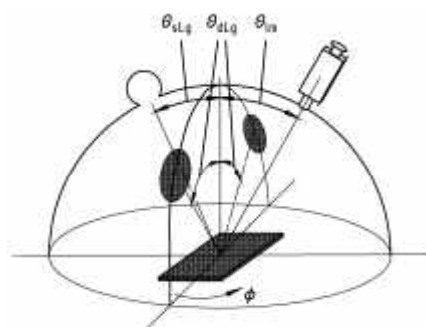


ISO-Lux™

Illumination system for reflectance evaluation and controlled ambient illuminance



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Version 07-01



ISO-Lux™ illumination system

The international standards ISO 9241-7 (*Ergonomic requirements for office work with visual display terminals, Part 7: Requirements for displays with reflections*) and ISO 13406-2 (*Ergonomic requirements for visual display units based on flat panels, Part 2: Requirements for flat panel displays*) describe methods for evaluation of the reflective properties of electronic display devices under well defined conditions of illumination.

Approximated diffuse illumination

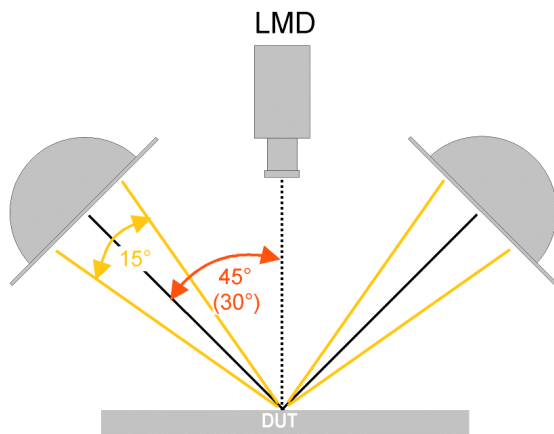


Figure 1A: Approximated diffuse illumination with two 15°-aperture sources (side view).

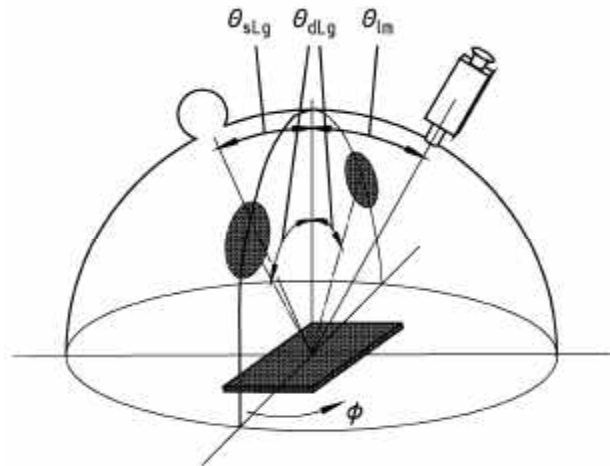


FIGURE 1B: Approximated diffuse illumination with inclined LMD. Only the exit ports of the light sources are shown.

The first setup (Fig. 1) illuminates the measurement spot on the *display under test* (DUT) with two sources with exit apertures that subtend 15° and that are inclined 30° or 45° from the normal of the display surface, thus providing an **approximated diffuse illumination**. The light measuring device (LMD) which is facing the spot of measurement from the normal direction does not receive light reflected in the specular direction (specular excluded, *spex*). For some measurements the LMD may be inclined in the plane perpendicular to the plane containing the center of the exit ports of the two 15° aperture sources as shown in Fig. 1B.

Ambient light reflected by the display device effects two degradations:

- ◆ reduction of contrast by increase of the luminance of the dark state,
- ◆ bleaching of colors by superposition of reflected white ambient light.

The reflectance of the DUT can be measured in different states of of the DUT (OFF, ON at different input signals). There are two ways to evaluate the performance characteristics of electronic displays under ambient illumination (here: approximated diffuse illumination):

- ◆ measurement of the reflectance at an illuminance E_m and calculation of the reflected luminance at a target illuminance E_t .
- ◆ measurement and evaluation of luminance contrast and chromaticities directly at the target illuminance E_t .



Illumination from the specular direction

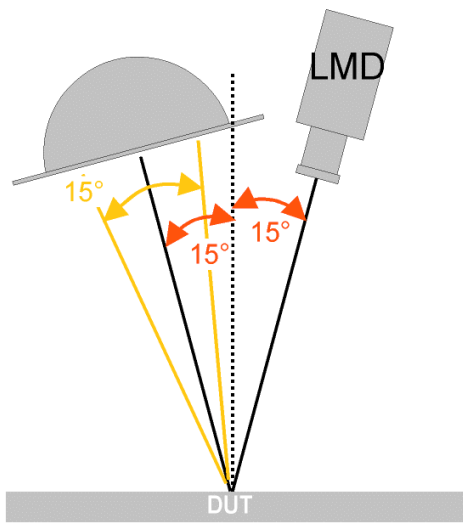


Figure 2A: Illumination from the direction specular to the LMD (15°) with either 15° or 1° source aperture.

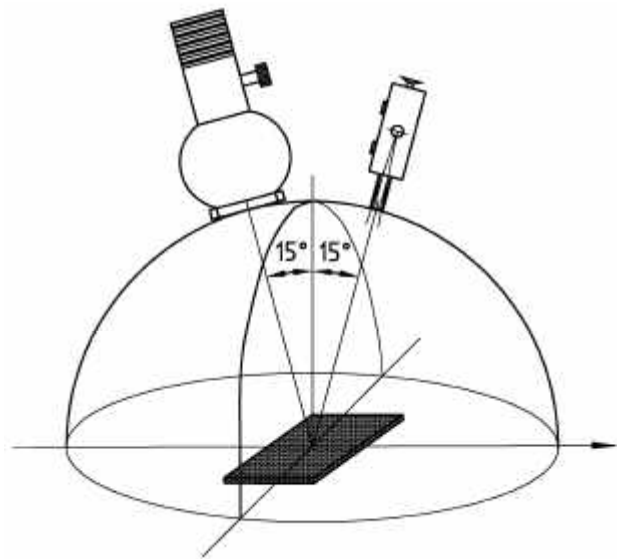


Figure 1B: Illumination from the direction specular to the LMD (15° inclination) with either 15° or 1° source aperture.

A second class of illumination conditions is called **specular illumination**, meaning that the LMD assumes the same angle of inclination as the source aperture and both are located in the *plane of incidence*. When the DUT in such a specular arrangement is replaced by a non-scattering mirror the measuring spot of the LMD must be located in the center of the exit aperture of the light-source. This alignment has a pronounced effect on the results of the measurement and thus has to be done with great care.

ISO-Lux illumination system



Figure 3: Components of the ISO-Lux illumination system: light-source with 15° aperture (left), stabilized adjustable current-source (center) and light-source with additional 1° aperture attached (right).



The ISO-Lux illumination system comprises the following components:

- ◆ 2 light sources with 60mm diameter exit ports (corresponding to 15° subtended angle measured from a distance of 228mm) with 8 x 5W white-light LEDs each.
- ◆ 2 covers for conversion of the 15° apertures into 1° apertures with magnetic attachment.
- ◆ 1 power supply and control unit providing an adjustable highly stabilized DC-current for the LEDs. The lamps can individually be switched ON or OFF, the intensity is adjusted for both lamps in common.

For evaluation of the *VASA* (*variable aperture specular reflectance*) as a measure for the degree of scattering a set of additional apertures is optionally available (for 2°, 3°, 5°, 7°, 10° exit apertures).

Integration into existing measurement setups is available on request.

Reflectance characteristics

according to CIE No. 38, CIE No. 44 and CIE No.17.4

Reflectance	ρ
Reflectance Factor	R
Luminance Factor	β
Luminance coefficient	q ($q = \beta/\pi$)
Diffuse Reflectance	ρ_d ($\rho_d = \rho_L + \rho_H$)
Lambertian component	ρ_L
Haze component	ρ_H
Regular (Specular) Reflectance	ρ_r
Uniform Diffuser, Perfect Reflecting Diffuser	

Technical data

Highly stable current sources	$I_{out} = 0 - 1,5 \text{ A}$
Luminance at exit port	20.000 cd/m ²
Luminous flux of single LED	170 lm (nominal)
Correlated color temperature	6500 K (nominal)
Exit port diameter	60 mm (15° at a working distance of 228 mm)
additional aperture	4 mm (1° at a working distance of 228 mm)
Mass	1,5 kg per light-source
Mains supply	230 V @ 50 Hz

