Lens Tables for Canon Cameras

January 2013

Instruction Conventions

Dark Red Text

Many data column headings and data items are abbreviated by necessity. Dark red text is used in these instructions to fill-in the missing letters or words in an abbreviated data column heading or data item.

Text Position Markers

Data items having a particular position within a data cell are indicated by the position markers "**[FIRST]**", "**[SECOND]**", and "**[THIRD]**".

Text Color Markers

Data items having a particular color in the tables are indicated in these instructions by the color markers "**[BOLD-BLACK]**", "**[BLACK]**", "**[BOLD-DARK RED]**", "**[RED]**", "**[GREEN]**", and "**[BLUE]**".

Text Position Markers

Data items having a particular position within a data cell are indicated by the position markers "**[FIRST]**", "**[SECOND]**", and "**[THIRD]**".

Where text position and color markers are adjacent, they are be combined, e.g., "**[FIRST–RED]**".

Symbol

The symbol "**#**" is used in these instructions to represent an unspecified numerical value.

Special Words

Two special words are used in these instructions:

Product	The word "product" is used to indicate the specific lens, converter, adapter, or extension tube at hand; and
Data Item	The words "data item" are used to indicate the data for the specific product under discussion.

The Files

The Normal POTN Files

The tables as presented in POTN are contained in six Adobe pdf files:

The **1301_Instr.pdf** file (277kb), contains the **Instructions** for the tables and is **REQUIRED** to make sense of any of the tables;

The **1301_Prime.pdf** file (879kb) contains the **Prime Lens Table**;

The **1301_Zoom1.pdf** file (679kb) contains part 1 of the **Zoom Lens Table**;

The **1301_Zoom2.pdf** file (688kb) contains part 2 of the **Zoom Lens Table**;

The **1301_Zoom3.pdf** file (562kb) contains part 3 of the **Zoom Lens Table**; and

The **1301_Other.pdf** file (377kb) contains all the other tables:

The **Tilt/Shift Lens Table**;

The **Selective-Focus Lens Table**;

The Telec**onverters Table**;

The **Extension Tube Table**; and

The **Extension Tube Set Table**.

The Master File

Any POTN member may send me a PM with their email address and request a copy of the master file. They may then format the data anyway they wish, or use it for any purpose they wish. I consider these tables and the data they contain to be in the public domain. There is no copyright.

The **1301_Master.zip** file (12,253kB), the file that is actually sent out, contains the following master files in Microsoft Word 2007 docx format:

The **1301_MInstr.docx** file (278kB) contains the instructions for the tables in raw form, plus data and formulas used for the calculations, formatting, etc.

The **1301_Master.docx** file (6,318kB) contains all seven tables in raw form.

The **1301_Pagentated.docx** file (6,395kB) contains all seven tables in paginated form, ready for printing or display.

The Tables

There are seven tables. Note the abbreviation for each table at the right margin of the title line. These abbreviations are used at the right margin of the title line for each data column in the **Table Data** section to indicate to which table (s) a given data column applies.

Prime Lens Table PR

The **Prime Lens Table** presents the data for prime lenses, excluding tilt/shift and selective focus lenses. Prime lenses are lenses that have a single, invariable focal length.

Tilt/Shift Lens Table TS

The **Tilt/Shift Lens Table** presents the data for tilt/shift and shift lenses, also known as perspective-control lenses. These are special prime lenses that have the capability of precision controlled tilting and/or shifting of the optical axis. These lenses require additional data columns not needed for conventional prime lenses.

Selective-Focus Lens Table SF

The **Selective-Focus Lens Table** presents the data for selective focus lenses, also known as Lensbaby lenses. These are special lenses that offer non-precision tilting and focus control. These lenses require an additional data column not needed for conventional prime lenses.

Zoom Lens Table ZM

The **Zoom Lens Table** presents the data for zoom lenses. Zoom lenses are lenses that have a continuously variable range of focal lengths from a minimum focal length to a maximum focal length. Because of POTN file size constraints, the **Zoom Lens Table** is divided into three parts:

Part 1 contains the data for all zoom lenses whose minimum focal length is less than 28mm;
Part 2 contains the data for all zoom lenses whose minimum focal length is greater than or equal to 28mm and less than 70mm; and
Part 3 contains the data for all zoom lenses whose minimum focal length is greater than or equal to 70mm.

Those obtaining the **1301_Master.zip** file may, of course, have a one-piece **Zoom Lenses** table

Teleconverter Table TC

The **Teleconverter Table** presents the data for teleconverters. Teleconverters are auxiliary lenses that go between the primary lens and the camera to increase the overall effective focal length.

Also included in this table is the **Canon Life-Size Converter EF**, an auxiliary lens for use with the Canon **EF 50mm f.2.5 Compact Macro** lens.

Extension Tube Table ET

The **Extension Tube Table** presents the data for extension tubes sold individually. Extension tubes are auxiliary devices that go between the lens and the camera to increase the maximum magnification.

Also included in this table is the Canon **Mount Adapter EF-EOS M** EF to EOS-M adapter, which allows lenses for normal Canon DSLR cameras to be used with the Canon EOS-M camera.

Extension Tube Set Table ES

The **Extension Tube Set Table** presents the data for extension tubes sold in sets.

Table Sorting

The **Prime Lens Table, Tilt/Shift Lens Table**, and **Selective-Focus Lens Table** are sorted by the following criteria, in order:

The **FOCAL LENGTH**, from shortest to longest;
The **MAXIMUM APERTURE**, from largest to smallest;
The **MANUFACTURER**, in alphabetical order; and
The **PRODUCT RELEASE**, from latest to earliest.

The **Zoom Lens Table** is sorted by the following criteria, in order;

The **MINIMUM FOCAL LENGTH**, from shortest to longest;
The **MAXIMUM FOCAL LENGTH**, from shortest to longest;
The **MAXIMUM APERTURE** at the **MINIMUM FOCAL LENGTH**, from largest to smallest;
The **MAXIMUM APERTURE** at the **MAXIMUM FOCAL LENGTH**, from largest to smallest;
The **MANUFACTURER,** in alphabetical order; and
The **PRODUCT RELEASE**, from latest to earliest.

The **Teleconverter Table** is sorted by the following criteria, in order:

The **TELECONVERTER POWER**, from lowest to highest;
The **MANUFACTURER**, in alphabetical order; and
The **PRODUCT RELEASE**, from latest to earliest.

The **Extension Tube Table** and **Extension Tube Set Table** are sorted by the following criteria, in order:

The **OPTICAL LENGTH**, from shortest to longest;
The **MANUFACTURER**, in alphabetical order; and
The **PRODUCT RELEASE**, from latest to earliest.

Table Conventions

The following conventions are used in the tables:

Pale Green Data Cells

The data for products designed for use with the Canon EOS-M camera is presented in rows of pale green data cells. This serves to set these products apart from those designed for use with all other cameras.

There are currently only three products designed for use with the Canon EOS-M camera: the Canon EF-M 22mm f/2 STM prime lens; the Canon EF-M 18-55mm f/3.5-5.6 IS STM zoom lens; and the Canon Mount Adapter EF-EOS M.

Pale Blue Data Cells

The data for products designed for use only with APS-C digital cameras is presented in rows of pale blue data cells. This serves to set these products apart from those designed for use with all other cameras. Mounting one of these lenses on a camera with a full-frame or APS-H sensor will result in severe vignetting.

WARNING: Canon EF-S lenses are designed to mount on Canon APS-C cameras released in September 2003 or later. EF-S lenses will not mount properly on a full-frame or APS-H camera, nor on an APS-C camera released before September 2003 (specifically, an EOS 10D, EOS D60, EOS D30, EOS D2000, or EOS DCS 3 camera). To attempt to mount an EF-S lens on one of these cameras may damage the lens mount, the camera mount, and/or the camera's reflex mirror assembly.

White Data Cells

The data for products designed for use with all Canon film and digital cameras, except the EOS-M camera, is presented in rows of white (uncolored) data cells.

Black Text

Black text **[BLACK]** is used for all manufacturer-provided data items.

Red Text

Red text **[RED]** is used for calculated data items. Calculated data items are derived from manufacturer-provided data items.

WARNING: When using calculated data, beware of false accuracy! Data is ***never*** more accurate than that provided by the manufacturer.

Tricolor Data Cells

Tricolor data cells (three text colors in one data cell) are used for calculated data items, where the **[FIRST–RED]** data item is for use with a full-frame sensor, the **[SECOND–GREEN]** data item is for use with an APS-H sensor, and the **[THIRD–BLUE]** data item is for use with an APS-C sensor.

WARNING: When using calculated data, beware of false accuracy! Data is ***never*** more accurate than that provided by the manufacturer.

Boxed Text

Boxed text [text in a colored box] is used in the **GRADE | USE**, **NOTES**, **AOV RANGE**, and **FOCUS** data columns to color-code the data. Boxed text always has leading and trailing hard spaces within the box to increase clarity.

Special Abbreviations

Three special abbreviations are used in the table data:

N/A	**Not Applicable:**	This indicates a data item that is not applicable to the product at hand;
N/C	**Not Calculable:**	This indicates a calculated data item that is not calculable with the data provided by the manufacturer for the product at hand; and
N/S	**Not Specified:**	This indicates a data item that is not specified by the manufacturer for the product at hand.

Table Formats

Table Sizes

The tables are formatted for screen display, one page at a time. All pages are landscape U.S. Ledger size, 431.8×279.4mm (17×11 in.), as the smallest standard paper size wide enough for all of the tables. This makes the tables as large as possible on screen when viewed one page at a time.

If desired, the tables may be printed on ISO A3 (420×297mm) or U.S. Ledger (17×11 in.) paper with slight reductions in size to allow for margins.

Due to file-size constraints in POTN, the tables are converted to Adobe pdf format using screen (lowest) resolution. For maximum print quality, I suggest you PM me for a copy of the master tables and print from them. For this reason, a paginated version of the master tables is provided.

Sensor Classifications

EOS-M Sensors

Only products with rows of pale green data cells may be directly used for the Canon EOS-M camera. Note that the EOS-M camera has an APS-C sensor. However, unlike other APS-C cameras, the mount-to-sensor distance is significantly reduced.

To compensate for the reduced mount-to-sensor distance, the Canon Mount Adapter EF-EOS M may be coupled to the EOS-M camera. Products with rows of white or pale blue data cells may then be used with the EOS-M camera fitted with the adapter.

Because the Canon ESO-M camera has an APS-C sensor, the relevant calculated data will be the bottom **[BLUE]** data item in **Tricolor** data cells.

The assumption for calculating EOS-M data in these tables is the 22.3×14.9mm sensor (1.61324× factor) of the Canon EOS-M.

APS-C Sensors

All products with rows of white or pale blue data cells may be used for APS-C digital sensors. The relevant calculated data will be the bottom **[BLUE]** data item in **Tricolor** data cells.

The following are Canon cameras with APS-C sensors:

Camera	Sensor Size	Sensor Factor
EOS 7D	22.3×14.9mm	1.61324× ⬅
EOS 60Da	22.3×14.9mm	1.61324× ⬅
EOS 60D	22.3×14.9mm	1.61324× ⬅
EOS 50D	22.3×14.9mm	1.61324×
EOS 40D	22.2×14.8mm	1.62162×
EOS 30D	22.5×15.0mm	1.60000×
EOS 20Da	22.5×15.0mm	1.60000×
EOS 20D	22.5×15.0mm	1.60000×
EOS 10D	22.7×15.1mm	1.58698×
EOS D60	22.7×15.1mm	1.58698×
EOS D30	22.7×15.1mm	1.58698×
EOS D2000	22.8×15.5mm	1.56935×
EOS DCS 3	20.5×16.4mm	1.64808×

Camera			Sensor Size	Sensor Factor
EOS 650D	**| Rebel T4i**	**| Kiss X6**	22.3×14.9mm	1.61324× ⬅
EOS 600D	**| Rebel T3i**	**| Kiss X5**	22.3×14.9mm	1.61324×
EOS 550D	**| Rebel T2i**	**| Kiss X4**	22.3×14.9mm	1.61324×
EOS 500D	**| Rebel T1i**	**| Kiss X3**	22.3×14.9mm	1.61324×
EOS 450D	**| Digital Rebel XSi**	**| Kiss X2**	22.2×14.8mm	1.62162×
EOS 400D	**| Digital Rebel XTi**	**| Kiss Digital X**	22.2×14.8mm	1.62162×
EOS 350D	**| Digital Rebel XT**	**| Kiss Digital N**	22.2×14.8mm	1.62162×
EOS 300D	**| Digital Rebel**	**| Kiss Digital**	22.7×15.1mm	1.58698×
EOS 1100D	**| Rebel T3**	**| Kiss X50**	22.2×14.7mm	1.62499×
EOS 1000D	**| Digital Rebel XS**	**| Kiss F**	22.2×14.8mm	1.62162×

The assumption for calculating APS-C data in these tables is 22.3×14.9mm, as used by the current EOS 7D, EOS 60D and 60Da, and the EOS 650D | Rebel T4i | Kiss X6 cameras.

WARNING: The EOS 10D, EOS D60, EOS D30, EOS D2000, and EOS DCS 3 cameras, even though they are APS-C cameras, will not accept Canon EF-S lenses.

APS-H Sensors

Products with rows of white data cells may be used for APS-H digital sensors. The relevant calculated data will be the middle **[GREEN]** data item in **Tricolor** data cells.

The following are Canon cameras with APS-H sensors:

Camera	Sensor Size	Sensor Factor		Camera	Sensor Size	Sensor Factor
EOS-1D Mark IV	27.9×18.6mm	1.29032×	⬅	**EOS-1D**	28.7×19.1mm	1.25503×
EOS-1D Mark III	28.1×18.7mm	1.28184×		**EOS D6000**	27.6×18.4mm	1.30435×
EOS-1D Mark II N	28.7×19.1mm	1.25503×		**EOS DCS 1**	27.6×18.4mm	1.30435×
EOS-1D Mark II	28.7×19.1mm	1.25503×				

The assumption for calculating APS-H data in these tables is 27.9×18.6mm, as used by the EOS-1D Mark IV, the last of the APS-H cameras.

Full-Frame Film and Sensors

Products with rows of white data cells may be used for full-frame 35mm film or full-frame digital sensors. The relevant calculated data will be the top **[RED]** data item in **Tricolor** data cells.

The following are Canon cameras with full-frame sensors:

Camera	Sensor Size	Sensor Factor		Camera	Sensor Size	Sensor Factor	
EOS-1DC	36.0×24.0mm	1.00000×					
EOS-1DX	36.0×24.0mm	1.00000×	⬅	**EOS 6D**	35.8×23.9mm	1.00515×	
EOS-1Ds Mark III	36.0×24.0mm	1.00000×		**EOS 5D Mark III**	36.0×24.0mm	1.00000×	⬅
EOS-1Ds Mark II	36.0×24.0mm	1.00000×		**EOS 5D Mark II**	36.0×24.0mm	1.00000×	
EOS-1Ds	35.8×23.8mm	1.00645×		**EOS 5D**	35.8×23.9mm	1.00515×	

The assumption for calculating full-frame data in these tables is 36×24mm, as used by the current EOS-1DX and EOS 5D Mark III cameras.

Data Columns

Each given data column is found in the table(s) whose abbreviation is listed at the right margin.

Focal Length — PR, TS, SF, ZM

The **Focal Length** data column contains the focal length(s) of a lens in millimeters.

Prime Lenses

Prime lenses have a single focal length.

Zoom Lenses

Zoom lenses have two focal lengths, designating the minimum and maximum focal lengths, respectively. The focal length varies continuously from the minimum focal length to the maximum focal length while zooming.

Teleconverter Power — TC

The **Teleconverter Power** data column contains the magnifying power of a teleconverter expressed as a multiplier. The power of a teleconverter is the factor by which a lens' native focal length(s) should be multiplied to obtain the effective focal length(s) of the lens and teleconverter combined.

Optical Length — ET, ES

The **Optical Length** data column contains the optical length of an extension tube in millimeters. The optical length is the length added to the optical path when the extension tube is in use.

Maximum Aperture — PR, TS, SF, ZM

The **Maximum Aperture** data column contains the maximum relative aperture(s) of a lens expressed as f/number(s).

Prime Lenses

Prime lenses have a single maximum relative aperture.

Constant-Aperture Zoom Lenses

Constant-aperture zoom lenses have a single maximum relative aperture. The maximum relative aperture remains constant while zooming.

Variable-Aperture Zoom Lenses

Variable-aperture zoom lenses have two maximum relative apertures. The relative aperture varies from the first maximum relative aperture at the minimum focal length to the second maximum relative aperture at the maximum focal length while zooming.

GRADE | USE

PS, TS, SF, ZM, TC, ET, ES

The **GRADE | USE** data column contains two data items: the **PRODUCT GRADE [FIRST]** and the **PRODUCT USE [SECOND]**.

PRODUCT GRADE

The **PRODUCT GRADE [FIRST]** data item consists of one of five designators indicating the overall product quality, three for Canon products and two for non-Canon products:

PG The **PROFESSIONAL GRADE** designator indicates a Canon professional grade product. Canon professional grade products include:

All Canon "L" (luxury) lenses, usually marked with a red ring;
All Canon "DO" (diffractive optics) lenses, marked with a green ring;
All Canon teleconverters; and
All Canon extension tubes.

SG The **STANDARD GRADE** designator indicates a Canon standard grade product. Canon standard grade products include:

All Canon standard-grade ultrasonic-motor lenses, usually marked with a broken gold ring;
All Canon stepper motor lenses;
All Canon standard-grade DC-motor lenses ;
The Canon Life-Size Converter EF; and
The Canon Mount Adapter EF-EOS M.

CG The **CONSUMER GRADE** designator indicates a Canon consumer grade product. Canon consumer grade products include:

Canon consumer-grade lenses, usually marked with a silver ring.

HG The **HIGH(ER) GRADE** designator indicates a higher grade product for those non-Canon manufacturers having more than one product grade, or a high grade product for those non-Canon manufacturers having only one grade. Non-Canon high(er) grade products include:

All Kenko "PRO 300" or "MC7" products;
All Schneider products;
All Sigma "EX" products;
All Tamron "SP" products;
All Tokina "PRO" products;
All Voigtlander products; and
All Zeiss products.

LG The **LOWER GRADE** designator indicates a non-Canon product of a lower grade for those manufacturers having more than one grade, or a low grade product for those non-Canon manufacturers having only one grade. Non-Canon low(er)-grade products include:

All Bower products;
All DotLine products;
All Kenko non-"PRO 300" and non-"MC7" products;
All Lensbaby products;
All Phoenix products;
All Promaster products;
All Pro-Optic products;
All Quantaray products;
All Rokinon Products;
All Samyang products;
All Sigma non-"EX" products;
All Sunex products;
All Tamron non-"SP" products;
All Tokina non-"PRO" products;
All Vivitar products;
All Zeikos products; and
All Zenit products.

PRODUCT USE

The **PRODUCT USE [SECOND]** data item consists of one of four designators indicating the use for which the product was designed:

EFM The **EF-M** designator indicates a product designed for use with a Canon EOS-M camera. These products may **NOT** be used with 35mm film SLR cameras nor with full-frame, APS-H, or APS-C DSLR cameras.

All **EFM** products are differentiated by pale green data cells and include:

All Canon "EF-M" lenses; and
Canon Mount Adapter EF-EOS M.

APS The **APS-C** designator indicates a product designed for use with APS-C digital sensors. These products may **NOT** be used with 35mm film, nor with full-frame or APS-H digital sensors. Doing so would produce significant vignetting.

All **APS** products are differentiated by pale blue data cells and include:

All Canon "EF-S" lenses (see warning above);
All Promaster "Digital" lenses;
All Quantaray "DC" lenses;
All Sigma "DC" lenses;
All Sunex All lenses;
All Tamron "Di-II" lenses;
All Tokina "DX" lenses; and
Select Vivitar lenses.

DIG The **DIGITAL** designator indicates a product designed for use with full-frame digital sensors. These products may also be used with 35mm film, or APS-H or APS-C digital sensors.

The primary difference between **DIG** and **FLM** products is the presence of multiple anti-reflective coatings on the lens elements of **DIG** products. Digital sensors are much more reflective that film emulsion, and are therefore prone to flare and ghosting. These additional coatings significantly reduce flare and ghosting.

DIG products have white data cells and include:

All Canon "EF" and "TS-E" lenses and "EF" teleconverters released September 2003 or later;
All Kenko "DGX" and "DG" teleconverters and extension tubes;
All Promaster "EDO" lenses and "Digital" teleconverters and extension tubes;
All Sigma "DG" lenses;
All Tamron "Di" lenses and "SP" teleconverters;
All Tokina "D" lenses; and
Select Vivitar lenses and all "MC7" teleconverters.

FLM The **FILM** designator indicates a product designed for use with full-frame 35mm film SLR (single-lens reflex) cameras These products may also be used with full-frame, APS-H, or APS-C DSLR (digital single-lens reflex) cameras.
NOTE: It is known that some manufacturers have upgraded at least some of their film products for digital use without changing their designations. These products should be marked **DIG** instead of **FLM**, but the data necessary to do this is not specified.
FLM products have white data cells and include all products not specified above for **EFM**, **APS**, and **DIG** product uses.

NOTES

PR, TS, SF, ZM, TC

The **NOTES** data column contains none or more color-coded boxed-text designators for special characteristics of the product.

CFE The **CIRCULAR FISHEYE** designator indicates a fisheye lens that has a 180° angle of view (AoV) in each of the diagonal, longer, and shorter optical planes. See further comments in the **ANGLES OF VIEW GROUP** section.

DFE The **DIAGONAL FISHEYE** designator indicates a fisheye lens that has a 180° AoV in the diagonal optical plane, but a less than 180° AoV in at least one of the longer and shorter optical planes. See further comments in the **ANGLES OF VIEW GROUP** section.

UFE The **ULTRAWIDE FISHEYE** designator indicates a fisheye lens that has a less than 180° AoV in each of the diagonal, longer, and shorter optical planes. See further comments in the **ANGLES OF VIEW GROUP** section.

SFE The **SUPER FISHEYE** designator indicates a fisheye lens that has a greater than 180° AoV in each of the diagonal, longer, and shorter optical planes. See further comments in the **ANGLES OF VIEW GROUP** section.

DO The **DIFFRACTIVE OPTICS** designator indicates a Canon "DO" lens with diffractive optics.

MA The **MACRO** designator indicates a true macro lens. See further comments in the **MAXIMUM MAGNIFICATION** data column section.

CD The **CATADIOPTRIC** designator indicates a catadioptric lens, i.e., a lens with both reflective and refractive elements. Catadioptric lenses are often called mirror lenses.

TS The **TILT/SHIFT** designator indicates a tilt/shift lens, i.e., a lens capable of precision controlled tilting and shifting of the optical axis. Tilt/shift lenses are also call perspective-control lenses.

SH The **SHIFT** designator indicates a shift lens, i.e., a lens capable of precision controlled shifting, but not tilting, of the optical axis.

SF The **SELECTIVE FOCUS** designator indicates a selective focus (Lensbaby) lens, i.e., a lens that offers non-precision tilting and focus control.

HSF The **HIGH-SPEED FOCUS** designator indicates a lens with high-speed focusing capabilities, i.e., a lens with an ultrasonic, stepping, or piezoelectric focusing motor. This is in contrast to a lens with a standard or arc-form DC motor, or no focusing motor at all.

High-speed focus lenses include:
Canon "USM" (ultrasonic motor) and "STM" (stepper motor) lenses;
Sigma "HSM" (hypersonic motor) lenses; and
Tamron “PZD” (piezo drive) and “USD” (ultrasonic silent drive) lenses.

IS# The **IMAGE STABILIZATION #** designator indicates a lens that has image stabilization. If there is a numerical designator, the lens offers that many stops of image stabilization. If there is no numerical designator, the lens offers at least two stops of image stabilization.

Image-stabilized lenses include:
Canon “IS” (image stabilization) lenses;
Quantaray “OS” (optical stabilization) lenses.
Sigma “OS” (optical stabilization) lenses;
Tamron “VC” (vibration control) lenses; and

LSC The **LIFE-SIZE CONVERTER** designator indicates the Canon Life-Size Converter EF or the Canon EF 50mm f/2.5 Compact Macro lens compatible with the Life-Size Converter EF. The Canon Life-Size converter EF is effectively an extension tube and a teleconverter combined, and may be used with other lenses to increase both magnification and effective focal length, but no data is provided for such a use.

CTC The **CANON TELECONVERTER** designator indicates a Canon teleconverter or a Canon lens compatible with a Canon teleconverter.

WARNING: Canon teleconverters have front elements that protrude into the rear of mating lenses. Such teleconverters can only be used with compatible lenses. To attempt to use a Canon teleconverter with a non-compatible lens risks damage to the lens' rear element, the teleconverter's front element, or both.

STC The **SIGMA TELECONVERTER** designator indicates a Sigma teleconverter or a Sigma lens compatible with a Sigma teleconverter.

WARNING: Sigma teleconverters have front elements that protrude into the rear of mating lenses. Such teleconverters can only be used with compatible lenses. To attempt to use a Sigma teleconverter with a non-compatible lens risks damage to the lens' rear element, the teleconverter's front element, or both.

ST5 The **SIGMA TELECONVERTER 50-500MM** designator indicates a Sigma 50-500mm lens compatible with a Sigma teleconverter in the range of 100–500mm only.

2TC The **2.0× TELECONVERTER** designator indicates a lens with an included matched 2.0× teleconverter.

TMT The **T-MOUNT** designator indicates a product with a standard T-mount lens mount instead of a Canon lens mount.

MANUFACTURER — PR, TS, SF, ZM, TC, ET, ES

The **MANUFACTURER** data column contains the name(s) of the manufacturer and/or supplier(s) of a product. These tables list products from the following manufacturers and suppliers:

Bower:	supplier;	Promaster:	supplier;	Schneider:	manufacturer;	Vivitar:	supplier;
Canon:	manufacturer;	Pro-Optic:	supplier;	Sigma:	manufacturer;	Voigtlander:	manufacturer;
DotLine:	supplier;	Quantaray:	supplier;	Sunex:	manufacturer;	Zeikos:	supplier;
Kenko:	manufacturer;	Rokinon:	supplier;	Tamron:	manufacturer;	Zeiss:	manufacturer; and
Lensbaby:	manufacturer;	Samyang:	manufacturer;	Tokina:	manufacturer;	Zenit:	manufacturer.
Phoenix:	supplier;						

Multiple Listings

Certain products have multiple manufacturers and/or suppliers listed. This indicates a product that may carry more than one name. Regardless of the number of names under which a given product may be sold, it remains the same identical product.

When known, the manufacturer of the product is **[FIRST]**, followed by the suppliers of the product in alphabetical order. The **DESIGNATION** data column contains the designation of the first-listed manufacturer or supplier.

Canon Products

For Canon products only, the month and year of release, when known, is given below the “Canon” name in the **MANUFACTURER** data column.

Canon for Canon

To make genuine Canon products stick out, the text in the **MANUFACTURER** and Designation data columns is **[BOLD-DARK RED]** instead of **[BOLD-BLACK]**.

DESIGNATION — PR, TS, SF, ZM, TC, ET, ES

The **DESIGNATION** data column contains the manufacturer's or supplier's designation for the product. The designation is usually, but not always, descriptive.

IMAGE — PR, TS, SF, ZM, TC, ET, ES

The **IMAGE** data column contains an image of the product, where available.

PRICE — PR, TS, SF, ZM, TC, ET, ES

The **PRICE** data column indicates the on-line price of a product in U.S. dollars.

A price in bold type indicates the normal (not-on-sale) price advertised on adorama.com, bhphotovideo.com, or kremlinoptics.com as of 1 January 2013 and rounded to the nearest dollar. Prices are for comparison only. Always check online for the current price.

The **Discontinued** designator indicates that a product is discontinued, i.e., is no longer listed in a manufacturer's current catalog.

ZOOM — ZM

The **ZOOM** data column contains two data items: the **ZOOM FACTOR [FIRST]** and the **ZOOM TYPE [SECOND]**.

ZOOM FACTOR

The **ZOOM FACTOR [FIRST]** data item is the amount of zoom, expressed as a power. It is a calculated **[RED]** data item accurate to three significant digits.

ZOOM TYPE

The **ZOOM TYPE [SECOND]** data item is the method by which zooming is achieved. It is a manufacturer-supplied **[BLACK]** data item.

Zooming may be achieved by any of several methods:

Linear Zoom	Zooming is accomplished by sliding a zoom ring in or out. The length of the lens changes while zooming. Linear zoom is also known as push-pull zoom or one-touch zoom.
Rotary Zoom	Zooming is accomplished by rotating a zoom ring. The length of the lens may or may not change while zooming. Rotary zoom is also known as two-touch zoom.
Power Zoom	Zooming is accomplished electronically by motor action. The length of the lens does not change while zooming.

MINIMUM APERTURE — PR, TS, SF, ZM

The **MINIMUM APERTURE** data column contains the minimum relative aperture of a lens, expressed as an f/number. It is a manufacturer-supplied **[BLACK]** data item.

PRIME LENSES

Prime lenses have a single minimum relative aperture.

CONSTANT-APERTURE ZOOM LENSES

Constant-aperture zoom lenses have a single minimum relative aperture for all focal lengths.

VARIABLE-APERTURE ZOOM LENSES

Variable-aperture zoom lenses may have one or two minimum relative aperture(s).

Two minimum relative apertures indicate a lens whose minimum relative aperture varies from the first minimum relative aperture at the minimum focal length to the second minimum relative aperture at the maximum focal length.

A single aperture minimum relative aperture indicates that the manufacturer only provided a single minimum relative aperture, which may apply at either the minimum focal length or the maximum focal length, or both.

APERTURE LOSS — TC

The **APERTURE LOSS** data column contains the aperture loss of a teleconverter, expressed as the number of f-stops lost when the teleconverter is in use.

MINIMUM FOCUS DISTANCE — PR, TS, SF, ZM

The **MINIMUM FOCUS DISTANCE** data column contains the minimum focusing distance of a lens, i.e., the minimum distance at which the lens will focus.

The minimum focus distance is measured from the sensor plane of the camera, usually indicated by a mark " ⊖ " on the top of the camera, and is given in centimeters **[FIRST]**, inches **[SECOND]**, and feet **[THIRD]**. One of the three data items is a manufacturer **[BLACK]** data item, the other two are calculated **[RED]** data items. Calculated centimeters are accurate to the nearest $^{1}/_{10}$ centimeter (nearest millimeter), inches to the nearest $^{1}/_{10}$ inch, and feet to the nearest $^{1}/_{100}$ foot.

NOTE: The location of the sensor plane is.

For lenses with a "macro" switch, the minimum focus distance is given with the macro switch on.

For zoom lenses, the minimum focus distance is normally given at the maximum focal length.

MAXIMUM MAGNIFICATION

PR, TS, SF, ZM

The **MAXIMUM MAGNIFICATION** data column contains the maximum magnification of a lens as a power **[FIRST]** and as a ratio **[SECOND]**. One of these numeric data items is a manufacturer **[BLACK]** data item, the other is a calculated **[RED]** data item accurate to three significant digits.

The maximum magnification is normally taken at the minimum focus distance.

Macro Lenses

For macro lenses, a **Macro** designator is displayed ahead of the magnification power.

The industry classifies macro lenses apart from other lenses. It takes more than a high magnification and/or a close minimum focus distance for a lens to be classed as a macro lens. To be classed as a macro lens, a lens **must** meet the following five criteria:

1: It must be a **prime lens**;
2: It must have a **short minimum focus distance**;
3: It must have a **high magnification** (0.5× or better) at its minimum focus distance;
4: It must have a **long focus ring movement** to allow the very fine focus control required at the shallow depths of field common to macro work; and
5: It must have a **flat field of focus** to properly capture planar macro objects.

Most close-focusing lenses, and all zoom lenses (at least so far) fail criterium 5 above. Failure in this area produces a “focus plane distortion” unique to macro work. This makes them unsuitable for copy and flat-object (stamps, coins, etc.) photography.

Lenses that do not meet all five criteria listed above are close-focusing lenses, not macro lenses. Many, however, may be labeled “Macro” for marketing purposes. Sigma is infamous for this: lots of non-macro Sigma lenses have “Macro” in their designation. That these are not really macro lenses is proven by Sigma itself, where they group true macro lenses separately on their own site.

A lens need not be a macro lens to be used for macro photography. Macro lenses just do it better.

MINIMUM FIELD SIZE — PR, TS, SF, ZM

The **MINIMUM FIELD SIZE** data column contains the minimum field size of the lens, in centimeters. In this digital age, the minimum field size is a better indicator of a lens' ability to capture an image of a small object than is the maximum magnification.

The lens' minimum field size is a **Tricolor** calculated data cell, with the **[FIRST–RED]** data item being for use with a full-frame sensor, the **[SECOND–GREEN]** data item being for use with an APS-H sensor, and the **[THIRD–BLUE]** data item being for use with an APS-C sensor. All calculated data items are accurate to three significant digits.

35MM EQUIVALENT FOCAL LENGTH — PR, TS, SF, ZM

The **35MM EQUIVALENT FOCAL LENGTH** data column contains the 35mm equivalent focal length of a lens, i.e., the focal length that a lens must have to have the same angle of view as this lens would have on a full-frame 35mm film camera.

The lens' equivalent focal length is a **Tricolor** calculated data cell, with the **[FIRST–RED]** data item being for use with a full-frame sensor (hence, the same as the **FOCAL LENGTH** data column), the **[SECOND–GREEN]** data item being for use with an APS-H sensor, and the **[THIRD–BLUE]** data item being for use with an APS-C sensor. All calculated data items are accurate to three significant digits.

ANGLE OF VIEW RANGE

PR, TS, SF, ZM

The **ANGLE OF VIEW RANGE** data column contains the angle of view (AoV) range of a lens, i.e., the AoV group(s) into which a lens falls.

The lens' AoV range is a **Tricolor** calculated data cell with designators instead of colored text, with the **[FIRST]** designator being for use with a full-frame sensor, the **[SECOND]** designator being for use with an APS-H sensor, and the **[THIRD]** designator being for use with an APS-C sensor.

There are two broad lens classifications: **fisheye lenses** and **rectilinear lenses**. These classifications affect how data is calculated and displayed.

Fisheye Lens AoV Ranges

Fisheye lenses are lenses having extremely wide angles of view. Unlike conventional (rectilinear) lenses, a fisheye lens lack distortion compensation and exhibits a distinctive pincushion effect (the fisheye effect) regardless of camera sensor size.

The range of a fisheye lens consists of one, for prime lenses, or two, for zoom lenses, color-coded boxed-text designators indicating the operational AoV range of the lens in completely arbitrary broad terms. There are four such terms, very loosely based upon the classifications used by Canon and Nikon. These four terms are as follows:

CF A **CIRCULAR FISHEYE** lens has an angle of view of 180° in all three optical planes (diagonal, longer, and shorter) when used with a camera having a sensor of a size for which the lens was designed. The image of a circular fisheye lens will be vignetted to a circle centered in the frame and just fitting the sensor in the shorter optical plane.

When used with a camera having a sensor smaller than that for which the lens was designed, the image circle will be larger than the sensor in at least one optical plane, resulting in an angle of view of less than 180° in that plane.

When used with a camera having a sensor larger than that for which the lens was designed, the image circle will be smaller than the sensor in the shorter optical plane.

DF A **DIAGONAL FISHEYE** lens has an angle of view of 180° in the diagonal optical plane and less than 180° in at least one of the longer and shorter optical planes when used with a camera having a sensor of a size for which the lens was designed. The image of a diagonal fisheye lens will fill the frame.

When used with a camera having a sensor smaller than that for which the lens was designed, the angle of view will be less than 180° in all three optical planes.

When used with a camera having a sensor larger than that for which the lens was designed, the image will be vignetted in at least the diagonal optical plane, and will exhibit a greater angle of view in the other optical planes, but not greater than 180°.

UF An **ULTRA-WIDE FISHEYE** lens has an angle of view of less than 180° in all three optical planes when used with a camera having a sensor of a size for which the lens was designed. The image of an ultra-wide fisheye lens will fill the frame.

When used with a camera having a sensor smaller than that for which the lens was designed, the angle of view will be less than the design angle of view in all three optical planes.

When used with a camera having a sensor larger than that for which the lens was designed, the image will be vignetted in at least the diagonal optical plane, and will exhibit a greater angle of view in the other optical planes, but not greater than the design angle of view.

An ultra-wide fisheye lens differs from an ultra wide angle rectilinear lens in that an ultra wide fisheye lens lacks distortion correction, thereby producing the fisheye effect.

SF A **SUPER FISHEYE** lens is a lens that has an angle of view greater than 180° in all three optical planes when used with a camera having a sensor of a size for which the lens was designed. The image of a super fisheye lens will be vignetted to a circle centered in the frame and just fitting the sensor in the shorter optical plane.

When used with a camera having a sensor smaller than that for which the lens was designed, the image circle will be larger than the sensor in at least one optical plane, resulting in a reduced angle of view in that plane.

When used with a camera having a sensor larger than that for which the lens was designed, the image circle will be smaller than the sensor in at least the shorter optical plane.

Rectilinear Lens AoV Ranges

Rectilinear lenses are the normal lenses used for photography. Image distortions are usually minimized in these lenses.

The range of a rectilinear lens is a function of its angle of view, rather than its focal length. This means that range of a lens changes according to the size of the camera sensor with which the lens is used. That is, a lens that is a wide-angle lens when used with a camera having a full-frame sensor may be a normal lens when used with a camera having an APS-C sensor.

Canon presumes a full-frame 24×36mm sensor for all its lens ranges, even for EF-S lenses that cannot be used with such a camera. This makes no sense to me. I therefore have developed my own arbitrary ranges, based (very loosely) upon Canon and Nikon ranges. These ranges are based upon the assumption that a 50mm lens is **THE** assumed normal lens for a full-frame 35mm image, and then doubling or halving the focal lengths accordingly.

The range of a rectilinear lens consists of one, for prime lenses, or two, for zoom lenses, color-coded boxed-text designators indicating the AoV of the lens in completely arbitrary broad classes. There are eight such ranges. These eight ranges are:

UW An **ULTRA-WIDE ANGLE** lens is a rectilinear lens with a diagonal angle of view that is greater than or equal to 100°. In terms of focal length, this equates to:

Full-Frame:	$FL \leq 18mm$
APS-H:	$FL \leq 14.1mm$
APS-C:	$FL \leq 11.25mm$

WA A **WIDE-ANGLE** lens is a rectilinear lens with a diagonal angle of view that is less than 100° and greater than or equal to 63.4°. In terms of focal length, this equates to:

Full-Frame:	$18mm < FL \leq 35mm$
APS-H:	$14.1mm < FL \leq 27.1mm$
APS-C:	$11.25mm < FL \leq 21.7mm$

NO A **NORMAL** lens is a rectilinear lens with a diagonal angle of view that is less than 63.4° and greater than 34.3°. Technically, a normal lens is a lens whose focal length is approximately equal to the diagonal dimension of the sensor/film. In terms of focal length, this equates to:

Full-Frame:	$35mm < FL < 70mm$
APS-H:	$27.1mm < FL < 54.3mm$
APS-C:	$21.7mm < FL < 43.5mm$

MT A **MEDIUM TELEPHOTO** lens is a rectilinear lens with a diagonal angle of view that is less than or equal to 34.3° and greater than 17.6°. In terms of focal length, this equates to:

Full-Frame:	70mm ≤ FL < 140mm
APS-H:	54.3mm ≤ FL < 108mm
APS-C:	43.5mm ≤ FL < 86.6mm

TE A **TELEPHOTO** lens is a rectilinear lens with a diagonal angle of view that is less than or equal to 17.6° and greater than 8.84°. In terms of focal length, this equates to:

Full-Frame:	140mm ≤ FL < 280mm
APS-H:	180mm ≤ FL < 217mm
APS-C:	86.6mm ≤ FL < 173mm

LT A **LONG TELEPHOTO** lens is a rectilinear lens with a diagonal angle of view that is less than or equal to 8.84° and greater than 4.42°. In terms of focal length, this equates to:

Full-Frame:	280mm ≤ FL < 560mm
APS-H:	217mm ≤ FL < 434mm
APS-C:	173mm ≤ FL < 347mm

ST A **SUPER TELEPHOTO** lens is a rectilinear lens with a diagonal angle of view that is less than or equal to 4.42° and greater than 2.24°. In terms of focal length, this equates to:

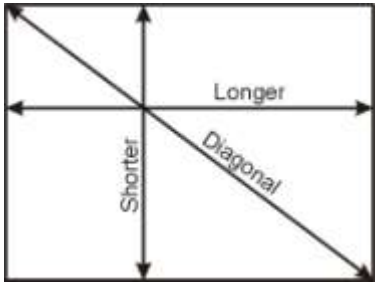
Full-Frame:	560mm ≤ FL < 1100mm
APS-H:	434mm ≤ FL < 858mm
APS-C:	347mm ≤ FL < 686mm

ET An **EXTREME TELEPHOTO** lens is a rectilinear lens with a diagonal angle of view that is less than or equal to 2.24 In terms of focal length, this equates to:

Full-Frame:	1100mm ≤ FL
APS-H:	858mm ≤ FL
APS-C:	686mm ≤ FL

DIAGONAL ANGLE OF VIEW — PR, TS, SF, ZM
LONGER ANGLE OF VIEW — PR, TS, SF, ZM
SHORTER ANGLE OF VIEW — PR, TS, SF, ZM

The **DIAGONAL ANGLE OF VIEW**, **LONGER ANGLE OF VIEW**, and **SHORTER ANGLE OF VIEW** data columns contain the angles of view (AoV) in degrees of a lens in the diagonal, longer, and smaller optical planes, respectively.



The diagonal optical plane is a plane between opposing corners of the sensor. This is the plane used for the manufacturer's published angles of view. Since an image is rarely, if ever, diagonally framed, the longer and shorter angles of view are more relevant to the photographer—but not, perhaps, to the manufacturer's marketing department.

The longer optical plane is a plane parallel to the longer sides of the sensor, and the shorter optical plane is a plane parallel to the shorter sides of the sensor. The longer and shorter optical planes are often called the horizontal and vertical optical planes, respectively, but this presumes the camera is held in a landscape orientation. These tables make no such presumption.

Each data column is a **Tricolor** calculated data cell, with the **[FIRST–RED]** data item being for use with a full-frame sensor, the **[SECOND–GREEN]** data item being for use with an APS-H sensor, and the **[THIRD–BLUE]** data item being for use with an APS-C sensor. All calculated data items are accurate to three significant digits.

Fisheye Lenses

The angles of view of fisheye lenses cannot be calculated normally, and are a function of special designs. At least one angle of view for a fisheye lens is provided by the manufacture, and is given in the tables as a **[BOLD-BLACK]** data item. Angles of view not provided by the manufacturer are calculated geometrically.

Rectilinear Lenses

Rectilinear lenses have angles of view calculated in a conventional manner using the standard formula.

FOCUS

PR, TS, SF, ZM

The **FOCUS** data column contains none to three data items: a **FOCUS METHOD** abbreviation; a **FOCUS DRIVE** designator; and a **FULL-TIME MANUAL FOCUS** abbreviation. Each of these data items depends upon specified manufacturer data, and may be missing if appropriate data was not supplied.

Focus Method

The **FOCUS METHOD** abbreviation, when provided, is a normal **[BLACK]** text abbreviation indicating the focus method used by the lens:

FRE The **FRONT ROTATIONAL EXPANSION** abbreviation indicates a Canon lens in which the front group is rotationally expanded to effect focus. The lens length changes and the front element rotates during focusing. This focusing method is typically used with low-cost lenses.

FLE The **FRONT LINEAR EXPANSION** abbreviation indicates a Canon lenses in which the front group is linearly expanded to effect focus. The lens length changes but the front element does not rotate during focusing.

OLE The **OVERALL LINEAR EXPANSION** abbreviation indicates a Canon lenses in which the overall lens is linearly expanded to effect focus. The lens length changes but the front element does not rotate during focusing.

FF The **FRONT FOCUSING** abbreviation indicates a lens in which the front group is moved to effect focus. The lens length changes and the front element usually rotates during focusing.

IF The **INTERNAL FOCUSING** abbreviation indicates a lens in which an inner group is moved to effect focus. The lens length does not change and the front element does not rotate during focusing,

RF The **REAR FOCUSING** abbreviation indicates a lens in which the rear group is moved to effect focus. The lens length does not change and the front element does not rotate during focusing,

Focus Drive

The **FOCUS DRIVE** designator, when provided, is a colored boxed-text designator indicating the type of autofocus drive incorporated by the lens:

MM The **MICROMOTOR** designator indicates a Canon lens with a basic DC motor for autofocus.

AFD The **ARC-FORM DRIVE** designator indicates a Canon lens with an arc-form DC motor for autofocus. This drive is faster and quieter than Canon's micromotor drive.

DC The **DC MOTOR** designator indicates a non-Canon lens with a basic DC motor for autofocus.

MUSM The **MICRO-TYPE ULTRASONIC MOTOR** designator indicates a Canon lens with a micro-type ultrasonic motor for autofocus. This drive is faster and quieter than Canon's arc-form drive.

RUSM The **RING-TYPE ULTRASONIC MOTOR** designator indicates a Canon lens with a ring-type ultrasonic motor for autofocus. This drive is faster and quieter than Canon's micro-type ultrasonic drive.

HSM The **HYPERSONIC MOTOR** designator indicates a Sigma lens with a hypersonic autofocus motor for autofocus. This is Sigma's version of an ultrasonic drive.

USD The **ULTRASONIC SILENT DRIVE** designator indicates a Tamron lens with an ultrasonic silent drive motor for autofocus. This is Tamron's version of an ultrasonic drive.

STM The **STEPPER MOTOR** designator indicates a Canon lens with a stepper motor for autofocus.

PZD The **PIEZOELECTRIC DRIVE** designator indicates a Tamron lens with a piezoelectric motor for autofocus.

MF The **MANUAL FOCUS** designator indicates a lens without a drive motor than must be manually focused.

Fixed The **FIXED FOCUS** designator indicates a lens that has a fixed, non-adjustable focus.

Full-Time Manual Focus

The **FULL-TIME MANUAL FOCUS** abbreviation, when provided, is a normal **[BLACK]** text abbreviation:

FTMF The **FULL-TIME MANUAL FOCUS** abbreviation indicates a lens that can be manually focused while in autofocus mode.

CONSTRUCTION — PR, TS, SF, ZM, TC

The **CONSTRUCTION** data column contains three or two data items: the number of elements **[FIRST]** and number of groups **[SECOND]**, and the number and shape of diaphragm blades **[THIRD]** in the product. Lenses have all three data items, teleconverters only the first two.

 # E The **# ELEMENTS [FIRST]** data item indicates the number of elements in the product.

 # G The **# GROUPS [SECOND]** data item indicates the number of groups into which those elements are grouped.

 # B The **# BLADES [THIRD]** data item indicates the number of blades making up the diaphragm.

 # BC The **# BLADES, CIRCULAR APERTURE [THIRD]** data item indicates the number of blades making up the diaphragm, with the blades shaped to produce a circular aperture. Shaping the diaphragm blade so as to produce a circular or nearly circular aperture provides a significant increase in the quality of the lens' bokeh.

FX B The **FIXED BLADELESS [THIRD]** data item indicates the diaphragm has a fixed, non-adjustable aperture, usually a single non-removable disk. Fixed bladeless diaphragms usually provide a circular aperture.

DK B The **DISKS BLADELESS [THIRD]** data item indicates the lens uses interchangeable aperture disks as the diaphragm. Interchangeable aperture disks usually provide a circular aperture.

TILT — TS, SF

The **TILT** data column indicates the amount a tilt/shift or selective focus lens may tilt the optical axis, in degrees.

SHIFT — TS

The **SHIFT** data column indicates the amount a tilt/shift or shift lens may shift the optical axis, in millimeters.

ROTATE — TS

The **ROTATE** data column indicates the amount a tilt/shift or shift lens may be rotated about the optical axis, in degrees.

FILTER — PR, TS, ZM

The **FILTER** data column indicates the diameter of the filter, in millimeters, and any special characteristics of the filter.

#MM The **#MM** data item indicates the diameter of a front-mounted screw-in filter in millimeters.

#MM R The **#MM REAR** data item indicates the diameter of a rear-mounted screw-in filter in millimeters.

#MM DI The **#MM DROP-IN** data item indicates the diameter of a rear-mounted drop-in filter in millimeters.

RG The **REAR GELATIN** data item indicates a rear-mounted gelatin filter.

DIAMETER — PR, TS, SF, ZM, TC, ET, EC

The **DIAMETER** data column contains two data items, the overall diameter of a product in millimeters **[FIRST]** and inches **[SECOND]**, excluding any hood (unless integral), tripod mount, and/or knobs. One data item **[BLACK]** is provided by the manufacturer, and the other **[RED]** is calculated. Calculated millimeter data items are accurate to the nearest $^{1}/_{10}$ millimeter, and inch data items to the nearest $^{1}/_{100}$ inch.

LENGTH — PR, TS, SF, ZM, TC, ET, EC

The **LENGTH** data column contains two data items, the overall unextended length of a product in millimeters **[FIRST]** and inches **[SECOND]**, measured from the mounting plane and excluding any hood (unless integral). One data item **[BLACK]** is provided by the manufacturer, and the other **[RED]** is calculated. Calculated millimeter data items are accurate to the nearest $^{1}/_{10}$ millimeter, and inch data items to the nearest $^{1}/_{100}$ inch.

WEIGHT — PR, TS, SF, ZM, TC, ET, EC

The **WEIGHT** data column contains three data items, the overall weight (mass) of a product in grams **[FIRST]**, ounces **[SECOND]**, and pounds **[THIRD]**, excluding any hood (unless integral) and/or tripod mount. One data item **[BLACK]** is provided by the manufacturer, and the other two **[RED]** are calculated. Calculated grams are accurate to the nearest gram, ounces to the nearest $^{1}/_{100}$ ounce, and pounds to the nearest $^{1}/_{1000}$ pound.

HOOD — PR, TS, SF, ZM

The **HOOD** data column contains the manufacturer's designation for a hood for the lens, where known, along with one of three qualifiers:

INTEGRAL The hood is integral to the lens, i.e., built-in.

INCLUDED The hood is included with the lens.

OPTIONAL The hood is not included with the lens, and must be purchased separately.