

American National Standard

ANSI/ISO IT10.7000-2004

for Photography –

*Digital Still Cameras –
Guidelines for Reporting
Pixel-Related Specifications*



ANSI/I3A IT10.7000-2004

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for Photography—

**Digital Still Cameras –
Guidelines for Reporting
Pixel-Related Specifications**

Secretariat

International Imaging Industry Association

Approved June 24, 2004

American National Standards Institute, Inc.

American National Standard

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Published by

**American National Standards Institute, Inc.
25 West 43rd Street, New York, NY 10036**

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Printed in the United States of America

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Foreword (This foreword is not part of American National Standard ANSI/I3A IT10.7000-2004.)

This standard has been developed in order to meet the industry need for a standardized method of reporting the pixel-related specifications (e.g., the "number of pixels") for digital still cameras (DSCs). Without an ANSI standard, several different methods will continue to be used by various camera vendors, causing significant user confusion. In July 2001, the Japan Camera Industries Association (JCIA) in Japan adopted a "Guideline for Noting Digital Camera specifications in Catalogs", which provides standardized pixel-related definitions for DSCs. In July 2002, JCIA was dissolved and the Camera and Imaging Products Association (CIPA) was formed. CIPA now has responsibility for the JCIA guideline. I3A/IT10 and CIPA have cooperated in the development of this complementary standard for the USA.

The pixel-related specifications defined in this standard are not a ranking of the image quality of the DSC. For example, it is possible that a first DSC with a smaller reported value will provide better image quality than a second DSC having a larger reported value. ISO TC42 - Photography has developed a number of standards for measuring image quality related attributes of a DSC. These include ISO 12232:1998, *Photography - Electronic still picture cameras - Determination of ISO speed*; ISO 12233:2000, *Photography - Electronic still picture cameras - Resolution measurements*; ISO 14524:1999, *Photography - Electronic still picture camera - Methods for measuring opto-electronic conversion functions (OECFs)*; and ISO 15739:2003, *Photography - Electronic still picture imaging - Noise measurements*.

It is possible that an ISO standard specifying guidelines for reporting pixel-related specifications for DSCs will be developed in the future. Once such an ISO standard is published, it is anticipated that this standard will be withdrawn.

Annexes A and B of this standard are for information only.

Suggestions for the improvement of this standard will be welcome. They should be forwarded to the International Imaging Industry Association, Inc. (I3A), 550 Mamaroneck Avenue, Suite 310, Harrison, NY 10528, e-mail: i3astds@i3a.org.

This standard was processed and approved for submittal to ANSI by I3A Technical Committee IT10, Electronic Still Picture Imaging. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this edition of the standard, the IT10 Committee had the following members:

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American National Standard
for Photography—

Digital Still Cameras — Guidelines for Reporting Pixel-Related Specifications

1 Scope

This standard specifies guidelines for reporting pixel-related specifications (e.g., the number of camera pixels) of a digital still camera, for the purposes of camera labeling, camera packaging, advertising, and the like. It is applicable to monochrome and color digital still cameras using one or more image sensors

2 Normative references

The following standard contains provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

ISO 12231:1998 *Photography – Electronic still picture imaging – Terminology*

3 Terms and definitions

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

3.1

digital still camera (DSC)

A device that incorporates an image sensor and produces a digital signal representing a still picture.

NOTE: A digital camera is typically a portable, hand-held device. The digital signal is usually recorded on a digital storage media, such as a solid-state memory card or magnetic disk.

3.2

effective pixels

The number of photoelements included in an area equal to the picture area plus the ring pixel area, as defined in this standard.

NOTE: The definition of effective pixels is based on the definition of the "Number of Effective Pixels" in the JCIA *Guideline for Noting Digital Camera Specifications in Catalogs*.

3.3

35mm-equivalent focal length

The measured focal length of a DSC camera lens multiplied by a normalization factor, as defined in this standard.

NOTE: The normalization factor is equal to the ratio of the focal plane diagonal distance used for 35mm film photography and the focal plane diagonal distance of the image sensor used in the DSC.

3.4

focal plane size

The horizontal and vertical distances of the focal plane of an image sensor that receives illumination from a portion of the scene that is represented in the image file provided by a DSC, as defined in this standard.

3.5

image compression

A process that alters the way digital image data are encoded in order to reduce the size of an image file.

3.6

image data compression ratio

The ratio of the size of the compressed image data to the size of the image data that was input to the image compression process, as defined in this standard.

3.7

image file size

The amount of data that comprises one image frame stored in the digital storage media of a DSC, as defined in this standard.

3.8

imager size

The classification of the focal plane size of an image sensor, as defined in this standard.

3.9

number of output pixels

The number of horizontal and vertical luminance pixels comprising one picture frame, which is output by the DSC via a cable or wireless connection, as defined in this standard.

3.10

number of recorded pixels

The number of horizontal and vertical luminance pixels comprising one picture frame stored on the digital recording media of a DSC, as defined in this standard.

3.11

picture area

The number of photoelements on the image sensor which receive illumination from the scene through the camera's optical lens, and which represent a portion of the scene which is represented in the image file provided by the DSC.

3.12

pixel

The contraction of picture element, smallest geometric unit of information in a digital representation of an image, corresponding to a single spatial sample.

NOTE 1: For a single-channel (e.g. monochrome) image, a pixel value can be represented as a single digital code value.

NOTE 2: The number of pixels in a digital image can be arbitrarily increased or decreased as a result of resampling.

NOTE 3: It is common to also use the term pixel to mean a photoelement on an image sensor, a display element on an image display, or a printed element on a hardcopy print.

3.13

resolution

The measure of the ability of a digital image capture system, or a component of a digital image capture system, to depict spatial picture detail.

3.14

sensor cell pitch

The horizontal and vertical spacing of photoelements on an image sensor.

NOTE: For an image sensor that provides "square pixels", the sensor cell pitch is equal in the horizontal and vertical dimensions.

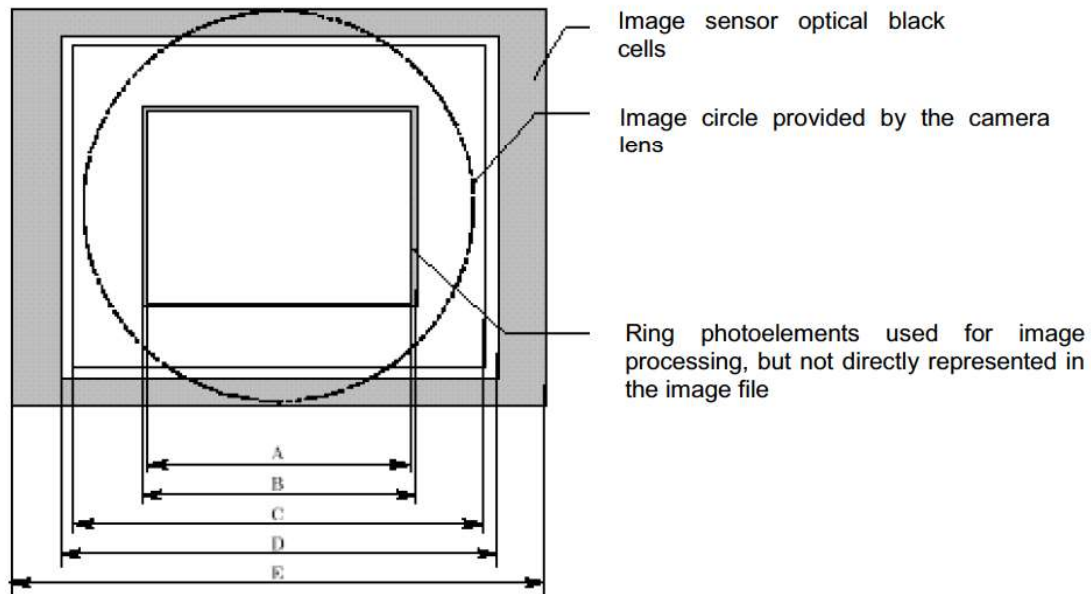
3.15

total number of image sensor cells

The number of cells in the image sensor array, including all effective image sensor cells and all optical black cells, as defined in this standard.

4 Relationship between pixel-related terms for image sensors and DSCs

Figure 1 shows an example of the relationships between pixel-related terms for image sensors. In many DSCs, the image circle provided by the camera lens completely encircles area C, and illuminates all of the usable image sensor cells. However, in this particular example, the camera lens provides an image circle that does not illuminate all of the image sensor cells in area C. As a result, the number of effective pixels in area B is significantly smaller than the number of image sensor cells in area C.



A: Picture area - Photoelements which capture a portion of the scene included in the image file.

B: Number of effective pixels (including ring photoelements) used to produce the image file

C: Maximum usable sensor cells (Maximum number of photoelements guaranteed by image sensor vendor)

D: Effective image sensor cells (Number of photoelements on the image sensor)

E: Total number of image sensor cells (Number of photoelements plus optical black cells on image sensor)

Figure 1 — Relationships of pixel-related terms for image sensors

Figure 2 shows an example of the relationship between pixel-related terms for DSC cameras. The DSC stores an image file that represents an image corresponding to the picture area of the image sensor. The number of effective pixels is equal to the picture area plus the number of ring pixels. The total number of image sensor cells is larger than the number of effective pixels, since some of the cells are opaque, or are outside the ring pixel area. The number of recorded pixels may be significantly larger or smaller than the picture area value, if the DSC performs interpolation or decimation prior to recording. The number of output pixels provided by the DSC may be significantly larger or smaller than the number of recorded pixels, if the

DSC system performs interpolation or decimation when playing back the stored image file. This playback processing may be provided by the DSC itself or by a separate device, such as a host computer.

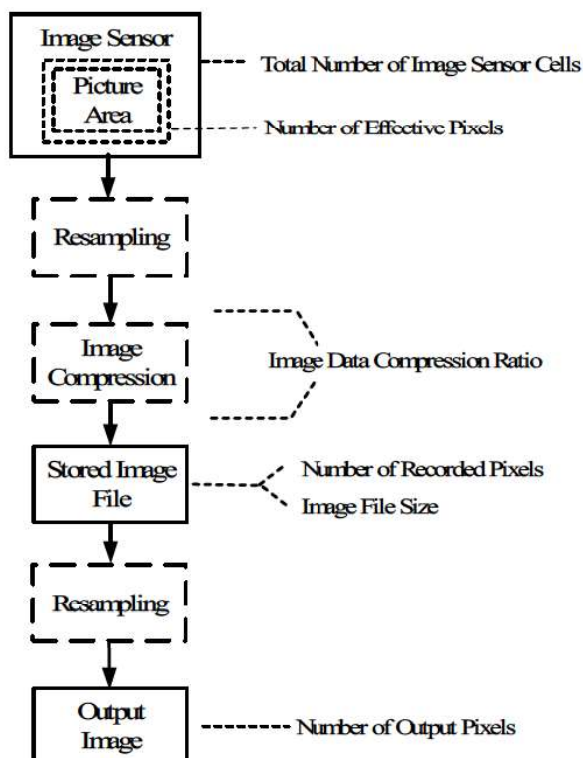


Figure 2 — Relationship of pixel-related terms for image sensors and DSCs

5 Rules for reporting

When reporting any pixel-related specifications for DSCs, the number of effective pixels shall be reported using the highest priority notation. All other pixel-related specifications defined in this standard are optional, and do not need to be reported.

Using the highest priority notation means that the value is reported using the largest font and most prominent placement in labeling or advertising. When multiple pixel-related specifications are reported, careful consideration should be used to ensure that the other reported values, such as the number of total image sensor cells, or the number of recorded pixels, cannot be confused with the number of effective pixels.

5.1 Number of effective pixels

The number of effective pixels is the number of physical photoelements in the picture area, plus the number of ring pixels. The number of ring pixels is the reasonable, minimum number of pixels surrounding the image area that are necessary for the DSC's filtering processes. The number of effective pixels shall not include optical black pixels, or pixels used for vibration compensation. The value of the number of effective pixels is reported in Megapixels (M pixels), where 1 Megapixel equals 1,000,000 pixels. The value can be rounded off to two significant digits.

Reporting the number of ring pixels is optional.

NOTE 1: The number of effective pixels is not a ranking of the image quality of the DSC. For example, it is possible that a first DSC with a smaller number of effective pixels will provide better image quality than a second DSC having a larger number of effective pixels.

NOTE 2: The number of effective pixels is equal to the "Number of Effective pixels" defined in the *JCIA Guideline for Noting DSC Specifications on Catalogs*.

NOTE 3: The term "resolution" should not be used to describe the number of effective pixels.

NOTE 4: The application of this standard to DSCs using multiple image sensors, multi-layered images sensors, and image sensors with different size pixels is still under study.

For DSCs that use an image sensor (such as a linear sensor) that captures an image by moving the sensor or camera lens to different spatial positions as the image is read out, the number of effective pixels is equal to the sum of the values at each spatial position. For such DSCs, the number of effective pixels shall be reported with a note indicating that the value is the "total number of effective pixels provided by scanning".

EXAMPLE Suitable notations:

Single sensor DSC:

Number of Effective Pixels = 3.4 M pixels, or

3.4 M effective pixels

Scanning linear sensor DSC:

Number of Effective Pixels = 8.4 Megapixels (total picture area provided by scanning)

5.2 Total number of image sensor cells

The total number of image sensor cells is the number of cells in the image sensor array, including all effective image sensor photoelements and all optical black cells. This term shall only be used for explanations of the image sensor used in a DSC. The picture area defined in this standard shall be used when specifications of the DSC are reported.

Terms representing the opto-electronic conversion element(s) used in the DSC, such as "image sensor", "solid-state photo sensor" "CCD", or "CMOS sensor", shall be used when the total number of image sensor cells is reported, in order to avoid confusion. The term "resolution" shall not be used to describe the total number of image sensor cells. The value shall be reported in M (1,000,000) cells and can be rounded off to two significant digits.

EXAMPLE Suitable notations:

Single sensor DSC:

Image sensor: 2.0 M total cells

5.3 Number of Recorded Pixels

The number of recorded pixels is the number of horizontal and vertical luminance pixels comprising one picture frame stored on the digital recording media of a DSC. A notation using the order of horizontal number of luminance pixels followed by vertical number of luminance pixels is recommended, unless the DSC makes no distinction between horizontal and vertical image dimensions. The values can be rounded off to two significant digits. To avoid confusion, the "number of recorded pixels", or other wording that has the same meaning, shall be used when reporting these values. The term "resolution" shall not be used to describe the number of recorded pixels.

An additional notation describing the image format, either using a symbolic description such as RGB or YCbCr, or using words such as "YC System", "line sequential system", or "color difference system", is recommended.

A notation such as "monochrome signal", to indicate lack of a color signal, shall be included when no color signal is recorded by the DSC. Further notation of the composition ratio of the color signal, such as "4:4:4", "4:2:2", or "4:1:1", is recommended.

NOTE 1: The notation 4:4:4 indicates an equal number of Y, Cb, and Cr samples. The notation 4:2:2 indicates that there are twice as many horizontal Y samples as Cb or Cr samples, and equal number of vertical Y, Cb, and Cr samples. The notion 4:1:1 indicates that there are twice as many Y samples as Cb or Cr samples in both the horizontal and vertical directions.

NOTE 2: For DSCs that use resampling (e.g., interpolation or decimation) prior to image recording to increase (or decrease) the image size, the number of recorded pixels will be different than the picture area value.

EXAMPLE Suitable notations:

Number of Recorded Pixels: 1,280 x 960 (1.2M), Image format: YCbCr 4:2:2

Number of Recorded Pixels: 640 x 480 (RGB 4:4:4)

5.4 Number of Output Pixels

The number of output pixels is the number of horizontal and vertical luminance pixels comprising one picture frame that is output by the DSC, via a cable or wireless connection. A notation using the order of horizontal number of luminance pixels followed by vertical number of luminance pixels is recommended, unless the DSC makes no distinction between horizontal and vertical image dimensions. The values can be rounded off to two significant digits. To avoid confusion, the "number of output pixels", "number of pixels communicated", or the "number of transmitted pixels" or other wording which has the same meaning, shall be used when reporting these values. The term "resolution" shall not be used to describe the number of output pixels.

Additional notation of the image format is recommended, but when the image format is described as part of the "number of recorded pixels", this additional notation is unnecessary. Further notation of the composition

ratio of the color signal, such as “4:4:4” or “4:2:2”, is recommended, but when the composition ratio of the color signal is described as part of the “number of recorded pixels”, this additional notation is unnecessary.

NOTE: For DSCs that use interpolation or decimation after image recording to change the image array size, the number of output pixels can be different than the number of recorded pixels.

EXAMPLE Suitable notations:

Number of Transmitted Pixels: 1,280 x 960 (1.2M)

Number of Output Pixels: 640 x 480 (RGB 4:4:4)

5.5 Image File Size

The image file size is the amount of data used to store one image frame in the digital storage media. The image file size value is the amount of data in bytes (B), kilobytes (kB) or megabytes (MB) comprising one image frame, including the image header and any other data contained in the image file. The numerical value can be rounded off to two significant digits. To avoid confusion, the term “image file size”, or similar wording which has the same meaning, should be used. The term “resolution” shall not be used to describe the image file size.

If the DSC uses scene-dependent (e.g. variable) compression to produce image files that vary in size as a result of the scene content, a notation that the DSC produces variable size files should be added. In such cases, it is recommended that the normal range of file sizes for one frame image be reported.

EXAMPLE Suitable notations:

Image File Size: 400kB / frame

Image File Size: Approximately 300-600 kB (Variable file size)

NOTE: One kilobyte equals 1024 bytes and one megabyte equals 1024 kilobytes.

5.6 Image Data Compression Ratio

The image data compression ratio is the ratio of the size of the compressed image data to the size of the image data that was input to the image compression process. It is recommended that the value be reported using a fraction with a numerator of 1. In this case, all numeric values can be rounded off to eliminate the decimal point. To avoid confusion, the term “image data compression ratio”, or similar wording which has the same meaning, should be used. The term “resolution” shall not be used to describe the image file size.

If the DSC uses scene-dependent (e.g. variable) compression to provide an image data compression ratio that varies with scene content, a notation that the DSC produces a variable compression ratio should be included along with the average compression ratio.

EXAMPLE Suitable notations:

Image Data Compression Ratio: 1/10

Image Data Compression Ratio: 1/15 Average (varies with scenes)

When the image data compression ratio is reported, either the composition of the input image data to be compressed, or the "image file size", should be reported.

The image data compression ratio shall not be used to indicate image quality in a comparison between cameras, but can be used to distinguish between modes in the same camera.

5.7 Sensor Cell Pitch

The sensor cell pitch is the horizontal and vertical spacing between adjacent photoelements on an image sensor. If the image sensor provides "square pixels", the sensor cell pitch is equal in the horizontal and vertical dimensions, and only one dimension needs to be reported. If the image sensor photoelements are not arranged using a rectangular grid, the type of arrangement (e.g., honeycomb, equilateral triangle) shall also be reported.

The values should be reported in microns and rounded to one decimal place.

NOTE 1: The sensor cell pitch is not a ranking of the image quality of the DSC. For example, it is possible that a first DSC with a smaller sensor cell pitch will provide better image quality than a second DSC having a larger sensor cell pitch.

NOTE 2: The photosensitive area of the cell can be much smaller than the photoelement cell size, for some types of image sensors.

EXAMPLE Suitable notations:

Sensor cell pitch = 3.6 microns

CCD cell pitch = 4.0 x 4.2 microns

5.8 Focal Plane Size

The focal plane size is the physical size of the focal plane area of the image sensor that corresponds to the picture area (area A in Figure 1) or alternatively that corresponds to the number of effective pixels (area B in Figure 1). It is equal to the photoelement cell size times the number of horizontal and vertical pixels included in the picture area, or alternatively in the area corresponding to the number of effective pixels.

The values should be reported in millimeters, and should be rounded to two decimal places. The report shall state whether the focal plane size corresponds to the picture area (e.g., including ring pixels) or the number of effective pixels (e.g., including ring pixels).

For example, if the photoelement cell size is 3.6 microns and the picture area corresponds to 960 x 1280 pixels, the focal plane size of the picture area is 3.46 mm x 4.61 mm. If there are 16 total rows and 16 total columns of ring pixels, the focal plane size corresponding to the number of effective pixels is 3.50 mm x 4.67 mm.

EXAMPLE Suitable notations:

Focal plane size = 3.50 mm x 4.65 mm (including ring pixels)

Focal plane size = 3.46 mm x 4.61 mm (picture area only, does not include ring pixels)

5.9 35mm-equivalent Focal Length

The 35mm-equivalent focal length provides the focal length of a 35mm film camera lens that gives approximately the same field of view as the DSC camera lens. It is given by the equation:

35mm-equivalent focal length = (measured DSC lens focal length (in mm) x 43.27 mm) / (diagonal focal plane distance (in mm))

35mm-equivalent focal lengths shall not be reported as actual focal lengths.

NOTE The diagonal focal plane distance of a 35mm film camera is 43.27 mm.

EXAMPLE Suitable notations:

35mm-equivalent focal length = 46 mm

Focal length = 7mm to 21 mm (35mm-equivalent: 40 mm to 120 mm)

NOTE: When considering 35mm-equivalent focal lengths, it is important to note that the focal plane size significantly influences the depth of field at a given f-number. This affects the range of f-numbers that provide a suitable depth of field for photographing various subjects. For example, a lens with Focal Length = 10mm (35mm-equivalent = 40mm) used with a sensor that has a diagonal focal plane distance equal to ¼ that of 35mm film, will have four times the depth of field at the same f-number as a 40mm lens on a 35mm format camera, when each camera is used to produce the same size final image of a subject taken from the same distance.

5.10 Sensor optical format

The sensor optical format provides a classification of the focal plane size of an image sensor used in a DSC. The format is the entry from table 1 having a nominal diagonal distance closest to the value of the diagonal distance of the focal plane size specified in 5.8. When reporting the sensor optical format, the actual dimensions of the focal plane size (i.e., the vertical, horizontal, or diagonal dimensions) and the aspect ratio of the focal plane size should also be reported.

NOTE: The sensor optical format types (e.g., ½" type) listed in table 1 are historically based on the outer diameter of the glass envelop of a vidicon tube.

Table 1 — Sensor optical formats

Sensor optical format	Nominal diagonal distance	Nominal focal plane size for 4:3 image aspect ratio
3" type	48.0 mm	38.4 mm x 28.8 mm
2" type	32.0 mm	25.6 mm x 19.2 mm
4/3" type	22.0 mm	17.6 mm x 13.2 mm
1" type	16.0 mm	12.8 mm x 9.6 mm
2/3" type	11.0 mm	8.8 mm x 6.6 mm
1/1.8" type	8.9 mm	7.1 mm x 5.3 mm
1/2" type	8.0 mm	6.4 mm x 4.8 mm
1/2.7" type	6.7 mm	5.3 mm x 4.0 mm
1/3" type	6.0 mm	4.8 mm x 3.6 mm
1/4" type	4.5 mm	3.6 mm x 2.7 mm
1/6" type	3.0 mm	2.4 mm x 1.8 mm
1/8" type	2.25 mm	1.8 mm x 1.35 mm

Annex A

(informative)

Examples of suitable specifications

Table A.1 — Suitable specification example 1

DSC	Number of effective pixels	2.1 M pixels (including 0.2 M ring pixels)
	Number of Recorded Pixels	1,600 x 1,200 (1.9M) fine mode 1,280 x 960 (1.2M) standard mode
Image sensor	Type	Interline CCD (Interlace readout)
	Sensor optical format	1/2" type, 4:3 aspect ratio, 8.0 mm diagonal
	Total number of cells	2,110k
	Sensor cell pitch	4.0 microns
	Focal plane size	6.4 mm x 4.8 mm
Recording	Image File Size	700kB / frame (fine mode)
	Image Data Compression Ratio	Approx. 1/10 (fine mode)
Lens	Equivalent 35 mm focal length	40 mm to 120 mm
	Minimum f/number	f/4.0 – f/5.6

The data is specified in accordance with ANSI/I3A IT10.7000-2004.

Table A.2 — Suitable specification example 2

Number of effective pixels	2.1 Megapixels (including 0.2 M ring pixels)
Image sensor	2/3" type CCD (Total Number of cells = 2,110k)
Number of Recorded Pixels	1,600 x 1,200 (fine mode) 1,280 x 960 (standard mode)
Image File Size	700kB / frame (fine mode)

The data is specified in accordance with ANSI/I3A IT10.7000-2004.

Annex B

(informative)

Bibliography

JCIA GLA03, "Guideline for Noting Digital Camera specifications in Catalogs", Japan Camera Industry Association, revised July 17, 2001.