International Display Standards: Status & Agenda

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◆ Motivation: Specmanship at work
◆ Usability, Context of intended Use
◆ Rating of usability and Performance Compliance
◆ Standards - some Specifications
◆ Status of ISO TC159-SC4 activities
◆ Status of IEC TC110 activities
◆ Horizontal Synchronizations
◆ Action Proposals
Specmanship at work ...

<table>
<thead>
<tr>
<th>X-black / CrystalView / Color-Shine / ...</th>
<th>Brandnames for mirrors with display function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viewing-angels 178/178</td>
<td>LCD TV set</td>
</tr>
<tr>
<td>Contrast ratio 10,000:1 - 1,300 cd/m² “brightness”,</td>
<td>PDP TV set</td>
</tr>
<tr>
<td>550 billion colors (550 • 10^9 !!!)</td>
<td>3 x 13 bit → 549,755,810,000 states</td>
</tr>
<tr>
<td>Unprecedented color accuracy ...</td>
<td>LCD TV set - more color per dollar ...</td>
</tr>
</tbody>
</table>

... 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.

| “% 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


Edward F. Kelley: “What do the specifications mean ?”, 2004 SID ADEAC
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!).
Context of Intended Use

Task to be performed
♦ **work** (office work, text processing, CAD, grafic 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

Context of Use
- Task
- Application Situation
- Ergonomics (physiology, psychology)
- ...

Performance Requirements

Measurement & Evaluation of Components
- Display system
- Task
- Application Situation
- User (physiology, psychology)
- ...

Actual Performance of System
Evaluates by
- Measurement
- Modelling
- Assessment

ISO 9241
IEC TC110

Performance under realistic illuminance?
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
Standards in this Presentation

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?


ISO / IEC should take care of this!
ISO Standards related to Displays

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 Standards related to Displays

### ISO Standardization

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<tr>
<th>TC</th>
<th>Subject</th>
<th>Description</th>
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<tr>
<td><strong>TC 42</strong></td>
<td>Photography</td>
<td>Dec. 2003: Proposal for formation of a <em>TC on Flat Panel Displays</em></td>
</tr>
<tr>
<td><strong>TC 36</strong></td>
<td>Cinematography</td>
<td>ISO 12608: <em>Cinematography - ...evaluation of television displays</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ISO 14121: <em>Work stations used for film &amp; video production</em></td>
</tr>
<tr>
<td><strong>TC 130</strong></td>
<td>Graphic technology</td>
<td>ISO 12646: <em>Graphic technology - Displays for colour proofing - Characteristics and viewing conditions</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>New: Softproofing with LCD-monitors <em>(incl. metrology)</em></td>
</tr>
</tbody>
</table>
ISO Standards related to Displays

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)
  - 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 Flat Panel Display Standards

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

<table>
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<tr>
<th>IEC TC 110</th>
<th>IEC TC 100</th>
<th>ISO TC159 -SC47</th>
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<tr>
<td>Flat Panel Display Devices</td>
<td>MM Equipment</td>
<td>Ergon. Displays</td>
</tr>
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</table>

#### General

| LCD | PDP | OLED | LCD | PDP | CRT | LCD | ... ...
|-----|-----|------|-----|-----|-----|-----|-------
|     |     |      |     |     |     |     |       |

#### Terms & Definitions

- Consistent terms & definitions

#### Generic Specifications

- TV-set power consumption
- Motion artefacts
- Performance under ambient illuminance
- etc.
- etc.

#### Blank Detail Specifications

- 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.
**Action Proposals**

**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.
Action Proposals

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*.
Thank you very much for your attention!

Questions, comments & remarks are welcome.