NIKKOR Z 28-135mm f/4 PZの開発

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Development of the ‘NIKKOR Z 28-135mm f/4 PZ’

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2025年４月，「NIKKOR Z 28-135mm f/4 PZ」を発売した．ニコンの光学性能を継承しつつ動画パフォーマンスに特化したレンズであり，様々な映像制作のワンマン・オペレーション撮影においてビデオグラファーの快適な操作性を追求している．この提供価値のために詰め込んだ最新の要素技術を，ここに説明する．

The NIKKOR Z 28-135mm f/4 PZ was launched in April 2025. This lens inherits the optical performance of Nikon and is also specialized for video performance. It offers comfortable operability for videographers in one-man shootings for various video productions. In this paper, the latest elemental technologies packed into this lens are explained to elucidate its value.

Key words ニコンＺマウント，交換レンズ，パワーズーム，動画撮影
Nikon Z mount, interchangeable lens, power zoom, video shooting

1 Introduction

In April 2025, Nikon released the standard zoom lens “NIKKOR Z 28-135mm f/4 PZ” compatible with the Nikon Z mount system (Fig. 1).

Fig. 1 NIKKOR Z 28-135mm f/4 PZ

2 Background to the Development of a Standard Power Zoom Lens for Video Shooting

Nikon offers interchangeable lenses designed for video shooting; however, if asked whether they have been widely used as full-fledged video lenses, the answer would be “No.” Based on this understanding, we investigated the challenges encountered in video shooting and the needs of users. Further, we defined the product concept of this model as “a power zoom lens that, as a professional video production tool, can be used with confidence for event coverage, reporting, and live streaming.”

Building on this, we first clarified the extent to which existing NIKKOR Z lenses match the aforementioned concept and where their shortcomings lay. Then, we examined what Nikon, as a late entrant into the video industry, should and could offer.

As a result, we undertook the development with the following considerations in mind: a power zoom that, in one-person shooting, allows the lens to perform smooth zooming so the operator can concentrate on other shooting tasks; the construction of a shooting system optimal for event coverage, reporting, and live streaming—areas not fully addressed by existing lenses; and an optical design anticipating the era when 8K becomes the mainstream.

3 Operability and Functions that Support Videographers

3.1. “Easy-to-Use” Focal Length Range and Controls

In one-person shooting environments, the equipment selected is chosen with a strong emphasis on production efficiency due to the limited number of shooting staff. In addition, one-take documentary shooting or wedding filming should be possible without mistakes, even from a long distance. To accommodate a wide variety of event coverage, achieving an extremely high zoom ratio from wide-angle to telephoto would be ideal; however, as with broadcast television lenses, this would result in an extremely large optical system, far removed from ease of use. Therefore, we investigated concrete anticipated use cases—such as the size of the subject to be captured and shooting distance—and determined a focal length range of 28–135 mm, which is compatible with a practical overall size (Fig. 2).

Fig. 2 Versatile focal length range: 28–135 mm

3.2. Power Zoom Capable of Ease-In and Ease-Out

The zoom lever allows for "ease-in/ease-out" of operation, in which the zooming speed is gradually varied at the start and end of zooming (Fig. 3). This enables smooth and natural-looking zoom-in and zoom-out transitions. This ease-in/ease-out of operation is achieved by imparting the zoom lever a suitable resistance and finely tuning the relationship between the operating stroke and zooming speed.

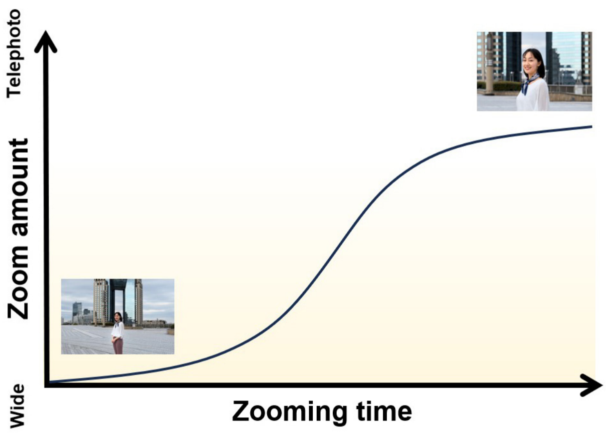

Fig. 3 Ease-in & ease-out

3.3. Internal Zoom Mechanism that Suppresses Shift in Center of Gravity

In general, standard zoom lenses often employ a variable overall length design in which the foremost lens group is extended, from the standpoint of reducing the size. In a variable overall length type, the foremost group also tends to have a large lens diameter, resulting in a substantial shift in the center of gravity when zooming from wide-angle to telephoto. A large shift in the center of gravity causes the balance to be disrupted when the camera is tripod-mounted or used on a gimbal, introducing unintended motion into the footage and making it visually unappealing. By adopting an internal zoom mechanism with the front group fixed, this model suppresses the shift in the center of gravity during zooming to approximately 2 mm. When mounted on the Z9, the shift in the center of gravity is further reduced to approximately 1 mm (Fig. 4). Furthermore, even when using a gimbal, there is no concern about balance being disrupted by a shift in the center of gravity, allowing comfortable zoom operation (Fig. 5).

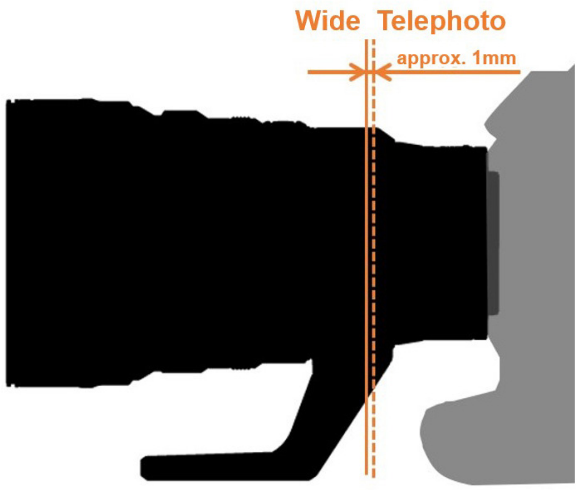

Fig. 4 Minimal shift in center of gravity

Fig. 5 Shooting with a gimbal

4 Accessories for Video Shooting and Remote Shooting System

4.1. Compatibility with Matte Boxes and Follow Focus Systems

The front-end diameter of the lens barrel is ϕ104 mm, accommodating diameter compatibility with multiple matte boxes. In addition, anticipating the use of a follow focus system for more precise and finer manual focusing, a gear profile compatible with gear module 0.8 has been incorporated into the operation ring. This is expected to provide high convenience in situations such as documentary shooting, where precise focus adjustment in accordance with subject movement is required.

4.2. Square Lens Hood with Filter Adjustment Window

While lens hoods for still photography are often petal shaped, the hood supplied with this product adopts a square shape familiar in the video shooting industry (Fig. 6). In addition, by incorporating a filter adjustment window, it is possible to operate a circular polarizing filter or variable ND filter while the hood is attached, eliminating the need to remove and reattach the hood. The hood is designed to be attachable facing either up or down, allowing the position of the adjustment window to be selected according to the equipment setup.

Fig. 6 Square lens hood with filter adjustment window

4.3. Support for Remote Zoom Operation

The incorporation of a power zoom enables remote zoom operation from devices such as computers and smartphones. Applications tailored to each device are available: NX Tether for computers and SnapBridge or NX Field for smartphones and tablets. Remote operation, unlike manual operation, eliminates the risk of inadvertently moving the equipment and disturbing the composition, making it useful for situations such as interviews, where maintaining a fixed composition is important. One-person operations are also possible in setups utilizing multiple cameras.

5 Optical Performance Enabling Ultra-High-Definition 8K Resolution

5.1. Optical Performance Objectives Considering Video Viewing Environments

In recent years, the number of camera bodies capable of 8K recording has been increasing, and an infrastructure for 8K editing has also been progressively established. In addition, as there are use cases in which footage is recorded in 8K, cropped in post-production, and output in 4K without digital interpolation, it was necessary to consider optical performance with an eye towards a future era in which 8K recording becomes mainstream. Building upon the optical performance targeted by conventional NIKKOR Z lenses, this model redefined the required number of resolvable lines based on 8K monitor viewing environments and human visual characteristics, thereby determining the target optical performance from key shooting scenarios in event coverage and reporting applications. Furthermore, in video shooting, unintended and unnatural "movements" must not appear in the footage, making it necessary to suppress abrupt changes in aberrations across the zoom range. Specifically, these include spherical aberration, which determines the overall image contrast; coma and field curvature, which determine resolution in the peripheral areas of the image; and chromatic aberrations, such as color fringing in out-of-focus areas and purple fringing in high-luminance regions. By suppressing these aberrations and minimizing their variation across the zoom range, high-quality imaging performance has been achieved throughout the entire zoom range.

5.2. Optical Performance Enabling High-Quality Video Shooting

This model adopts a zoom type with a positive-lead structure. In a positive-lead structure, the front group converges the light, allowing the subsequent groups to have smaller diameters, which contributes to overall size reduction. This model was designed with a focus on driving the zoom group without relying on an external power source, leading to the adoption of the positive-lead structure, which is advantageous for reducing the weight of the zoom group.

A positive-lead structure standard zoom lens generally has a three-group structure of positive – negative – positive, with the second negative group serving as the main variator group and the third positive group functioning as the master lens.

In general, many standard zoom lenses have the first positive group extend during zooming; this is because varying the spacing between the first positive and second negative group significantly enables the change in angle of view during zooming while keeping the incident angle of light into the third positive master lens group as constant as possible, thereby making it easier to suppress changes in aberrations across focal lengths. This model can also be broadly divided into three groups—positive, negative, and positive—but differs from the aforementioned standard zooms in that it is of the fixed overall length type. Unlike the variable overall length type, the fixed overall length type has inherent factors that increase size: ① the overall product length becomes longer, and ② the front element diameter becomes larger. The first factor exists because, in a variable overall length type, the telephoto end—i.e., the state with the greatest optical length—becomes the product length in a fixed overall length type. The second factor exists because, as a consequence of the first, the optical length at the wide-angle end inevitably becomes longer, requiring a larger front element diameter to maintain peripheral illumination.

In addition, because the front positive group cannot be moved for zooming, the burden on the subsequent negative group increases, resulting in a stronger power (optical refractive power). Because the power of the negative group corresponds to the amount of movement required for zooming, an excessively strong power reduces the required movement but imposes stricter demands on the group's driving precision while also increasing the amount of aberration variation across the zoom range. Conversely, if the power is too low, the required movement increases, extending the optical length and resulting in a larger product size. To achieve both high driving precision and suppression of aberrations, it is necessary to set an appropriate power. To reduce the burden on the negative group, the third-group master lens is separated, with part of it assigned the role of the variator group. In addition, by appropriately arranging Extra-low Dispersion (ED) lenses and aspherical lenses and taking advantage of the large-diameter Z mount, which allows large-diameter lenses to be positioned near the mount opening, the design contributes to improved contrast all the way to the edges of the image. Accordingly, an appropriate distribution of power among the groups, combined with specialized optical elements, balances optical length, aberration variation, and driving precision. Moreover, rather than relying solely on the design to achieve the desired optical performance, every unit undergoes inspection and adjustment during mass production to ensure that the optical performance targeted in the design is realized.

6 Development of Elemental Technologies Supporting Comfortable Power Zoom

6.1. Adoption of a Coupling Mechanism

This model also incorporates measures to address vibration and noise during operation. In existing NIKKOR Z lenses already on the market, the autofocus mechanism is designed with a silent structure; however, in the zoom mechanism of this product, the lens groups must be driven at even higher speeds and over longer strokes, necessitating more effective noise reduction measures than those in previous products. To address this, a coupling (shaft coupling) was adopted at the connection between the actuator—which tends to be a source of vibration—and the lead screw for driving the lens group, positioned in close proximity to the actuator, thereby absorbing even slight misalignments between the actuator shaft and lead screw and achieving quiet operation.

6.2. Highly Efficient Lens Drive System

The zoom group is often heavier than the focus group, and this model was no exception. Although increasing the actuator's driving force would make operation possible, it would come at the cost of increased noise; therefore, it was necessary to drive the heavy lens while keeping the driving force at the same level as in previous models. Therefore, the conventional drive efficiency was reconsidered from the ground up, with a focus on reducing friction during lens drive operation. From this perspective, multiple design solutions were proposed and repeatedly compared and evaluated, ultimately resulting in a configuration in which ball bearings are placed at numerous sliding interfaces. Compared with the conventional sliding-friction-based structure, to date, adopting a rolling-friction-based structure has enabled an exceptionally high drive efficiency among interchangeable lenses.

6.3. Control Tuning

In addition to mechanical refinements, careful consideration has also been given to the control method of the actuator. The acceleration and deceleration at the start and stop of driving have been tuned to achieve smooth operation while maintaining a balanced trade-off with drive response.

6.4. Thermal Design

As the multiple actuators used in this model tend to become sources of heat, consideration has also been given to the heat dissipation structure.

The fundamental design concept involves reducing the power consumption of heat sources, ensuring thermal conduction paths around heat sources, and distributing the placement of heat sources. Although the power required to drive the lens groups was optimized from the initial design stage, desk calculations predicted a significant temperature rise. Therefore, a design layout was adopted in which multiple actuators are distributed, and graphite sheets were utilized to connect the actuators to internal metal components, thereby securing efficient heat dissipation paths while also taking assembly workability and product size into consideration. Finally, thermal simulations were conducted, confirming that even under demanding conditions, such as prolonged continuous zooming, effective heat dissipation is achieved without heat concentrating in specific areas (Fig. 7).

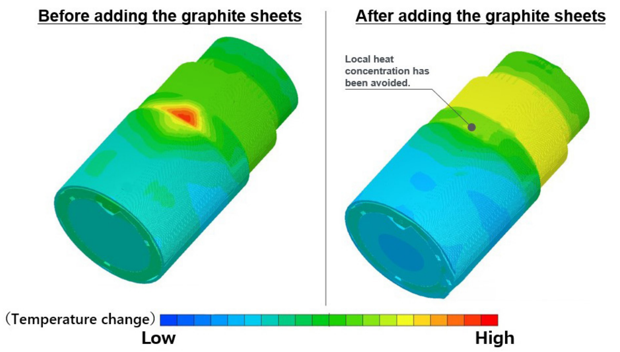

Fig. 7　Thermal dissipation simulation

7 High Mobility Achieved through Weight Reduction and Optical Specifications

7.1. Refining the Specifications through Trial and Error

When designing a lens with user mobility in mind, constraints on weight inevitably arise. For example, attempting to increase the zoom ratio beyond that of this model would, as shown in the translucent area of Fig. 8, enlarge both the maximum diameter and overall product length, thereby impairing handheld usability. In this lens, as mentioned above, we investigated the focal lengths in highest demand and repeatedly examined those that offer a good balance with mass, ultimately adopting the specifications of 28–135 mm and f/4.

Fig. 8　Specification optimization process

In addition, at the minimum shooting distance, it is possible to get close to the subject—0.34 m on the wide-angle side (reproduction ratio of 0.15 ×) and 0.57 m on the telephoto side (reproduction ratio of 0.25 ×)—making it possible to capture most scenes with this single lens without the need for lens changes, and, through the synergistic effect with weight reduction, resulting in a highly mobile lens.

7.2. Largest Number of Aspherical Lenses in the History of NIKKOR Z Lenses

For this lens, to drive the zoom group without relying on an external power supply, it was essential to reduce the weight of the moving group. To cover the wide angle-of-view range from 28 to 135 mm, the general optical design principle is to increase the number of lenses so that light is gradually refracted, thereby minimizing aberrations; however, in the case of this lens, this approach resulted in the zoom group becoming excessively heavy and thus impossible to drive. To address this, we employed a total of five aspherical lenses—four conventional and one ED aspherical lens produced by applying aspherical processing to an ED lens—thereby assigning to these few aspherical lenses the corrective functions that would otherwise require a considerably larger number of spherical lenses, achieving both aberration correction and group weight reduction (Fig. 9). As of April 2025, this lens uses the largest number of aspherical lenses in the history of NIKKOR Z lenses. The surface accuracy of aspherical lenses requires processing technologies at the submicron to nanometer level, as well as stable production. Although the design team has investigated shapes that balance aberration correction and manufacturability, the expertise of the engineering and manufacturing teams is indispensable for realizing them. Through close interdepartmental collaboration from the design stage onwards, we successfully adopted five high-precision aspherical lenses, making a significant contribution to weight reduction.

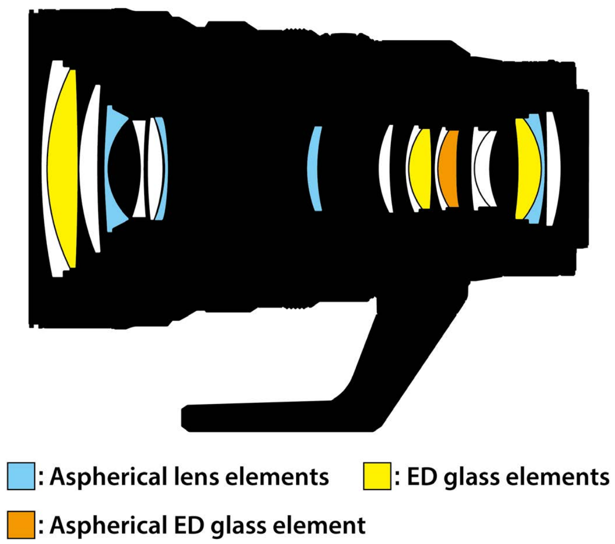

Fig. 9　Lens configuration diagram

7.3. Weight Reduction while Ensuring Reliability

While ensuring reliability in terms of strength and durability, we thoroughly pursued weight reduction by examining the thinning of metal parts and reducing the number of components.

In recent years, our in-house strength simulation technology has also improved, enabling efficient assurance of component strength and structural design, which has greatly contributed to weight reduction. As a result, the lens achieved a mass of 1,210 g while incorporating a tripod collar.

8 Hi-Res Zoom Extending the Telephoto Range

8.1. Hi-Res Zoom

In October 2022, the hi-res zoom function was added in firmware C:Ver.3.00 for the Z9. Even with a prime lens, it allows zooming up to 2 × without any degradation in image quality. Since its release on the Z9, this function has been deployed to multiple products, continuing to steadily evolve with features such as speed adjustment and power/hi-res zoom collab, and can be fully experienced with this lens as well.

8.2. Support for Power/Hi-Res Zoom Collab

Because the power zoom is electronically controlled, both power zoom and hi-res zoom can be operated during shooting with the manipulation of a single control. When linked, the focal length becomes twice as long (equivalent to 270 mm when shooting 4K video with the Z9/Z8). Furthermore, selecting the DX (APS-C) image area makes it possible to extend the magnification by an additional 1.5 × (equivalent to 405 mm in full-frame terms), although when the image size is set to DX, the resolution is limited to FHD.

8.3. Extended Mode and Synchronized Mode

Power/hi-res zoom collab can be selected from two modes. The extended mode performs hi-res zooming in the range beyond the focal length of the optical zoom, while the synchronized mode performs optical zoom and hi-res zoom simultaneously (Fig. 10). The extended mode is characterized by natural changes in perspective and depth of field within the optical zoom range according to the focal length while the telephoto-side state is maintained as is in the hi-res zoom range. The synchronized mode enables uninterrupted zooming without pauses in the zooming operation, allowing smooth zooming and is considered effective when actively zooming over a wide focal length range during video recording. Each mode can be selected according to its intended application.

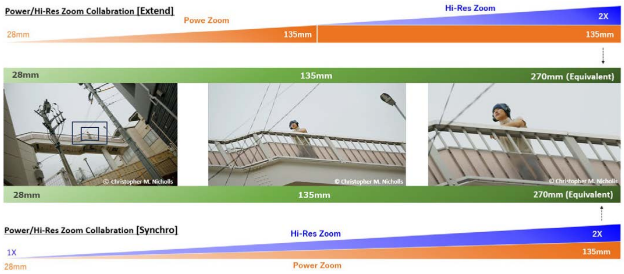

Fig. 10 Hi-res zoom collab

It should be noted that this function was made possible precisely because both the camera body and lens were developed in-house.

9 Excellent Backlight Resistance

9.1. Meso Amorphous Coat and Optimized Lens Shapes

This lens achieves excellent backlight resistance through optical and mechanical innovations, enabling the capture of clear, high-contrast images even in scenes with strong light sources. From an optical perspective, backlight resistance is controlled through appropriate lens shapes, arrangements, and coats. Because each lens element contributes to aberration correction but also becomes a potential surface for ghost generation, we have repeatedly conducted ray-tracing simulations to determine optimal lens shapes that prevent prominent ghosts from being focused on the image plane while still meeting the targeted optical performance. Another measure is to apply an extremely low-reflectance coat to the lens, thereby reducing the intensity of the light rays that cause ghosts. This lens employs the Meso Amorphous Coat, which offers the highest anti-reflective performance in the history of NIKKOR lenses. The Meso Amorphous Coat is formed by depositing a structure composed of particles with minute amorphous structures interconnected with each other onto an underlying coat, thereby creating particle gaps—called mesopores—throughout the entire film (Fig. 11). The presence of air within these numerous mesopores results in a film structure with a low refractive index and low

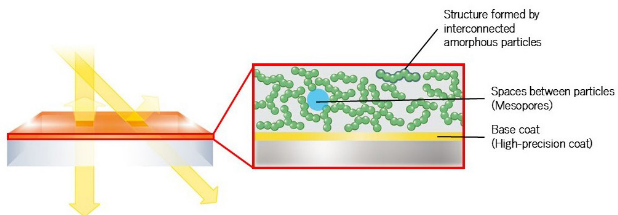

Fig. 11 Structure of the meso amorphous coat

scattering properties [1].

With a thorough understanding of the characteristics of the Meso Amorphous Coat and Super Integrated Coat, this lens achieves both high optical performance and excellent backlight resistance by arranging the lenses in optimal shapes and applying the most suitable coat to the appropriate locations.

9.2. Measures in Structural Components

In this lens, the space required to accommodate the zoom drive actuators has resulted in complex internal component shapes, making it extremely challenging to implement measures to reduce internal reflections while also taking manufacturing constraints into consideration. By repeatedly conducting ray-tracing simulations and effectively incorporating anti-reflective geometries and low-reflectance surface treatments, we have achieved a high level of backlight resistance.

10 Operability without Visual Cues

10.1. Knurled Patterns and Diameter Differences of the Operating Rings

From the front end of the lens barrel, the focus, zoom, and control rings are arranged in the order of assumed frequency of use (Fig. 12). The focus ring features a moderately contoured finger grip to enhance the sense of hold. The zoom ring has a special knurled pattern and is designed with a diameter difference from the focus ring. These features allow the two most frequently used rings to be distinguished and operated naturally using a fingertip. The control ring employs the common diamond knurling used in NIKKOR Z lenses, with its shape designed to be easily distinguishable by touch from the other rings.

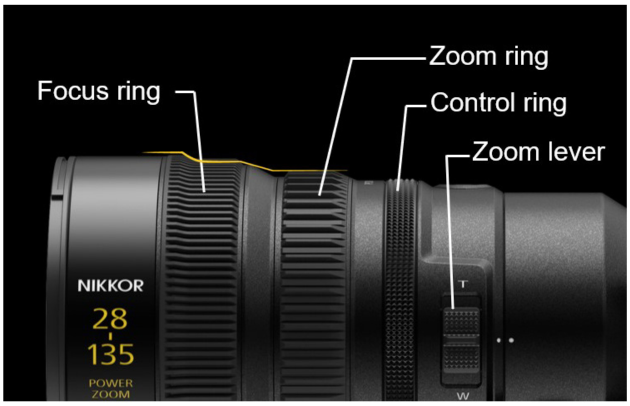

Fig. 12 Operability without relying on visual cues

10.2. Placement and Design Features of the Zoom Lever

The zoom lever is positioned on the side of the lens barrel for ease of use from waist to shoulder level, accommodating both vertical and horizontal shooting orientations (Fig. 12). The lever's protrusion is made relatively tall for a secure catch, and diamond knurling is applied near the protrusion, also serving as a non-slip surface to support precise ease-in/ease-out operations.

11 Conclusion

The NIKKOR Z 28-135mm f/4 PZ is, we believe, a lens that combines hi-res imaging, a shooting system, operability, and mobility suitable for professional video production. We hope that users will be able to concentrate on shooting with confidence and expand the possibilities for one-person operations in client work.

We will continue to develop products that exceed customer expectations, thereby contributing to the further evolution of the Nikon Z mount system and the advancement of imaging culture.

References

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