
GENERAL
DIGITAL
The Innovators of Flat Panel Technology

TEST METHODOLOGY AND COMPARISON DATA ON GENERAL DIGITAL LCD MONITORS

In order to address the needs of display users in high ambient lighting conditions in both air traffic control towers and avionic cockpit applications, General Digital Optical Bonding Laboratories began performing optical enhancements on displays. It became necessary to establish a protocol for taking data that would allow comparison of displays, with each other and with differing film stacks. The data requirements take into consideration the FAA qualification tests and MIL-L-85762A (now MIL-STD-3009). Appropriate test equipment was engineered and verified by an outside testing lab (Hoffman Engineering).

MIL-L-85762A requires that the display (**D**) reflection properties be measured by a photometer (**C**) at an angle of 30° (**Θb**) to one side of the display normal and using two different light sources; one a high brightness light source (**B**) located on the display normal and the other a lambertian source (**A**) located at the complementary 30° (**Θa**) angle.

The light source on the display normal access is intended to represent the effect of ambient light landing on the display surface. The level of the light from this source is adjusted by use of an independently calibrated white reflector (NIST traceable) placed on the same plane as the display under test at the intended measurement site. The white standard is then replaced by the display to be tested and the diffuse reflectance of the display surface is determined.

The light source -30 degrees from the displays normal axis is intended to represent the effect of the indirect sunlight that might strike the display. The level of the light from this source is adjusted by use of an calibrated (NIST traceable) mirror placed on the same plane as the display under test at the intended measurement site. The mirror is then replaced by the display to be tested and the lambertian reflectance is determined.

Once the white and black levels are determined as described, the viewability of the display is calculated by summing the two anticipated light levels (10,000 fc of light at the normal angle and 2,000 fL of light located at the complementary 30° angle) and then calculating the Weber contrast. This contrast is then compared to table II in the MIL-L-85762A document to determine the display classification.

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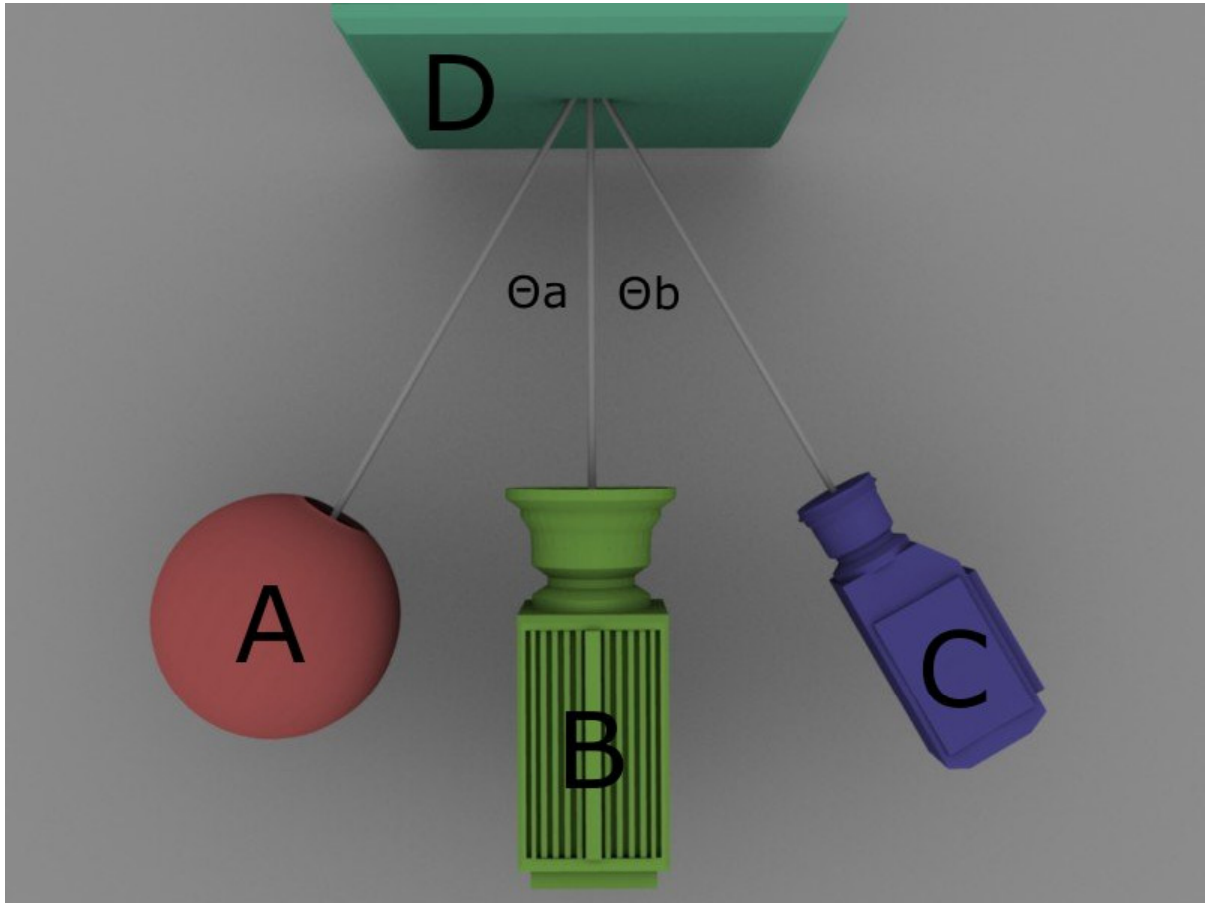
Weber Contrast Lookup Chart

Display Class	Contrast Range*	Short Description*	Ideal Applications
Class 1	0 to 1.49	Not sunlight readable	Not suitable for direct sunlight use
Class 2	1.5 to 1.99	Numeric ONLY	Useful for numerics only in direct sunlight
Class 3	2.0 to 2.99	Alphanumeric	Useful for characters and numerical data
Class 4	3.0 to 4.659	Graphic symbols and Alphanumerics	Useful for characters, numerical data and static images
Class 5	4.66 to 10.29	Acceptable video performance	Useful for characters, numerical data, static images, and low quality video (6 √2 shades of gray with counting off as 1)
Class 6	10.3 and higher	Best case video performance	Useful for characters, numerical data, static images, and high quality video (eight or more √2 shades of gray counting off as 1)

*The above table was created at General Digital Corporation. Contrast range and descriptions obtained from page 34 of MIL-L-85762A.

SUNLIGHT SIMULATION AND MEASUREMENT TEST SETUP



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Test Equipment

Photometer:	Minolta CS100
Colorimeter:	Minolta CS100
Reflectometer:	GDC
Video Source:	TEAM VG819

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