



Standard of Camera & Imaging Products Association

CIPA DC-X011–Translation-2012

**Measurement and Description Method
for Image Stabilization Performance of Digital Cameras
(Optical Method)**

This translation is based on the original Standard (CIPA DC-X011-2012). In the event of any doubts arising as to the contents, the original Guidelines in Japanese shall prevail.

Prepared by
Standardization Committee

Published by
Camera & Imaging Products Association

This draft reflects only a technological review; further revisions may be made to parts of this draft before Standard DC-X011 is formally issued. This draft is for reference only.

Contents

1. Introduction	3
2. Scope	3
3. Overview of Standard	
3-1 Basic Approach	5
3-2 Disclaimer	7
3-3 Definition of Terms	7
3-4 Referenced Standards	11
4. Measurement Method	
4-1 Preconditions	13
4-2 Equipment and Environment for Measurement	13
4-3 Settings of Camera to be Measured	17
4-4 Measurement Procedures	20
4-5 Calculation of Image stabilization Performance	23
5. Description Method	
5-1 Lens Integrated Camera	31
5-2 Camera Body with Image Stabilization Mechanism	31
5-3 Interchangeable Lens with Image Stabilization Mechanism	32
5-4 Combination of Camera Body with Image Stabilization Mechanism and Interchangeable Lens with Image Stabilization Mechanism	32
6. Commentary	
6-1 Background of Specifying Measurement Method	34
6-2 Vibratory Apparatus	34
6-3 Vibration Waveform	35
6-4 CIPA Motion Blur Measurement Chart	37
6-5 Motion Blur Measurement Software	37
6-6 Shooting Distance	38

6-7 The Number of Shots	39
6-8 Determination Level for Image Stabilization Performance	39
6-9 Image Stabilization Performance Calculation	40
6-10 Illumination	41
6-11 Shooting Mode	41
6-12 Image Quality Mode (Compression Ratio)	42
6-13 Image Quality Mode (the Number of Recording Pixels)	42
6-14 ISO Sensitivity	42
6-15 Flash	42
6-16 Recording Media	42
6-17 Focal Length on Measurement (in the Case of Zoom Lens Mounted Camera) ---	43
6-18 Electronic (Digital) Zoom	43
6-19 Focus Control	43
6-20 White Balance	43
6-21 Image Aspect Ratio	43
6-22 Image Stabilization Mode	44

Measurement and Description Method for Image Stabilization Performance of Digital Cameras (Optical Method)

1. Introduction

In recent years, along with the spread of digital cameras, new functions taking users' convenience into consideration have successively been incorporated in new products. Among them, a lot of cameras with functions to detect the camera shake and correct the image blur have been commercialized, and the advantage of image stabilization performance is presented in brochures for such products. However, until now, the industry had not developed any unified methods for measuring or describing the image stabilization performance of cameras. Accordingly, it has been difficult to compare the image stabilization performance of respective cameras based on brochures.

Standards and guidelines of the Camera and Imaging Products Association (hereinafter called CIPA) have so far been established as standards for digital cameras, battery life, resolution, sensitivity and brochure description. Brochures of many digital cameras are prepared in compliance with those standards and guidelines, contributing to the realization of fair competition.

In the context of this background, this standard specifies measurement and description methods for image stabilization performance of digital cameras, in addition to the existing standards and guidelines.

2. Scope

This standard applies to digital cameras for consumers with an optical image stabilization function for still image shooting. Electronic image stabilization as shown in 3-1-1 or cases for professional or industrial use where users and suppliers arrange specifications dedicated for each case are outside the scope of application. Apparatuses with still image shooting functions such as camcorders and mobile phones shall not be precluded from adopting this standard.

This standard mainly assumes to be applied in describing the image stabilization performance in brochures and other printed media or websites that specify product.

However, notations on product main bodies or individual packages, and expressions used in advertising campaigns as well as point-of-purchase advertising for sales promotions shall also comply with objectives of this standard.

Furthermore, any party, other than suppliers, who carries out measurements based on this standard (hereinafter called “measurer”) shall not be precluded from publishing the results of their measurements in their own publication, for example.

DRAFT

3. Overview of Standard

3-1 Basic Approach

This standard is established on the basis of the following concept to contribute to the sound development of the industry through the realization of fair competition.

3-1-1 This standard specifies the methods for measurement and description with regard to "image stabilization" among "motion blur suppression" defined in 3-3-2, but does not define those with regard to "motion blur reduction" and "subject shake correction."

Further, representative image stabilization methods include optical and electronic systems. In both systems, exposure time (\cong shutter speed) is an important factor. However, electronic image stabilization has diverged into a broad spectrum of systems, including many systems with unclear definitions of the exposure time. Accordingly, it is difficult to measure image stabilization performance on the basis of this standard. Hence, the electronic image stabilization is excluded from the application of this standard since measurement results are highly likely to be questionable.

3-1-2 This standard does not enforce brochures to describe it in them: It is merely a specification in case it is described.

3-1-3 The objective of this standard is to specify how to measure the image stabilization performance in a case where a user takes a shot with a hand-held camera. Accordingly, in a measuring session, it would better simulate a real shooting situation if a camera to be measured is actually hand-held by a person. However, in such a case, it would be difficult to eliminate variations due to differences among individual photographers or how well the camera is designed for hand-holding. In order to ensure the fairness of the results of measurement, a camera to be measured is mounted on a vibratory apparatus to which a vibration waveform discussed later is fed to give the camera vibration, and the image stabilization performance shall be measured on the basis of results of shooting the motion blur measurement chart specified in this standard.

3-1-4 Upon drafting this standard, two waveforms which almost faithfully simulate the characteristics of the camera shake induced by hand-holding are specified. Those two

waveforms are developed by analyzing a lot of measured data and adding further theoretical observations.

However, in an actual shooting sequence, the general flow of operation starts by taking a camera out of a pocket or a bag, carrying out a given setting operation, determining the composition of pictures by looking through a viewfinder or a liquid crystal monitor, and then pressing a shutter button. As a result, the camera tends to undergo larger vibrations or shaking than those that arise during shooting. This would result in negative effects for some cameras on their image stabilization performance at the instant of shooting that is the subject of this standard. However, it is difficult to faithfully simulate vibrations that would develop those negative effects in measurements carried out under the present standard using a vibratory apparatus. Also, it is technically possible to produce a camera that is intentionally designed to generate favorable measurement results without regard to practicality by giving special settings that are adapted to the characteristics of the camera vibration waveforms specified in this standard.

In the case of such a camera, the image stabilization performance available for a user when it is hand-held in actual shooting would be significantly lower than that presented in its brochure. Accordingly, if the image stabilization performance obtained in a measurement carried out under this standard for such camera were presented in its brochure as it stands, it would be misleading and detrimental, and as a consequence, deceptive for to users. Therefore, suppliers must pay full attention not to make any presentation on the image stabilization performance that might be misleading or detrimental to users. In a case of a camera for which the image stabilization performance presented in its brochure is only available under a specific condition, such a condition shall be expressly stated unless users can easily obtain such a condition or fact from other information.

3-1-5 Performance of a camera will be measured according to the setup based on 4 Measurement Method in this standard and described based on the specifications in 5 Description Method. Here, descriptions of measurement conditions may be omitted except where it is mandatory.

Description of values measured with a method other than that in this standard is not prohibited, but such a description shall be made less prominently and its measurement condition shall be described.

3-1-6 If a numerical value to be described is an integer, its fractional portion does not

necessarily have to be added, irrespective of the number of digits specified for each item.(e.g.: 2.0 stops → 2 stops)

3.1.7 Specific names, designations, Japanese long-sound symbols, and distinctions between single-byte and double-byte character expressions may accord with customary expressions or names used by the suppliers or measurers as long as that does not cause misunderstanding. It shall be noted that:

- Items clearly specified to be uniformly used and names defined in this standard shall follow such instructions; and
- Names that tend to be confused with those defined in this standard shall not be used under a different definition.

3-1-8 To measure the image stabilization performance specified in this standard, a vibratory apparatus that has been well examined for its accuracy will become necessary. Therefore, information necessary to examine the accuracy of a vibratory apparatus (i.e., verification specification of a vibratory apparatus) can be supplied separately from CIPA to those who perform measurements of the image stabilization performance or those who manufacture such vibratory apparatuses.

3-1-9 Information or tools (i.e., vibration waveforms, motion blur measurement software, CIPA motion blur measurement chart, etc.) necessary to perform measurements of the image stabilization performance specified in this standard shall be separately presented by CIPA.

3-1-10 The vibration waveforms specified in this standard may be revised as necessary as camera geometries or the ways pictures are taken change, and image stabilization techniques get improved in response to such changes.

3-2 Disclaimer

Even in the case of measurement and description pertaining to image stabilization performance according to this standard, all claims and litigation from third parties shall be dealt with by suppliers and measurers on their own.

3-3 Definition of Terms

Definitions of terms used in this standard are described below.

3-3-1 Motion Blur

"Motion blur" means deviation from a predetermined position. "Motion blur" used as a camera term is divided broadly into "camera shake" and "subject shake."

1) Camera Shake

Camera shake refers to a movement of a camera caused by unstable hands holding the camera, resulting in blurring of a subject in an image taken.

2) Subject Shake

Subject shake refers to blurring of a subject in an image taken caused by a movement of the subject or a part of the subject during exposure, irrespective of presence or absence of camera shake.

3-3-2 Motion Blur Suppression

Motion blur suppression refers to suppression of "camera shake" or "subject shake" by some means of control within a camera. Although "motion blur suppression" is classified broadly into "image stabilization" and "motion blur reduction," this standard does not specify "motion blur reduction."

"Image stabilization" is further classified roughly into "camera shake correction" and "subject shake correction." This standard does not specify "subject shake correction."

1) Image Stabilization

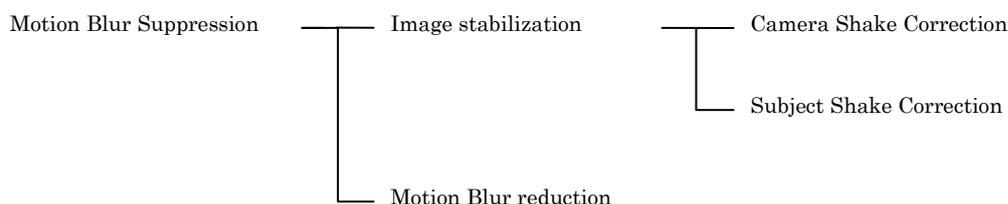
This function corrects for motion blur in an output image caused by movement of a camera body due to camera shake (see 3-3-6) using an output from blur detection means.

However, methods of primarily shooting at a fast shutter speed by optimizing an exposure control program in the end are considered "motion blur reduction" described below even if the output from the blur detection means is used.

2) Motion Blur Reduction

"Motion blur reduction" is a function or a mode for reducing motion blur in an output image caused by both movement of a subject and camera shake primarily by means of shooting at a fast shutter speed by optimizing an exposure control program.

"Image stabilization" and "motion blur reduction" shall not be confused with each other because they have largely different technical elements.



3-3-3 Vibratory apparatus

A “vibratory apparatus” is an apparatus capable of generating vibration in response to the magnitude of amplitude of input vibration waveforms. Typically, a camera to be measured is mounted on the movable part of the vibratory apparatus using certain fixing methods to transmit the vibration to it.

3-3-4 Vibration Waveform

“Vibration waveform” is an embodiment of camera shake (vibration) that occurs during shooting of a subject with a camera, by means of temporally-changing amplitude value. A vibration waveform adopted in this standard has two axes, Yaw and Pitch, which are vibration components especially dominant in an image taken.

Since characteristics of camera shake vary depending on camera masses, two types of vibration waveforms, WB-H and WB-L, shall be employed.

3-3-5 Motion Blur Amount

“Motion blur amount” is an amount that corresponds to a shift of a subject in an image taken induced by camera shake.

3-3-6 Bokeh and Bokeh Amount

“Bokeh” refers to a phenomenon where deterioration of sharpness in an image taken is induced by the deviation of the focal plane of a lens from the image plane of an image sensor, or camera shake. Sometimes, the bokeh may be caused by image processing of image data. “Bokeh amount” means quantified value of the magnitude of the bokeh.

3-3-7 Motion Blur Measurement Chart

“Motion blur measurement chart” means a chart to be used as a subject in measuring the image stabilization performance. At the time of establishing this standard, CIPA prepared a motion blur measurement chart called the “CIPA motion blur measurement chart.”

3-3-8 Motion Blur Measurement Software

“Motion blur measurement software” means dedicated software for measuring the bokeh offset amount (3-3-10) and estimated comprehensive bokeh amount (3-3-14) from an image using the CIPA motion blur measurement chart (3-3-7). “Pixel” is the unit for the bokeh amount generated by this software.

3-3-9 Stop (Stop Number)

The difference of TV values according to the APEX expression is represented by "stop." For instance, the difference between shutter speeds of 1/1000 (TV10) and 1/500 seconds (TV9) or that between shutter speeds of 1/125 (TV7) and 1/60 seconds (TV6) accounts for one stop of shutter speeds.

3-3-10 Bokeh Offset Amount

“Bokeh offset amount” is a bokeh amount of an image taken caused by factors other than camera shake. The bokeh offset amount is a value unique to an individual instrument and is dependent on the optical performance, effective number of pixels and image processing of a camera to be measured. By removing this, almost all factors affecting image stabilization performance other than the image stabilization function can be removed.

3-3-11 Determination Level for Image Stabilization Performance

“Determination level for image stabilization performance” is the level used in making judgment when calculating the image stabilization performance. In this standard, it is defined as 63 μ m.

3-3-12 Theoretical Motion Blur Amount

“Theoretical motion blur amount” is a theoretical value of motion blur amount that can be measured from an image taken when the image stabilization function is turned OFF (OFF setup is assumed in a camera without OFF setup) when the camera to be measured is vibrated according to a vibration waveform.

3-3-13 Estimated Comprehensive Bokeh Amount

“Estimated comprehensive bokeh amount” is a theoretically estimated value of a bokeh amount of an image taken in the state where the image stabilization function is turned OFF (OFF setup is assumed in a camera without OFF setup) when the camera to be measured is vibrated according to a vibration waveform. This is expressed as the square root of sum of squares of the bokeh offset amount and the theoretical motion

blur amount.

3-3-14 Measured Comprehensive Bokeh Amount

“Measured comprehensive bokeh amount” is an actual measurement value of a bokeh amount of an image taken in the state where the image stabilization function is turned ON when the camera to be measured is vibrated according to a vibration waveform.

3-3-15 Reference Motion Blur Amount

“Reference motion blur amount” is a value to be referenced to calculate an image stabilization performance. The reference motion blur amount is a value acquired by subtracting the bokeh offset amount from a theoretically estimated value of the bokeh amount of an image taken (estimated comprehensive bokeh amount) caused in the state where a camera is vibrated, in the case where the image stabilization function does not exist or the case where the image stabilization function is OFF (OFF setup is assumed in a camera without OFF setup).

3-3-16 Measured Motion Blur Amount

“Measured motion blur amount” is a value representing a residual motion blur after correction under the condition where the image stabilization function of a camera to be measured is ON, and it can be acquired by subtracting a bokeh offset amount from a measured comprehensive bokeh amount.

3-3-17 Average Vibration Angle

“Average vibration angle” is an average value of vibration angles caused by vibration according to the vibration waveform (3-3-4) at respective shutter speeds.

3-4 Reference Standards

3-4-1 Reference Standards

- CIPA DCG-002 Specification Guideline for digital cameras
- CIPA DCG-005 Measurement and description methods of weight and dimensions of digital cameras

3-4-2 Response to Revision of Reference Standard

Response in the case where specifications referred to by this standard are revised is as follows.

- On specifications and guidelines managed by CIPA, revised editions shall be complied with.

- On other specifications, this standard shall be complied with in principle until this standard is revised.

DRAFT

4. Measurement Method

4-1 Preconditions

To measure the image stabilization performance, the following 4-2 Equipment and Environment for Measurement, 4-3 Setting of Camera to be Measured and 4-4 Measurement Procedures shall be complied with. The decision regarding the number of cameras to be measured is left to the supplier or the measurer. However, the number shall not render questionable measurement results. Figure 4-1 shows the overview of the measurement method.

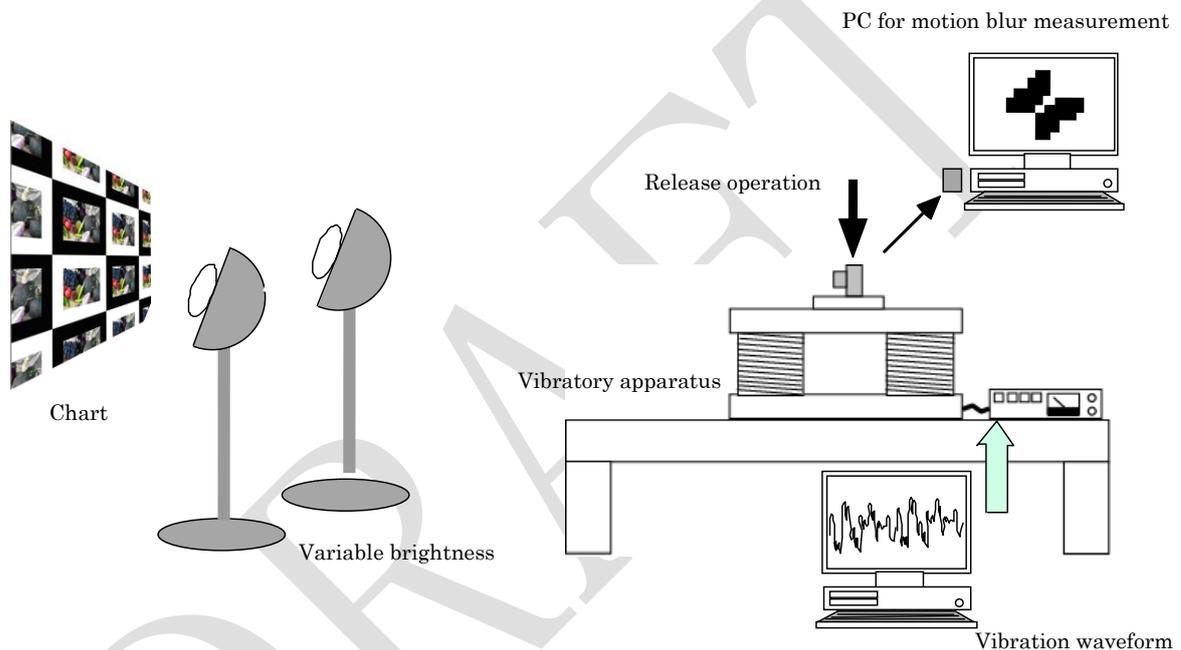


Figure 4-1 Overview of Measurement Method

4-2 Equipment and Environment for Measurement

4-2-1 Motion Blur Measurement Chart

The CIPA motion blur measurement chart illustrated in Figure 4-2-1 should be used to carry out the measurement of image stabilization performance in this standard. Note that the CIPA motion blur measurement chart has natural images inserted for the sake of ease in focusing or general purpose application. The dimensions of the CIPA motion blur measurement chart are 1000 mm × 750 mm considering the shooting distance.

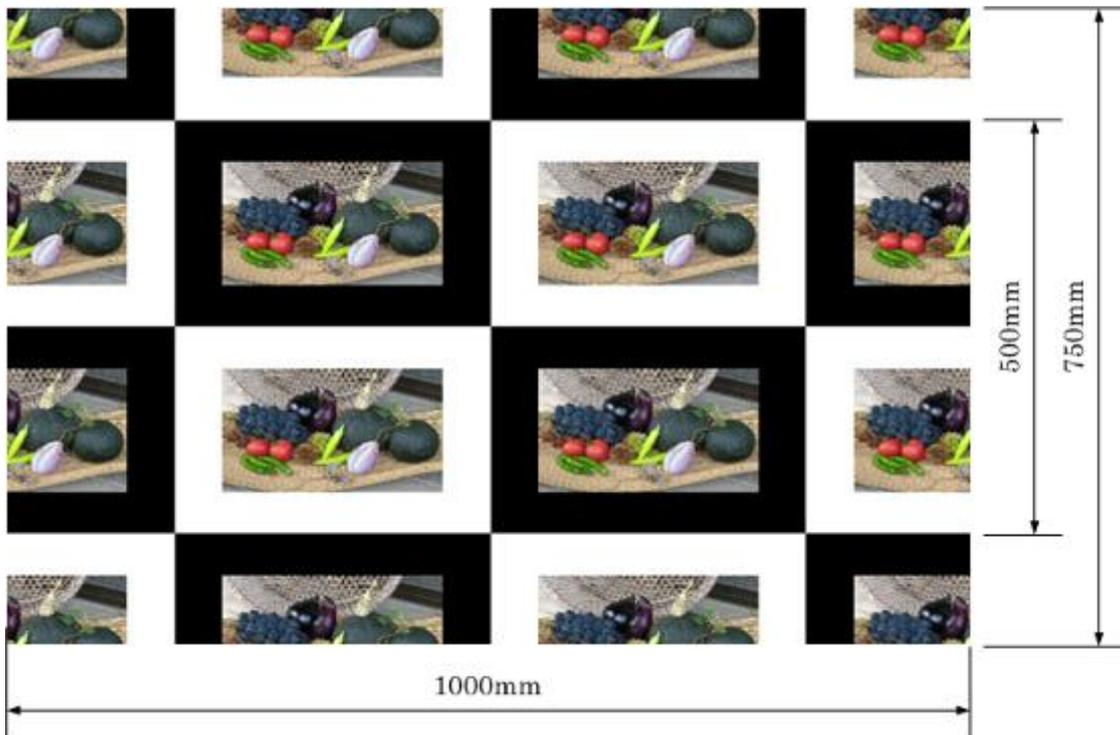


Figure 4-2-1 CIPA motion blur measurement chart

In case the CIPA motion blur measurement chart in Figure 4-2-1 is not available, a chart that satisfies the following specifications for motion blur amount measurement shall be used:

- 1) The chart shall be comprised of a portion having multiple black stripes and white stripes with a certain width extending in the horizontal and vertical directions and a portion having color natural images;
- 2) The ratio of the reflectance of the white stripes portion to that of the black stripes shall be 20:1 or higher, and the black stripe and white stripe shall be wider in width than the expected maximum amount of the bokeh.
- 3) No particular feature is specified for the natural image portion and it shall have contents similar to real subjects and an area as wide as possible under the above-mentioned conditions.

4-2-2 Illumination

Although types of illumination are not specified, flicker-free illumination shall be used and care should be taken to prevent reflection from the light source or uneven illuminance on the motion blur measurement chart to make sure no question would arise about measurement results. It is convenient to use illumination with variable

brightness.

For example, some illumination by a fluorescent lamp or LED develops flickers due to switching (uneven luminance). Such illumination shall not be used in principle, as it could possibly render questionable measurement results.

4-2-3 Temperature and Humidity

Temperature and Humidity shall be $23 \pm 2^\circ\text{C}$ and 30-70%, respectively. Measurement may be carried out under other conditions as long as there is no room for questions.

4-2-4 Vibratory apparatus

A vibratory apparatus shall function in the manner that accurately reproduces vibrations according to the vibration waveforms. Always check that the accuracy of the vibratory apparatus is maintained before taking a measurement. Refer to the verification specification for a vibratory apparatus to be specified separately.

4-2-5 Mounting of Camera to be Measured on Vibratory apparatus

When mounting a camera to be measured on a vibratory apparatus, vibration of the vibratory apparatus and that of the camera to be measured mounted on the vibratory apparatus have to match.

In the case of measuring a camera with a lens having a long lens barrel (e.g. high-powered zoom lens), vibrations of the camera body and the lens may not match because distortion induced in the lens by excitation prevents the applied vibration from being correctly transmitted to the lens. Thus, in the case of measuring the camera with a lens having a long lens barrel, certain measures such as fixing not only the camera body but also the lens to the vibratory apparatus shall be taken so that the lens and camera body vibrations would match.

4-2-6 Vibration waveform

There are two types of vibration waveforms. The criteria for selecting a waveform are as follows: (Here, the total mass means the sum of the masses of a body including a recording medium and a battery, and a lens)

Selection Criterion I. WB-H shall be used for total mass of 600 g or more;

Selection Criterion II. WB-L shall be used for total mass of less than 400 g;

Selection Criterion III. Both WB-L and WB-H shall be used for total mass between 400 g and 600 g.

Both waveforms consist of 2-axes waveform components in Yaw and Pitch. Both Yaw

and Pitch components shall be excited at the same time.

4-2-7 Shooting Distance

The shooting distance should be such that the range shown by broken red lines in Figure 4-4-1 in the CIPA motion blur measurement chart can be shot to approximately fill the whole picture frame. It is a distance about 20 times the 35 mm equivalent focal length. In case a motion blur measurement chart other than that of CIPA is used, the shooting distance shall be about 20 times the 35 mm equivalent focal length.

In the event a location that satisfies the conditions cannot be secured, it is acceptable to change the shooting distance by the minimum amount required from about 20 times the 35 mm equivalent focal length. However, extreme care should be taken so that there is no room for questions in the results of measurement, as the motion blur measurement software is prepared on the assumption that measurement shall be carried out with a distance of about 20 times the 35 mm equivalent focal length, using the CIPA motion blur measurement chart.

4-2-8 Motion Blur Measurement Software

The bokeh offset amount and measured comprehensive bokeh amount of an image of the CIPA motion blur measurement chart taken in accordance with 4-4 Measurement Procedures can be measured using the motion blur measurement software (3-3-8). "Pixel" is the unit of the bokeh offset amount and measured comprehensive bokeh amount generated by this software. It is recommended that this software be used to measure the bokeh offset amount and measured comprehensive bokeh amount in accordance with this standard. The CIPA motion blur measurement chart shall be used without fail when this software is used.

However, even when this software is used, sometimes unreasonable measurement results may be generated depending on settings of the camera to be measured or measurement environment. Accordingly, if any question arises in measurement results, settings of the camera to be measured or the measurement environment shall be reviewed, and some measures such as repeating the measurement again shall be taken.

In case some other method is used other than the motion blur measurement software specified in this standard, the bokeh offset amount and measured comprehensive bokeh amount shall be measured in accordance with the following:

- 1) The signal levels of the boundary regions between black portions and white portions in the image of a shot chart shall be normalized from 0% to 100%. To

- eliminate the noise effect, the number of pixels in the section between 10% to 90% of signal levels (A in Figure 4-2-8) shall be calculated and then multiplied by 10/8;
- 2) At that time, the inverse γ correction ($\gamma = 2.2$) shall be carried out on the image in advance in order to linearize the tone characteristic as much as possible;
 - 3) To carry out stable measurement, the boundary regions between black portions and white portions near the center of the image of the shot chart shall be used and furthermore, an average of multiple places shall be calculated.

Refer to the instruction manual for motion blur measurement software for details of the method of measurement for the bokeh offset amount and measured comprehensive bokeh amount using this software.

If any variation or error occurred in measurement of the bokeh offset amount and actual measurement of the comprehensive bokeh amount (or measured motion blur amount), it would compromise the measurement of the image stabilization performance in accordance with this standard. The accuracy of measurement of the bokeh offset amount and measured comprehensive bokeh amount (or measured motion blur amount) shall be verified without fail before starting the measurement.

Refer to the verification specification for a vibratory apparatus to be separately specified for the method of verifying the measurement.

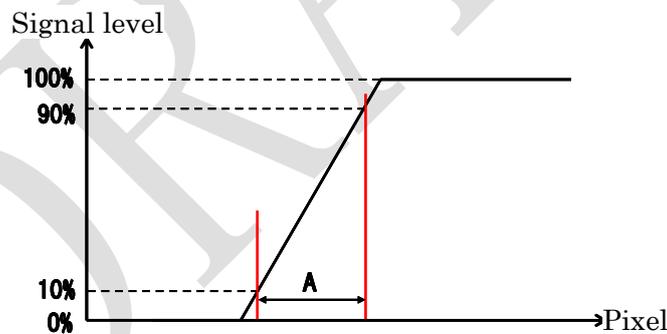


Figure 4-2-8 Method of measuring the bokeh offset amount and the measured comprehensive bokeh amount

4-3 Settings of Camera to be Measured

4-3-1 Power to be Used

Not specified. Cameras capable of being supplied with external power source may use external power.

4-3-2 Shooting Mode

Although no specific shooting mode is stipulated, because shooting must begin as soon as possible after the power is turned ON, a shooting mode which remembers as many items as possible specified in 4-3-3 to 4-3-19 that are set in advance even when the power is OFF, or a shooting mode capable of easily changing the shutter speed, are desirable. However, such a shooting mode should not include any image processing which might raise questions in the measurement results.

For example, there are many cameras that have modes adapted to specific shooting scenes. Many of such modes perform image processing that is optimized for respective specific scenes. Therefore, there is a possibility that questions may arise in the measurement results, making such modes unsuitable for the measurement of image stabilization performance. Accordingly, such modes as those especially adapted to some specific scenes where extreme edge enhancement takes place, for instance, shall not be used in principle, even if such mode is capable of easily changing the shutter speed.

4-3-3 Image Stabilization Mode

Setting shall be in the image stabilization mode to be measured.

4-3-4 Image Quality Mode (Compression Ratio)

Although no specific compression ratio is specified, a high image quality mode (low compression ratio) setting is desirable.

4-3-5 Image Quality Mode (The Number of Recording Pixels)

Although no specific number of recording pixels is specified, it is desirable to set it to the maximum number of recording pixels in the camera to be measured. However, setting that would exceed the effective number of pixels of the image sensor by means of pixel interpolation, image processing or the like shall not be adopted.

4-3-6 ISO Sensitivity

Sensitivity shall be set such that hardly any image noise is generated. It should be set to a constant value as much as possible.

4-3-7 Flash

Not to be used.

4-3-8 Recording Media Capacity

Not specified.

4-3-9 Focal Length on Measurement (in the Case of Zoom Lens Mounted Camera)

Not specified.

4-3-10 Electronic (Digital) Zoom

Not used.

4-3-11 Focus Control

A focus control system, such as autofocus and manual focus, is not specified. However, the focus shall be correctly adjusted on the motion blur measurement chart.

4-3-12 White Balance

Appropriate white balance must be attained by light sources used.

4-3-13 Color Setting

Although no specific color setting is specified, factory default setting is desirable.

4-3-14 Exposure Setting

Although no specific exposure setting is specified, setting capable of shooting with an appropriate exposure shall be adopted.

4-3-15 Aperture

Although no specific aperture value is specified, shooting shall be performed at a constant value as much as possible for the same focal length and the same shutter speed.

4-3-16 Aspect Ratio

Although no specific aspect ratio is specified, factory default setting is desirable.

4-3-17 Continuous Shooting Mode

Although no specific continuous shooting mode is specified, setting should be one that enables performance of 4-4-1 Measurement of Bokeh Offset Amount and 4-4-2 and 4-4-3 Measurement of Actual Measurement Comprehensible Bokeh Amount discussed later.

4-3-18 Self Timer

Although no specific self-timer setting is specified, setting shall be one that enables performance of 4-4-1 Measurement of Bokeh Offset Amount and 4-4-2 and 4-4-3 Measurement of Actual Measurement Comprehensible Bokeh Amount discussed later.

4-3-19 Other

When shooting is performed with a changed shutter speed, it is desirable not to change measurement conditions other than illumination. Setup that might raise questions in the measurement results shall not be adopted.

4-4 Measurement Procedures

4-4-1 Measurement of Bokeh Offset Amount:

- 1) Make preparation on the basis of environment settings described in 4-2 and 4-3;
- 2) Set the camera to be measured on the vibratory apparatus;
- 3) Turn the power of the camera to be measured ON. In the case of one mounted with a zoom lens, set the lens at the focal length where the image stabilization performance is measured. Here, the shooting distance, the positions of the camera to be measured or the CIPA motion blur measurement chart shall be adjusted so that the part enclosed by the broken lines shown in Figure 4-4-1 fills the entire screen when shot;
- 4) The shutter speed shall be set around "1/ focal length (35 mm equivalent)";
- 5) Let the vibratory apparatus be in a stop state, and start shooting. At this time, take at least ten images. No upper limit of number of images taken is specified but it is not acceptable to select only those data that are desirable out of the whole lot. In principle, set the image stabilization function to OFF, except the case without the OFF setup. It is desirable to use a remote release, remote control and the like if possible; and
- 6) Reduce the shutter speed sequentially by one stop at most. Repeat similar shooting until the necessary and sufficient shutter speed is attained.

The environment of shooting and settings of camera of 4-4-1 shall not be changed in principle from the Measurement of the Measured Comprehensible Bokeh Amount of 4-4-2 and 4-4-3.

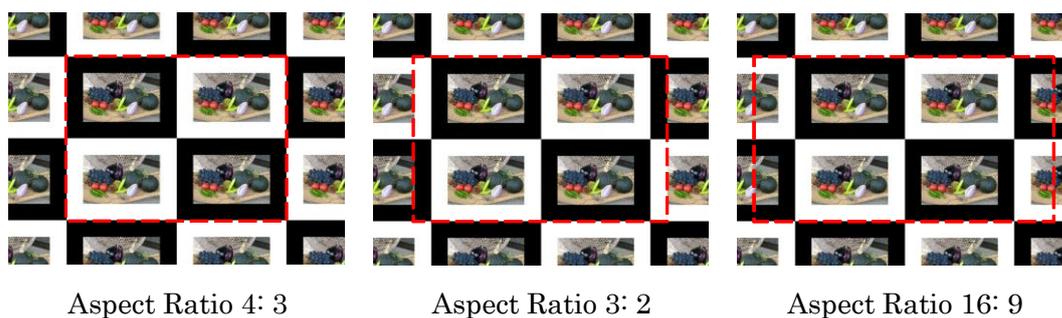


Figure 4-4-1 Range of Shooting in the Case of Mounting Camera to be Measured on Vibratory Apparatus (Vibratory apparatus is in stationary state.)

4-4-2 Measurement of Measured Comprehensive Bokeh Amount (in the Cases of 4-2-6 Selection Criteria I and II):

- 1) Make preparation on the basis of environment setup shown in 4-2 and 4-3;
- 2) Set the camera to be measured on the vibratory apparatus;
- 3) Turn the power of the camera to be measured ON. In the case of one mounted with a zoom lens, set the lens at the focal length where the image stabilization performance is measured. Here, the shooting distance, the positions of the camera to be measured or the CIPA motion blur measurement chart shall be confirmed if necessary so that the part enclosed by the broken lines shown in Figure 4-4-1 fills the entire screen when shot. Further, the shutter speed shall be set at the setting where the measured motion blur amount is estimated to be at or around the Determination level for image stabilization performance mentioned below. After setting is completed, turn the power OFF once;
- 4) Vibrate the vibratory apparatus using the vibration waveform stipulated in 4-2-6. At this time, it is desirable that the vibratory apparatus shall be vibrated continuously until the step 8) mentioned below is completed. However, if the vibratory apparatus stops in the middle due to its specification, resume vibration immediately;
- 5) While vibrating, turn the power of the camera to be measured ON again at unspecified timing. At this time, if the setting in 3) above is changed, reset it as soon as possible;
- 6) After steps up to 5) are completed, start shooting immediately with the image stabilization function of the camera to be measured ON. The shooting interval shall be approximately one second, and a total of 10* shots shall be taken. However, finish shooting when 30* seconds have passed after turning the power

of the camera ON, even if the number of shots does not reach 10. Turn the power OFF after shooting is finished;

*If no question arises about the measurement results, these figures may be changed.

- 7) Repeat the steps from 5) to 6) and take 200 or more shots. No upper limit of the number of images taken is specified but it is not acceptable to select only those data that are desirable out of the whole lot. Note that operation of shooting shall be performed so as not to affect the vibrating state. In a case permitting use of a remote release or a remote control, it is desirable to use it;
- 8) Reduce or increase the shutter speed by one stop at most, and repeat steps from 3) and 7) above; and
- 9) Finish measurement when two measurement results are obtained, i.e. the slowest shutter speed at which the measured motion blur amount does not exceed the determination level for image stabilization performance, and the fastest shutter speed at which it exceeds the determination level for image stabilization performance.

4-4-3 Measurement of Measured Comprehensive Bokeh Amount (in the case of 4-2-6 Selection Criterion III):

- 1) Make preparation on the basis of environment setup shown in 4-2 and 4-3;
- 2) Set the camera to be measured on the vibratory apparatus;
- 3) Turn the power of the camera to be measured ON. In the case of one mounted with a zoom lens, set the lens at the focal length where the image stabilization performance is measured. Here, the shooting distance and the positions of the camera to be measured or the CIPA motion blur measurement chart shall be confirmed if necessary, so that the part enclosed by the broken line shown in Figure 4-4-1 fills the entire screen when shot. Furthermore, the shutter speed shall be set at the setting where the measured motion blur amount is estimated to be at or around the determination level for image stabilization performance mentioned below. After setting is completed, turn the power OFF once;
- 4) Vibrate the vibratory apparatus using the vibration waveform specified in 4-2-6. At this time, it is desirable that the vibratory apparatus be vibrated continuously until step 8) mentioned below is completed. However, if the vibratory apparatus stops in the middle due to its specification, resume vibration immediately;
- 5) While vibrating, turn the power of the camera to be measured ON again at unspecified timing. At this time, if the setting in 3) above is changed, reset it as

soon as possible;

- 6) After steps up to 5) are completed, start shooting immediately with the image stabilization function of the camera to be measured ON. The shooting interval shall be approximately one second, and a total of 10* shots shall be taken. However, finish shooting when 30* seconds have elapsed after turning the power of the camera ON, even if the number of shots does not reach 10. Turn the power OFF after shooting is finished;

*If no question arises about the measurement results, these figures may be changed.

- 7) Repeat the steps from 5) to 6) and use two kinds of waveforms to take 100 or more shots for each waveform. No upper limit of number of images shot is specified but it is not acceptable to select only those data that are desirable out of the whole lot. Note that operation of shooting shall be performed so as not to affect the vibrating state. Use of a remote release or a remote control is desirable when permitted;
- 8) Reduce or increase the shutter speed by one stop at most, and repeat steps from 3) and 7) above; and
- 9) Finish measurement when two measurement results are obtained, i.e. the slowest shutter speed at which the measured motion blur amount does not exceed the determination level for image stabilization performance, and the fastest shutter speed at which it exceeds the determination level for image stabilization performance.

4-5 Calculation of Image Stabilization Performance

4-5-1 Calculation of Basic Values Required to Calculate Image stabilization performance

To calculate the image stabilization performance, six quantitative values are used, including the bokeh offset amount, the theoretical motion blur amount, the estimated comprehensive bokeh amount, the measured comprehensive bokeh amount, the reference motion blur amount, and the measured motion blur amount.

Its main objectives are the following two items:

- a) Remove effects of image bokeh that is included in the measured comprehensive bokeh amount measured in 4-4-2 and 4-4-3 which is caused by factors other than camera shake.
- b) Allow for calculation of the image stabilization performance according to this

standard even with the camera incapable of turning the image stabilization function OFF.

For further detail, see "6 Commentary." Methods of calculating these values will be shown below.

1) Bokeh Offset Amount

The bokeh offset amount is quantified from the image taken according to the method described in 4-4-1. In detail, the square root of sum of squares of the bokeh amounts in Yaw and Pitch obtained from each of the images taken shall be calculated, and then the total of such values is averaged by the number of shots. If the unit of the averaged bokeh offset amount is a "pixel," it shall be converted into the 35 mm equivalent bokeh offset amount [μm] according to the method which will be described in 4-5-2. However, values that are clearly questionable in the results of the bokeh amount measurement shall not be used. Use 10 or more values in calculating the average.

2) Theoretical Motion Blur Amount

Theoretical motion blur amounts are calculated for the respective shutter speeds according to the following equation. Note that, since the average vibration angles are different for the selection criteria I, II and III described in 4-2-6 vibration waveform, the amount corresponding to the vibration waveform used in the measurement shall be employed.

Theoretical Motion Blur Amount [μm] = Focal Length [mm] on a 35 mm equivalent $\times \tan \theta \times 1000$

θ : Average vibration angle.

3) Estimated Comprehensive Bokeh Amount

An estimated comprehensive bokeh amount is calculated according to the following equation. Note that values at the same shutter speed shall be used for the bokeh offset amount and the theoretical motion blur amount.

Estimated Comprehensive Bokeh Amount [μm] =

$$\sqrt{(\text{Bokeh Offset Amount}[\mu\text{m}])^2 + (\text{Theoretical Motion Blur Amount}[\mu\text{m}])^2}$$

4) Measured Comprehensive Bokeh Amount

A measured comprehensive bokeh amount is quantified from the image taken according to the methods described in 4-4-2 and 4-4-3. In detail, the square root of sum of squares of the bokeh amounts in Yaw and Pitch obtained from each of the images taken shall be calculated, and then the total of such values is averaged by the number of shots. If the unit of the averaged bokeh offset amount is a “pixel,” it shall be converted into the 35 mm equivalent actual measurement comprehensive bokeh offset amount [μm] according to the method described in 4-5-2. However, values that are clearly questionable in the results of the bokeh amount measurement shall not be used. The number of values used to calculate the average shall be 200 or more for the case in 4-4-2 and 100 or more of the same number for both cases in 4-4-3.

5) Reference Motion Blur Amount

A reference motion blur amount is calculated according to the following equation. Note that the estimated comprehensive bokeh amount and the bokeh offset amount shall be values measured at the identical shutter speed. Factors that may affect images taken, such as ISO sensitivity, shall be identical.

$$\text{Reference motion blur amount } [\mu\text{m}] = \text{Estimated Comprehensive Bokeh Amount } [\mu\text{m}] - \text{Bokeh Offset Amount } [\mu\text{m}]$$

6) Measured Motion Blur Amount

Measured motion blur amount is calculated according to the following equation. Note that the measured comprehensive bokeh amount and the bokeh offset amount shall be values measured at the identical shutter speed. Factors that may affect images taken, such as ISO sensitivity, shall be identical. If the measured motion blur amount becomes a negative value, the value shall be 0 μm .

$$\text{Measured Motion Blur Amount } [\mu\text{m}] = \text{Measured Comprehensive Bokeh Amount } [\mu\text{m}] - \text{bokeh offset amount } [\mu\text{m}]$$

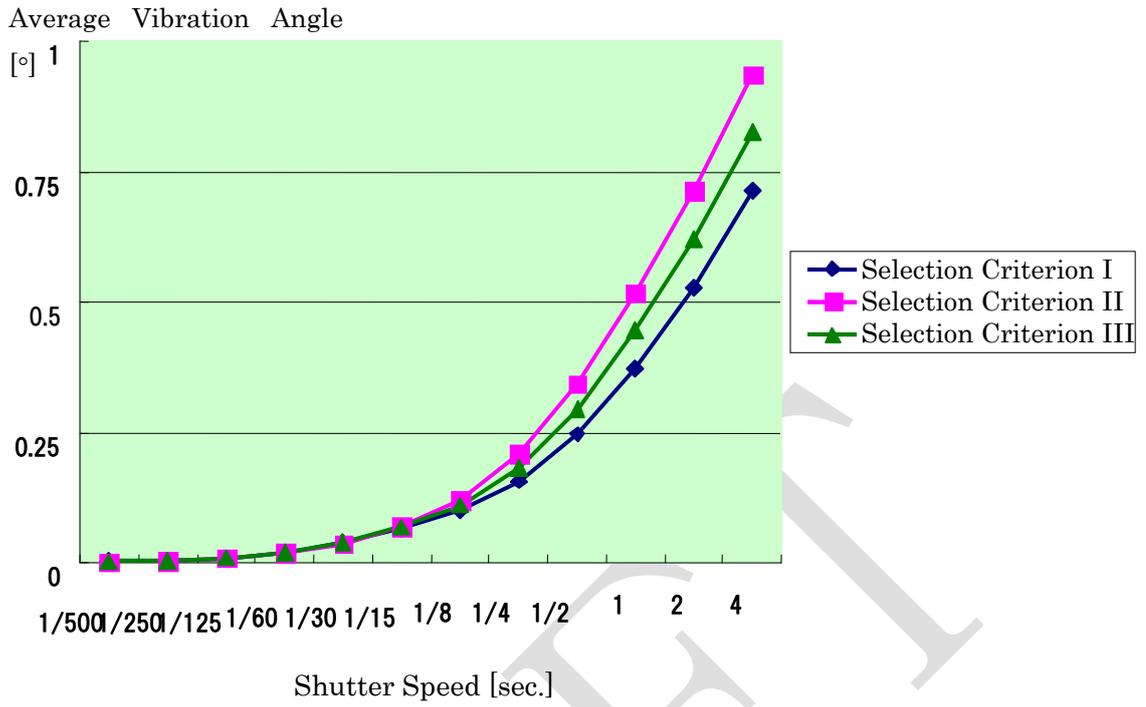


Figure 4-5-1a Average Vibration Angle

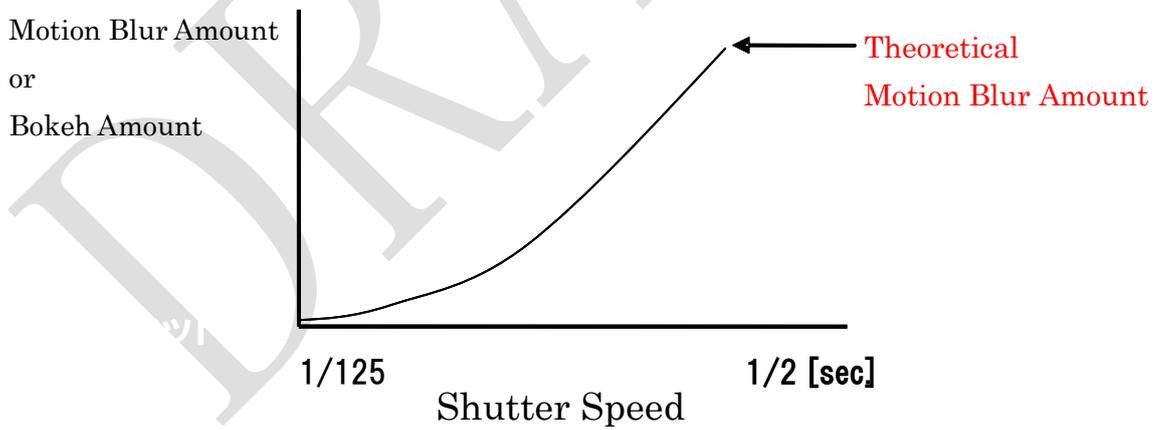


Figure 4-5-1b Theoretical Motion Blur Amount

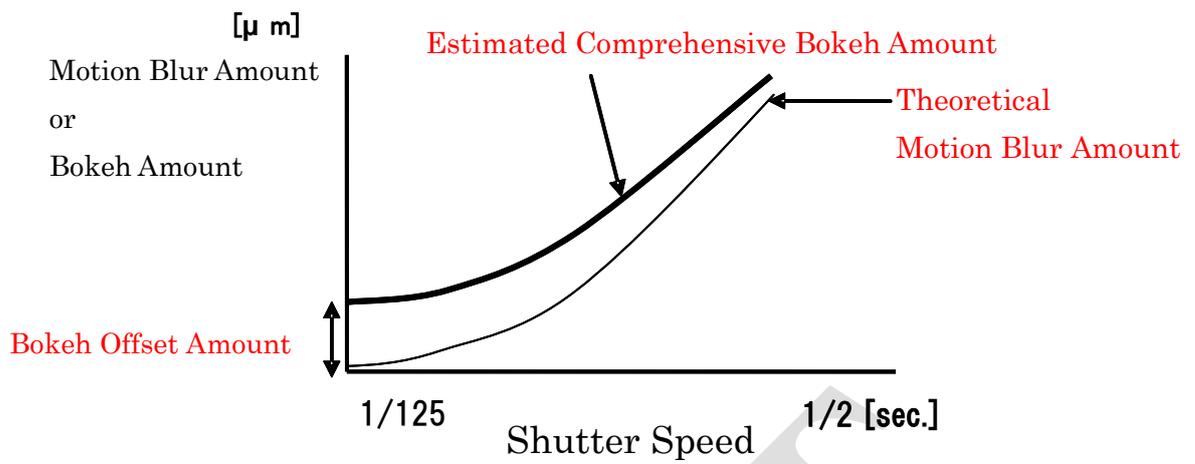


Figure 4-5-1c Estimated Comprehensive Bokeh Amount

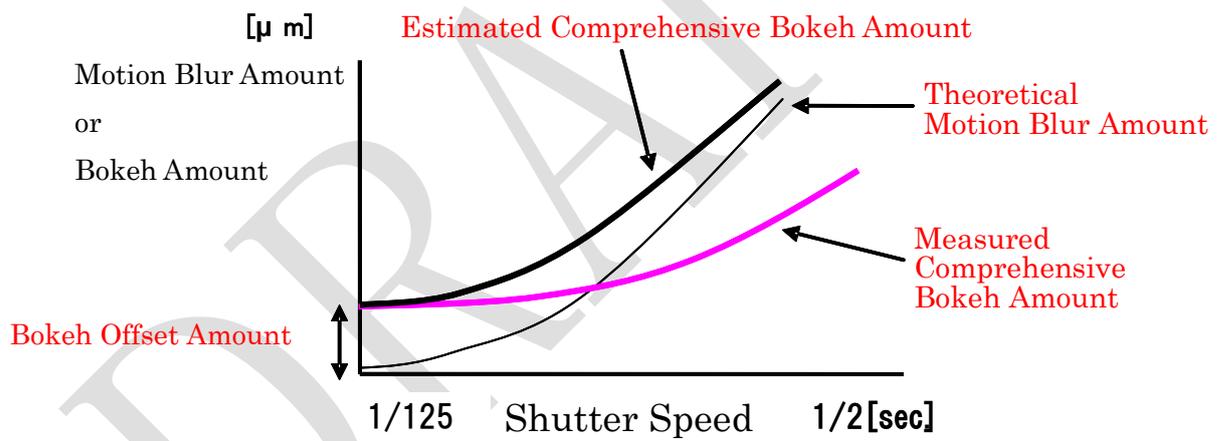


Figure 4-5-1d Measured Comprehensive Bokeh Amount

4-5-2 Method of Converting Bokeh Offset Amount and Measured Comprehensive Bokeh Amount into 35 mm Equivalent Values

If units of the bokeh offset amount and the measured comprehensive bokeh amount are the number of pixels as they are, the image stabilization performance cannot be determined. Thus, a method of conversion into 35 mm equivalent values (the unit is μm) will be described below.

Value on 35 mm equivalent [μm] = Bokeh Offset Amount (or Measured comprehensive bokeh amount)[pixel] \times (Diagonal Length of one Frame of 35 mm Film [μm] / Diagonal Length of Taken Image [pixel])

1) Diagonal Length of one Frame of 35 mm Film

One Frame of 35 mm film is 24 mm in the vertical direction, and 36 mm in the horizontal direction. Accordingly, the diagonal length can be calculated as follows:

$$\text{Diagonal Length}[\mu\text{m}] = \sqrt{24^2 + 36^2} \times 1000$$

2) Diagonal Length of Image Taken

Diagonal Length of Image Taken [pixel] can be calculated as follows:

Diagonal Length of Image Taken [pixel] =

$$\frac{\sqrt{(\text{the Number of Recorded Pixels in Vertical Direction})^2 + (\text{the Number of Recorded Pixels in Horizontal Direction})^2}}{1}$$

4-5-3 Image Stabilization Performance Calculation

An image stabilization performance is calculated on the basis of the reference motion blur amount and the measured motion blur amount among the values calculated in 4-5-1. In this calculation method, the difference between the shutter speeds where both the reference motion blur amount and the measured motion blur amount are at the determination level for image stabilization performance is acquired in stop number (0.5 stop increment and fractions less than 0.5 stop is dropped).

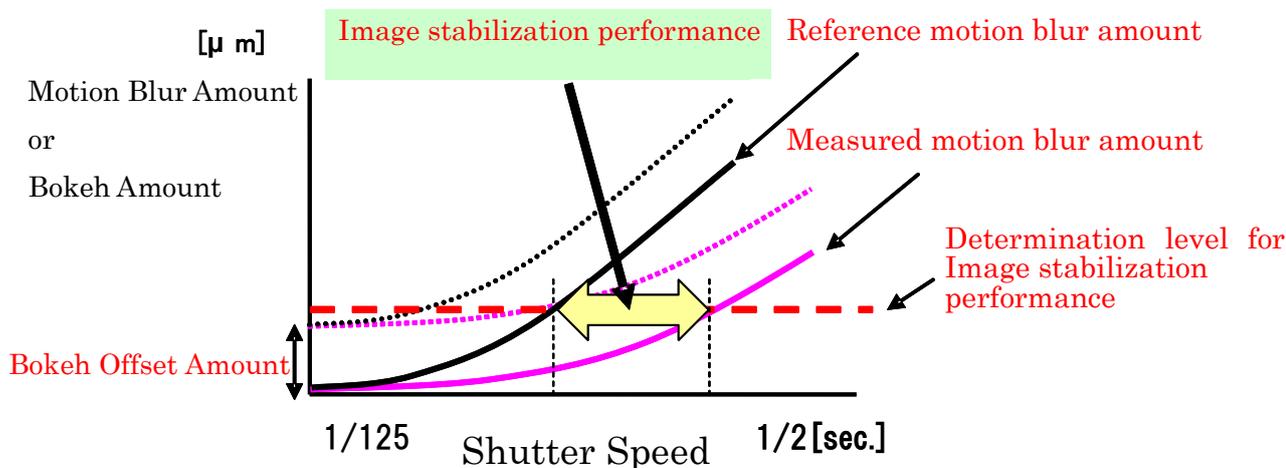


Figure 4-5-3a Image stabilization performance

Both the reference motion blur amount and the measured motion blur amount are discretely acquired at intervals of one stop of shutter speed at most. Accordingly, these amounts are calculated from two shutter speeds sandwiching the determination level for image stabilization performance.

To explain it using Figure 4-5-3b as an example, SS_OFF, at which the reference motion blur amount becomes the determination level for image stabilization performance, is calculated by linearly interpolating the intersection between the line connecting the reference motion blur amount SS1 and the reference motion blur amount SS2 and the determination level for image stabilization performance on the logarithmic axis.

Likewise, SS_ON, at which the measured motion blur amount becomes the determination level for image stabilization performance, is calculated by linearly interpolating the intersection between the line connecting the measured motion blur amount SS3 and the measured motion blur amount SS4 and the determination level for image stabilization performance on the logarithmic axis.

It is provided that the difference between SS_OFF and SS_ON is the number of stops of the image stabilization performance.

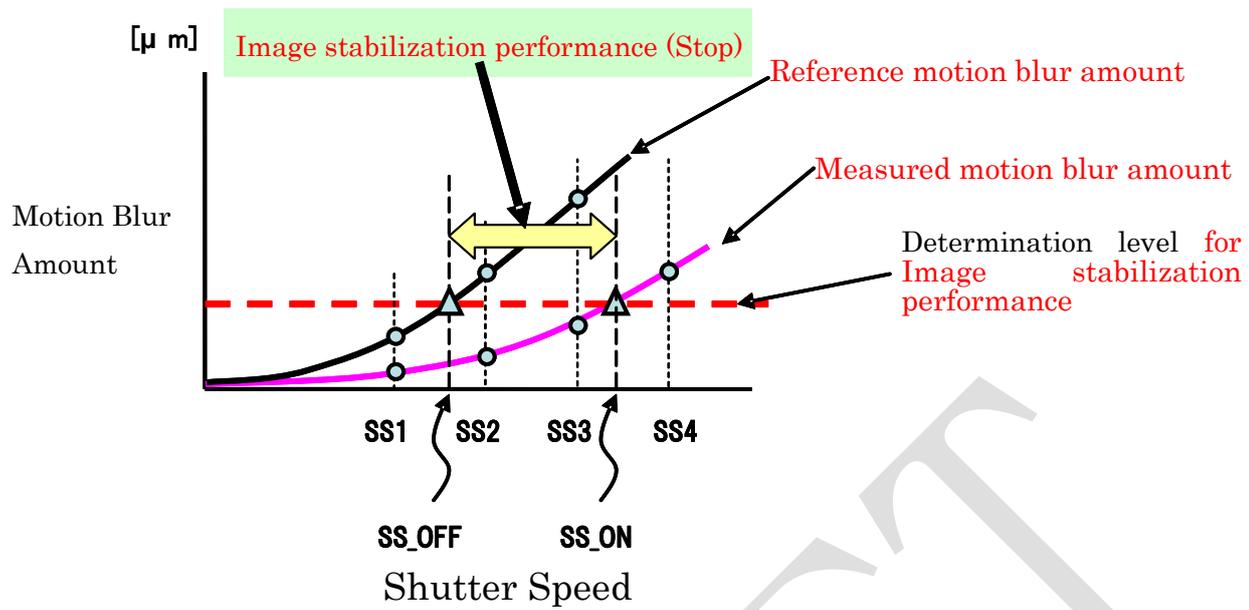


Figure 4-5-3b Image stabilization performance Calculation Method

5. Description Method

The method of describing an image stabilization performance in brochures shall be as follows.

The image stabilization performance shall be described using "stop." Values shall be rounded by dropping fractions on 0.5-stop basis (e.g.: 2.7 stops → 2.5 stops), and described as shown in the following example. Also, the image stabilization performance at multiple focal lengths is not precluded from being described. However,

- a) The factory default setting is recommended for the image stabilization mode. When the image stabilization performance in this mode is described by itself, the name of the image stabilization mode used in the measurement may be omitted.
- b) In the case of using an image stabilization mode other than the factory default setting, the name of the image stabilization mode used for measurement shall be clearly described.
- c) In the case of a zoom lens, the focal length (35 mm equivalent) at which measurement is made or information replacing the focal length (such as "tele-photo end") shall clearly be described.
- d) If the image stabilization performance presented is only available under specific conditions, such conditions shall be expressly stated unless users can easily obtain such conditions or fact from other information.

Note that it is acceptable to present only the electronic image stabilization performance or together with the optical image stabilization performance, but it shall be expressly stated that the measurement results do not comply with this standard.

5-1 Lens Integrated Camera

Description Example 1

- Image stabilization performance: 2.5 stops (focal length $f = 100$ mm, $f = 450$ mm on a 35 mm equivalent, image stabilization mode IS1)

Description Example 2

- Image stabilization performance: 2.0 stops (wide angle end), 2.5 stops (tele-photo end)

Description Example 3

- Image stabilization performance: at least 2 stops (in the entire focal length)

5-2 Camera Body with Image Stabilization Mechanism

The model name of the lens capable of acquiring the image stabilization performance shall be described.

Description Example 1

- Image stabilization performance: 2.0 stops (focal length $f = 55$ mm, $f = 85$ mm on a 35 mm equivalent, AB lens is used, image stabilization mode IS1)

Description Example 2

- Image stabilization performance:
 - 2.0 stops (focal length $f = 55$ mm, $f = 85$ mm on a 35 mm equivalent, AB lens is used)
 - 2.5 stops (focal length $f = 200$ mm, $f = 300$ mm on a 35 mm equivalent, CD lens is used)

Description Example 3

- Image stabilization performance: at least 2 stops (in the entire focal length, AB lens is used)

Description Example 4: only the single-focal case

- Image stabilization performance: 2.5 stops (EF lens is used)

5-3 Interchangeable Lens with Image Stabilization Mechanism

The name of the camera capable of acquiring the image stabilization performance shall also be described.

Description Example 1

- Image stabilization performance: 2.0 stops (focal length $f = 200$ mm, $f = 300$ mm on a 35 mm equivalent, AB camera is used, image stabilization mode IS-auto)

Description Example 2

- Image stabilization performance:
 - 2.0 stops (focal length $f = 55$ mm, $f = 85$ mm on a 35 mm equivalent, CD camera is used)
 - 2.5 stops (focal length $f = 200$ mm, $f = 300$ mm on a 35 mm equivalent, CD camera is used)

Description Example 3

- Image stabilization performance: at least 2 stops (in the entire focal length, in every camera)

Description Example 4: only the single-focal case

- Image stabilization performance: 2.5 stops (EF camera is used)

5-4 Combination of Camera Body with Image Stabilization Mechanism and

Interchangeable Lens with Image Stabilization Mechanism

The names of the camera and the lens capable of acquiring the image stabilization performance shall be described.

Description Example 1

- Image stabilization performance: 2.0 stops (focal length $f = 55$ mm, $f = 85$ mm on a 35 mm equivalent, AB camera and AB lens are used, image stabilization mode IS-auto)

Description Example 2

- Image stabilization performance:
 - 2.0 stops (focal length $f = 55$ mm, $f = 85$ mm on a 35 mm equivalent, AB camera and AB lens are used)
 - 2.5 stops (focal length $f = 200$ mm, $f = 300$ mm on a 35 mm equivalent, AB camera and CD lens are used)

Description Example 3

- Image stabilization performance: at least 2 stops (in the entire focal length, AB camera and AB lens are used)

Description Example 4: only the single-focal case

- Image stabilization performance: 2.5 stops (EF camera and EF lens are used)

6. Commentary

6-1 Background of Specifying Measurement Method

When the image stabilization performance is measured, it is most comprehensible to compare the state where the image stabilization function is OFF against the state where the image stabilization function is ON and to quantitatively describe the difference thereof as an effect of image stabilization. In this case, the bokeh offset amount is preliminarily removed in each of the states where the image stabilization function is OFF and where the image stabilization function is ON, and then the comparison is performed. This enables bokeh elements caused by factors other than camera shake to be easily removed and enhances the fairness of measurement results.

The measurement method according to this standard however, vibrates the camera to be measured using the vibratory apparatus using the vibration waveform specified by the standard and prescribed performance. Accordingly, theoretically speaking, the shake amount when the image stabilization function is OFF should not be any different among cameras except for subtle individual differences. In fact, it has been confirmed through the results of measurements performed on many cameras for this standard that there is no significant difference among cameras.

Along with full automatization of camera functions, cameras without the mode where the image stabilization function is OFF have already been commercialized. Accordingly, it is difficult to measure all the cameras based on the difference between OFF and ON of the image stabilization function. It is predicted that this tendency will escalate even further in the future.

Considering errors or operation man-hours associated with the measurement, instead of measuring both cases of the image stabilization function being OFF and ON, if the measurement is completed only with the image stabilization function being ON, measurement errors will be cut in half and the work load will be reduced as well.

According to the above reasons, in this standard, the image stabilization performance is calculated from the reference motion blur amount corresponding to the actual measurement result with the image stabilization function OFF, and the measured motion blur amount that is the actual measurement result with the image stabilization function ON.

6-2 Vibratory apparatus

To measure the image stabilization performance of a camera, shooting the motion blur measurement chart in the state where the camera is actually held by hands

corresponds to reality. However, it is well known that the magnitude and characteristics of camera shake vary among different individuals, and even the same person renders different results depending on differences in camera or shooting conditions.

To specify the methods for measurement and description of an image stabilization performance, such uncertain elements need to be eliminated. An effective method for realizing the above is to generate vibration simulating camera shake by a mechanical device and transmit the vibration to the camera. This device is called a vibratory apparatus and is designed to reproduce camera shake by human hands by an electric signal (vibration waveform) applied to vibrate the movable part of the device.

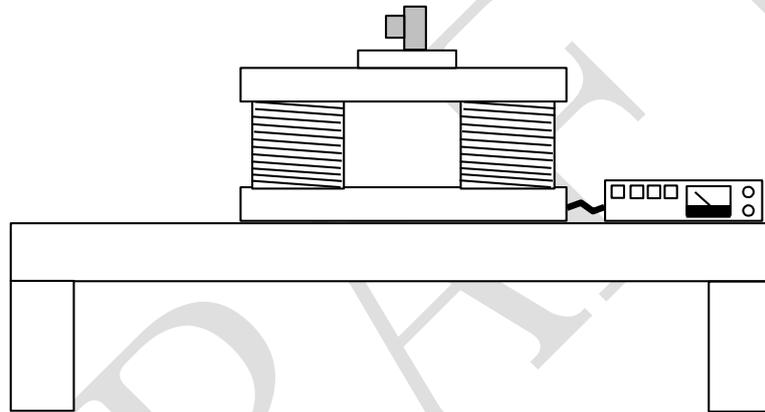


Figure 6-2-1 Vibratory apparatus

6-3 Vibration Waveform

It is desirable if the vibration waveform is as close as possible to camera shake characteristics. Accordingly, frequencies and amplitudes of camera shake of many people were acquired by a sensor attached to a camera and separated into Yaw and Pitch. The data was analyzed, and characteristic frequency and amplitude were extracted and synthesized to generate the vibration waveforms.

Camera shake has components in six directions (Yaw, Pitch, Roll, X, Y, Z) in total. However, when the shooting distance is about 20 times the focal length, Yaw and Pitch are dominant, and the other directions can be practically negligible. Accordingly, the waveform only with two-axis components is adopted.

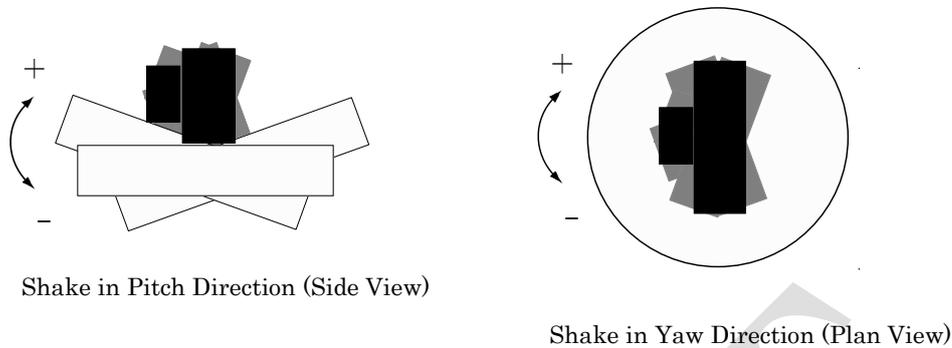


Figure 6-3a Shake Directions

In the process of analyzing the characteristics of camera shake, it has been verified that the frequency and the amplitude of the camera shake are different between single-lens reflex cameras and compact cameras. One of the major factors is the difference in total mass. Accordingly, two types of vibration waveforms, or WB-H assuming a single-lens reflex camera and WB-L assuming a compact camera, have been created in the manner such that both include optimal amplitude and frequency components.

In principle, two waveforms are used for different purposes in carrying out measurements; one for single-lens reflex cameras and the other for compact cameras. However, some compact cameras have total masses close to those of a single-lens reflex camera. Furthermore, a new category of cameras called non-reflex cameras have hit the market. In the case of those camera having a total mass of somewhere between that of a compact camera and single-lens reflex camera, it has been confirmed that using only one of the two types of waveforms results in discrepancy between the image stabilization performance acquired by measurement and the image stabilization performance* acquired by the shooting experiment on many test subjects (Figure 6-3b).

Thus, the two types of vibration waveforms are used according to the total mass, instead of the camera category, to calculate the image stabilization performance. WB-L is used for a total mass of less than 400 g, WB-H is used for a total mass of 600 g and above, and both of the vibration waveforms are used if it is greater than 400 g but less than 600 g. This is a result of statistical calculation based on results of measurement on many cameras.

A method originally considered was to take the weighted average of measurement results according to the total mass in the case where both types of vibration waveforms

are used. However, no significant difference was found despite the complication of the the computation. Accordingly, it was decided that a typical arithmetic method be used.

* In the experiment, the image stabilization performance was measured from images taken in the state where the image stabilization function is OFF and the state where the image stabilization function is ON. The method of measuring the image stabilization performance accords with the method described in 4-4. That is, the image stabilization performance is calculated by comparing values corresponding to the measured motion blur amount acquired from the images taken in the state where the image stabilization function is OFF and the state where the image stabilization function is ON at the determination level for image stabilization performance.

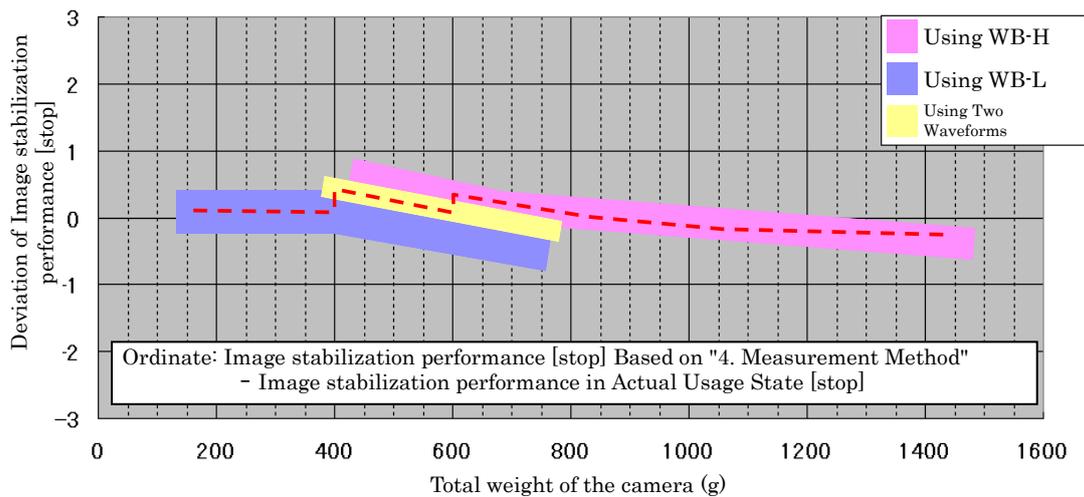


Fig. 6-3b Test Result

6-4 CIPA Motion Blur Measurement chart

In consideration of ease of focusing and general versatility, natural images are inserted in the CIPA motion blur measurement chart as shown in Figure 4-2-1.

6-5 Motion Blur Measurement Software

In finding the bokeh offset amount and measured comprehensive bokeh amount, it is possible, for example, to visually read out the width of the boundary region between

the black and white portions of the chart. However, it is not possible to eliminate variations among measurements. In order to eliminate the variations and to enhance the convenience, motion blur measurement software was developed.

6-6 Shooting Distance

In principle, the distance between the motion blur measurement chart and the camera to be measured when measuring the image stabilization performance shall be about 20 times the 35mm equivalent focal length. This distance is calculated in consideration of practical aspects so that the distance hardly causes questions about measurement results and of the experiment environment, etc. For instance, in the case of a camera with a focal length of 100 mm on a 35 mm equivalent, the shooting distance is about 2 m.

Here, with a wide-angle lens having focal length of 24mm (on a 35mm film equivalent), there is a case where the shooting distance is no more than 500 mm, and the motion blur measurement chart, the vibratory apparatus, and the illumination device interfere, making the measurement difficult. On the other hand, with a telephoto lens having a focal length of at least 500mm (on a 35mm equivalent), the shooting distance would be 10m or more, causing a possibility that a shooting site with desirable conditions cannot be prepared.

Thus, in such an unavoidable case, it is not prohibited to increase or shorten the shooting distance from that 20 times the 35 mm equivalent focal length by the minimum amount required.

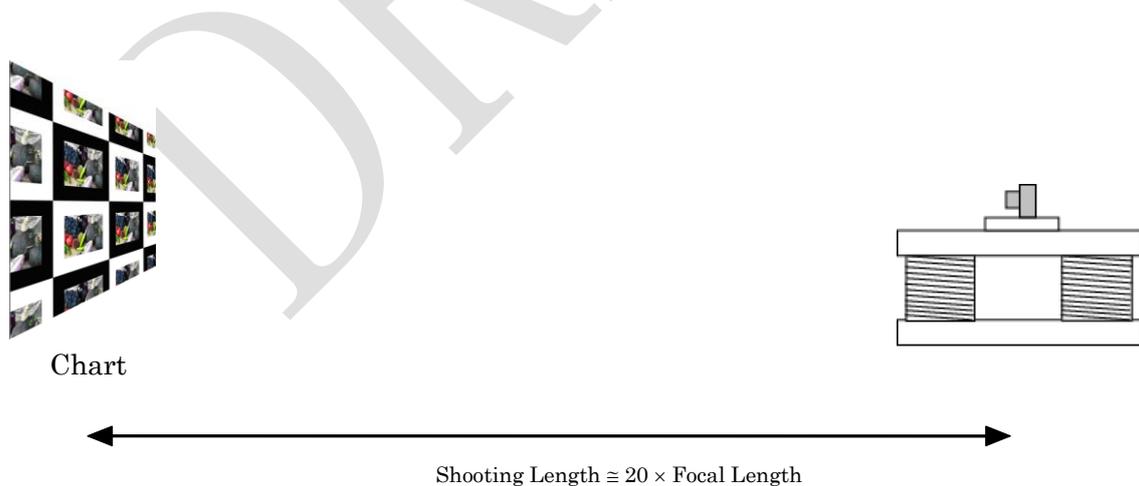


Figure 6-6 Shooting Length

6-7 The Number of Shots

To measure the image stabilization performance in this standard, the vibration waveforms shown in 6-3 are used. However, in the case where the number of shots is small, bias in acquired data may cause an error in the image stabilization performance.

Thus, this standard specifies that the number of shots for each shutter speed is at least 200. This is because shooting experiments (shooting at the shutter speed of 1/8 second) on many test subjects have statistically revealed that about 95% of variations in every measurement taken for the measured comprehensive bokeh amount can be suppressed to the determination level for image stabilization performance or less by taking about 200 images.

6-8 Determination Level for Image Stabilization

To determine the image stabilization performance, a motion blur amount measured from an image is used as a measurement target. Accordingly, determination is difficult in the state where only little bokeh or motion blur exists.

In the field of photography, "the diameter of a circle of confusion" is often used for determining bokeh. The largest circle of confusion incapable of determining bokeh and motion blur is called "permissible circle of confusion." The size of the permissible circle of confusion becomes different values depending on the size of a picture to be appreciated, the appreciation distance and the grounds for calculation and so on. There is one exemplary data*¹ that shows 31.4 μm on a 35 mm equivalent.

Thus, to acquire the determination level for image stabilization performance, a level that is close to the size of the "permissible circle of confusion" and does not raise questions about performance measurement was experimentally derived.

More specifically, an A5 size test image was created by incrementally enlarging the diameter of the circle of confusion from 31.4 μm by computer simulation, and a panel test was conducted using this image. Generally, in a sensuous evaluation of image quality, a reference is often set at a point where greater than 10% of panelists can recognize difference in image quality. According to the panel test, about 10% of panelists can identify bokeh or blur at the diameter of the circle of confusion of about 70 μm .

If this result is converted into a postcard size, the diameter of the circle of confusion would be about 63 μm (see following calculation equation *²).

According to the above result, in consideration of appreciation conditions for typical pictures and the result of the panel test, the determination level for image stabilization performance was set to 63 μm .

*1) In the case of appreciating a picture in the world's most popular postcard size, the average distance between the eyes and the picture is said to be about 450 mm. In this case, the minimum distance [μm] between two points which a person with an eyesight of 1.0 is capable of discriminating is:

$$\tan (1/60) \times 450 \times 1000/4.16 = 31.4,$$

where 4.16 is a ratio of the postcard size to the diagonal length of one frame of 35mm film (180/43.3).

*2) The equation for calculating the diameter of the circle of confusion (about 63 μm):

$$70 \times 1.433 \times 45 / \sqrt{(65 \times 80)} = 62.6,$$

where 1.433 is a ratio of the diagonal length of the appreciated image; and

$$45 / \sqrt{(65 \times 80)}$$

is a ratio of the appreciation length.

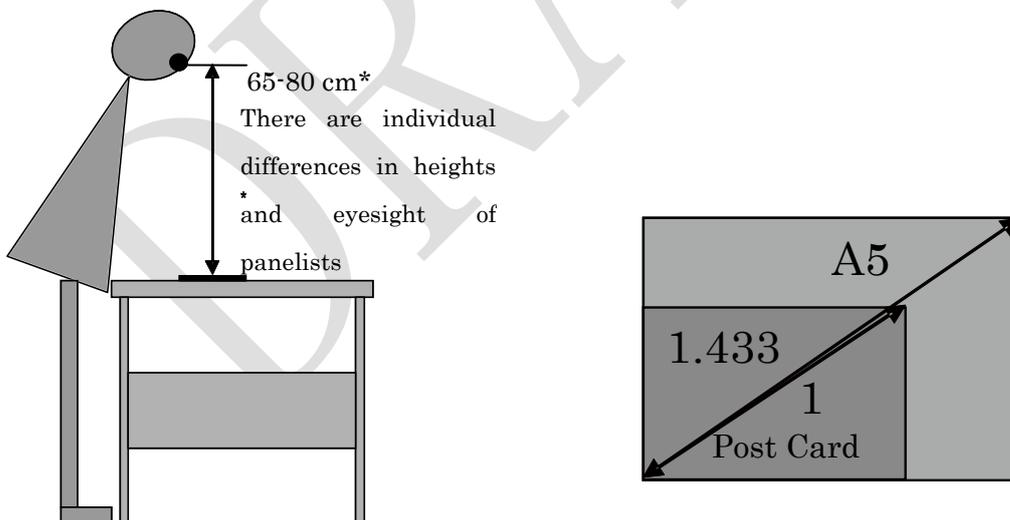


Figure 6-8 Panel Test Method and Comparison between A5 Size and Postcard Size

6-9 Image Stabilization Performance Calculation

Generally, the measured motion blur amount rapidly increases with reduction in

shutter speeds. Accordingly, the actual motion blur amount is a curve connecting motion blur amounts acquired discretely at intervals of one stop at most with a curve. A sophisticated mathematical approach is necessary to correctly derive the function of this curve, but linear approximation would not result in a significant error either as long as the interval is one stop at most. Furthermore, since the reference motion blur amount forms a curve similar to that of the measured motion blur amount, it is expected that linear approximation of them would cancel out both of the errors by subtraction and further reduces an error.

Thus, this standard avoids computation using a complicated curve for calculating the image stabilization performance and adopts a method of linear approximation by connecting two points with a straight-line.

6-10 Illumination

Since there is little possibility that the type and color temperature of illumination largely affect the measurement result, the type of illumination is not specified. However, it is necessary to evenly illuminate light on the motion blur measurement chart during measurement. Accordingly, the position of the illumination and the number of lights, etc. shall be considered.

In the case where the shutter speed cannot easily be changed by camera operation, it is necessary to change the shutter speed by controlling the brightness of illumination. Accordingly, the brightness of illumination shall be adjustable. In this case, the combined use with a ND filter is an effective method.

6-11 Shooting Mode

As for the shooting mode for the measurement of the image stabilization performance, it is stated that "Although no specific shooting mode is stipulated, because shooting must begin as soon as possible after the power is turned ON, a shooting mode which remembers as many items as possible specified in 4-3-3 to 4-3-19 that are set in advance even when the power is OFF is desirable." This is because shooting cannot start immediately if the power is first turned ON to start the measurement and then a camera is set for the measurement.

Next, it is specified that "a mode capable of easily changing the shutter speed is desirable." This is because it is necessary to measure motion blur amounts for respective shutter speeds while changing the shutter speed.

However, there are many cameras that only have shooting modes such as so-called "Auto" and "Program" that automatically change the shutter speed and the aperture

value according to shooting environments and situations of a subject. For such cameras, certain means for changing the shutter speed while changing the brightness of illumination is required.

6-12 Image Quality Mode (Compression Ratio)

The compression ratio is not specified. However, there is a possibility that questions may arise about measurement results due to noise effects caused by image compression. Accordingly, it is desirable to adopt a high image quality mode (low compression ratio).

6-13 Image Quality Mode (the Number of Recording Pixels)

The number of recording pixels is not specified. However, if the number of recording pixels becomes small, questions may arise about measurement results due to effects of deterioration in resolution. Accordingly, it is desirable to take images with the number of pixels (the maximum number of pixel of the camera) that is not affected by it..

6-14 ISO Sensitivity

ISO sensitivity is not specified. However, there is a possibility that noise effects caused by shooting at high sensitivity may raise questions about the measurement results. Accordingly, it is desirable to set the sensitivity to low to a certain extent to prevent the noise effect.

However, there are cameras that will not allow the ISO sensitivity to be arbitrarily set. In this case, efforts shall be made so as not to render measurement results that are questionable. When ISO sensitivity changes, the noise level changes accordingly; so it is desirable to adopt a setup at which ISO sensitivity changes as little as possible.

6-15 Flash

There is a possibility that flash changes image quality according to the presence or absence of light emission and causes doubts on measured results. There are many cameras where the shutter speed cannot be adjusted while the light is emitted. Accordingly, measurement shall be made in the state without light emission.

6-16 Recording Media

Since types and capacities of recording media are not likely to cause issues about measurement results, these are not specified. However, if recording media with extremely small capacity is used, it has to be replaced frequently during

measurements and will require data to be deleted. This would be a concern since changing a camera setting might cause measurement nonuniformity.

Accordingly, it is convenient to use a recording medium with sufficiently large capacity that does not have to be replaced during measurements.

6-17 Focal Length on Measurement (in the Case of Zoom Lens Mounted Camera)

The magnification of the optical zoom and the range of focal length vary from product to product, making it impossible to measure every digital camera at the same focal length. Methods of selecting from several predetermined focal lengths, including the telephoto end, was once considered. However, a specific focal length cannot be selected in certain cameras, so it was decided that the decision on a focal length for measurement will be left up to suppliers and measurers. However, there are cameras with which a different focal length renders different image stabilization performance. Accordingly, in describing the image stabilization performance, the focal length for the measurement shall clearly be described.

6-18 Electronic (Digital) Zoom

Use of an electronic (digital) zoom deteriorates image quality, which may raise questions about measurement results. Accordingly, the electric zoom shall not be used.

6-19 Focus Control

Methods of focusing include AF (auto focus) and MF (manual focus). Regardless of the methods, if the focus is not correctly adjusted on the motion blur measurement chart, so-called out-of-focus bokeh and motion blur cannot be discriminated from each other. This could possibly raise questions in measurement results.

Accordingly, the focus shall correctly be adjusted on the motion blur measurement chart during measurement.

6-20 White Balance

The white balance is not specified. However, there is a possibility that shooting at extremely unbalanced color temperature setup raises questions about measurement results. Accordingly, the white balance shall be maintained appropriately for the light source to be used.

6-21 Image Aspect Ratio

There are cameras capable of changing the image aspect ratio during imaging, but the possibility of differences in image aspect ratio raising issues about measurement results of the image stabilization performance is small. Therefore, there is no need to specify the image aspect ratio, and a factory default setting mode is recommended.

6-22 Image Stabilization Mode

There are cameras having several image stabilization modes, such as a mode where the image stabilization function always operates and a mode where the image stabilization function operates only on shooting (shutter releasing), or having image stabilization function characteristics that vary depending on shooting modes and zoom positions.

Generally, in many cameras, the factory default mode is set to "auto." Since suppliers recommend the shooting mode to be in "auto," the image stabilization mode where the camera operates in this state should be adopted.

There are cases where it is not possible to set image stabilization in the factory default shooting mode, or cases where the image stabilization mode other than the factory default setting exhibits higher image stabilization performance at a certain focal length. In these cases, a supplier or measurer is not precluded from setting an appropriate image stabilization mode. However, in the case of using an image stabilization mode other than the factory default setting, the name of the image stabilization mode used for the measurement shall be clearly described.

Any and all standards and guidelines published by CIPA have been set forth without examining any possibility of infringement or violation of Intellectual Property Rights (patent right, utility model right, trademark right, design right, copyright and any other rights or legal interests of the same kind).
In no event shall CIPA be liable in terms of Intellectual Property Rights for the contents of such standards and guidelines.

CIPA DC- x011-Translation-2012

Published by Camera & Imaging Products Association
JCII BLDG., 25, Ichiban-cho, Chiyoda-ku, Tokyo, 102-0082 Japan
TEL +81-3-5276-3891 FAX +81-3-5276-3893

All rights reserved

No part of this guideline may be reproduced in any form
or by any means without prior permission from the publisher.