



## Deviations request #76 for an ETSO approval for CS-ETSO applicable to Airborne Multipurpose Electronic Displays (ETSO-C113) Consultation Paper

### 1. Introductory note

The hereby presented deviation requests shall be subject to public consultation, in accordance with EASA Management Board Decision No 7-2004 as amended by EASA Management Board Decision No 12-2007<sup>1</sup> products certification procedure dated 11<sup>th</sup> September 2007, Article 3 (2.) of which states:

“2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.”

### 2. ETSO-C113#4

Deviate from ETSO-C113 §3.1 to use SAE AS8034A in lieu of AS8034 as in deviation ETSO-C113#1 and substitute reference tests for CRT and LCD direct-view displays from SAE ARP4260 and SAE ARP1782 with corresponding standards from SAE AS8055 for a reflective head-up display (HUD) in the case of a monochrome Display Unit (DU) only. The additional acceptable display colours as stated in ETSO-C113 3.1.1 (a), (b) and (c) are not applicable to the (monochrome) unit which does not include a symbol generator.

### Requirement

See below.

### Industry:

The following requirements from SAE AS8034A are not applicable to the unit:

SAE AS8034A requirement	Rationale
3. General standards 3.8.1 Malfunction Indication	This HUD is a DU (display unit) only configuration. Most malfunction indications will be indicated by the symbol generator which is not included in the unit. It is proposed to select corresponding standards from SAE AS8055. See Table 2 below.
3. General standards 3.9 Multiple Mode Indications	The HUD should be exempt from this requirement as it is a Display Unit (DU) only, per section 1. of SAE AS8034A. This requirement is considered applicable only to Electronic Display Systems that include the Symbol Generator (SG) function.
3. General standards 3.11 Display	The HUD should be exempt from this requirement as it is a Display Unit (DU) only, per section 1. of SAE AS8034A. See additional details below.

<sup>1</sup> Cf. EASA Web: <http://easa.europa.eu/management-board/docs/management-board-meetings/2007/04/MB%20Decision%2012-2007%20amending%20the%20certification%20procedure.pdf>

SAE AS8034A requirement	Rationale
3. General standards 3.11.1 Discernibility	<p>This type of HUD should be exempt from this requirement as it is a Display Unit (DU) only, per section 1. of SAE AS8034A.</p> <p>This requirement is considered applicable only to Electronic Display Systems that include the Symbol Generator (SG) function. Moreover, at the system level, the symbol generation function can influence the performance of the display.</p> <p>Therefore, the DDP (Declaration of Design and Performance) will provide performance characteristics of the DU (display unit). However, the overall assessment of the HUD will have to be assessed for the complete system.</p>
3. General standards 3.11.2 Critical Information	
3. General standards 3.11.3 Information Limit Indication	
3. General standards 3.11.4 Scale Readability	
3. General standards 3.11.5 Ambiguity	
4. Minimum Performance Standards under standard conditions 4.2.2 Symbol Alignment	
4. Minimum Performance Standards under standard conditions 4.2.8 Symbol Quality	
4. Minimum Performance Standards under standard conditions 4.3.3 Luminance and Color Discrimination	<p>This type of HUD should be exempt from this requirement as it is monochrome and does not use color for symbol discrimination.</p> <p>This requirement is considered applicable only to Electronic Display Systems that have color.</p>
4. Minimum Performance Standards under standard conditions 4.3.4 Color	<p>This monochrome HUD should be exempt from this requirement.</p> <p>This requirement is considered applicable only to Electronic Display Systems that have color.</p>
4.4 CRT	This type of display is not a CRT but a partial HUD. These requirements are not strictly applicable to the unit. It is proposed to select corresponding standards from SAE AS8055. See Table 2 below.
4.5 LCD	This display is not a LCD but a partial HUD. These requirements are not strictly applicable to the unit. It is proposed to select corresponding standards from SAE AS8055. See Table 2 below.
4.6 Operating Time 4.6.2 Lag Time	This type of HUD is a Display Unit only. The lag time of the DU will be documented in the associated DDP. However, the symbol generation function will also need to be considered at the system level.
5. Minimum Performance Standards under environmental conditions 5.1.3 Color	<p>A monochrome HUD should be exempt from this requirement.</p> <p>This requirement is considered applicable only to Electronic Display Systems that have color.</p>
5. Minimum Performance Standards under environmental conditions 5.1.4 Color Registration	<p>A monochrome HUD should be exempt from this requirement.</p> <p>This requirement is considered applicable only to Electronic Display Systems that have color.</p>

**Table 1: not applicable SAE AS8034A requirements**

The following corresponding standards from SAE AS8055 for a reflective head-up display (HUD) in the case of a monochrome Display Unit (DU) without a symbol generator are proposed to be documented in the DDP (declaration of design and performance):

SAE AS8055 requirement	Rationale	Proposal
3. General requirements	Demonstrate compliance to: 3.6 Self-Test Capability 3.7 Effect of Tests 3.8 Malfunction Indication 3.8.1 Power Failure Indication 3.8.2 Fail Safe Provision 4.1 Equipment Functions and Mechanical Operation	This enables to address SAE AS8034A requirement 3.8.1 (Malfunction Indication) which is not applicable to the unit.
4. Minimum Performance Standards under standard conditions 4.2 Display Characteristics	Demonstrate compliance to: 4.2.1 HUD Display Viewing Angles 4.2.2 HUD Eyebow 4.2.5 Display Drift 4.2.6 Line Width 4.2.7 Display Jitter 4.2.8 Display Flicker 4.2.10 Display Binocular Parallax Errors	This enables to address SAE AS8034A requirement 3.11 (Display) which is not applicable to the unit.
4. Minimum Performance Standards under standard conditions 4.3 HUD Photometric Characteristics	Demonstrate compliance to: 4.3.1 HUD Luminance 4.3.2 Luminance Uniformity 4.3.3 Display Contrast Ratio 4.3.4 HUD Combiner Transmissivity 4.3.6 Manual and Automatic Luminance Control	This enables to address SAE AS8034A requirements 4.4 (CRT) and 4.5 (LCD) which are not applicable to the unit.  Only the general HUD Photometric characteristics for the DU from paragraph 4.3 of SAE AS8034A will be demonstrated and documented into the DDP. Compliance to the other performance requirements will have to be assessed for the complete monochrome HUD.

**Table 2: applicable SAE AS8055 requirements**

The table below summarises how compliance to SAE AS8034A will be demonstrated and documented in the Declaration of Design and Performance (DDP).

Requirement from AS8034A	Status	Compliance	Documentation in DDP
<b>AS8034A §</b>	Title	OK. Noted.	None.
<b>1. SCOPE</b>	Information. The scope of AS8034A includes Head Up displays with reference to AS8055	OK. Noted.	None.

Requirement from AS8034A	Status	Compliance	Documentation in DDP
<b>2. REFERENCES</b>	Header	OK. Noted.	None.
2.1 Applicable Documents	Information	OK. Noted.	None.
2.1.1 SAE Publications	Guidance	OK. Noted.	None.
2.1.2 U.S. Government Publications	Guidance	OK. Noted.	None.
2.1.3 RTCA/EUROCAE Publications	Guidance	OK. Noted.	None.
2.1.4 CIE Publications	Guidance	OK. Noted.	None.
2.1.5 Electronic Industry Association (EIA) Publications	Guidance	OK. Noted.	None.
2.1.6 VESA Publications	Guidance	OK. Noted.	None.
2.2 Applicable References	Information	OK. Noted.	None.
2.2.1 SAE Publications	Information	OK. Noted.	None.
2.2.2 U.S. Government Publications	Information	OK. Noted.	None.
2.2.3 RTCA/EUROCAE Publications	Information	OK. Noted.	None.
2.3 Definitions	Information	OK. Noted.	None.
<b>3. GENERAL STANDARDS</b>	Header	OK. Noted.	None.
3.1 Material	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 3.1 Material
3.2 Workmanship	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 3.2 Workmanship
3.3 Compatibility of Components	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 3.3 Components Compatibility

Requirement from AS8034A	Status	Compliance	Documentation in DDP
3.4 Interchangeability	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 3.4 Interchangeability
3.5 Accessibility of Controls	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 3.5 Accessibility of Adjustments and Controls
3.6 Self-Test Capability	Requirement	COMPLY (initiated at power up and continuously during operation)	Demonstrate compliance to SAE AS8055 and document: 3.6 Self-Test Capability
3.7 Effect of Tests	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 3.7 Effect of Tests
3.8 Malfunctions	Header	OK. Noted.	None.
3.8.1 Malfunction Indication	Requirement	COMPLY (partial). DU (Display Unit ) only. Specific malfunctions from symbol generator will have to be provided by the complete HUD.	Demonstrate compliance to SAE AS8055 and document: 3.8 Malfunction Indication 3.8.1 Power Failure Indication
3.8.2 Fail Safe Provision	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 3.8.2 Fail Safe Provision
3.9 Multiple Mode Indications	Requirement	NOT APPLICABLE. DU (Display Unit) only without an embedded Symbol Generator (SG).	None.
3.10 Identification	Requirement	DEVIATION CS-ETSO Subpart A 2.1#2 published in ETSO.DevP.26	Demonstrate compliance to RTCA/DO160F and document deviation in DDP.

Requirement from AS8034A	Status	Compliance	Documentation in DDP
3.11 Display	Requirement	NOT APPLICABLE.  This is a Display Unit (DU) only, per section 1. of SAE AS8034A.  This requirement is considered applicable only to Electronic Display Systems that include the Symbol Generator (SG) function.	The DU will provide sufficient resolution and other characteristics to enable this requirement to be met by the complete HUD system.
3.11.1 Discernibility	Requirement	NOT APPLICABLE.  See justification for 3.11.	
3.11.2 Critical Information	Requirement	NOT APPLICABLE.  See justification for 3.11.	
3.11.3 Information Limit Indication	Requirement	NOT APPLICABLE.  See justification for 3.11.	
3.11.4 Scale Readability	Requirement	NOT APPLICABLE.  See justification for 3.11.	
3.11.5 Ambiguity	Requirement	NOT APPLICABLE.  See justification for 3.11.	
3.11.6 Integral Lighting	Requirement	COMPLY	
3.12 Resistance to Dust and Moisture	Requirement	COMPLY	
3.13 Mechanical Hazard System Protection	Requirement	COMPLY	
3.14 Fire Resistance	Requirement	COMPLY	

Requirement from AS8034A	Status	Compliance	Documentation in DDP
3.15 Supplemental Heating/Cooling	Requirement	COMPLY	
<b>4. MINIMUM PERFORMANCE STANDARDS UNDER STANDARD CONDITIONS</b>	Requirement	REQUEST DEVIATION	
4.1 Equipment Functions and Mechanical Operation	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 4.1 Equipment Functions and Mechanical Operation
4.2 Viewing Characteristics	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 4.2 Display Characteristics 4.2.2 HUD Eyebox
4.2.1 Viewing Angle	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 4.2.1 HUD Display Viewing Angles 4.2.2 HUD Eyebox
4.2.2 Symbol Alignment	Requirement	NOT APPLICABLE No symbol generator in DU	
4.2.3 Positional Accuracy	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 4.2.3 Symbol Positioning Accuracy (External): External Symbol Positioning Accuracy, or Display Accuracy
4.2.4 Drift	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 4.2.5 Display Drift
4.2.5 Line Width	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 with an external "symbol line" and document: 4.2.6 Line Width
4.2.6 Jitter	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 4.2.7 Display Jitter

Requirement from AS8034A	Status	Compliance	Documentation in DDP
4.2.7 Flicker	Requirement	COMPLY	Demonstrate compliance to SAE AS8055 and document: 4.2.8 Display Flicker
4.2.8 Symbol Quality	Requirement	NOT APPLICABLE	
4.2.9 Crosstalk	Requirement	COMPLY	
4.2.10 Image Retention	Requirement	COMPLY	
4.2.11 Defects	Requirement	COMPLY	
4.2.12 Multiple Images	Requirement	COMPLY	
4.3 General Photocolorimetric Characteristics	Header	OK. Noted.	None.
4.3.1 Ambient Illumination Characteristics	Requirement	COMPLY	
4.3.2 Luminance Characteristics	Requirement	COMPLY	
4.3.3 Luminance and Color Discrimination	Requirement	COMPLY	
4.3.4 Color	Requirement	NOT APPLICABLE	
4.4 CRT	Header	OK. Noted.	None.



Requirement from AS8034A	Status	Compliance	Documentation in DDP
4.4.1 Luminance Uniformity	Requirement	<p>APPROVED DEVIATION</p> <p>This requirement is for direct-view CRT displays which is not appropriate for this DU.</p> <p>Approval for this DEVIATION is implied by the reference to AS8055 in section 1. of AS8034A.</p>	<p>Demonstrate compliance to SAE AS8055 with SAE AS8055 test or human factors assessment in a specialised laboratory or in a flight simulator. Document compliance to SAE AS8055 for:</p> <p>SAE AS8055, section 4.3 as in Table 2.</p>
4.4.2 Convergence	Requirement	<p>APPROVED DEVIATION</p> <p>This requirement is for direct-view CRT displays which is not appropriate for this DU.</p> <p>Approval for this DEVIATION is implied by the reference to AS8055 in section 1. of AS8034A.</p>	<p>Demonstrate compliance to SAE AS8055 with SAE AS8055 test or human factors assessment in a specialised laboratory or in a flight simulator. Document compliance to SAE AS8055 for:</p> <p>SAE AS8055, section 4.3 as in Table 2.</p>
4.5 LCD	Header	OK. Noted.	None.

Requirement from AS8034A	Status	Compliance	Documentation in DDP
4.5.1 Maximum Luminance, Transmissive Displays	Requirement	<p>APPROVED DEVIATION</p> <p>This requirement is for direct-view LCD displays which is not appropriate for this DU.</p> <p>Approval for this DEVIATION is implied by the reference to AS8055 in section 1. of AS8034A.</p>	<p>Demonstrate compliance to SAE AS8055 with SAE AS8055 test or human factors assessment in a specialised laboratory or in a flight simulator. Document compliance to SAE AS8055 for:</p> <p>SAE AS8055, section 4.3 as in Table 2.</p>
4.5.2 Contrast Ratio (CR)	Requirement	<p>APPROVED DEVIATION</p> <p>This requirement is for direct-view LCD displays which is not appropriate for this DU.</p> <p>Approval for this DEVIATION is implied by the reference to AS8055 in section 1. of AS8034A.</p>	<p>Demonstrate compliance to SAE AS8055 with SAE AS8055 test or human factors assessment in a specialised laboratory or in a flight simulator. Document compliance to SAE AS8055 for:</p> <p>SAE AS8055, section 4.3 as in Table 2.</p>
4.5.3 Viewing Envelope(s) Color Tolerance	Requirement	<p>APPROVED DEVIATION</p> <p>This requirement is for direct-view LCD displays which is not appropriate for this DU.</p> <p>Approval for this DEVIATION is implied by the reference to AS8055 in section 1. of AS8034A.</p>	<p>Demonstrate compliance to SAE AS8055 with SAE AS8055 test or human factors assessment in a specialised laboratory or in a flight simulator. Document compliance to SAE AS8055 for:</p> <p>SAE AS8055, section 4.3 as in Table 2.</p>

Requirement from AS8034A	Status	Compliance	Documentation in DDP
4.5.4 Gray Scale	Requirement	<p>APPROVED DEVIATION</p> <p>This requirement is for direct-view LCD displays which is not appropriate for this DU.</p> <p>Approval for this DEVIATION is implied by the reference to AS8055 in section 1. of AS8034A.</p>	<p>Demonstrate compliance to SAE AS8055 with SAE AS8055 test or human factors assessment in a specialised laboratory or in a flight simulator. Document compliance to SAE AS8055 for::</p> <p>SAE AS8055, section 4.3 as in Table 2.</p>
4.5.5 Specular Reflections	Requirement	<p>APPROVED DEVIATION</p> <p>This requirement is for direct-view LCD displays which is not appropriate for this DU.</p> <p>Approval for this DEVIATION is implied by the reference to AS8055 in section 1. of AS8034A.</p>	<p>Demonstrate compliance to SAE AS8055 with SAE AS8055 test or human factors assessment in a specialised laboratory or in a flight simulator. Document compliance to SAE AS8055 for:</p> <p>SAE AS8055, section 4.3 as in Table 2.</p>
4.5.6 Inactivated Segments	Requirement	<p>APPROVED DEVIATION</p> <p>This requirement is for direct-view LCD displays which is not appropriate for this DU.</p> <p>Approval for this DEVIATION is implied by the reference to AS8055 in section 1. of AS8034A.</p>	<p>Demonstrate compliance to SAE AS8055 with SAE AS8055 test or human factors assessment in a specialised laboratory or in a flight simulator. Document compliance to SAE AS8055 for:</p> <p>SAE AS8055, section 4.3 as in Table 2.</p>

Requirement from AS8034A	Status	Compliance	Documentation in DDP
4.5.7 Response Time	Requirement	<p>APPROVED DEVIATION</p> <p>This requirement is for direct-view LCD displays which is not appropriate for this DU.</p> <p>Approval for this DEVIATION is implied by the reference to AS8055 in section 1. of AS8034A.</p>	<p>Demonstrate compliance to SAE AS8055 with SAE AS8055 test or human factors assessment in a specialised laboratory or in a flight simulator. Document compliance to SAE AS8055 for:</p> <p>SAE AS8055, section 4.3 as in Table 2.</p>
4.6 Operating Time	Header	OK. Noted.	None.
4.6.1 Start-Up	Requirement	COMPLY	
4.6.2 Lag Time	Requirement	COMPLY	The lag time of the DU supports this requirement, but at the system level, the symbol generation function will need to be considered. The DDP will document the lag time of the DU.
4.6.3 Data Update	Requirement	COMPLY	
<b>5. MINIMUM PERFORMANCE STANDARDS UNDER ENVIRONMENTAL CONDITIONS</b>	Requirement	COMPLY	
5.1 Requirements	Requirement	COMPLY	
5.1.1 Display Characteristics	Requirement	COMPLY	
5.1.2 Luminance	Requirement	COMPLY	
5.1.3 Color	Requirement	NOT APPLICABLE	This is a monochrome display unit. This will be indicated in the DDP.
5.1.4 Color Registration	Requirement	NOT APPLICABLE	This is a monochrome display unit. This will be indicated in the DDP.
5.1.5 Response Time	Requirement	COMPLY	

Requirement from AS8034A	Status	Compliance	Documentation in DDP
5.1.6 Mechanical Operation	Requirement	COMPLY	
5.2 Definition of Terms	Information	OK. Noted.	None.
5.3 Conditions of Tests	Information	OK. Noted.	None.
5.4 Temperature and Altitude Tests (Section 4.0, DO-160D/ED-14D)	Requirement	COMPLY with DEVIATION for RTCA/DO160F	Environmental tests will be performed in accordance with the appropriate categories in RTCA/DO-160F. The DDP will declare the DO-160F qualified levels, and the product will be marked accordingly.
5.4.1 Low-Temperature Test	Requirement		
5.4.2 High-Temperature Test	Requirement		
5.4.3 Altitude Test	Requirement		
5.4.4 Decompression Test (When Required)	Requirement		
5.4.5 Overpressure Test (When Required)	Requirement		
5.5 Temperature Variation Test (Section 5.0, DO-160D/ED-14D)	Requirement		
5.6 Humidity Test (Section 6.0, DO-160D/ED-14D)	Requirement		
5.7 Shock Tests (Section 7.0, DO-160D/ED-14D)	Requirement		
5.8 Vibration Tests (Section 8.0, DO-160D/ED-14D)	Requirement		
5.9 Explosion Test (When Required) (Section 9.0, DO-160D/ED-14D)	Requirement		
5.10 Waterproofness Test (When Required) (Section 10.0, DO-160D/ED-14D)	Requirement		

Requirement from AS8034A	Status	Compliance	Documentation in DDP
5.11 Fluids Susceptibility Test (When Required) (Section 11.0, DO-160D/ED-14D)	Requirement		
5.12 Sand and Dust Test (When Required) (Section 12.0, DO-160D/ED-14D)	Requirement		
5.13 Fungus Resistance Tests (When Required) (Section 13.0, DO-160D/ED-14D)	Requirement		
5.14 Salt Spray Test (When Required) (Section 14.0, DO-160D/ED-14D)	Requirement		
5.15 Magnetic Effect Test (Section 15.0, DO-160D/ED-14D)	Requirement		
5.16 Power Input Test (Section 16.0, DO-160D/ED-14D)	Requirement		
5.16.1 Normal Operating Conditions	Requirement		
5.16.2 Abnormal Operating Conditions	Requirement		
5.17 Voltage Spike Conducted Test (Section 17.0, DO-160D/ED-14D)	Requirement		
5.17.1 Category A Test	Requirement		
5.17.2 Category B Test	Requirement		
5.18 Audio Frequency Conducted Susceptibility Test (Section 18.0, DO-160D/ED-14D)	Requirement		

Requirement from AS8034A	Status	Compliance	Documentation in DDP
5.19 Induced Signal Susceptibility Test (Section 19.0, DO-160D/ED-14D)	Requirement		
5.20 Radio Frequency Susceptibility Test (Radiated and Conducted, Section 20.0, DO-160D/ED-14D)	Requirement		
5.21 Emission of Radio Frequency Energy Test (Section 21, DO-160D/ED-14D)	Requirement		
5.22 Lightning Induced Transient Susceptibility (Section 22, DO-160D/ED-14D)	Requirement		
5.23 Lightning Direct Effects (When Required) (Section 23, DO-160D/ED-14D)	Requirement	NOT APPLICABLE	The product will be installed inside the fuselage. The RTCA/DO160F will be documented as X in the DDP. The installer has to check that the demonstrated RTCA/DO160F categories meet the installation requirements.
5.24 Icing (When Required) (Section 24, DO-160D/ED-14D)	Requirement	NOT APPLICABLE	The product will be installed inside the fuselage. The RTCA/DO160F will be documented as X in the DDP. The installer has to check that the demonstrated RTCA/DO160F categories meet the installation requirements.
5.25 Electrostatic Discharge (ESD) (Section 25, DO-160D/ED-14D)	Requirement	COMPLY with DEVIATION for RTCA/DO160F	Environmental tests will be performed in accordance with the appropriate categories in RTCA/DO-160F. The DDP will declare the DO-160F qualified levels, and the product will be marked accordingly.
5.26 X-ray Radiation	Requirement	COMPLY	

Requirement from AS8034A	Status	Compliance	Documentation in DDP
5.27 UV Radiation	Requirement	COMPLY	
5.28 Fogging (Hermetically Sealed or Desiccated Display Units Only)	Requirement	COMPLY	
5.29 Thermal Shock (When Required)	Requirement	COMPLY	
5.30 Dielectric Test	Requirement	COMPLY	
<b>6. TEST PROCEDURES</b>	Header	OK. Noted.	None.
6.1 Test Conditions	Requirement	COMPLY with DEVIATION for RTCA/DO160F	Environmental tests will be performed in accordance with the appropriate categories in RTCA/DO-160F. The DDP will declare the DO-160F qualified levels, and the product will be marked accordingly.
6.2 Ambient Room Conditions	Requirement	COMPLY	
6.3 Power Conditions	Requirement	COMPLY	

**Table 3: detailed compliance matrix**

#### **EASA:**

The unit is a partial system per SAE AS8034A. Moreover, it is a monochrome display using the airborne reflective head-up display (HUD) technology whose minimum performance standard is detailed in SAE AS8055. The proposed compliance to some requirements from SAE AS8055 address brightness and its possible adjustment, contrast<sup>1</sup>, combiner transmission ratio, HUD viewing angles, HUD eyebox and HUD display characteristics. The unit does not include the symbol generator and is monochrome. However, the symbol generation and colour influence the performance of the HUD such as for example missing pixels in the virtual image. Moreover, once installed in the cockpit, each display is seen under a certain angle of view which depends on the relative position of the pilot's head and the display, the size of the display and the tilt angle of the display. Therefore, integrated performance of the HUD has to be assessed for the complete system. Since the product to be assessed is incomplete, it is accepted to adapt some test means.

Note <sup>1</sup>: Contrast is also of particular importance in the HUD application where the display is meant to be looked through.

We accept the deviation as alternate means to meet the requirement, provided that the Declaration of Design and Performance indicates the performance characteristics of the DU (display unit).