Improved Beamwidth Control in Canon Speedlite Flash Units

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ABSTRACT

With the Speedlite 580EX flash unit, Canon introduced an "image size compensation" feature intended to optimize the automatic beamwidth control (the automatic "head zoom" functionality) when the flash units are used with EOS digital SLR cameras having different image sizes. However, an anomaly in the scheme put into effect an insufficient beamwidth for smaller focal length lenses.

In this article, we review the overall matter of beamwidth control, the Canon image size compensation scheme, the anomaly in the initial 580EX and its impact, and how the scheme works, without anomaly, in newer production of the 580EX and in later models. Charts are included to present the tedious details.

An appendix discusses the operation of the beamwidth control system when a Canon Speedlite 580EX II is used on a Canon Powershot SX20 IS compact camera.

THE CANON SPEEDLITE HEAD ZOOM SYSTEM

Introduction

Many Canon Speedlite flash units have been equipped with a "zoom head" that could be set to one of a number of predetermined positions, varying the beamwidth of the illumination. This allows the user to tailor the beamwidth of the flash to the field of view of the camera. Doing so increases the energy efficiency of the flash illumination process (in turn reducing battery drain) and increases the maximum "reach" of the flash. This is because the concentration of a certain overall luminous output of the unit into a narrower beam increases the *luminous intensity-time product*[1], the measure that—for a given camera ISO sensitivity, aperture, and subject reflectance—determines the "reach".

In many of these units, "head zoom position" can be automatically set based on the lens focal length (including the current focal length of a zoom lens).

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[1] I will sometimes, for conciseness, colloquially refer to this measure as the "potency" of the beam.

Zoom positions and their beamwidths

Speedlite flash units having "head zoom" are provided with a fixed repertoire of "head zoom positions", each of which provided a certain beamwidth. These positions are designated in terms of the focal length (in mm) of the lens that would, **on a full-frame 35-mm film camera, or a digital camera with a comparable image size**, give a field of view that was (just) covered by the beamwidth emitted from the flash unit with that head position.

For the Speedlite 550EX, the most advanced unit prior to the introduction of the improved beamwidth control scheme we will discuss shortly, there were seven head positions, designated:

24, 28, 35, 50, 70, 80, and 105 mm

Those positions are said to have been chosen as representative of popular fixed-focal-length lens focal lengths (again, in contemplation of the field of view they would provide on a "full-frame" camera).

This unit also has a supplemental lens (the "wide panel") that can be manually folded to in front of the head (the head proper then moving automatically to the "24 mm" position) to give a beamwidth suitable for use with lenses of focal length down to 17 mm (again, assuming "full-frame" image size).

Automatic beamwidth control

On modern Speedlite flash units, the unit sets the head position automatically, based on the lens focal length as reported to the flash unit from the camera body (which in turn receives it from the lens).[2]

Conceptually, the flash unit rounds the focal length (down, if possible) to the nearest head position value and sets the head to that position. Thus, unless the focal length was in fact lower than the lowest head position designation, the beamwidth that was provided would at least span the field of view of the camera.

On the display panel of the camera, the "focal length designation" of the chosen head position is displayed. But, separating the matter of head setting and focal length display (which distinction will serve us well later in the discussion), we can equally well describe this as, "The reported focal length of the lens, rounded (down, if possible) to the nearest head position designation, is displayed".

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[2] With the exception of the Speedlite 300EZ and 420EX, the user can override that and set the head position manually.

Smaller-image cameras

On a camera with a smaller image (such as an EOS 20D, whose image dimensions in each direction are 1/1.6 those of a "full-frame" camera[3]), a given focal length provides a field of view correspondingly smaller than it would on a full-frame camera. Accordingly, on smaller-image cameras, the beamwidth set by the flash unit on the basis described above is wider than necessary, While this causes no exposure problem (the discrepancy is in the "fail safe" direction), it does deny the user of smaller-image cameras the benefit of greater energy efficiency and greater flash "reach" that would conceptually be available.

Many of us wondered why Canon, when introducing these "smaller-image" digital cameras, didn't just make them report to the flash unit not the actual focal length but the "full-frame 35-mm equivalent focal length", a number that tells us the focal length of a lens that, used on a full-frame camera, would yield the same field of view that the lens yields on the smaller-image camera (for a "1.6x" image size, 1.6 times the actual focal length).

When I asked Canon USA's chief technical information officer, in an online forum, about this, the reply was, essentially. "Well, we just didn't. And of course it fails safe. In fact, on smaller image cameras, the present arrangement gives some extra margin in coverage".

IMAGE SIZE COMPENSATION

The Speedlite 580EX

In August, 2004, Canon introduced the Speedlite 580EX flash unit. When used with an EOS digital SLR camera providing the proper support (firstly the EOS 20D, introduced in September, 2004), this unit provided "image size compensation" for automatic zoom control.

In this scheme, the camera feeds to the flash unit not only the focal length of the lens but as well the image size (sometimes spoken of as *format size* or *sensor size*) of the camera as a choice over the three nominal image sizes offered by Canon in its range of digital SLR cameras: "full-frame" ("1.0x"), "1.3x" (whose image dimensions are 1/1.3 times those of the full-frame size); and "1.6x" (whose image dimensions are 1/1.6 times those of the full-frame size). The flash unit

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[3] This is often spoken of as a "1.6x" image size, since the field of view given by a lens of focal length *f* on such a camera is field of view that would be given, on a camera with a "full-frame 35-mm" image size, by a lens of focal length 1.6*f*. The factor 1.6 can be called the "35-mm full frame equivalent focal length factor". Here, for compactness, we will call it just the "image size factor".

in effect multiplies the lens focal length by the image size factor and uses this as the basis for selecting a head position.

All subsequent EX-series Speedlite flash units with automatically variable beamwidth have provided this feature, which is supported by all EOS-series camera bodies from the 20D onward.

The bug

Shortly after 580EX flash units and 20D bodies came into widespread use, there were disturbing reports that, when lenses of fairly short focal lengths were used, the beamwidth of the flash was not wide enough to illuminate the field of view of the camera. Some users, suspecting that the image size compensation feature was misbehaving, tried disabling it (a provision in the custom functions of the 580EX). They found that now they did have adequate breadth of illumination with these fairly-short focal length lenses. Others, using the 580EX on older "1.6x" cameras (not equipped to transmit image size information to the flash unit), also found no shortfall in beamwidth with such lenses.

Some "reverse engineering" by interested users soon characterized the problem. Of course, we do not know the actual algorithm used by Canon in these flash units. But we can describe the externally-observed behavior in terms of an assumed algorithm.

Before I do so, I need to describe a curious behavior that Canon had adopted for the 580EX. Regardless of the sensor size, the front panel would still display the actual lens focal length [sensible], still rounded (down, if possible) to the nearest value in the list of head position designators [silly]. When I describe what I think the algorithm should have been, it honors that silly practice.

Now, for reference, I will first describe (in a sort of pseudo-code) the algorithm evidently used in flash units (such as the Speedlite 550EX) that do not have the image size compensation feature:

- Input: reported lens focal length, *f*
- Round *f* (down, if possible) to the series 24, 28, 35 etc. to get *f′*
- Display *f′*
- Set the head to position *f′*

This could also be stated this way (more elaborate, but a better template for what is to come):

- Input: reported lens focal length, *f*
- Round *f* (down, if possible) to the series 24, 28, 35 etc. to get *f′*
- Display *f′*
- Round *f* (down, if possible) to the series 24, 28, 35 etc. to get *h′**

- Set the head to position *h′*

  * Note that this step is inherent in the fact that these are the only head positions that can be set.

This is what I felt the algorithm for the 580EX (with image size compensation) should have been:

- Input: focal length, *f*; image size factor, *j (e.g.*, 1.6*)*
- Round *f* (down, if possible) to the series 24, 28, 35 etc. to get *f′*
- Display *f′*
- Multiply *f* by *j* to get *h*
- Round *h* (down, if possible) to the series 24, 28, 35 etc. to get *h′* *
- Set the head to position *h′*

  * Note that this step is inherent in the fact that these are the only head positions that can be set.

However, it seems that the algorithm in the 580EX actually was:

- Input: focal length, *f*; image size factor, *j (e.g.*, 1.6*)*
- Round *f* (down, if possible) to the series 24, 28, 35 etc. to get *f′*
- Display *f′*
- **Multiply *f′* by *j* to get *h***
- Round *h* (down, if possible) to the series 24, 28, 35 etc. to get *h′* *
- Set the head to *h′*

  * Note that this step is inherent in the fact that these are the only head positions that can be set.

The faulty step is shown in bold, with the specific error underlined. That error was in taking the reported focal length, already rounded to a number in "the list", and multiplying that (rather than the unrounded focal length) by the sensor size factor to determine the "ideal" head position. That quantity, of course, was then unavoidably rounded again (to a number in the same list) for setting the head position.

The effect

The most prominent effect of this "bug" is that (for a "1.6x" sensor size camera), regardless of the lens focal length, head positions "24" and "28" are never put into play; the widest beamwidth ever used is that from head position "35".

In terms of the algorithm, this occurs because the largest rounded value of the lens focal length, *f′* (even for very small focal lengths) is 24, the smallest value in the list of head position designations. Multiplying by 1.6 gives 38.4, which dictates a head position of "35".

This means that, for lens focal lengths less than 22 mm (which would, theoretically, be just served on a "1.6x" camera by the beamwidth given by head position "35"), inadequate beamwidth would be provided.

Note that with the proper algorithm, on a "1.6x" camera, lens focal lengths down to 15 mm would be properly served. On such a camera, that focal length is (just) supported by the beamwidth of head position "24", which the proper algorithm would enact for that focal length.

There were other less prominent effects of the erroneous algorithm. Among those was the fact that for several small ranges of reported lens focal length, the "most effective" head position is not chosen (giving a tiny lapse in efficiency).

A BETTER IMPLEMENTATION

The Speedlite 430EX

In August, 2005, Canon introduced the Speedlite 430EX. This was a smaller, lower output flash unit. Soon, there were reports that the 430EX did not exhibit the beamwidth setting anomaly of the 580EX. Further, it was discerned by several users that evidently the 430EX had ten, rather than seven, head positions that could be engaged during automatic head zoom operation with image size compensation in effect. The total repertoire of head positions (designated as discussed above) seemed to be:

24, 28, 35, 40, 50, 60, 70, 80, 90, and 105 mm

The "added" positions are shown underlined.[4]

However, these three added positions are not available when setting the head position manually. Neither are their designations in the list used to round the reported lens focal length for display.

We can characterize the behavior of the 430EX in a pseudo-code algorithm thus:

- Input: focal length, *f*; image size factor, *j (e.g.*, 1.6*)*
- Round *f* (down, if possible) to the 7-member series 24, 28, 35, 50 etc. to get *f′*
- Display *f′*
- Multiply *f* by *j* to get *h*

[4] We don't know their "official" designations, as Canon has never acknowledged their existence.

- Round *h* (down, if possible) to the 10-member series 24, 28, 35, 40, 50 etc. to get *h'* *
- Set the head to position *h'*

  * Note that this step is inherent in the fact that these are the only head positions that can be set.

Newer production 580EX flash units

As data on this anomaly continued to accrete, some users reported that their 580EX flash units did not seem to exhibit the anomaly. Further surveys revealed that, for 580EX units produced after a certain point, the incorrect algorithm was apparently replaced by a correct algorithm (There was no increase in the repertoire of head positions to the ten found in the 430EX.) It seems as though the new algorithm was in place from about serial number 200000 onward (perhaps as of about March, 2005).

Canon's non-reaction

Notwithstanding the introduction of a "corrected" algorithm in later production 580EX units, Canon made no statements about this matter. My inquiries to official Canon USA technical information contacts on this issue were not answered.

Many users around the world with "older" 580EX units contacted their Canon Factory Service Centers to look into having their units "corrected" or replaced. Basically the reactions were:

- "We have received no service bulletins from Canon on this matter"
- "We don't know of any misbehavior of 580EX units"
- "There is no program of recall or modification of the 580EX"
- "Your 580EX tests as working properly"

But persistent users, some armed with "statements of the problem" prepared by this office, gradually persuaded repair technicians in some service centers that there **was** an anomaly in their units. (Sometimes this required demonstrations on the intake counters at the Service Center!) Eventually, in many of Canon's regions, the Service Centers became willing to accept "older" 580EX units and modify them (evidently requiring replacement of one or more circuit boards) to bring them to the newer production configuration (generally on an "under warranty" basis). The US region of Canon was among the last to do so.

To this date, I am unaware of any official statement by Canon regarding this matter.

The nay-sayers

During the period in which the anomaly in the Speedlite 580EX was being "cussed and discussed", there was one camp that said the behavior should not be considered anomalous at all: the behavior was evidently consistent with Canon's intent in this matter.

They based their position on the language in the official Canon manual for the Speedlite 580EX, which says:

> The flash coverage can be set to match the lens focal length from 24mm to 105mm. The flash coverage can be set manually or automatically. Also, with the built in wide panel, the coverage can be expanded to 14 mm wide-angle lenses.[5]

In a later passage, the manual says:

> EOS cameras have one of three image sizes. The lens' effective focal length will differ depending on the camera's image size. The Speedlite automatically recognizes the EOS digital camera's image size and automatically sets the flash coverage for lens focal lengths from 24mm to 105mm.
>
> When the Speedlite is attached to a compatible camera, <🎞> will appear on the Speedlite's LCD panel.

Thus, said these commenters, Canon obviously had in mind that, for example, a 20 mm lens should be served by deploying the wide panel, and their was thus no deficiency in the unit's performance. And indeed that is what the manual language, taken at face value, suggests.

I disagreed with these commenters, believing that Canon actually intended the full potential capability of the image size compensation feature to be in play (but bungled its execution), and that the language in the manual just did not adequately reflect this (perhaps to keep the manual from becoming too complicated in this regard).[6]

Still, perhaps the initial 580EX worked exactly as Canon had (for some reason) intended, and the commenters were right. I doubt it. If the behavior were not a result of an "error", it certainly represented a

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[5] Note that the wide panel in the 580EX gave a wider beam than the wide panel of the 550EX, which supported focal lengths down to 17 mm on a full-frame camera.

[6] We find exactly the same language (except for the number in connection with the wide panel) in the manual for the Speedlite 580EX II, notwithstanding the fact (as we will see shortly) that a Speedlite 580EX II, on a "1.6x" camera, properly supports focal lengths down to 15 mm automatically, without recourse to the wide panel.

peculiar, and questionable, design choice. With a "proper" algorithm, on a "1.6x camera" lens focal lengths down to 15 mm would have been accommodated automatically, without requiring any different design of the actual head mechanism. And, at a focal length of 20 mm, the use of the wide panel (leading to a beamwidth that, on a "1.6x" camera, would have theoretically supported focal lengths down to about 9 mm), would have given substantially-less "potency" to the beam than would be given under what I consider the correct algorithm (about "two stops" less, based on the "guide number" table[7] in the manual).

But, as in all life, it is often hard, judging only by the results, to discriminate between "a bad idea" and "flawed execution".

The 580EX II

In February, 2007, Canon introduced the Speedlite 580EX II flash unit, to supersede the 580EX in the product line. Although this unit has the same basic physical form as the 580EX and offers essentially the same overall performance, it has many valuable new or improved features. In 2008, I acquired a 580EX II and was able to test its behavior with respect to beamwidth control.

I found that:

- The 580EX II uses an appropriate algorithm for choosing head position taking image size into consideration
- The 580EX II, like the 430EX, has ten, rather than seven, available head positions. As in the 430EX, the "added" head positions are not accessible under manual selection of head position, and their designations are not in the list used for rounding reported lens focal length for display.

It appears that in fact the algorithm used by the 580EX II is, for all practical purposes, identical to that used by the 430EX.

Canon has not discussed this aspect of the 580EX II beyond indicating that is offers the "image size compensation" feature.

RESIDUAL GRIPES

There are three aspects of the matter of beamwidth control and related issues in which I believe Canon has not done the best job.

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[7] *Guide number* is a metric for quantifying the "potency" of a flash unit's output on a scale that makes it simple to calculate the proper exposure in a situation without automatic flash exposure control. The guide number doubles for a four-times increase in "potency".

Manual beamwidth control

On all current Speedlite flash units with ten available head positions (that we know of at this writing), the user can still only manually choose head positions from the set of seven originally provided on the 550EX.

Lens focal length display

Even on Speedlite flash units that "correctly" implement image size-aware beamwidth control, the reported lens focal length is displayed as rounded (down if possible) to the nearest value in the series of seven head position designations that goes back to the Speedlite 550EX.

In a unit with only those seven head positions, and without image size compensation (such as the 550EX), this made sense: it told the user what head position had been set.

With image size compensation in effect with a "smaller-image" camera. this makes no sense. For example, suppose that with a "1.6x" camera, the lens has a reported (actual) focal length of 68 mm (a "full-frame 35-mm equivalent focal length" of 106 mm). The flash unit will accordingly select head position "105", which theoretically accommodates the field of view of this camera with lenses having focal lengths of 66 mm or greater. The flash unit panel displays "50 mm". What is the significance to the user of this number?

It would make more sense to display either:

- The actual reported lens focal length, perhaps rounded in some uniform or systematic way, not necessarily always to the nearest mm (in the example above, probably "68 mm"), or
- The minimum lens focal length supported by the head position chosen (in the example above, "66 mm")

The "range" indicator

This is not directly relevant to beamwidth control, but does involve image size compensation.

Most Speedlite flash units have a scale on which is indicated, for:

- the ISO sensitivity of the camera
- the aperture slated for use in the upcoming shot, and
- the lens focal length

the range of subject distances (from the flash unit) for which the unit can reasonably be expected to give the illumination needed for proper flash exposure. Lens focal length gets into the matter because of its implication (in these flash units) on head position, and in turn on beamwidth, and thus on the maximum available "potency"[8] of the flash burst.

On the 580EX II, for any values of ISO sensitivity and aperture, the rounded reported lens focal length is treated only in four "ranges" insofar as it affects the maximum range:

- 14 mm (applies to use of "wide panel")
- 24, 28 mm
- 35, 50 mm
- 70 mm and above (through 105 mm)

This is perhaps understandable, since this indication is only a very rough guide to the actual "range" of the flash unit.

However, it is not the lens focal length that affects the "reach" of the flash unit, but rather the head position (and thus the beamwidth).

But, for any focal length, the 580EX II range display is not affected by the image size of the camera on which the flash is mounted. Thus, when operating on a "smaller-image" camera, the range shown is less than it should be (even under the very broad approach mentioned above).

It would be much more appropriate if the range display were predicated on the head position in effect (still, of course, in the light of ISO sensitivity and aperture).

The instruction manual

For the 580EX II (for example), the passage on using the head zoom feature still misleadingly (without any recognition of the image size compensation feature) instructs that the wide panel should be deployed for lens focal lengths less than 24 mm (as discussed above).

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[8] I use "potency" as a concise colloquialism for the more meaningful but cumbersome "beam luminous intensity-time product".

DISABLEMENT AND DEFAULTS

Manual disablement

On all the Speedlite flash units to date offering image size compensation (430EX, 580EX, 580EX II), the feature may be disabled by a setting of one of the unit's custom functions.

When disablement is selected, the behavior of the unit seems to revert completely to the behavior of the Speedlite 550EX. That is:

- Image size is no longer taken into account when setting the head position; the head position is set to correspond to the (rounded) reported lens focal length directly, as if the camera had a "full-frame" image size [of course].

- Only seven head positions are in play; on the 430EX and 580EX II, the three "added" head positions are never used [curious].

It is not clear what the expected utility of this option was. However, it turned out to be handy in overcoming the "bug" in the head zoom control algorithm in the early-production Speedlite 580EX. With image size compensation disabled, the unit gives adequate coverage of the field of view in the range of focal lengths from 15 mm to 22 mm, which it would not properly cover with the feature enabled.

For focal lengths above 22 mm, having the image size compensation enabled is advantageous from a standpoint of improved energy efficiency and flash "reach" (as intended for the new feature).

Non-cooperating cameras

When Speedlite flash units having the image size compensation feature are mounted to a camera that does not cooperate with that feature (notably, EOS cameras earlier than the 20D), the flash unit reverts to direct selection of head position based on reported focal length.

What about the three "extra" head positions on the 430EX and 580EX II? I'm not sure. My suspicion is that they are taken completely out of play for a non-cooperating camera. (I have no non-cooperating camera here and thus have not been able to test to confirm this.)

At this writing, I do not know the situation with recent "full-frame" cameras such as the EOS 1Ds Mark III. Of course, when the flash unit is mounted to such a camera, there would be no need to actually "compensate" the reckoning of head selection by virtue of image size—the "default" (old) behavior would be optimal. Nevertheless, the camera may advise the flash unit that "I understand the feature, and I am a 'full frame' camera". Would that have any effect on flash unit

behavior? I don't know. Conceivably, it might cause a 430EX or 580EX to employ all ten available head positions (even though not multiplying the reported focal length by any factor before using it for head position selection).

Why would Canon do that? Well, why do they disable those head positions when image size compensation is disabled or not supported? Perhaps they would enable them when the feature is enabled and "supported", even in the degenerate way applicable to a full-frame camera.

LENS FOCAL LENGTH REPORTING

As an aside, it is important to note that the various zoom lenses themselves do not, typically, report their current focal length (as observed, for example, in the focal length reported in the Exif metadata for an image) rounded in any systematic way.

Rather, each lens model reports its focal length rounded to one of an arbitrary list of values. For example, for the Canon EF 24-105 mm f/2.8L IS USM zoom lens, the focal length is always reported as a value in this series (in mm):

24, 28, 32, 35, 40, 45, 47, 50, 55, 58, 60, 65, 67, 70, 73, 75, 80, 82, 84, 85, 88, 90, 92, 93, 95, 96, 97, 98, 99, 100, 105

For the Canon EOS mount Sigma 18-200 mm f/3.5-6.3 DC OS zoom lens, the list is (in mm):

18, 21, 24, 28, 31, 35, 42, 51, 63, 78, 96, 115, 134, 154, 173, 200

Go figure!

Some colleagues have suggested that these rounding algorithms are artifacts of the data encoding in the Exif metadata, and may not reflect the way in which focal length is transmitted to the flash unit. I think not. For one thing, in the Exif metadata, lens focal length is represented as the ratio of two 32-bit unsigned integers, giving a granularity far finer than to the nearest mm over the entire range of focal lengths we are likely to encounter (by about two million times!).

In any case, we only observe the flash unit display of focal length changing at a boundary where the focal length reported in the Exif metadata changes.

BEHAVIOR CHARTS

Attached is a set of four charts summarizing, in graphic form, the four different behaviors discussed in this article. All are predicated on the use of the flash unit on a "1.6x" camera body.

The image of this presentation was suggested by a colleague during the initial "flap" over the image size compensation algorithm in the Speedlite 580EX.

The horizontal scale of the charts is actual lens focal length, as, shown on the top band as reported by the camera to the flash unit. The scale is labeled only at discrete positions: those focal lengths at which something of interest changes, plus the ends of the scale. The numbers in the upper row are the focal lengths at which the display of focal length on the flash unit changes; the numbers in the lower row are the focal lengths at which the head position changes. In some cases, a certain focal length has both these properties, and thus appears in both rows.

The next two bands show the focal length display and the head position as a function of lens focal length.

The bottom band of the chart ("Beam coverage") indicates whether or not the beamwidth of the head positions set by the unit is theoretically "inadequate", "adequate", or "optimal" with respect to the field of view of the camera at the lens focal length of interest. Optimal means that the head position in use, **among the unit's repertoire of head positions**, gives the greatest energy efficiency and flash "reach". For graphic clarity, this band has its own set of focal length labels.

MY CONTEXT

When I undertook the study that led to the first issue of this article, I did not have a 580EX Speedlite flash unit and the 580EX II had not yet been introduced. My initial "reverse engineering" was wholly based on data kindly supplied by colleagues (as is discussed under "Acknowledgements").

As mentioned earlier, I eventually acquired a Speedlite 580EX II flash unit. With it in hand, I was able to generally confirm and refine my earlier conclusions regarding the behavior of that unit.

ON A CANON "COMPACT" CAMERA

The information above pertains to the use of certain Canon Speedlite flash units on Canon EOS-series digital single-lens reflex cameras.

Certain Canon "compact" cameras (for example, the Powershot SX20-IS) have a flash shoe accommodating Canon Speedlite flash

units, in general providing support for, and taking advantage of, most of their features.

Appendix A discusses the matter of beamwidth control for Speedlite 580EX II flash unit on a Powershot SX20 IS camera.

ACKNOWLEDGEMENTS

Great thanks to the many Canon Speedlite users (many of them members of the Digital Photography Review forums) who contributed test results and observations during the investigation of the apparent anomaly in the image size compensation algorithm of the initial production Speedlite 580EX flash units, and who contributed their own insights into its nature and consequences.

Special thanks to:

- John Pane, who first characterized the "inappropriate" 580EX algorithm.
- "Noremac", for reporting on the different behavior of the Speedlite 430EX (including that it actually has ten head positions), and for suggesting the graphic format I have used on the attached charts.
- Marcio Ferrari, who first reported the changed behavior of later-production 580EX units.
- Neil K. Guy, whose definitive online treatise, "Flash Photography with Canon EOS Cameras", was of great assistance in preparing this report, in particular in helping me put the information I have into its proper place in the Speedlite landscape. His paper is available here:

  http://photonotes.org/articles/eos-flash/index.html

Thanks also to Carla Kerr for her perceptive copy editing of this tedious manuscript at Issue 1.

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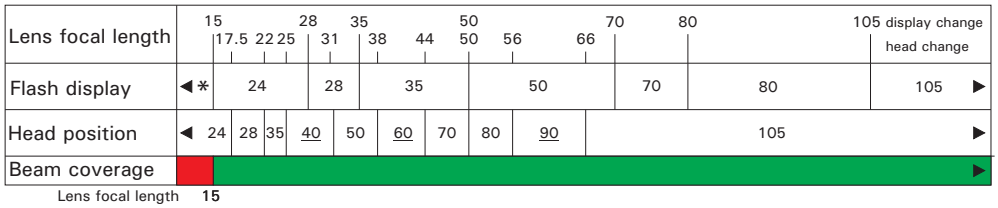
Canon Speedlite flash units
430EX, 550EX, 580EX, 580EX II

Behavior of automatic head zoom (beamwidth) control on a "factor 1.6" sensor size camera with sensor size compensation support (e.g., EOS 20D, 30D, 40D, 350D, 400D)

Behavior W

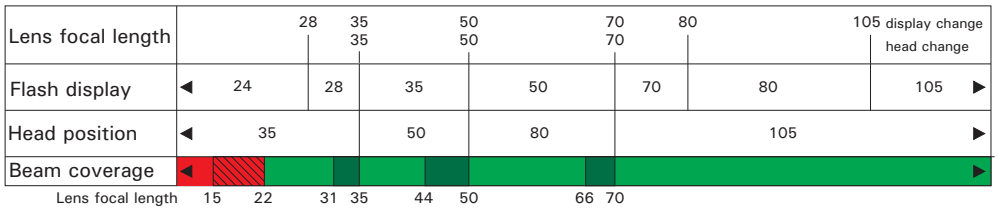
430EX, 580EX II with sensor size compensation active



* Display flashes "24" 40 Head position "name" and bottom of span not authentically known

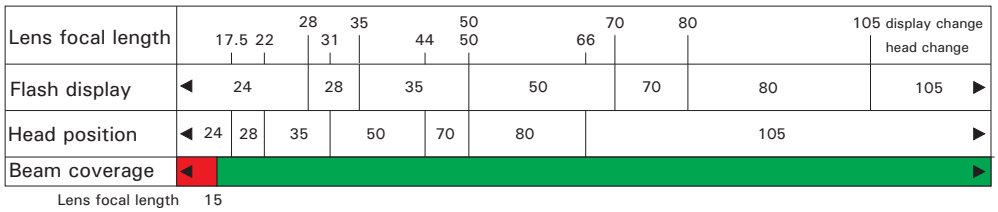
Behavior X

Early production 580EX, with
sensor size compensation active (anomalous behavior)



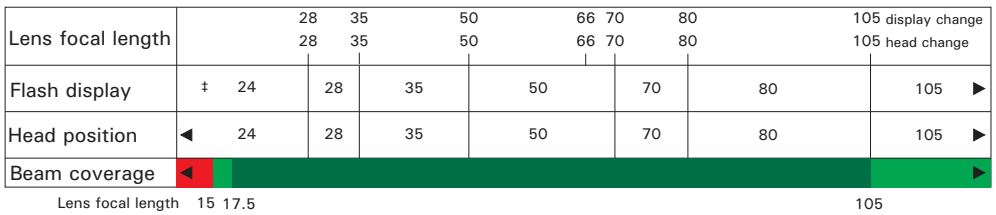
Behavior Y

Later production 580EX, with
sensor size compensation active (corrected behavior)



Behavior Z

550EX; 430EX, 580EX, 580EX II with
sensor size compensation inactive
(including on "factor 1.6" or "factor 1.3" cameras not supporting sensor size compensation)



‡ 430EX: For focal length less than some value, display may flash "24" (specifics not known).

Beam coverage legend

- Theoretically optimal (considering available head positions)
- Theoretically adequate but not optimal (considering available head positions)
- Theoretically inadequate (beyond wide end of range of head positions)
- Theoretically inadequate (due to anomalous sensor size compensation algorithm)

APPENDIX A

Beamwidth control of the Canon Speedlite 580EX II flash unit used on a Canon Powershot SX 20 IS camera

The Canon Powershot SX20 IS camera is a "superzoom compact" camera with a non-interchangeable zoom lens affording a range of focal lengths whose full-frame 35-mm equivalent focal length range is 28-560 mm.

It is provided with a "hot" flash shoe supporting the operation of all Canon EX-series Speedlite flash units. The camera supports and takes advantage of essentially all the advanced features available in those flash units.

Of interest is how beamwidth control operates when a Speedlite 580EX II flash units is used on a Powershot SX20 IS camera.

A round of basic tests suggest the following:

- The camera apparently reports to the flash unit the full-frame 35-mm equivalent focal length of the lens (at its current zoom setting). (Evidently a focal length factor of 5.6 is used for this conversion.)

- The flash unit rounds this down to one of these values: 28, 35, 50, 70, 80, and 105 mm, and adopts the corresponding head position (designated in terms of "full-frame 35-mm focal length field of view").

  The significance is that head positions 40, 60, and 90 mm are never used (nor 24 mm, but that would not be needed for the range of fields of view of this camera).

- The adopted head position is reported on the flash indicator panel. We can also look at this as being the full-frame 35-mm equivalent of the reported focal length, rounded down to the nearest of the seven "primary" head positions.

Note that the display of the head position differs from the operation of these flash units on EOS-series cameras, where the display is of the actual focal length (again, rounded down, if possible, to the nearest of the seven "primary" head positions).

Overall, this behavior seems entirely appropriate (although it might have been nice for the additional head positions to be considered).

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