Nikon

Z 8 **Professional Technical Guide**
—Pixel Shift Edition—
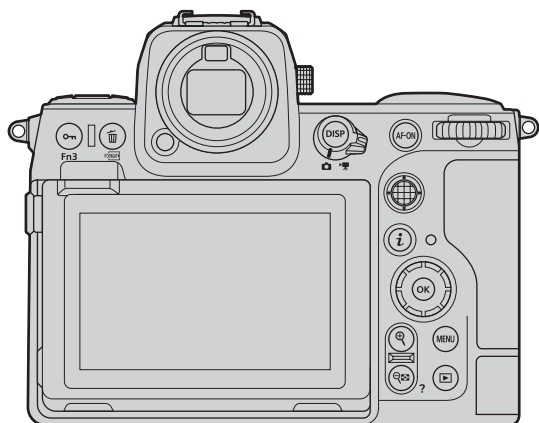
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Pixel Shift

What Is "Pixel Shift"?

Pixel shift allows you to take multiple pictures while shifting the camera's image sensor by a single pixel or less and to merge them to generate a higher-resolution image than that which can be obtained through normal single-frame shooting.

How Pixel Shift Works

The Bayer image sensor installed in general cameras including Nikon cameras can only capture one type of color information (R, G, or B) per pixel. When displaying in RGB, the remaining colors must be interpolated from the surrounding pixels. In the following example, color information is captured in the ratio of R:1, G:2, and B:1, and each RGB channel captures the color information of the remaining pixels through the interpolation process.
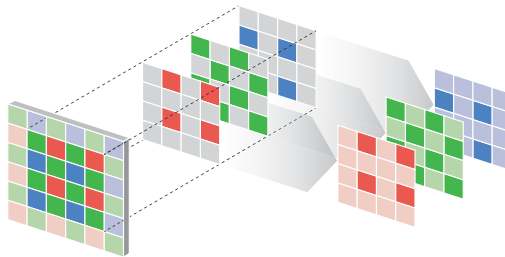
In pixel shift shooting, taking multiple pictures while shifting the image sensor by one pixel unit allows G or B to be captured at the pixel location where R was captured. Since RGB can be overlapped without interpolation, *moiré*, and color fringing caused by the interpolation process can be reduced, improving color reproducibility in the details.

1st shot   2nd shot   3rd shot   4th shot

Sensor area
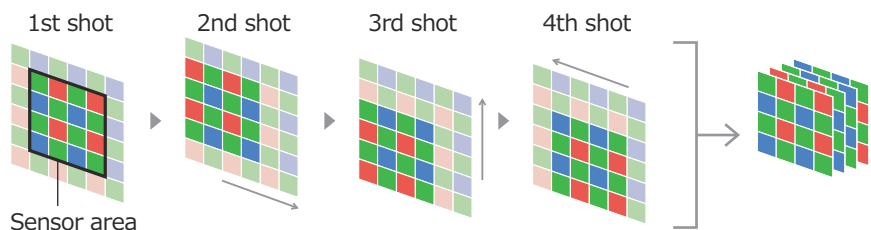
The image sensor can also be shifted by units smaller than a single pixel. Since the camera captures more detailed information, higher-resolution images than those captured by shifting one pixel unit can be generated. Nikon cameras can shift the image sensor by 0.5 pixels.

Shifting   Shifting   Shifting
0.5 pixels   0.5 pixels   0.5 pixels

Sensor area
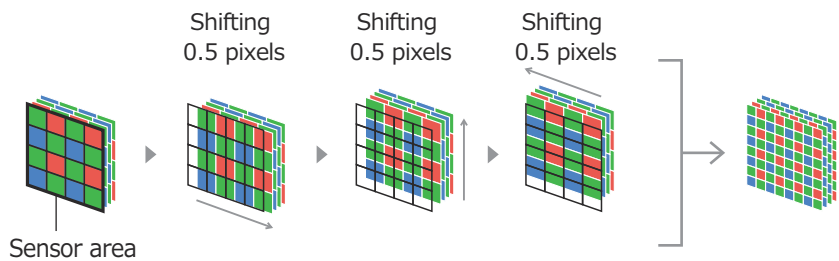
Pictures taken with the pixel shift shooting function can be merged into a single, high-resolution image with Nikon's NX Studio software. Noise can also be averaged and reduced by merging multiple images.
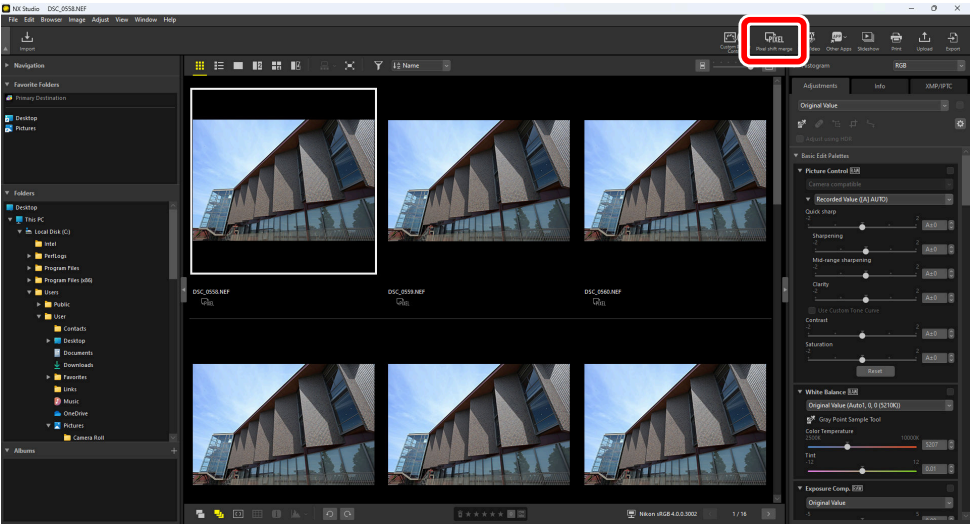
☑ **Images and Illustrations**
The images and illustrations in this document are for expository purposes only.

The Pixel Shift Workflow

Pictures taken using pixel shift cannot be merged within the camera. NX Studio allows you to generate high-resolution images by merging pictures taken with pixel shift.

Step1	Step2	Step3
Shoot	**Merge**	**Adjust**

Camera · NX Studio · NX Studio · Adobe Photoshop · Capture One

Step1: Take pictures for pixel shift merge with your camera

Take pictures using pixel shift to generate images for merging (📖 20). Pixel shift shooting is available with camera "C" firmware version 2.00 or later.

Step 2: Merge pictures taken using pixel shift with NX Studio

Merge pictures taken by the camera using pixel shift with NX Studio. Use NX Studio to view and edit pictures shot with Nikon digital cameras (📖 28). Use the latest version of the software to merge pictures taken using pixel shift. NX Studio can be downloaded from the Nikon Download Center (https://downloadcenter.nikonimglib.com/).

Step 3: Adjust merged pixel shift images with NX Studio or third-party software

Adjust merged pixel shift images with NX Studio or third-party image processing software. The brightness, contrast and other factors of merged pixel shift images can be adjusted with NX Studio (📖 35).

The Benefits of Pixel Shift

Here are the benefits of pixel shift.

Reducing *Moiré* and Color Fringing

Pixel shift can reduce *moiré* and color fringing because it does not interpolate between pixels.
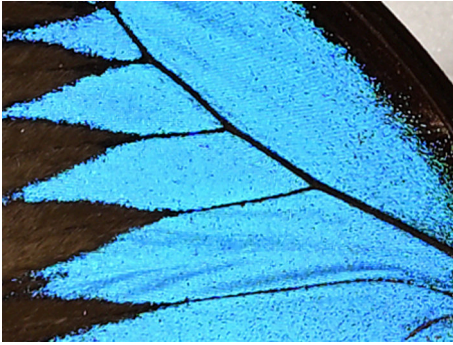
Single frame image
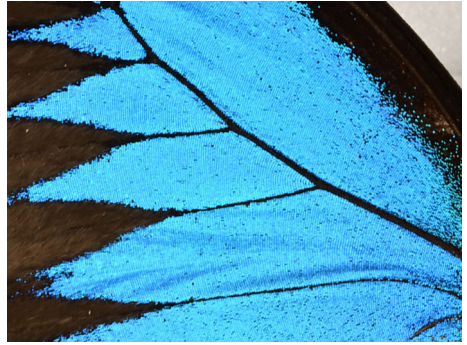
Merged pixel shift image

Improving Color Reproduction of Details

Pixel shift does not interpolate between pixels regardless of whether it merges 4, 8, 16, or 32 pictures, so color reproduction of details can be improved when compared to single frame shooting.
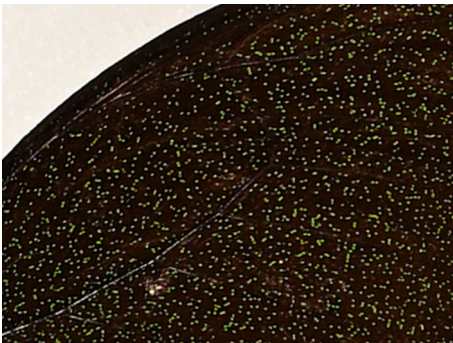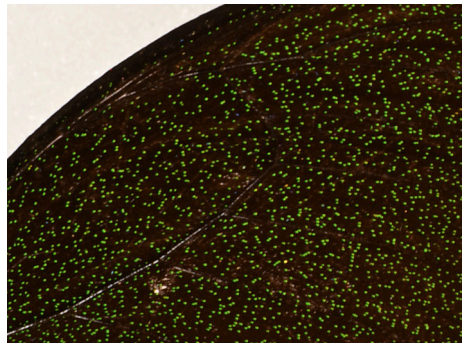
Single frame image

Merged pixel shift image

Improving Resolution

By using pixel shift, more detailed information can be captured, resulting in high-resolution and high-definition images.

Single frame image   Merged pixel shift image

Reducing Noise

Noise can be noticeably reduced by merging 8 or 32 pictures with NX Studio.
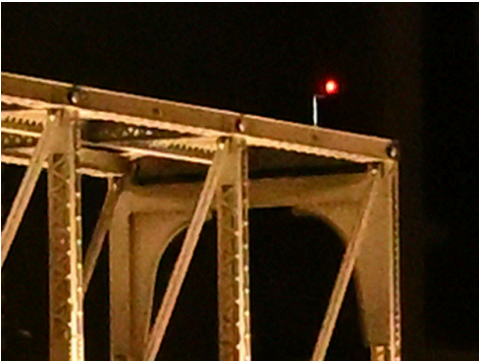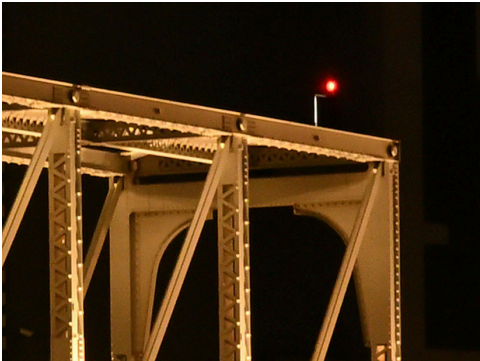
Single frame image   Merged pixel shift image

Scenes Where Pixel Shift Is Effective

Here are some examples where pixel shift is effective and how to take advantage of it.

When You Want Images with a Larger Size or Higher Definition

Pixel shift is effective when you want images with a larger size or higher definition. The resulting image has four times the number of pixels of the original and it can be generated in a larger size. When 16 or 32 pictures taken using pixel shift are merged into a single image, the resulting height and width are double those of the original pictures. For example, images taken at 8256 × 5504 pixels can be merged to generate an image of 16,512 × 11,008 pixels.

© Taylor Gray

Single frame image

Merged pixel shift image with quadruple the number of pixels

When You Want High Quality Images with the Same Size as Single Frame Shooting

Pixel shift is effective even when a large image is not needed. "Oversampling," in which higher-resolution data is taken and then resized to a smaller size, can generate a high-definition and high-quality image at a high resolution while having the same image size as single frame shooting. The file size of the generated image is not significantly different from that of an image of the same image size without oversampling and is recommended from an archive perspective.

- If 32 pictures are merged to make a generated image and oversampled to be the same image size with the merged image of 4 or 8 pictures, the resulting image will produce a higher image quality than those counterparts.

© Taylor Gray

Single frame image

Merged pixel shift image from 8 shots

Merged pixel shift image from 32 shots, resized to a single frame image size
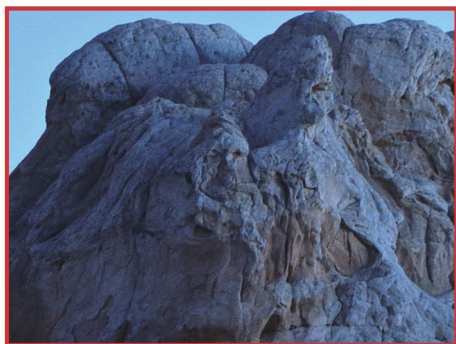
Merged pixel shift image from 32 shots

When You Shoot Subjects that Cause *Moiré*

Moiré occurs due to the relationship between the fineness (frequency) of a subject's structure, its colors, and the performance of the camera. It is difficult to eliminate *moiré* from pictures after shooting, so it is important to prevent it during shooting. Pixel shift is effective when shooting subjects with repeated fine structures, such as textiles, building roofs, or tile walls.

• Regardless of the [**Number of shots**] setting (4, 8, 16, or 32 pictures), *moiré* may be less noticeable compared to single frame shooting.
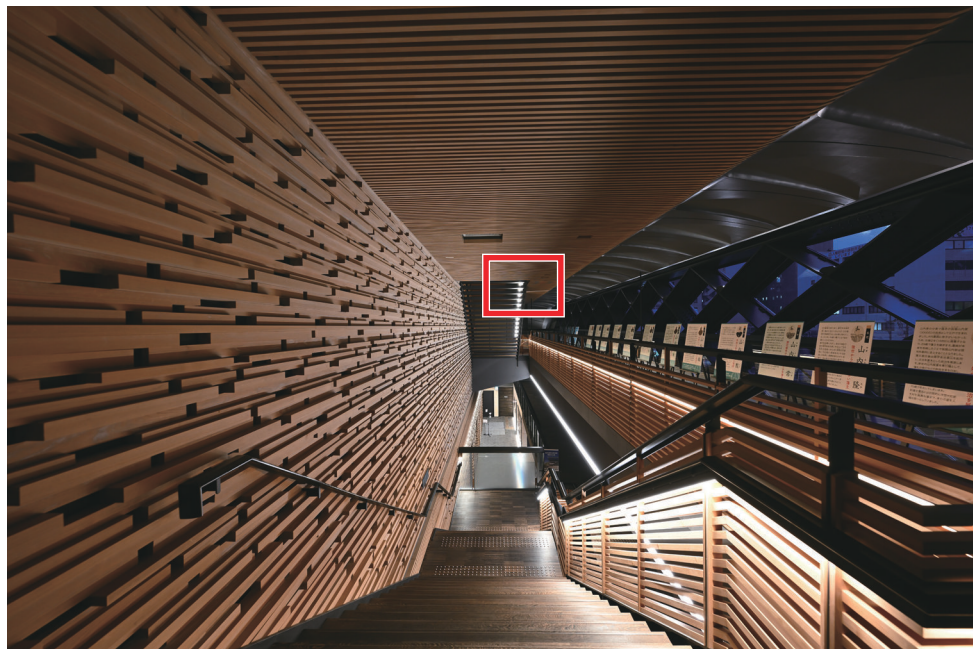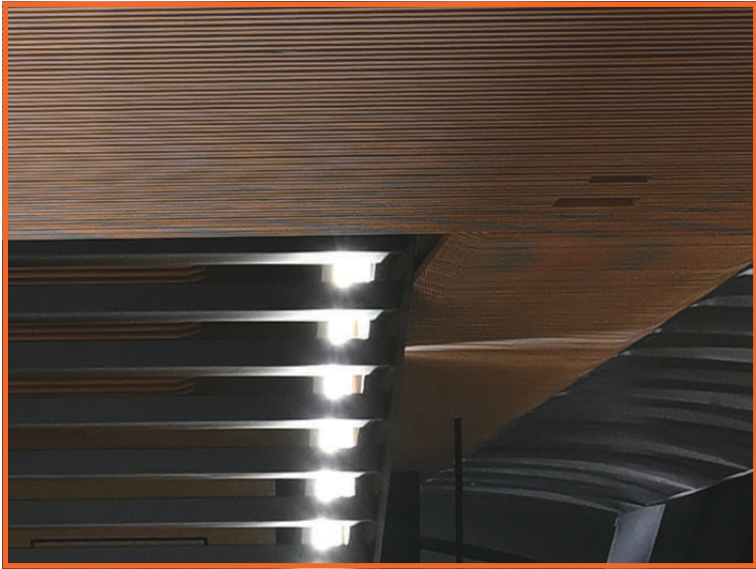
Single frame image
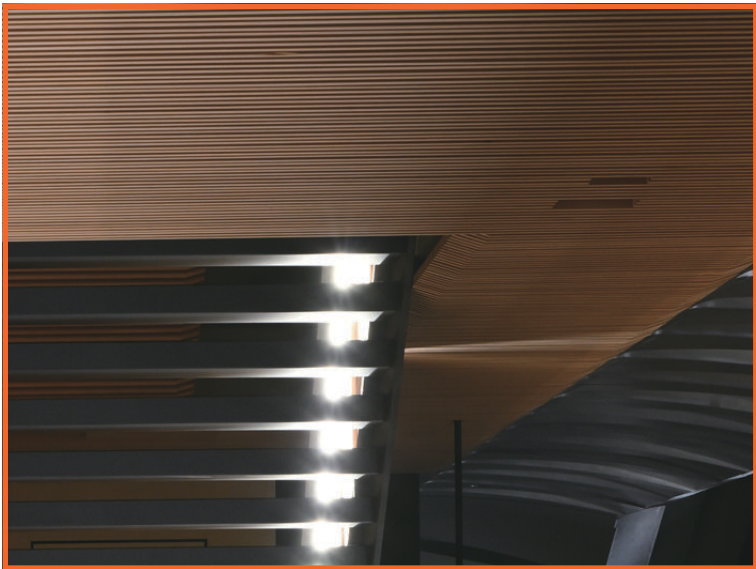
Merged pixel shift image

When You Need a Deeper Depth of Field or a Wider Angle of View

Pixel shift is effective when you want to increase the area in focus or to include a wider area in the picture. It can generate images with approximately four times the resolution of a single frame shot. Therefore, it is possible to shoot away from the subject while maintaining the equivalent resolution of a single frame shot. A longer distance from the subject may lead to lower magnification and a change in perspective, but can also provide a deeper depth of field and a wider angle of view.
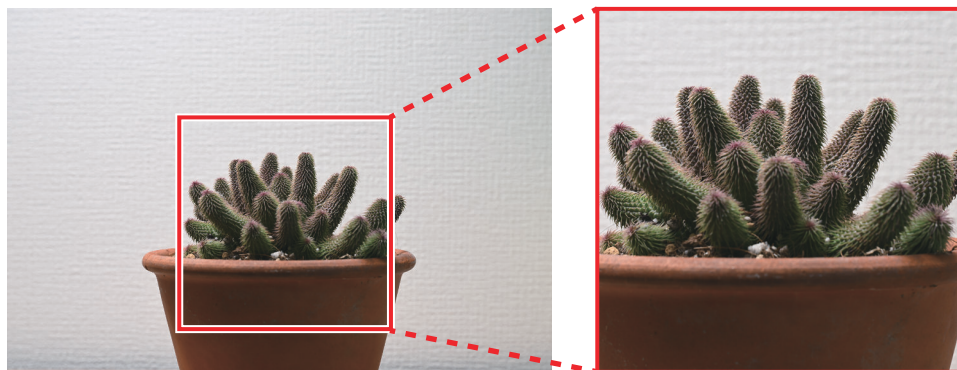
Single frame image shot at a focal length of 70 mm, aperture of f/8, and shutter speed of $^1/_2$ s
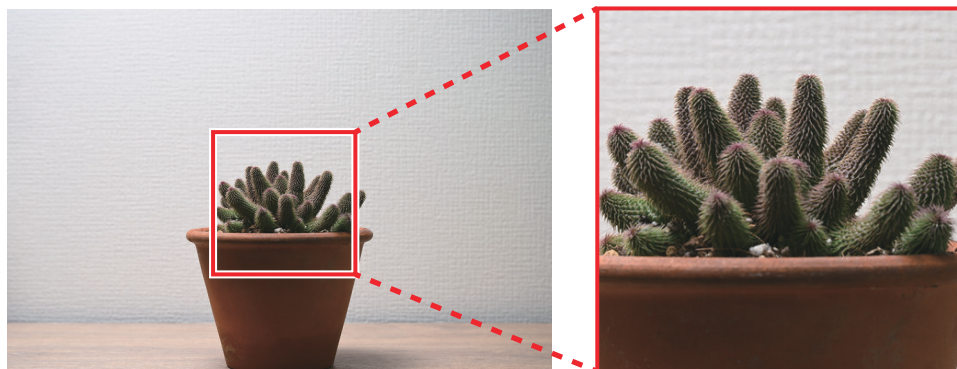
Merged pixel shift image shot at a focal length of 70 mm, aperture of f/5.6, and shutter speed of $^1/_4$ s

As shown above, pixel shift provides a better image quality and a deeper depth of field than a single frame shot, even with a wider angle of view, a larger aperture value, and faster shutter speed achieved. This allows you to take pictures with extra space and with a wider aperture than usual. It also reduces the time and effort required for post-processing focus stacking.

Tip: The Number of Pictures Taken during Pixel Shift Shooting

In pixel shift shooting, you can select the number of pictures taken from 4, 8, 16, or 32. This provides several advantages during a pixel shift merge, depending on the number of pictures taken. More advantages can be gained as more pictures are taken.

Number of shots	Advantages
4	Reducing *moiré* and color fringing, improving color reproduction of details and resolution. Single frame image Merged pixel shift image from 4 shots
8	Reducing *moiré*, color fringing, and noise, improving color reproduction of details and resolution. Merged pixel shift image from 4 shots Merged pixel shift image from 8 shots

Number of shots	Advantages
16	Reducing *moiré* and color fringing, improving color reproduction of details and resolution, doubling the image size. Merged pixel shift image from 4 shots — Merged pixel shift image from 16 shots
32	Reducing *moiré*, color fringing, and noise, improving color reproduction of details and resolution, doubling the image size. Merged pixel shift image from 16 shots — Merged pixel shift image from 32 shots

The number of images generated, as merged pixel shift images can be selected if more than 4 shots are taken. For example, when shooting 32 shots, 32 shots be merged into 1 image, and multiple merged images can be generated (such as 2 images each from 16 shots, 4 images from 8, and 8 images from 4). Even if a merged image is disrupted due to blurring of the subject in some shots, the desired merge result may be generated by changing the number of images to be generated. (📖 32). It is recommended to always take 32 shots unless there is a particular reason, such as shortening the shooting time or saving storage device capacity.

Notes on Pixel Shift

Pixel shift is a technique that takes multiple pictures of the same subject while gradually changing in-camera settings and merges them into an image. Therefore, if some changes occur with the subject during pixel shift shooting, the pictures cannot be successfully merged. It is recommended to use pixel shift only when shooting a completely static subject with the camera fixed on a tripod or similar device.

Conditions Unsuitable for Pixel Shift Merge

The desired merge results may not be generated if any of the following conditions occur during pixel shift shooting:

- **When the subject moves**: Moving subjects (people, animals, etc.) are not suitable for pixel shift merge.
  - Even if shooting a completely static subject such as a building, if there is something moving within the angle of view, the merge of that area may not work.
  - The desired merge result may not be generated if the subject looks like it is moving due to atmospheric fluctuations (heat haze, mirages, etc.) when shooting landscapes.

- **When the camera moves**: Be sure to fix the camera on a tripod or similar device. Even when the camera is fixed on a tripod, it may be shaken by wind or vibrations caused by people or cars passing by.

- **When the brightness of the subject changes**: Changes in the brightness of the subject due to changes in weather conditions, sunrise and sunset, flickering lighting, etc. will affect the merge result.

Shooting Time

It is difficult to control external factors such as light, atmosphere, and ground during shooting. The longer the shooting time, the more susceptible the camera is to external factors, so it is recommended to set the camera to complete shooting in as short a time as possible.

Tip: Raise the ISO Sensitivity to Shorten the Shooting Time

Even if the ISO sensitivity is set to a low value, a high-resolution image may not be available due to external factors depending on the shooting time. In these cases, it is recommended to raise the ISO sensitivity and shorten the shooting time. For example, when shooting with 32 pictures, better results are expected by shooting at ISO 500 and a shutter speed of 4 seconds than at ISO 64 and a shutter speed of 30 seconds.

Pixel Shift Shooting

Before Pixel Shift Shooting

Note the following before starting pixel shift shooting.

Choose a Static Subject

As mentioned in "Notes on Pixel Shift" (), choose a static object as the subject. Examples of subjects suitable for pixel shift merge include:

- Buildings
- Objects
- Specimens and taxidermy mounts
- Landscapes

Fix the Camera

Be sure to fix the camera on a tripod or with a camera arm so that it will not move during pixel shift shooting. Choose a location where the tripod is not subject to vibrations from the ground or wind.

Perform Pixel Mapping

If unexpected bright spots appear in a shot taken during pixel shift shooting, performing a pixel shift merge may cause them to be more noticeable. We recommend using [**Pixel mapping**] in the setup menu before shooting.

	SETUP MENU	❓
🎬	Save zoom position (PZ lenses)	OFF
✏️	Auto temperature cutout	STNDRD >
▶️	Sensor shield behavior at power off	OFF >
🔧	Clean image sensor	>
	Image Dust Off ref photo	>
⊕	Pixel mapping	>
≡	Image comment	OFF >
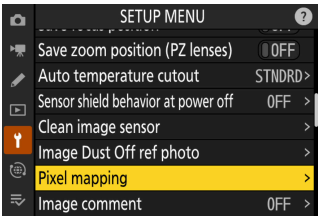
Set Functions That Can Be Used with Pixel Shift Shooting

The following camera features can be used in combination with pixel shift shooting. Configure the settings before shooting begins.

- Added features for pixel shift shooting with "C" firmware version 3.00. See "Features Available with 'C' Firmware Version 3.00" for details (📖 40).

Flash Photography

An optional flash unit can also be used during pixel shift shooting. Choose a longer interval in [**Pixel shift shooting**] > [**Interval until next shot**] than the time needed for the flash to charge, so that the flash can fire at a constant intensity for each shot.

	Pixel shift shooting	❓ ↻
📷	Pixel shift shooting mode	ON🔄 >
🎬	Number of shots	16 >
✏️	Delay	2″ >
▶️	Interval until next shot	0″ >
🔧		
⊕		
≡		

- Banding and uneven colors may occur during a merge due to variations in light intensity. If uneven colors are noticeable, use a flash unit with stable flash output. Also, uneven colors can be reduced by increasing noise reduction when adjusting merged pixel shift images.
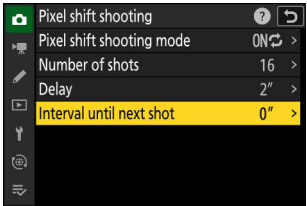
Tone Mode [HLG]

You can select [**HLG**] for [**Tone mode**] in the photo shooting menu to take NEF (RAW) pictures that can be saved as HEIF copies with a wide dynamic range.

	Tone mode	↻
📷		
🎬	SDR	
✏️	HLG	
▶️		
🔧	An HLG-compatible monitor is required for the display of pictures taken in this mode. See the manual for details.	
⊕		
≡		
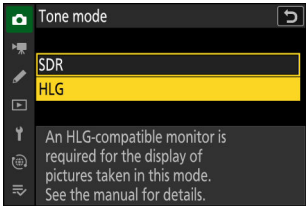
Image Area

Image areas can be selected using [**Image area**] in the photo shooting menu. Image areas other than [**FX (36 x 24)**] can also be set for pixel shift shooting.

	Image area	↩
	Choose image area	FX >
	DX crop alert	OFF

Before Pixel Shift Shooting
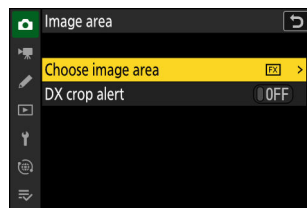
Pixel Shift Shooting Settings

Pixel shift shooting can be set using the camera or NX Tether.

Using the Camera

You can adjust pixel shift shooting settings in [**Pixel shift shooting**] in the photo shooting menu.

Option	Description
[**Pixel shift shooting mode**]	• [**On (series)**]: Take multiple series of pixel shift pictures. To end pixel shift photography, select [**Pixel shift shooting mode**] again and choose [**Off**]. • [**On (single photo)**]: End pixel shift photography after recording a single series. • [**Off**]: End pixel shift photography.
[**Number of shots**]	Choose the number of shots taken each time the shutter-release button is pressed. • Long series require more time to record but produce better-quality results when merged into a single image. • Unless there is a particular reason, 32 shots is recommended.
[**Delay**]	Choose the delay between the shutter-release button being pressed all the way down and the start of pixel shift photography.
[**Interval until next shot**]	Choose the interval between shots, in seconds. • If you are using an optional flash unit, choose an interval longer than the time needed for the flash unit to charge. If the interval is too short, it may not fire or fire at less than the power needed for full exposure.

Tip: Functions and Settings Useful for Creating Shortcuts for Pixel Shift Shooting

Here are recommended functions and settings useful for creating shortcuts for pixel shift shooting.

- **Assigning [Pixel shift shooting] to the _i_ menu**: Assign [**Pixel shift shooting**] using Custom Setting f1 [**Customize 🖪 menu**] to promptly move to the [**Pixel shift shooting**] settings display.
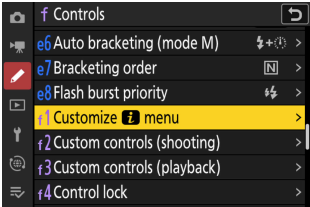
- **Assigning [Pixel shift shooting] to a custom control**: [**Pixel shift shooting**] can be assigned to a control using Custom Setting f2 [**Custom controls (shooting)**].
  - Rotate the main command dial while pressing the assigned control to change the [**Pixel shift shooting mode**] setting.
  - Rotate the sub-command dial while pressing the assigned control to change the [**Number of shots**] setting.
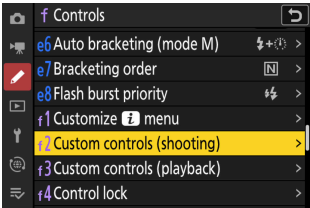
- **Switching between multiple settings with [Shooting menu bank]**: Save the pixel shift shooting settings in the camera with [**Shooting menu bank**] in the photo shooting menu to promptly recall them when needed. This is effective when managing multiple shooting settings. See "Recommended Settings" > "Camera" > "Storing and Selecting Menus Used for Pixel Shift Shooting" for details ( ).
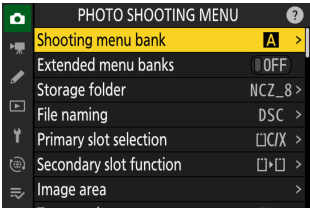
Using NX Tether

Use NX Tether "tethered photography" software to take pictures while a camera is connected to the computer. Click [**Pixel shift shooting**] in the [**Shooting Settings**] pane to adjust shooting settings. Available settings are the same as those in the camera menu. Select [**ON**] to enable pixel shift photography at the selected settings.
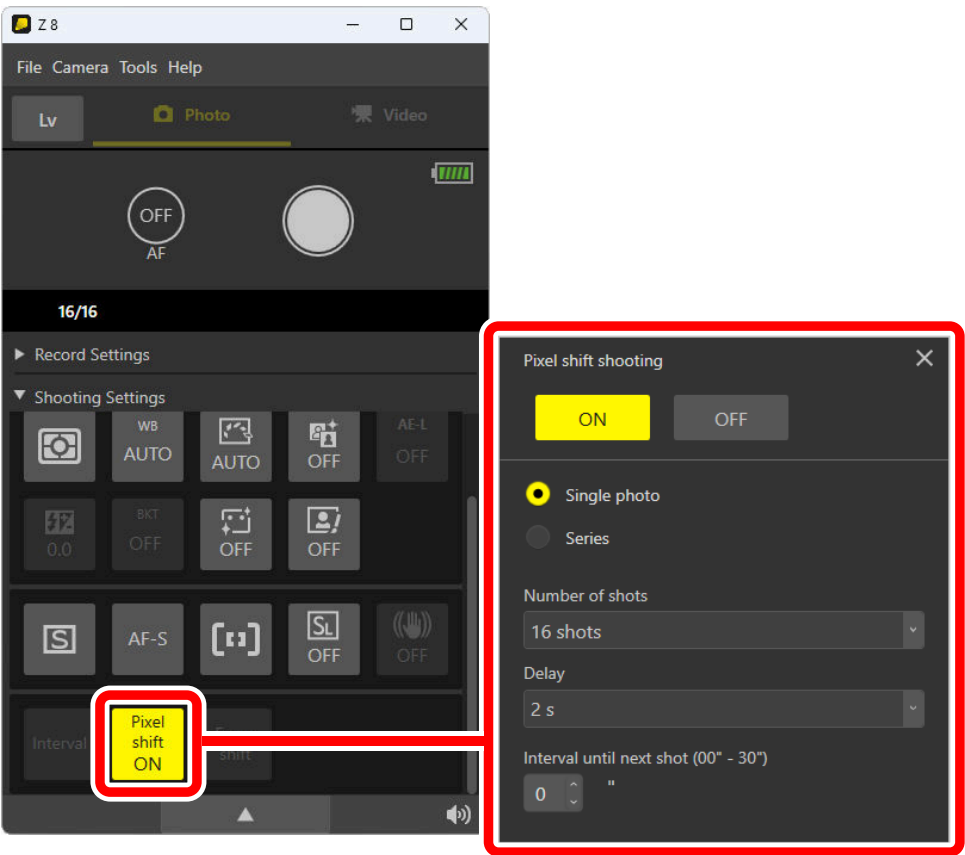
- Download NX Tether from the Nikon Download Center (https://downloadcenter.nikonimglib.com/). Use the latest version of the software for pixel shift photography.
- For information on connection to NX Tether and its basic operations, see NX Tether online help (https://nikonimglib.com/nx_tether/onlinehelp/en/).

- For information on connecting the camera to a computer via an Ethernet cable and controlling the camera remotely from the computer, see "Computers: Connecting via Ethernet" (https://onlinemanual.nikonimglib.com/z8/en/computers_connecting_via_ethernet_91.html) and "What You Can Do When the Camera Is Connected to a Computer or FTP Server" > "Camera Control" (https://onlinemanual.nikonimglib.com/z8/en/uploading_pictures_94.html) in *Z 8 Reference Guide*.
- If an insufficient number of pixel shift pictures are downloaded from the camera, consult "Troubleshooting" > "Not All Pictures Taken in Tethered Photography Are Downloaded" (📖 54).

Tip: Making the Most of NX Tether

NX Tether comes with convenient features. Customize the settings according to your objectives and situation.

- **Changing downloaded file names**: Select [**File Name**] under the [**Tools**] menu > [**Options**] > [**Destination**] tab to specify image file names. Selecting [**Same as camera**] for [**Naming convention**] enables the use of the same file names as those saved with your camera, making file handling easier. You can also set prefixes or suffixes to generate unique file names.
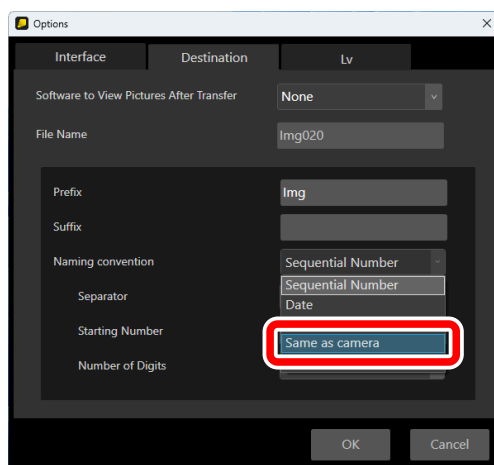
- **Increasing the number of the live view framing grid lines**: Select [**Horizontal line count**] or [**Vertical line count**] in [**Framing grid display**] under the [**Tools**] menu > [**Options**] > [**Lv**] tab to customize the number of framing grid lines displayed on the live view image.

- **Drawing framing guides at the desired positions in live view**: Click the show framing guides icon in the live view window to display framing guides, which you can drag to any desired position.
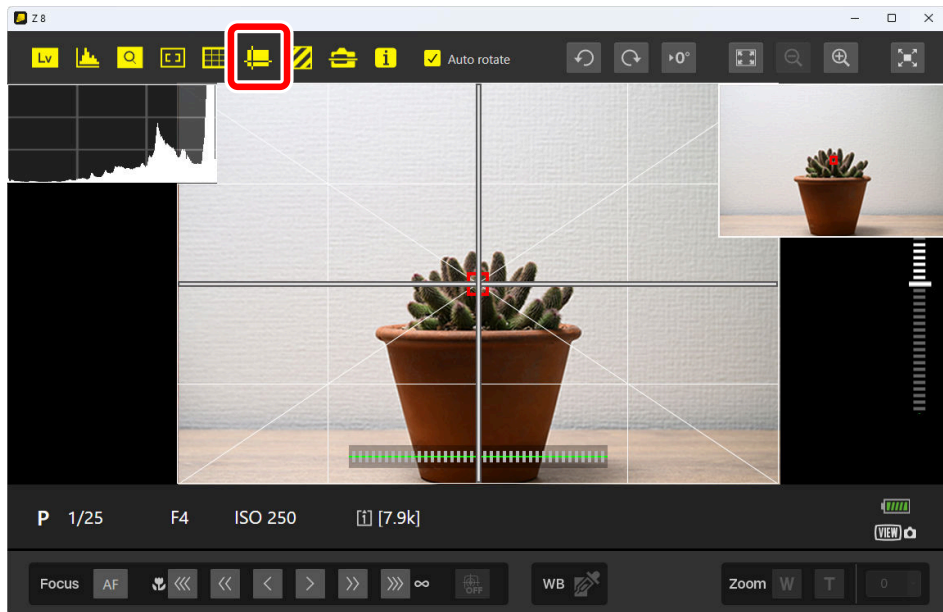
- **Downloading pictures shot using the camera shutter-release button**: Placing a check next to [**Enable Controls on Camera Body**] in the [**Camera**] menu automatically downloads pictures taken with the camera shutter-release button to your computer.

- **Measuring preset manual white balance to apply to photos**: With version 2.3.0 or earlier, you cannot measure preset manual white balance in photo mode. Instead, switch to video mode to measure preset manual white balance, then switch back to photo mode to apply the obtained preset data to photos.

Merge Pictures Taken Using Pixel Shift

Merge Pictures Taken Using Pixel Shift with NX Studio

Merge pictures taken using pixel shift with NX Studio. The software will detect the pixel shift sequence of the selected picture and the pictures in the sequence can be merged into a single file.

Using Pixel Shift Merge

1 Display the folder containing the pixel shift sequence, and click [**Pixel shift merge**] in the toolbar.
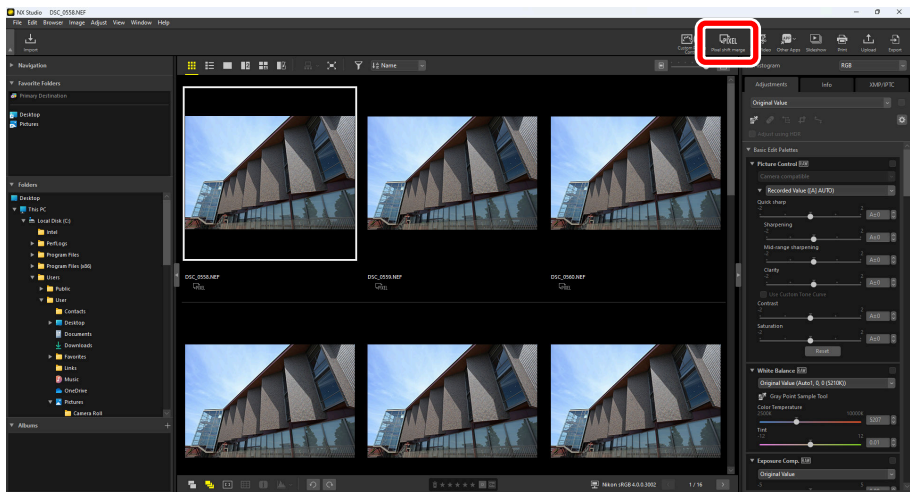
- The [**Pixel Shift Merge**] dialog will be displayed where you can choose a series of pictures taken with the camera using [**Pixel shift shooting**].

2 In the [**Pixel Shift Merge**] dialog, adjust settings such as "Merge mode" (number of generated images) and "Chromatic aberration correction" (🔲 30).
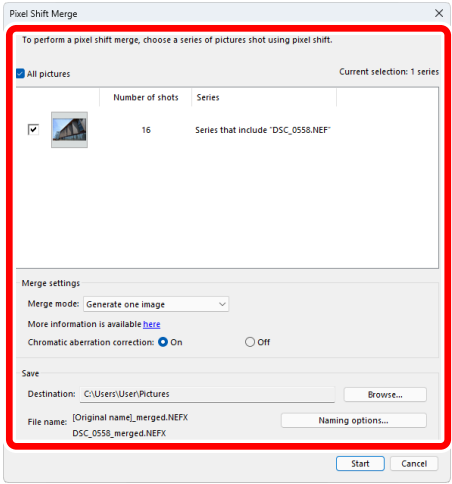
3 Click [**Start**] to save merged pixel shift images in the selected destination folder.
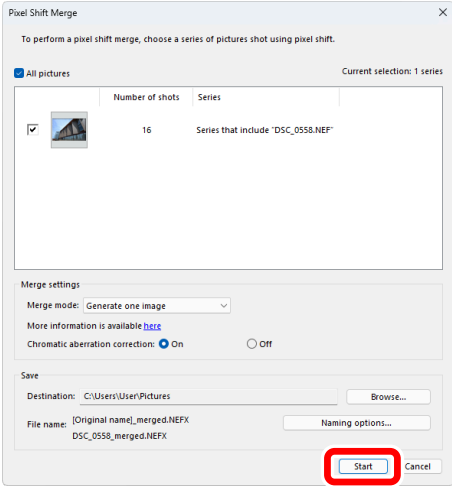
Pixel Shift Merge Setting Options

Set options in the [**Pixel Shift Merge**] dialog as follows:
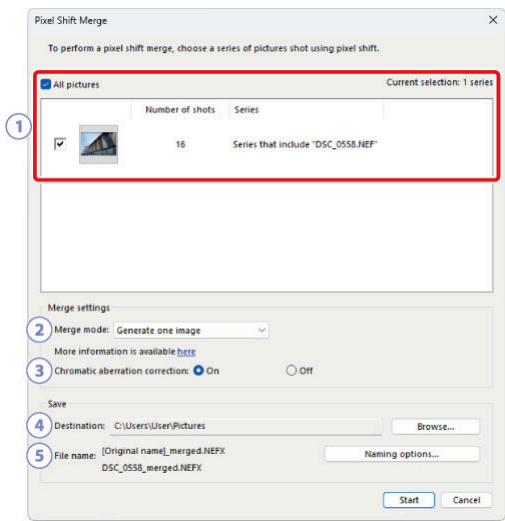
Option		Description
①	Pixel shift sequence	Select the sequence to merge. If there are multiple sequences in the view area, they can be selected and merged at the same time.
②	[**Merge mode**]	Select the number of images to generate after merging. The number of images depends on the number of pictures to be merged (📖 31).
③	[**Chromatic aberration correction**]	Select [**On**] to reduce lateral color aberrations.
④	[**Destination**]	Choose the destination folder for the generated images.
⑤	[**File name**]	Name the generated files. Click [**Naming options**] to select how files are named with prefix and suffix.

▌ Number of Images Generated

- The number of generated images that can be selected varies as follows according to the number of pictures to be merged:

No. of original pictures	No. of generated images	Details
4	1	One merge to generate 1 image from 4 pictures.
8	1	One merge to generate 1 image from 8 pictures.
	2	Two merges to generate 2 images from 4 pictures.
16	1	One merge to generate 1 image from 16 pictures. • The resulting height and width are double those of the original pictures.
	4	Four merges to generate 4 images from 4 pictures.
32	1	One merge to generate 1 image from 32 pictures. • The resulting height and width are double those of the original pictures.
	2	Two merges to generate 2 images from 16 pictures. • The resulting height and width are double those of the original pictures.
	4	Four merges to generate 4 images from 8 pictures.
	8	Eight merges to generate 8 images from 4 pictures.

- When multiple sequences of pictures taken using pixel shift are selected at the same time, it is only possible to generate a number of images that are available to all selected sequences. For example, if a sequence of 8 pictures and a sequence of 16 pictures are selected at the same time, only 1 image can be generated; if a sequence of 8 pictures and a sequence of 32 pictures are selected at the same time, you can select whether 1 or 2 images will be generated.

Tip: Time Required for Merging

The read/write speed of the hardware greatly affects the processing time of a pixel shift merge. A fast read/write storage device such as an SSD is recommended.

Tip: When the Merged Image Is Partially Disrupted

If the camera, the subjects, or the light source moves during a pixel shift shooting, the merged image may be partially disrupted. The following figure shows how 32 pictures are merged into a single image.
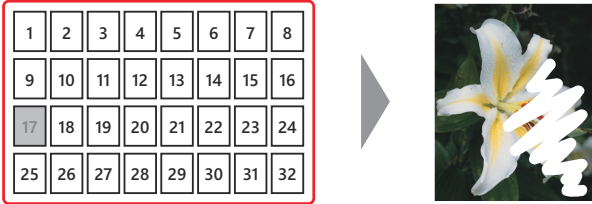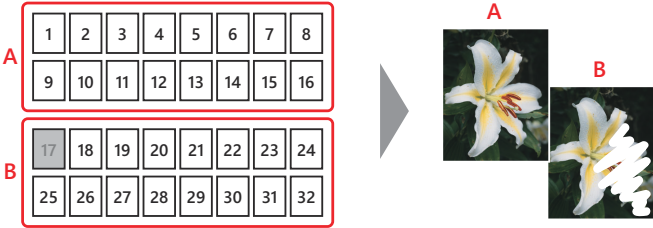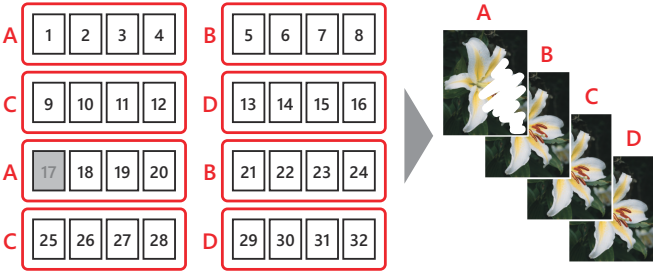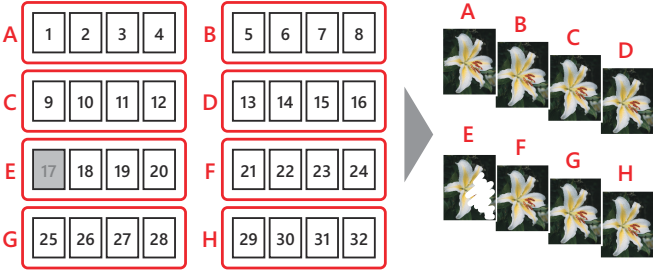
If a merge includes pictures disrupted, the resulting image will be partially disrupted.

An example of a disrupted merged image caused by a moving subject during the 17th picture.

In these cases, we recommend changing the number of merged images to be generated. Increasing the number of generated images may change the image quality of the merged image, but the merged image can be generated with pictures that do not include the cause of the disruption. Set the number of generated images with [**Merge mode**] in NX Studio when performing a pixel shift merge. The number of generated images can only be selected if 32, 16, or 8 was selected for [**Pixel shift shooting**] > [**Number of shots**] in the photo shooting menu. The relationship between each picture taken with number of shots set to 32 and the resulting merged images is as follows:

No. of generated images	The relationship between pictures taken and the merged images to be generated
1	
2	
4	
8	

When generating a single image, the merged image is disrupted because all the pictures are used, including those that were disrupted. Generating two images, on the other hand, causes the first merged image to be generated using the first to 16th pictures and the second merged image to be

generated using the 17th to 32nd pictures, so the first merged image, which does not include the 17th disrupted picture, will not be disrupted. The desired result is more likely to be achieved by generating a single image that produces the highest image quality first, and if disruption occurs, by increasing the number of generated images in the order of 2 images, 4 images, and 8 images. It is also recommended to always take 32 shots unless there is a particular reason not to.

- When 32 pictures are taken and 4 images are generated, each image is made of 8 pictures, and note the discontinuity of the combination of the 8 picture components to be merged. Consequently, a better result may be obtained by choosing to generate 1 image merging 8 pictures when 8 consecutive pictures are taken in the shortest possible time. Specifically in situations where the brightness changes quickly (sunrise, sunset, etc.), it is recommended to set the number of shots to 8.

Take Advantage of Pictures Taken Using Pixel Shift

Adjust/Export the Images with NX Studio

Pixel shift images merged with NX Studio can be adjusted in the adjustments/info palette [**Adjustments**] pane. Exported (converted) images can be adjusted or processed with third-party image editing software.

Adjust Merged Pixel Shift Images

Adjust images using tools in the [**Adjustments**] pane. Adjust settings such as [**Picture Control**], [**Exposure Comp.**], and [**White Balance**] as necessary. The tools that can be used to adjust merged pixel shift images are the same as ones for normal RAW (NEF/NRW) images. For detailed instructions on how to use NX Studio, see the documentation provided with the software or online help.
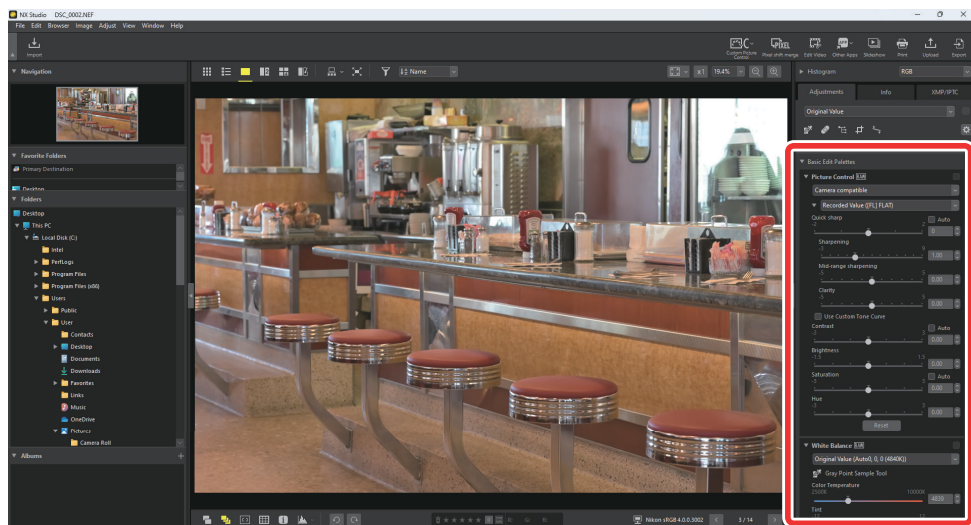
Noise Reduction

With the [**Noise Reduction**] item, you can set the amount of processing to reduce noise in the merged images. For merged pixel shift images, select [**Resolution-priority pixel shift merge**] to completely disable [**Noise Reduction**]. Since noise reduction is not performed, noise remains in the image, but the resolution of the image is maintained.
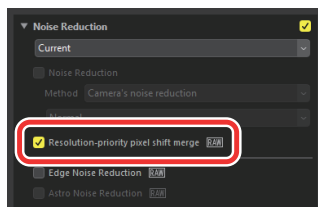
[**Resolution-priority pixel shift merge**] is off (the default setting)

[**Resolution-priority pixel shift merge**] is on

Tip: Noise Reduction

[**Noise reduction**] is not available for HEIF pictures. To process [**Resolution-priority pixel shift merge**], select [**SDR**] for [**Tone mode**] in the photo shooting menu in the camera before taking pictures.

Export Merged Pixel Shift Images

Click [**Export**] in the toolbar to export merged pixel shift images in JPEG, HEIF, or TIFF format.

Choose a format, adjust image quality, size, and other settings, and click [**Export**] to export the files to the selected destination folder.
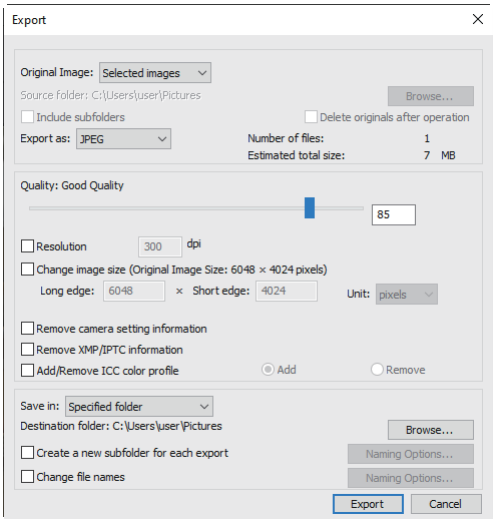
Tip: Using Third-Party Image Editing Software That Supports the NEFX Format

When using third-party image editing software that supports images in the NEFX (merged pixel shift) format (extension: .nefx), save the image using [**Save**] or [**Save As**] in the [**File**] menu. In these cases, select [**Save adjustments, labels, and ratings to the original image file**] in the [**Save**] category of the options dialog before saving the image.
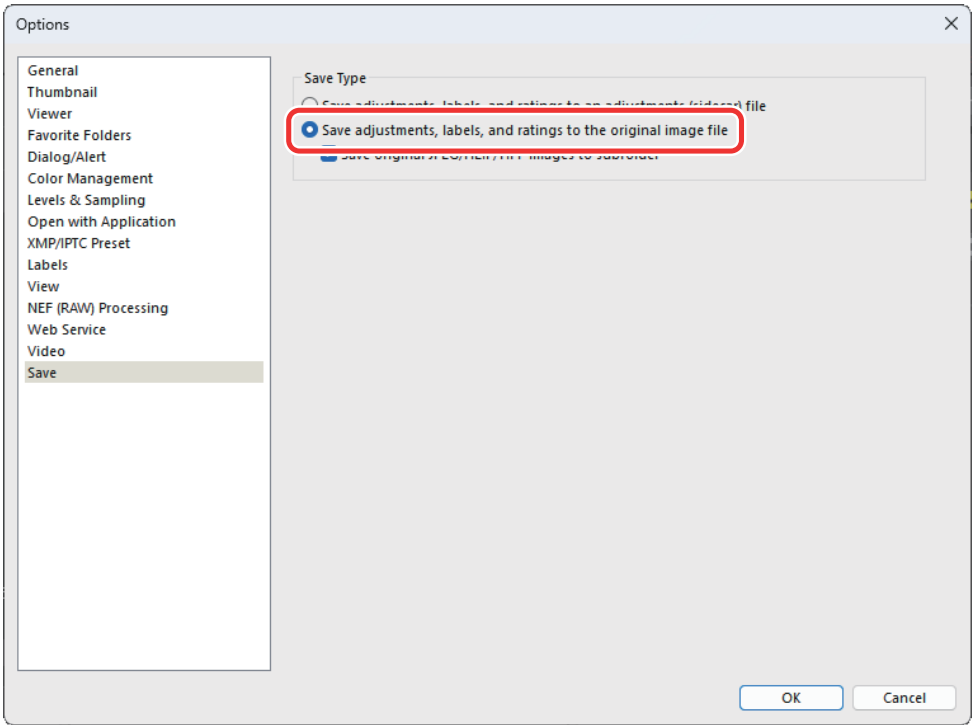
Using Third-Party Software

Exported image files can be further processed and edited using third-party image editing software. Use image editing software that supports images in NEFX (merged pixel shift) format (extension: .nefx) to open a merged pixel shift image as is without converting it to JPEG or TIFF format.

Software Manufacturers Providing Image Editing Software That Supports the NEFX Format

The following software manufacturers provide image editing software that supports the NEFX format. For detailed information on the software, visit the respective manufacturer's website.

Software manufacturer	URL
Adobe	https://www.adobe.com/products/photoshop-lightroom.html
Capture One	http://www.captureone.com/

- Nikon does not recommend or guarantee operation of above software.
- NEFX is supported in Adobe Camera Raw version 16.1.1or later.
- NEFX is supported in Capture One version 16.3.4 or later.

Adobe

CAPTURE ◯NE

Changes with Camera "C" Firmware Version 3.00

Features Available with "C" Firmware Version 3.00

The features added with camera "C" firmware version 3.00 are summarized below.

● **Focus Shift and Pixel Shift Shooting Can Be Used Simultaneously (📖 42)**

[**Options**] has been added under [**Focus shift shooting**] in the photo shooting menu to enable [**Pixel shift shooting**]. This combination allows you to perform pixel shift shooting while automatically varying the focus position, producing higher resolution images that focus across a wide range.

● **Pixel Shift Shooting and AE Bracketing Can Be Used Simultaneously (📖 46)**

[**Options**] has been added under [**Pixel shift shooting**] in the photo shooting menu to enable [**AE bracketing**]. This combination allows you to perform pixel shift shooting while automatically varying exposure, producing higher resolution images with a wide dynamic range.

● **New Folders Can Now Be Created During Pixel Shift Shooting**

A [**Starting storage folder**] item has been added to [**Pixel shift shooting**] in the photo shooting menu.
- Selecting (☑) [**New folder**] automatically creates a new folder for each new sequence.
- Selecting (☑) [**Reset file numbering**] when [**New folder**] is selected (☑) resets file numbering to 0001 whenever a new folder is created.
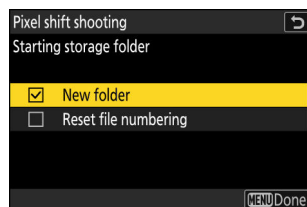
● **Pixel Shift Can Be Set with a Self-Timer**

Pixel shift shooting can now be set when [**Self-timer**] release mode is selected. Note that Custom Setting c2 [**Self-timer**] will be disabled. The delay between the shutter-release button being pressed all the way down and the start of pixel shift photography can be set via [**Pixel shift shooting**] > [**Delay**] in the photo shooting menu.

Tip: Other Useful Features Added in the Firmware Update

Updating to "C" firmware version 3.00 also provides the following new features. See the *Z 8 Supplementary Firmware Update Manual* for details.

- **Added Custom Setting a14 [Maximum aperture Lv]**: When set to [**On**], the shooting display appears with the maximum aperture regardless of the actual aperture. This improves both live view quality and autofocus precision in low-light conditions.

- **Added a [Minimum] option to Custom Setting c2 [Self-timer] > [Interval between shots]**: Selecting [**Minimum**] for [**Interval between shots**] allows self-timer shooting at intervals shorter than 0.5 seconds.

- **Added a [400%] option to [Zoom on/off] in Custom Setting f2 [Custom controls (shooting)]**: Pressing the control assigned this role allows you to easily zoom the display up to 400%, centered on the current focus point.
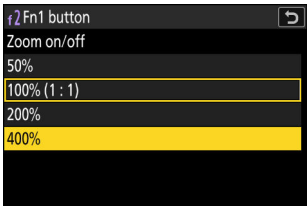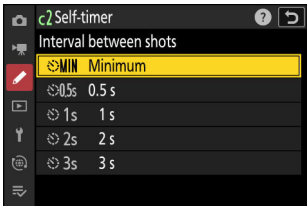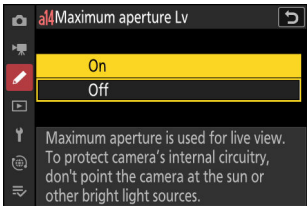
Using Focus Shift Shooting and Pixel Shift Shooting Simultaneously

With camera "C" firmware version 3.00, you can now set [**Pixel shift shooting**] from [**Focus shift shooting**] > [**Options**]. Combining "focus shift shooting," which automatically shoots while varying the focus position, with "pixel shift shooting" allows you to produce high-resolution images that focus across a wide range.

About Focus Shift Shooting Combined with Pixel Shift Shooting

Focus shift photography is a feature that varies the focus position after taking a photo to shoot the next one. When combining focus shift shooting with pixel shift shooting, the camera performs a pixel shift sequence consisting of the set number of shots, with varying focus position according to the number of shots specified in the focus shift settings.

Shift the focus position

1st sequence   2nd sequence ⋯   Nth sequence
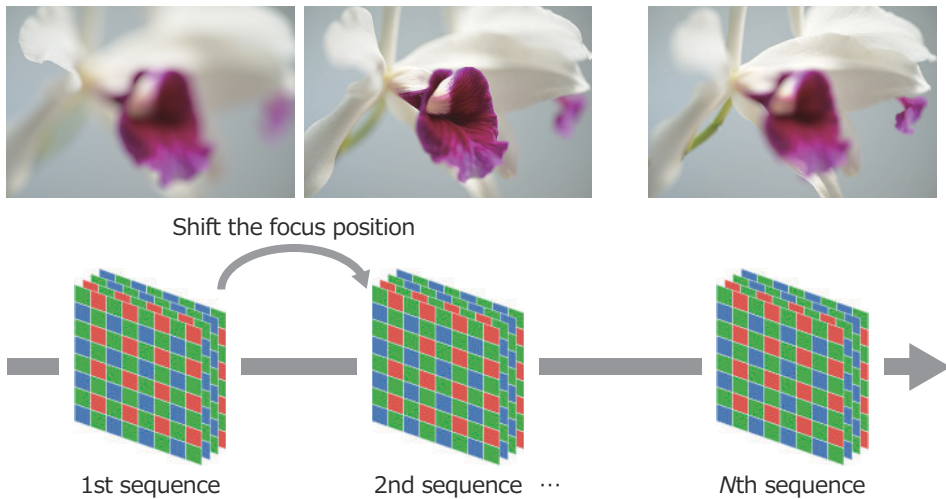
You can use the camera to automatically take high-resolution photos with different focus positions and use image editing software to merge these photos by depth compositing to produce high-resolution images that focus across a wide range.

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Configuring Focus Shift and Pixel Shift Shooting Combination

Selecting [**Pixel shift shooting**] under [**Focus shift shooting**] > [**Options**] in the photo shooting menu displays the following options.
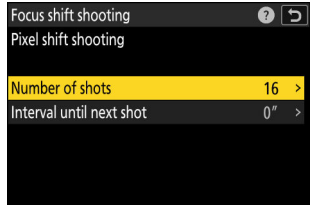
- [**Number of shots**]: Select the number of pixel shift shots taken at each focus shift interval. A long series will require more time to record but will produce better-quality results when merged into a single image.
- [**Interval until next shot**]: Choose the interval between pixel shift shots, in seconds. This setting overrides the interval set for [**Focus shift shooting**] > [**Interval until next shot**].

Tip: Vibration Reduction When Shooting Photos to Be Merged

Pixel shift shooting uses the camera's vibration reduction mechanism to shift the image sensor. Vibration reduction can be disabled for focus shift photography. There may be slight differences in the captured area between photos taken when using focus shift without vibration reduction and those taken using the combined focus shift and pixel shift shooting, preventing these images from being merged successfully. To align the captured area, you can either:

- Select [**Normal**] or [**Sport**] for [**Vibration reduction**] when performing focus shift shooting only, or
- Extract one shot from each pixel shift sequence in the combined focus shift and pixel shift shooting, then merge these shots.

Tip: Focus Step Width

The "focus step width" item in focus shift photography determines the amount of focus movement based on a calculated defocus value that accounts for the set step width and the aperture value of the lens (considering the effective f-number and how many stops the aperture is stopped down from maximum aperture). For example, when using a lens with a maximum aperture of f/2.8, shooting at a focus step width 1 with an aperture of f/5.6 will result in different movement amounts from shooting at step width 1 with an aperture of f/8 (the step size 1 at f/8 will move more than step size 1 at f/5.6). We recommend setting the focus step width to 1, since the focus movement amount is adjusted according to the aperture value. When combining focus shift with pixel shift shooting, use an aperture value of f/4 to f/5.6 and a step width of 1 to make the most of pixel shift. Note that using a smaller aperture than f/4 to f/5.6 may increase the effects of diffraction, while using a larger aperture may result in a shallower depth of field, and both interfere with focus stacking performance.

Tip: Number of Shots Required for Focus Stacking

We recommend taking a test shot to determine the number of shots required for focus stacking. Confirming the required number of shots in advance is important when combining focus shift and pixel shift shooting, as it can significantly reduce both shooting time and post-processing time considering the enormous total shot count this technique requires. Here is how to find the required number of shots for focus stacking:

1. Move the focus position to the closest point on the subject.
2. Set [**Focus step width**] and [**No. of shots**] to desired values and [**Focus position auto reset**] to [**OFF**] for focus shift shooting and choose [**Start**].
   - We recommend setting [**Focus step width**] to [**1**] and [**No. of shots**] to [**50**].
3. Review shots in the playback display to confirm whether the focus moved all the way to the farthest point you want in focus.
   - If the focus didn't move far enough, return to Step 2, increase the value for [**No. of shots**] and perform focus shift shooting again.
   - If the focus has moved all the way you want, determine which shot number of the sequence corresponds to the focus position at the intended farthest point and proceed to the next step.
4. Set the [**No. of shots**] based on the shot number that reached the focus position at the intended farthest point.
   - For example, if you set the number of shots to 50 and the focus reached the farthest point in the 37th shot, this means you have taken all necessary shots for focus stacking between shots 1 and 37. Set [**No. of shots**] to [**37**].

Using Pixel Shift Shooting and AE Bracketing Simultaneously

With camera "C" firmware version 3.00, you can now set [**AE bracketing**] from [**Pixel shift shooting**] > [**Options**]. Pixel shift photography previously required manually changing the exposure for each pixel shift shooting sequence, but now selecting AE bracketing enables automatic capture of high-resolution photos at different exposure levels.

About Pixel Shift Shooting Combined with AE Bracketing

When combining pixel shift shooting with AE bracketing, the camera performs a pixel shift sequence consisting of the set number of shots, with automatically varying exposure levels according to the number of shots specified in the AE bracketing settings. These pixel shift shots can be combined using image editing software for HDR overlay, producing images with both high resolution and extended dynamic range.

Change exposure

1st sequence   2nd sequence …   *N*th sequence
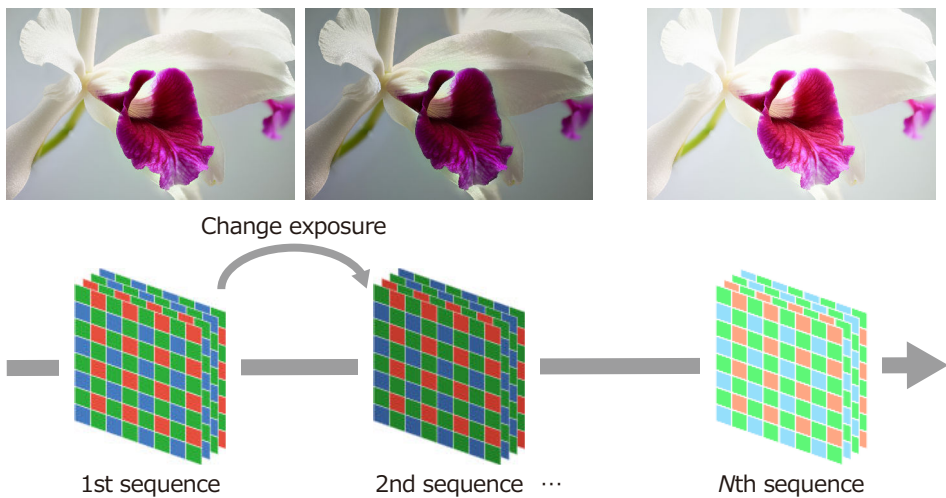
Configuring Pixel Shift Shooting and AE Bracketing Combination

Select [**AE bracketing**] under [**Pixel shift shooting**] > [**Options**] in the photo shooting menu to select values for [**Number of shots**] and [**Increment**] for exposure bracketing for each pixel shift shooting sequence.

Tip: Shooting Fine-Detailed and High-Contrast Subjects

We recommend using auto bracketing together with [**Number of shots**] set to [**4**] for pixel shift shooting when photographing subjects, with fine details prone to *moiré* patterns, such as buildings, in high-contrast lighting conditions. Reducing the number of shots minimizes the required time to complete the shoot while preventing disruptions in image overlay. This allows you to create images with reduced *moiré* and wider dynamic range.

Appendix

Recommended Settings

Here are recommended settings for pixel shift shooting and merging images.

Camera

▍ "Pixel Shift Shooting" in the Photo Shooting Menu (📖 **23**)

Option	Settings	Description
[**Pixel shift shooting mode**]	[**On (series)**]	Take multiple series of pixel shift pictures.
[**Number of shots**]	32 pictures	Merging 32 pictures generates the highest quality images. There will also be more options for the number of images to be generated than other settings. You will be able to choose the number of generated images according to your purpose, such as generating 2 merged images from 16 pictures each or 4 merged images from 8 pictures each (📖 31).
[**Delay**]	2-5 seconds	Reduce blur caused by camera shake when the shutter-release button is pressed.
[**Interval until next shot**]	0 seconds	Minimize shooting time.

▍ *i* Menu and Custom Control Assignments

Assign [**Pixel shift shooting**] to the *i* menu or a custom control to promptly configure the settings for pixel shift shooting (📖 24). To support focus operation, it is recommended to assign [**Zoom on/off**] to the lens Fn button or a custom control on the camera.

▎ "Series Playback" in the Playback Menu

Option	Settings	Description
[**List series as single thumbnails**]	[**ON**]	Only the first shot in each pixel shift shooting sequence will appear in the thumbnail list. This allows you to delete unsuccessful sequences or upload all images in a sequence with a single action.

▎ "Camera Sounds" in the Setup Menu

Option	Settings	Description
[**Beep**]	[**On**]	Selecting [**On**] for [**Beep**] emits a sound when pixel shift shooting is complete, making it easy to identify the end of a shooting sequence even when using remote control or in tethered photography.
[**Type**]	Other than [**Type E**]	Always select an option other than [**Type E**] for [**Type**] as selecting [**Type E**] may mute the beep when a beep and shutter sound overlap.

❙ Storing and Selecting Menus Used for Pixel Shift Shooting

Photo shooting menu options can be stored in four banks (banks "A" through "D") that can be selected using [**Shooting menu bank**] in the photo shooting menu. For example, you can store optimal settings for various shooting options; use the bank "A" for normal shooting, "B" dedicated to pixel shift shooting, "C" to focus shift shooting, and "D" to auto bracketing.

- Assign [**Shooting menu bank**] to the *i* menu or a custom control and use the control to make it more efficient to switch between saved settings.
- An example of photo shooting menu settings dedicated to pixel shift shooting is shown below. You can customize these settings according to your preferences.

Option	Settings
[**Shooting menu bank**]	B
[**Storage folder**]	
[**Rename**]	_PXS_
[**Select folder by number**]	200
[**RAW recording**]	[**High efficiency★**]
[**Focus mode**]	[**Single AF**]
[**AF-area mode**]	[**Pinpoint AF**]
[**Pixel shift shooting**]	
[**Pixel shift shooting mode**]	[**On (series)**]
[**Number of shots**]	32
[**Delay**]	2 seconds
[**Interval until next shot**]	0 seconds

- Add a descriptive caption to the shooting menu bank name ("A", "B", "C", or "D") to distinguish each bank. To rename a bank, highlight it, press ⊛, and select [**Rename**].

Recommended Settings

NX Studio

▎ "Pixel Shift Merge" (📖 **30**)

Option	Settings	Description
[**Merge mode**]	[**Generate one image**]	By merging all the pictures in series, a merged image with the highest image quality is generated (📖 30).
[**Chromatic aberration correction**]	[**On**]	Perform accurate lateral color aberration corrections suitable for pixel shift shooting.

▎ "Noise Reduction" (📖 **36**)

| Option	Settings	Description
[**Noise Reduction**]	[**Resolution-priority pixel shift merge**]	Emphasize fine colors and details. Recommended when shooting at low sensitivities from ISO 64 to ISO 500. • The same effect can be achieved with third-party software by disabling the noise reduction function. Noise may remain in the image, but fine colors and details can be emphasized. It is recommended to select this option when shooting 32 or 8 pictures because, in these cases, noise is less noticeable than in normal RAW (NEF/NRW) images.

Other

The longer the shooting time, the more susceptible the camera is to external factors, and it may not be able to produce the desired result. Better results can be achieved by raising the ISO sensitivity and shortening the shooting time (📖 19).
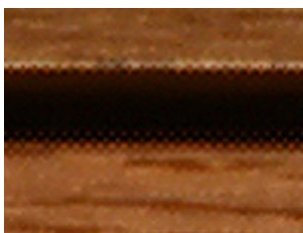
Troubleshooting

Solutions to common issues are listed below.

Merged Images Show Disruption Such as Banding, Uneven Colors, Mosaic Patterns, or Other Distortions
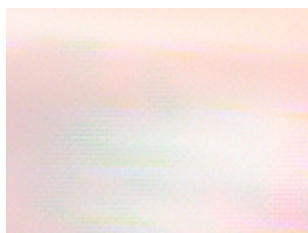
Example of uneven colors
(When the subject moved)

Example of mosaic patterns
(When the camera moved)

Example of bandings
(When the brightness changed)

- Change the number of images to be generated in pixel shift merge and re-examine the combination of pictures to be merged (🕮 31).
- The pictures may not have been taken properly. Check the subject and shooting environment and try again (🕮 20).

Bright Spots Appear on the Merged Image

- Perform pixel mapping before shooting (🕮 21).
- The image can be retouched with NX Studio. For more information, see NX Studio online help.

Banding Shows in Depth-Composed Focus Shift Images
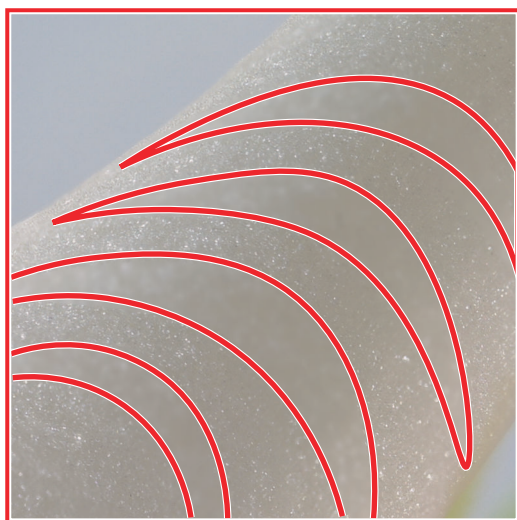
How banding appears

The depth of field or focus position step width for focus shift shooting may not be optimal. Using a smaller aperture (higher f-number) than f/5.6 and setting the [**Focus step width**] to [**1**] for focus shift shooting may improve this issue. We recommend using software that suits your workflow and desired quality, as results may vary by image editing software used for focus stacking.

Not All Pictures Taken in Tethered Photography Are Downloaded

When using NX Tether for tethered photography, the camera's internal memory may become full if image transfer speed from the camera to the computer drops. Pixel shift shooting will be interrupted when the internal memory becomes full. In these cases, a pixel shift merge cannot be performed due to insufficient number of images for composition. This issue can be resolved by reconfiguring the camera-computer connection, such as by using cables or interfaces that allow faster transfer, or by changing the storage destination to an SSD with faster write speeds. You can also select [**On**] for [**Camera sounds**] > [**Beep**] in the setup menu to easily determine when pixel shift shooting is complete. See "Recommended Settings" > "Camera" > "'**Camera Sounds**' in the Setup Menu" for details (🔲 49).