Leica II and studying its design. Yoshida, who had always been fascinated by cameras, taking them apart and putting them back together when still a schoolboy, dropped out of junior high school and began working as a repairman and remodeler working on movie cameras and movie projectors. In the mid-1920s, before he had even reached 30 years of age, he was often traveling back and forth between Japan and Shanghai to get parts for movie projectors. What made him decide to make a high-quality 35mm camera was something an American trader he met in Shanghai told him. He said, "Why do you have to come all the way to Shanghai to get parts? Japan makes some of the best warships in the world, and if you can make those, there's no reason you can't make something as simple as parts for cameras. Save yourself some time and make them yourself." A born tinkerer, Yoshida's imagination was set aflame. Besides, his work involved repairing and remodeling movie cameras, so it is no surprise that he decided to build a camera himself. And while that is the story of how the idea for the first Canon camera was born, the lesson is one of equality: that everyone, even the Japanese at that time, could do something if they tried hard enough.

In 1933, the Precision Engineering Research Laboratory (later changed to "Canon") was established in a room in a three-floor apartment building in Roppongi in Tokyo, as a workshop for building high-quality 35mm cameras. The first glimpse the world got of this new company was an advertisement in the June 1934 issue of Asahi Camera, which even today remains one of Japan's top photography magazines. The gutsy ad copy under a picture of the Kwanon prototype read: "The "I" class submarine, the "92-Type" airplane, and the Kwanon camera: all world leaders." Japan developed several variants of the "I" class submarine in the 1920s, and the "92-Type" referred to the Japanese Imperial Army's air-cooled warplane. Both the vessel and plane were trumpeted in Japan as symbols of state-of-the-art weaponry. So Canon's advertisement linked Japan's first 35mm camera with top examples of the nation's technological prowess.

The Kwanon name itself originates in the Buddhist Goddess of Mercy, known as Kwanon in Japanese, and the logo pictured the thousand-armed Kwanon with the letters KWANON in the flames above her head. The name of the lens, on the other hand, came from Mahakashapa, one of the Buddha's disciples and leader of a religious group. It was chosen because of its similarity to the words the Japanese use when imitating the sounds the shutter makes – "kasha" (as it slides open) and "pa" (as it snaps shut).

The manufacture of the first high-quality 35mm rangefinder camera in Japan was the result of one man's dream to prove Japan's technological equality with Germany and all other western countries. That passion and pride continue to be passed on today in Canon EF lenses, which are the crystallization of the newest technologies and uncompromising craftsmanship.

Changing the way people think about lenses: the new DO lens optical element.

A challenge by Canon's technical team to the future of optical technology

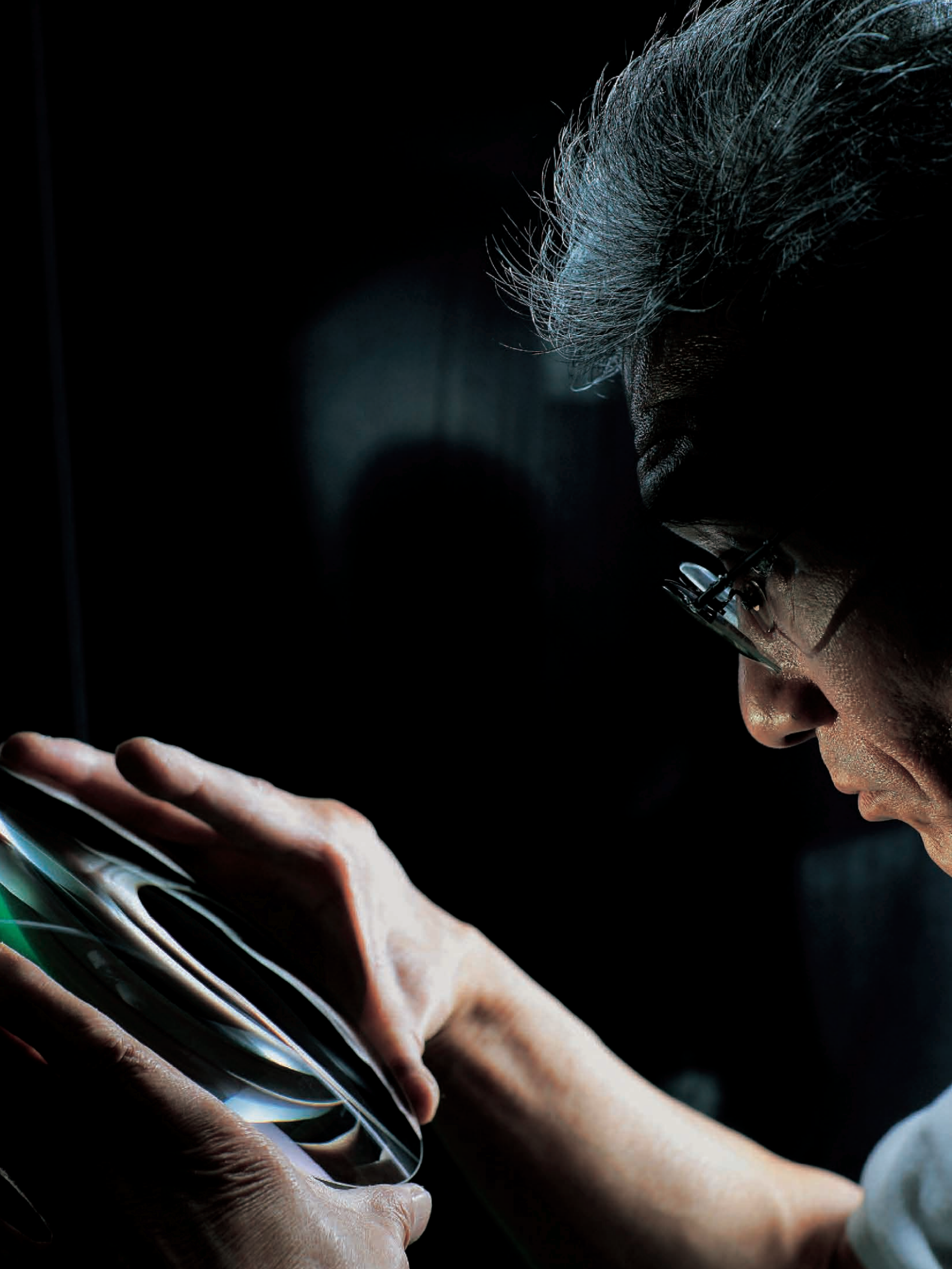
The ultra telephoto EF 400mm f/4 DO IS USM lens turns the old "big and heavy" image of telephoto lenses on its head, achieving a significantly lighter and more compact design than conventional models. And behind the appearance of the innovative new "DO Lens (multi-layered diffractive optical elements)" used in this lens lies the bold efforts by members of the Canon Development and Production teams.

In the mid 1990s, some of the young optical engineers at Canon noticed the possibilities available for a new optical system using "diffractive optical elements" which apply "wave optics," a way of treating light as waves. Diffractive optical elements are known to be much better at compensating for colour aberration than conventional optical elements, so the engineers thought that using diffractive optical elements in telephoto lenses would make it possible to design much smaller and lighter lenses, while at the same time endowing them with very effective colour aberration compensation.

However, the single-layered diffractive optical element which existed at that time caused much unnecessary flare (diffraction flare) when taking photographs using natural light, and were therefore not usable for photographic lenses. One of the engineers working on the design commented about the trouble the design team had, saying, "Everything we were attempting had never been tried before. For instance, we had a lot of trouble figuring out the complex formulas for calculating the diffraction flare accurately and establishing colour canceling techniques for each instance of diffraction and methods for correcting chromatic aberration." As a result of the team's persistent efforts, however, the first prototype for the "DO lens" with an original multi-layer construction was produced, five years after design started, and it succeeded in rendering almost all light entering the lens usable for photographic purposes.

Meanwhile, the production team was working in tandem with the design team to develop techniques to mass-produce the new elements. For example, a diffractive optical element has a diffraction grating which stands 10 micro-millimeters high in a concentric circle. They successfully formed this very fine shape by greatly improving the replica aspherical lens technology, accuracy, and process, which were successfully used to produce the EF lenses. And while normal lens molds have ground surfaces on the lens side, the surfaces of the molds for the diffraction grating required a convex-concave pattern, so grinding them was out of the question. In order to solve this problem they developed an original 3D ultra high-precision micro-machining tool which could be controlled on the order of several nanometers, in order to produce a lens surface employing only cutting and no grinding or polishing. Not only that, but a new ultra-high-precision position technology was incorporated, on a micrometer scale, for joining the diffractive optical elements together – a key aspect of the design. It took five years to establish this mass-production system. And the result of the strenuous efforts by the design and manufacturing teams was the "DO lens," the first photographic lens in the world to incorporate diffractive optical elements.

Canon has in the past spared no effort in developing advanced original optical elements such as fluorite and wide-angle aspherical lenses, and by incorporating them immediately into products has worked to increase the performance of its optical systems, but of all these achievements, it is probably the DO lens that has the greatest chance of turning the world of interchangeable lenses on its head. These technologies keep being developed because of the atmosphere of challenge among Canon's engineers, passed down over the years. And that challenge will go on as Canon continues to develop new and innovative technologies.



Grinding on the order of nuclear particles. The craftsman's skill delivers high-performance EF lenses.

EF lenses boast ultra-high resolution and picture quality with very high contrast. Behind the achievement of such high levels of performance lie advances in design technology using computers and design software, themselves the object of relentless advances. Yet, no matter how advanced or new the technology may be that an engineer uses to design a high-performance optical system, if the lenses to be mass-produced are not ground and polished with very high precision, the target optical performance cannot be reached. For this reason, the ground and polished lenses are inspected using a reference tool known as a "prototype standard," an instrument which must be made using the fine craftsmanship of an experienced grinding engineer – a skill which today is believed to have little or nothing to do with technology.

The prototype standard is actually a special lens which contains a mirror image of the convex and concave parts of the ground lens. It could be thought of as the yardstick against which the lens is measured. Any disparities in the curvature of the surfaces of the prototype standard and the ground lens cause striped patterns called Newton rings to appear. These rings are used to judge the precision with which the lens was ground – the fewer the better. For the prototype standard to work as a yardstick in this manner, however, it itself must be ground at extremely exacting standards, on the order of less than 0.03 micrometers for the roundness (3/100,000th of a millimeter), and ± 1 micrometer for the curvature radius. However, this level of precision cannot be achieved simply by punching a few numbers into a computer. As one grinding engineer puts it, "the condition of the grind of the lens surface is judged by looking at the colour and shape of the Newton rings, and the grinding machine is adjusted accordingly. It's a very difficult process." In other words, it is nothing but the grinding engineer's own knowledge and "feel" that make it possible to grind at a precision unattainable by a machine tool.

These remarkable engineers grind and polish lenses in accordance to minute factors, such as determining the condition of the surface by placing their hands on the grinding machine when it is running and fine-tuning it accordingly, or adjusting the amount of grind by factoring in the amount the glass has swollen from the heat of the grinding. In the hands of one of these remarkable engineers, the surface roughness of the finished prototype standard attains a fineness measured in angstroms, or in the magnitude of atomic particles, since one angstrom is 1/10 billionth of a meter. This is only possible for a very experienced craftsman, and is definitely not the work of a typical grinding engineer.

The prototype standards that they polish for use with optical equipment come in over 3,000 varieties, ranging from a curvature radius of less than 1 mm to infinity (flat surface), and more are being made to meet the continuing demand from the production floor.

Canon technology, which has created so many outstanding lenses, is only made possible by the grinding engineer's skill as a craftsman, which turns the design concept into a real object. Canon lenses, blazing trails in the world of imaging, derive their unrivalled levels of performance from the handiwork of the people who make them.

L Lenses
Where Dreams Are Crystal Clear.

The bright red line engraved on the lens barrel. And an L for “luxury.”
The Canon EF lens L series possesses a level of quality sufficiently high to be called professional,
designed to include groundbreaking image performance, outstanding operability, and resistance to weather and aging.
“L.” This name is reserved only for those few lenses that can meet stringent standards of performance,
using fluorite (an artificial crystal), a ground and polished aspherical surface,
UD, super UD lenses, or other special optical materials.
Optical design without compromise together with optical theory and precision engineering
technologies that are as steeped in tradition as they are cutting edge.
And the result of our relentless pursuit of these ideals is the L series of Canon EF lenses.

The Never Ending Challenge – The History of Canon Lenses

The history of Canon Lenses has undergone several transitions – from the range finder to the R Series, the FL Series, the FD Series, and now the EF Series. No matter the age, Canon has always focused on development that pursues further evolution. Aspherical lenses, fluorite, USM, IS, and DO lenses, and other new technologies are actively incorporated, helping Canon maintain its position as world leader in lens development.
Let us present to you some of our lenses which have made their mark in the history of lens development.

1946

Serenar 50mm f/3.5 I

Canon first began working on lenses not long after the end of WWII. Developed and produced completely in-house, the first lens to see the light of day was the Serenar 50mm f/3.5. Serenar means “clear,” symbolising the clarity that the development team was aiming for.

1951

Serenar 50mm f/1.8 I

Five years after starting production, a lens appeared which could truly be called a classic. Taking a Gauss-type lens (one of the basic types of lens construction) and developing it further, we achieved crystal-clear imaging performance even at full aperture. Lens designers throughout the world were amazed with the result, and Canon lenses quickly gained recognition for their world-class quality.

1953

Serenar 100mm f/3.5

The first 100mm Canon lens was the long-focus type f/4 Triotar with a construction of three lens elements in three groups. Fame came with the telephoto type 100mm f/3.5 with five lens elements in four groups – a lightweight, compact medium telephoto lens only 69.5 mm long, 205 g/7.2 oz. in weight, and with a maximum diameter of 44mm. The model II was further reduced in weight to 184 g/6.5 oz., and became a hit among camera lovers.

1961

Canon 50mm f/0.95

In 1961 the 50mm f/0.95 went on sale, boasting the largest aperture of any photographic camera lens in the world. This legendary lens gained a reputation as being brighter than the human eye, and further strengthened Canon’s international standing.

1964

FL 19mm f/3.5

This super wide-angle 19mm lens boasted the largest angle of view of any lens for SLR cameras at the time. The symmetrical arrangement in the optical system with concave lens elements in the front and back and convex lens elements in the center made it possible to eliminate distortion, chromatic difference of magnification, and comatic aberration, known as astigmatism. The concave lenses help achieve sufficient peripheral illumination while delivering a super wide angle. It was often said to be difficult to achieve a small lens size, correct spherical aberration, and deliver sufficient brightness from corner to corner with this type of optical system, but the FL 19mm f/3.5 succeeded thanks to the incorporation of the convex lens group. It was sold with a special finder, as attaching the lens required the mirror to be raised, and it was also used for portraits of women with a slightly surreal effect.

1969

FL-F 300mm f/5.6

From early on Canon undertook research to make fluorite, which has characteristics not possessed by optical glass, into a material for camera lenses. Natural fluorite, however, is difficult to find in large crystals and is filled with impurities, making it impossible to use in a lens. Canon succeeded in beating the competition to development of techniques to eliminate the impurities and artificially grow crystals. The first lens in the world to use fluorite was the FL-F 300mm f/5.6. Not only did fluorite succeed in eliminating colour aberration, but it also made it possible to design shorter lenses. This 300mm was an innovative compact super telephoto lens in its day. These fluorite lens elements have been incorporated into many EF lenses as well as many of the lenses in the super telephoto high-performance L Lens Series.

1971

FD 55mm f/1.2 AL

1971 saw the birth of the F-1, a real system SLR camera with professional specifications, and this was accompanied by the FD Series of lenses, which received high marks for their optical performance, including high contrast, sharpness, and outstanding colour balance, as well as excellent mechanical performance and ease of use. The FD 55mm f/1.2 AL was the world's first aspherical lens to support SLR viewing and auto-diaphragm control. Light rays entering the edge of a spherical lens are refracted differently than those passing through the center. For this reason the position of focus becomes misaligned causing spherical aberration, which in large-aperture lenses can lead to flaring. Aspherical lenses solve this problem, with no flaring at full aperture while nevertheless achieving high contrast images. Canon had to develop the machine tools required to make these lenses. Incorporating new technologies into products is the result of constant development from beginning to end.

1973

TS 35mm f/2.8 SSC

This was the first 35mm camera lens with tilt and shift functionality, and was ideal for architectural and commercial photography, which until then had been monopolised by large-format view cameras. This lens acted as the springboard for the EF Series TS-E.

1973

FD 35-70mm f/2.8-3.5 SSC

This lens was a pioneer in short zoom lenses, thanks to its unique and simple two-lens-group design. It was equipped with a precise barrel construction in which zooming would move the front and rear lens groups at the same time in a non-linear fashion, with the positions of the front and rear lens groups moving apart at wide angles and coming together at telephoto angles, but without the barrel changing length. Also, the diaphragm in the rear lens group would move with it, and the aperture diameter changed in accordance with the zoom. Not only that, but it also came with a macro mechanism. This was truly an innovative lens. At that time zoom lenses were said to be lacking in comparison with single focal length lenses and were therefore rarely used by professional photographers, but as the exceptional performance of this lens gained recognition, it became a standard piece of equipment for the professional.

1975

FD 400mm f/4.5 SSC

Since conventional telephoto lenses required the entire lens to extend when focusing, the mechanical structure inevitably became very large. However, this lens adopted a rear-focusing system in which only part of the lens moved during focusing, thereby offering smooth operability. Another feature was the variable focus pitch system, which focused on the subject slowly for distant shots and swiftly for close-ups, just like the human eye. It was also compact and lightweight. The rear focusing system has since been employed in many lenses, and has contributed greatly to the creation of the high-speed autofocus used in EF lenses.

1982

New FD 14mm f/2.8L

This was the lens with the widest angle in the FD lens series, employing aspherical lens elements to eliminate distortion. Canon developed the software to design the aspherical lens using computers. It was necessary to start with the basic and peripheral technologies in order to continue to produce cutting-edge technologies.

1989

EF 50mm f/1.0L USM

This standard lens boasted the largest aperture of any 35mm SLR camera lens when it went on sale. With two ground and polished aspherical elements and four high-index refractive glass lens elements, it delivered outstanding imaging performance with high contrast and minimal flare, even at the maximum aperture of f/1.0. The floating mechanism helped maintain high picture quality even at close focusing distances, while the electronic manual focus function allowed full-time manual focusing with a very light touch even in autofocus mode. This worked to enhance the already quick and rapid autofocus which employed a ring-type USM (Ultrasonic Motor) for the drive.

1995

EF 75-300mm f/4-5.6 IS USM

This was the first interchangeable telephoto lens for SLRs equipped with an image stabilizing function. A pair of gyro sensors detects the movement of the camera and moves the corrective optics (the second lens group) in the opposite direction to cancel any possible blurring of the image, making this an innovative lens. The image stabilization effect is good for the equivalent of two shutter speeds.* Silent autofocus is achieved through the use of a micro USM for the autofocus drive.

* Based on a shutter speed of "1/focal length" seconds, said to be the limit for hand-held photography without image stabilization.

1999

EF 300mm f/2.8L IS USM

This lens has achieved such a high reputation that it has come to be known as the symbol of Canon's professional lenses. In 1974 the FL 300mm f/2.8 SSC Fluorite lens was created, a high-performance telephoto lens with the world's first use of fluorite in a large-aperture camera lens. That lens blazed the trail to be followed by the FD 300mm f/2.8 SSC and eventually the EF 300mm f/2.8L IS USM. Its innovative performance has produced numerous classic photographs in the fields of sports, journalism, and advertising. The EF 300mm f/2.8L IS USM is equipped with an image stabilizing mechanism to greatly improve mobility. The optical system achieves outstanding image quality thanks to the inclusion of one fluorite lens element and two UD lens elements. Reduced weight in the focus lens group and improvements to the autofocus drive algorithm make the autofocus extremely fast, while additional functions include a new function which makes instantaneous focus adjustments as well as a new autofocus stop function. Use of magnesium and a lighter weight optical system give the lens an overall reduced weight compared to previous models, while the rubber used on the mount and switches endows the lens with outstanding dust-proof and drip-proof characteristics.

2001

EF 400mm f/4 DO IS USM

The EF 400mm f/4 DO IS USM is a super telephoto lens which incorporates in part of the optical system Canon's own "DO lens (multi-layered diffractive optical elements)." Compared with lenses that have the same design specifications using only refractive optical elements, it not only maintains the same high image quality, but also delivers a 27% shorter length and 31% lighter weight. It is also equipped with an image stabilizing mechanism which corrects blurring during hand-held photography for the equivalent of two shutter speeds*, as well as an AF stop function, and a dust-proof and drip-proof construction, giving it almost the same performance as the Super Telephoto L-Type IS Lens Series.

* Based on a shutter speed of "1/focal length" seconds, said to be the limit for hand-held photography without image stabilization.

The Birth of the EF Lens

EF lenses, born of an active pursuit of new technologies and based on a foundation of expertise gained from 60 years of lens development experience, have equaled or exceeded the optical performance of the FD Lens Series to achieve a new level of precision in autofocus and fully electronic control and create the core of the EOS SLR camera system with next-generation design specifications.

The lenses were designed with an eye on the future, not just focusing on image performance, but also keeping the entire system in mind – specifically, the large-diameter electronic mount which allows total computerization of data communication between the camera and lens, and the lens motor drive system which utilises a high-precision electromagnetically driven diaphragm together with an ideal autofocus actuator (drive system) inside the lens.

One of these autofocus actuators was the world's first USM (UltraSonic Motor), which delivers high torque with no operating noise, is equipped with outstanding start and stop characteristics and is an ideal actuator which makes the autofocus speed and precision even greater. The USM was at first only included in L lenses, but is now found in almost all EF lenses. In 1995 the EF 75-300mm f/4-5.6 IS USM was developed, the world's first interchangeable SLR lens with a built-in image stabilizing mechanism. This mechanism is now found in the super telephoto L-Type IS Series, represented by the EF 300mm f/2.8L IS USM, establishing a whole new category of lenses. The EF 400mm f/4 DO IS USM developed in 2001 with DO lens holds the hidden potential to bring about a new revolution in the world of interchangeable lenses.

Our Memories … Your Memories

1930


Kwanon
(Prototype)


Original
(Hansa Canon)


S


J


JS


NS

1940


JII


JII


S


SII


IIB

1950


IIC


III


IV


IIIA


IVS


IIA


IID


IVSb


IIF


IVSb2


IIS2


IID2


VT


L2


VT Deluxe


L1


L3


VL


VL2


VIT


VIL


P


Canon Flex

1960


RP


R2000


7


RM


FX


FP

7S

Pellix

FT QL

Pellix QL

TL

EX EE

1970

F-1

FTb

F-1 High speed
Motor Drive
Camera

EX AUTO

FTb-N
(Later model)

EF

TX

AE-1

TLb

F-1(Later model)

AT-1

A-1

AV-1

1980

AE-1 Program

New F-1

AL-1

T50

New F-1 High
Speed Motor
Drive Camera

T70


T80


T90


EOS 650


EOS 620


EOS 750


EOS 850


EOS 630


EOS-1


EOS RT

1990


EOS 10


EOS 700


T60


EOS 1000


EF-M


EOS 100


EOS 1000S


EOS 5


EOS 500


EOS-1N


EOS 5000


EOS 55

EOS·DCS 1/3


EOS 500N


EOS IX E


EOS IX 50


EOS-3


EOS 3000


EOS D6000/2000


EOS 300

2000


EOS-1V


EOS 30


EOS 3000 N


EOS Kiss III L


EOS D30


EOS-1D


EOS D60


EOS 300V


EOS-1Ds


EOS 10D


EOS 300D

EOS 3000V

EOS-1D Mark II

EOS 30V/33V

EOS-1Ds Mark II

EOS 20D

EOS 300X

EOS 350D

EOS 20Da

EOS-1D Mark II N

EOS 5D

EOS 30D

EOS 400D

Canon interchangeable lens cameras produced since the 1930s.
•Any references to products with the Kiss naming are Japanese models.

White Canon lenses capturing the moment at a sporting event

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