TECHNICAL SPECIFICATION

ISO/TS 14815

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Road transport and traffic telematics — Automatic vehicle and equipment identification — System specifications

Télématique de la circulation et du transport routier — Identification automatique des véhicules et équipements — Spécification des systèmes

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed every three years with a view to deciding whether it can be transformed into an International Standard.

Attention is drawn to the possibility that some of the elements of this Technical Specification may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 14815 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 204, *Transport information and control systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European pre-Standard..." to mean "...this Technical Specification...".

Annexes A to E of this Technical Specification are for information only.

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FOREWORD

This European Prestandard has been prepared by Technical Committee CEN/TC 278 "Road transport and traffic telematics ", the secretariat of which is held by NNI**,** in collaboration with Technical Committee ISO/TC 204 "Transport information and control systems".

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

INTRODUCTION

SYSTEM SPECIFICATION

This pre-Standard is designed to enable users and suppliers of AVI/AEI systems to specify system specification that will enable a nominal interoperability based on a DSRC link (see clause 5.5).

The terms “AVI” and “AEI” are used both to describe “independently functioning AVI/AEI systems” and as “the function of identification within other RTTT/TICS systems”. Both such uses are supported by this pre-Standard where no other application or sector standard applies.

Whilst it may be desirable to determine a single set of requirements for operation in all environments and under all operating conditions, this could impose unacceptable costs.

This pre-Standard therefore provides standard “classes” for different aspects of system specification, such that a system specifier may select the appropriate performance parameters to meet a particular requirement. Supporting (informative) annexes also provide a number of general use “categories” which may be used to specify the environmental and operating parameters to support interoperable applications.

The architecture descriptions provided in this pre-Standard are in compliance with the guidelines provided by CEN TC 278 WG13/ISO TC 204 WG1.

For the data structure elements, Abstract Syntax Notation One (ASN.1) Packed Encoding Rules (PER) (ref. ISO/IEC 8824:1998 and ISO/IEC 8825-1:1998, ISO/IEC 8825-2:1998 and ISO/IEC DIS 8825-3:1992) are used. This usage provides maximum interoperability and conformance to existing Standards.

For detailed information on the use of ASN.1 PER for AVI/AEI applications reference is made to pre-Standard ENV ISO 14816 (AVI/AEI Numbering and Data Structures).

This pre-Standard (ENV ISO 14815) provides classification procedures and details test requirements needed to support system definition. These requirements are, wherever possible, determined by reference to existing Standards and established practices.

TEST REQUIREMENTS

Test Requirements are determined for AVI/AEI system components. The requirements to meet this pre-Standard encompass general performance measurement, operational, and environmental aspects.

HOW TO USE THIS STANDARD

It is also an objective to provide users with different applications and in different environmental circumstances a useful tool that is flexible enough to serve the various different needs. The categorisation and classification system in this pre-Standard provides for this.

A brief guide showing how to use this pre-Standard is provided at the end of Annex A of this pre-Standard.

COMPLIANCE

In order to claim compliance with this pre-Standard, a supplier shall provide, for each physically separated component, detail of the classification of its product for all relevant (environmental and operational) parameters determined within this pre-Standard.

1. SCOPE

This pre-Standard defines a generic AVI/AEI System specification for nominal AVI/AEI to provide an *enabling* Standard, which, whilst allowing the system specifier to determine the performance levels and operating conditions, provides a framework for nominal interoperability.

Within the Road context of the Transport and Traffic Telematics Sector, AVI and AEI systems have the specific objective of achieving a unique or unambiguous positive identification of a vehicle or item of equipment, and to make that identification automatically.

Whilst AVI may also be seen as an essential component of some applications, the particular needs of such systems are outside the scope of this pre-Standard. As far as is possible, care is still taken to provide a useful tool for such applications.

This pre-Standard only refers to AVI/AEI in the road environment. Multimodal and intermodal exchanges of AVI/AEI are outside the scope of this pre-Standard

Where AVI/AEI applications are part of a larger system, and where no standardised application specific test requirements exist, these test requirements shall apply.

Anonymity and privacy issues are not handled in this part standard. Please refer to ENV ISO 14816.

This pre-Standard is designed for system specification that will enable a nominal interoperability based on a DSRC link (as defined by prENV ISO 17264 and referred to in clause 5.5). AVI/AEI systems that are relying on other link types are outside the scope of this pre-Standard for those parameters where the link type influences parameters.

The Scope of this pre-Standard is confined to Generic AVI/AEI System specification for systems that have the following ‘core’ components:

A means of communication between the vehicle/equipment and the reading station (e.g. a DSRC link, reference prENV ISO 17264)

Operation within a reference architecture which enables compatible systems to read and interpret the identification (See ENV 12314-1)

Compliance to commonly understood data structures that enable meaningful interpretation of the data exchanged in the identification sequence (See ENV ISO 14816)

The provision of operating and environmental parameters (or classes of operating parameters) within which such systems must successfully function without impairing interoperability. This to ensure that the System specifier can state his requirements clearly to Implementation Designers and Integrators, and measure the performance of such systems (This standard, ENV ISO 14815)

2. NORMATIVE REFERENCES

This pre-Standard incorporates by dated or undated reference provisions from other publications.

For dated references, subsequent amendments to or revisions of any of these publications apply to this pre-Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.
These normative references are cited at the appropriate places in the text (in order of appearance) and the publications are listed hereafter (including amendments).

ENV 12314-1	Road Transport and Traffic Telematics - Automatic vehicle and equipment identification - Part 1: Reference architectures and terminology (ISO TR 14814)
ENV 12795	Road Transport and Traffic Telematics - Dedicated Short-Range Communication (DSRC) - DSRC Data link layer: Medium Access and Logical Link Control
ENV ISO 14816	Road Transport and Traffic Telematics - Automatic vehicle and equipment identification - Numbering and data structures
ENV ISO 17264	Road Transport and Traffic Telematics - Automatic Vehicle and Equipment Identification (AVI/AEI) - AVI/AEI Interfaces
EN 50081	Electromagnetic compatibility – Generic emission Standard
EN 300 674	Electromagnetic compatibility and Radio spectrum Matters (ERM) - Road Transport and Traffic Telematics (RTTT) - Technical characteristics and test methods for data transmission equipment operating in the 5, 8 GHz Industrial, Scientific and Medical (ISM) band
IEC 60068-1:1988	Environmental Testing Procedures - Part 1: General and Guidance
IEC 60068-4:1987	Basic Environmental Testing Procedures -Part 4: Information for specification writers - Test Summaries
IEC 60215:1987	Safety requirements for radio transmitting equipment
IEC 60721-3-4:1995	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weather protected locations
IEC 60721-3-5:1988	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities – Section 5: Ground vehicle installations
IEC 61000-4-2	Electromagnetic compatibility (EMC) – Part 4: Testing and measuring techniques – Section 2: Electrostatic discharge immunity test – Basic EMC Publication
IEC 61000-4-6	Electromagnetic compatibility (EMC) - Part 4: Testing and measuring techniques – Section 6: Immunity to conducted disturbances, induced by radio-frequency fields
ISO 7637-1:1990	Road vehicles - electrical disturbance by conduction and coupling - Part 1: Passenger cars and light commercial vehicle with nominal 12V supply voltage - Electrical transient conduction along supply lines only
ISO/IEC 8824-1:1998	Information technology - Abstract Syntax Notation One (ASN.1) - Part 1: Specification of the basic notation
ISO/IEC 8824-2:1998	Information technology - Abstract Syntax Notation One (ASN.1) - Part 2: Information object specification

ISO/IEC 8824-3:1998	Information technology - Abstract Syntax Notation One (ASN.1) - Part 3: Constraint Specification
ISO/IEC 8824-4:1998	Information technology - Abstract Syntax Notation One (ASN.1) - Part 4: Parameterization of the ASN.1 specifications
ISO/IEC 8825-1:1998	Information technology - ASN.1 encoding rules - Part 1: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)
ISO/IEC 8825-2:1998	Information technology - ASN.1 encoding rules - Part 2: Specification of Packed Encoding Rules (PER)
ISO/IEC DIS 8825-3:1992	Information technology - ASN.1 encoding rules – Part 3: Distinguished canonical encoding rules
CEPT/ERC T/R 22/04 : 1991	Harmonisation of Frequency Bands for Road Transport Information Systems
US MIL-STD-721	Definition of Terminology

3. DEFINITIONS

The Glossary of Definitions used is maintained within the pre-Standard ENV ISO 14815 Reference Architectures and Terminology.

For the purpose of this pre-Standard, the following definitions apply.

AVI/AEI System: With the term "AVI/AEI System" is meant the AVI/AEI application in a RTTT system either as a stand-alone system or as part of a RTTT application.

Bi-directional monologue: A "Read only" functionality with a start signal from the FE side.

Category: In the Informative Annexes supporting this pre-Standard 'Category' is used to provide groupings of common class requirements to support interoperability between AVI/AEI systems of common purpose (e.g. a "Ruggedised" category versus a "Standard" category).

Class: In this pre-Standard used to differentiate between System components with different "grades" of requirements for parameters. (e.g. class 1 for "extreme" operational and environmental requirements).

Environmental parameters: In this pre-Standard used to describe different environmental component properties/specifications

Extreme: Term used in this pre-Standard to refer to class 1 requirements for the "Ruggedised" system category "A".

Fixed Equipment (FE): Equipment required to interrogate, receive and interpret the data in the On-Board Equipment (OBE) in order to present the identification.

Lifetime: The period of time during which an item of equipment exists and functions according to the relevant requirements of this pre-Standard.

Maintainability: The ability to keep in a condition of good repair or efficiency

Mean Time to Failure: The average time that a system functions before first failure.

Mean Time between Failures: The mean cycle (one failure and one repair) time of a maintained system.

Nominal Interoperability: Stands for " Application Area Interoperability" in a region spanning two or more areas with cross-border operation between operator domains, districts or nations. The capability for a nominal AVI/AEI System FE to operate with a nominal AVI/AEI System OBE.

Normal: Term used in this pre-Standard to refer to class 2 requirements for the "Standard" system category "B".

On-Board Equipment (OBE): Equipment fitted to the vehicle or item to be identified and containing the unique or unambiguous positive identification.

Operational parameters: In this pre-Standard used to describe different operational component properties/specifications

Physical Architecture: The physical configuration and physical interconnection of equipment to achieve its function (not the equipment itself)

Selected: Term used in this pre-Standard to refer to class 1-6 requirements for the system categories "3 - 6".

Shadowing: A condition where the close proximity of a vehicle/equipment interposed between FE and OBE obscures the signals thus preventing a successful AVI/AEI transaction. The shadowing caused by normal traffic behaviour is taken into account and overcome to provide a successful transaction. Abnormal shadowing may be caused by large or unusually shaped vehicles/equipment or by vehicles travelling too closely together.

(AVI/AEI) Transaction A completed cycle of communication (across the air interface at reference point delta) wherein a message identifying a vehicle or item of equipment is successfully received and understood by the receiver during one passage through the read zone. The number of attempts, retries and repeats is not relevant, it is only that one fully completed identification process communication cycle is successfully completed to the extent that no communications error could be detected.

4. ABBREVIATIONS

The following abbreviations are used in this pre-Standard:

AEI	**A**utomatic **E**quipment **I**dentification
AIB	**A**ccredited, **I**ndependent, Testing **B**ody
ASN.1	**A**bstract **S**yntax **N**otation One
AVI	**A**utomatic **V**ehicle **I**dentification
CEPT	**C**omité **E**uropéenne de **P**ostes et **T**elecommunication (Fr.) European Committee for Post and Telecommunication
DSRC	**D**edicated **S**hort **R**ange **C**ommunication
FE	**F**ixed **E**quipment
MTBF	**M**ean **T**ime **B**etween **F**ailure
OBE	**O**n **B**oard **E**quipment
OSI	**O**pen **S**ystems **I**nterconnection
RTTT	**R**oad **T**ransport and **T**raffic **T**elematics (CEN TC278)
TICS	**T**ransport **I**nformation and **C**ontrol **S**ystems (ISO TC204)

The following abbreviations are used to designate the IEC 60721 - Environmental classes :

B - Biological

C - Chemical substances

F - Contaminating fluids

K - Climatic

M - Mechanical

S - Mechanical substances

Z - Special Climatic conditions

5. REQUIREMENTS

5.1 GENERIC SYSTEM SPECIFICATION FOR AVI/AEI SYSTEMS

This clause summarises the Generic System specification for AVI/AEI Systems in terms of functions supported, data exchanges, categorisation and classification. The requirements defined in this clause:

- provide operation within the Reference Architecture defined in ENV 12314-1
- allocate application data in accordance with ENV ISO 14816
- enable nominal interoperability.

To obtain interoperability, it is a requirement that nominal AVI/AEI System FE shall have the capability to operate with nominal AVI/AEI System OBE albeit of different capability using a air interface as referenced in clause 5.5.

However, the environmental and operating conditions within which such equipment has to function may be different according to geographical location, traffic operating conditions, etc. This pre-Standard provides environmental/operational classes grouped into categories to enable the market place to decide the most appropriate FE for individual fixed locations. This is with the knowledge that, within the operating/environmental constraints selected, any properly configured Standard Compliant AVI/AEI System OBE shall have the capability to be identified by all Standard Compliant AVI/AEI System FE.

To obtain nominal AVI/AEI System interoperability, it is a requirement that OBE's shall have the capability to operate with nominal AVI/AEI System FE.

However, the environmental and operating conditions within which on board equipment has to function may be different according to geographical location, vehicle or equipment type, OBE location, etc. This pre-Standard provides options and environmental/operational classes to enable the market place to select the most appropriate OBE equipment, with the knowledge that, within the operating/environmental constraints selected, any properly configured Standard compliant AVI/AEI System FE shall have the capability to identify all Standard compliant AVI/AEI OBE's passing within its compass.

These Generic System specifications provide a migration path to later generations of equipment and to equipment of greater capability.

In order to enable an AVI/AEI system to operate across wide areas, it is necessary for the system to use the Standardised interfaces architecture and data structures normalised in this family of AVI/AEI pre-Standards. As particular system specification will vary, well declared and flexible structures are used. It is important, for example, that AVI/AEI System FE facilities can effectively operate different variants of OBE. The System specification defined in this pre-Standard support the numbering schemes and data structuring defined in ENV ISO 14816.

5.2 SYSTEM SPECIFICATION: ARCHITECTURE

It is the ***Vision*** of the AVI/AEI System specification pre-Standard to:

"provide a method (trans-national and interoperable) of automatically identifying a vehicle or item of equipment using a standard DSRC link."

Other subsequent Standards may determine Requirements for AVI/AEI Systems working at other air interfaces.

It is the ***Mission*** of the AVI/AEI System specification pre-Standard to:

"Define the functionality, environmental and operating parameters (System specification for AVI/AEI) such that they may achieve the objectives of the Vision Statement in an Open Systems Environment, enabling interoperability, whilst retaining the ability for different equipment to coexist."

According to the operational situation, AVI/AEI Systems may be viewed either as a service to support an application (such as the vehicle identification component in a public transport system or freight management system), or as an application in itself (for example, the identification of a 'probe' vehicle in a traffic management situation or in an enforcement situation). As such the AVI/AEI System function may be achieved using purpose specific dedicated equipment *(such as an AVI/AEI System transponder*), or may be achieved using equipment installed for the application that it supports, or indeed, using existing equipment installed for another application (*such as a freight logistics system utilising AVI techniques).* Such multi-application support and interoperability will be particularly common in respect of the OBE, although will also be required in respect of the FE.

5.2.1 Conceptual Architecture

See ENV 12314-1.

5.2.2 Logical Architecture

See ENV 12314-1.

5.2.3 Functional Architecture

See ENV 12314-1.

5.2.4 Control Architecture

See ENV 12314-1.

5.2.5 Identification Principles

This pre-Standard adheres to the Open Systems Interconnection (OSI) philosophy, i.e. the definition is concerned with the exchange of information between systems and not the internal functioning of each individual system component.

In order to co-operate, entities in any OSI layer, other than the lowest layer, communicate by means of the set of services provided by the next lower OSI layer.

This pre-Standard references the series of pre-Standards developed by CEN TC 278/WG9.

The work of ISO/TC 204, especially WG1/SG3, is taken into account as far as possible as are other existing relevant definitions of data elements (such as the 'Data elements to be used in surface transport applications of machine-readable cards' (CEN TC 224/WG11)).

Where the RTTT/TICS system service has to support devices in an interoperable environment, it is essential that the devices are capable of 'upwards migration', either to accommodate different types of devices in the emerging specifications, or as new generations of systems are developed.

5.2.6 Information Architecture

See ENV 12314-1 and ENV ISO 14816.

5.2.7 Physical (Application) Architecture

This Clause describes the physical configuration and physical interconnection of equipment to achieve its function (not the equipment itself).

The physical architecture shall be as defined in pre-Standard ENV 12314-1 clause 4.5.

The following clauses provide a summary of the Application Architecture.

In the majority of situations the objective of the AVI/AEI System function is to uniquely identify vehicles or equipment. In some circumstances the position may be reversed and it may be for a moving vehicle or equipment to identify a static or moving object *(such as a location identifier, or another moving vehicle or equipment).*

In some cases it is necessary to protect the identity of a vehicle or equipment for reasons of privacy or security. In these cases the AVI/AEI System shall provide an alias or temporary

unambiguous identification that does not necessarily provide the permanent identification of the vehicle or equipment. *(It may, for example, identify a smart card temporarily located in an on board unit*). However, such identifications are supported within this pre-Standard.

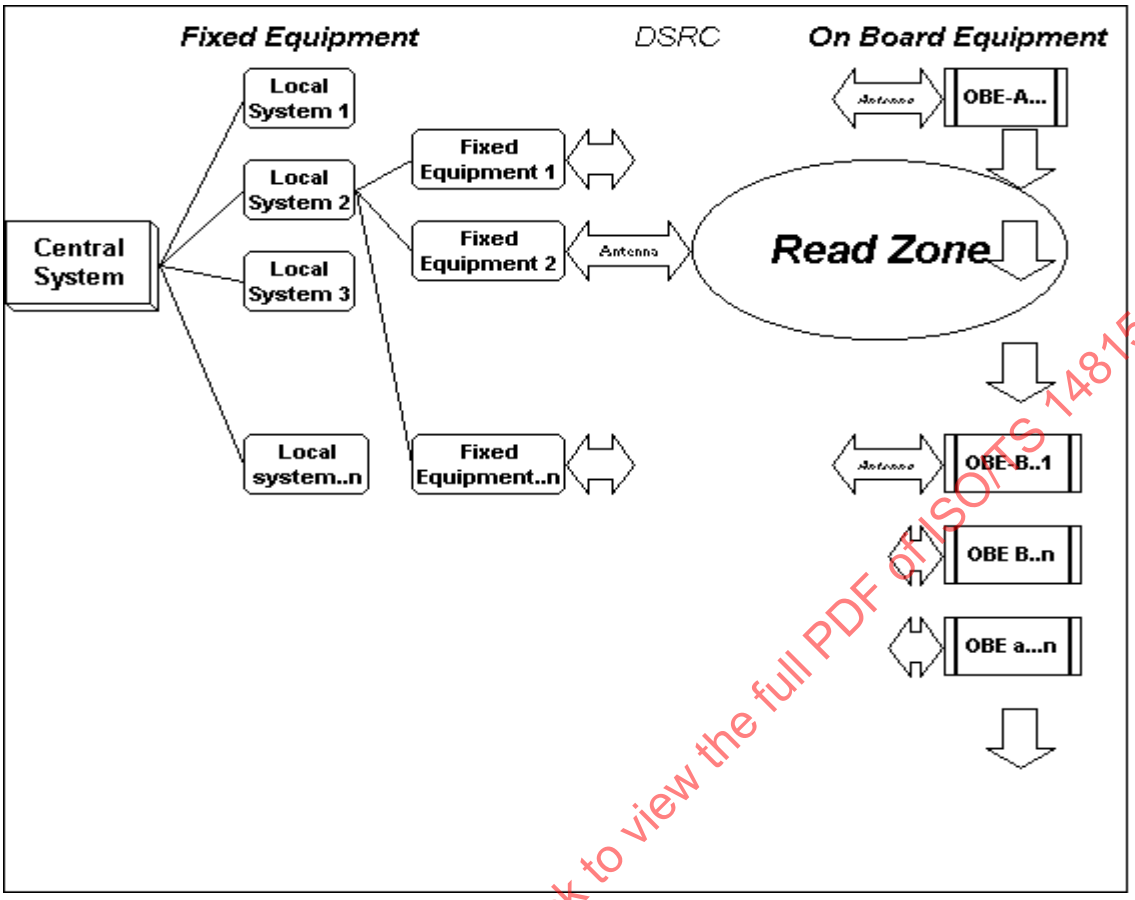

Figure 5-1: Example of physical architecture model

The example in Figure 5-1 shows one central FE system with a number of local FE systems. Each local system may have one or multiple FE connections. The example also shows OBE of two different types, without indication of the exact number of each.

The AVI/AEI System may be a stand alone function using dedicated equipment, or may be an application service within a more complex service (such as fee collection, route guidance, fleet management, etc.) achieved using the equipment provided for that service. The FE used may provide the functions of more than one service, or indeed the function may be performed by a combination of equipment (such as an interrogator plus an antenna).

The general application configuration shall comprise of FE and OBE (OBE) making use of the DSRC to communicate.

The FE shall utilise an antenna targeted on the identification zone. The FE shall normally, but not necessarily, be connected to either a local and/or a central computer system.

The OBE, shall utilise an antenna located such that it will pass through the identification zone.

As the OBE passes through the Identification Zone, communication shall be effected using a DSRC link (see clause 5.5 and prENV ISO 17264). All AVI/AEI System application specific data shall comprise of one or more Numbering Scheme(s) determined in ENV ISO 14816, or a 'Private' class data construct supported within that pre-Standard.

The AVI/AEI System identification component specified within this pre-Standard may be described as a 'bi-directional Monologue'. Bi-directional in that there shall be a communication phase where contact is established with the OBE and the OBE responds; a Monologue, in that the AVE/AEI identification is a data structure (or group of data structures) sent from the OBE to the FE.

Additional bi-directional data exchanges are permissible (and indeed are essential to support many application services) but are outside the domain of this AVI/AEI System pre-Standard. Other Standards for the Sector shall prescribe the form of these data exchanges.

An AVI/AEI System identification, or AVI/AEI System component of a more complex RTTT/TICS identification, shall only be regarded as a Standard compliant identification if it complies with the System specification determined in this pre-Standard. In order to ensure interoperability within the sector, no form of AVI/AEI System, other than that determined in this pre-Standard (and in its related pre-Standards ENV 12314-1 and ENV ISO 14816), may claim to be compliant with CEN TC278 RTTT Standards for AVI/AEI Systems or ISO TC204 TICS Standards for AVI/AEI Systems.

5.2.8 Deployment (Implementation) Design

The Deployment Architecture for AVI/AEI Systems is not considered appropriate for Standardisation.

5.3 SPECIFIC SYSTEM SPECIFICATION FOR STAND-ALONE AVI/AEI SYSTEMS

This clause defines the specific data exchange operation to achieve the AVI/AEI transaction.

The AVI/AEI transaction is an essentially simple bi-directional monologue transaction in which the FE requests the data from the OBE and the OBE provides its data.

The data shall comprise one or more Standardised data constructs as defined in ENV ISO 14816.

The transaction shall conform to prENV ISO 17264 and ENV 12795. The Clause below defines the description method used in describing the specific system specification for an AVI/AEI transaction.

5.3.1 GET function

The principal function to support access to the AVI/AEI data structures (defined in ENV ISO 14816) is:

GET

Note: This is the only standardised function required to perform AVI/AEI.

GET is an AVI/AEI System function used to initiate a read operation of AVI/AEI System information. i.e. AVI/AEI System application data

Usage: **GET**(<ASN.1DataStructureIdentifier>, Data)

5.3.2 Further (optional) functions

Some AVI/AEI systems may additionally provide further functions. The following functions are not mandatory, but if present shall conform to the following general form and to the definition to be specified in the AVI/AEI System Interface pre-Standard. This function requires a full bi-directional link.

5.3.2.1 SET

SET is an AVI/AEI System function used to put data into the memory of an on board equipment (OBE).

Usage: **SET**(<ASN.1 DataStructureIdentifier>.[DataElementIdentifier], data to be written,[<location>]).

5.4 SPECIFIC SYSTEM SPECIFICATION FOR THE AVI/AEI SYSTEM FUNCTION INCORPORATED INTO OTHER SYSTEMS

The AVI/AEI System may be used as an identification element within another application (e.g. fleet management, parking management, etc.).

Where an application requires simply an AVI/AEI System identification transaction it shall use the method defined in 5.3. above. In cases where there is an application-defined transaction using a standardised DSRC interface, this standard (ENV ISO 14815) does not apply.

5.5 AIR INTERFACE ASPECTS

This pre-Standard assumes the provision of adequate DSRC interface pre-Standards provided by ETSI (EN 300 674) and CEN (ENV 12253, 12795, 12834). The provisions and determinations specified within this pre-Standard assume a DSRC link at 5.795-5.805GHz as recommended by CEPT/ERC 22/04 or other frequencies as may be specified in such ETSI and CEN Standards. The air interface parameters will also be referenced in ENV ISO 17264.

Note 1: Whilst many of the system specification determined in this pre-Standard may be applicable regardless of the frequency, it will be necessary to reconsider each of the provisions of this pre-Standard in situations where new frequency ranges are to be used. Where appropriate, new Standards may need to be developed for specific frequency ranges.

Note 2: For the ISO parallel voting, the relevant ITU reference will be replacing or added to this clause as soon as available.

5.6 OPERATING PARAMETERS

5.6.1 AVI/AEI SYSTEM OPERATING PARAMETERS

In order to claim compliance a declaration for ALL tables, and table combinations shall be made. Omission of declaration of any one table or any table combination in this section shall constitute non conformance to the Standard.

Example: Where speed is claimed, the maximum number of transponders in zone must be declared; where life of transponders is claimed, the number of reads per period shall be declared.

5.6.1.1 Reliability, Availability, Lifetime, Maintainability.

The operational requirements for reliability, availability and maintainability on the AVI/AEI System level are formulated in a qualitative way, not quantitatively.

5.6.1.1.1 Reliability

This clause relates to the reliability requirements between reference points “alpha” and “delta” determined in ENV 12314-1.

In order to be considered reliable, a compliant AVI/AEI system shall deliver a declared maximum of undetected erroneous identification results under nominal operational conditions at reference point Beta.

5.6.1.1.2 Maintainability

The FE shall be designed to facilitate maintenance.

The OBE (excluding exchangeable batteries or external power source) shall not require maintenance.

5.6.1.1.3 Minimum number of identifications per year for the OBE

Table 5-1: Identification per year for OBE

CLASS	IDENTIFICATIONS PER YEAR *
A1	20,000
A2	10,000
A3	4,000
A4	2,000

* Where an internal battery is used in the OBE, Class A is to be considered in conjunction with Class B below. In order to claim compliance with a particular ‘Class A’ Classification, the OBE shall also meet the claimed OBE lifetime classification.

5.6.1.1.4 Lifetime of OBE

The minimum lifetime of the OBE shall be as determined in Table 5-2.

Table 5-2: Minimum lifetime of OBE

CLASS	OBE LIFETIME
B1	15 years
B2	10 years
B3	5 years
B4	3 years
B5	2 years
B6	1 year
B7	6 Months
B8	3 Months
B9	1 Month

Note: In the case of using an exchangeable battery in the OBEs, the lifetime of the battery shall be as determined in Table 5-3.

Table 5-3: OBE battery lifetime

CLASS	BATTERY LIFETIME*
BB1	15 years
BB2	10 years
BB3	5 years
BB4	3 years
BB5	2 years
BB6	1 year
BB7	6 Months
BB8	3 Months
BB9	1 Month

*Based on 500 transactions per month.

5.6.1.1.5 Distance between FE and OBE antennas

Table 5-4: Distance between FE and OBE antennas

CLASS	READING DISTANCE TEST POINTS
C1	20m
C2	10m
C3	6m
C4	3m
C5	1m
C6	0.5m

Note 1: To achieve Class C1, it shall read at all test point, Class C2, all test points up to 10m etc.

Note 2: Where EN 300 674 applies, distance shall be measured according to power levels as defined by EN 300 674. The power class, where applicable, shall be documented (e.g. Class C1/1, Class C1/2.etc). Applicable ETSI power classes shall not be exceeded.

5.6.1.2 OBE Installation

The technology adopted for an AVI/AEI System shall not preclude OBEs that can be installed by the user, without any aid from any expert.

Installation is to be effected according to an approved, documented procedure provided by the manufacturer.

When being fitted to a vehicle, the equipment and the whole installation must comply with the provisions relating to maximum tolerances laid down by the manufacturer specifications.

The equipment shall be immune to damage caused by the normal handling, connection and disconnection that are necessary for installation and maintenance activities.

This shall not preclude OBE's which are specifically designed to cease functioning upon removal or tampering.

5.6.1.3 Electromagnetic Disturbance

The AVI/AEI System shall be able to perform identifications in an environment with electromagnetic disturbance in accordance with IEC 61000-4-2 and EN 50081. For the radio link part EN 300 674 applies.

5.6.1.4 Emissions

The electric or magnetic fields produced by the AVI/AEI System shall not exceed the levels as specified in IEC 60215. This clause applies to both FE and OBE. For the radio link part EN 300 674 applies.

Example: Specifically IEC 60215 requires that the transmitted electric and magnetic fields shall not exceed 200V/m or 0.5 A/m, respectively over the frequency range 30 MHz to 30 GHz. This approximately corresponds to a radiation power density of 100 W/m^2 (10 mW / cm^2) and applies to distance greater than 5 cm from accessible surfaces of the equipment.

Note: For the ISO parallel voting, the relevant ITU reference will be replacing or added to this clause as soon as available.

5.6.2 AVI/AEI SYSTEM SPECIFIC OPERATING PARAMETERS

Due to the variations in size and loading configurations of items of equipment that may be encountered in an RTTT/TICS environment, references to distance detailed in this clause refer to distances between the OBE antennas.

The system must be able to operate within the limits as specified in the following tables.

Table 5-5: Maximum number of OBE antennas per cubic metre

CLASS	OBE's per m^3
D1	0.1
D2	1
D3	10
D4	25
D5	50
D6	100 and above

Note: Depending on technical solution, there may be a requirement to specify the maximum number of OBE in the read zone as a factor of passing speed

Table 5-6: Minimum distance between OBE antennas

CLASS	Clearance between OBE's
E1	1 cm
E2	5 cm
E3	10 cm
E4	25 cm and above

Note: This will normally reference distance between monolithic OBEs when mounted according to manufacturers specification.

Table 5-7: Passing speed

CLASS	Speed Test Point	
	Km/h	m/s
F1	240	66
F2	160	44
F3	120	33
F4	72	20
F5	18	5
F6	9	2.5
F7	3.6	1

Note 1: To achieve Class F1, it shall read at all test point, Class F2, all test points from 1m/s up to 66m/s etc.

Note 2: F5 to F7 are applicable classes for use in low-speed AEI environments such as inventory management etc., but are also used as stop-and-go traffic test points.

5.7 DATA STRUCTURE REQUIREMENTS

The overall requirements for AVI/AEI System data are determined within ENV ISO 14816.

5.8 PRIVACY

Privacy is not a mandatory requirement for a nominal AVI system (or system service) as its principle objective is to positively identify vehicles/equipment. Reference ENV ISO 14816 for further details.

5.9 INFORMATION SECURITY

Security data at the message level and the security information objects (such as cryptographic checksums) can optionally be provided by adequate measures, but do not form part of this pre-Standard. Reference ENV ISO 14816 for further details.

5.10 ENVIRONMENTAL PARAMETERS

This clause is applicable for all parameters of operation, transport, and storage

The following abbreviations are used to designate the environmental classes defined in IEC 60721:

B - Biological
C - Chemical substances
F - Contaminating fluids
K - Climatic
M - Mechanical

S - Mechanical substances
Z - Special Climatic conditions

5.10.1 FE environmental parameters

FE environmental parameters are classified in accordance to IEC 60721-3-4.

Table 5-8: Environmental conditions for the FE

CLASS	REFERENCE	CATEGORY
G1	IEC 60721-3-4	4K4/4Z2/4Z5/4Z8/4B1/4C2/4S3/4M4
G2	IEC 60721-3-4	4K3/4Z7/4B1/4C2/4S3/4M4
G3	IEC 60721-3-4	4K2/4Z7/4B1/4C2/4S3/4M4
G4	IEC 60721-3-4	4K1/4Z7/4B1/4C2/4S3/4M4

5.10.2 OBE environmental parameters

OBE environmental parameters are classified in accordance IEC 60721-3-5.

Table 5-9: Environmental conditions for the OBE

CLASS	REFERENCE	CATEGORY
H1	IEC 60721-3-5	5K4/5B1/5C1/5S1/5F1/5M3
H2	IEC 60721-3-5	5K3/5B1/5C1/5S1/5F1/5M2
H3	IEC 60721-3-5	5K2/5B1/5C1/5S1/5F1/5M2

5.11 SAFETY

As this pre-Standard does not deal with any single defined application and as the implementation architecture is not part of the pre-Standard it is not possible to include strict quantitative requirements on safety. However it is expected that manufacturers take account of safety aspects in product design. Annex D details some aspects that should be considered by manufacturers as a minimum.

6. TEST REQUIREMENTS

6.1 OBJECTIVES

It is the objective of this pre-Standard to provide specific reference criteria for test requirements and reference tests for equipment claiming conformance with this family of pre-Standards for AVI/AEI Systems.

Wherever possible, the test requirements determined in this pre-Standard are formulated and referenced to existing Standards. This pre-Standard provides references to such Standards by classes.

All normative testing required in order to claim compliance with this Standard shall be certified by an Accredited, Independent, Testing Body (AIB), approved by the Nation State.

6.2 OPERATIONAL PARAMETERS TO BE TESTED

6.2.1 General Test Requirements

6.2.1.1 Reliability

(Refer to 5.6.1.1.1).

6.2.1.1.1 Error Rates

The manufacturer shall satisfy the AIB (e.g. by means of calculation) that the system components have been designed such that any relevant accuracy (maximum tolerated error rate) requirements determined in this pre-Standard for a particular classification are met. (The form of such calculation is not predetermined).

6.2.1.1.2 Failure Rates

The manufacturer shall satisfy the AIB (e.g. by means of calculation) that the system components have been designed such that any relevant MTBF (Mean Time Between Failure) requirement determined or advised in this pre-Standard for a particular classification are met. (The form of such calculation is not predetermined).

6.2.1.2 Availability

(The form of availability check is not predetermined).

6.2.1.3 Lifetime

6.2.1.3.1 FE Lifetime

The manufacturer shall satisfy the AIB (e.g. by means of accelerated life cycle tests and/or calculation) that the FE is expected to meet its claimed expected lifetime.

6.2.1.3.2 OBE Lifetime

The manufacturer shall satisfy the AIB (e.g. by means of accelerated life cycle tests and/or calculation) that the OBE is expected to meet its claimed lifetime. (refer to 5.6.1.1.4).

6.2.1.4 Maintainability

(Refer to 5.6.1.1.2).

The OBE (excluding replaceable battery or external power source) shall not require maintenance throughout its claimed lifetime.

Note: Maintainability requirements for Fixed Equipment is considered to be a commercial agreement between Vendor and Purchaser, and is not covered by this standard.

6.2.1.5 Number of transactions/identifications per year (OBE):

The AIB shall ascertain to its satisfaction that the OBE shall, at the minimum, achieve the number of transactions/identifications per year in accordance to classification (as specified in this pre-Standard) claimed by the manufacturer.

Where the OBE has a non-replaceable battery, such certification shall be based upon usage of an internal/non-replaceable battery for the expected minimum lifetime of the OBE as specified in Table 5-3.

Where the OBE has a replaceable battery, the AIB shall ascertain to its satisfaction that the OBE shall meet the minimum number of transactions/identifications between battery changes to meet the requirements of the classification (as specified in this pre-Standard) claimed by the manufacturer.

6.2.1.6 Distance between FE and OBE antennas

The AIB shall certify compliance with respect to operation of the system at each of the test points of the reading range according to the classification (as specified in this pre-Standard) claimed by the manufacturer.

6.2.1.7 Distance between OBE's

The AIB shall certify compliance with respect to operation of the system distance at each of the test points between OBE's (or, where separated, OBE Antennas) according to the classification (as specified in this pre-Standard) claimed by the manufacturer. (Table 5-6).

6.2.1.8 Passing speeds

The AIB shall certify compliance with respect to operation of the system at vehicle speeds according to the classification (as specified in this pre-Standard) claimed by the manufacturer. (Table 5-7).

Annex A (informative): CATEGORIES FOR AVI/AEI SYSTEMS

Note: This annex is informative at this stage. At the stage of auditing ENV ISO 14815, this annex may be removed or put in as a normative annex, depending on the reactions from the national bodies who have implemented and used this pre-standard.

A.1 Classes & Categories

Whilst it may be desirable to determine a single set of requirements for operation in all environments and under all operating conditions, this could impose unacceptable costs.

Equipment shall be defined according to its classes as determined in this Standard.

However, determination into classes does not by itself enable interoperability. In order to achieve interoperability different operators need to use similar classes or groups of classes to provide their minimum requirement. This pre-Standard therefore provides a range of "categories" for common uses. These Categories are advisory, rather than mandatory, and are determined in order to make the adoption and interoperable use of the Standard both practicable and easy.

These categories comprise sets of classes that specify the environmental and operating parameters. The categories are as follows:

1. **Nominal Interoperable *"Ruggedised"***
   "Capable of operation in extreme (as defined in classes) RTTT Environment / Operating Conditions that may be expected; operable within a wide range of temperatures; waterproof; high specification in respect of vibration, thermal shock, chemical resistance."
2. **Nominal Interoperable *"Standard"***
   "Capable of operating within normal (as defined in classes) RTTT Environments / Operating Conditions that may be expected in the RTTT sector. OBE mounted inside the vehicle (with the possible exception of Antenna and connections from OBE to Antenna)."
3. **Nominal Interoperable *"Within Selected Environmental Classes"***
   "Capable of operating within all normal (as defined in classes) RTTT operating conditions, and conforming to selected classes with respect to the environments in which the equipment may be expected to function."
4. **Nominal Interoperable "*Within Selected Operational Classes"***
   "Capable of operating within all normal (as defined in classes) environments that may be expected, and conforming to selected classes with respect to one or more operational aspects (e.g. operational parameters such as maximum speed)."
5. **Nominal Interoperable "*Within Selected Environmental And Operational Classes*"**
   "Capable of operating within selected environmental and operational classes."
6. **Not Nominal Interoperable "*Within Selected Environmental And Operational Classes"***
   "Selected classes, not capable of operating as defined in the RTTT set of Standards."

Categories 1 and 2 represent the most stringent, and least flexible situations. They each have a fixed specification of classes. They are designed for widespread use.

Categories 3, 4 and 5 support a range of classes to enable interoperability within limited and definable ranges of environmental classes, operational classes, or a combination of the two.

Category 6 is a Category providing for classification of systems not suitable for full nominal interoperability but within common *"selected environmental and operational classes"*.

Note: The terms: "Extreme", "Normal", "Selected" with respect to environmental conditions refer to the classes defined in this pre-Standard.

The table below defines the operational and environmental categories.

Table A-1: System categories

	Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
ENVIRONMENTAL	Extreme	Normal	Selected	Normal	Selected	Selected
OPERATIONAL	Extreme	Normal	Normal	Selected	Selected	Selected

Each of the system categories are assigned a set of parameters as shown in the tables (Table A-2, Table A-3, Table A-4) below :

- Fixed Equipment
- On Board Equipment

Table A-2: Fixed equipment, operational and environmental conditions

		Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
Reading Distance	(C)	1	2	2	1-5	1-5	1-5
Speed	(F)	1	2	2	1-6	1-6	1-6
Environmental	(G)	1	2	1-4	2	1-4	1-4

Table A-3: On board equipment (AVI), operational and environmental conditions

		Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
ID's per Year	(A)	1	2	2	1-4	1-4	1-4
Lifetime	(B)	1	2	2	1-5	1-5	1-5
Reading Distance	(C)	1	2	2	1-5	1-5	1-5
Speed	(F)	1	2	2	1-6	1-6	1-6
Environmental	(H)	1	2	1-3	2	1-3	1-3

Table A-4: On board equipment (AEI), operational and environmental conditions

		Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
ID's per Year	(A)	1	2	2	1-4	1-4	1-4
Lifetime	(B)	1	2	2	1-5	1-5	1-5
Reading Distance	(C)	1	2	2	1-5	1-5	1-5
Speed	(F)	1	2	2	1-6	1-6	1-6
Environmental	(H)	1	2	1-3	2	1-3	1-3

A.2 Examples on use of classes for system specification

The three examples below indicate how users/operators may specify AVI/AEI system specification using this pre-Standard and the Categories.

A.2.1 EXAMPLE 1 : REQUIRING A NOMINAL AVI SYSTEM, CATEGORY 2

Identifying the system specification

In this example, an AVI/AEI operator selects an AVI/AEI system that shall provide:

- enable nominal interoperability
- a high level of performance for operational requirements
- operation in most foreseeable environmental conditions
- *but not ruggedised equipment*

In respect of the operational requirements, he may, for example require:

speed: 150 km/h, read distance 8 metres, OBE lifetime 10 years, 10,000 reads per year per OBE, .

This implies the following classes:

Description		Class
Reads/Year	10,000	A2
OBE Life	10 years	B2
Read Distance	8 metres	C2
Vehicle Speed	150 km/h	F2

In respect of the environmental parameters, he may, for example require

Operation in -35^0- +70^0 C, no influence of road salt, sand, dust, oils etc. (OBE behind windscreen), normal vibration and shock resistance.

This implies Class:

I2	IEC 60721-3-5	5K3/5B1/5C1/5S1/5F1/5M2

In this example, in the system specification the operator may refer to this Standard as follows

prENV ISO 14815 OBE: Classes: A2/BIP2/C2/D2/I2

In many cases many groups of users will have similar requirements (for example Freight operators within ENV Countries), and in these circumstances, to maximise interoperability, it will be simpler and more consistent to refer to one of the Categories in this Annex.

Using the Categories, in the system specification, the operator would refer to this Standard as follows:

prENV ISO 14815 OBE: Category 2

A.2.2 EXAMPLE 2: REQUIRING A NOMINAL AVI/AEI SYSTEM, CATEGORY 5

Identifying the system specification

In this example, an AVI/AEI operator selects an AVI/AEI system that shall provide:

- nominal interoperability
- a limited level of performance for access control (e.g. a parking operation)
- *not ruggedised equipment*

In respect of the operational requirements, he may, for example require:

speed: 20 km/h, read distance 3 metres, OBE lifetime 3 years, 2,000 reads per year per OBE,

This implies the following classes:

Description		***Class***
Reads/Year	*2,000*	*A4*
OBE Life	*3 years*	*B3*
Read Distance	*3 metres*	*C4*
Vehicle Speed	20 km/h	F4

In respect of the environmental parameters, he may, for example require

Operation in -25^0- +70^0 C, no influence of road salt, sand, dust, oils etc. (OBE behind windscreen)

This implies Class:

I3	IEC 60721-3-5	5K2/5B1/5C1/5S1/5F1/5M2

In this example, in the system specification specification the operator may refer to this Standard as follows

prENV ISO 14815 OBE: Classes: A4/B4/C4/D6/I3

In many cases many groups of users will have similar requirements (for example Freight operators within Tropical Countries), and in these circumstances, to maximise interoperability, it will be simpler and more consistent to refer to one of the Categories in this Annex.

Using the Categories, in the system specification, the operator would refer to this Standard as follows:

ENV ISO 14815 OBE: Category 5

A.2.3 EXAMPLE 3: REQUIRING A RUGGEDISED ANTENNA, CATEGORY 3

Identifying the system specification

In this example, a user may require a category 1 antenna together with a category 2 OBE, this implies that the antenna is to be mounted externally and therefore ruggedised whereas the OBE is mounted inside the vehicle and therefore subject to a different set of environmental parameters

- enable nominal interoperability
- a high level of performance for operational requirements
- operation in most foreseeable environmental
- *ruggedised equipment (extreme environmental)*

In respect of the antenna alone, the operational requirements are not applicable, he may, for example require:

speed: 150 km/h, read distance 8 metres, OBE lifetime 10 years, 10,000 reads per year per OBE, .

This implies the following classes:

Description		Class
Reads/Year	10,000	A2
OBE Life	10 years	B2
Read Distance	8 metres	C2
Vehicle Speed	150 km/h	D2

In respect of the environmental parameters, he may, for example require

Operation in -45^0 : +85^0 C, impervious to ingress of road salt, sand, dust, oils etc. (OBE mounted on exterior of vehicle), vibration and shock resistant, may be subjected to flying stones.

This implies Class:

I1	IEC 60721-3-5	5K4/5B1/5C1/5S1/5F1/5M3

In this example, in the system specification specification the operator may refer to this Standard as follows

prENV ISO 14815 OBE: Classes: A2/B2/C2/D2/I1

Using the Categories, in the system specification specification, the operator would refer to this Standard as follows:

ENV12314-3 OBE: Category 3

Annex B (informative): Environmental parameters to be tested

Note: This annex is informative at this stage. At the stage of auditing ENV ISO 14815, this annex may be removed or put in as a normative annex, depending on the reactions from the national bodies who have implemented and used this pre-standard.

B.1 General aspects

The purpose of environmental classification is to ascertain the environmental conditions within which the equipment is able to operate (including storage) and survive. Environmental test requirements shall therefore ascertain that the equipment is fully operable within parameters of the environmental conditions specified within a particular classification (specified within this pre-Standard) claimed by the manufacturer.

A further requirement of environmental tests is to ensure compliance with environmental safety regulations.

Where possible, all such tests are by reference to established International Standards.

Note 1: Before performing environmental tests, the AIB shall determine if the OBE or FE are to be considered as "Heat dissipating specimens" or not. This is defined according to IEC 60068-1:1998, chapter 4.3 "Heat-dissipating specimen".

Note 2: Typically the OBE may be expected to be non heat dissipating, while the FE will be heat dissipating.

B.2 Environmental tests

The following tests shall normally be performed as a sequence of tests, in this sequence and using the same samples, except where otherwise noted. After all tests, mechanical checks are performed.

In this ENV, most test parameters are specified, however, as the development of other relevant Standards is still in process, some are dependent on other Standards under development at the time of issue of this pre-Standard, and some parameters remain only partly specified. Further additions and revisions to this pre-Standard are therefore to be expected.

The basis for testing determined in this Standard is the already well defined and accepted IEC 60068 Series “Basic Environmental Testing Procedures”, part 1: General and Guidance and Part 4: Summary of Tests.

B.2.1 Solar radiation

Test Sa, procedure A, as described in IEC 60068-2-5 (see also IEC 60068-2-9).

Pre-conditioning	:	Stabilise temperature
Pre-checks	:	Mechanical inspection
Condition of DUT	:	Operational
Irradiance	:	As specified in the requirements.
Temperature in test enclosure	:	+40°C
Duration	:	IEC 60068-2-9, test b, 3 cycles
Measurements	:	“Simplified performance test” at the end of the last irradiation period

Measure temperature rise inside of DUT. If it is necessary to damage the DUT to do this, then this measurement must be performed on separate sample(s). However the sample(s) to be used for the following tests, should also go through this test first.

B.2.2 Low temperature tolerence

Test Ab for non-heat dissipating specimen and test Ad for heat dissipating specimen. These are described in IEC 60068-2-1.

Condition of D.U.T.	:	Operational
Temperature	:	Same as low air temperature as specified.
Duration	:	For 96 hours .
Measurements	:	“Simplified performance test” should be performed at the end of the exposure (conditioning)

B.2.3 Dry Heat

Test Bb for non-heat dissipating specimen and test Bd for heat dissipating specimen. To be carried out according to, and as described in IEC 60068-2-2.

Condition of D.U.T.	:	Operational
Temperature	:	High air temperature as specified, plus the temperature rise found in test Sa (see B.2.1).
Duration	:	For 96 hours.
Measurements	:	“Simplified performance test” should be performed at the end of the exposure (conditioning).

B.2.4 Rapid change of temperature air/air

Test Na; to be carried out according to, and as described in IEC 60068-2-14 (see also IEC 60068-2-33).

Condition of D.U.T.	:	Operational
Temperatures	:	As given in requirements
Number of cycles	:	5
Change-over time	:	30s (automatic transfer)
Exposure time	:	For 30 min
Measurements	:	“Simplified performance test“ should be performed immediately after the last exposure. This measurements may be performed in standard atmospheric conditions (see IEC 60068-1:1998, chapter 5.3).

B.2.5 Gradual change of temperature air/air

Test Nb; to be carried out according to, and as described in IEC 60068-2-14 (see also IEC 60068-2-33).

Condition of D.U.T.	:	Operational
Temperatures	:	As specified in requirements
Number of cycles	:	2
Rate of change of temperature	:	As specified in requirements.
Exposure time	:	For 30 min
Measurements	:	“Simplified performance test” should be performed at the start of the test, and each 5 minutes during the test period.

B.2.6 Rapid change of temperature air/water (not applicable where OBE is mounted inside)

Test Nc; to be carried out according to, and as described in IEC 60068-2-14, except that air is used at the higher temperature.

Condition of D.U.T.	:	Operational
Temperatures	:	As given in requirements
Number of cycles	:	10
Change-over time	:	2s
Exposure time	:	5 min
Measurements	:	“Simplified performance test” should be performed immediately after the last exposure. This measurements may be performed in standard atmospheric conditions (see IEC 60068-1:1998, chapter 5.3).
Liquid	:	Water
Exceptions from std. test	:	Air is used instead of liquid at the higher temperature. The exposure time at the higher temperature must then be increased higher than at the lower temp.

B.2.7 Impact and non stationary vibration, shock

IEC tests Ea (IEC 60068-2-27), Eb (IEC 60068-2-29), Ec (IEC 60068-2-32), Ed (IEC 60068-2-32) and Ee (IEC 60068-2-55) are considered. These shall then be linked to the requirement specifications.

Performance measurements will not be made during conditioning in this case, but are done immediately afterwards.

B.2.8 Stationary vibration, sinusoidal

Test Fc; to be carried out according to, and as described in, IEC 60068-2-6.

Condition of D.U.T.	:	Operational
Displacement /acceleration amplitude	:	10 mm
Frequency range	:	10 Hz - 150 Hz, (or as specified in requirements)
Procedure	:	Endurance by sweeping with vibration response investigation to find critical frequencies. Then endurance at the critical frequencies is found.
Duration of sweeping	:	For 2 hours / axis
Duration at critical freq's	:	For 10 min.
Measurements	:	"Simplified performance test" should be performed at the lower, logarithmic middle and upper sweep frequencies and at each of the critical frequencies tested (at the end of the exposure to each frequency). "Simplified performance test" should also be performed after the complete test.

Note: It should be investigated if the random test below could be extended to give the same information as this test, so that this test could be skipped when the random test is performed.