BS ISO 15781:2015

BSI Standards Publication

# Photography — Digital still cameras — Measuring shooting time lag, shutter release time lag, shooting rate, and start-up time

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**National foreword**

This British Standard is the UK implementation of ISO 15781:2015. It supersedes BS ISO 15781:2013 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CPW/42, Photography.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.


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INTERNATIONAL STANDARD

**ISO 15781**

Second edition
2015-03-15

# Photography — Digital still cameras — Measuring shooting time lag, shutter release time lag, shooting rate, and start-up time

*Photographie — Caméras numériques — Mesurage du décalage dans le temps de la prise de vue, décalage dans le temps de l'ouverture de l'objectif, cadence de prise et temps de démarrage*

Reference number
ISO 15781:2015(E)

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# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 42, *Photography.*

This second edition cancels and replaces the first edition (ISO 15781:2013), of which it constitutes a minor revision.

# Introduction

Taking pictures of a moving target was nearly impossible in the early days of digital photography. After pressing the exposure button, it took a significant amount of time to capture the image and the chance to preserve the desired moment was gone.

Part of the time between pressing the exposure button and the exposed picture is needed to focus while another part is needed to adjust the exposure, etc. This unwelcome, but unavoidable period of time is called the **shooting time lag.** This is often mixed with the term **shutter release time lag** which is also defined in this International Standard. Optimized systems are nowadays able to decrease these time lags.

Capturing the different stages of a fast moving object is sometimes very important, especially in areas like sports or people photography. This high **shooting rate** requires a fast image processing within the digital still camera that can be measured according to the method described in this International Standard.

When a photographer decides to capture an image of a changing scene, if his or her digital still camera takes a long time to be ready to shoot once it is turned on, the opportunity to capture the image is lost. This time named **start-up time** is therefore another important value which can be determined using this International Standard.

# Photography — Digital still cameras — Measuring shooting time lag, shutter release time lag, shooting rate, and start-up time

## 1 Scope

This International Standard specifies how to measure and report the shooting time lag, shutter release time lag, shooting rate, and start-up time for digital still cameras including camera modules in phones and tablet computers. It includes a method that uses control signals inside the digital still camera and a method that determines the timing values without requiring access to the inside of the digital still camera.

Depending on the method used to start the timing device, there can be a time lag between the activation of the timing device and the closure of the exposure switch of the digital still camera.

This International Standard does not address the measurement of auto focus accuracy and speed at low light conditions.

For digital still cameras that continuously shoot images into the buffer, the exposure button only acts as a selector of an image that was taken before the exposure button was pressed. The methods to measure shutter time lag and shooting time lag do not address this case and cannot be used for this type of digital still camera.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7589, *Photography — Illuminants for sensitometry — Specifications for daylight, incandescent tungsten and printer*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1**
**digital still camera**
device which incorporates an image sensor and produces a digital signal representing a still picture

Note 1 to entry: A digital still camera is typically a portable, hand-held device. The digital signal is usually recorded on a removable memory such as a solid-state memory card or magnetic disk.

Note 2 to entry: This term is also defined in ISO 12231, ISO 12232, ISO 15739, and ISO 17321-1.

**3.2**
**shooting time lag**
time between pressing the exposure button (firmly depressing the shutter button to the maximum extent without introducing a discontinuity) on a *digital still camera* [3.1] or a module built into a mobile device and the beginning of the exposure

Note 1 to entry: This period of time includes all measurements and adjustments (e.g. auto focus and exposure control) a digital still camera needs to make prior to the beginning of the exposure.

Note 2 to entry: When the exposure button of a digital still camera is pressed, it performs a number of time-consuming measurements and adjustments, e.g. determination of the exposure and focus adjustment. The time needed for these procedures is part of the shooting time lag.

**3.3**
**shutter release time lag**
time duration to the time of starting the exposure from the time of fully pressing down the shutter button after having stabilized the focus operation due to half pressing of the shutter, in case of *digital still cameras* [3.1] that distinguish between the half pressing and the fully pressing

Note 1 to entry: Instead of shutter release time lag, the terms shutter lag and release lag are used in some publications.

**3.4**
**start-up time**
time between switching a *digital still camera* [3.1] on and the moment the camera has reached a *standby state* [3.6] ready to shoot

Note 1 to entry: It excludes the initialization of a memory card.

**3.5**
**shooting rate**
reciprocal of the time between the beginning of the exposure of an image until the beginning of the exposure of the next image

**3.6**
**standby state**
state achieved following the power-up process in which a *digital still camera* [3.1] is powered on and ready to capture an image

Note 1 to entry: If the digital still camera uses an electronic viewfinder, a preview image is normally displayed during the standby state.

**3.7**
**pre-capture point**
position of a user control of a *digital still camera* [3.1] which activates pre-capture processes such as auto-focus and exposure calculation

Note 1 to entry: The pre-capture point is typically reached by pressing an exposure button roughly halfway down.

**3.8**
**capture point**
position of a user control of a *digital still camera* [3.1] which activates the image capture operation

Note 1 to entry: The capture point is typically reached by fully depressing the exposure button.

# 4 Test conditions

## 4.1 Illumination of the test scene

The illumination level of the shooting area including the test chart should be even and above 500 lx and below 5 000 lx. The test scene shall be illuminated in a way that avoids specular reflection (see Figure 1). This can be achieved by using geometry typical for reproduction photography which means positioning the light sources in approximately 45° angle to the surface of the chart. The illumination level of the area shall be reported together with the measurements.

Timing measurements shall be performed under daylight conditions or a tungsten lamp. Procedures for determining whether the illumination used for OECF measurements is an acceptable match to the daylight illuminant shall be conducted in accordance with ISO 7589.

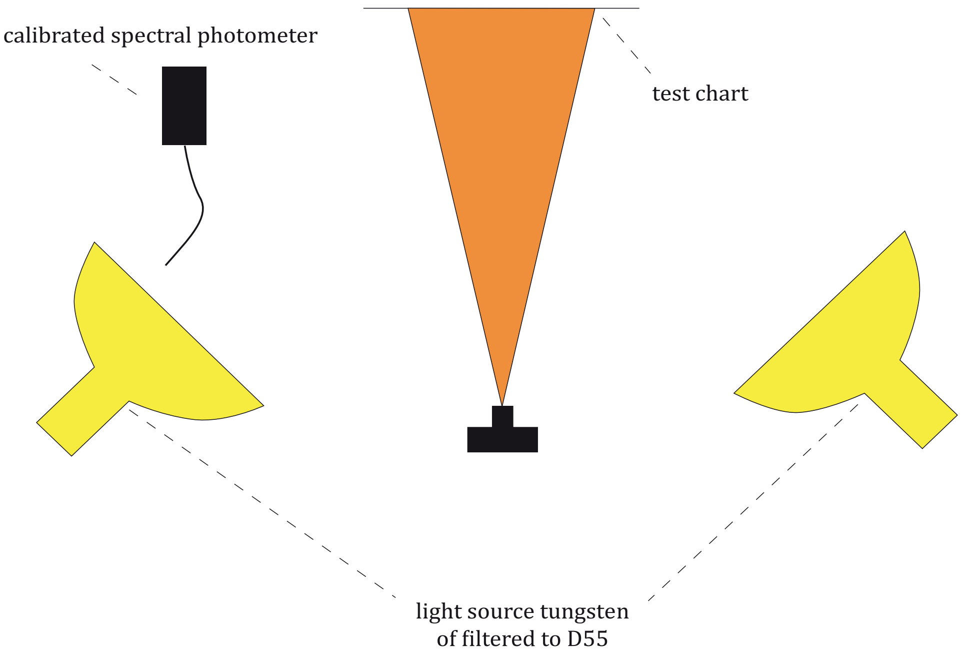



**Figure 1 — Principle for illuminating the target**

## 4.2 The chart and positioning of the digital still camera

The digital still camera shall be mounted on a solid stand (e.g. heavy tripod) perpendicular to and facing the surface of the chart (see Figure 2).

As for the test chart, the chart shall allow the digital still camera to focus easily and allow an easy determination whether the captured image is correctly focused. Examples include a black-and-white checker board or the three-line chart shown in Annex B. If the above condition is met, a typical image assessment chart can be used. Also, the ISO 12233 resolution chart can be placed in the chart area to determine whether the captured images are in focus.

The height of the chart shall be (80 ± 10) cm and the distance to the chart shall be adjusted in a way that the height of the image is in accord with the chart height.

The surround areas should be filled with a reflective area of 18 % neutral grey. Prior to the measurement, the digital still camera shall be checked to see if it correctly focuses on the chart. If not, the correct focus shall be obtained by changing the chart or the illumination condition. If different setup conditions are required when the focal length of the lens is extremely long or short, these setup conditions shall be reported together with the measurement results.

Dimensions in millimetres

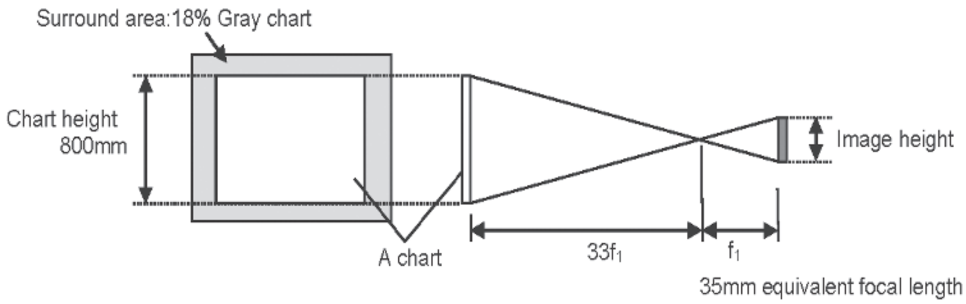



**Figure 2 — Chart and positioning**

### 4.3 Battery status

A secondary battery should always be fully charged and a primary battery should always be a new one prior to performing the measurements in order to avoid inconsistent measurements caused by varying power supply. For cameras that support an AC power supply, the AC power supply should be used.

### 4.4 Memory card

For digital still cameras that support connection to an external memory card, a card with a sufficient capacity that does not interfere with the test shall be used. The card shall be initialized and formatted in the camera. After formatting the card, it shall remain in the digital still camera.

If the digital still camera only has the internal memory, all images should be deleted by initializing the memory prior to the measurement.

### 4.5 Flash

If the flash is used to perform the measurements, it shall be reported together with the results.

## 5 Measurements

### 5.1 Definition of measurement

#### 5.1.1 General

This International Standard defines two measurement methods. The first method is the "external measurement" method which can be performed without disassembling the digital camera. The second method is the "internal measurement" method which requires the camera body to be partially disassembled in order to perform measurements using electrical signals inside the camera body. The first method is the preferred method for measurements made by users of digital cameras. The second method is the preferred method for measurements made by digital camera manufacturers.

NOTE 1 Figure 3, Figure 4, and Figure 5 show the periods of time to be measured.

NOTE 2 "Procedure related to the pre-capture point" means the procedure by which the digital still camera measures the light intensity and distance, determines the exposure, and adjusts the focus when the pre-capture point switch of the digital still camera is pressed.

NOTE 3 "Procedure related to the capture point" means the procedure by which the digital still camera processes the image captures and preparation of the image storage when the capture point switch of the camera is pressed.

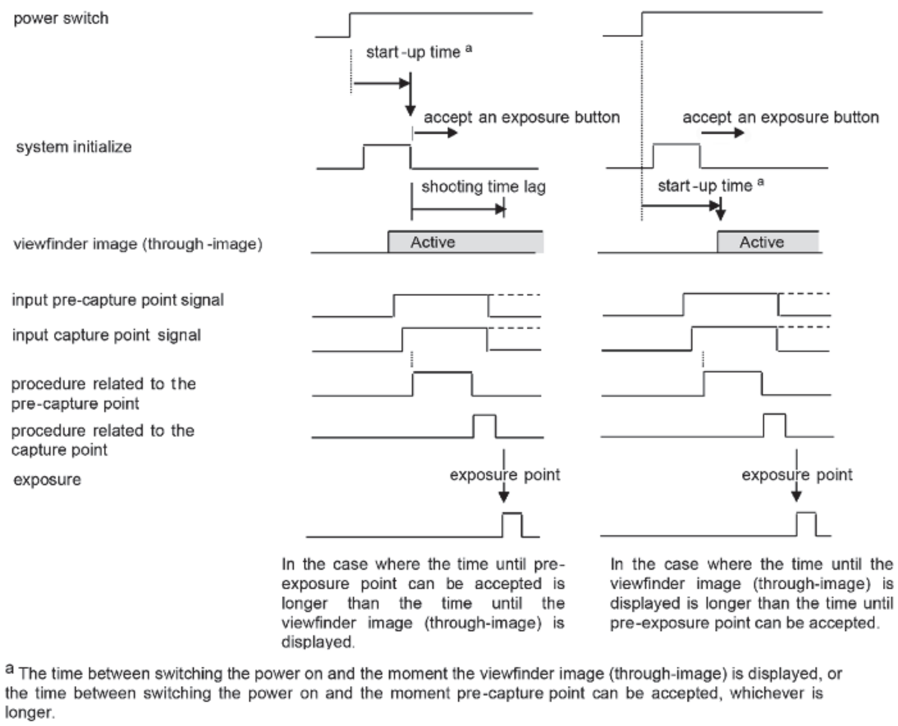



**Figure 3 — Measurement period for start-up time**

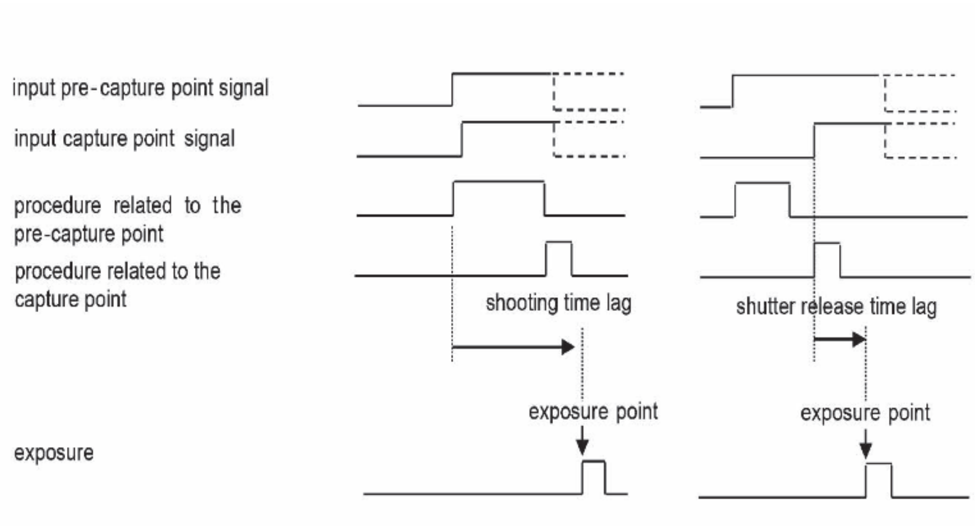



**Figure 4 — Measurement period for shooting time lag and shutter release time lag**

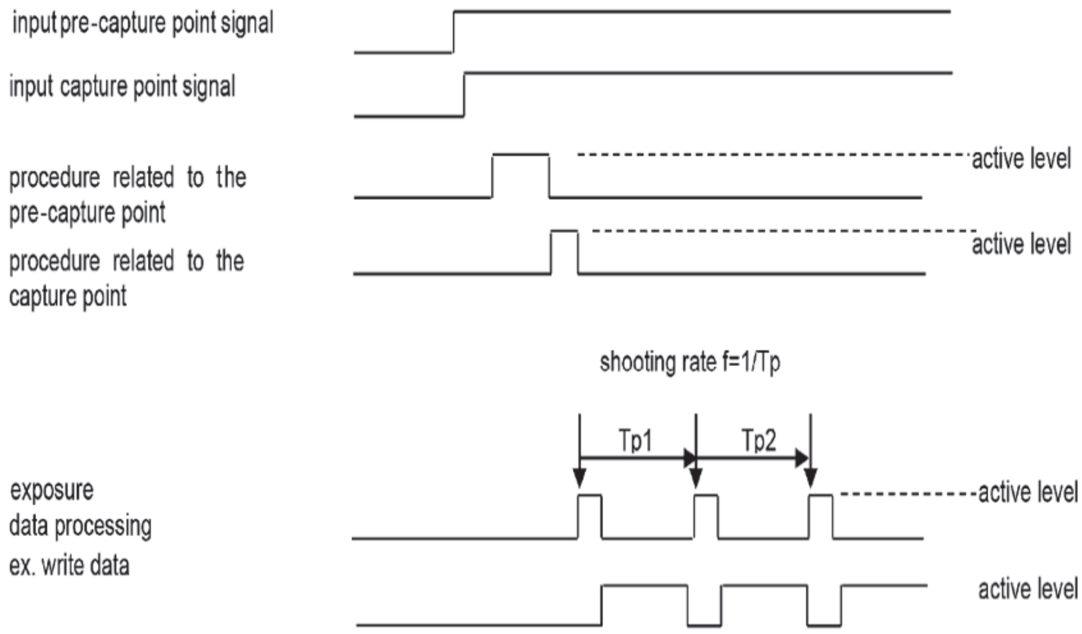



**Figure 5 — Measurement period for shooting rate**

### 5.1.2 External measurement

The external method of measurement is performed without disassembling the camera with the advantage that the measurement can be performed on the product level. Specifically, for instance, the measurement can be performed shooting a timing device that can determine a time interval from captured images. An example of this method is shown in Annex B.

When using the external measurement, the acceptable level of the time lag between pressing the exposure button and activating the timing device is application dependent and needs to be considered prior to performing a test and the estimated error caused by this time lag shall be reported together with the results (see Annex B). A test was performed using different approaches and the results are shown in Annex A.

### 5.1.3 Internal measurement

Internal measurement is a method which directly measures a time interval between input signals and device control signals and involves disassembling the camera. This allows the operational timing to be surely obtained and has the advantage that the measurement can be performed accurately and stably. However, camera manufacturers usually use this method because it is very difficult for parties other than camera manufacturers to disassemble the camera and select and measure the device control signals. An example of this method is shown in Annex C.

## 5.2 Measurement method

### 5.2.1 Start-up time

The digital still camera shall be switched on and set to record mode. Every setting that requires additional time when switching the camera on (e.g. playing an intro sound) shall be turned off and the camera shall be focused on the timing device before it is switched off again. Start the measurement when the power switch is turned on again. The measurement value shall be an average of at least 10 measurements.

The digital still camera shall not be disconnected from the power supply until the test is finished. The measurement results and conditions shall be reported according to the description in Clause 6.

For camera modules in mobile devices, the starting point for turning the camera function on is the phone mode or regular operation mode of the device. If it is necessary to enter one or multiple menus to start the camera module, this time shall be integrated in the reported start-up time.

When using the external measurement, the timing device shall electronically be connected to the power switch or the power supply of the camera, if possible. The accuracy of the timing device for measuring the start-up time shall be at least 0,1 s (the sampling shall be 0,01 s). If the timing device is started manually, all measured values <0,5 s shall be reported as 0,5 s and the fact of the manual activation shall be reported together with the result. When the power switch is turned on, the timing device shall be started. A picture of the chart (object) shall be taken immediately after the shutter release becomes active after turning the camera on.

If the shooting images can only be checked through an optical viewfinder or if the initial setting of the product is “image display device off” in a digital still camera that consists of both an optical viewfinder and an image display unit, the time elapsed from operating the power switch until the beginning of the exposure of the first image minus the shooting time lag determined from the second image shall be called the start-up time.

$$T_S = T_0 - T_{SL} \tag{1}$$

where

$T_S$ is the start-up time;

$T_0$ is the time elapsed from operating the switch until the beginning of the exposure of the first image;

$T_{SL}$ is the shooting time lag.

However, in the case where the shooting image cannot be checked through an optical viewfinder, or if the initial setting of the product is “image display device on” in the camera with both optical viewfinder and image display unit, the time between switching the power on and the moment the viewfinder image (through-image) is displayed shall be measured.

When using the internal measurement, suppliers, as shown in Annex C, shall directly observe appropriate signals and the time defined in 5.1.1 shall be measured.

### 5.2.2 Shooting time lag

Prior to each measurement of the shooting time lag, the digital still camera shall be turned to face a distant object and shall focus on this object. The elapsed time between turning the camera on the stand and pressing the exposure button shall be less than 3 s.

The distant object shall be located at a distance of at least 100 times the focal length of the camera lens, or 5 m, whichever is greater.

For products that allow manually focusing to infinity, this option may be used. The focus point can also be set to infinity using a collimator.

The shooting time lag, $T_{SL}$, shall be measured by turning the digital still camera to face the chart and by fully pressing the exposure button with the continuous auto focus turned off. In the case of the external measurement, the time between starting the timing device and the first illuminated time indicator in the correct focused image is the shooting time lag. If the image is clearly out of focus, it shall not be used to measure the shooting time lag because in this case, the camera can trade the focus accuracy for higher speed (shutter priority) and the image of the timing device is blurred and unable to show the correct timing. For cameras that do not deliver sharp images when pressing the exposure button fully, the digital still camera shall be allowed to focus by first, pressing the exposure button halfway down. Immediately after the camera indicates that it is in focus, the exposure button shall be fully pressed. The timing device shall be started when the exposure button is pressed halfway down and the fact that the digital still camera did not focus correctly without this manual adjustment shall be reported together with the results.

In the case of the internal measurement, appropriate signals shall be directly observed as shown in Annex C and the time period defined in 5.1.1 shall be measured.

The reported shooting time lag shall be an average of at least 10 measurements shot in a row right after the previous image has been stored to the storage media and without switching the camera off.

If the measured time is significantly shorter or longer for the first of the 10 images, the measurement shall be repeated. If the same results occur, values for the first and the following exposures shall be reported separately.

The measurement results and conditions shall be reported according to the description in Clause 6.

### 5.2.3 Shutter release time lag

The shutter release time lag shall be measured using the same requirements for the shooting time lag except that the timing device shall be started after the digital still camera is facing the chart (object) and is in focus. The measurement results and conditions shall be reported according to the description in Clause 6.

### 5.2.4 Shooting rate

The shooting rate should be measured with the camera set to the highest pixel count available in the camera and the highest image quality (e.g. lowest JPEG compression) available. However, any other setting may be used and the setting shall be reported along with the measurement results. The camera shall be positioned as described in 4.2 and correctly focused on the target. To achieve the highest frequency possible, the digital still camera shall be set to burst mode (if it exists) and the exposure time shall be 1/100 of a second or less (if adjustable). If the camera does not allow setting mode and exposure time, the measurement shall be performed using the default setting.

A set of the images should be taken with the camera by keeping the exposure button pressed until the shooting rate slows significantly down. The reciprocal of the time elapsed from the beginning of the exposure for one image and the beginning of the exposure of the next image is the value of the shooting rate. If the shooting rate changes significantly during the test, the number of exposures possible at the used mode shall be reported along with the value of the shooting rate.

NOTE Digital still cameras often shoot several images at a constant frequency at the beginning of capturing a series of images. In case the buffer memory fills up because the camera is not able to process and transfer the images to the storage medium fast enough, the frequency decreases after the memory is full. This is the point where the camera noticeably slows down.

The shooting rate shall be reported as the mean value for all images taken until the camera begins to slow down.

$$f = \frac{n-1}{(t_n - t_1)} = \frac{1}{T_\mathrm{p}} \qquad (2)$$

where

$f$ is the image frequency;

$n$ is the number of the last image before the camera begins to slow down;

$t$ is the time from the start until the beginning of the exposure for a specific image;

$T_\mathrm{p}$ is the arithmetic mean of the measured value for $n$ intervals from the beginning of the exposure for one image until the beginning of the exposure for the next image.

The measurement results and conditions shall be reported according to the description in Clause 6.

## 6 Reporting the results

The results of the timing values described in this International Standard depend on several camera settings as well as surrounding conditions. Therefore, these camera settings and surrounding conditions shall be managed enough during the measurement and they shall be reported with the results. In some cases, however, simpler presentation without complete description on the camera settings or the surrounding conditions may be used. An example is specification notes in a catalogue for the end users.

The results of measurements should be reported with at least two significant digits. When the shooting time lag and start-up time is less than one second, the shutter release time lag is less than 10 ms or the shooting rate is less than one image per second. The results can be reported with one significant digit.

A complete report of the results shall contain all the necessary information in order to reproduce the measurement. In particular, the following shall be recorded:

— measurement method used;

— identification of the measured product, e.g. product type, serial number, firmware version, information on the used lens;

— identification of the used memory card, e.g. card specifications, memory size;

— any special environmental conditions in which the test was performed, e.g. illumination of the test scene, subject distance, special setup conditions;

— any specific conditions necessary to enable the test to be performed, e.g. power supply;

— any operating states of the camera necessary to enable the test to be performed, e.g. number of recorded pixels, image quality, capture mode (e.g. portrait, sports), focal length, focus mode (e.g. high speed), flash usage.

An example of a test report with information to report and associated values are given in Annex D.

# Annex A
(informative)

# Test results of methods to start the timing device

## A.1 General

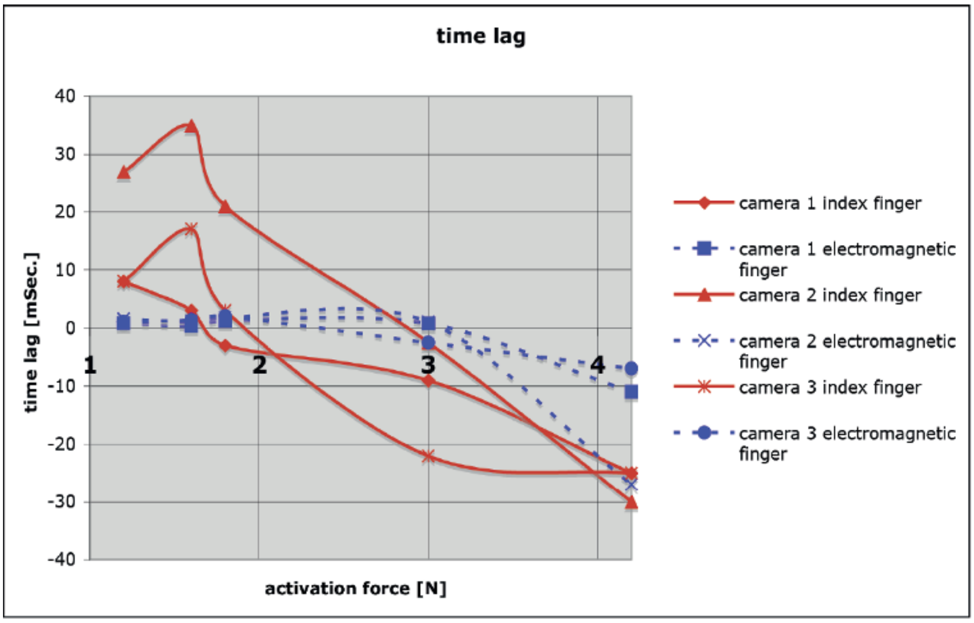
To find out about the time lag between the actuation of the timing device and the closure of the exposure switch (activated by the exposure button) of the digital still camera, an experiment has been performed using several real cameras (see Figure A.1).

A modified version of the timing device mentioned in B.2 has been used. This version used one input for the micro switch to start the device and a second input that was connected to the exposure button of the sample camera as a stop signal. This way, the time lag between the two signals could be measured.

A positive value in Table A.1 means that the micro switch was actuated before the camera exposure switch. A negative value means that the force needed for the micro switch was higher than that needed for the camera which leads to the case that the camera was actuated before the micro switch.

**Table A.1 — Measured time lags between actuation of the micro switch and the camera exposure switch (in milliseconds)**

| Activating force needed for micro switch | Camera 1 index finger | Camera 1 electromagnetic finger | Camera 2 index finger | Camera 2 electromagnetic finger | Camera 3 index finger | Camera 3 electromagnetic finger |
|---|---|---|---|---|---|---|
| 1,2 N | 8 ms | 0,8 ms | 27 ms | 1,5 ms | 8 ms | 1 ms |
| 1,6 N | 3 ms | 0,35 ms | 35 ms | 1,1 ms | 17 ms | 1,4 ms |
| 1,8 N | -3 ms | 1,25 ms | 21 ms | 1,7 ms | 3 ms | 2 ms |
| 3 N | -9 ms | 0,75 ms | -2,5 ms | 1 ms | -22 ms | -2,5 ms |
| 4,2 N | -25 ms | -11 ms | -30 ms | -27 ms | -25 ms | -7 ms |




NOTE Solid lines show the results from the index finger and the dashed lines are the results from the electromagnetic finger.

**Figure A.1 — Time lag**

The experiment shows that for using the index finger, it is important to select a micro switch that has about the same activating force as the camera exposure button if a time lag smaller than 10 ms is needed. Using an average switch, the time lag is typically within the area of 30 ms. Therefore, the assigned accuracy of the measurement using the index finger to actuate a micro switch is ±30 ms.

For the "electromagnetic finger", the results show that as long as the force needed to actuate the micro switch is smaller than that needed to actuate the camera exposure button, the time lag is within ±2 ms. Only if the force needed to actuate the micro switch is much higher than that for the exposure button, the time lag is significantly higher. Therefore, the assigned accuracy for the measurement using the electromagnetic finger is ±2 ms.

# Annex B
(informative)

# Timing device

## B.1 Actuation of the timing device

This International Standard notes three different ways to actuate the timing device that is needed to perform the described measurements. Each way has been evaluated (see Annex A for details) and, based on the results, have been given a related accuracy. The term accuracy in this case describes the time lag between the actuation of the timing device and the closure of the exposure switch of the camera. This time lag is a deviation of the measured result versus the real timing value that is supposed to be measured.

Index finger is starting the timing device using a micro switch that is activated by the tester’s index finger (see Figure B.1). Although a carefully selected switch in combination with an experienced tester may lead to higher accuracies, the assigned accuracy is ±0,03 s. The typical activating force for a camera exposure button is between 1,0 and 3,0 N. If a micro switch is used to activate the timing device, it should have about the same activating force. There are various switches with a defined activation force commercially available.

**Figure B.1 — Digital still camera with a micro switch mounted on the exposure button using an adhesive tape**

Electronic finger: the timing device is activated using an “electromagnetic finger” that actuates a micro switch on top of the exposure button of the camera or the switch that activates the finger also starts the timing device. This construction has an assigned accuracy of 0,002 s and the manufacturer of the device makes sure that it meets this requirement.

An even more accurate alternative to the electronic finger shown in Figure B.2 is the use of an actuator with a calibrated position. The calibration requires a few shots, but once that is done, the method results in almost no timing difference between the actuation and exposure switch.

NOTE An electronic finger provides a higher accuracy compared to manual pressing of the exposure button with a mounted micro switch.

**Figure B.2 — Electronic finger**

Direct electronic connection to the exposure switch is the highest level of accuracy that reaches the direct electronic connection of the timing device with the exposure switch of the camera. The timing device is started at the same time the camera’s exposure switch is closed. Typically, this method requires partially disassembling the camera and modifying the exposure switch and is therefore not applicable to all kinds of tests, although if applicable, it should be the first choice.

The way the timing device was activated should be reported together with the results (see Clause 6).

## B.2 The timing device

The device used to measure the time should have an accuracy of at least 1 ms and be capable of measuring times up to 10 s or more.

It is possible to use digital clocks if the display is fast enough to show at least a 1/100 of a second.

NOTE 1 The problem with using a digital clock is that the display always stays at the same location which means that numbers lay on top of each other, for example, 0,01, 0,02, 0,03 ... seconds. Therefore, the beginning of an exposure cannot be clearly identified if the exposure time is longer than the required accuracy.


**Figure B.3 — Sample device for a LED panel**

The frequency of the LEDs is selectable and each LED is illuminated for a defined period of time. With longer exposure times, one or more LEDs will be illuminated in the image (see Figure B.3).

NOTE 2 The same thing can be possible using a software solution and displaying a "virtual LED panel". In this case, care has to be taken for the image frequency of the monitor. Many LCD monitors are not set to refresh rates high enough or suffer from a long response time. In that case, the "digital LEDs" are not displayed fast enough to lead to reliable results. In addition, the timing circuit on the computer board has to be checked for its accuracy as it may require a calibration prior to the measurement. The program might not show the same speed when another software is running on the same computer which also requires resources of that computer. Another uncertainty is how to trigger the virtual LED panel. There can be variable delays in between when the trigger signal is sent to the computer and when the computer begins updating the "virtual LED panel". A software solution needs to address these problems, otherwise, it should not be used for measurements related to this International Standard.

## B.3 Timing device position for focal plane shutter and rolling shutter

This subclause describes the positions of the chart and timing device when the exposure timing of the sample camera that has a focal plane shutter or a rolling shutter differs depending on the image location. If the camera has a rolling shutter, only this chart layout is intended to be used for cameras with a readout speed for an entire frame faster than 1/10 of a second.

The timing devices are positioned in two diagonal corners and shorter time duration between the measurement start time (power switch, pre-capture point, and capture point). The measurement end time (exposure start) is adopted as measured value. Alternatively, measurement is performed with the timing device positioned in one of the diagonal corners of the shooting image, then with the timing device positioned in other diagonal corner. The shorter time duration between measurement start time (power switch, pre-capture point, and capture point) and measurement end time (exposure start) is adopted as measured value.

Prior to the measurement, it should be ensured that the timing device (such as LED) is exposed appropriately. The shutter speed and positions can be changed if necessary.

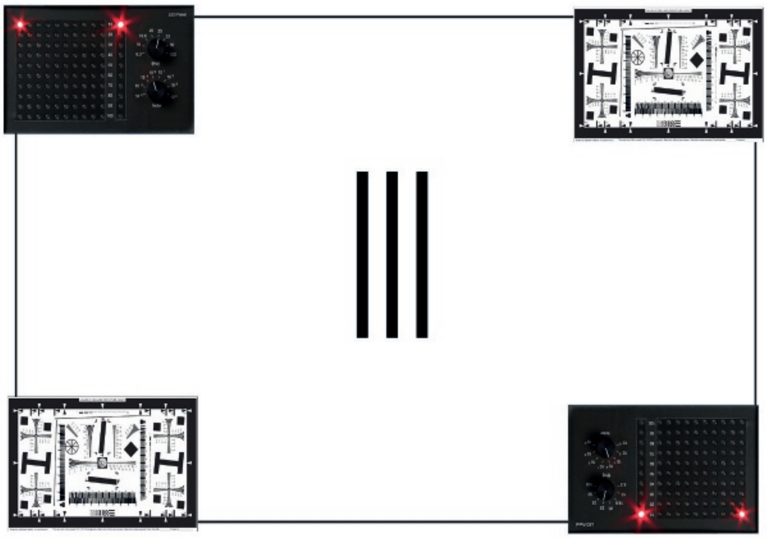


**Figure B.4 — Example of positioning charts and timing devices**

An ISO 12233 chart with a height of 20 cm is positioned in the diagonal corners of the three-line chart with a height of 80 cm. Furthermore, the timing devices are positioned in the other diagonal corners. The two timing devices need to be synchronized and the accuracy of the synchronization should be smaller than 1 ms (see Figure B.4).

NOTE By intention, the timing device in the lower right corner is turned 180° to ensure that the starting LED is as close to the image corner as possible and captures the beginning of the exposure.

# Annex C
(informative)

# Measurement by internal method

## C.1 General

This Annex describes examples for measuring each time lag using control signals inside the digital still camera. A typical digital still camera consists of components as shown in Figure C.1. The time lag can be measured by measuring the differences among each control signal during the time between the moment the input signal becomes active and the moment the exposure starts using a timing measurement device such as an oscilloscope.

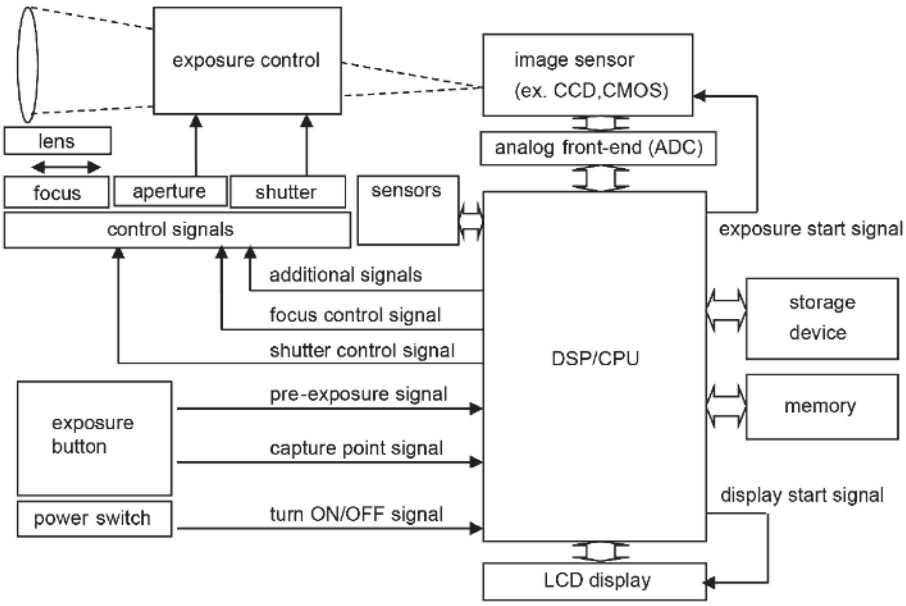



**Figure C.1 — Block diagram of a standard digital still camera**

## C.2 Start point (measurement start point)

The power switch input signal may be used for the camera power-on signal in the start-up time measurement (see “power switch” in Figure C.1).

As for the exposure button signals in the shooting time lag and the shutter release time lag, the exposure button is typically provided with two operating points, the half pressing (pre-capture point) and the fully pressing (capture point). The capture point is the exposure start point. The signal of pre-capture point may be used in the shooting time lag measurement and the signal of capture point may be used in the shutter release time lag measurement.

## C.3 Exposure point (exposure start point)

### C.3.1 General

Some digital still cameras have no mechanism to block light for exposure control. Such products control the exposure to start by electrically controlling the image sensor. Even products that have a mechanical shutter use the above control method. Each time lag is able to be measured with these products by observing the exposure start signal for the image sensor to identify the exposure start point, as shown in C.3.2. The method of determining the exposure starting point in case a mechanical shutter controls an exposure start is described in C.3.3.

Whether the focus is achieved or not can be determined by observing signals such as the focus control signal.

### C.3.2 Exposure start point of image sensor shutter

For the exposure start point, the signal (exposure start signal) to reset the electric charge of the image sensor may be used. Figure C.2 and Figure C.3 show measurement points.

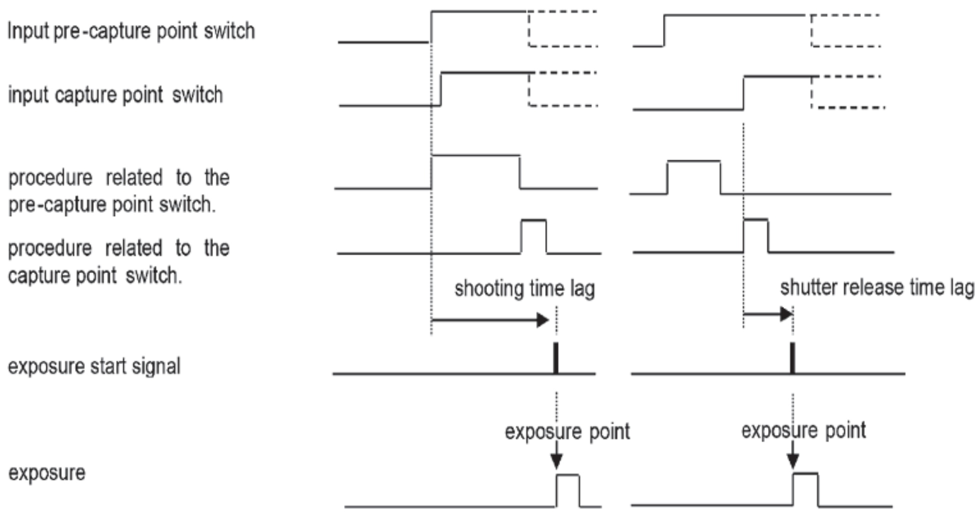



**Figure C.2 — Measurement point of shooting time lag and shutter release time lag**

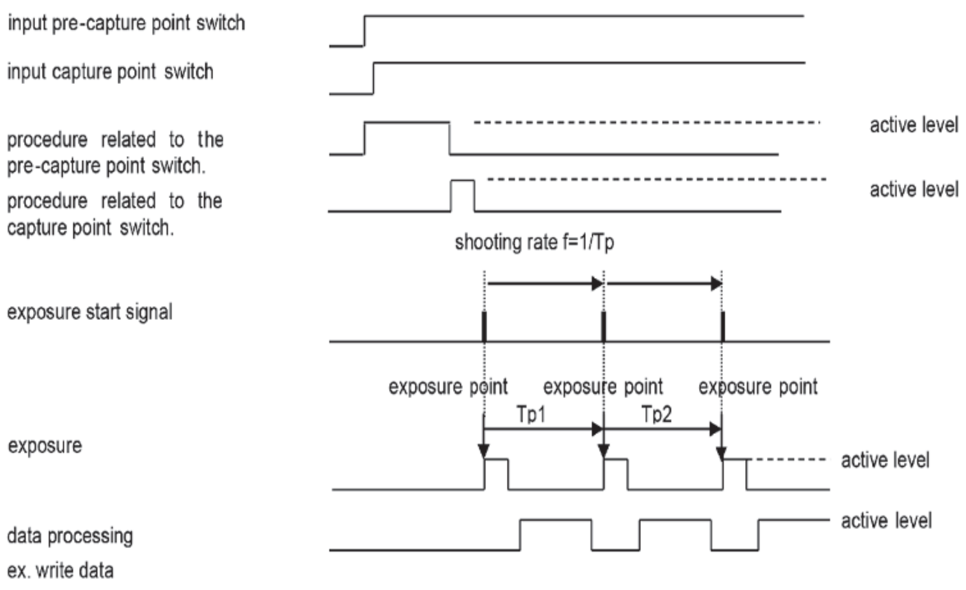



**Figure C.3 — Measurement point of shooting rate**

### C.3.3 Exposure start point of mechanical shutter

Care has to be taken to determine the exposure start point (exposure point) for products in which the exposure start is controlled by the mechanical shutter. Generally, time lag occurs between the time when the shutter control signal is sent out and the moment when the shutter is actually opened to start the exposure.

There is a highly accurate measurement method to measure the exposure start point (exposure point) which obtains the exposure state of an actual exposure frame by observing the movement of the mechanical shutter with a high-speed camera.

NOTE It can also be possible to trigger an LED device as described in Annex B with the appropriate signal and use the target described in that Annex.

When using the shutter control signal, the delay time before the opening of the mechanical shutter is first measured using the above method. Then, the delay time is added to the measured time before the output of the shutter control signal to obtain the exposure start point.

Figure C.4, Figure C.5, and Figure C.6 show measurement points of shooting time lag, shutter release time lag, and shooting rate, respectively.

Also, in the case of the mechanical shutter, the start-up time can be obtained by measuring the time between turning on the power switch and the moment the system initialize is completed.

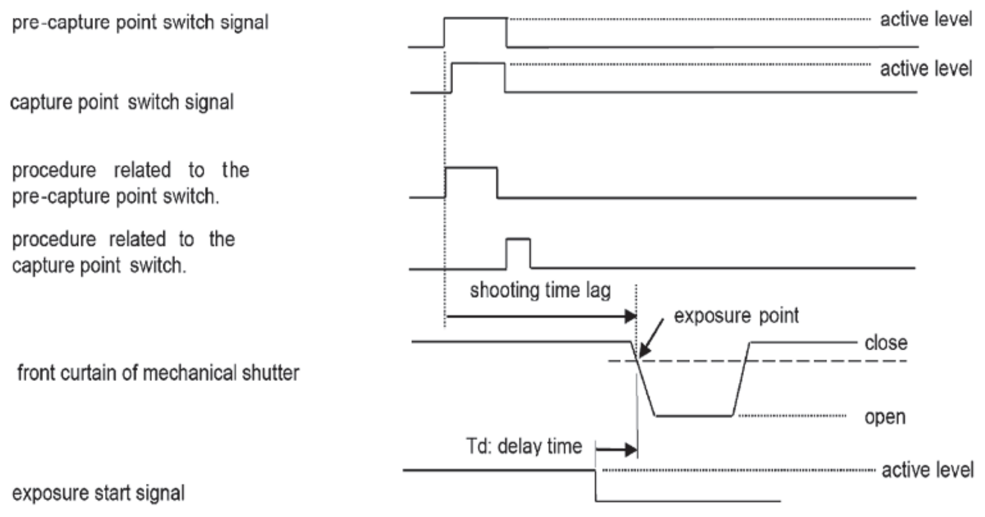



**Figure C.4 — Measurement point of shooting time lag (mechanical shutter)**

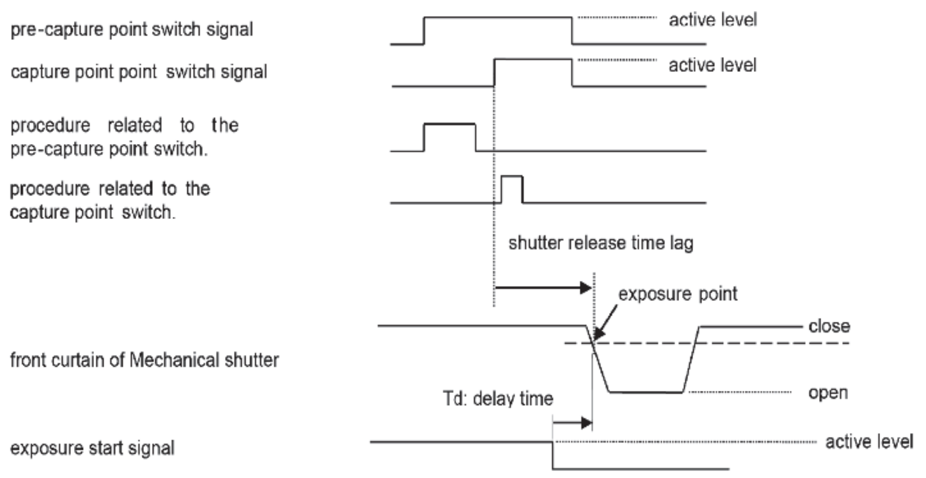



**Figure C.5 — Measurement point of shutter release time lag (mechanical shutter)**

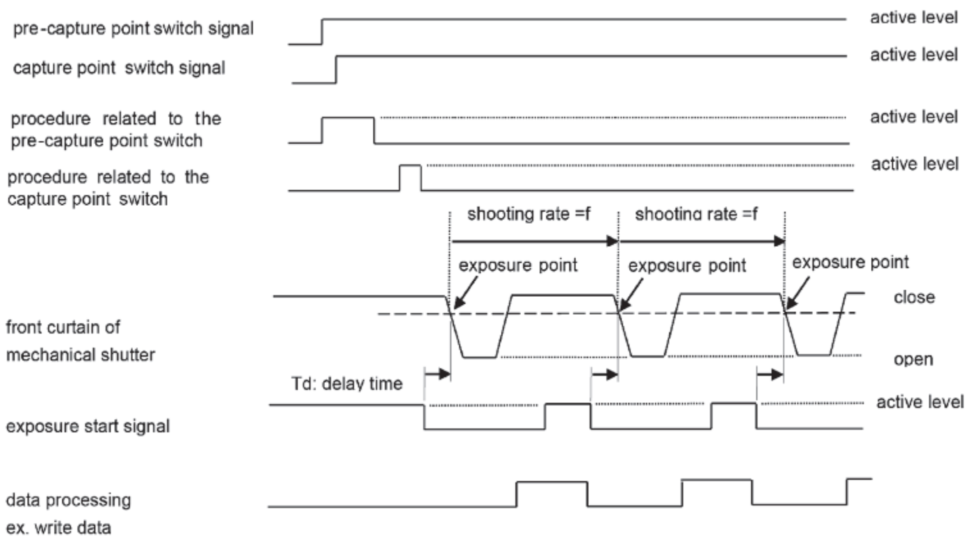



**Figure C.6 — Measurement point of shooting rate (mechanical shutter)**

## C.4 Identifying standby state (measuring start-up time)

### C.4.1 General

Care has to be taken to determine the standby state in cameras with the image display device such as LCD to check the shooting image (viewfinder image) or in products with no optical viewfinder. This is due to the fact that viewfinder image has to be checked before shooting.

If the shooting images can only be checked through an optical viewfinder or if the initial setting of the product is image display device off in the camera with both an optical viewfinder and image display unit, only the time between switching the power on and the moment the pre-capture is accepted can be measured.

However, if the shooting image cannot be checked through an optical viewfinder or if the initial setting of the product is image display device on in the camera with both optical viewfinder and image display unit, the time between switching the power on and the moment pre-capture is accepted and the time between switching the power on and the moment the viewfinder image (through-image) is displayed should both be measured.

### C.4.2 Measuring the time until pre-capture is accepted

The point when the system initialization is completed can be regarded as the above point because it is generally equal to the point when pre-capture is accepted. Figure C.7 shows the measurement points.

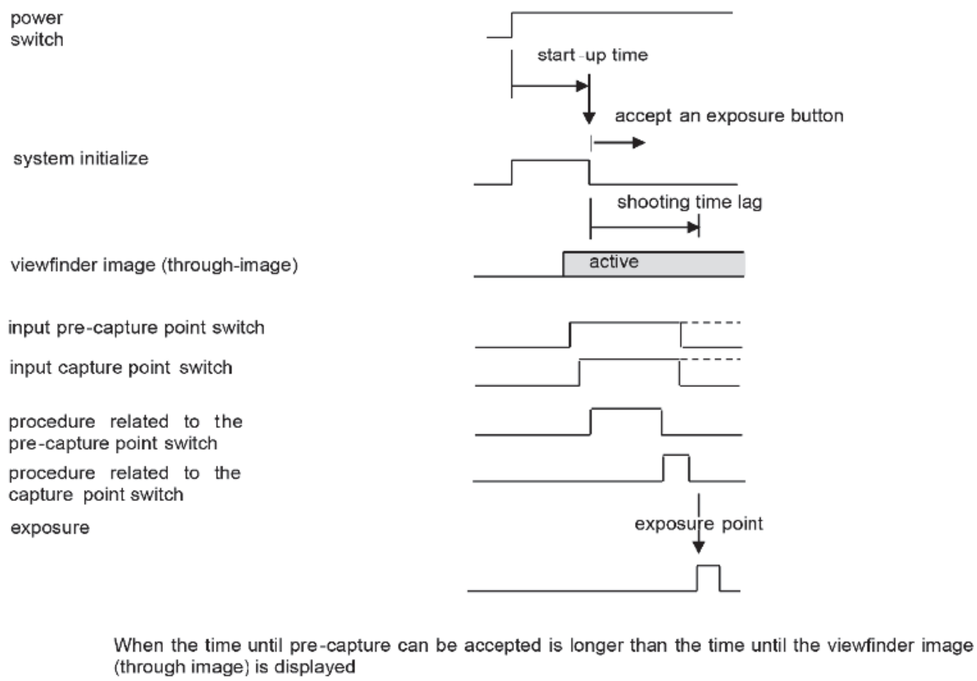



**Figure C.7 — Measurement point of start-up time**

### C.4.3 Measuring the time until the viewfinder image (through-image) is displayed

For the point where the viewfinder image (through-image) is displayed, the signal to display the image picked up by the image sensor to the display unit can be used. Figure C.8 shows the measurement points.

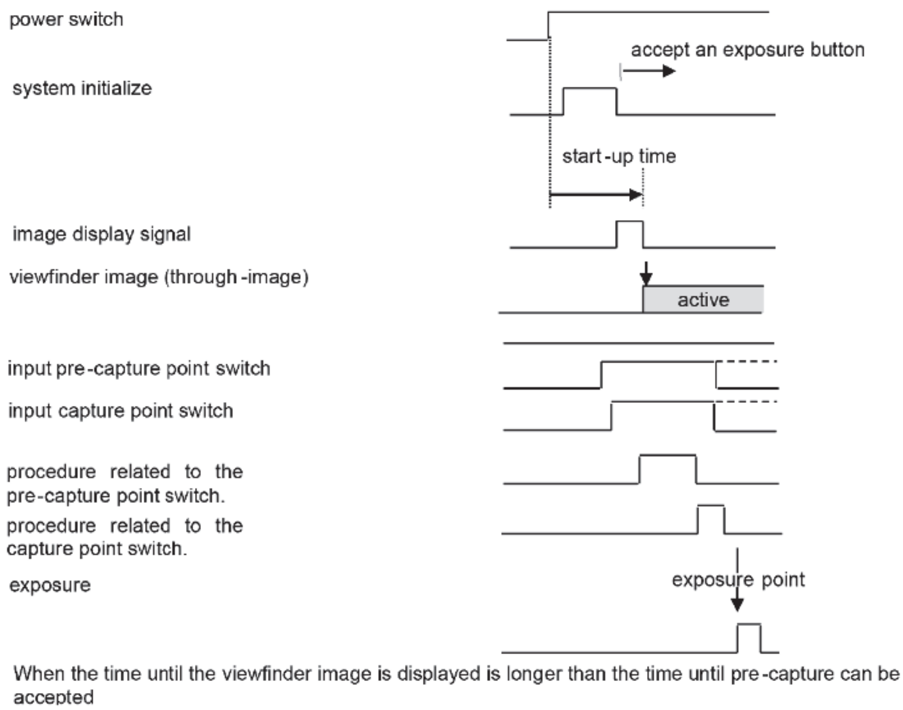



**Figure C.8 — Measurement point of start-up time**

# Annex D
(informative)

# Examples of reporting the result

## D.1 Report examples

This Annex describes examples for the statement of test reports. Table D.1 gives examples of information for common conditions. Table D.2, Table D.3, Table D.4, and Table D.5 give examples of reports for each measurement.

**Table D.1 — Example of information for common conditions**

| | |
|---|---|
| Camera | XYZ |
| Serial number | 1234567 |
| Firmware version | Version 1,00 |
| Lens | 1:2, 8, 60 mm |
| Memory card type [a] | XY ultra-fast 70× |
| Memory card size [a] | 4 GB |
| Number of recorded pixels [a] | 3 000 × 2 000 pixel |
| Illumination of the test scene [a] | 2 000 lx |
| Power supply | Lithium ion battery |
| Measurement method | External (electromagnetic finger) |

[a] Omissible if described in each measured item.

**Table D.2 — Example of report for shooting time lag**

| | |
|---|---|
| Capture mode (e.g. portrait, sports) | Factory setting |
| Shooting distance | 1,32 m |
| Focal length | Wide or 40 mm |
| Focus mode | High speed of mode |
| Different result for first image | No |
| Memory type | XY ultra-fast 70× |
| Memory size | 4 GB |
| Number of recorded pixels | 3 000 × 2 000 pixel |
| Illumination of the test scene | 2 000 lx |
| Measurement method | External |
| Shooting time lag | 0,6 s |

**Table D.3 — Example of report for shutter release time lag**

| | |
|---|---|
| Capture mode (e.g. portrait, sports ) | Factory setting |
| Shooting distance | 1,98 m |
| Focal length | 60 mm |
| Measurement method | Internal |
| Shutter release time lag | 0,015 s or 15 ms |

**Table D.4 — Example of report for start-up time**

| | |
|---|---|
| Capture mode (e.g. portrait, sports) | Factory setting |
| Memory type | Internal memory |
| Memory size | 4 GB |
| Flash | OFF |
| Illumination of the test scene | 2 000 lx |
| Power supply | Lithium ion battery |
| Measurement method | Internal |
| Measurement point | Time until pre-capture can be accepted |
| Start-up time | 1,3 s |

**Table D.5 — Example of report for shooting rate**

| | |
|---|---|
| Capture mode (e.g. portrait, sports) | Sports burst mode |
| Memory type | XY ultra-fast 70× |
| Memory size | 4 GB |
| Number of recorded pixels | 3 000 × 2 000 pixel |
| Quality | JPEG lowest compression |
| Number of images at highest speed | Until card full |
| Illumination of the test scene | 2 000 lx |
| Measurement method | External |
| Shooting rate | 4,4 images per second |

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