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Space systems — Non-flight items in flight hardware — Identification and control

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Foreword

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ISO 22108 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

Introduction

It is essential that non-flight items which have been used for test, safety or as production aids are removed from flight hardware before flight, so that they do not interfere with mission performance. In order to achieve that requirement, positive identification of such non-flight items is needed. A log needs to be maintained of all critical non-flight items pertaining to a stated piece of flight hardware. Each item needs to be identified by coloured streamers and covers as appropriate. Upon removal from the hardware, evidence of removal needs to be recorded for each item, e.g. by placing the item in a dedicated accountability box that is then photographed when full to demonstrate complete removal of all non-flight items from the hardware. This International Standard addresses the identification of non-flight items and the control measures required to ensure their removal before launch.

Throughout this International Standard, the minimum essential criteria are identified by the use of the key word “shall”. Recommended criteria are identified by the use of the key word “should”, and while not mandatory, are considered to be of primary importance in providing serviceable, economical and practical procedures. Deviation from the recommended criteria is acceptable only after careful consideration, extensive testing and thorough service evaluation have shown alternative methods to be satisfactory.

Space systems — Non-flight items in flight hardware — Identification and control

1 Scope

This International Standard describes the identification of critical non-flight items in space flight hardware and the procedure to account for their complete removal prior to flight. This International Standard is used in context with project-specific quality requirements and procedures related to flight hardware and related activities prior to launch and at the launch site. Verification of removal of critical non-flight items is described in this International Standard.

Removal of other non-flight items is outside the scope of this International Standard and is verified by relevant inspection procedures.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
critical non-flight item
item of non-flight equipment whose presence in or on launched flight hardware would severely jeopardise mission performance

EXAMPLE Protective equipment cover, safety device, locking pin, fastener, ground support interface equipment.

2.2
other non-flight item
item of non-flight equipment that is not considered in the procedure described in this International Standard

EXAMPLE Tape and connector caps that can be used to provide temporary protection.

3 Control method

3.1 General

The control of critical non-flight items shall consist as a minimum of three elements, as follows:

a) log of critical non-flight items;

b) visual identification of critical non-flight items;

c) storage of critical non-flight items.

Appropriate procedures for handling non-flight items should be defined. In addition, good practice may involve using additional documentation, including

— the operation manual, and

— a data card for the products involved.

Note that the log of critical non-flight items implies maintaining a full list of all critical non-flight items, as well as a log recording the current status of each item.

3.2 Responsibilities

A person or persons shall be identified as being responsible for each of the following tasks:

a) ensuring that each critical non-flight item is identifiable as described in this International Standard;

b) providing a complete list of critical non-flight items;

c) creating the log of critical non-flight items;

d) ensuring the log is maintained accurately;

e) retaining the log and evidence of removal with an appropriate level of security;

f) establishing a dedicated storage facility for critical non-flight items.

Suggested responsible bodies are indicated below.

Non-flight items should be designed and manufactured with provisions for identification and to the correct colours.

The organizations responsible for fitting the non-flight item should ensure that it is identified in accordance with this International Standard.

The flight hardware design authority should produce a list of all critical non-flight items, identifying the requirements for major test phases and launch site activities.

Using these lists, a delegated quality representative or other person should be responsible for

— the preparation of the critical non-flight item log,

— its subsequent signature endorsement when these items are removed, and

— for controlling access to the dedicated storage facility.

The assigned technicians should be responsible for removal of the non-flight items, together with associated streamers/covers and their placement in the dedicated storage facility. At completion of each placement, the technician should sign the log against the relevant item(s).

3.3 Log of critical non-flight items

The identities and serial numbers (where applicable) of all critical non-flight items shall be recorded in a non-flight items log when the item is attached or assembled to the flight hardware.

NOTE An example of a non-flight items log is given in Annex B.

Specific logs may be produced identifying the individual requirements for the following major activities:

— vibration testing;

— spin balancing;

— solar simulation;

— launch activities.

Individual logs shall be maintained for each piece of hardware, as appropriate. These logs shall be compiled into a single flight hardware log, from which it can be ascertained that all non-flight items have been removed when the flight hardware is complete and ready for launch.

When the critical non-flight item is removed from the flight hardware, the removal shall be recorded in the log. The removal should also be recorded in the product's data card (when this is used) together with a list of persons responsible for this operation along with their signatures.

3.4 Visual identification

Critical non-flight items fitted to flight hardware at assembly, integration and test (AIT) and subsequent stages (e.g. environmental test, fuel loading and installation of the flight hardware onto the launch vehicle) shall be clearly and visually identified. Identification may be by the attachment of streamers conforming to the requirement of 4.1, or where the use of streamers would cause a hazard themselves (e.g. mechanisms or optical sensors) coloured covers may be used.

The method of identification shall be recorded in the relevant critical non-flight items log book.

Each streamer and cover shall be uniquely identified to simplify checks for missing items.

3.5 Storage of critical non-flight items

All critical non-flight items removed from the flight equipment shall be placed in a dedicated storage facility clearly identified as to its purpose. This facility shall provide appropriate and identified storage for all critical non-flight items and any special tools required for their installation or removal. It may also contain a configured item reference so the presence of all listed items can quickly be determined.

Items too large for the dedicated storage facility (e.g. thruster covers or items of mechanical ground support equipment) shall be kept at a safe, controlled and identified location.

All fixings for covers, etc. shall be fully accounted for and maintained with their respective covers.

Critical non-flight items placed in the dedicated storage facility, or otherwise kept securely, shall be kept for a period not less than the operational period of the equipment they were protecting if the operational manual does not explicitly state otherwise.

3.6 Removal of non-flight items from flight hardware

As each critical non-flight item is removed from the flight hardware (even temporarily), it shall be placed, together with the associated streamer or cover (as applicable) and associated special tools, in the dedicated storage facility. Items too large for this facility shall be stored in an appropriate place, if possible, nearby. The critical non-flight item log shall be signed and dated by the technician removing the item and by the delegated quality representative. During removal, particular care should be taken to avoid damaging the flight equipment, and large metal non-flight items (e.g. thruster covers) should be earthed up to the moment of their removal.

Critical non-flight items that are repeatedly removed and replaced (e.g. test equipment) shall be reinstated in the log each time they are placed on the flight equipment such that the non-flight item log reflects the current configuration of non-flight items on the flight equipment at all times.

Evidence of removal and the log of critical non-flight items shall be retained until non-flight item removal for the item concerned is confirmed by mission performance verification or until the end of the mission.

3.7 Evidence of removal

An appropriate method shall be used to provide lasting evidence that all critical non-flight items have been removed from the flight hardware and placed in their dedicated storage facility or location. Evidence may be in the form of photographs.

This evidence shall be attached to the log.

4 Materials and construction

4.1 Identification streamers/covers

4.1.1 General

Some typical streamers are described in Annex A. Identification streamers and covers should conform to the requirements given in 4.1.2 to 4.1.4.

The length of the streamer should be selected to suit location of installation. While the attached streamer should be visible, the length should be kept as short as possible to avoid damage in the attachment area.

4.1.2 Materials

All materials used in the construction of identification streamers/covers shall be compatible with the environments to which they are likely to be exposed (e.g. high or low temperature, vacuum) and suitable for use in clean rooms and flight hardware assembly halls.

Streamers and covers shall be of a material selected to prevent physical damage or contamination to personnel and items of flight hardware.

Attachment devices for streamers shall be made from a non-degradable material.

4.1.3 Colouring and identification

Streamers should be coloured using a standard format to identify the non-flight items to which they pertain. Colours used for identification should draw attention to the streamer and cover.

Colours such as those described in ISO 3864-1 and ISO 14625 may be used. Where this is the case, their meaning should be clearly stated on the relevant project documentation and drawings and the operations manual.

Streamers may also be identified to further clarify their purpose (e.g. “REMOVE BEFORE FLIGHT” or “REMOVE PIN BEFORE FLIGHT”). The wording on the streamer may be written in the language of the flight hardware manufacturer, but the manufacturer should take into account the language used at the launch site. Examples of the wording in several languages are presented in Table A.1.

4.1.4 Method of attachment

Streamers shall be securely attached to the non-flight item, using appropriate attachment devices. In some instances, it may be appropriate to link a series of covers with fixing wire or lightweight line and identify them as a set with a suitable streamer.

4.2 Storage facility

The accountability box and trays should be constructed from materials that will not produce contamination in an area with a controlled environment (e.g. a satellite assembly building).

The storage location of each critical non-flight item shall be identified with the description as recorded in the list of critical non-flight items and the log book.

The storage facility shall be constructed to ensure controlled access at all times, in order to prevent the unauthorized removal of contents.

Annex A
(informative)

Typical identification of streamers

Figures A.1 and A.2 illustrate some typical streamers.

Figure A.1 — Streamer with lanyard (see Reference [3])

Figure A.2 — Streamer without lanyard (see Reference [4])

Some alternative language translations of the wording for streamers are given in Table A.1. Readers are encouraged to use one of these translations and to bear in mind the languages of those likely to handle the spacecraft.

Table A.1 — Alternative languages

Language	Warning 1	Warning 2
English	**REMOVE PIN BEFORE FLIGHT**	**REMOVE BEFORE FLIGHT**
French	RETRAIT PROTECTION AVANT VOL	RETRAIT AVANT VOL
Japanese	打上げ前にピンを取外せ	打上げ前に取外せ
Portuguese	**REMOVER O PINO ANTES DO VÔO**	**REMOVER ANTES DO VÔO**
Russian	Вытащить штырь перед пуском	Снять перед пуском

Annex B
(informative)

Critical non-flight items log

Table B.1 shows a suggested format of the critical non-flight items log.

Table B.1 — Critical non-flight items check list

Project .....

Critical non-flight item					Action		Signatures	
Item	Location on flight hardware	Serial No.	Description	Location	Install/Remove	Date/Time	Technician	Quality

Bibliography

[1] ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs in workplaces and public areas*

[2] ISO 14625, *Space systems — Ground support equipment for use at launch, landing, or retrieval sites — General requirements*

[3] NAS 1091, *Streamer assembly, Warning*

[4] NAS 1756, *Streamer, Warning*

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