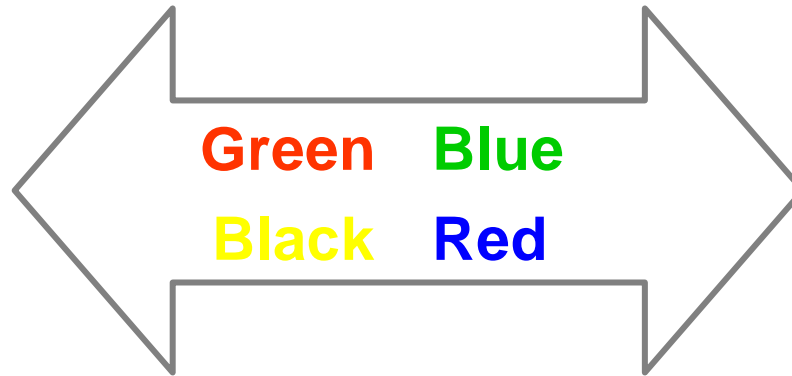


International Display Standards: Status & Agenda



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- ◆ Usability, Context of intended Use
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- ◆ Status of ISO TC159-SC4 activities
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Specmanship at work ...

◆ X-black / CrystalView / Color-Shine / ...

Brandnames for mirrors with display function

◆ Viewing-angles 178/178

LCD TV set

◆ Contrast ratio 10,000:1 - 1,300 cd/m² "brightness",

◆ 550 billion colors (550 • 10⁹ !!!)

PDP TV set

3 x 13 bit → 549,755,810,000 states

◆ Unprecedented **color accuracy** ..

LCD TV set - more color per dollar ...

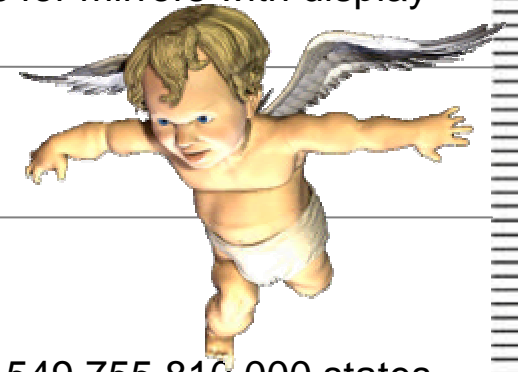
... a breakthrough in the art of **color reproduction**... opens up the spectrum of colors on the screen to breathtaking effect. Significant **boosts in the range of red and green** ..

Key to **broadening the spectrum of color** the screen displays, or **widening its color gamut**, is the specially redesigned backlight... This **actively extends the red and green spectrum components**. ... **completely transforms the characteristics of the screen.**

◆ "gray-to-gray response times", "crispness of colors", etc.

◆ "% NTSC", "ANSI-lumen", "brightness", ...

??????



Customers' requirements

Numbers & terms, numbers & terms, numbers, numb....

- ◆ What do the terms & numbers mean ?
- ◆ How are they measured ?
- ◆ What is their significance ?

The escalating hype of dizzying “performance specifications” leaves the customers **confused** and the products often cause **disappointment** ...

What do customers want ?

- ◆ Acquiring electronic displays that are *fulfilling the performance requirements* as good as possible at an affordable price.
- ➔ Reliable (unbiased), understandable and meaningful specification as basis for purchasing decisions without hangover, regrets and disappointment.

Fulfillment of users' requirements ➔ usability

Don Williams: “Debunking specmanship: Progress on ISO/TC42 Standards for Digital Capture Imaging Performance”, IS&T-PICS 2003

Edward F. Kelley: “What do the specifications mean ?”, 2004 SID ADEAC

Usability

Usability is the measure of **ease & efficiency** with which users of a product can employ a particular device in order to carry out a **specific task**.

Usability according to ISO 9241:

The **effectiveness, efficiency** and **satisfaction** with which

- ◆ **specified users** achieve
- ◆ **specified goals** in
- ◆ **specified environments**.

In the process of defining a list of required or wanted **performance features** for the "**optimum display for a specific purpose**" we start with an analysis of the **context of intended use** (*since the ideal display is not yet available !*).

Task to be performed

- ◆ **work** (office work, text processing, CAD, graphic arts, etc.),
- ◆ **entertainment** (home theater, video, TV, games, etc.),
- ◆ **mixed and other tasks.**

Application situation

- ◆ **conditions of observer**
e.g. impairment of vision, etc.
- ◆ **conditions of observation,**
location of observer, degrees of freedom of observer,
number of observers, etc.
- ◆ **ambient conditions,**
illumination [spatial and spectral distribution of light sources,
intensities, dimensions, etc.], temperature, humidity, noise, etc.

Context of Intended Use

Context of intended use, definition according to ISO 9241-307

“Attributes concerning **user**, **environment**, **tasks** and the **use of the technology** are derived by an **analysis of the intended context of use** as they are essential and prerequisite for the compliance assessment.”

ISO 9241 and ISO 13 406-2 define minimum visual performance requirements for **office work with computer monitors** (based on CRTs and LCDs).

⇒ Important step in protecting the user and the customer !

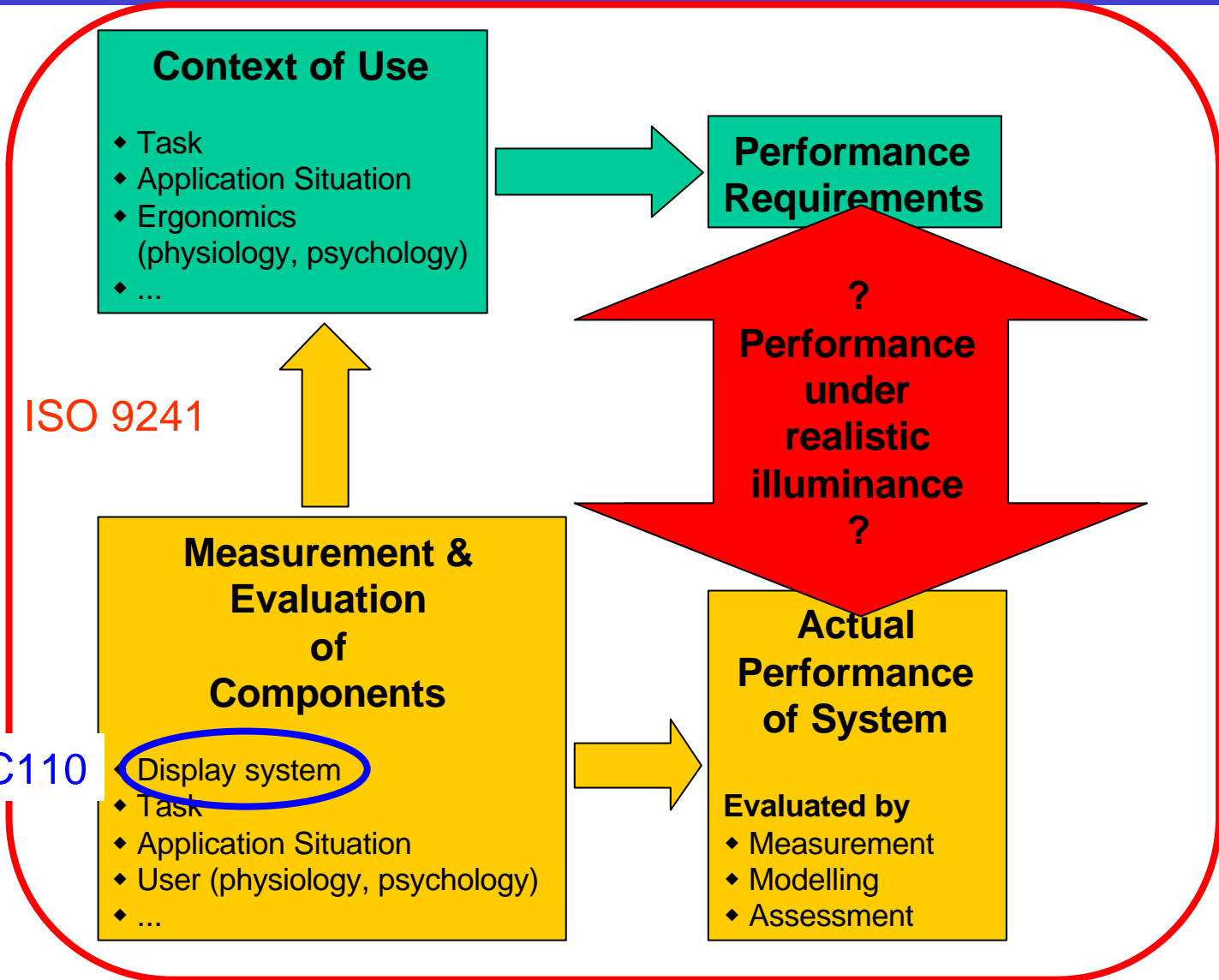
From ISO 13 406-2 to ISO 9241-300

Context of use of **ISO 13 406-2**: “Ergonomic requirements for **work** with visual displays based on flat panels”, **ISO 9241-300**: “Ergonomics of human-system interaction - Ergonomic requirements and measurement techniques for electronic visual displays”

→ covering **all tasks and applications** (from office and mobile work to entertainment) and **all available display technologies**.

Exceptions: Monitors for medical and graphical applications.

Rating of Usability and Performance Compliance



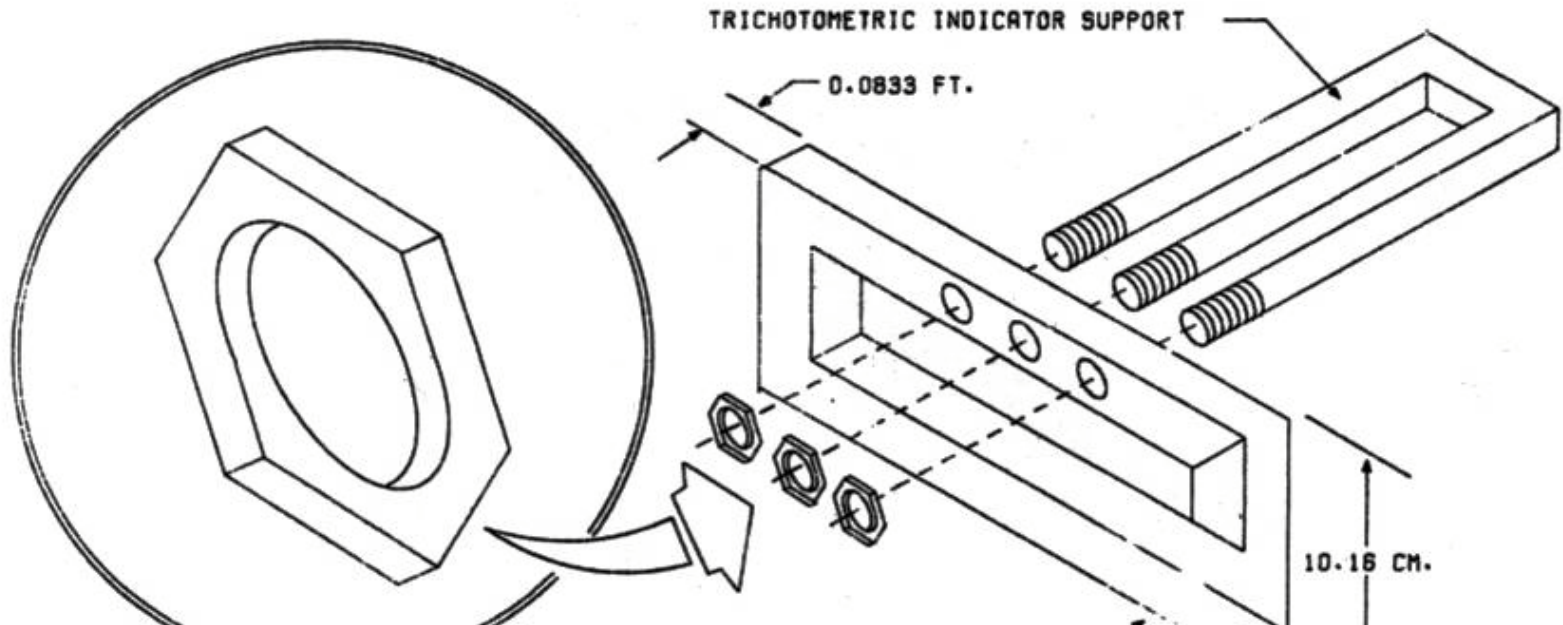
What is a Standard ?

- ◆ A concrete example of an item or a specification against which all others may be measured (e.g. minimum performance requirements).
 - ◆ An agreed basis for communication of technical data.
 - ◆ Definitions of mechanical, electrical, data and other interfaces.
 - ◆ Definitions of terminology, letter symbols, measurement and evaluation methods, etc.
- ⇒ **Understanding between communicating parties in industry, commerce and daily life**



Definition of the Interface

(visual human-machine interface)



Standards for electronic displays related to their visual performance and its specification

... to make things fitting !



ISO / IEC Directives, Part 3: Drafting and Presentation of International Standards

The objective of a **Standard** is to define **clear and unambiguous** provisions in order to facilitate international trade and communication.

To achieve this objective, the **Standard** shall be as **complete** as necessary; **consistent**, **clear** and **concise**; and **comprehensible** to qualified persons who have not participated in its preparation.

Implications for display metrology: see E. F. Kelley's list



Displays Standards Organizations & Activities

- ◆ **AAPM: American Association of Physicists in Medicine**
- ◆ **ANSI: American National Standards Institute**
- ◆ **ASTM: American Society for Testing and Materials (color & appearance)**
- ◆ **CIE: Commission Internationale de l'Eclairage (*Colorimetry of Displays*)**
- ◆ **CORM: Council for Optical Radiation Measurements (USA)**
- ◆ **EIA: Electronic Industries Association (USA)**
- ◆ **JEITA: Japan Electronics & IT Industries Association (former: EIAJ)**
- ◆ **IEC: International Electrotechnical Committee (LCDs, PDPs, OLEDs, etc.)**
- ◆ **IEEE: Institute of Electrical and Electronics Engineers**
- ◆ **ISO: International Organization for Standardization (Visual Ergonomics, etc.)**
- ◆ **NEMA: National Electrical Manufacturers Association**
DICOM Grayscale Standard Display Function
- ◆ **NIDL: National Information Display Laboratory (USA)**
- ◆ **SAE: Society of Automotive Engineers**
- ◆ **SMPTE: Society of Motion Picture and Television Engineers**
- ◆ **VESA: Video Electronics Standards Association (USA)**
Flat Panel Display Measurement Standard

Reversal of Effect

The variety of different standardization activities
- if not properly synchronized -
may provide more confusion than help !

⇒ contradictory terms and definitions

⇒ contradictory measurement methods

Approach of marketing division:

Choose the standard that provides the “best numbers” !

Who could support an international standards synchronization ?

SID ? (see J. Greeson: "Display Standards in Trouble", ID Magazine 12(1994), p. 24)

⇒ **ISO / IEC should take care of this !**

ISO Technical Committees (excerpt from 188)

- ◆ **JTC 1** Information technology
(joint ISO/IEC technical committee)
- ◆ **TC 20** Aircraft and space vehicles
- ◆ **TC 22** Road vehicles
- ◆ **TC 23** Tractors & machinery for agriculture and forestry
- ◆ **TC 36** Cinematography
- ◆ **TC 42** Photography
- ◆ **TC 130** Graphic technology
- ◆ **TC 159** Ergonomics



ISO Standardization

TC 42 **Photography**

Dec. 2003: Proposal for formation of a *TC on Flat Panel Displays*

TC 36 **Cinematography**

ISO 12608 *Cinematography - ...evaluation of television displays*

ISO 14121 *Work stations used for film & video production*

TC 130 **Graphic technology**

ISO 12646 *Graphic technology - Displays for colour proofing -
Characteristics and viewing conditions*

New: Softproofing with LCD-monitors (incl. metrology)



ISO Standards: Ergonomics of Electronic Displays

◆ ISO 9241-1/17 (under revision)

Ergonomic requirements for office work with visual display terminals

◆ ISO 13406-1/2 (under revision)

Ergonomic requirements for work with visual displays based on flat panels
(i.e. LCD-monitors)

◆ ISO 15008

Road vehicles — Ergonomic aspects of transport information and control systems — Specifications and compliance procedures for in-vehicle visual presentation
(metrology accord. SAE)

◆ ISO 4513

Road vehicles — Visibility — Method for establishment of eyellipses for driver's eye location

ISO Standards: Ergonomics of Electronic Displays

ISO 13406 revised → ISO 9241-301 ... 307

Ergonomic Requirements and Measurement Techniques for Electronic Visual Displays

- ◆ Part 301 *Introduction*
- ◆ Part 302 *Terminology*
- ◆ Part 303 *Ergonomic requirements*
- ◆ Part 304 *User performance test methods*
- ◆ Part 305 *Optical laboratory test methods*
- ◆ Part 306 *Field assessment methods*
- ◆ Part 307 *Analysis and compliance test methods*

Revisions & Extensions to ISO 13406-2 / 9241

- ◆ Image formation times (IFTs of LCDs)
 - ◆ Full-swing transitions are best-case IFTs,
 - ◆ Moving images feature more transitions between intermediate gray-levels,
 - ➔ **Combinations of min. 20 or 72 start and end-levels,**
 - ➔ **Consideration of motion artefacts** (e.g. edge blurring).
- ◆ Pixel-fault classes
 - ◆ Class I zero defects
 - ◆ Class II specified # defects per million pixels (# too high)
 - ◆ Class III/IV # defects too high
- ◆ Viewing-direction classes (4 classes)
 - ◆ Class IV is *privacy-screen* (not included in scope of Std.),
 - ◆ Class III represents *absolute minimum requirement*,
 - ◆ remaining 2 classes not sufficient.



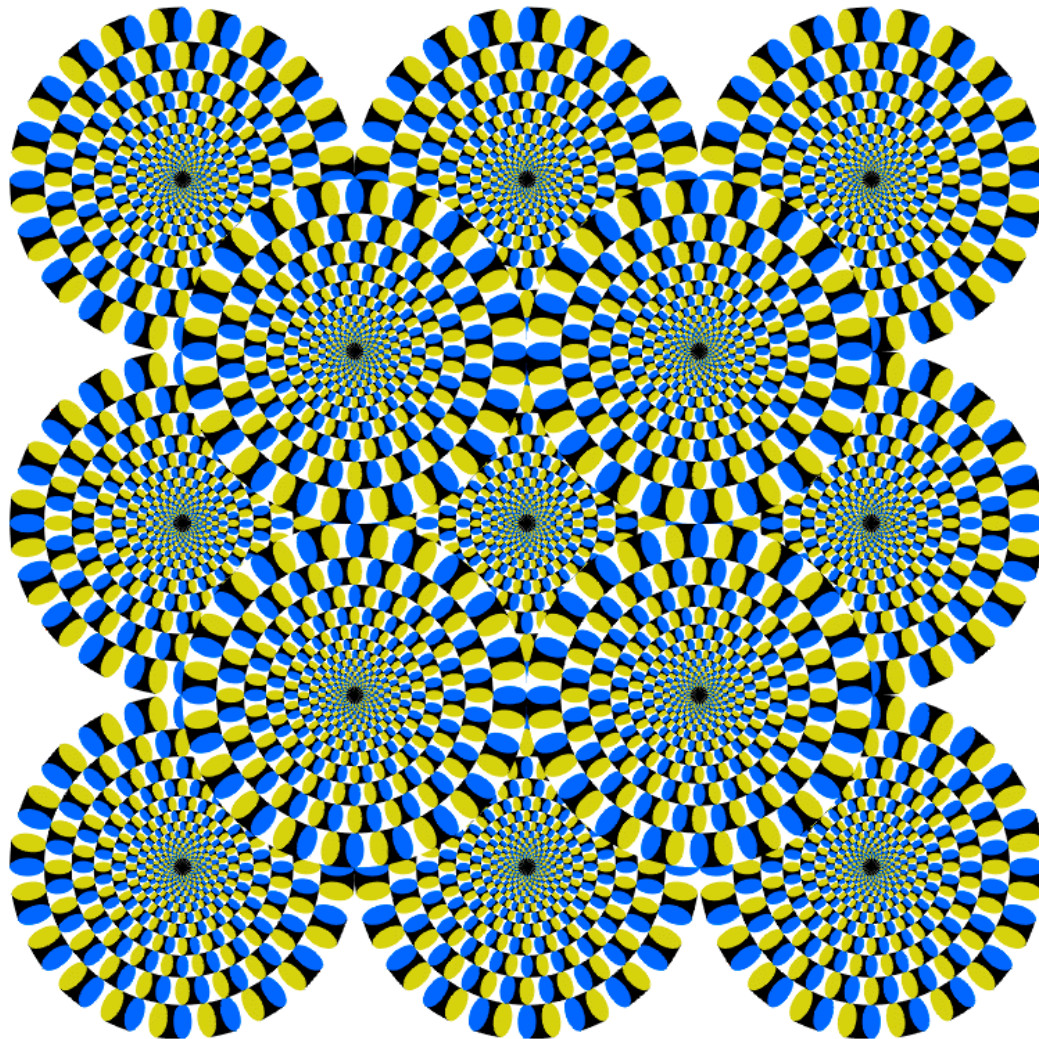
Revisions & Extensions to ISO 13406-2 / 9241

- ◆ Viewing-direction classes (4 classes) proposal
 - ◆ Class IV VC of 15° (absolute minimum)
 - ◆ Class III VC of 30° (comfortable range) (ITU recmd. 4 CRT-TV)
 - ◆ Class II VC of 45° (multi-user, e.g. TV) (29% distortion @ 45°)
 - ◆ Class I VC > 45° (public address)

Viewing-cone = range of viewing-directions that is usable for the *intended application* under realistic conditions (e.g. amb. illumin.)

⇒ Realistic specification of viewing-cone needed !

- ◆ Contrast under ambient illumination (e.g. @ design VD)
 - ◆ with diffuse illumination of e.g. 50 / 100 / 500 lx (large aperture sources, specular excluded)
 - ◆ with directional illumination of e.g. 2 000 cd/m² (small aperture source, specular included)



IEC Technical Committees and Subcommittees (total of approx. 180)



- ◆ **SC 62B**
DIAGNOSTIC IMAGING EQUIPMENT

- ◆ **TC 100**
AUDIO, VIDEO AND MULTIMEDIA SYSTEMS AND EQUIPMENT

- ◆ **TC 110**
FLAT PANEL DISPLAY DEVICES

Former IEC SC47C became a Technical Committee in December 2003

IEC Electronic Display Standards - TC110



- ◆ **LCDs** IEC 61747- N, IEC 61966 - 4

- ◆ **PDPs** IEC 61988 *Plasma Display Panels*
 - ◆ Part 1 *Terminology and letter symbols*
 - ◆ Part 2.1 *Measuring methods – optical*
 - ◆ Part 2.2 *Measuring methods – opto-electrical*
 - ◆ Part 3 *Guidelines of mechanical interface*
 - ◆ Part 4 *Environmental, endurance and mechanical test methods*

- ◆ **OLEDs** IEC 62341-1/6 *Organic Electroluminescent Displays*

- ◆ **MEMs ...**



IEC TC110 - Flat Panel Displays

WG2 - Document Series 61747: LCDs (transmissive)

- 1 *Generic Specifications*
- 2 *Terminology and Letter Symbols*
- 3 *Sectional Specifications, Blank Detail Specifications*
- 4 *Essential Ratings and Characteristics*
- 5 *Environmental Endurance Tests*
- 6 *Visual Inspection*
- 7 *Measuring Methods*

- ➔ **New Work Item: MM for Reflective LCDs !**
- ➔ **New Work Item: Motion-artefact Measurement !**
- ➔ **Joint WG for metrology across technologies !**

IEC 61747

MEASUREMENT METHODS FOR REFLECTIVE LCDs

Standard Measuring Conditions

- ◆ Measurement and evaluation of reflectance
 - ◆ Introduction of the BRDF and its measurement
 - ◆ Basic illumination geometries (according to CIE 38)
 - *directional illumination*
 - *conical illumination (intermediate state)*
 - *hemispherical illumination*

- ◆ Standard measuring geometries
 - 1 Directional illumination
 - 2 Ring-light illumination
 - 3 Conical illumination
 - 4 Hemispherical illumination

Such a set of illumination conditions, once established, introduced and accepted could be useful for any kind of display for evaluation of performance characteristics under well-defined ***ambient illumination*** and thus eventually fill an existing gaping vacancy.



IEC Standards for LCDs

◆ **TC110/WG2 IEC 61747- N:**

Transmissive LCDs (cells, modules, matrix, segment, active & passive matrix, monochrome, color, ...)

status: accepted

Need for unification ... (during regular revision process)

◆ **TC100 Multimedia systems & eqpmnt. IEC 61966**

*Colour measurement and management – Part 4:
Equipment using liquid crystal display panels*

status: accepted

Need for alignment with IEC 61747-N (during revision)



Synchronisation of Standards

	IEC TC 110 Flat Panel Display Devices				IEC TC 100 MM Equipment		ISO TC159 -SC47 Ergon. Displays			
	General	LCD	PDP	OLED	LCD	⋮	PDP	CRT	LCD
Terms & Definitions	Consistent terms & definitions									
Generic Specifications										
Blank Detail Specifications										
Measurement Methods		TV-set power consumption					Motion artefacts		Performance under ambient illuminance	etc. etc.
etc.										
etc.										



Private customers

- ◆ Remain critical and sceptical, trust your eyes !
- ◆ Do not listen to specmanship and oversimplified advertising.
- ◆ Be or become a discerning customer.
- ◆ Collect substantial information before you choose & buy (sometimes not easy to separate the wheat from the chaff, but the louder & more blatant things are offered and advertised, the lower the chance for true values ...).
- ◆ Return the goods if they should not perform at the final destination as advertised, expected or promised.

Corporate customers

- ◆ Take an active part in standardization processes.

Working-group members

- ◆ Synchronize your activities with other standards-bodies active in the same field.

Display manufacturers

- ◆ Make sure that the customers get reasonable ratings and characteristics for their purchasing decisions.
- ◆ Stay away from specmanship.
- ◆ Make sure that the applied standards are up-to-date.
- ◆ Provide experts with hands-on experience.

Public Opinion Makers

- ◆ Get some solid education before spreading your “wisdom” !
- ◆ Your function is important, be aware of that & act responsibly !

Standards Organizations

- ◆ Actively support synchronization of the various TCs and WGs to reduce and avoid confusion !

Governmental Organizations

- ◆ Support the ergonomics aspects (i.e. minimum performance requirements) in order to protect public health.
- ◆ Support the protection of *citizens of the information society*.

International Display Standards: Status & Agenda

Thank you very much for your attention !



Questions, comments & remarks are welcome