TSMAD26/DIPWG5-09.4D

Paper for Consideration by the Digital Information Portrayal Working Group (DIPWG)

Comment about recommendation on S-52 Colour Calibration Procedure

Submitted by:	Furuno Finland Oy.
Executive Summary:	This paper is a written comment in a chain of documents submitted to DIPWG.
Related Documents:	TSMAD26_DIPWG5-09.4A Calibration Guidelines for Displays in S-52 TSMAD26/DIPWG5-09.4B Comments about S-52 Colour Calibration Formula TSMAD26_DIPWG5-9.4C_Recommendation_on_S-52_Color_Calibration_Procedure.doc
Related Projects:	

Introduction / Background

1. There has been a good discussion by correspondence for this subject in form of submitted input or comment papers

Analysis/Discussion/Conclusions

2. First input paper proposed development and inclusion of analytic formulas for specific LCD displays
3. Second input paper stated that today there are too many display technologies to address the analytic formulas for all of them in an IHO standard. The second paper proposed that IHO keep colour coordinates and tolerances for verification within the IHO standard.
4. Third input paper proposed how to do the proposal of second paper in practice by amending the existing text in the IHO S-52
5. The submitter of this comment is of opinion that the third paper is excellent and nearly perfect for the purpose
6. The one and only issue to address is: What is currently going within IEC TC80 – the organization maintaining the standards related to the colour calibration of navigation instruments.
7. Currently requirements for verification of colour calibration based on IHO S-52 colour coordinates and tolerances are in both “IEC 61174 ECDIS” applicable only for ECDIS and “IEC 62288 Presentation” applicable to ECDIS, INS and Radar with chart.
8. Currently IEC want to remove duplicate rules and both IEC 62288 and IEC 61174 are under a process to be published as new editions. The IEC 62288 is in this process well ahead of the IEC 61174. The IEC 62288 is already under CDV voting and therefore the workgroup who drafted it is not anymore in business. The secretary of IEC TC80 has instructed the workgroup drafting the new edition of IEC 61174 to remove the duplication.
9. Long story short: the IEC 61174 references in TSMAD26_DIPWG5-9.4C_Recommendation_on_S-52_Color_Calibration_Procedure.doc should be replaced by IEC 62288.
10. A mark-up with blue colour of proposal from “TSMAD26_DIPWG5-9.4C_Recommendation_on_S-52_Color_Calibration_Procedure.doc” with this change is provided in Annex 1 of this paper.

Recommendations

11. Approve the proposal of “TSMAD26_DIPWG5-9.4C_Recommendation_on_S-52_Color_Calibration_Procedure.doc“ as amended in the Annex 1 of this paper

Justification and Impacts

12. The justification and impacts are already well described in the first, second and third input paper for this subject

Action Required of DIPWG

DIPWG is invited to:

a. endorse the findings of this paper
b. direct the recommended changes in the revised S-52 (See Annex 1)

ANNEX 1 Markup of S-52

4.1 General

The ECDIS manufacturer can use any technology to build his display as long as his display fulfils the requirements of this specification. It is known that at least displays based on CRT, TFT or LCD can be made to fulfill the requirements of this standard. The colours are specified in CIE (Commission Internationale de l'Eclairage) xy chromaticity coordinates and luminance L. *CIE colour coordinates are used because any other colour specification, such as RGB, is specific to a particular monitor and so cannot be specified either in relative or in absolute terms*. The ECDIS colour scheme based on specification of colour tokens and color conversion tolerances and tests are described in sections 4.2.6 and 5.2.3. ~~Procedures for converting these CIE coordinates to RGB values for the ECDIS display are described in sections 4.2.6, 5.2.3 and 5.2.4 below, and in Annex B. It is strongly recommended that these procedures be followed.~~

~~The ECDIS manufacturer may use other methodology if he wishes, however the colours of features on the ECDIS display should appear the same as would be obtained by following the procedures in this document.~~

4.2.3 Display calibration and verification

The ECDIS display should be calibrated initially in order to transform the CIE colour table coordinates to screen coordinates. The main components of the ECDIS display are the monitor and the image generator. Both the monitor and the image generator used to drive the ECDIS display can be calibrated together as a colour generating unit. Another alternative is to calibrate separately both the monitor and image generator. ~~This process is described for CRT screens in Annex B1, and software for processing calibration and converting CIE colour coordinates to RGB, with worked examples, is included in the Presentation Library~~.

The following international standards describe methods for calibration of a monitor's RGB values to produce an output. Other methodologies may be followed, but the same verification test requirements apply regardless of method.

CIE 122-1996
Technical Report: The Relationship between Digital and Colorimetric Data for Computer-Controlled CRT Displays

IEC 61966-3-2000
Multimedia systems and equipment - Colour measurement and management - Part 3: Equipment using cathode ray tubes, Edition 1

IEC 61966-4-2000
Multimedia systems and equipment - Colour measurement and management - Part 4: Equipment using liquid crystal display panels, Edition 1

4.2.4.3. Initial setting of the controls.

The controls should be set up in preparation for initial calibration~~, as described in Annex B section 1.3,~~ and their positions marked at that time (e.g. by a detent) so that they are recoverable.

5.2.3.1

1. The discrimination difference between any two colours displayed (except those with a tabular ΔE* less than 20 - see list ~~in Annex B 4.5~~) should be not less than 10 ΔE* units.

[insert table from B 4.5 here]

Token	**Colour x, y, L**	**Token**	**Colour x, y, L**	**ΔE***
DEPMD	(.27 .30 65) pale blue	CHWHT DEPDW UIBCK	(.28 .31 80) white	11
CHBRN	(.42 .45 30) brown	ADINF	(.41, .47. 35) yellow	14
DEPMS	(.24 .26, 55) medium blue	DEPVS UIAFD	(.22 .24 45) medium blue	17
DEPMD	(.27 .30 65) pale blue	CHGRF NODTA Ed 3.3 colours have greater ΔE	(.28 .31 45) faint grey	18

5.2.3.2 Instrumental calibration verification test. For CRT displays, an instrumental test to check that the results of the colour conversion calibration ~~described in Annex B1~~ are within tolerance should be made by displaying the colours of the Day colour table (restricted to colour pairs of tabular ΔE* greater than 20); measuring their CIE coordinates x,y and L; and applying a tolerance test. ~~The procedure is described in Annex B section 4.~~ For LCD displays the instrumental test should be applied to all three colour tables.

Note that since the tolerance test is intended solely to check successful colour calibration, and not to test colour maintenance at sea, this test should be performed on the bench in the manufacturer's or type-approval authority's plant under normal conditions of temperature, humidity and vibration.

~~Should the colour tolerances be tested independently (as by a type approval authority) without also carrying out colour conversion calibration, a slightly extended procedure is necessary, involving individual control of the R, G and B colours. This is also described in Annex B4.~~

"5.2.4 n/a ~~Software for colour calibration and tolerance verification Software is provided in the Presentation Library to compute the instrumental calibration results, the CIE to RGB conversion, and the tolerance checks.~~

ANNEX 2 Background Information

Color specification

Significant human testing was done during the late 1990's to establish a set of dusk and night colors for ECDIS defined using the long-established CIE-15.2 color model. It makes sense to continue verification testing using the same CIE color model as no better quantitative model for human visual perception is has been available and the general scientific and industrial community has followed this approach. Correspondingly, the necessary instruments for these luminance and color measurements are also widely available. The test requirements specified in IEC ~~61174~~62288 are very clear. S-52 establishes performance requirements but is not the governing specification of test methods. Note that the EU MED ("Wheelmark") refers to IEC ~~61174~~62288 as the international test standard. For type approval, the technical test methods are conducted as invoked by IEC ~~61174~~62288.

One of the more important developments in this field since 1997 was CIE's publication "Recommended system for mesopic photometry based on visual performance" (CIE 191-2010). This work is the culmination of nearly a decade of work on human visual perception in the low light conditions under which both rods and cones of the eye are active. It should motivate future work to adjust the specifications or the test methods used for ECDIS symbols in the dusk and night color tables. CIE has documented other work that specifies a correction to the color perception model when applied to very small symbols. This particularly affects symbols that are small compared with the 4-degree span of the targets on which CIE-15, particularly those using shades of blue (ARPAT for example). Most ECDIS symbols span less than 1-degree with significant detail much finer than that. ECDIS already defines color tokens for background area fills that are different than those used for foreground, i.e. symbols. So, a future revision of the color specifications would have limited impact.

Display technology

The calibration test results for one monitor cannot be applied to all monitors of the same design or even a group of monitors produced at the same time. A study of accumulated test data shows that, even for LCD's with digital video inputs, the random variation in color performance from unit-to-unit is large enough so that the cal data results from one unit cannot be applied to other monitors of the same model with confidence; although some would pass a verification test, a percentage will fail. Within the LCD panel, each of the many components in the light path can vary from batch-to-batch; there can be variations in the front glass, in the color filters and coatings applied and in the drive electronics integrated into the panel. The unit-to-unit variation is significantly larger for analog video LCD's and larger again for CRT's.

Studies have been conducted to understand the change in luminance and in color as a monitor ages. To provide an allowance margin for these changes over its service life, the initial accuracy of a new unit must meet the minimum accuracy specified in S52 as tested per ~~61174~~62288. This provides some confidence that the operational life of the monitor will exceed a minimum threshold. The color difference diagram is a more lax requirement but provides a simple and very practical functional check that can be performed aboard ship without special skill or training.

S-52 Revision

The guidance on color calibration process provided in S-52 describes an analytical model that is only valid for CRT monitors. At the time IHO published it in 1997, CRT's were the only

feasible display technology for ECDIS. By 2000, when ECDIS developers began working with LCD monitors, they found that the software provided by IHO produced results that failed verification tests. Since that time, the same information is now published in international standards that cover CRT, LCD and other display technologies. Some manufacturers have developed non-analytical processes capable of meeting the verification test requirement, for example by repeating cycles of adjustment and verification measurement. Other manufacturers have combined analytical and non-analytical processes.

IHO S-52 can avoid unnecessary specification of process implementation and focus on required performance and verification tests. S-52 clause 5.2.4 should be revised to point to the relevant international standards as examples and Annex B should be deleted. The software utilities for color calibration distributed by IHO with the PresLib should be removed from the PresLib distribution.