

Digital Photography Standards

“An Overview of Digital Camera Standards Development in
ISO/TC42/WG18”

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International Standards Bodies

- International Standards Organisation (ISO)
 - World's largest developer of standards
 - Comprises a network of 146 countries.
 - P-members: Countries that have chosen to participate in standards development activities.
- ISO TC42 – Photography
 - Responsible for conventional and digital photography standards
- Digital Photography working group
 - ISO/TC42 WG18: Electronic Still Picture Imaging
 - Formed in 1993
 - Key participating national bodies include Japan (JISC), USA (ANSI), Germany (DIN), and UK(BSI)



Why are Standards Needed in Digital Photography?

- The development of **standards** in digital photography ensures that:
 - Manufacturers of digital imaging equipment introduce technology into products that conforms to internationally agreed specifications.
 - Products operate more smoothly and safely in the environment they were designed to operate in.
- Benefits:
 - Development costs for manufacturers are lowered.
 - Different products operate seamlessly with one another.
 - Cross comparison of products is easier when manufacturers measure and report specifications according to agreed standards.
- Consumers can make informed purchasing decisions
 - Incompatibilities between products can be costly and result in loss of confidence by the consumer.

Lifecycle of a Standard in ISO

- NPI - New work item proposal
 - WD# - Working Draft
 - CD# - Committee Draft
 - DIS – Draft International Standard
 - FDIS – Final Draft International Standard
 - IS – International Standard
-
- Alternatives:-
- ISO/PAS Publicly Available Specification
 - ISO/TS Technical Specification
 - ISO/TR Technical Report
- All international standards are reviewed at least once every 5 years.

TC42 WG18 standards participants

These include experts from the following companies:

- Adobe
- Canon
- Eastman Kodak
- Fuji
- HP
- Nikon
- Olympus
- Sony
- Apple



ISO TC42/WG18 Standards

- Terminology and reporting to define terms used in digital photography
- Performance measurements and characterisation
 - Tone and characterisation
 - Resolution, noise and dynamic range for DSC's, print and film scanners
 - ISO speed for digital cameras
 - Psychophysical experimental methods to estimate image quality
- Digital image interfaces
 - Image formats
 - Picture transfer protocol (PTP)

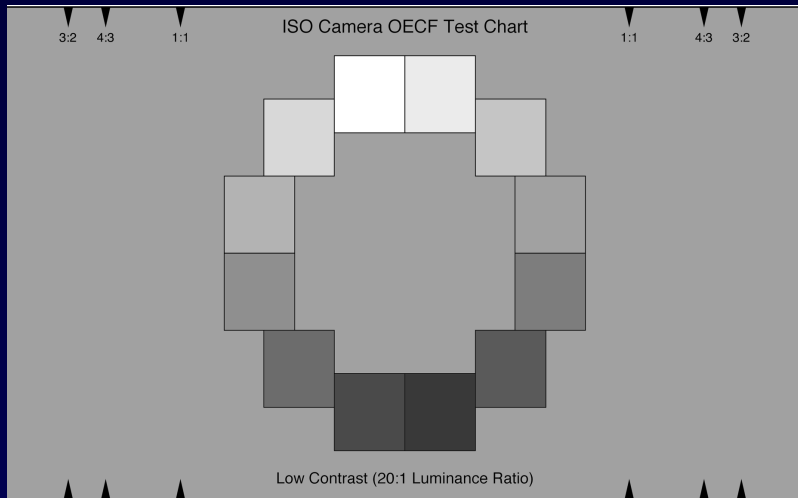
Terminology – ISO 12231

- ISO 12231: 2005 Photography - Electronic still picture imaging – Vocabulary
 - First edition was published in 1997, work on 3rd edition is now underway
- Standardise the use and meaning of terms associated with electronic still picture imaging.
- Comprises a collective summary of definitions from digital photography standards developed by TC42.
- Includes 250 terms and definitions, such as
 - Digital still camera
 - Minimum exposure limit
 - Incremental signal to noise ratio
 - ISO speed latitude

Methods for Measuring Opto-electronic Conversion Functions (OECF) – ISO 14524

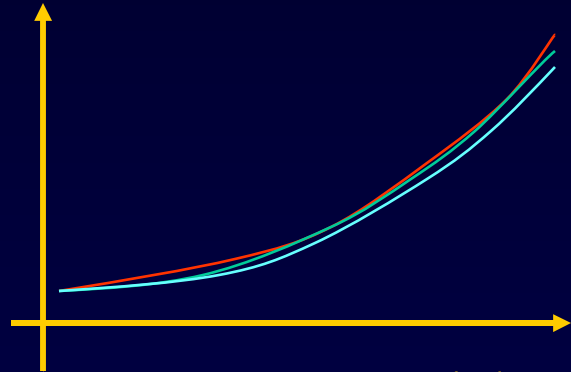
- First edition was published in 1999, 2nd edition was approved for publication
- The standard describes methods for measuring and reporting the relationship between the input scene log luminance values and the digital output levels for a digital camera.
- The response function is called OECF. Two types can be measured:
 - Focal plane OECF (camera response with lens removed)
 - Camera OECF (includes effects of lens and flare)
- OECF is frequently used in many of TC42 performance standards and is sometimes integrated into the test charts of other standards.

OEFC (cont.)



ISO Camera OECF chart

Digital output level



Input log luminance

Sample camera OECF curve

Log luminance	Mean output levels		
	Red	Green	Blue
-0.22	13.9	14.7	14.2
...
1.68	149.6	135.0	124.5

Sample camera OECF table

Resolution, Noise and Dynamic Range

Resolution of a camera is not always dependent on megapixels



Noise can be an objectionable at high ISO

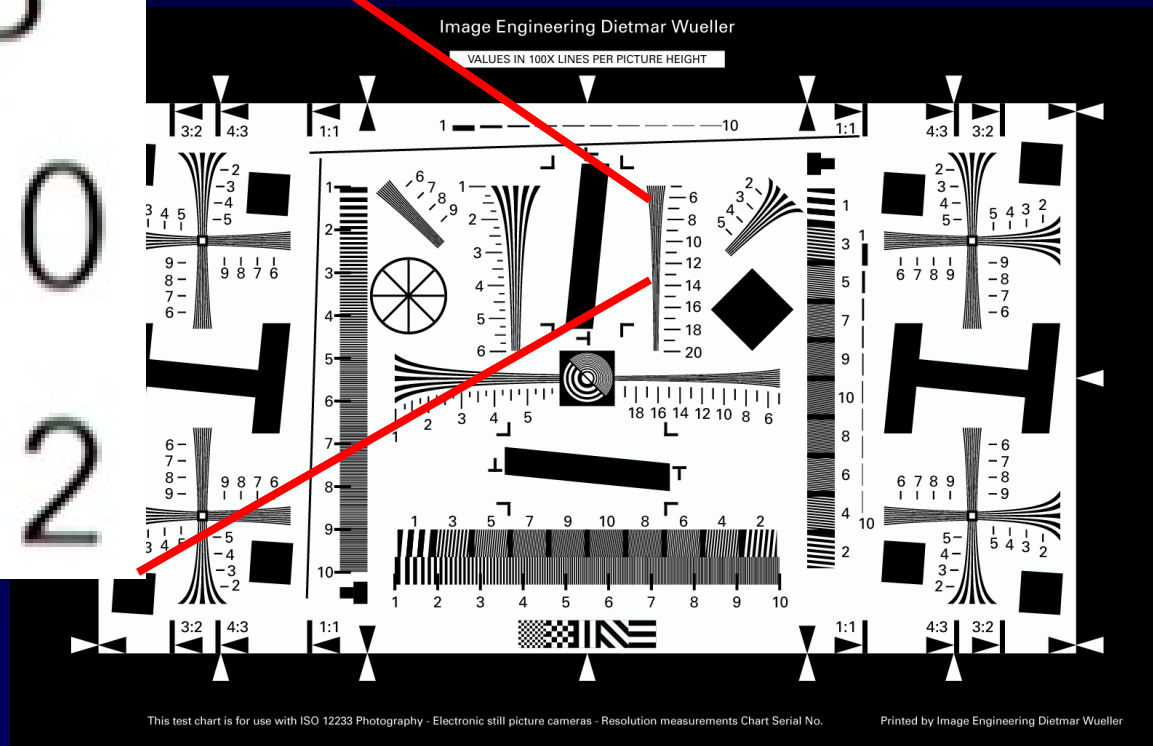
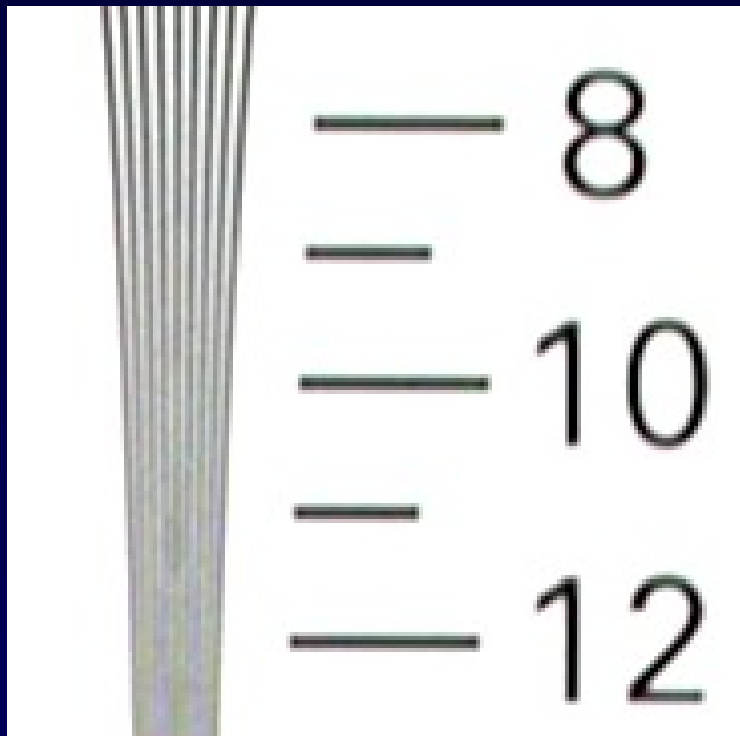
High dynamic range is desirable



Camera Resolution – ISO 12233

- ISO 12233:2000 defines test charts and test methods for measuring DSC resolution.
- Work on 2nd edition is now underway
- Three types of resolution are defined:
 - **Visual resolution**
 - Determined through visual inspection of bi-tonal hyperbolic wedges.
 - **Limiting resolution**
 - Spatial frequency where average modulation of a square wave falls below 5% of the reference response.
 - **Spatial Frequency Response (SFR)**
 - Modulation transfer function as obtained from an edge of specified contrast.

Measurement of visual resolution : ISO 12233

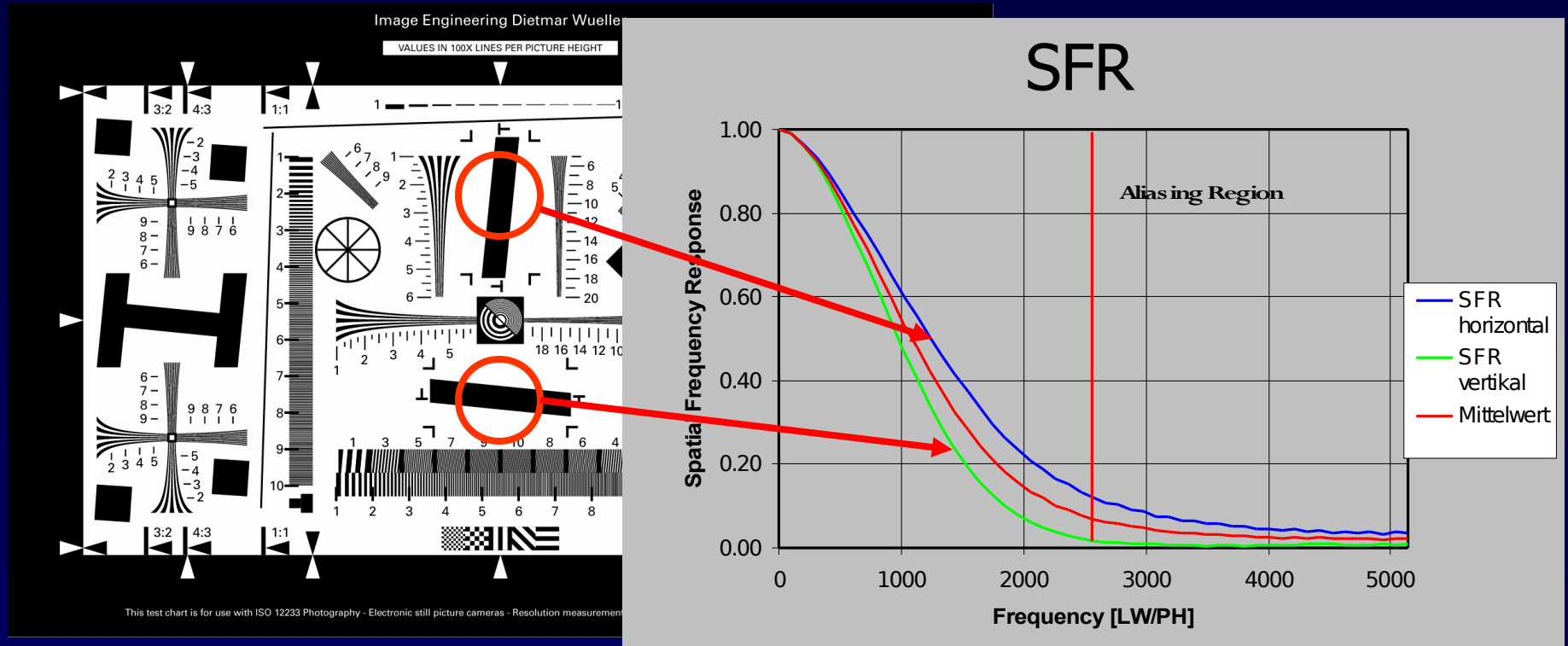


Visuals thanks to
Dietmar Wueller

Spatial Frequency Response (SFR): ISO 12233

- Capture image of a slanted edge target
- Algorithm automatically measures SFR
 - Software is available from the I3A website

Visuals thanks to
Dietmar Wueller



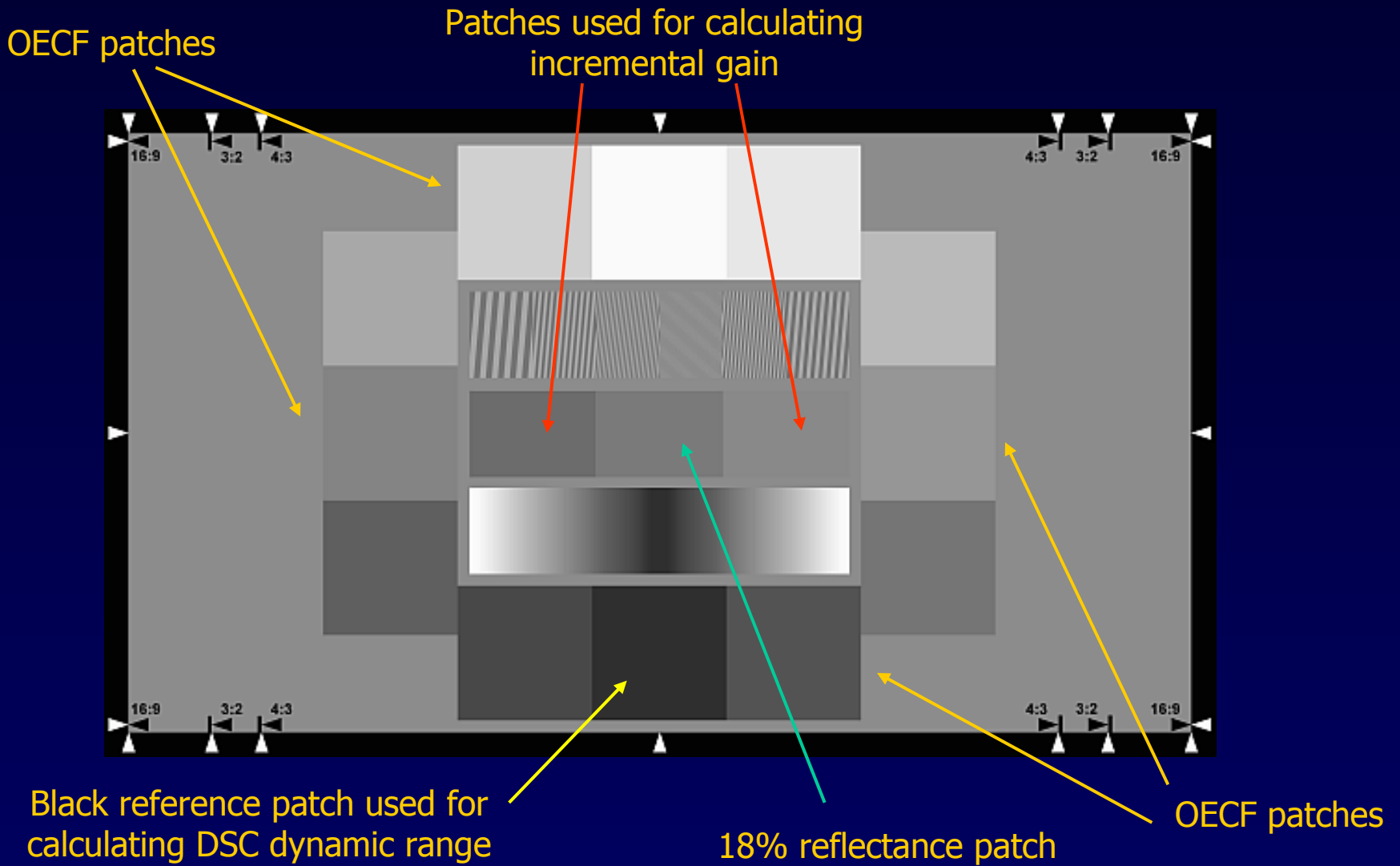
Standards Relating to Scanners

- ISO 16067 - Specifies methods for measuring and reporting the spatial resolution of electronic scanners.
 - Part 1: Scanners for reflective media
 - Test chart is described. Designed to evaluate continuous tone colour and monochrome print scanners.
 - Published in 2003
 - Part 2: Film scanners
 - Relates to measurement and reporting of resolution for continuous tone photographic negatives and reversal films.
 - Published in 2004
- ISO 21550: Dynamic range measurements
 - Describes methods for measuring OECF and SFR for film scanners.
 - Published in 2004

Noise Measurement : ISO 15739

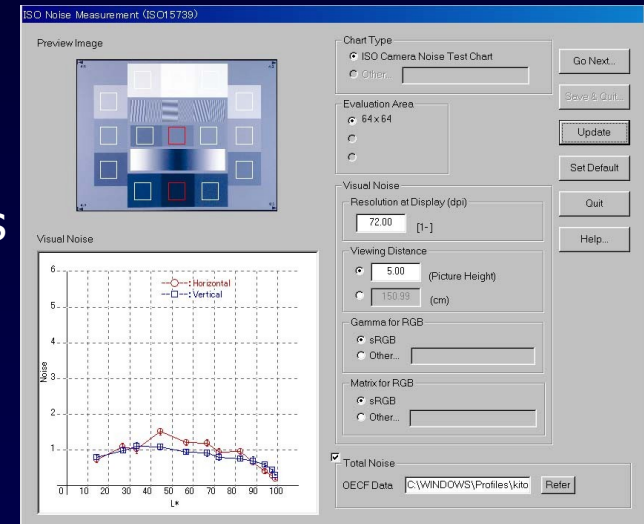
- Standard defines methods for measuring and reporting the noise versus signal level and dynamic range of DSC's:
 - Signal to noise ratio
 - Noise standard deviation
 - DSC dynamic range
 - Visual noise (informative part of the standard)
- Total, temporal and fixed pattern noise are reported, where:
$$\sigma^2_{total} = \sigma^2_{fp} + \sigma^2_{temp}$$
- Noise metrics are reported for an 18% reflectance patch (or reference signal level).

Noise measurement test chart: ISO 15739



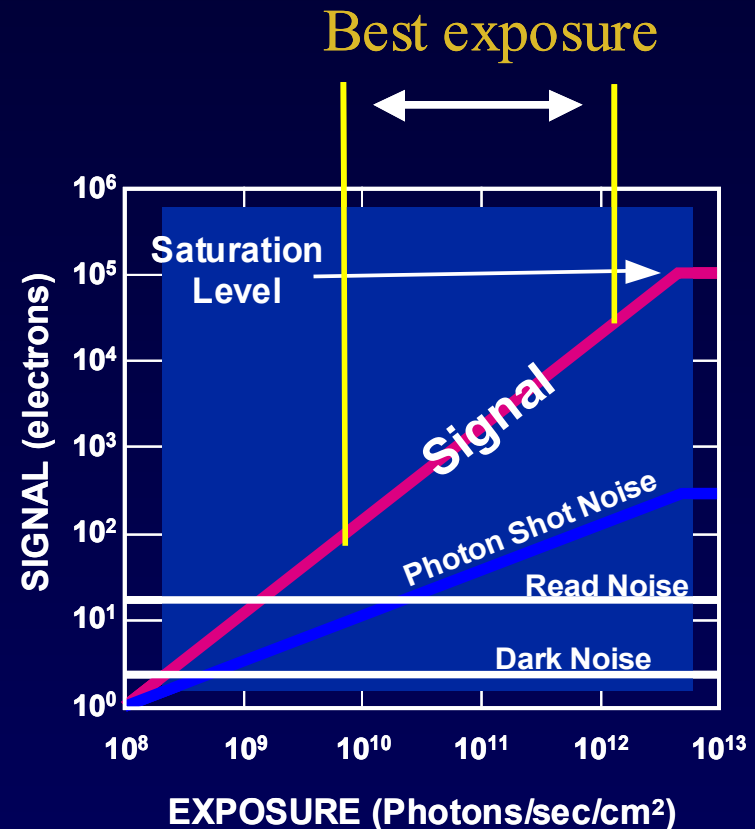
Noise measurement status: ISO 15739

- Standard was published in 2003
 - Work on 2nd edition is now underway
- A noise measurement Photoshop plug-in filter is available for evaluating noise metrics.
 - Measures all noise metrics in normative part of standard.
 - Visual noise is measured and represented graphically.
 - Plug-in was developed by Konica Minolta.
- A utility is available for creating a test chart on an ink-jet printer.
 - High resolution test chart images.
 - Excel spreadsheet for calculating code values for aim patch densities.
 - Utility was developed at Kodak Limited.
- Both tools are available for download from:
<http://www.i3a.org/resources/iso/iso-tools/>



Determination of ISO Speed: ISO 12232

- ISO 12232: 2006 *Photography – Digital still cameras – Determination of exposure index, ISO speed ratings, standard output sensitivity and recommended exposure index*
- First edition was published in 1998
- Issue:
 - If the camera exposure is too high clipping can be introduced in highlights.
 - If camera exposure is decreased amplification of the sensor data can increase noise to objectionable levels.
- ISO 12232 provides a method for measuring and reporting ISO speed metrics that correlate with image quality.



ISO 12232

- Two types of ISO speeds are measured:
 - **Saturation based speed rating:**
 - The largest exposure that can be used for the average scene without introducing objectionable levels of clipping.
 - Useful for studio photography, where scene illumination is controlled.
 - **Noise based speed rating:**
 - Useful where the lowest possible exposure is desired.
 - Two definitions of noise speed are made

Snoise40 : At this speed rating an image is produced with “excellent” image quality (incremental SNR of 40)

Snoise10 : At this speed rating an image is produced with “acceptable” image quality (incremental SNR of 10)

– **ISO Speed Latitude** 

• Saturation speed  Snoise10

ISO 20462: Psychophysical Experimental Method to Estimate Image Quality

- Published in 2005
- Three part standard that documents methods of determining subjective image quality in a calibrated manner.
- Part 1: Overview of psychophysical elements
 - Describes how the standard can be extended to include other psychometric techniques
- Part 2: Triplet comparison method
 - Method for subjective image quality assessment that is much faster per sample than paired comparison method. Data is comparable.
- Part 3: Quality Ruler Method
 - Describes a method for generating quality rulers varying in sharpness. The standard quality scale (SQS) may be measured.



Digital Interface Standards



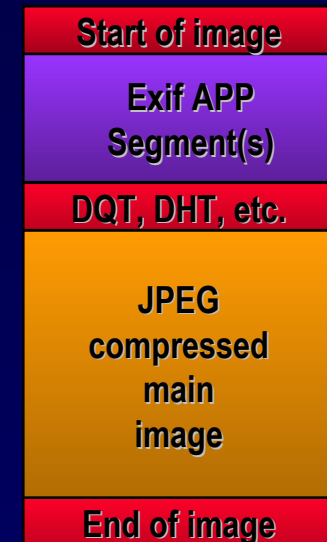
- There is a need to standardise the interface between:
 - Cameras
 - Storage media
 - PC's and software
 - Printers
- Image format is of key importance:
 - More important than the physical storage medium
 - Need for common formats
 - Support consumer through professional applications
 - Extensible

Image Format Standards: ISO 12234

- Part 1 : Removable memory
 - Provides a reference model
 - References Exif and TIFF/EP image formats
 - First edition published in 2001
 - Second edition published in 2007
 - Third edition is now in development
- Part 2 : TIFF/EP image data format
 - Raw mode standard for host processing
 - Origin of capture metadata
 - First edition published in 2001
 - Second edition now in development



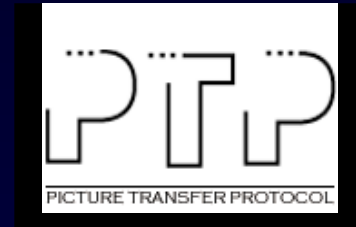
.TIF file



.JPG file

ISO 15740:2008

Picture Transfer Protocol (PTP)



- First edition published in 2005
 - Second edition (2008) is backward compatible and adds new optional features
- Specifies a command language and protocol for controlling digital cameras and other digital photography devices
- Advantages:
 - Device independent
 - Users do not have to load custom camera drivers
 - Easier for DSC's, PC's and printers to support multiple transports
- Based on the PIMA 15740:2000 standard developed by I3A/IT10
- PTP has been implemented over USB since 2000
- CIPA in Japan has developed a standard for PTP over TCP/IP that is used by a number of companies
- Pictbridge (CIPA) standard is based on PTP
- Media Transfer Protocol (MTP) is based on PTP

Summary

- A review of the international standards developed by ISO/TC42/WG18 was presented.
- International standards are successful when they are adopted by the manufacturing industry.
- This drives the growth of digital imaging and ultimately benefits the consumer.
- The work of ISO/TC42 helps promote the adoption of standards by providing education and enablement to the industry.
- Software, test targets and publications help reach that goal.