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Space systems — Subsystems/units to spacecraft interface control document

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Space systems — Subsystems/units to spacecraft interface control document

Systèmes spatiaux — Document de contrôle des interfaces entre les sous-systèmes/unités et le véhicule spatial

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Foreword

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ISO 11892 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

INTERNATIONAL STANDARD ISO 11892:2012(E)

Space systems — Subsystems/units to spacecraft interface control document

1 Scope

This International Standard provides space system manufacturing organizations with the minimum interface related items and generic format for creating the interface control document (ICD) which subsystems or units suppliers prepare for spacecraft systems (SC) integrators.

In this International Standard, ICD is not defined to contain descriptions regarding various properties of subsystems or units or tasks to be done by suppliers, i.e. performance, functions, endurance to launch mechanical environment, or quality assurance provisions. Such descriptions are presumed to be defined in other contractual documents such as technical specifications.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendment) applies.

ISO 15864:2004, *Space systems — General test methods for space craft, subsystems and units*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

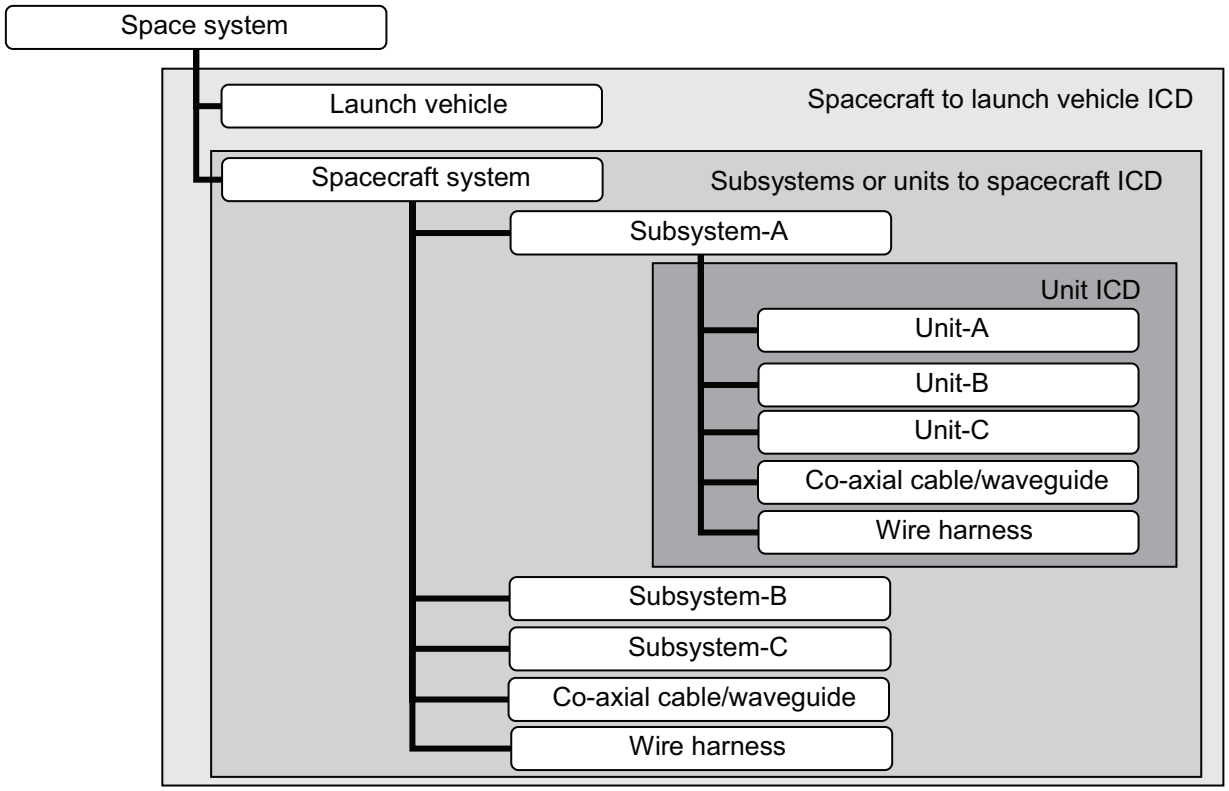
3.1.1
subsystem
assembly or group of electrical, thermal and/or mechanical units which is dedicated to specific functions of a spacecraft system (SC)

3.1.2
unit
independently handled device at the lowest level of hardware assembly that works with specified complex electrical, thermal and/or mechanical functions

NOTE Several units build up a subsystem. A single unit may occasionally comprise a subsystem by itself.

3.1.3
subsystems/units to spacecraft interface control document
set of documents that defines and controls the electrical, thermal, and mechanical interface requirements between a subsystem and the spacecraft system (SC)

NOTE Figure 1 illustrates the hierarchy of a space system and the ranges where various interface control documents are applicable.



Hierarchy of a space system and related interface control document (ICD)

3.2 Abbreviated terms

CAD computer aided design

ICD interface control document

IDS interface data sheet

MOI moment of inertia

RF radio frequency

4 Subsystem to spacecraft ICD

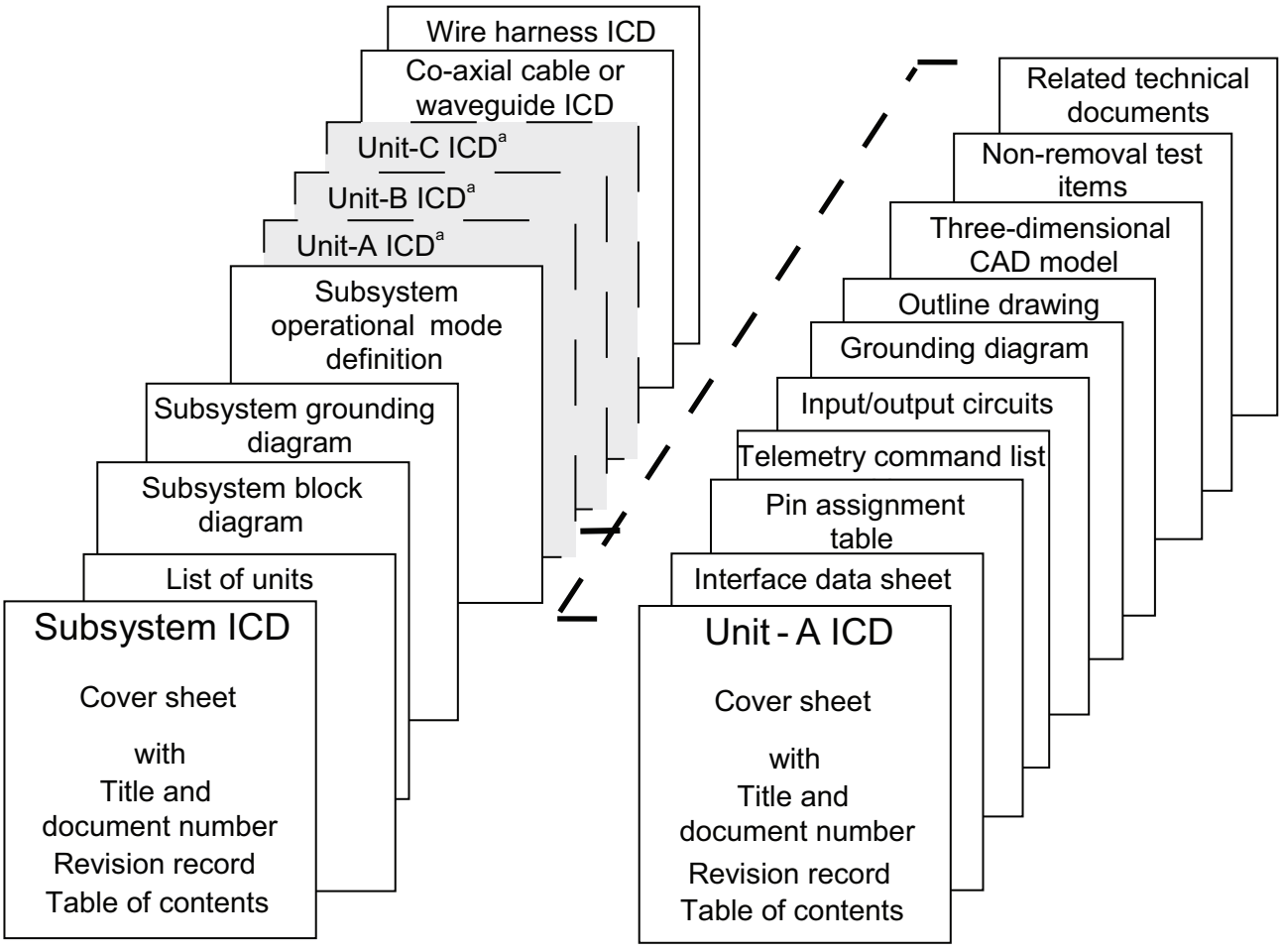
4.1 General

A subsystem ICD is a package constructed of sub-documents as shown in Table 1. It shall contain configuration control information, subsystem definition diagrams, and if applicable, co-axial cable or waveguide or wire harness in the subsystem. An individual ICD of each unit in the subsystem is normally a separate document. However, it may be contained as part of the subsystem ICD.

Layered construction of a subsystem ICD package is illustrated in Figure 2.

Construction of subsystem to spacecraft ICD package

No	Title	Description (Subclause)
1	Cover sheet (with title and document number, revision record and table of contents)	4.2
2	Applicability	4.3
3	List of units	4.4
4	Subsystem block diagram	4.5
5	Subsystem grounding diagram	4.6
6	Subsystem operational mode definition (if applicable)	4.7
7	Unit ICD (if applicable)	4.8
8	Co-axial cable or waveguide ICD (if applicable)	4.9
9	Wire harness ICD (if applicable)	4.10



[a] The individual ICD of each unit may be contained as a part of the subsystem ICD.

Layered construction of subsystem ICD package

4.2 Cover sheet

4.2.1 Title and document number

The cover sheet of the subsystem ICD shall contain the following items:

— title of the subsystem ICD package;

— document number of the ICD package;

— issue date;

— issuing organization.

4.2.2 Revision record

The revision record shall contain the following items:

— revision number;

— revision date;

— summary of revision contents;

— authorization.

4.2.3 Table of contents

The table of contents shall indicate the name, document number and revision number of the following sub-documents which build up the subsystem ICD:

— list of units;

— subsystem block diagram;

— subsystem grounding diagram;

— subsystem operational mode definition (if applicable);

— unit ICD (if applicable);

— co-axial cable or waveguide ICD (if applicable);

— wire harness ICD (if applicable);

— non-removal test items (if applicable).

4.3 Applicability

The following information shall be addressed in the ICD:

— applicable documents;

— definitions;

— physical units.

4.4 List of units

The list of units shall contain all units included in the subsystem, including the co-axial cable or waveguide and/or wire harness provided to the spacecraft system by the subsystem organization. The list of units shall include the document number and revision record of each unit ICD if it is a separate document.

4.5 Subsystem block diagram

The subsystem block diagram shall graphically indicate the connection and relationship of all of the units included in the subsystem. The subsystem block diagram shall also show the connection and relationship between the subsystem and other relevant subsystems.

4.6 Subsystem grounding diagram

The subsystem grounding diagram shall graphically indicate the grounding and bonding configuration of all the units included in the subsystem.

4.7 Subsystem operational mode definition (if applicable)

The subsystem operational mode definition shall indicate all of the operational modes of the subsystem if applicable.

For this International Standard, "operational mode" is defined as any operational status which has different power consumption or heat dissipation from another status. Operational modes can also be differentiated by mechanical configurations, e.g. before and after deployment.

The definition shall also describe whether transition to the designated mode is caused by the subsystem itself or by a trigger from another subsystem.

4.8 Unit ICD (if applicable)

The unit ICD shall show the interface information of each unit contained in the subsystem. Details are defined in Clause 5.

4.9 Co-axial cable or waveguide ICD (if applicable)

The co-axial cable or waveguide ICD shall show the interface information of the co-axial cable or waveguide connecting the units in the subsystem or connecting the units to other subsystems.

4.10 Wire harness ICD (if applicable)

The wire harness ICD shall show the interface information of the wire harness connecting the units in the subsystem or connecting the units to other subsystems.

5 Unit ICD in detail

5.1 General

A unit ICD is a document package constructed from a sub-document as shown in Table 2.

Construction of unit ICD package

No	Title	Description (Subclause)
1	Cover sheet (with title and document number, revision record and table of contents)	5.2
2	Interface data sheet (IDS)	5.3
3	Pin assignment table	5.4
4	Telemetry command list	5.5
5	Input/output circuits	5.6
6	Grounding diagram	5.7
7	Outline drawing	5.8
8	Three-dimensional CAD model (if applicable)	5.9
9	Non-removal test items (if applicable)	5.10
10	Related technical documents (if applicable)	5.11

5.2 Cover sheet

5.2.1 Title and document number

The cover sheet of a unit ICD shall contain the following items:

— title of the unit ICD package;

— document number and revision of the ICD package;

— issue date;

— issuing organization.

5.2.2 Revision record

The revision record shall contain the following items:

— revision number;

— revision date;

— summary of revision contents;

— authorization.

5.2.3 Table of contents

The table of contents shall indicate the name, document number and revision number of each sub-document which builds up the unit ICD:

— interface data sheet;

— pin assignment table;

— telemetry command list;

— input/output circuits;

— grounding diagram;

— outline drawing;

— photographs (if applicable);

— three-dimensional CAD model (if applicable);

— structure mathematical model (if applicable);

— thermal mathematical model (if applicable);

— appendix.

5.3 Interface data sheet (IDS)

Each interface item shall be given in the standard tabular format. A sample is shown in Table 3.

If the description is expressed with a drawing, figure or separate document, the ID number shall be listed.

Values shall be given with appropriate tolerances reflecting design maturity.

Interface data sheet (IDS) **— Example**

Name	Full name of the unit	**Part number**	Part number of the unit
Acronym	Abbreviation of unit name	**Revision**	Issue of the table

Category	**No**	**Item**	**Description**	**Notes**
Mechanical	1	Identification	Describe identification marking labelled on the unit. Indicate location of the label.	Refer to drawing
	2	Physical configuration	Indicate the physical configuration with outline dimensions.	In drawing
	3	Dynamic envelope (volume)	Indicate the envelope affected e.g. by vibrations, acoustic influence, etc.	In drawing
	4	External surface finish	Describe surface finish of external surface except for mounting surface.	Refer to drawing
	5	Mounting surface finish	Describe surface finish of mounting surface.	
	6	Mounting surface roughness	Describe roughness of mounting surface.	
	7	Mounting surface flatness	Describe flatness of mounting surface.	
	8	Materials	Describe material of chassis, and connectors if they use non-standard materials.	May refer to declared material list if available
	9	Thickness of mounting foot	Describe the thickness of mounting foot.	Refer to drawing
	10	Key hole location	Indicate the key (datum) hole location.	In drawing
	11	Mounting hole location	Indicate the mounting hole location and quantity.	In drawing
	12	Fastener	Describe the type of fastener.	
	13	Fastener torque	Describe fastener torque with tolerance.	Unit: Nm
	14	Coordination system	Describe the coordination system of the unit.	
	15	Mounting requirement	Describe specific requirements for mounting, e.g. alignment.	
	16	Stiffness	Describe the lowest fundamental natural frequency in mounted configuration, for each axis if required.	Unit: Hz
	17	Mass	Describe mass with tolerance.	Unit: kg
	18	Center of mass location	Indicate the location of centre of mass.	In drawing
	19	Mass properties	Describe product of inertia and moment of inertia (MOI) for each axis through centre of mass with tolerance.	Unit: kg/m^2

Interface data sheet (IDS) *(continued)*

Name	Full name of the unit	**Part number**	Part number of the unit
Acronym	Abbreviation of unit name	**Revision**	Issue of the table

Category	**No**	**Item**	**Description**	**Notes**
Electrical	20	Radio frequency (RF) input/output connector	Indicate location and ID of RF connectors. Show pin assignment list as defined in Table 4.	In drawing
	21	Grounding/bonding point	Indicate location of the grounding or bonding point where continuity check will be made.	In drawing
	22	Non-RF input/output connector	Indicate location and ID of non-RF connectors. Show pin assignment list as defined in Table 4.	In drawing
	23	Operational modes	Describe operational modes defining power consumption and heat dissipation.	
	24	Power consumption	Describe power consumption in each operational mode with tolerance. Provide maximum and minimum values considering input voltage variation and temperature. Indicate time variation, if applicable.	Unit: W Refer to 2D plot for time variation
	25	RF power	Describe RF power in each operational mode with tolerance. Provide maximum and minimum values considering power variation. Indicate time variation if applicable.	Unit: W or W/m^2

Interface data sheet (IDS) *(continued)*

Name	Full name of the unit	**Part number**	Part number of the unit
Acronym	Abbreviation of unit name	**Revision**	Issue of the table

Category	**No**	**Item**	**Description**	**Notes**
Thermal	26	Contact area	Describe mounting surface contact area.	Unit: mm^2 Refer to drawing or photograph
	27	Heat dissipation	Describe heat dissipation in each operational mode with tolerance. Provide maximum and minimum values considering input voltage and temperature. Indicate time variation, if applicable. Indicate the different localizations of heat dissipation (e.g. within an RF chain of units).	Unit: W Refer to 2D plot for time variation Refer to figure or drawing for localization
	28	Heat flow rate density	Describe heat flow rate density at mounting interface. Indicate heat spot location in drawing if required.	Unit: W/m^2
	29	Heat capacity	Describe heat capacity of the unit.	Unit: J/°C
	30	Allowable temperature range	Describe allowable temperature range in non-operational, operational, and start up (with qualification and acceptance limits). Describe allowable limits at launch with mechanical loads if applicable.	Unit: °C Refer to separate table if complicated
	31	Allowable temperature transition rate	Describe allowable temperature transition rate.	Unit: °C/min
	32	Temperature reference point	Indicate location where allowable temperature is defined on the unit.	In drawing
	33	Temperature sensor location	Indicate location of temperature sensor(s).	In drawing

Interface data sheet (IDS) *(continued)*

Name	Full name of the unit	**Part number**	Part number of the unit
Acronym	Abbreviation of unit name	**Revision**	Issue of the table

Category	**No**	**Item**	**Description**	**Notes**
Thermal	34	Temperature sensor type	Describe type of temperature sensor.	
	35	Interface temperature	Define temperature range of the spacecraft structure where unit is mounted. Define requirements for interface temperature stability and interface temperature homogeneity if applicable.	
	36	Emissivity	Describe the emissivity of external finish. Clarify whether value is for hemispherical or normal emissivity. Describe name/reference of the finish, area, temperature variation, ageing (beginning of life/end of life) and specularity.	Refer to separate table Refer to 2D plot, drawing and photograph if applicable.
	37	Absorptivity	Describe the solar absorptivity of external finish, if unit is exposed to space environment. Describe name/reference of the finish, area, temperature variation, ageing (beginning of life/end of life) and specularity.	Refer to separate table Refer to 2D plot, drawing and photograph if applicable.
	38	Active thermal control characteristics	Describe the characteristics of active thermal control, such as thermostat-controlled heaters, thermo electric coolers or cryogenic coolers. Describe temperature stability and homogeneity if applicable.	Refer to drawing, figure or photograph if applicable.
	39	Passive thermal control characteristics	Describe the characteristics of passive thermal control, e.g. multi-layer insulations, thermal insulating fixations, thermal straps etc. Describe temperature stability and homogeneity if applicable.	Refer to drawing, figure or photograph if applicable.

Interface data sheet (IDS) *(continued)*

Name	Full name of the unit	**Part number**	Part number of the unit
Acronym	Abbreviation of unit name	**Revision**	Issue of the table

Category	**No**	**Item**	**Description**	**Notes**
Misc.	40	Envelope for deployable portion	Indicate the envelope of the deployable elements of the unit in drawings.	
	41	Deployable characteristics	Describe the dynamic disturbance of the deployable elements.	
	42	Field of view	Indicate the field of view of the unit in drawings.	
	43	Rotor characteristics	Describe the dynamic characteristics of rotating elements, e.g. mass, speed, axis, MOI.	
	44	Structure mathematical model	Indicate the document number if applicable. The model shall be submitted in another package or electronically.	
	45	Thermal mathematical model	Indicate the document number if applicable. The model shall be submitted in another package or electronically.	
	46	Polarity	Describe specific requirements of unit regarding polarity and direction, which shall be managed by the SC integrator — Definition of geometrical axes and directions of attitude sensors, and their relationship with electrical signal polarity; — Definition of geometrical axes and directions of moving element or rotating object, and their relationship with electrical signal characteristics; — Definition of geometrical axes and directions of attitude control actuators, and their relationship with drive signals; — Relationship between switch positions and drive signals.	
	47	Standard signal interface	Define major frame rate and minor frame rate.	
	48	Electromagnetic compatibility	Indicate electrical and magnetic fields within which units stay at their full functional performance.	For particularly sensitive units
	49	Mechanical stay-out zone or authorised zone	Indicate stay-out zone or authorised zone for integration at higher levels of flight/test hardware (e.g. thermal control subsystem components as temperature sensors, heaters or multi-layer insulations, etc.).	In drawing

5.4 Pin assignment table

The pin assignment table of RF and non-RF connectors shall show the pin assignment and characteristics of the signals of each connector in the unit. A sample is shown in Table 4.

Pin assignment table — Example

No	Item	Description	Notes
1	Connector ID	Define connector ID	
2	Type	Describe connector type	
3	Product name	Describe commercial product name	
4	Pin number	Describe pin number	
5	Full name of signal	Describe full name of signal	
6	Acronym for signal	Describe abbreviated name of signal	
7	Type of signal	Describe type of signal (e.g. analog, digital, pulse)	
8	Wire gauge	Describe wire gauge (AWG) within unit	
9	Current	Describe current	Unit: mA
10	Voltage	Describe voltage	Unit: V
11	Input or output	Designate input or output	
12	Frequency or bit rate	Describe frequency or bit rate of the signal	
13	Interface circuit	Designate interface circuit defined in 5.6	
14	HOT/Return pairing information	Describe pairing HOT or Return pin number, if applicable	
15	Requirement for harness	Describe requirement for harness (shielding, twisting, etc.)	
16	Redundant connection type	Define redundant connection type (e.g. single, wired or cross strap)	
17	Redundant pairing information	Describe pairing redundant pin number if applicable	
18	Destination	Define connection destination	
19	Notes	Describe special requirements or notifications	
20	Resistance to grounding	Describe insulation resistance of wires against grounding if applicable	Unit: M Ohm

5.5 Telemetry command list

This section shall show a tabular list which describes the following characteristics of the telemetry and commands for the unit:

— ID number;

— abbreviated name;

— signal type;

— packet length;

— description.

5.6 Input/output circuits

This section of the ICD shall show the simplified full schematic diagram of each input/output interface circuit.

Detailed schematics shall show full components reference, internal power supply range and RLC figures.

5.7 Grounding diagram

This section shall show a simplified schematic diagram which illustrates the grounding and bonding connections of the unit.

5.8 Outline drawing

This section of the ICD shall show configuration drawings of the unit, which show and define the following physical characteristics of the unit with appropriate tolerances reflecting design maturity:

— outline dimensions with maximum envelope;

— mounting hole location, size and quantity;

— mounting footprint;

— mounting foot thickness;

— location of identification marking;

— location of centre of mass;

— location and orientation of connectors with pin#1 location;

— location of temperature reference point;

— location of temperature sensors;

— location of venting holes;

— location of ground path;

— field of view (if applicable);

— coordinate axes definition;

— mechanical stay-out or authorised zones;

— external surface finishes of major exposed parts.

5.9 Three-dimensional CAD model (if applicable)

This section shall describe the three-dimensional CAD model of the unit. The model shall be submitted in another package or electronically.

An example of the model data format is the STEP format defined in ISO 10303-203.

5.10 Non-removal test items (if applicable)

This section shall describe non-removal test items as interface information, if applicable. Non-removal test items are the test devices left in flight hardware after use, e.g. thermocouples, strain gauges and accelerometers installed inside the unit. They shall be indentified in the ICD and inhibited or disabled after use if applicable.

5.11 Related technical documents (if applicable)

This section shall describe the related technical documents used to draft the ICD, if applicable, such as the design basis of ICD, analysis documents of products etc.

6 Verification

6.1 General

Each subsystem or unit provider shall provide the SC integrator with the documents necessary to assure compliance of the deliverable hardware with the ICD.

6.2 Verification method

In principle, all the items described in the ICD shall be verified. The verification methods shall be inspection, test or analysis, depending on each item. The basic physical characteristics such as physical dimensions shall be measured. However, complex physical characteristics, such as MOI, may be verified by analysis based on measurements. General requirements for testing and inspection are defined in ISO 15864.

Bibliography

[1] ISO 10303-203, *Industrial automation systems and integration — Product data representation and exchange — Part 203: Application protocol: Configuration controlled 3D design of mechanical parts and assemblies*

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