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Aircraft/Store Common Interface Control Document Format Standard

FOREWORD

The Aircraft/Store Common Interface Control Document Format is a standard that defines a common document format for aircraft-store logical, mechanical, and environmental interfaces. Its purpose is to assist and harmonize aircraft-store interface standardization and to provide a common document format for the development and comparison of aircraft-store interface control documents (ICDs).

This document was prepared by the AS-1B3 Task Group, Aircraft-Store System Integration, under the jurisdiction of the AS-1B Subcommittee, Aircraft-Store Integration, of the SAE AS-1 Committee, Aircraft Systems and System Integration.

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1. SCOPE:

This SAE Aerospace Standard (AS) defines the editorial format and policies necessary for the publication of Interface Control documents. The Common Interface Control Document Format Standard defines a common format for aircraft/store interface documents to foster increased interoperability. It is designed with the versatility to serve differing "ICD" philosophies and organizations.

This aerospace standard defines the common technical data sections for the Common Interface Control Document Format down to the third header level for the majority of sub-sections. The Common Interface Control Document Format Aerospace Standard provides a structured document format in appendixes supported by example paragraphs, drawings, etc.

1.1 Purpose:

The Aircraft/Store Common Interface Control Document Format defines the document format to be utilized to define and document aircraft/store interfaces. A common document format is desired to foster increased interoperability of stores and aircraft across platforms.

1.2 Field of Application:

This standard applies to new Aircraft/Store Interface Control Documents, and may be applied to existing ICDs when they are being revised.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AIR5532	Generic Aircraft Store Interface Framework
AS15531	Digital Time Division Command/Response Multiplex Data Bus

2.1.2 ANSI Publications: Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ASCII	American Standard Code for Information Interchange

2.1.3 U.S. Government Publications: Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-1760-D	DEPARTMENT OF DEFENSE INTERFACE MILITARY STANDARD FOR AIRCRAFT/STORE ELECTRICAL INTERCONNECTION SYSTEM
MIL-STD-1553B Notice 4	Digital Time Division Command/Response Multiplex Data Bus NOTE: Revision B Notice 4 is specifically required.
MIL-HDBK-1553	

2.2 Applicable References:

None

2.3 Definitions:

AIRCRAFT: Any vehicle designed to be supported by air, being borne up either by the dynamic action of the air upon the surfaces of the vehicle, or by its own buoyancy. The term includes fixed and movable wing airplanes, helicopters, gliders, and airships, but excludes air-launched missiles, target drones, and flying bombs.

CARRIAGE STORE: Suspension and release equipment that is mounted on aircraft on a non-permanent basis as a store, and is intended to carry other store(s). Carriage store includes both single adapters and multiple store carriers. Pylons and primary racks (such as an MAU-12 and BRU-10) shall not be considered carriage stores.

DISPENSER: Equipment that is mounted on an aircraft on a non-permanent basis as a store and is intended to carry devices that are dispensed. Dispensers include, but are not limited to, chaff and flare dispensers, rocket pods, and small munitions dispensers.

STORE: Any device intended for internal or external carriage and mounted on aircraft suspension and release equipment, whether or not the item is intended to be separated in flight from the aircraft.

2.3.1 Terminology:

SHALL: This Term in the Aircraft/Store Common Interface Control Document Format is to be used wherever the criterion for conformance with the specific recommendation requires that there be no deviation.

SHOULD: This Term in the Aircraft/Store Common Interface Control Document Format is to be used wherever the criterion for conformance with the specific recommendation is to meet a system objective. Failure to meet a “Should” statement shall be justified

MUST: This Term in the Aircraft/Store Common Interface Control Document Format is used for a legislative or regulatory requirement (e.g. health and safety) with which the customer, the aircraft company and the store company shall comply. It is not used to express a requirement of the specification.

WILL: This Term in the Aircraft/Store Common Interface Control Document Format is used for the future tense. It does not express a requirement of the specification.

MAY: This Term in the Aircraft/Store Common Interface Control Document Format expresses a permissible practice or action. It does not express a requirement of the specification.

3. AIRCRAFT/STORE COMMON INTERFACE CONTROL DOCUMENT FORMAT REQUIREMENTS:

3.1 Background:

Prior to the establishment of this standard, there were two major approaches to the definition of aircraft/store interface control documents. One approach was the "J-weapon” interface control document the United States store and airframe industry has developed. The second was several ICD structure proposals used in Europe on various aircraft programs with the most common being the European Industrial Group working on the Typhoon fighter.

In addition to the format differences between the two industry approaches, there is also a philosophical difference. Historically, the airframe industry in Europe writes an aircraft to store interface control document based on the inputs from the store contractor, i.e. manufacturing or qualification information or even a store interface control document. This was the case when an already developed store had to be integrated in an existing airframe. The interface control document itself may be a part of the contract documentation.

3.1 (Continued):

In the United States the store contractor writes the core interface control document with inputs from the airframe contractors through the interface control working group process. The core document defines the store mechanical, electrical, and environmental interfaces. The core document also defines the functional requirements for the store and aircraft to support integration of the interface. Each aircraft that integrates the store then writes an annex, to define aircraft peculiarities for specific requirements implementation. The aircraft annex is written to define aircraft dependent implementation of the mechanical, electrical, environmental and functional interfaces and optional capabilities that are implemented from the core interface control document. If for example there is an optional capability, which the aircraft may use, it is described in the core as an "aircraft may" and introduced in the aircraft annex as an “aircraft shall”.

Since neither industrial group (Europe and United States) is expected to adopt the others approach to aircraft/store interface definition, the Aircraft/Store Common Interface Control Document Format is structured to serve both approaches. It can be used as a single form to describe the agreed interface or as the form to lay down store interface considerations and - as an annex - the aircraft side of the interface reflecting the same basic structure. Figure 1 and Figure 2 illustrate the dual uses of this document format.

The Aircraft/Store Common Interface Control Document Format is split into two volumes. The reason the document is defined in two volumes is to separate the hardware driven elements of the interface, which tend to change infrequently from the software elements of the interface which historically change very frequently during the development process.

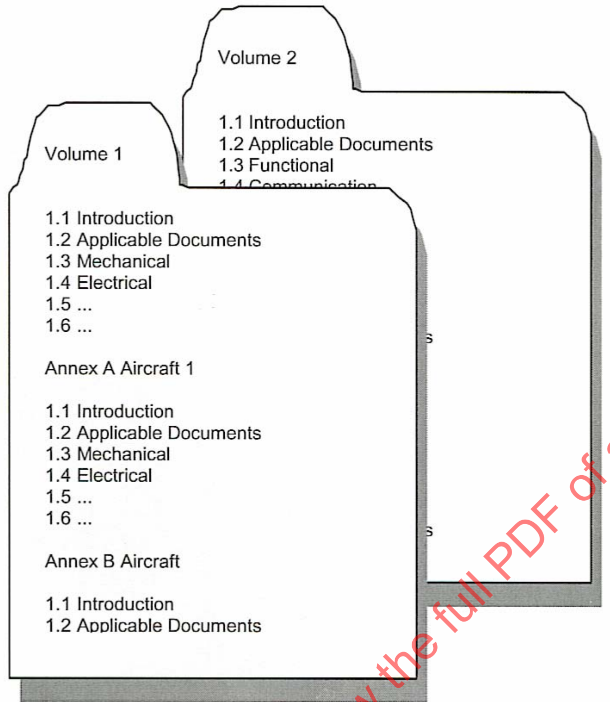


FIGURE 1 - CICD Format for a "J-ICD" Approach for One Store with Multiple Aircraft Annexes

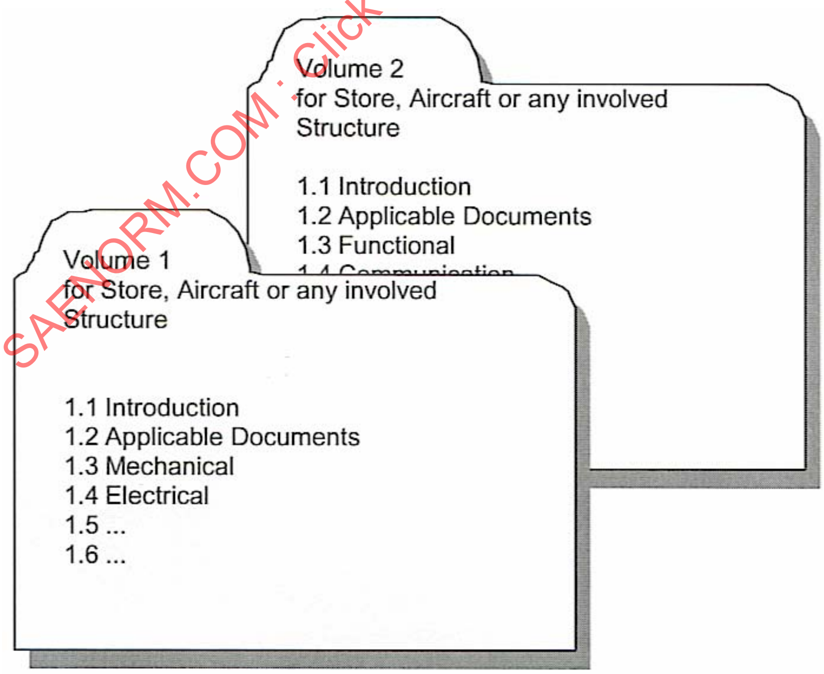


FIGURE 2 - CICD Format for an "ICD" Approach for a Single Store or Aircraft or Structure

3.2 Application Areas and Format Utilization:

3.2.1 Application Areas: The Aircraft/Store Common Interface Control Document Format is intended for use in all areas and combinations of aircraft to store integration for all kinds of stores (including miniature stores, carriage stores and dispensers) of any origin (legacy or new products).

3.2.2 Utilization and Basic Considerations: In principle there exists just one interface, which shall be described within one Interface Control Document. That is the direct interface between the aircraft and the store mechanically and electrically directly connected (no intermediary system) together. However, depending on the interface control document approach (European verses United States) and on the stage of the development or the integration, there may be a single point of view, that is the interface can only be described from one side. For example during European aircraft development with the requirement to integrate a specific set of stores, the store design authority will produce a document that provides baseline information describing the interface between the store and a non-specific or generic aircraft, sometimes referred to as a Generalized Aircraft Interface Specification (GAIS). The GAIS structure is identical to that of the ICD to be generated later, containing detailed information relevant to the store and generic information on what is expected of the aircraft. For a United States interface control document approach, the document will contain the functional requirements for both sides of the interface and the mechanical, electrical, and environmental requirements for the store (called the "Core Interface Control Document"), but the aircraft specific appendix, which describes the aircraft peculiar implementation of the functional, mechanical, electrical, and environmental interface, may not be available.

If a carriage store is connected between the aircraft and the weapon, things can become more complicated because the carriage store employs an interface to the aircraft and an interface to the store, but part of the carriage store interface to the aircraft may depend on which weapon is carried below the carriage store. For carriage stores with internal electronic boxes or signal adaptation units, several different interface control documents approaches could be utilized. Two Volume 1 documents could be written, one for the carriage store to the aircraft and one for the carriage store to the weapon since each has unique mechanical, electrical, and environmental criteria. As mentioned above, this will be related to the point of view and the approach to integration (European or United States). Alternatively, for the logical interface defined in the Volume 2 content, the carriage store may act like a black box and simply routes the appropriate signals directly from aircraft to the store and vice versa. Thus only one Volume 2 could be written, because the carriage store interface to the aircraft is a direct reflection of the weapon interface. The interface control author has the flexibility to choose the best approach for their program.

3.2.2 (Continued):

From the aircraft viewpoint, regarding the mechanical or electrical interface and other Volume 1 content, it is important to know the mechanical and electrical specifications of the overall structure i.e. carriage store and store, despite the fact that the aircraft has only one interface with the carriage store. The same principles apply to dispenser or similar structures.

3.2.2.1 Concept for Interface Control Document Generation Involving a Carriage Store: To explain the concept further, consider two basic system configurations, the first involving an intelligent carriage store and the second involving a relatively simple or dumb carriage store. This simple distinction becomes a little blurred when considering the ownership of design authority for the three parts of the system. In discussions between the various design authorities, it is therefore essential that the subject interface is defined with total clarity at the front of the ICD, together with a description of how the related interfaces are being managed. However, regardless of who is responsible for what, there must be a definition of the interface between each part of the system.

3.2.2.1.1 Simple Carriage Store: For the situation where the carriage store is simple, the two main possibilities are:

a. If the carriage store design authority is a third party, then there must be a complete ICD for each of the two interfaces (aircraft to carriage store, carriage store to store) so that the contractual arrangement is fully recognized. It should be noted that the carriage store design authority may well not be fully conversant with all of the nuances of the aircraft and store system operation and will need close supervision by the two other design authorities to ensure all systems operate as specified. In particular, there is an additional responsibility on the aircraft design authority to act as a 'coordinating integrator' to ensure correct definition/operation of the combined system.

b. If the carriage store design authority is also the design authority for either the aircraft or the store, then there may be a single interface control document covering the interface between the areas of each design authority responsibility. However, the interface control document must clearly define the 'store present' situation and the 'store not present' situation. Note that it is not unusual to have two separate interface control documents here also, particularly if the store design authority is responsible for the carriage store and there are variations in the carriage store design where the same basic equipment may be used on more than one aircraft type.

3.2.2.1.2 Complex Carriage Store: For the situation where there is a complex carriage store that has an intelligent role within the overall system operation, there are alternatives as well depending on the overall system design. It is probable that there would need to be two Volume 1 interface control documents to identify the unique hardware aspects of the carriage-store-to-aircraft and carriage-store-to-store interfaces if that carriage store will be used to carry stores from multiple design authorities. If the carriage store will only be utilized to carry stores from the same design authority, then one Volume 1 document maybe sufficient. Similarly there is flexibility in the utilization of Volume 2. If the carriage-store-to-aircraft interface is fully or partially a reflection of the carriage-store-to-store interface, a single Volume 2 document may suffice. If the carriage store is intended to be used to support stores from multiple design authorities, then it may be necessary to write two separate Volume 2 documents to reflect the carriage-store-to-aircraft and carriage-store-to-store functional interfaces. It may even be necessary to write a third Volume 2 document if part of the carriage-store-to-store interfaces is directly routed to the carriage-store-to-aircraft interface without any processing by the carriage store. Again, the aircraft design authority must operate as the system integrator to ensure overall system operation.

3.3 Basic Structure and Generation Rules:

The Aircraft/Store Common Interface Control Document is split into two volumes. Volume 1 covers mostly hardware aspects such as the mechanical or electrical interface, while Volume 2 specifies the logical part and provides the Signal Format Sheets.

For simple interfaces, the two volume approach may be unnecessary. Dependent on the size and intent of the interface control document, the author may retain a single volume approach, but shall keep to the same section/paragraph sequence defined in the Aircraft/Store Common Interface Control Document Format for that document. For example, if the store has no logical interface requirements with the aircraft, the author may drop Volume 2 and only write a Volume 1 document, but the entire format must be utilized. Parts that are not applicable can be simply marked as “Not Applicable” but they must not be deleted.

However, all parts of the Aircraft/Store Common Interface Control Document Format may be tailored to the author’s needs. This may be necessary to cope with special requirements or needs of a project such as stores integration, where test assets may be necessary during the development phase. This may require a separate ICD to cover separation rounds or environmental stores or specific flight test instrumentation connections and recording capability. For the purpose where a separate ICD is not regarded necessary, separate sections have been included in both volumes without further substructure.

3.3.1 Volume 1 Overview: Volume 1 covers mostly hardware aspects such as the mechanical or electrical interface. The heading level 1 structure for Volume 1 is shown in Figure 3. Examples for each paragraph of the Volume 1 template are provided in Appendix A.

1. Introduction
2. Applicable Documents
3. Mechanical Interface
4. Electrical Interface
5. Aerodynamics Interface
6. System Safety
7. Environmental Considerations
8. Store/ Aircraft Interface Specific
9. Store/ Aircraft Post-Launch (Data-Link) Interfaces
10. Support Interface

FIGURE 3 - CICD Format Structure Volume 1 Level 1

3.3.1.1 Volume 1 Section 1 Introduction: This section shall cover the introduction to the Volume 1 of the interface control document. An overview of the volume content and detailed information concerning updates shall be given. The use of terms within the interface control document shall be defined. In the installation subsection, the purpose of the store, aircraft or the combination shall be identified, and the commonality for use of a store on different aircraft shall be defined (for store only interface control document). Figure 4 provides an outline of this section.

1. Introduction
1.1 Scope
1.2 Updating
1.2.1 Information Accuracy
1.2.2 Definition of Terms
1.3 General Description
1.3.1 Installation
1.3.2 Commonality Considerations

FIGURE 4 - CICD Format Structure for Volume 1, Section 1

3.3.1.2 Volume 1 Section 2 Applicable Documents: This section lists the referenced and considered documents relevant for Volume 1 of the interface control document and defines the order of precedence if any. All documents referenced elsewhere in Volume 1 of the interface control document and which are fundamental for the interface shall be listed in this section. The listing shall include the relevant document issue used during document generation to prevent invalidating the interface control document after an update of the referenced document. Figure 5 provides an outline of this section.

2.	Applicable Documents
2.1	General
2.2	Specifications
2.3	Standards
2.3.1	Military Standards
2.3.2	Civilian Standards
2.4	Project Specific Documents
2.5	Other Documents
2.6	Precedence

FIGURE 5 - CICD Format Structure for Volume 1, Section 2

3.3.1.3 Volume 1 Section 3 Mechanical Interface: The mechanical interface shall be defined within this section. This section specifies physical characteristics such as moments of inertia or center of gravity, any physical clearance issues, hardware locations or alignment as well as loads, stiffness and loading considerations. A definition of units of measurement, scaling and scaling factors to facilitate interoperability and common understanding shall be included. Figure 6 provides an outline of this section.

3.	Mechanical Interface
3.1	General
3.2	Physical Characteristics
3.2.1	Dimensional Envelope
3.2.2	Mass
3.2.3	Centre of Gravity
3.2.4	Moments of Inertia
3.3	Suspension Interface
3.3.1	Connector Interfaces
3.3.2	Fuzing and Arming Connections
3.3.3	Suspension Details
3.3.4	Clearances
3.3.5	S&RE Settings
3.3.6	Carriage Store Unique Provisions
3.4	Alignment
3.5	Loads
3.5.1	Separation Loads
3.5.2	Captive Carriage Loads (Air to Ground)
3.5.3	Store Unique Loads
3.6	Store Stiffness
3.7	Loading Considerations
3.7.1	Loading to Aircraft
3.7.2	Off-loading from Aircraft
3.8	Additional Mechanical Interface Considerations

FIGURE 6 - CICD Format Structure for Volume 1, Section 3

3.3.1.4 Volume 1 Section 4 Electrical Interface: This section shall define all ICD relevant electrical, electromagnetic, and optical signals that are contained in the interface between the aircraft and the store. If possible, reference to existing standards and definitions shall be given to avoid multiple specifications. The layout of this section specifies the connection first (i.e. connector description including the umbilical, connector layout and contact assignment) and is followed by a general description of the signals separated between power signals, analogue signals, digital signals and signal lines. Further, the signal description comprises a section to specify the single pin. The employment of this structure is due to the fact that the signal type description is more common and may affect multiple connections (i.e. redundant signal lines such as multiples data bus connections). Deviations may be explained in the pin descriptive part. Figure 7 provides an outline of this section.

4.	Electrical Interface
4.1	General
4.2	Interface Connection
4.2.1	Connector Description
4.2.2	Contact Assignment and Contact Description
4.3	Contact Types
4.3.1	Power Lines
4.3.2	State Signals
4.3.3	Information Signals

FIGURE 7 - CICD Format Structure for Volume 1, Section 4

3.3.1.5 Volume 1 Section 5 Aerodynamics Interface: This section shall define all aerodynamic aspects of captive carriage, release/jettison, and post launch maneuvers in the vicinity of the aircraft. Figure 8 provides an outline of this section.

5.	Aerodynamics Interface
5.1	Configuration
5.2	Drag Data
5.2.1	Drag Characteristics
5.2.2	Altitude Dependency
5.2.3	Incidence Angle Dependency
5.3	Flutter
5.4	Ballistic Data
5.5	Store Post Launch Separation Control
5.6	Engagement Envelopes
5.6.1	Carriage Envelope
5.6.2	Release Envelope
5.6.3	Jettison Envelope

FIGURE 8 - CICD Format Structure for Volume 1, Section 5

3.3.1.6 Volume 1 Section 6 System Safety: This section shall specify all safety issues for ground operations of the store, captive carriage, release/jettison, and post launch. The section is split in subsections to deal with mission phases such as ground operation related safety, captive flight or safe separation safety. Figure 9 provides an outline of this section.

6. System Safety
6.1 Ground Safety
6.1.1 Dangerous Components
6.1.2 Ammunition
6.1.3 Compressed Air
6.1.4 Chemical Substances
6.1.5 Anti-Corrosive Coatings
6.1.6 Batteries
6.1.7 Electrical Installations
6.1.8 Electromagnetic Radiation
6.1.9 Dangerous Areas
6.1.10 Fire Fighting
6.1.11 Hangfire
6.2 Captive Flight Safety
6.2.1 Hangfire during Captive Flight
6.3 Launch/ Release/ Jettison Safety
6.4 Hazards of Electro-Magnetic Radiation to Ordnance (HERO)
6.5 Personnel Safety

FIGURE 9 - CICD Format Structure for Volume 1, Section 6

3.3.1.7 Volume 1 Section 7 Environmental Considerations: This section shall address interface relevant influences caused by environmental impact.

Environmental requirements evolve during the store development and integration with the host platforms. This section of the ICD will evolve during this process. It starts out defining the environmental conditions specified for the store and/or aircraft standalone and eventually evolves to the definition for the store/aircraft combination. At the conclusion of the integration program it shall define the environmental conditions the aircraft and store can withstand (either combined in one section or as the store design environments in the core and the specific aircraft/store combination in the aircraft annexes). In addition, the level of definition is predefined as follows to cope with the severity of the environmental influence, for the aircraft/store combination:

- remain safe in a specific environment, means that the system will not endanger personnel, aircraft or store when exposed to the specified environment, or subsequently during any handling and disposal. The system is not required to operate either during or after exposure to the environment,

- operate means that the system will survive exposure to, and function correctly within its performance limits during exposure to the specified environment and

3.3.1.7 (Continued):

- survive a specific environment means that the store/aircraft combination in addition to staying safe throughout and following exposure to the environment, will subsequently be capable of operating satisfactorily within its performance limits after exposure to the environment.

Figure 10 provides an outline of this section.

7. Environmental Interface
7.1 Introduction
7.2 Environmental Condition
7.2.1 General
7.2.2 Altitude and Ambient Pressure
7.2.3 Dynamic Pressure Change
7.2.4 Temperatures
7.2.5 Humidity
7.2.6 Solar Radiation
7.2.7 Fungus Resistance
7.2.8 Salt Fog
7.2.9 Rain - Rain Erosion
7.2.10 Hail
7.2.11 Drip
7.2.12 Sand and Dust
7.2.13 Icing/ Freezing Rain
7.2.14 Climatic Zones
7.2.15 Vibration
7.2.16 Gunfire Vibration
7.2.17 Mechanical Shock
7.2.18 Acoustic Noise
7.2.19 Linear Acceleration
7.2.20 Angular Motion, Acceleration and Angular Rates
7.2.21 Radiation (nuclear)
7.2.22 X-Ray Emissions
7.2.23 Explosive Atmosphere
7.2.24 Contamination
7.2.25 Bio and Chemical Hardening
7.2.26 TEMPEST
7.2.27 NEMP
7.3 Electromagnetic Environmental Effects (E^3)
7.3.1 Conducted Emissions, Power Lines
7.3.2 Conducted Emissions, Control and Signal Lines
7.3.3 Exported Spikes and Transients
7.3.4 Radiated Emissions, Electric Field
7.3.5 Conducted Susceptibilities, Power Leads
7.3.6 Bulk Current Injection Test
7.3.7 Imported Spikes and Transients
7.3.8 Radiated Susceptibility, Magnetic Induction Field
7.3.9 Radiated Susceptibility, Electric Field
7.3.10 DC Magnetic Field Environment
7.3.11 Compass Safe Distance
7.3.12 EMP
7.3.13 Conducted Emissions, Antenna Terminal
7.3.14 Spurious and Harmonic Emissions
7.3.15 Inter-Modulation
7.3.16 Rejection of Unwanted Signals
7.3.17 Cross-Modulation
7.3.18 Electrostatic discharge
7.3.19 Lightning Protection
7.4 Store Life Constraints

FIGURE 10 - CICD Format Structure for Volume 1, Section 7

3.3.1.8 Volume 1 Section 8 Store/Aircraft Interface Specific: All interface relevant issues which have not been allocated to a specific section shall be defined within this section (e.g. cooling, signatures plume, etc). If due to security reasons all or part of the information is classified, a reference to where the classified information can be found shall be given. Figure 11 provides an outline of this section.

8.	Store/ Aircraft Interface Specific
8.1	Cooling
8.1.1	Cooling line connection
8.1.2	Cooling Medium and Constituents
8.1.3	Pressure
8.1.4	Flow Rate
8.1.5	Duration of Supply
8.2	Plume Data
8.2.1	Propellant and Plume Composition
8.3	Signatures and Emissions
8.4	Air Fuel Transmissions

FIGURE 11 - CICD Format Structure for Volume 1, Section 8

3.3.1.9 Volume 1 Section 9 Store/Aircraft Post-Launch (Data-Link) Interfaces: This section specifies the post launch interface used to guide the store to its destination, update store information or simply to communicate with the store for data evaluation, sensor data retrieval, etc. While this section shall address the electrical part of the post launch communication, the logical description shall be part of the functional section of Volume 2 and the signal content structure shall be described in Volume 2 Section 5. Figure 12 provides an outline of this section.

9.	Post-Launch Interface
9.1	Overall System Architecture
9.2	Interface Description
9.3	Non-Radiating Post-Launch Communications
9.3.1	Introduction
9.3.2	Overall System Architecture

FIGURE 12 - CICD Format Structure for Volume 1, Section 9

3.3.1.10 Volume 1 Section 10 Support Interface: This section shall cover aspects with respect to the testing and ground handling of the store. For example, it would address flight test specific interfaces, such as precautions for handling of flight test instrumentation (specific connection etc.) or ground operation issues such as ground equipment (STE) considerations. Figure 13 provides an outline of this section.

10. Support Interface
10.1 Store and Aircraft Testing
10.1.1 Store Pre-load Testing
10.1.2 Aircraft Testing
10.1.3 Store Testing on the Aircraft
10.2 Loading and Handling
10.2.1 Aircraft Store Loading Provisions
10.2.2 Handling of the Store

FIGURE 13 - CICD Format Structure for Volume 1, Section 10

3.3.2 Volume 2 Overview: Volume two covers mostly software aspects of the interface such as the functional requirements, logical signal sheets, timelines and sequences. The heading level 1 structure for Volume two is shown in Figure 14. Examples for each paragraph of the Volume two templates are provided in Appendix B.

1. Introduction
2. Applicable Documents
3. Functional Interface
4. Communication Interface
5. Post Launch Communication Interface
6. Signal Format Sheets
7. Post-Launch Signal Format Sheets

FIGURE 14 - CICD Format Structure Volume 2 Level 1

3.3.2.1 Volume 2 Section 1 Introduction: This section shall cover the introduction to the Volume 2 of the ICD. An overview of the volume content and detailed information concerning updates shall be given. The use of terms within the ICD shall be defined. Figure 15 provides an outline of this section.

1. Introduction
1.1 Scope
1.2 Updating
1.2.1 Information Accuracy
1.2.2 Definition of Terms
1.3 General Description

FIGURE 15 - CICD Format Structure for Volume 2, Section 1

3.3.2.2 Volume 2 Section 2 Applicable Documents: The section lists the used and considered documents relevant for Volume 2 of the ICD and defines the order of precedence if any. Figure 16 provides an outline of this section.

2.	Applicable Documents
2.1	General
2.2	Specifications
2.3	Standards
2.3.1	Military Standards
2.3.2	Civilian Standards
2.4	Project Specific Documents
2.5	Other Documents
2.6	Precedence

FIGURE 16 - CICD Format Structure for Volume 2, Section 2

3.3.2.3 Volume 2 Section 3 Functional Interface: The functional interface is the core of Volume 2. The operation of a store as a system of systems shall be described in conjunction with the aircraft operation. Co-ordinate systems and parameter definition is included. Relevant system states and modes shall be specified and coarse and detailed timelines are defined. An example to represent timelines is provided. In principle the functional requirements for each bit specified in the signal format sheets, unless defined elsewhere, shall be described in the functional section. Figure 17 provides an outline of this section.

As in Volume 1, a specific section is defined for a flight test or integration phase provisions has been included.

A further detailed structure is proposed with examples in appendix B, which highlights the different points of view – from aircraft and store - for a specific function.

3.	Functional Interface
3.1	General
3.2	Basic Mission Data and Definitions
3.2.1	Mission Data Overview
3.2.2	Axis Systems and Parameter Definitions
3.3	States and/or Modes of Operation
3.4	Sequence of Events
3.5	Event Description

FIGURE 17 - CICD Format Structure for Volume 2, Section 3

3.3.2.4 Volume 2 Section 4 Communication Interface: The communication interface section shall specify the implemented protocols, restrictions to standard protocols and optional capabilities of a protocol that are used. Important parts of standards shall be referenced and deviations shall be specified. Formal message representation, word and bit content and sequencing, etc. shall be defined.

The subsection "Operational Flight Programming" shall be used to address, for example OFP programming issues of a store. Figure 18 provides an outline of this section.

4.	Communication Interface
4.1	Introduction
4.2	Protocol Options Implemented
4.3	Data Structure and Sequence
4.4	Operational Flight Program
4.4.1	Scope of Possible Store Program Changes
4.4.2	Interface Operation for Store Programming by the Platform

FIGURE 18 - CICD Format Structure for Volume 2, Section 4

3.3.2.5 Volume 2 Section 5 Post Launch Communication Interface: The post-launch communication interface section shall specify the implemented protocols and any restrictions or optional capabilities used. Important parts of standards shall be referenced, and any deviations shall be specified. Formal message representation, word and bit content and sequencing, etc. shall be defined. To get a more holistic view of all aspects of the post launch interface, section 9 of Volume 1 and sections 3 and 5 of Volume 2 have to be considered together. Figure 19 provides an outline of this section.

5.	Post Launch Communication Interface
5.1	Introduction
5.2	Post-Launch Link Interface

FIGURE 19 - CICD Format Structure for Volume 2, Section 5

3.3.2.6 Volume 2 Section 6 Information Format Sheets: This section contains the signal format sheets for the onboard interface. Figure 20 provides an outline of this section.

6.	Information Format Sheets

FIGURE 20 - CICD Format Structure for Volume 2, Section 6

3.3.2.7 Volume 2 Section 7 Post-Launch Information Format Sheets: This section contains the signal format sheets for the post-launch interface. Figure 21 provides an outline of this section.

7.	Post-Launch Information Format Sheets

FIGURE 21 - CICD Format Structure for Volume 2, Section 7

3.4 Rules for the Interface Control Document Generation Using This Format:

3.4.1 Introduction: The Aircraft/Store Common Interface Control Document Format structure can be tailored to the project's needs. This means that for simple ICDs where a two-volume approach may not be necessary, the document could be covered with a single volume that maintains the defined section structure. The same applies for the decision whether a single two volume document should cover all store variants used during integration and test (including the operational stores) or whether separate documents will be required.

3.4.2 General: As of the release date of this Aerospace Standard, this Aircraft/Store Common Interface Control Document Format standard can be regarded as complete. To provide some growth, and to cover future developments, the writer of an Interface Control Document using this format shall establish all sections down to the 3rd heading level (example: 2.1.2) as defined herein. It is anticipated that the top-level structure will rarely change. Although the standard format in Appendices A and B have sections below the third level, the structure below heading level 3 can be regarded as an example.

If explicitly outlined in the text of Appendix A or B or identified through a colored headline, even a higher-level structure (above heading level 4) may be regarded as an example. The higher-level example (above level 4) is required in areas, where this particular part of an Interface Control Document is still evolving or the structure is at the authors' discretion.

In contradiction to a higher-level example, a lower level structure (below heading level 3) may be required when the substructure is regarded mandatory for the Aircraft/Store Common Interface Control Document Format layout.

An interface control process (ICP) is established to define the rules for changing or updating the interface control document, including the maintenance of the correct relationship between the contents of Volume 1 and Volume 2. It is essential that each volume identify explicitly the related issue status of the other volume.

3.4.2 (Continued):

Commonly, the release of a new issue occurs more often in the early phases of an interface design when frequent changes require a new release. When the design is mature, interface changes can be distributed between new issues and a new release is only required after some major changes have been identified and when the project is close to completion.

3.4.3 Design and Layout Rules: Where the interface control document is used to define interface requirements, the requirements for the store or platform shall be uniquely identifiable throughout the ICD. Table 1: Tracking Identifiers provides a suggested tracking identifier that should be followed by sequential numbering of the requirement type. To facilitate identification and to enable traceability, a table containing all requirements should be generated.

TABLE 1 - Tracking Identifiers

First character – Interface Element Affected	Second character – Requirement Type
a – Aircraft	s – Shall
c – Carriage Store	m – May
s – Store	t – Must
l - Launcher	d – Should
Examples: {as-001} would be aircraft shall number 1, {lt-005} would be launcher must number 5.	

Figures and tables shall be numbered. The figure and table numbering shall contain the section and the consecutive number within the section e.g. "figure 3-13 – Figure Title" (section 3, figure 13) or "table 2-12 – Table Title" (section 2, table 12). All figures and tables shall be listed in a list of figures and a list of tables and shall be included in the document following the table of contents. Each table or figure shall be mentioned in the text. The position of a figure in the text is at the authors' discretion, i.e. either interspersed with the text or at the end of a section or subsection. The examples in the Appendix A and B cover both possibilities.

A table of content shall be generated for each volume.

An abbreviations list shall be generated. A definition of symbols or a glossary is optional.

The applicable documents shall be listed by title and alphanumeric descriptor. References to these documents in the content of the ICD shall be by the descriptor rather than the document title

3.4.4 Use of the Formats in Appendix A and B: As required above, the interface control document author is required to keep the structure down to level 3. Exceptions are possible due to tailoring or a single volume approach. However, to comply with the Aircraft/Store Common Interface Control Document Format standard, the parts of the sections in the Appendices A and B that are not marked as described below are required.

The beginning of an example in Appendices A and B are marked and identified with the line: "---------- Begin Example", and end with "---------- End Example". The example itself is written in Arial 11pt bold for headlines and Arial 10pt plain for the textual content in blue color.

Whenever possible, metric units shall be used.

3.4.5 Classified Information: An ICD may contain classified information. The author has three approaches, first classify the whole ICD, and second refer to the classified material in a reference document, and third place the classified material in a separate annex to the ICD. The approach selected will depend upon the proportion of classified material, level of classification and national security policies

4. NOTES:

4.1 Revision Indicator:

Not applicable

4.2 Intended Use:

The Aircraft/Store Common Interface Control Document Format standard is intended to be used for airborne military applications for aircraft to store integration. ICDs written in compliance with this standard may define requirements for aircraft, stores, carriage stores, or dispensers, in any combination of legacy and new products. The term “aircraft” includes both manned and autonomous systems.

4.2.1 Implementation: Implementation and application of the standard is the responsibility of each military service, with technical guidance and direction provided by appropriate service program offices.

4.3 Tailoring Guidance:

This Aircraft/Store Common Interface Control Document Format standard defines a format for an Interface Control Document between stores and platforms/aircraft. This can be regarded as a first step towards a Common Interface for future plug and play weapons. To back this effort, tailoring of the Aircraft/Store Common Interface Control Document Format should be kept to a minimum. However, to facilitate the acceptance of the format, tailoring may be accepted in areas such as the incorporation of test assets and a single volume approach for simple interfaces.

4.4 Keyword Listing:

Aircraft, common interface, format, interoperability, interface control document, platform, plug and play, store, weapon, weapon interfaces

PREPARED UNDER THE JURISDICTION OF
SAE SUBCOMMITTEE AS-1B3, AIRCRAFT/STORE SYSTEMS INTEGRATION OF
COMMITTEE AS-1, AIRCRAFT SYSTEMS AND SYSTEMS INTEGRATION

APPENDIX A
VOLUME 1: MECHANICAL/ELECTRICAL/PHYSICAL INTERFACE CONTROL DOCUMENT TEMPLATE

1. INTRODUCTION:

The introduction of the CICD shall give an overview of the document. Scope, updating rules, used terms and a general description. The whole ICD comprises 2 Volumes, Volume 1 contains the more stable parts of the integration process while this volume covers the logical and functional interface, which changes more often in the course of an integration. The introduction can be regarded as unique for both volumes, or, like in this example, for each volume separately. The introduction of the CICD volume 1 shall clearly define the subject interface, with a description or illustration of how related interfaces are being managed.

---------- Begin Example

This Interface Control Document (ICD) has been developed to support interface definition for host aircraft integration of weapon xyz. This includes the support of the definition of required hardware and software updates to the aircraft, as well as to support the requirements development process for the weapon xyz development.

---------- End Example

1.1 Scope:

The purpose of this volume shall be addressed with a short description of the affected interface. An overview of the content of the following sections shall be given.

---------- Begin Example

Store X is installed on the aircraft by being fitted to launcher Z that is fitted to the wing pylon of aircraft Y. The interface controlled by this document is the interface between store X and launcher Z.

The interface between the aircraft and launcher Z is controlled by a separate ICD, document reference ABC.

Volume 1 contains the following sections:
Section 1 establishes the document scope and provides background information for the document user.

Section 2 identifies the applicable documents that are referred to in the ICD. It establishes the order of precedence of the applicable documents and identifies the version and requisite tailoring of the documents applicable to this ICD.

1.1 (Continued):

Section 3 addresses the mechanical interface between the weapon xyz and the host aircraft abc.

Section 4 addresses the electrical interface between the weapon xyz and the host aircraft abc.

Section 5 contains requirements for the aerodynamics interface like considered aircraft configurations, drag date, etc.

Section 6 addresses safety issues relevant to the interface.

Section 7 lists environmental conditions and marginal conditions to be considered. This section includes also Electromagnetic Environmental Effects requirements and.

Section 8 specifies all other interface considerations like required cooling aids, plume data, signatures, and air fuel transmissions if any.

Section 9 comprises the hardware relevant requirements for a post launch interface.

Section 10 applies to support measure like testing of the store on and off the aircraft and any handling issues not covered e.g. in the mechanical section.

---------- End Example

1.2 Updating:

This section is used to document the update procedures of this volume e.g. applied change procedures, or the section shall be used to establish the change process.

---------- Begin Example

The ICD shall be updated on the design responsible authority's discretion. The information about and the reception of any updates are under the responsibility of the user. The update procedure shall be control by the established Interface Control Process (ICP) as defined in document xyz.

---------- End Example

1.2.1 Information Accuracy: This section records information concerning handling of values during the generation process of the ICD e.g. marking of currently unconfirmed values, uncertain statements or uncertain definitions.

---------- Begin Example

Throughout this document and unless otherwise stated, when a value is quoted which is still unconfirmed, a ´TBC´ rating follows the quoted value.

A star rating as follows grades this TBC rating system:

TBC*detailed calculations but not yet finalized
TBC**simple calculations and/or previous experience
TBC***best estimate

---------- End Example

1.2.2 Definition of Terms: This section records the rules to specify use of wording in the document like “may”, “shall” etc.

---------- Begin Example

1.2.2.1 Utilization of Common Terms:

The word "shall" in the text expresses a mandatory requirement of the specification. Departure from such a requirement is not permissible without formal agreement between customer and the aircraft company.

The word "should" in the text expresses a recommendation or advice on implementing a requirement of the specification. The customer expects such recommendation or advice to be followed unless good reasons are stated for not doing so.

The word "must" in the text is used for a legislative or regulatory requirement (e.g. health and safety) with which both the customer and the aircraft company shall comply. It is not used to express a requirement of the specification

The word "will" in the text is used for the future tense. It does not express a requirement of the specification.

The word "may" in the text expresses a permissible practice or action. It does not express a requirement of the specification.

Plain text (i.e. text not containing the above key words) is used to state facts and to describe existing capabilities or features. Such text does not express a requirement of the specification.

1.2.2.2 Non-common Terms: Terms not specified in 1.2.2.1 are of informal nature and are not authoritative.

---------- End Example

1.3 General Description:

The system controlled by this interface shall be described. Subject to deletion if already covered by 1.1.

---------- Begin Example

The weapon ´xyz´ is an air-to-air missile comprising of the following sections:

- Seekerhead
- Warhead (replaced by a Telemetry Section for test purposes or a inert warhead for training purposes)
- Propulsion

The aircraft ´abc´ is an agile all-weather super sonic strike fighter aircraft. Stores can be carried on external stations equipped with a MIL-STD-1760 interface:

- Center Pylon equipped with 2 heavy duty multi purpose ejection and release units
- Left and right hand shoulder pylons equipped with 2 light duty multi purpose ejection and release units or alternatively 1 heavy duty multi purpose ejection and release unit
- Left and right hand inboard wing pylons equipped with 2 light duty multi purpose ejection and release units or alternatively 1 heavy duty multi purpose ejection and release unit
- Left and right hand outboard wing pylons equipped with 2 light duty multi purpose ejection and release units
- Left and right hand wing tip pylons with specific air-to-air missile S&RE

---------- End Example

1.3.1 Installation: This section describes the installation of the store on the aircraft. It details the available positions of the stations specified in 1.3.

---------- Begin Example

1.3.1.1 Aircraft Installation: Depends on interface purpose here: aircraft side

1.3.1.2 Store Installation: Depends on interface purpose here: store side

---------- End Example

1.3.2 Commonality Considerations: Store commonality means for use of store on different aircraft. Not relevant for aircraft related ICD.

---------- Begin Example

The store is to be used on all fighter aircraft equipped with a MIL-STD-1760 interface and all related standards therein.

---------- End Example

2. APPLICABLE DOCUMENTS:

2.1 General:

This section shall give an overview of the content of the applicable documents

---------- Begin Example

The following documents, of the exact issue shown, form a part of this document to the extent specified herein. In the event of conflict between the document referenced herein and the contents of this document, see 2.6, Precedence.

---------- End Example

2.2 Specifications:

Aircraft or store related specifications relevant to the interface shall be listed in this section.

---------- Begin Example

- Equipment Specification for launcher interface box xxx-yyy-zzz
- System Specification for integration of weapon xyz SS-123
- System Software Requirement Specification SSRS-123

---------- End Example

2.3 Standards:

2.3.1 Military Standards: Aircraft or store related military standards relevant to the interface shall be listed in this section.

---------- Begin Example

- MIL-STD-1553: ´Aircraft Internal Time Division Command/Response Multiplex Data Bus´
- MIL-STD-1760D: ´Aircraft Store Electrical Interconnection System´
- STANAG 4586 (NATO Standardization Agreement) ´Leading the Way to NATO UAV Systems Interoperability´

---------- End Example

2.3.2 Civilian Standards: Aircraft or store related civilian standards relevant to the interface shall be listed in this section.

---------- Begin Example

- SAE Aerospace Information Report (AIR) ´AIR5532: Generic Aircraft-Store Interface Framework´
- SAE Aerospace Standard (AS) ´mnop´.

---------- End Example

2.4 Project Specific Documents:

Project handbooks, project specific and interface relevant technical notes shall be listed here.

---------- Begin Example

- MIL-HDBK-1760
- MIL-HDBK-1553

---------- End Example

2.5 Other Documents:

Supplier Documents, Plans, Configuration Procedures, Drawings

---------- Begin Example

- Drawing x
- Drawing y

---------- End Example

2.6 Precedence:

Defines the sequencing of documents including this ICD and which documents controls the others, etc.

---------- Begin Example

In the event of conflict between requirements specified in this and referenced documents, the following order of precedence applies:

- Document 1
- Document 2
- Document 3

---------- End Example

3. MECHANICAL INTERFACE:

3.1 General:

Store mechanical interface aspects are dealt with in the following with the aim to standardize the kind of related information as well as the way the information is represented.

As far as is applicable, the aspects of interface are separately considered from Store and Aircraft perspective, in an attempt to differentiate those parameters which are different or commonly needed by the two communities (aircraft design authority and store design authority) to carry out the interface analysis task.

NOTE 1: Any required data has to be inserted in the ICD only if relevant to the store – station interface.

NOTE 2: If a drawing is translated from Imperial to metric or vice-versa, a precautionary note has to be inserted, warning that the drawing has been translated from a different system and this should be taken into proper consideration in any assembly, tolerance or installation analysis.

Conversion methods will be clearly stated.

3.2 Physical Characteristics:

3.2.1 Dimensional Envelope: Dimensions will be expressed in mm.

Tolerances (and their applicable unit of measure) will be indicated.

Drawings and pictures should be presented in scales coherent with a representation on “A4” or “US letter” format pages.

Two recommended scales should be adopted: for drawings included in the text: one (i.e. 1/100) for large images, such as aircraft, and another one (i.e. 1/20 or 1/25) for smaller images, such as stores.

Full scale drawings or detailed graphical data can be dealt with as separate documents, which will be referred to in the applicable paragraphs together with suitable instruction in order to allow the exchange/download in electronic format (IGES or STEP formats to be preferred).

3.2.1 (Continued):

Ideally, dimensions provided here should allow:

- The aircraft design authority to create a simplified 3D model of the store itself
- The store design authority to gather the necessary information for a first fit trial analysis (station location, pylon geometry, etc).

Two kind of dimensions will be provided.

a. Absolute dimensions

Overall dimensions that allows the physical volume containing the store to be drawn.

---------- Begin Example

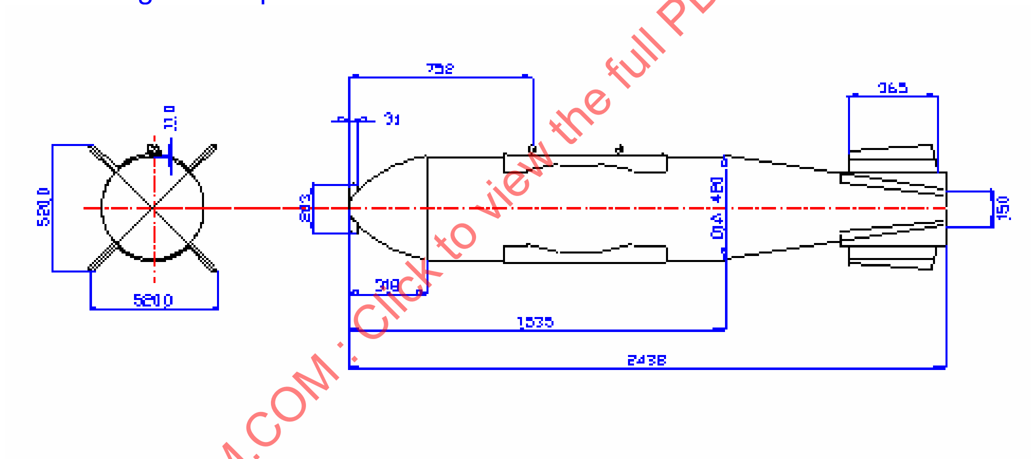


FIGURE 1 - Absolute Store Dimensions

---------- End Example

3.2.1 (Continued):

b. Relative dimensions

Dimensions that allow the reciprocal positioning of the parts of the store, which are significant from the interface perspective (wings, fins, air intakes, wave guides, etc.) shall be specified.

---------- Begin Example

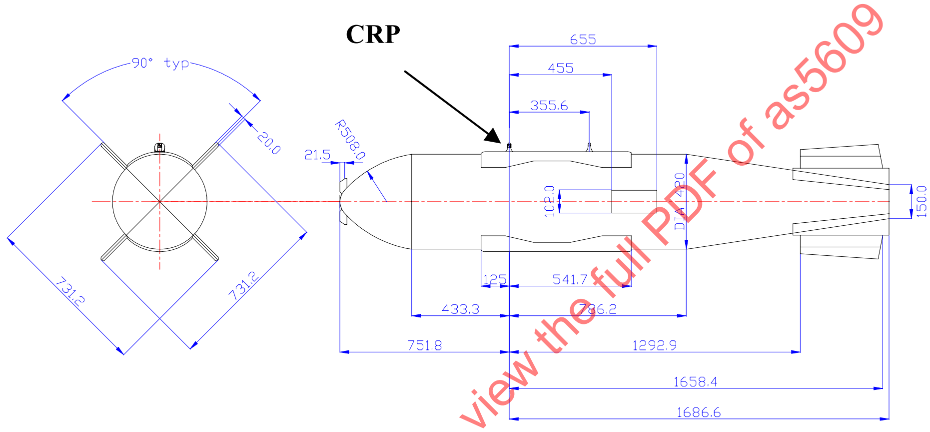


FIGURE 2 - Relative Store Dimensions

---------- End Example

The *relevant dimensions* will be referred to a common reference point (CRP).

It is proposed to locate the CRP on the forward attachment.

Details of the forward attachment geometry and the relevant position of CRP will be referred to in the paragraph where geometry of attachment elements is given (14” lugs, 30” lugs, 30” bolts, 30” T-Lugs, T-Hangers, etc.).

The use of Store or Aircraft Stations (i.e. STA 1245) should be avoided whenever possible in order to avoid the need to perform equivalence computations necessary to translate Store dimensions to Aircraft dimensions and vice versa.

In those cases where the store configurations for installation, carriage or release present different envelopes, these should be dealt with separately.

(Example: Access panels locally enlarge the installation envelope. Fins deploy or deflect during release; Rollerons disengage during launch, etc.).

3.2.2 Mass: Mass unit of measure will be: kg

Store Side:

Store mass will be provided for each store carriage configuration

(Example: gun pods/dispensers/tanks empty, fully loaded and, if deemed relevant, in intermediate loading conditions).

If necessary, variations of mass that could occur as a result of store functions (e.g. running of engines that consume fuel carried within the store), will be defined

A store mass distribution graph will be provided in cases of significant unevenness in mass distribution.

---------- Begin Example

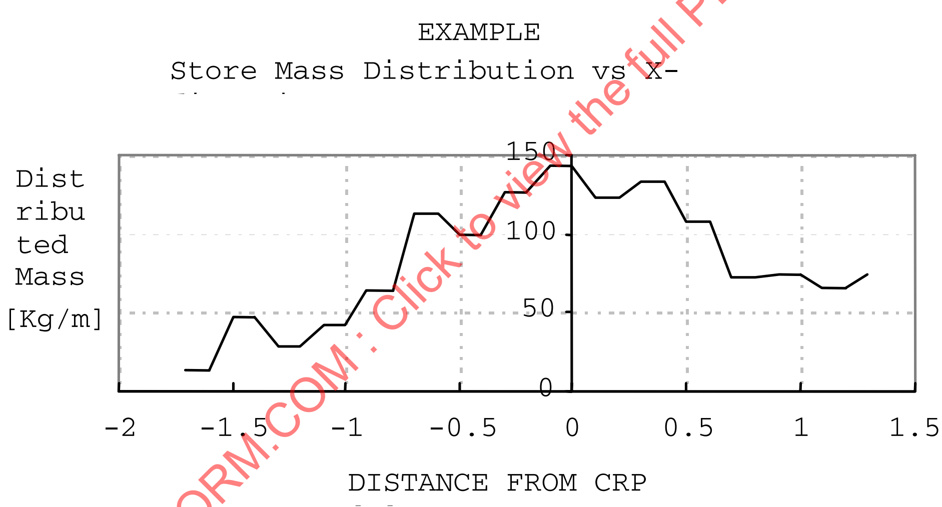


FIGURE 3 - Store Mass Distribution Graph

---------- End Example

Aircraft Side:

If applicable, the carriage mass limitation will be given for each candidate station

3.2.3 Centre of Gravity: It must be ensured that the variations that could occur simply as a measure of the tolerances associated with the agreed mass figures are addressed.

Store Side:

Position of centre of gravity will be provided for each carriage configuration and referred to the CRP.

---------- Begin Example

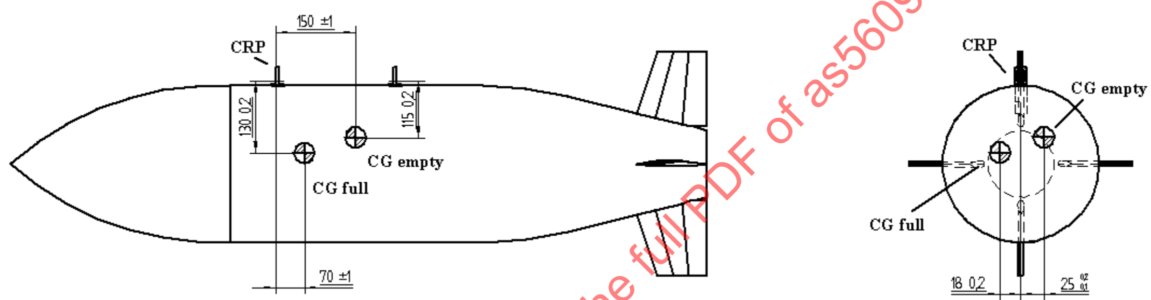


FIGURE 4 - Centre of Gravity Location

---------- End Example

Aircraft Side:

If applicable, the carried store center of gravity limitations will be given for each candidate station and referenced with respect to the CRP.

---------- Begin Example

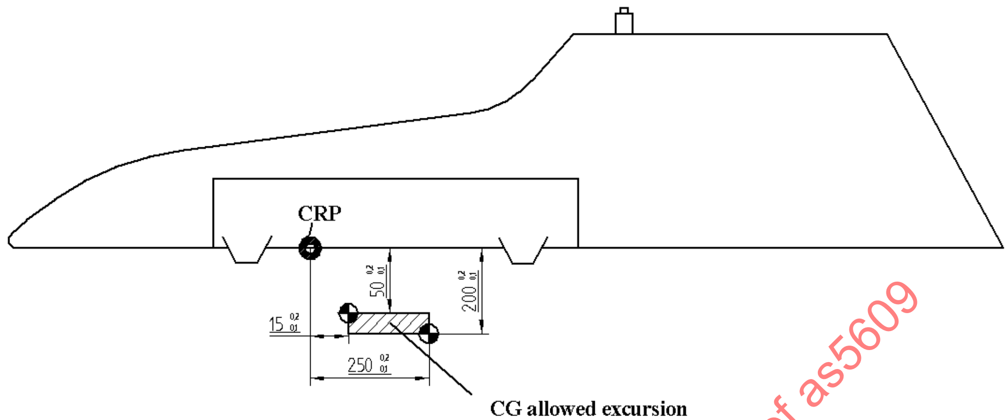


FIGURE 5 - Centre of Gravity Location

---------- End Example

3.2.4 Moments of Inertia: Moments of Inertia will be expressed in: kgm^2

It must be ensured that the variations that could occur simply as a measure of the tolerances associated with the agreed mass figures are addressed.

Store Side:

Moments of inertia in pitch, yaw and roll will be provided for each carriage configuration/status/combination

Aircraft Side:

Either “Not Applicable” or eventual limitations to Moment of Inertia for defined stations will be highlighted.

3.2.5 Natural Frequencies: The natural harmonic frequencies of the system are defined here in.

Store Side:

Relevant store vibration modes shall be provided here.

Aircraft Side:

Relevant Aircraft Vibration modes shall be provided here (for example: number of rotor blades and rotation velocities)

3.3 Suspension Interface:

3.3.1 Connector Interfaces:

Connector Interface: Umbilical location(s) and clearance(s) e.g. primary and auxiliary interface connections, specific fuzing connectors. Orientation

Store Side:

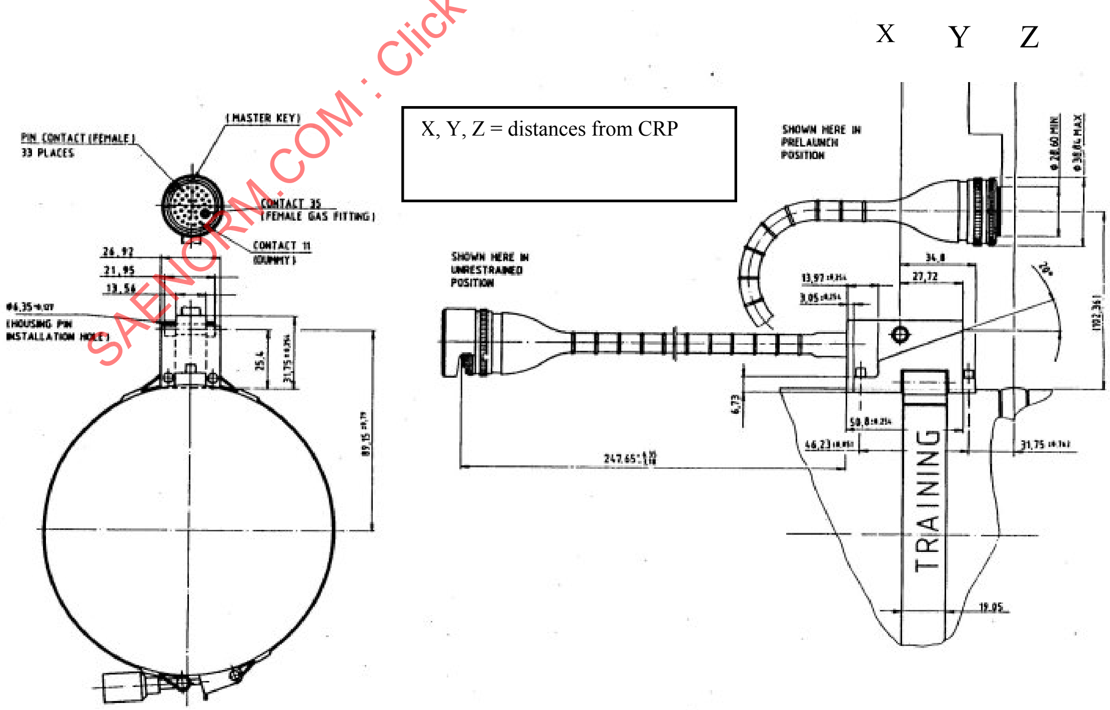
Location, height above store surface, identification and orientation of store connectors shall be specified.

Specific mating and de-mating requirements will be detailed (blind or bayonet mating, connection forces, torques, travel, shearing or tearing forces, etc.)

Care will be given to ensure that all information leading to complete identification of the geometry of the connector and its mating condition are provided.

NOTE: Shielding properties and bonding features of electrical connectors will be covered in the proper paragraph of the electrical interface section

---------- Begin Example



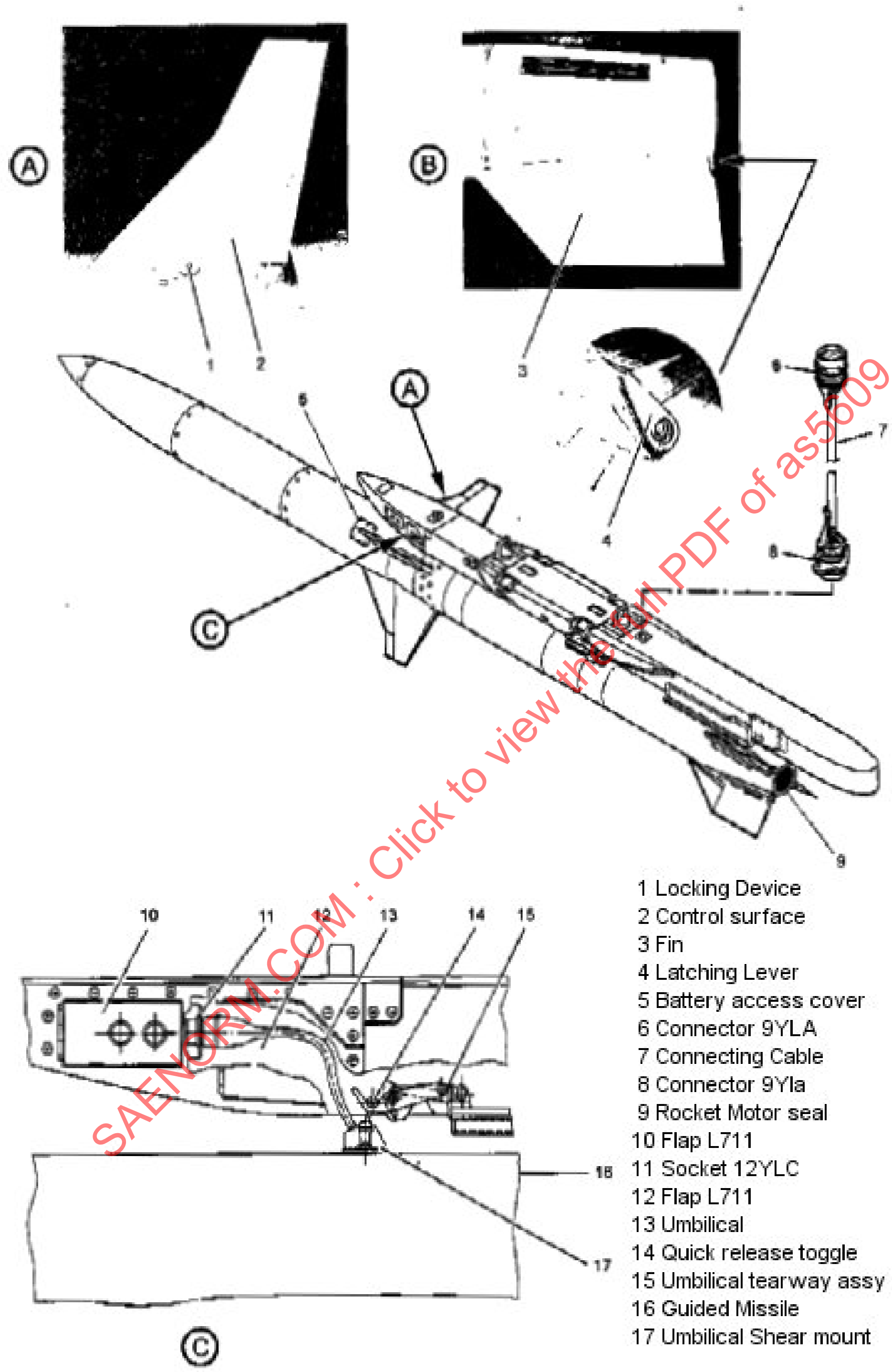


FIGURE 6 - Store Connector Interface (Store Side)

---------- End Example

3.3.1 (Continued):

Aircraft Side:

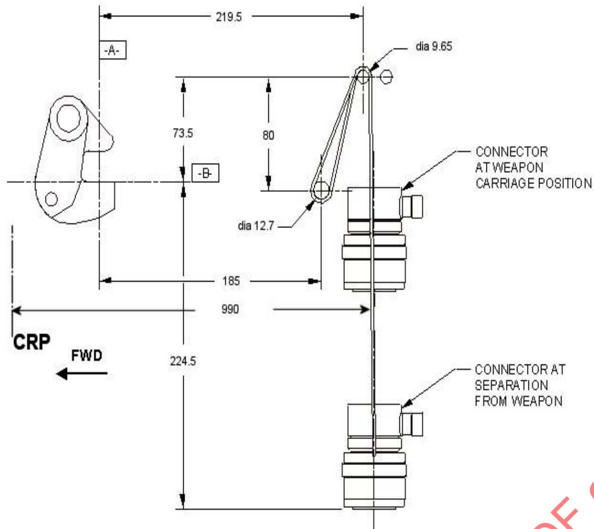
Location, identification and orientation of Pylons, stations and S&RRE connectors shall be specified.

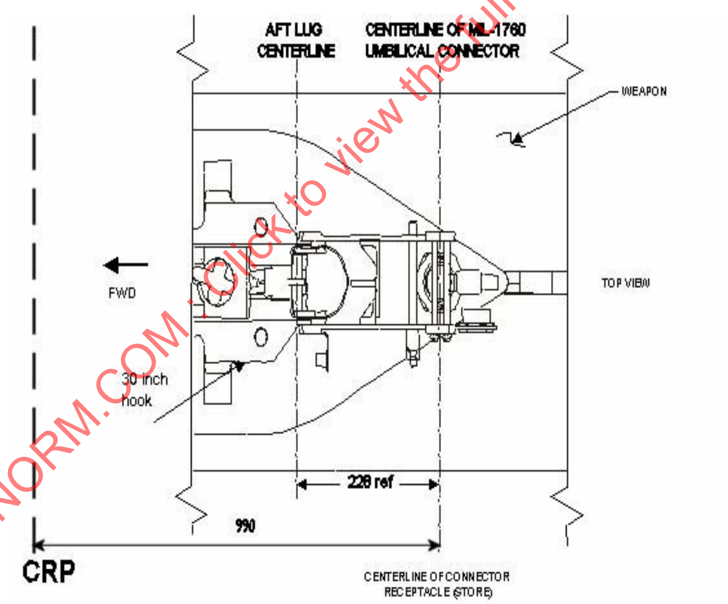
Specific mating and de-mating requirements will be detailed (blind or bayonet mating, connection forces, torques, strokes, etc.)

Care will be given to ensure that all information leading to complete identification of the geometry of the connector and its mating condition are provided.

NOTE: Shielding properties and bonding features of electrical connectors will be covered in the proper paragraph of the electrical interface section.

---------- Begin Example


219.5
-A-
dia 9.65
73.5
80
-B-
CONNECTOR
AT WEAPON
CARRIAGE POSITION
dia 12.7
185
990
CRP
FWD
224.5
CONNECTOR AT
SEPARATION
FROM WEAPON


AFT LUG
CENTERLINE
CENTERLINE OF MIL-1760
UMBILICAL CONNECTOR
WEAPON
FWD
TOP VIEW
30 inch
hook
228 ref
990
CRP
CENTERLINE OF CONNECTOR
RECEPTACLE (STORE)

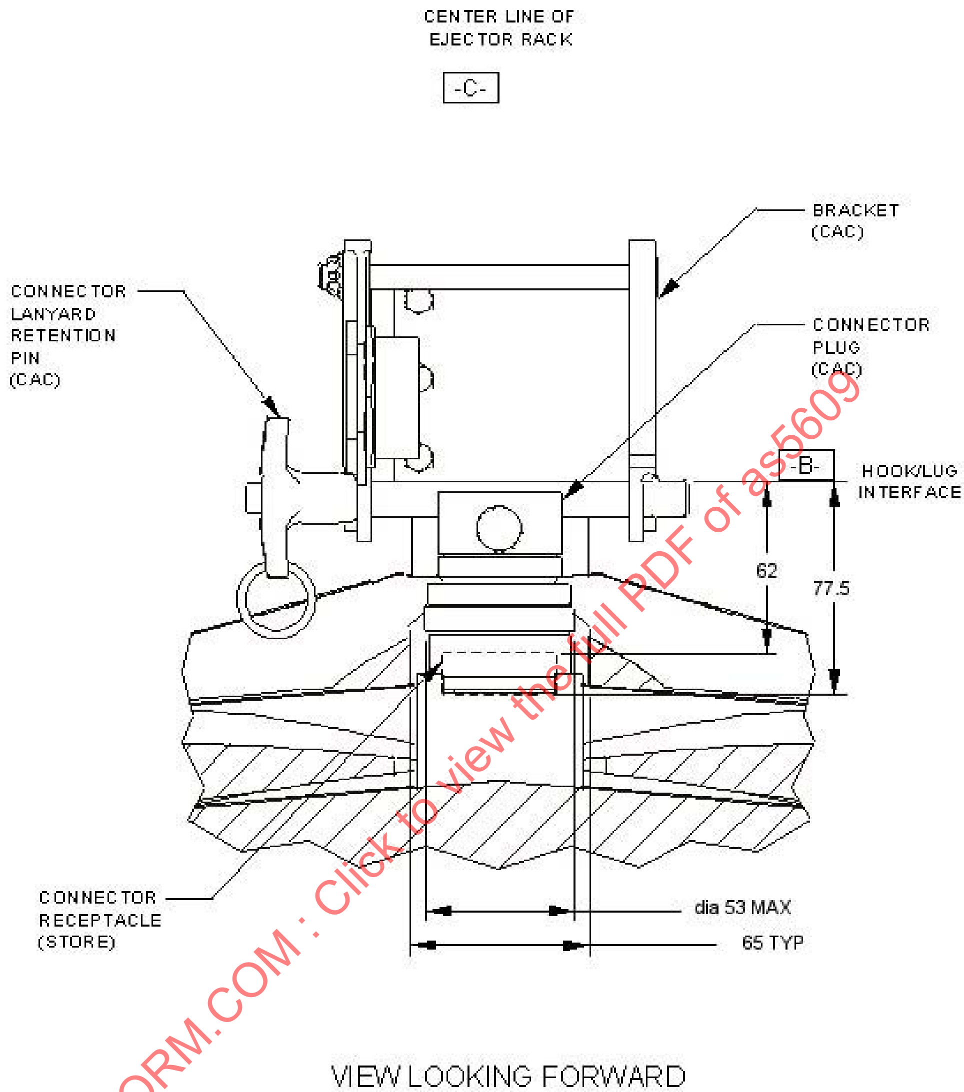


FIGURE 7 - Store Connector Interface (A/C Side)

---------- End Example

3.3.2 Fuzing and Arming Connections:

Store Side:

Number, type and location of fuzing and arming devices with their operating modes shall be specified.

Mechanical devices (to be connected to Strong Points or arming units)

The information to be provided for each lanyard is:

- Associated store function
- Connection intended for strong points or arming units
- Position (or ranges) of the lanyard (on store side and section view)
- Type of lanyard used
- Recommended (required) lanyard length
- Maximum force that can be exerted on the lanyard without actuation
- Minimum force required for actuation
- Eventual requirement for zero retention force
- Allowable pulling angle

Electrical devices (to be connected to fuzing units)

The information to be provided for each fuzing connector is:

- Associated store function
- Location
- Type of connector
- Recommended (required) cable length
- Allowable pulling angle
- Timing or sequencing requirement (if applicable)

3.3.2 (Continued):

---------- Begin Example

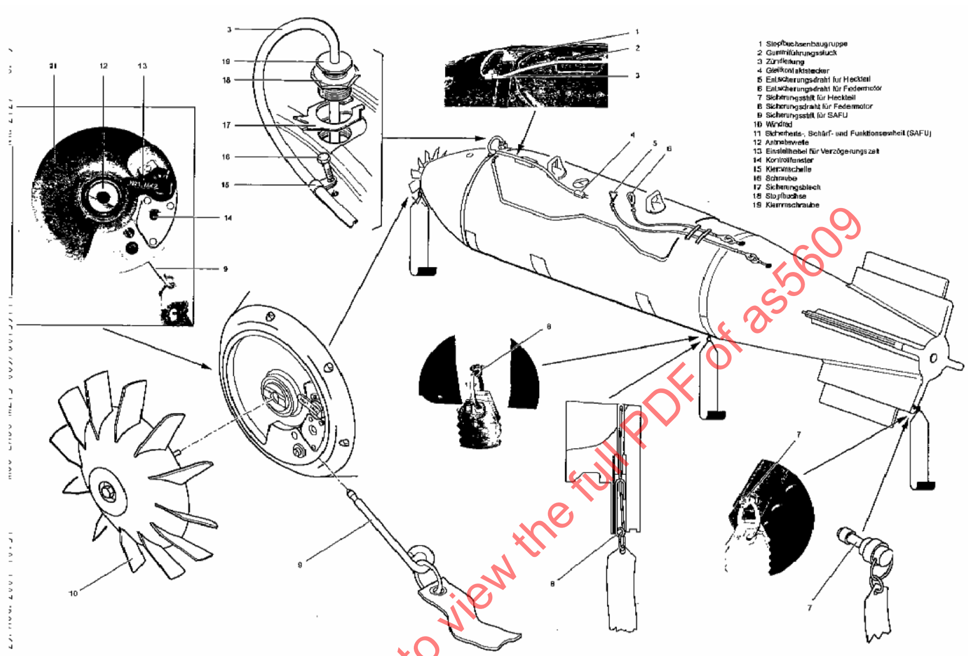


FIGURE 8 - Fuzing and Arming Connections (Store Side)

---------- End Example

Aircraft Side:

The following details, addressing only the specific aircraft/store combination, will be provided:

Strong points (unconditional retention of arming lanyards at store release)

- Number and location
- Operating instructions and tools (if needed)
- Type of lanyard accepted
- Maximum retention force
- Eventual limits of operation

3.3.2 (Continued):

Arming Units (conditional retention/release of lanyards at store release)

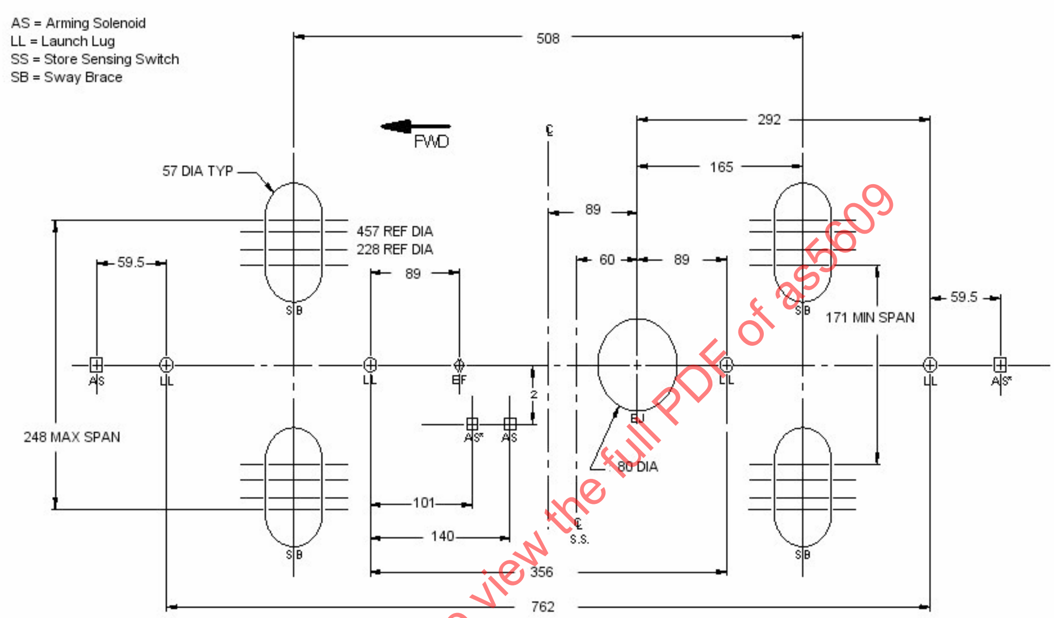
- Number and location
- Operating instructions and tools (if needed)
- Type of lanyard accepted
- Maximum retaining force when “armed” (eventually zero retention)
- Minimum retaining force when “unarmed”
- Allowable pulling angle
- Eventual limits of operation

Fuzing Units (conditional arming electrical signal supplied after store release)

- Number
- Location
- Type of connector
- Allowable pulling angle
- Timing of disconnection from firing pulse

3.3.2 (Continued):

---------- Begin Example



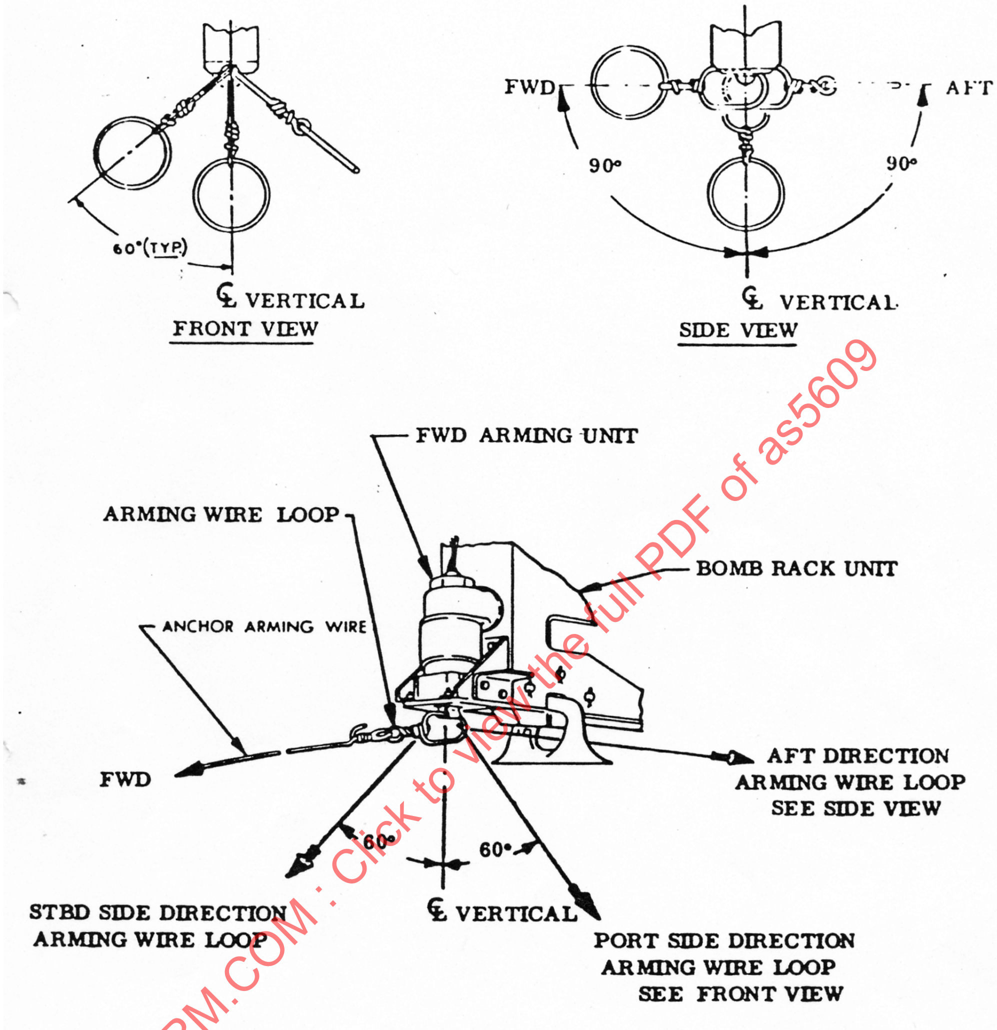


FIGURE 9 - Fuzing and Arming Connections (A/C Side)

---------- End Example

3.3.3 Suspension Details:

Store Side:

The store suspension type will be identified and the detail geometry of the attachment points will be provided:

NOTE:

The maximum allowable loads on each attachment point will be provided (single limit loads?).

The maximum allowable and minimum required (where appropriate) crutching/sway bracing/snubbing loads and the associated reinforced allowable area will be provided.

Eventual limitations or precautions to be adopted will be provided.

3.3.3 (Continued):

---------- Begin Example

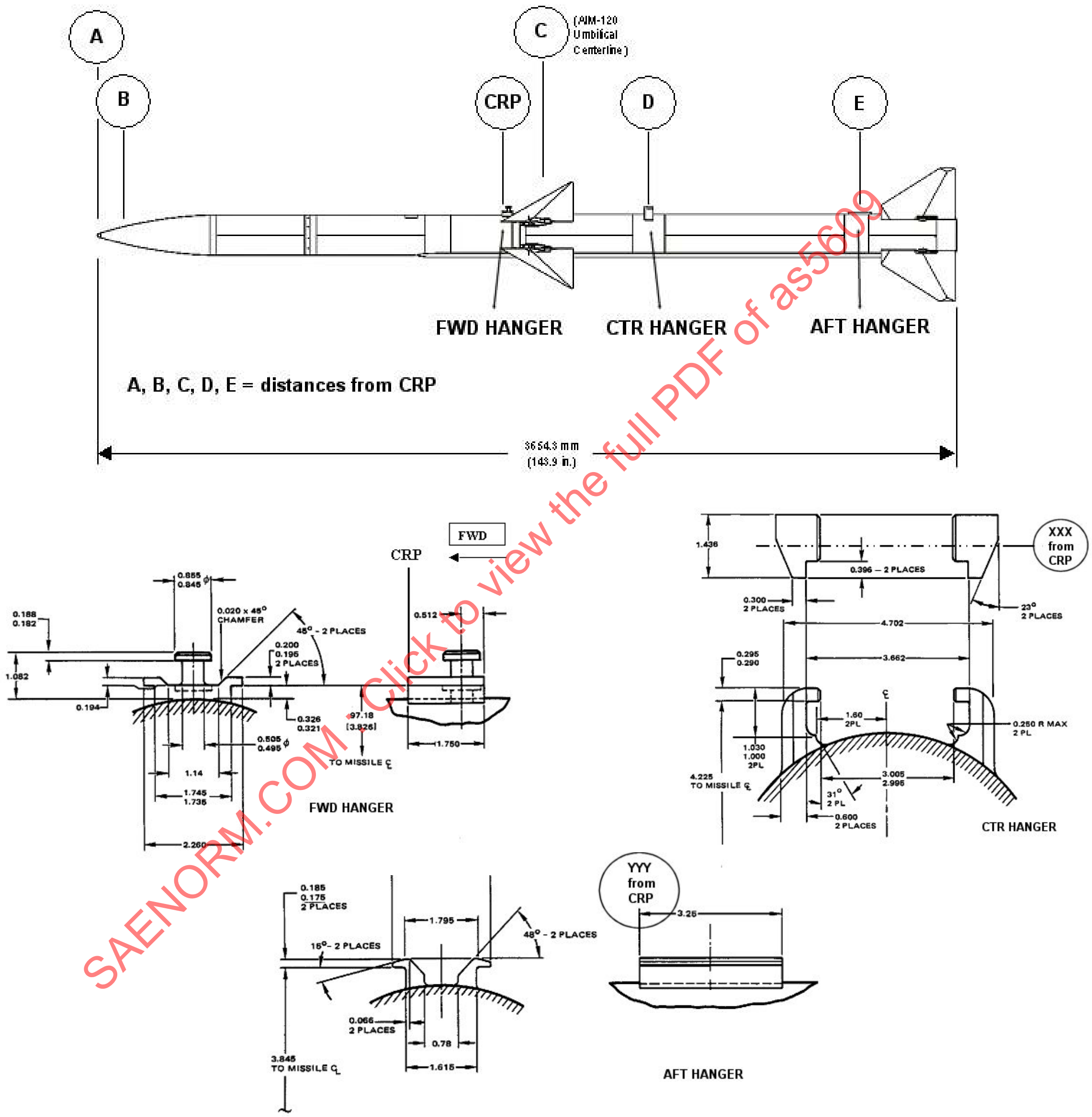


FIGURE 10 - Graphic Detail of Store Attachment

---------- End Example

3.3.3 (Continued):

Aircraft Side:

Interface data of the S&RRE installed in the candidate station will be provided.

Geometry of crutching/sway bracing/snubbing elements will be detailed.

---------- Begin Example

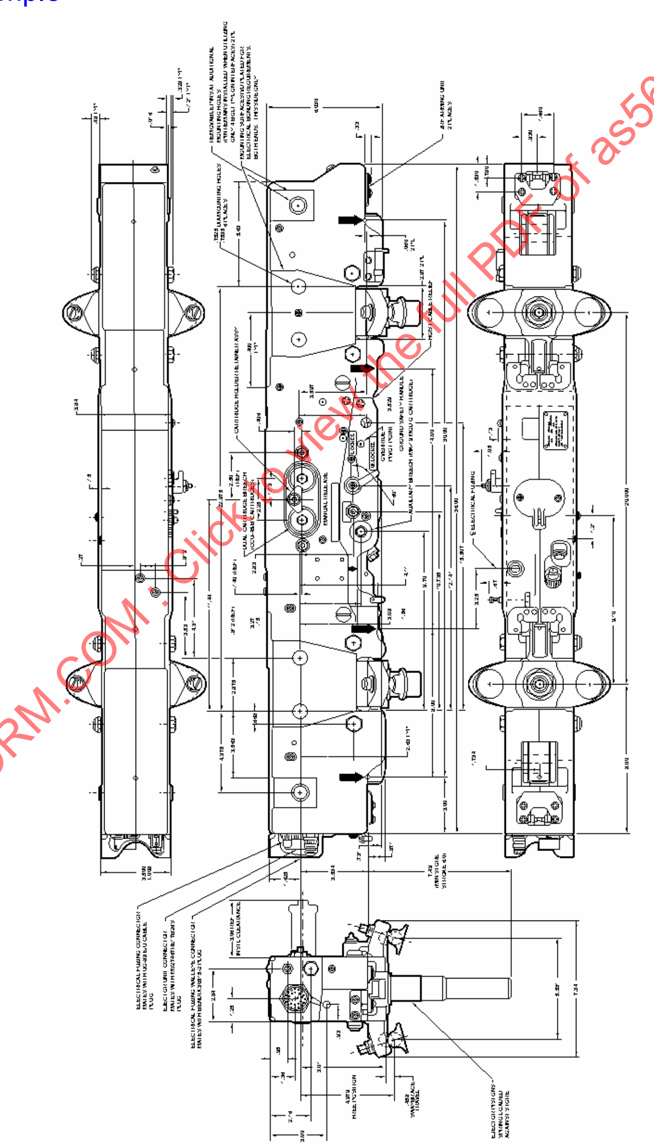


FIGURE 11 - S&RE Interface

---------- End Example

3.3.4 Clearances: This information is additional to that given with the store dimensional envelopes.

It is recommended that this data is provided in a separate set of pictures/drawings in order to reduce graphical clutter and to ease the addressing of eventual issues (for example a different loading procedure could be devised in case the standard procedure reveals incompatibilities or conflicts, i.e. rocket launchers to be installed only in loaded conditions as opposite to insert the rockets with the rocket launcher already installed).

Store Side:

The required clearances will be divided into the following sections (where applicable):

Clearances for Store loading

Clearance aspects of store loading devices and space envelopes to be respected during the store uploading will be addressed in this section.

Space needed to operate wrenches, special tools or to carry out mechanical and electrical connections will be specified.

---------- Begin Example

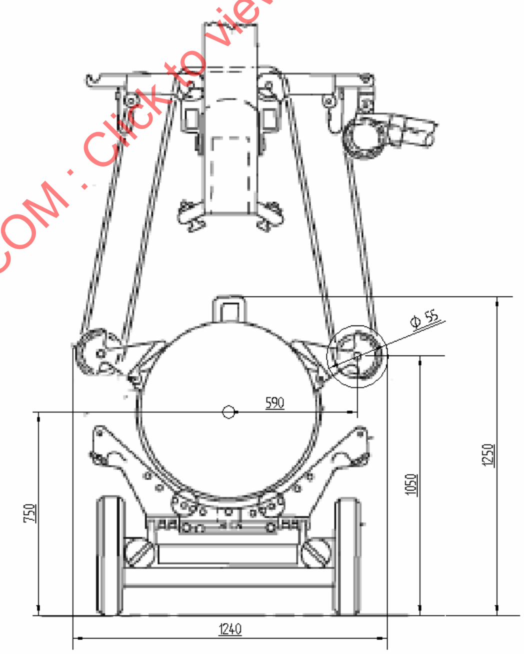


FIGURE 12 - Clearance Envelope for Store Loading – Figure 12

---------- End Example

3.3.4 (Continued):

Clearances for Store preparation/setting before flight

Space needed to operate 1st line functional check, setting or tuning operations, installation of checking devices, will be specified.

---------- Begin Example

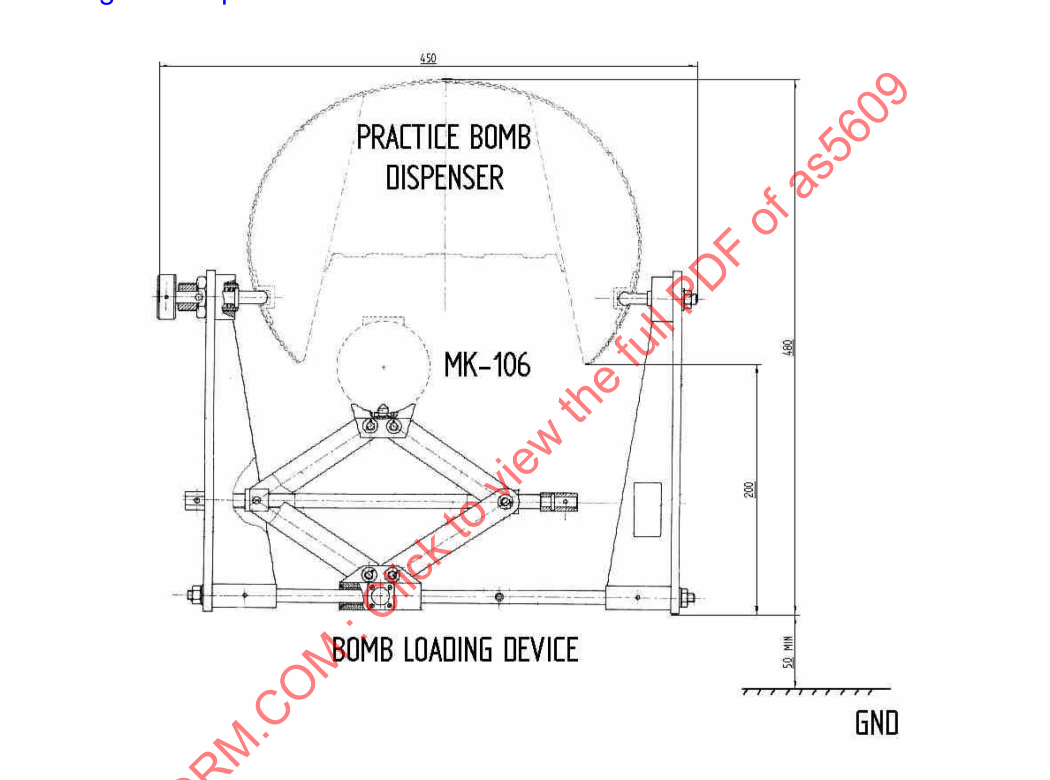


FIGURE 13 - Clearance Envelope for Store Preparation/Setting

---------- End Example

Clearances for Store carriage

Space envelopes needed for the safe carriage of the store (if already dealt with in the dimensional envelope paragraph, make a reference).

Clearances for Store release

Space envelopes needed for the safe release of the store. If needed, clearances will be identified for each store condition/status.

3.3.4 (Continued):

---------- Begin Example

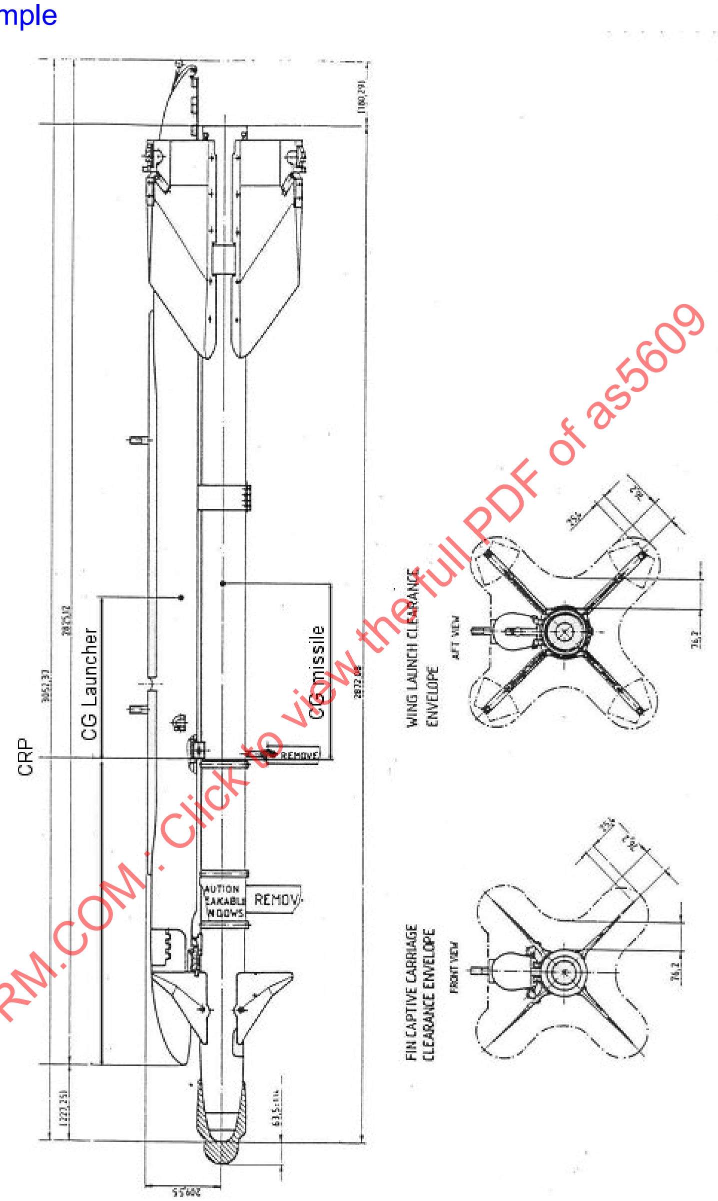


FIGURE 14 - Store Clearances for Carriage and Release

---------- End Example

3.3.4 (Continued):

Aircraft Side:

Minimum allowed clearances versus flaps, slats, ground (worst landing and take off case) and near pylons, store stations or aircraft structures in proximity of the installed store will be provided.

This information should allow the identification of the store loading profiles and combinations compatible with the candidate store.

---------- Begin Example

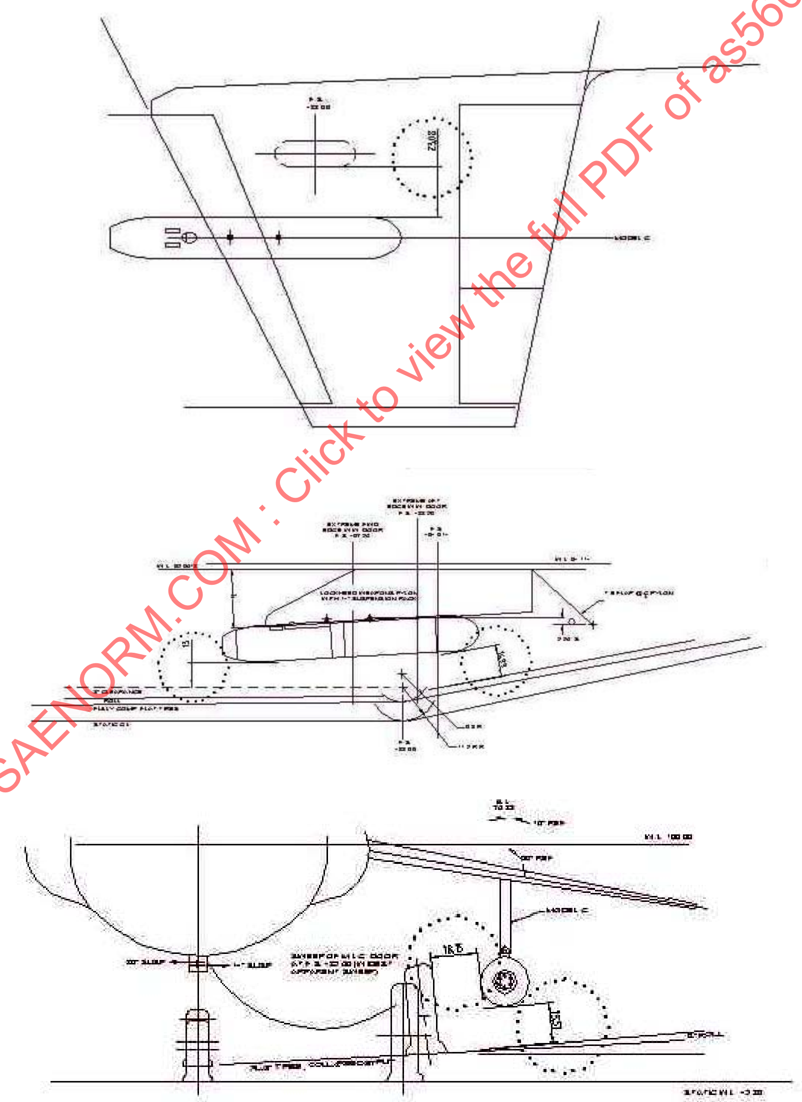


FIGURE 15 - Store Station Clearances

---------- End Example

3.3.5 S & RE Settings:

Store Side:

Not Applicable

Aircraft Side:

Unique items, tools and operations driven by the specific store will be described in this section (i.e. throttle setting operation, preloading precautions or specific to type observations as applicable)

3.3.6 Carriage Store Unique Provisions: Three categories of carriage store (CS) can be considered.

- CS which are unique to the aircraft (i.e. LAU-129 and F-16) are to be considered part of the Aircraft interface and dealt with in the relevant aircraft sections
- CS which are unique to the store (i.e. Maverick launcher) are to be considered part of the store interface and dealt with in the relevant store sections
- CS which are specific for a particular aircraft configuration (multiple store carriers) will be dealt with in this section replicating the contents of 3.3.1 to 3.3.5 as applicable.

3.4 Alignment (physical characteristics here, functional in Vol. 2):

Only static alignment is dealt with in this paragraph.

Dynamic alignment during carriage can be gathered from Section 6 (Air carriage loads) and Store stiffness

Store Side:

Store requirements for alignment repeatability will be provided (mrad ranges in yaw, pitch and roll)

Store requirements for mechanical alignment - orientation (if applicable) will be declared.

Store internal alignment adjustment capability (i.e. gun pod) will be declared and the achievable adjustment range provided

3.4 (Continued):

Aircraft Side:

For each station, the store Line (SL) nominal orientation (in degrees) with respect to a defined aircraft reference axis will be provided.

The alignment repeatability of the SL guaranteed by the candidate aircraft suspension will be provided (mrad ranges in yaw, pitch and roll).

If available, the SL mechanical alignment adjustments achievable on the candidate station will be identified (ranges in yaw and pitch will be indicated).

If applicable (in case of interface impact) the associated procedure and tools will be described and listed.

3.5 Loads:

3.5.1 Separation Loads:

Store Side:

Ejected stores

- Areas where ejection pistons can apply the ejection forces.
- Maximum total and single force that can be exerted by pistons.
- Maximum pressure allowed in the store/pistons contact area
- Maximum allowable, minimum required store acceleration (if applicable).
- Minimum ejection stroke (if applicable).

Specify whether the store needs to be controlled (roll, pitch, yaw) during ejection.

3.5.1 (Continued):

Rail Launched Stores

- Maximum motor thrust and related time history will be provided.

- Maximum allowed and minimum required retention force before release will be provided (possibly with time history).

- Minimum and maximum detention time at launch (if applicable)

- Number and position of umbilical connectors, typology of the disconnection system (e.g. tear, shear bolts etc.) and related forces (magnitude and direction) will be provided.

- Required disconnection operations, timing and sequence will be described together with eventual limitations or precautions to be respected.

Aircraft Side:

Ejection Stations

Ejection pistons spacing, location and store contact area will be provided.

Ejection stroke will be provided.

Store constraining capability during ejection to be declared.

Type and number of cartridges used (if applicable) and available set of throttle settings.

NOTE: It is proposed to adopt a common throttle setting definition (i.e. percentage of the total thrust available at each piston).

Maximum forces exerted by the pistons (at max Temp) and the minimum End Of Stroke (EOS) velocities (at min Temp).

Eventual angular EOS velocity to be declared.

3.5.1 (Continued):

Rail launch stations

- Number and position of snubbing devices.
- Number and position of forward and rearward locking systems.
- Minimum and maximum longitudinal force needed to open the latching system.
- Maximum restrain force in the rearward direction.
- Maximum force exerted by each snubbing unit.

For the candidate store, retention forces (and relevant duration) during launch as well as during lock shut firings will be provided

Guidelines:

Min retention force is dictated by safe separation criteria, being associated with min end of rail relative speed.

Max retention force is related to lock shut firings and it is to be compared with the max motor thrust of the candidate missile.

Max retention time influences missile performance/endurance.

NOTE: In the case where the contribution to the overall retention force, due to elements other than the Detent Mechanism (snubbers, shear screws), is not negligible (more than 10 to 15%), the split of the overall force among the retention elements will be provided.

3.5.2 Captive Carriage Loads (Air and Ground):

Store Side:

This records the store information needed by the aircraft design authority to determine the loads induced by the store inertia and aerodynamic properties into the aircraft (candidate carriage station).

The aerodynamic coefficients (C_X, C_Y and C_Z) of the store free stream shall be provided as a function of the angle of attack and sideslip

NOTE: Store inertia data has already been provided in the relevant section

3.5.2 (Continued):

Aircraft Side:

These records the aircraft (candidate carriage station) information needed by the store design authority to determine the loads induced on the store by the aircraft motion.

The candidate station inertial carriage loads envelope will be provided with a nz – ny graphic and the range of rotational accelerations will be provided.

To allow evaluation of aerodynamic loads, a graphic of dynamic pressure versus angle of attack and dynamic pressure vs angle of sideslip will be provided.

Identification and location of the selected loads reference point (if different than CRP) will be provided.

Minimum and maximum preload forces exchanged between the suspension station and the store will be defined and provided

Special load conditions (crash landing, aircraft carrier landing, barrier engagement, catapulting, etc) will be separately defined.

3.5.3 Store Unique Loads: Forces, which are transferred from store to aircraft as a result of the store specific function, and not associated with carriage or release (gun pods, rocket launchers. towed decoys, etc.), will be identified and detailed in this section.

3.6 Store Stiffness:

Store stiffness data shall be provided in terms of distribution along the longitudinal (X) axis of EJ (the product of the modulus of elasticity by the moment of inertia of the section) for the two flexional bending modes and of GJ_{polar} (the product of the shear modulus by the polar moment of inertia of the section) for the torsional mode.

EI and GJ_{polar} will be expressed in Nm^2

---------- Begin Example

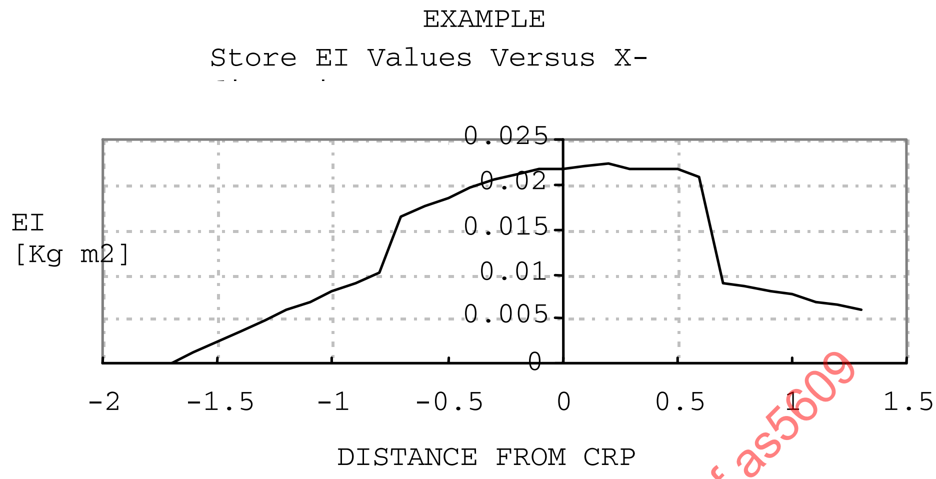


FIGURE 16 - Typical Store EJ Diagram

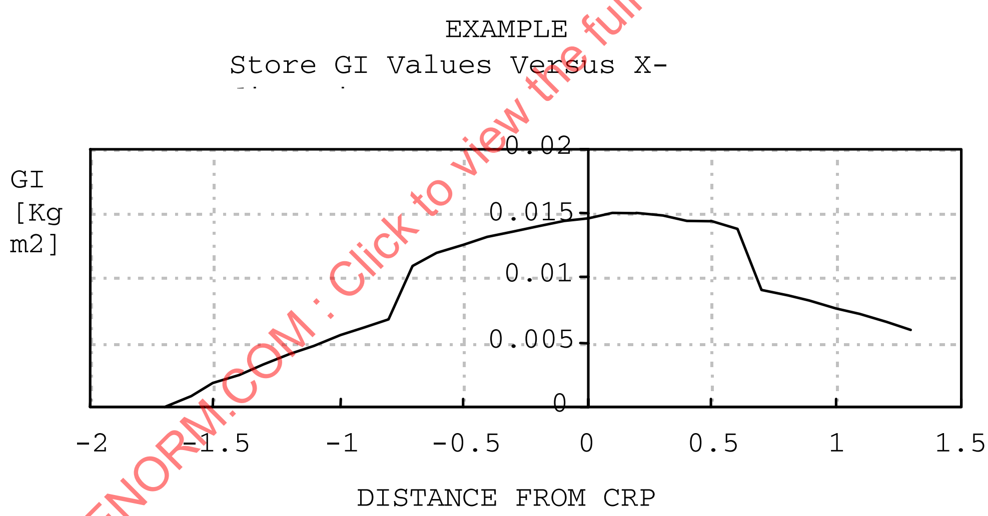


FIGURE 17 - Typical Store GJ Diagram

---------- End Example

3.7 Loading Considerations:

The topic of this paragraph is not the loading or unloading procedure but loading unloading considerations that can affect the interface.

3.7.1 Loading to Aircraft:

Store Side:

Indication of store hard points and reinforced areas where loading forces can be applied and the eventual limitations or precautions shall be identified.

---------- Begin Example

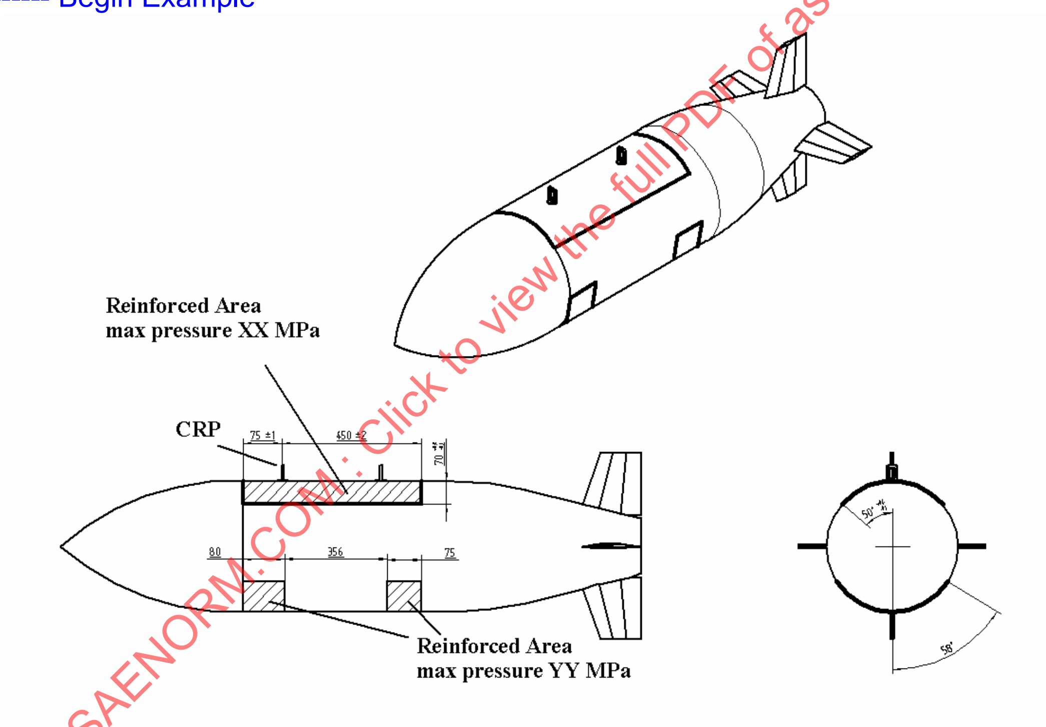


FIGURE 18 - Store Reinforced Areas Identification

---------- End Example

Description of loading procedure (and sequence(s) if any) elements or aspects that affect the interface shall be provided.

Identification of necessary associated devices/tools, list of aircraft where they are used, and list of stores that share the same devices/tools.

If applicable, store dressing (arming lanyard preparation) details to be provided.

3.7.1 (Continued):

Aircraft Side:

Indication of station hard points where loading forces can be applied and the eventual limitations or precautions.

---------- Begin Example

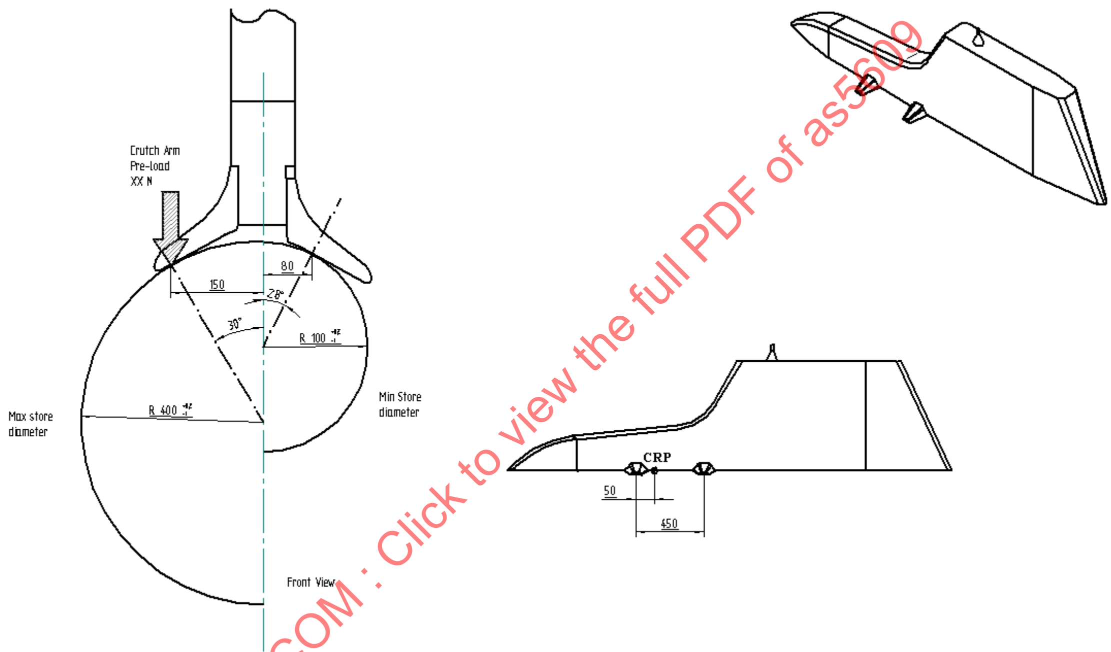


FIGURE 19 - Aircraft Carriage Station Hard Points Identification

---------- End Example

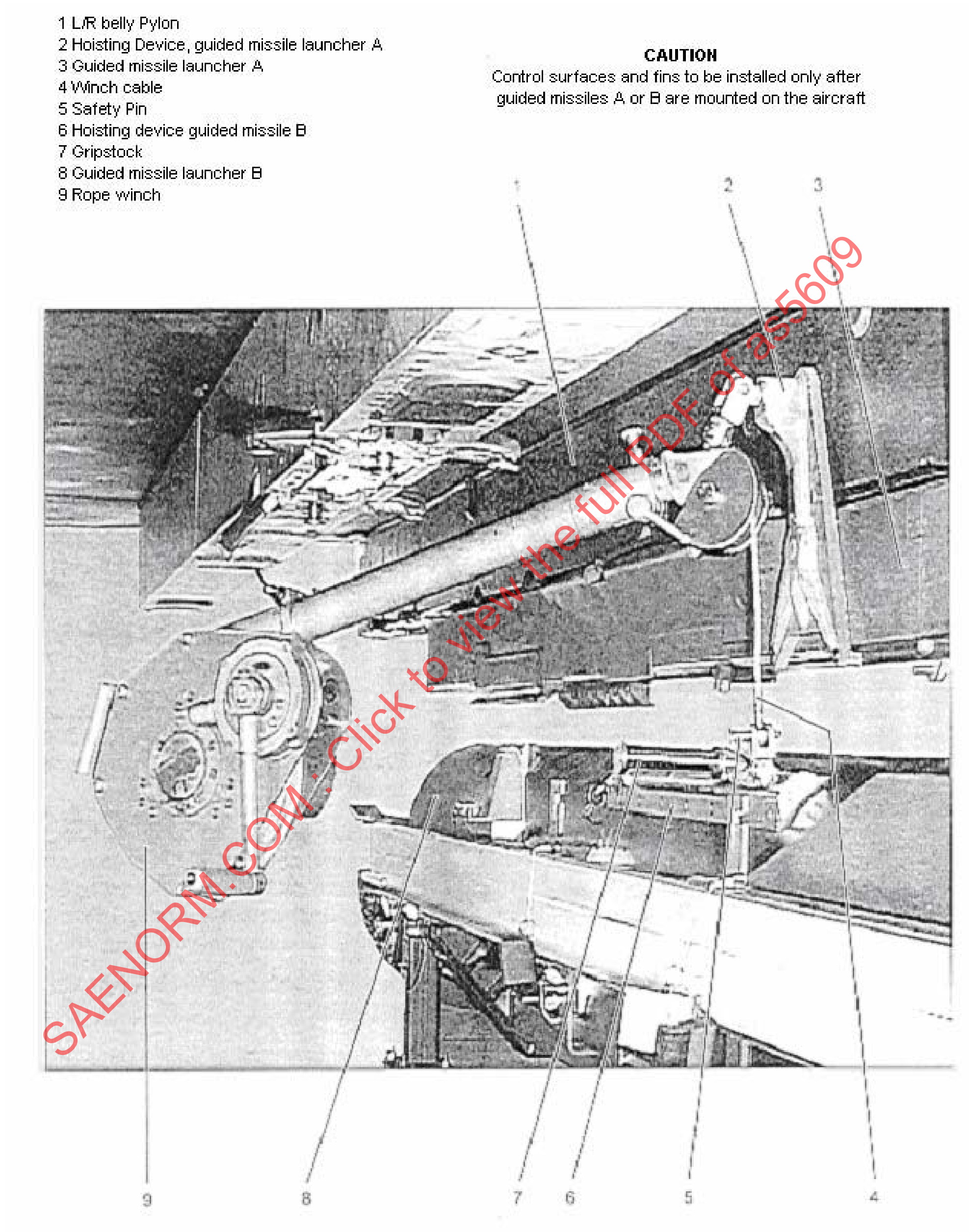
In case of impact on the aircraft/store interface, the relevant elements of the procedure for store loading at the candidate station will be provided, together (if necessary) with the list and description of the standard and special tools used.

Hoisting details, if applicable, will be detailed with indication of the allowable loads and eventual limitations or precautions to be observed.

If “common dressing” features are present they should be declared (i.e. 14” and 30” loading stations have the arming devices located in the same position).

3.7.1 (Continued):

---------- Begin Example



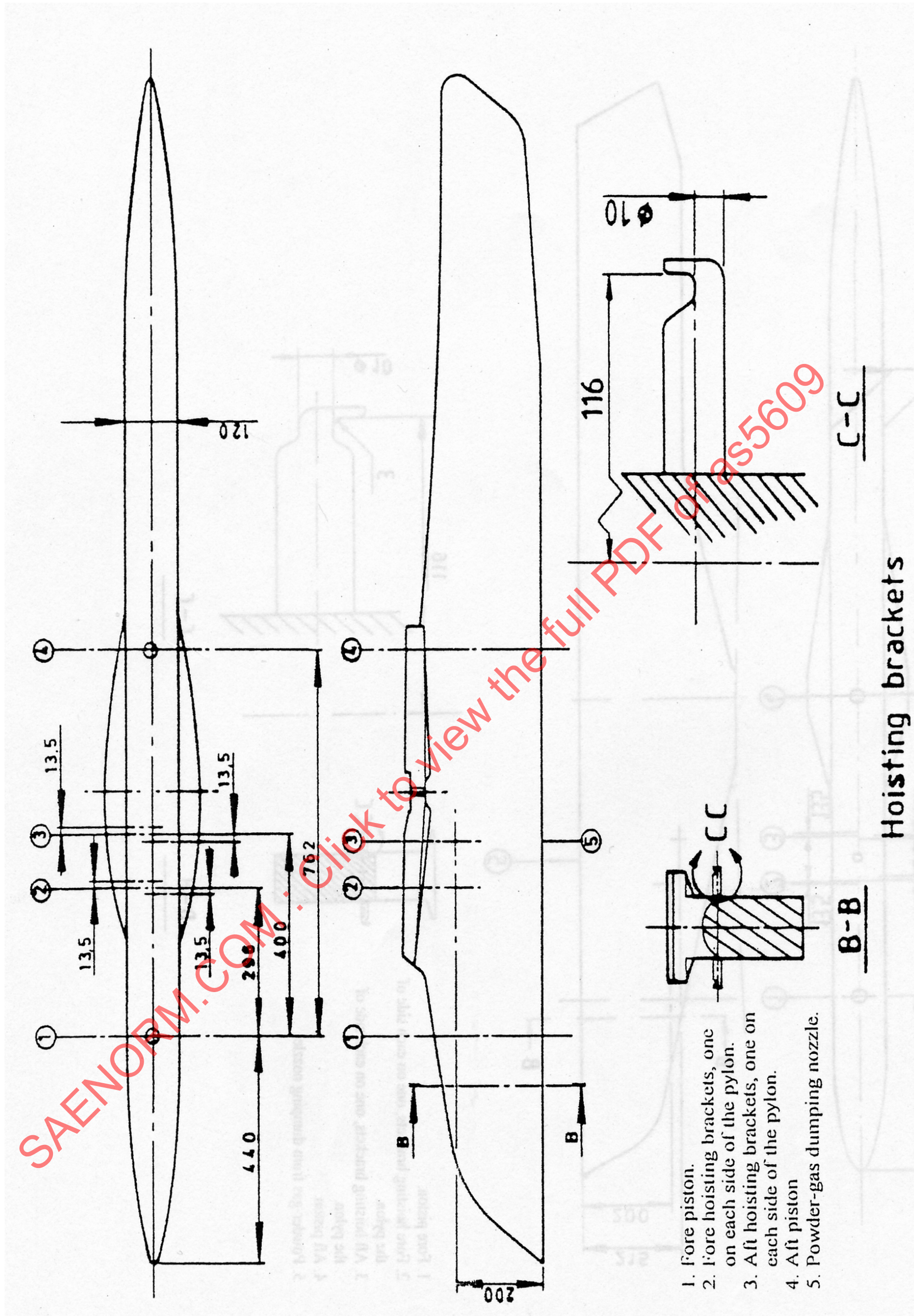


FIGURE 20 - Aircraft Store Loading Consideration

---------- End Example

3.7.2 Off-loading From Aircraft:

In case the off-loading aspects, affecting store aircraft interface, differ from those highlighted in store loading section (i.e. emergency off-load), they will be dealt with in this paragraph.

Store Side:

Description of off-loading elements, not covered in the previous paragraphs, affecting store – aircraft interface.

If necessary, identification of associated devices/tools.

Aircraft Side:

Description of off-loading elements, not covered in the previous paragraphs, affecting store – aircraft interface.

If necessary identification of associated devices/tools shall be identified in this section.

Example

The unloading of the XY store requires the respect of the following sequence in order to avoid fouling of arming lanyards and fuzing cables [Conditions assumed: A/C returned from a mission, store hoisting device in position] • Rotation of Safety Handle in "Safe" position • Removal of cartridges • Disengagement of arming lanyards from Arming Units • Disengagement of arming lanyards from strong points • Disengagement of fuzing connections • Rotation of Safety Handle in "Unsafe" position • Hook opening

3.8 Additional Mechanical Interface Considerations:

This section shall be used to cover any mechanical issues not included in the upper sections.

4. ELECTRICAL INTERFACE:

4.1 General:

Overview of the electrical interface part i.e. in the form “paragraph xy contains…”. In principle the whole paragraph or at least some parts could be covered by a reference to the entity of MIL-STD-1760 (including connectors together with the relevant slash-sheets) or other standards (like MIL-STD-704), provided this standard(s) applies. Some of the examples and the example structure are taken from MIL-STD-1760C. Provided that the platform or store would comply with the standard, a simple reference would be sufficient rather than a repetition of the standard content.

Provided that there is logical or functional information associated with the description of the electrical interface, a reference to Volume 2, section 2.6 Information Format Sheets shall be made.

4.2 Interface Connection:

Describes the electrical interface connection in general i.e. gives an overview of the parts of the electrical interface like discrete lines, data and power and introduces the next two subparagraphs. In addition the different parts of the interface should be addressed inclusive umbilical cable aspects.

4.2.1 Connector Description: Description of the electrical parts of the weapon connector(s) supported by drawing(s) and includes umbilical cable, buffers and any other adapters. Keyway orientation and connector location are specified in volume 1 section 3 Mechanical Interface.

---------- Begin Example

The ASI and MSI connections and umbilical cable are in accordance with MIL-DTL-38999. See Figure 21 and Figure 22 for reference to the connector layout and pin size and Figure 23 for pin allocation for the umbilical cable.

CONTACT LOCATION	SIZE	NOMENCLATURE
A	8	LB 1/
B	20	Interlock
C	16	28V DC power 1
D	16	28V DC power 1 return
E	16	28V DC power 2 return
F	16	28V DC power 2
G	20	Address parity
H	8	Mux B 2/
J	16	115V AC, phase C 4/
K	8	Mux A 2/
L	20	Address bit A_0
M	16	115V AC, phase B 4/
N (Reserved)	16	270V DC return
P	16	115V AC, phase A 4/
R (Reserved)	16	270V DC power
S	20	Interlock return
T	16	Structure ground
U	16	FO 2
V	20	Address bit A_4
W	12 6/	HB 2 3/
X	20	Address bit A_1
Y	16	FO 1
Z	16	115V AC neutral
1	20	Release consent
2	12 6/	HB 4 3/
3	12 6/	HB 3 3/
4	20	Address bit A_3
5	12 5/ **[Note86]**	HB 1 3/
6	20	Address return
7	20	Address bit A_2

FIGURE 21 - 1760 Interface: Contact Size

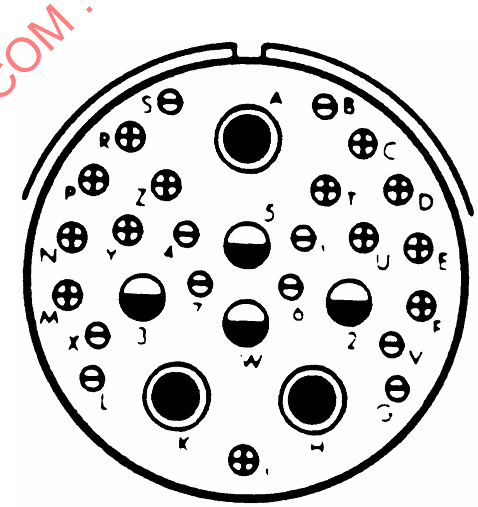


FIGURE 22 - Connector Pin Layout

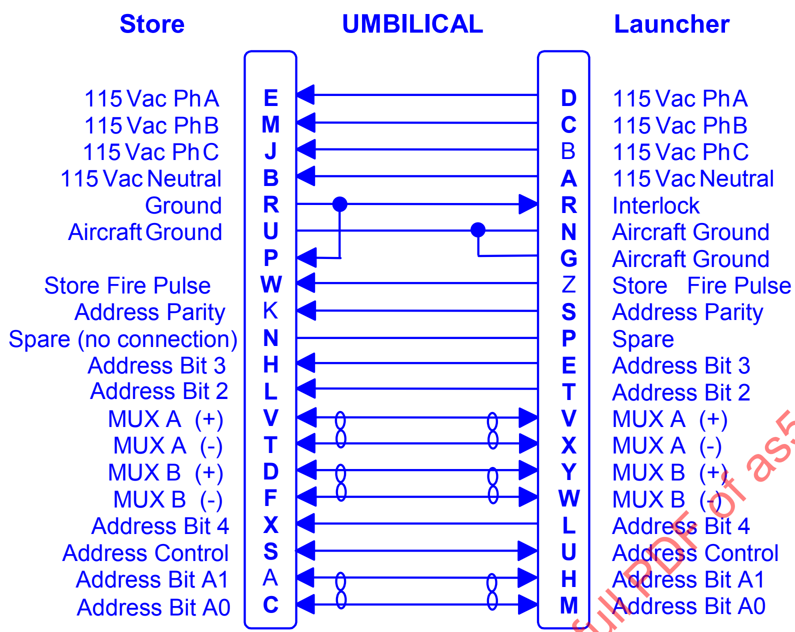


FIGURE 23 - Umbilical Cable Layout (deviates from MIL-STD-1760)

---------- End Example

4.2.2 Contact Assignment and Contact Description: Description connector contacts and layout of the electrical interface connection supported by the appropriate drawing(s).

This is the section to contain the pin assignments. The signals are divided by type in 4.3. To provide a reference to this paragraph and an overview of the interface, the signal type must be listed here. A detailed description of the pins may be given in the following paragraphs.

4.2.2 (Continued):

---------- Begin Example

TABLE 1 - 1760 Contact/Signal List for the ASI

PIN	SIGNAL NAME	TYPE
H	MUX B	Information Signal
K	MUX A	Information Signal
U	FIBER OPTICS CHANNEL 1	Information Signal
Y	FIBER OPTICS CHANNEL 2	Information Signal
5	HB1	Information Signal
W	HB2	Information Signal
3	HB3	Information Signal
2	HB4	Information Signal
A	LB1	Information Signal
1	RELEASE CONSENT	State Signal
6	ADDRESS RETURN	State Signal
G	ADDRESS PARITY	State Signal
V	ADDRESS BIT A4	State Signal
4	ADDRESS BIT A3	State Signal
7	ADDRESS BIT A2	State Signal
X	ADDRESS BIT A1	State Signal
L	ADDRESS BIT A0	State Signal
S	INTERLOCK RETURN	State Signal
B	INTERLOCK	State Signal
N	270 VDC POWER RETURN	Power
R	270 VDC POWER	Power
C	28 VDC POWER 1	Power
D	28 VDC POWER 1 RETURN	Power
F	28 VDC POWER 2	Power
E	28 VDC POWER 2 RETURN	Power
T	STRUCTURAL GROUND	Power
Z	115 VAC NEUTRAL	Power
J	115 VAC PH. C	Power
M	115 VAC PH. B	Power
P	115 VAC PH. A	Power

4.2.2.1 Power Pins: The section contains a unique paragraph for each power pin describing all requirements and possible schematics for both platform and weapon and any deviation or change with respect to a standard. This may comprise pin size, recommended wiring, etc.

4.2.2.1.1 Power Pin x: This section lists all the specific requirements for power pin x. For example:

- Pin A, phase A 115 VAC, size 10

4.2.2.1.2 Power Pin y: This section lists all the specific requirements for power pin y. For example:

- Pin C, 28 V DC power 1, size 10

4.2.2.1.3 Ground Pin z: This includes a description of the ground or bonding pins. For example:

- Pin Z, 115 VAC neutral, size 16

- Pin D, 28 V DC power 1 return, size 16

4.2.2.2 State Signal Pins: The section contains a unique paragraph for each state signal pin describing all requirements and possible schematics for both platform and store if required.

4.2.2.2.1 State Signal Pin m: This would list all the specific requirements for discrete pin m. For example:

- Pin 1, Release Consent, size 20

- Pin B, Interlock, size 20

- Pin S, Interlock Return, size 20

4.2.2.3 Information Signal Pins: This section provides a paragraph for the technical description of the pin including all requirements and possible schematics for both platform and store if required.

4.2.2.3.1 Information Signal Pin n: This would list all the specific requirements for the information pin n. For example:

- Pin H, MUX B, size 8, Twinax, shielded

---------- End Example

4.3 Contact Types:

The following sections contain a description of the electrical characteristics of each single connection. Commonly the basic conditions of each line are specified in other standards. In an ICD the signal restrictions or limitations with respect to the range defined in the standard are specified i.e. the true values of e.g. a transmitted signal.

4.3.1 Power Lines: General description of the electrical power interface shall be given in this section i.e. what power is applicable to drive the store and its functions etc.

---------- Begin Example

4.3.1.1 AC Power: Gives reference to any standard (if applicable) for AC power and provision of possible deviations or real life power consumption.

The section defines the electrical part of the power on sequencing of events and the characteristics of voltage and current. This may be defined in several subsections as given below. Power consumption in different operational phases like the maximum continuous current the store needs with respect to a specific load in the different phases of the store operation (e.g. initialization, data transfer, common communication, operational set-up, cooling, motor ignition or operation etc.) shall be defined. The functional section in volume 2 covers the timeline for the power on sequence. The pin requirements can be found in 4.2.2.1.

4.3.1.1.1 Voltage Level: The voltage at the ASI between each 115 VAC phase connection and the associated 115 VAC neutral connection shall comply with the 115 VAC normal and abnormal operation characteristics for utilization equipment defined in MIL-STD-704 with the following addition: the normal steady state lower voltage limit at the ASI shall be 108.0 V RMS at any current up to full rated load (10 A). Voltage transients at the ASI shall comply with MIL-STD-704.

4.3.1.1.2 Current Capacity: The aircraft shall be capable of sourcing the maximum load current levels of Figure 24 simultaneously through each of the three 115 VAC phases of the primary signal set ASI.

4.3.1.1.3 Overcurrent Protection: The aircraft shall ensure that the current flow through any 115 VAC power phase connection does not exceed the maximum overcurrent limits of Figure 24 for the primary ASI, respectively. The aircraft may achieve this current limit operation by the deactivation of the appropriate power interface and any other power interface at the associated ASI.

4.3.1.1.4 Off-State Leakage Current: The off-state leakage current at the ASI between any 115 VAC phase and the associated 115 VAC neutral shall be less than 2.0 milliamperes for the primary signal set ASI and shall be less than 5.0 milliamperes for the auxiliary power signal set ASI.

4.3.1.1.5 Stabilization Time: When tested with any valid resistive load connected to the ASI, the voltage at the ASI shall reach steady state levels within 3.0 milliseconds of power turn-on and turn-off (see Figure 25).

4.3.1.1.6 Phase Rotation: The three 115 VAC, 400 Hz, power phases at the ASI shall comply with the phase sequence and voltage phase difference requirements of MIL-STD-704. The power phase assigned to contact location A in the auxiliary ASI connector shall be the identical phase as assigned to contact location P in the primary ASI connector at the same ASI location.

4.3.1.1.7 Load Power Factor: The electrical characteristics at the ASI shall comply with the requirements herein when loads with a power factor within the limits of Figure 26 are applied to the ASI.

4.3.1.1.8 Phase Power Imbalance: The electrical characteristics at the ASI shall comply with the requirements herein when loads with a phase power unbalance within the limits of MIL-STD-704 are applied to the ASI.

4.3.1.1.9 Power Application: The aircraft may energize the 115/200 VAC power interface (primary and auxiliary) at any time under the assumption that all store functions so powered are either not safety critical or that multiple safety interlocks exist within the store such that store safety is not significantly degraded by activation of 115/200 VAC power.

4.3.1.2 DC Power: Gives reference to any standard (if applicable) for DC power and provision of possible deviations. The pin description can be found in 4.2.2.1.

4.3.1.2.1 DC Power Application Characteristics and Profile: See AC power example for a possible substructure (without the 3 phase specific characteristics).

4.3.1.3 Grounding and Bonding: This includes a description of the realization of bonding and grounding like specific connection pins for bonding, power return lines etc. Values specified and different from any specification (or mentioned here for completeness with reference to a specification) shall be put in here. The pin description can be found in 4.2.2.1.3.

4.3.1.3.1 Ground Reference: Each 115 VAC neutral connection in the primary signal set ASI and auxiliary power signal set ASI shall be the reference for its respective 115 VAC power phase.

The aircraft shall provide a connection in each primary signal set ASI and each auxiliary signal set ASI, which is terminated to aircraft structure and is capable of carrying the overcurrent levels defined in Figure 24. The structure ground interface shall not be used as a signal return or power return path.

4.3.1.4 Figures: This section provides a container for all figures of the power line section. Since most figures are referenced multiple times, it is appropriate to provide a centralized location.

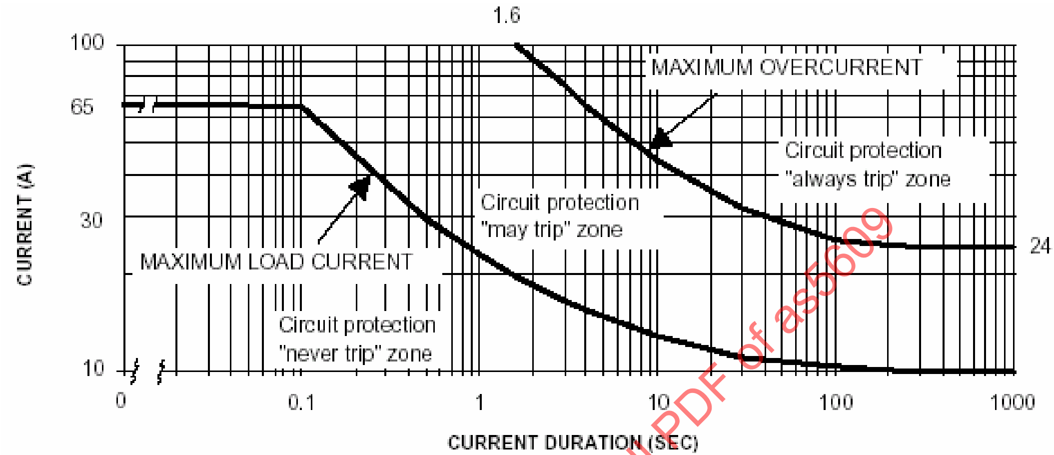


FIGURE 24 - Interface Current Level

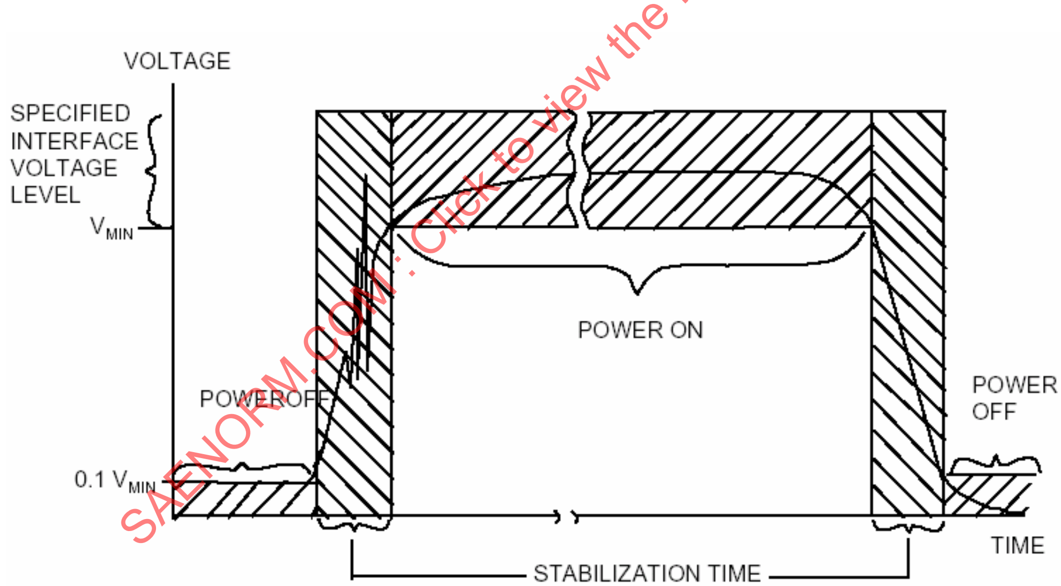


FIGURE 25 - Power Stabilization Time

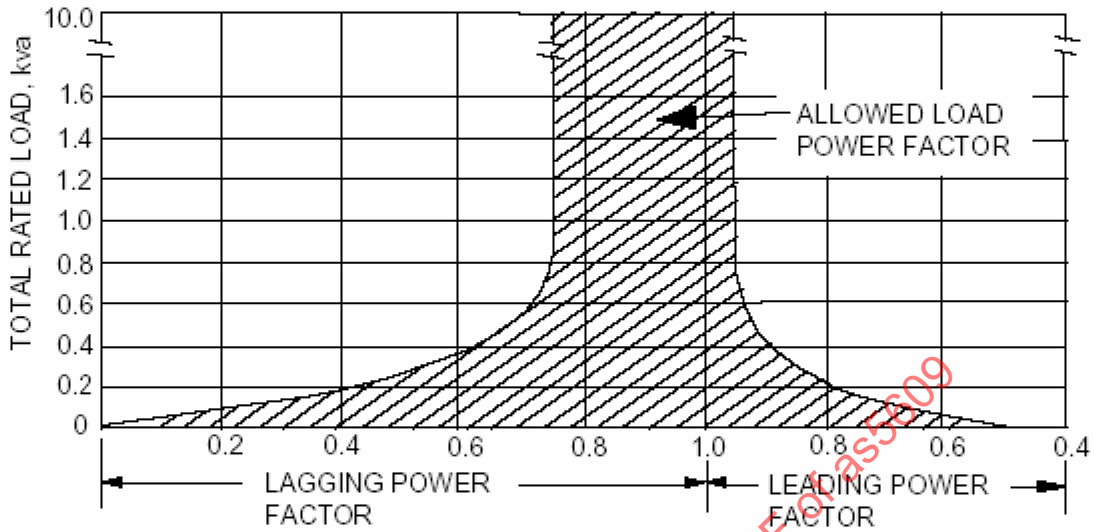


FIGURE 26 - Power Factor Limits

---------- End Example

4.3.2 State Signals: Should the discrete line consist of a single pin referenced to ground or shared return, the description of the signal implies the description of the pin. In the following example this would be the case for the interlock. The description of the shared return or ground can be defined in the power line section. If the discrete connection covers the signal line and the return (in the following example for the release consent), a description of the pin may be required. However the incorporation of the pin descriptive part in this section is on the authors´ discretion.

The following examples are a copy-over from MIL-STD-1760 with some minor adjustments for illustration purposes and to provide a suggestion for the structure of this subparagraph. Provided that the interface would be compliant with the standard, a simple reference to the standard would be sufficient.

---------- Begin Example

---------- Example 1:

4.3.2.1 Release Consent: The platform shall provide a release consent interface for transferring an enable/inhibit signal to the connected store. Release consent, when in the enabled state, shall indicate platform consent for stores to perform safety-critical functions (such as store release from a carriage store, missile launch from a rail launcher or rocket firing from a dispenser) when commanded over the data bus interface. The isolation shall be 100 kOhms minimum at dc. The pin description can be found in 4.2.2.2.

4.3.2.1.1 Voltage Level: The voltage level measured between the release consent connection and 28 V DC power 2 return connection at the connector shall be:

a. Steady State Conditions

(1) Enable: Minimum voltage of 19.0 V DC
Maximum voltage, in accordance with MIL-STD-704 for 28 V DC

(2) Inhibit: 1.50 V DC (maximum)

b. Voltage transients shall comply with MIL-STD-704 limits for 28 V DC applications.

4.3.2.1.2 Current Level: Mission and carriage stores may require 100 milliamperes steady state through the connector during the enable state and the platform shall be able to supply that current. The platform is not, however, required to supply any current in excess of 100 milliamperes. The platform shall comply with the requirements herein for store imposed load currents of 5.0 milliamperes minimum through the connection.

4.3.2.1.3 Stabilization Time: With any resistive load between 320 ohms and 3.8 kOhms connected between release consent and 28 V DC power 2 return, the voltage at the connector shall reach steady state levels within 3 milliseconds during transition between enable and inhibit states.

4.3.2.1.4 Enable Lead Time: If release consent is required by a store, the release consent signal shall attain the enable state at least 20 milliseconds prior to transferring the safety critical command over the data bus interface or prior to the firing signal to the parent S&RE, as applicable.

4.3.2.1.5 Inhibit Delay: If release consent at the connection has been enabled, the platform shall operate under the assumption that the store(s) connected to that connection may remain in an enable state for up to 20 milliseconds after the release consent signal has been returned to the inhibit state.

4.3.2.1.6 Ground Reference: The 28 V DC power 2 return connection shall be the ground reference for release consent.

---------- Example 2:

4.3.2.2 Address Lines: The purpose of the address interface discrete signal lines is to provide a means for the platform to assign a unique digital multiplex data bus address to the MIL-STD-1553 compliant remote terminal. A minimum of seven discrete lines is necessary to support the interface. The seven discrete lines consist of five address discrete lines with a binary coded weighting, one address parity discrete line and one discrete line for a common return. The nominal operating modes for these lines are an open circuit for Logic 1 or a connection to the common return for logic 0 for each address line. The pin description can be found in 4.2.2.2.

4.3.2.2.1 Address Signal: The aircraft shall comply with the requirements herein when signals with the following characteristics are applied to the address interface at the ASI by the connected store. The characteristics defined apply to the address bit and parity connections referenced to the address return connection.

a. Open circuit (logic 1) voltage

(1) Minimum voltage of 3.5 V DC

(2) Maximum voltage of 31.5 V DC

(3) Rise and fall times of applied voltage less than 10 milliseconds

b. Logic 0 current

(1) Minimum current of 5.0 milliamperes dc

(2) Maximum current of 100 milliamperes dc through each address bit and parity connection

(3) Maximum current of 600 milliamperes dc through the address return connection

(4) Rise and fall times of applied current less than 10 milliseconds

4.3.2.2.2 Logic Thresholds: The aircraft shall provide the following logic states under the voltage and current conditions of 4.3.2.2.1:

a. Logic 1 state characteristics. The aircraft shall maintain sufficient open circuit conditions between each logic 1 set address bit (or parity) connection and the return connection such that when the voltages of 4.3.2.2.1 are applied across the connections, the current flow shall not exceed 300 microamperes.

b. Logic 0 state characteristics. The aircraft shall limit the voltage drop between each logic 0 set address bit (or parity) connection and return connection at the ASI to 1.0 volts maximum when the current levels specified in 4.3.2.2.1 are applied. This maximum voltage drop applies when logic 0 states exist at any or all address bit and parity connections.

4.3.2.2.3 Response Characteristics: The aircraft shall produce valid address characteristics at the ASI within 10 milliseconds of excitation signal application from the store. The aircraft shall not require continuous application of the excitation signal.

4.3.2.2.4 Address Isolation: The aircraft shall electrically isolate all address connections (including address return) at each ASI from the address connections at all other ASIs, from power returns and from aircraft structure. The isolation shall be 100 kOhms minimum over the frequency range of dc to 4 kHz.

---------- End Example

4.3.3 Information Signals: Signals having significant information content should be described in this section. The state signals have lower information content. Information signals encompass data networks both low speed and high speed (MIL-STD-1553, Ethernet, CANBus for example), and analogue signals (audio, video, timing, radio frequency). The distinction between analogue and digital is not used at the top level because it is becoming blurred with the advance of high speed signaling for example Quadrature Amplitude Modulation.

A few examples of analogue information signals are audio, timing pulses, radio frequency, video, seeker slaving. Analogue Signals are best described by frequency domain and in other cases by time domain template diagrams. The template diagrams illustrate the salient points of the signal along with allowable variations. In example 2 based on stereo audio a frequency domain representation is more appropriate, example 1 based on a timing pulse a time domain representation is more appropriate. Another case is video where the use of both domains is more appropriate. If possible an external standard should be referenced. The parameters listed below to describe the analogue signals should be regarded as an initial list; others may be required in a particular instance.

4.3.3 (Continued):

The amount of signal present “signal strength” can be described in a number of different ways, the most suitable depending upon the application. Power, voltage or current may describe the signal strength. Is the value quoted a RMS, peak, average, maximum, or minimum? If averages are used the type of averaging should be made clear. Is the average based upon the signal amplitude (voltage or current) or upon the power and in each case was the averaging performed on linear units (Volts, Ampere, Watt) or logarithmic units (Decibel). In the descriptions below the generic term “signal strength” is used but this should be detailed as appropriate. The input and out put impedance should be stated.

An example for a digital information signal is the common bus in accordance with MIL-STD-1553. The definition encompasses the general data bus characteristics like transmission frequency, synchronization, voltage and requirements for cable (electrical characteristics like attenuation, capacity, impedance etc) and for the terminals (input/output voltage, output waveform, overshoot and ringing, output symmetry, output noise, input impedance, noise rejection, common mode rejection). Again as stated above, the list is not complete and has to be adjusted to the actual needs. If possible refer to an external standard.

---------- Begin Example

4.3.3.1 Analogue Information General:

4.3.3.1.1 General Description: A General Signal Description should detail the relationship between the constituent parts making up the signal and any interrelationship between this and other signals. The pin description can be found in 4.2.2.3.

4.3.3.1.2 Frequency Domain: A template diagram illustrating both the in-band and out of band signal, distortion and noise components and their range of signal strengths is provided. A series of templates may be required, one for the signal, one for distortions present, one for interference terms and one for noise.

4.3.3.1.3 Time Domain: A template diagram illustrating the signal strength over a period of time is provided. A series of templates may be required to detail all the different features of the signal. An example is one diagram to show the nanosecond time frame a second showing millisecond time frame.

4.3.3.1.4 Rates of Change: In time domain descriptions the maximum rate of signal should be detailed, to limit the upper frequency. This can be described in terms of slew rate, rise time or fall time.

4.3.3.1.5 Stability: For repetitive signals a measure of the amount of frequency variation that can be expected for both long and short term is required. This is normally quoted as the deviation from the nominal frequency in part per million.

4.3.3.1.6 Harmonic Distortion: What unwanted signals are present that are harmonically related to the desired signals. The allowable signal strength should be quoted. The harmonic signal maybe a spot frequency or a band of frequencies. Usually applied to a frequency domain representation.

4.3.3.1.7 Non-Harmonic: What unwanted signals are present that are not harmonically related to the desired signals. The allowable signal strength should be quoted. The non-harmonic distorting signal maybe a spot frequency or a band of frequencies. Usually applied to a frequency domain representation. Examples are inter-modulation products, adjacent channel in a frequency-multiplexed system, interfering cross-talk signal.

4.3.3.1.8 Ringing Overshoot Undershoot: Applied to the time domain representation of a signal, this is the amount of excursion beyond the initial and final mean values. This can be represented on the time domain template. The duration of the excursion may also be specified to limit the amount of ringing.

4.3.3.1.9 Pulse Width: The nominal value of the pulse width and its variation is provided. The deviation from ideal crossing points may also be described. This is applicable to the time domain representation.

4.3.3.1.10 Noise: This describes the random fluctuations present in the signal. A statistical model for the noise should be listed, the noise signal strength and the frequency band of interest. Rather than quoting signal noise strength a signal to noise ratio may be used. For oscillators and reference frequencies then a measure of phase noise may be required.

---------- Example 1:

4.3.3.2 Analogue High Bandwidth Connection: This example is a sawtooth wave where the falling edge is used for synchronization purposes.

4.3.3.2.1 General Signal Description: The signal approximates a sawtooth waveform. Timing is signified by the falling edge. Internal timers should be reset on this edge. There is background random noise. The output and input impedance is 100 kΩ.

Time Domain Template Diagram: Figure 27 illustrates the shape of the falling edge. T is the period of the sawtooth 10 μs. The times are measured from the last negative going zero crossing. The slew rate is limited to 200 V/μs. Figure 28 illustrates the period of the signal. The period shall be 10 μs ± 10 ns.

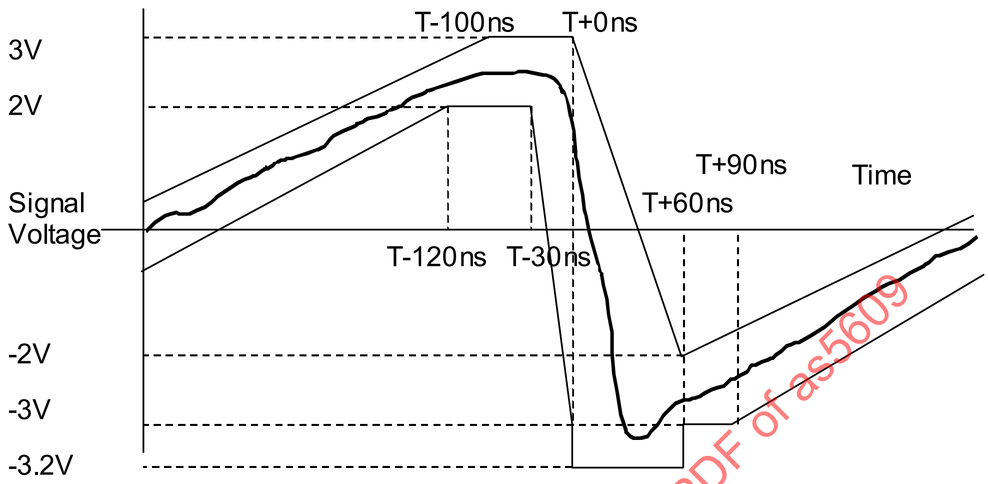


FIGURE 27 - Time Domain Template. One Pulse

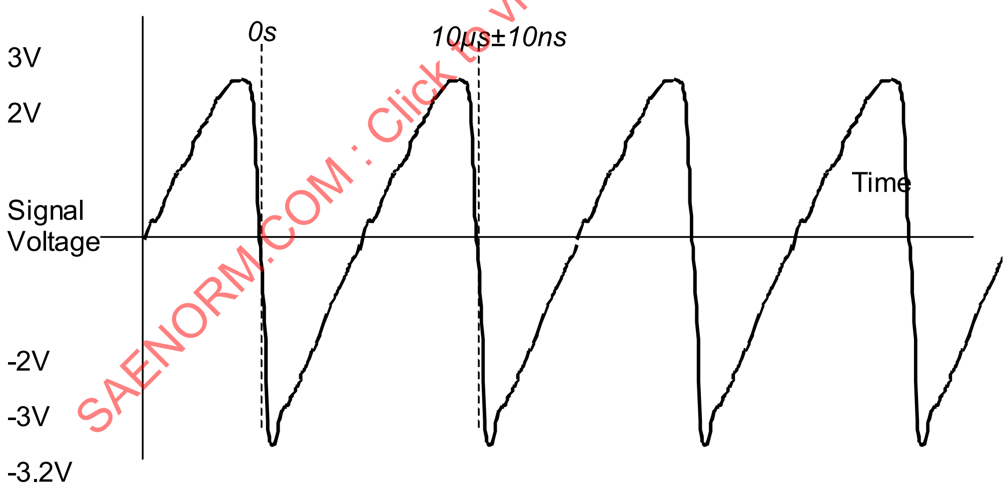


FIGURE 28 - Time Domain Template. Multiple Pulses

Noise. *The signal contains random noise with 50 mV maximum amplitude obeying a uniform distribution. The noise bandwidth is from 1 kHz to 400 MHz.*

---------- Example 2:

4.3.3.3 Analogue Low Bandwidth Connection: A second example is a stereo audio signal. This is best described in the frequency domain.

4.3.3.3.1 General Signal Description: The stereo audio signal has the sum of the left and right audio channels (L+R) in the baseband (20 Hz to 15 kHz). A 19 kHz pilot tone to indicates the presence of a stereo signal between 23 kHz and 53 kHz. The 19 kHz pilot tone is frequency doubled to give a 38 kHz carrier. The 38 kHz carrier is amplitude modulated by the left audio channel minus right audio channel signal (L-R) to form a double sideband suppressed carrier signal centered at 38 kHz. There are interfering signals at 60 Hz and 400 Hz and a residual amount of 38 kHz carrier. In addition there is a background random noise. The source impedance is 100 Ω and the sink impedance is 10 kΩ.

4.3.3.3.2 Frequency Domain Template Diagrams: The desired signal components are shown in Figure 29. The audio signal levels (L+R), (L-R) may fall to zero but shall not exceed the maximum values. The 19 kHz pilot tone shall have amplitude of 0.5 V_{rms} ± 0.1 V_{rms}. No other desired signal components present.

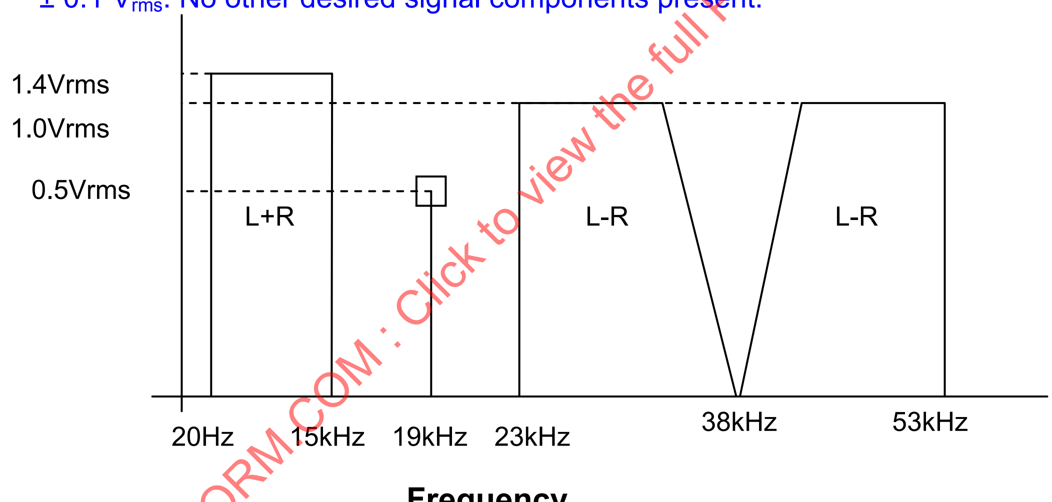


FIGURE 29 - Stereo Audio Frequency Domain Template Required Signal

The frequency domain diagram for undesired signal components (noise, interference and distortion) is shown in Figure 30. The background noise is random with a spectral density of less than 50 nVrms/√Hz over the bandwidth 2 Hz to 100 KHz. Outside of these frequencies the noise level is not controlled. In addition there are interfering signals at 60 Hz and 400 Hz, the amplitude being less then 10 mVrms. There is a residual 38 kHz carrier with a level less than 70 mVrms.

The noise can be assumed to be Gaussian over the frequency band shown. The pilot tone frequency is 19 kHz ±0.01 kHz.

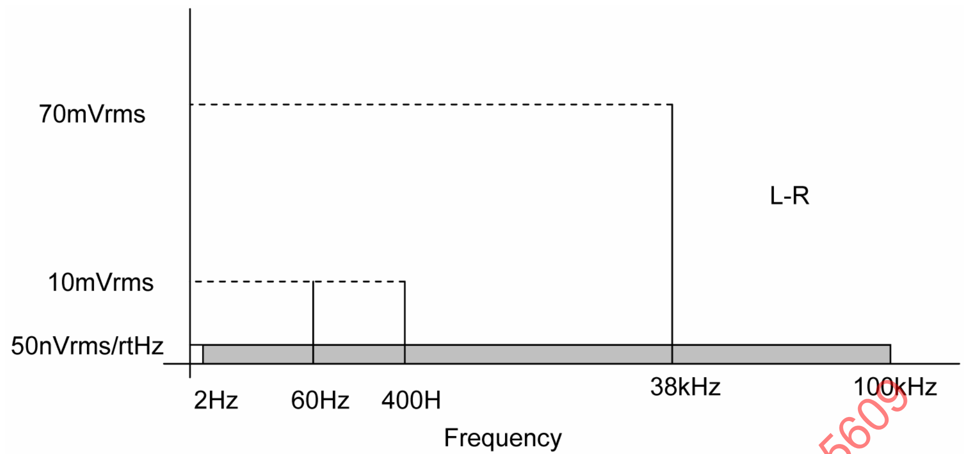


FIGURE 30 - Stereo Audio Frequency Domain Template for Undesired Signal Components

4.3.3.4 Digital Information: This section shall cover the description of the electrical characteristic of the used digital signals like specific shielding for data lines etc. The structure of the digital information (the protocol like messages, word, bits, synchronization etc. is specified in the communications interface description in volume 2, section 4

For the platform there may be a situation where e.g. the Mil Bus redundancy cannot be achieved. Any provisions for special solutions or restrictions for the data interface should be included in this section.

The example is taken from MIL-STD-1553.

TABLE 2 - Overview of Data Bus Characteristics

Parameter	MIL-STD-1553B
Transmission line	
Cable type	Twisted-shielded pair
Capacitance (wire to wire)	30 pF/ft, maximum
Twist	Four per foot (0.33/in), minimum
Characteristic impedance, (Z_O)	70 to 85 ohms at 1.0 MHz
Attenuation	1.5 dB/100 ft at 1.0 MHz, maximum
Length of main bus	Not specified
Termination	Two ends terminated in resistors equal to $Z_O \pm 2\%$
Shielding	75% coverage minimum
Cable coupling	
Stub definition	Short stub < 1 ft Long stub > 1 to 20 feet (may be exceeded)
Coupler requirement	Direct coupled—short stub; transformer coupled—long stub (ref. fig. I-1.7)
Coupler transformer	
Turns ratio	1:1.41
Input impedance	3,000 ohms, minimum (75 kHz to 1.0 MHz)
Droop	20% maximum (250 kHz)
Overshoot and ringing	± 1.0V peak (250-kHz square wave with 100-ns maximum rise and fall time)
Common mode rejection	45.0 dB at 1.0 MHz
Fault protection	Resistor in series with each connection equal to (0.75 Z_O) + 2.0% ohms
Stub voltage	1.0V to 14.0V p-p, I-1, minimum signal voltage (transformer coupled); 1.4V to 20.0V, p-p, I-1, minimum signal voltage (direct coupled)

4.3.3.4 (Continued):

The following information may be included in the description of a digital information signal (note: the list is not regarded complete and may vary with the nature of the digital information carrier):

- Digital Information Carrier (Data Bus Characteristics)
    - Cable (type, shielding, general requirements)
    - Characteristic Impedance
    - Cable attenuation
    - Cable termination
    - Cable stub requirements
        - Transformer coupled stubs
        - Coupling transformer
    - Transformer input impedance
    - Transformer waveform integrity
    - Transformer common mode rejection
        - Fault isolation
        - Cable coupling
        - Stub voltage requirements
    - Direct coupled stubs
        - Fault isolation
        - Cable coupling
        - Stub voltage requirements
    - Wiring and cabling for EMC

4.3.3.4.1 Tables for Digital Information Signals:

TABLE 3 - Terminal Output Characteristics

Output voltage	18.0 V to 27.0 V, p-p, l-l (transformer coupled) p-p, l-l) .0 V to 9.0 V, p-p, l-l (direct coupled)
Output waveform	Zero crossing deviation ±25 ns, maximum, time of this waveform shall be 100 ns measured with respect to previous crossing; rise and fall times 100 to 300 ns
Overshoot and ringing	±900 mV peak; maximum, l-l (transformer-coupled stub) Zero crossing deviation and rise and fall times same as above overshoot and ringing — ± 00 mV peak, maximum, l-l (direct-coupled stub)
Output symmetry	Voltage at 2.5 μs after midpoint of parity bit; ±250 mV peak, maximum, l-l (transformer-coupled stub) Voltage at 2.5 μs after midpoint of parity bit; ±90 mV peak, maximum, l-l (direct-coupled stub)
Output Noise	14.0 mV, RMS, l-l (transformer coupled) 5.0 mV, RMS, l-l (direct-coupled)

TABLE 4 - Terminal Input Characteristics

Input Voltage)	0.86 V to 14.0 V, p-p, l-l, terminal response required; p-p, l-l) terminal no response (with transformer coupled stubs 1.2 V to 20.0 V, p-p, l-l, terminal response required; 0.0 V to 0.28 V, p-p, l-l, terminal no response (with direct-coupled stubs)
Input impedance	1.000 ohms, minimum, from 75 kHz to 1.0 MHz 1.0 MHz (transformer-coupled stub) 2.000 ohms, minimum, from 75 kHz to 1.0 MHz (direct-coupled)
Noise rejection	Maximum word error rate of 1 in 10^7, AWG noise 1.0 kHz to 4.0 MHz, 140 mV, RMS level; signal level — 2.1 V, p-p, (transformer-coupled stub) Maximum word error rate of 1 in 10^7, AWG noise 1.0 kHz to 4.0 MHz, 200 mV, RMS level; signal level is 3.0 V, p-p, l-l (direct-coupled stub)
Common mode rejection	±10.0 V peak, line-to-ground, dc to 2.0 MHz, shall not degrade performance of the receiver Point A, (transformer-coupled stub) Same specification for the direct-coupled stub

4.3.3.4.2 Figures for Digital Information Signals:

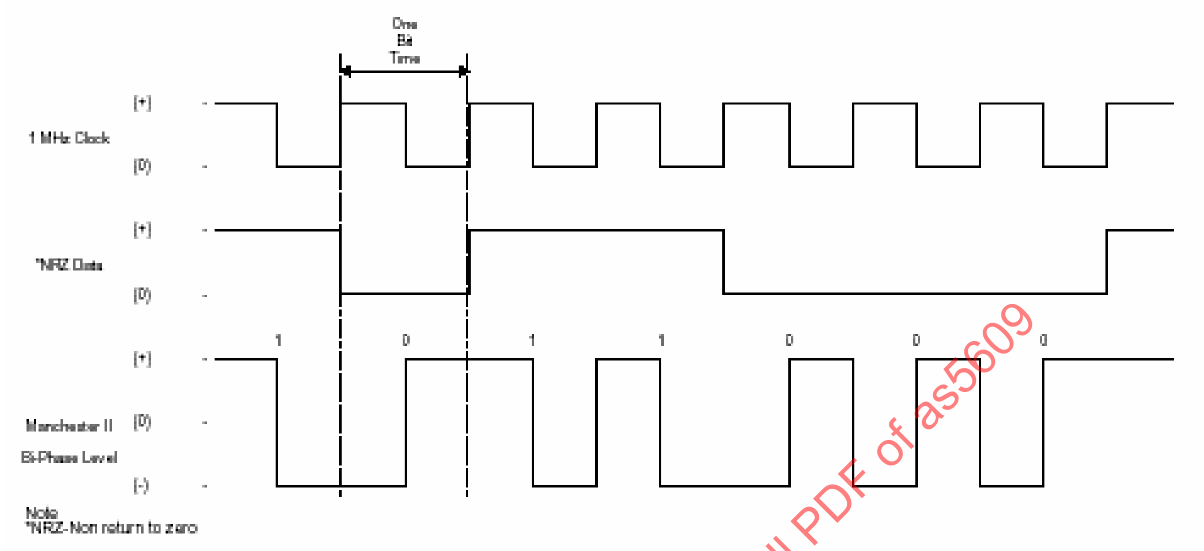


FIGURE 31 - Data Encoding

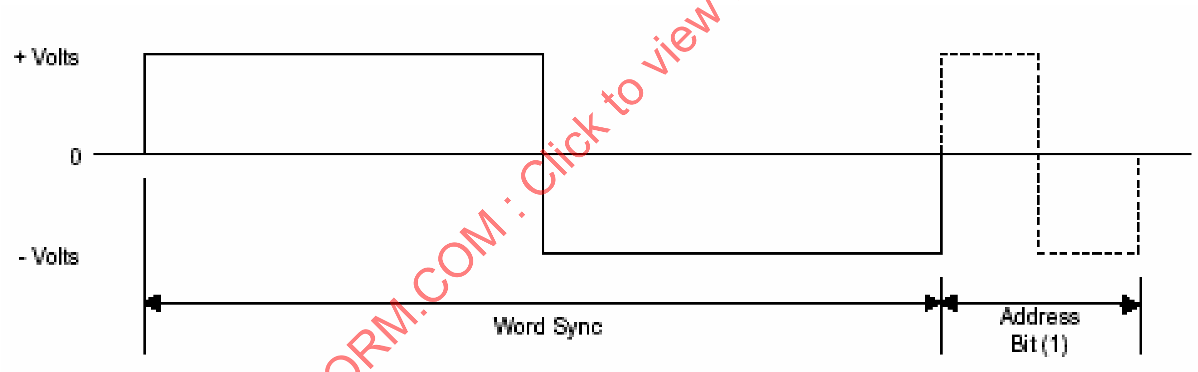


FIGURE 32 - Command and Status Sync Waveform

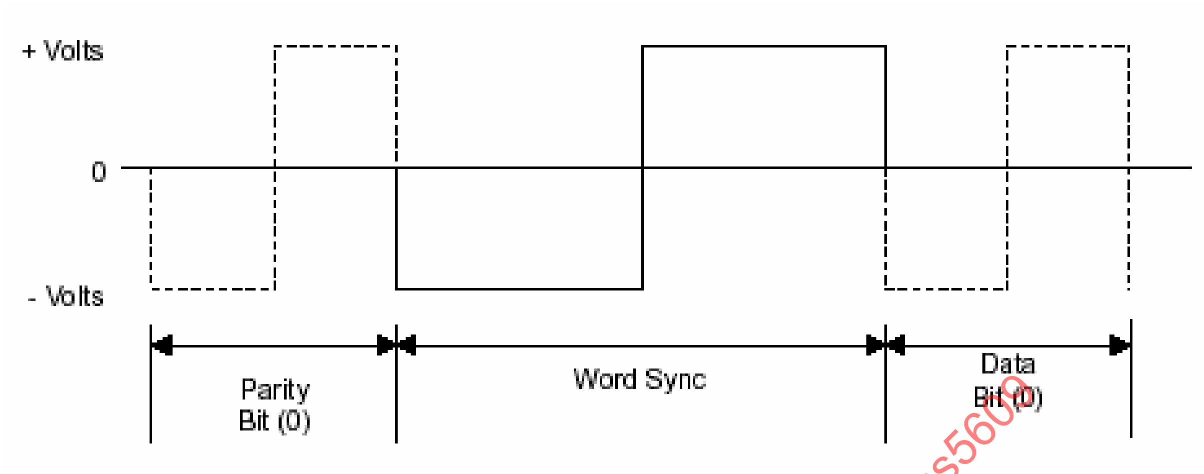


FIGURE 33 - Data Sync Waveform

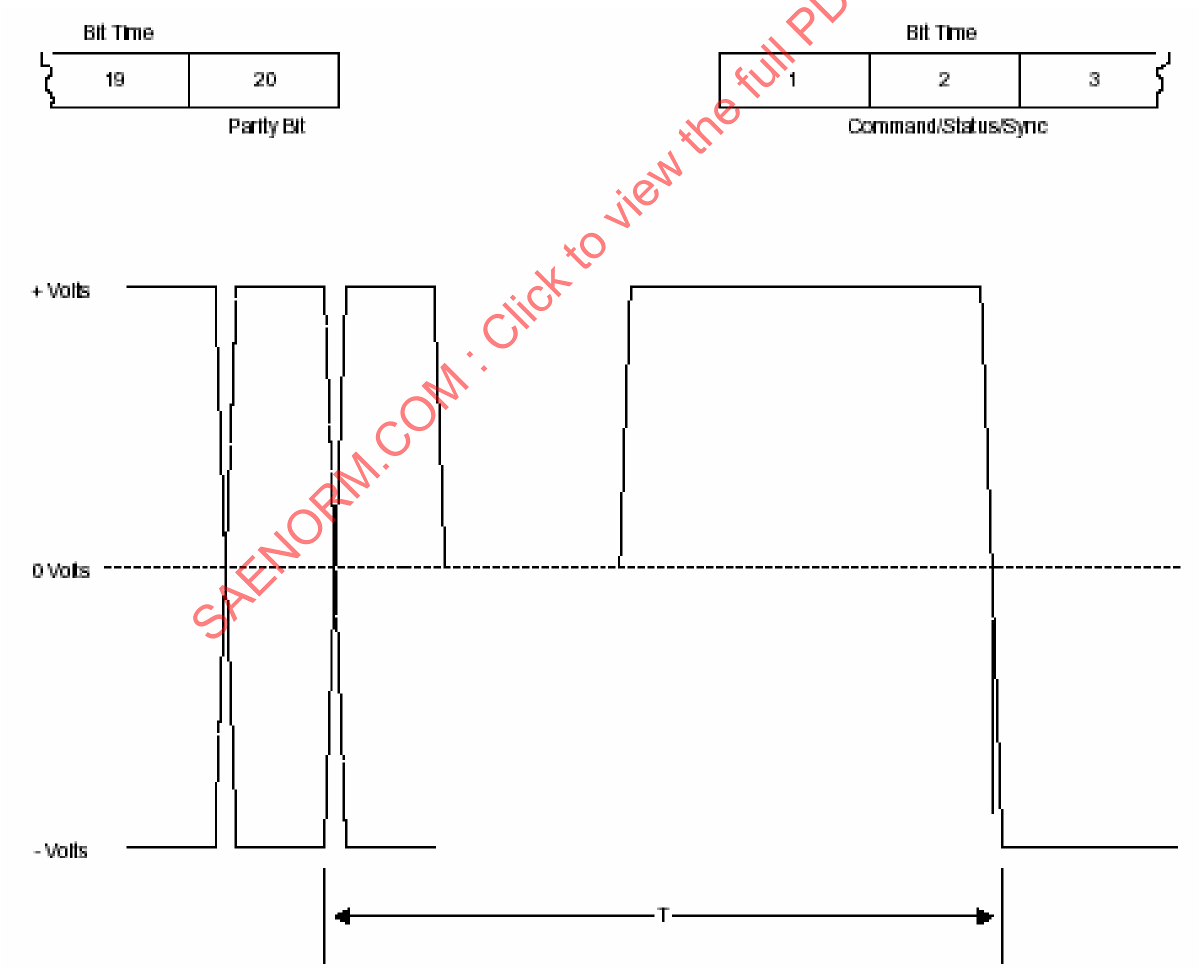


FIGURE 34 - Intermessage Gap and Response Time

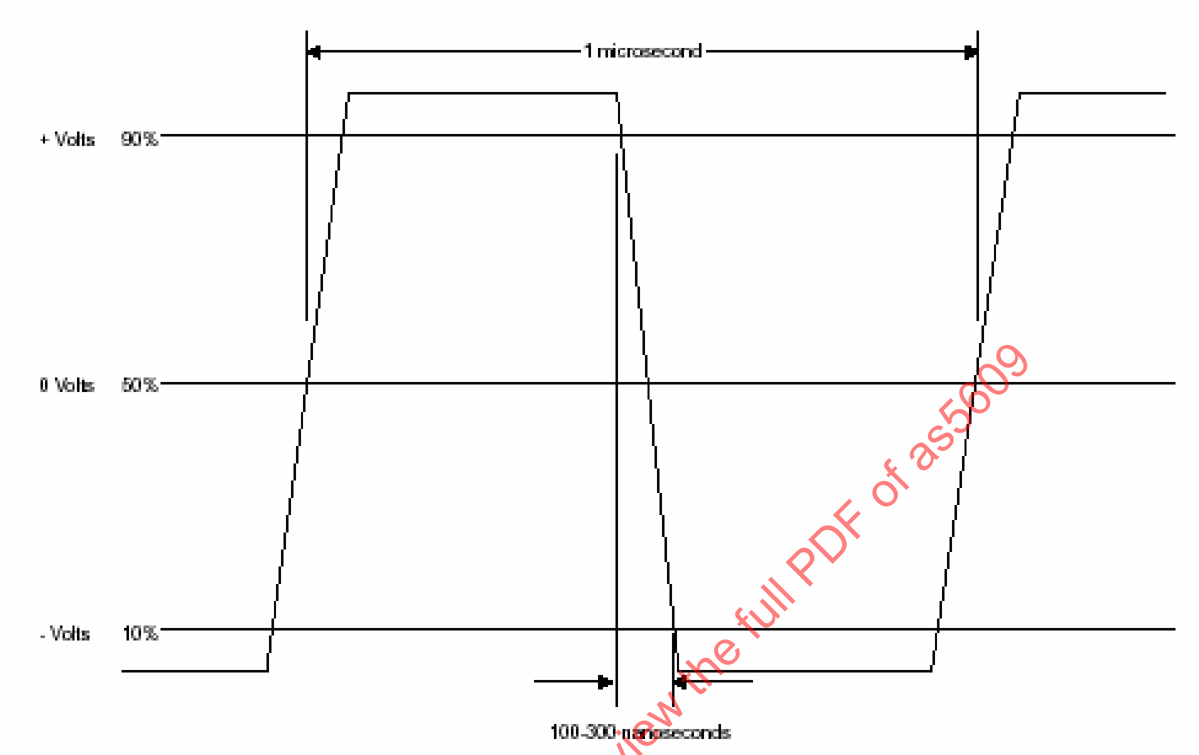


FIGURE 35 - Output Waveform

---------- End Example

5. AERODYNAMICS INTERFACE:

This section shall cover all aerodynamics aspects relevant for the interface. All possible carriage and release configurations are required as well as drag data, any post launch maneuvering required for the aircraft to avoid in-flight collision and the carriage and safe separation envelopes.

5.1 Configuration:

This section shall define the carriage and release configurations.

---------- Begin Example

5.1 (Continued):

The store will be carried and released from the stations in any of the configurations identified in the following table.

Station	Port						Starboard		
	O/B	I/B		UF			I/B		O/B
	Wing Pylon	Wing Pylon	Stub Pylon	Shoulder Pylon	Center-Pylon	Shoulder Pylon	Stub Pylon	Wing Pylon	Wing Pylon
Config. 1	+/- CFD or AECM	+/- Ext. Fuel Tank	+/- AAM	**Store**	---	**Store**	+/- AAM	+/- Ext. Fuel Tank	+/- CFD or AECM
Config. 2	+/- CFD or AECM	+/- Ext. Fuel Tank	+/- AAM	**Store**	---	---	+/- AAM	+/- Ext. Fuel Tank	+/- CFD or AECM
Config. 3	+/- CFD or AECM	+/- Ext. Fuel Tank	+/- AAM	---	---	**Store**	+/- AAM	+/- Ext. Fuel Tank	+/- CFD or AECM

---------- End Example

5.2 Drag Data:

Drag values caused by airflow shall be defined in this section.

---------- Begin Example

5.2.1 Drag Characteristics: The following drawing shows the store drag variations over a range of speeds, assuming undisturbed incident airflow.

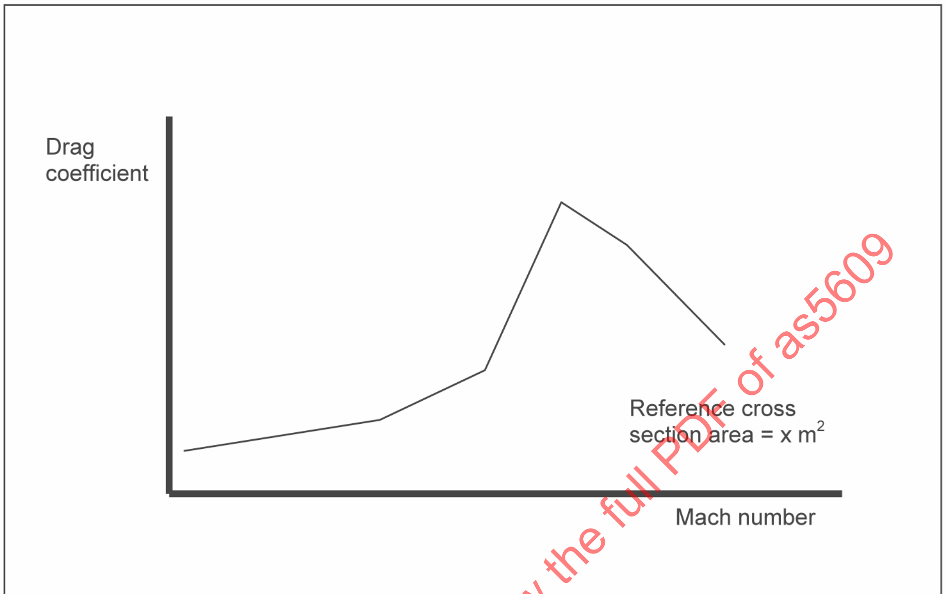


FIGURE 36 - Zero Lift Drag vs. Mach Number

5.2.2 Altitude Dependency: The correction of zero lift axial force coefficient with altitude is as following:

$$Cx_0(H) = Cx_0 * \left(1 + C * \frac{H - 5000}{10000}\right)$$

with

Cx0 = zero lift axial force coefficient for an altitude of 5000 m.

H = altitude (m)

C = factor tbd

5.2.3 Incidence Angle Dependency: The variation of the axial force coefficient with incidence angles up to xx deg is within ± yy percent of the zero lift axial force coefficient as shown in Figure 37. For higher incidence angles there is a general decrease of Cx for all Mach numbers.

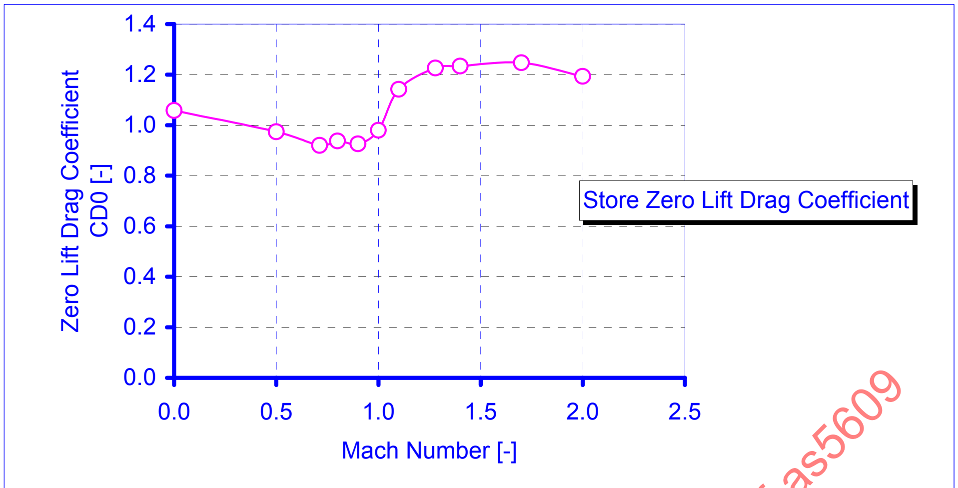


FIGURE 37 - Zero Lift Drag Coefficient

---------- End Example

5.3 Flutter:

Flutter is a self-excited oscillation of an aerodynamic surface and its associated structure caused by a combination of the aerodynamic, inertia, and elastic characteristics of the components involved. To prevent damage to the store or the platform, flutter effects need to be minimized. Requirements to limit flutter shall be defined in this section.

---------- Begin Example

All configurations of the store shall be free from any aero elastic instability for all combinations of altitude and speed encompassed by the limit speed (V_L/M_L) versus altitude envelope enlarged at all points by the airspeed margin of safety. The store shall meet the following stability design requirements for both normal and failure conditions:

a. Airspeed margin: The equivalent airspeed, V_e, margin of safety shall be not less than 15 percent at all points on the V_L/M_L envelope of the store, both at constant Mach number, M, and separately, at constant altitude (see Figure 38).

b. Damping: The total (aerodynamic plus structural) damping coefficient, g , shall be not less than 3 percent (g = 0.03) for any critical flutter mode for all altitudes and flight speeds from minimum cruising speeds up to V_L/M_L, (see Figure 39).

5.3 (Continued):

Through design layout (e.g. mass and stiffness properties, actuator stiffness, damping, backlash, and freeplay) flutter of the store wings and panels and other exposed surfaces shall not occur within the above-defined flutter design flight envelope. These conditions apply throughout the required lifetime of xyz hours and are relevant for stores in carriage on a platform and in the near-field of a platform during safe separation.

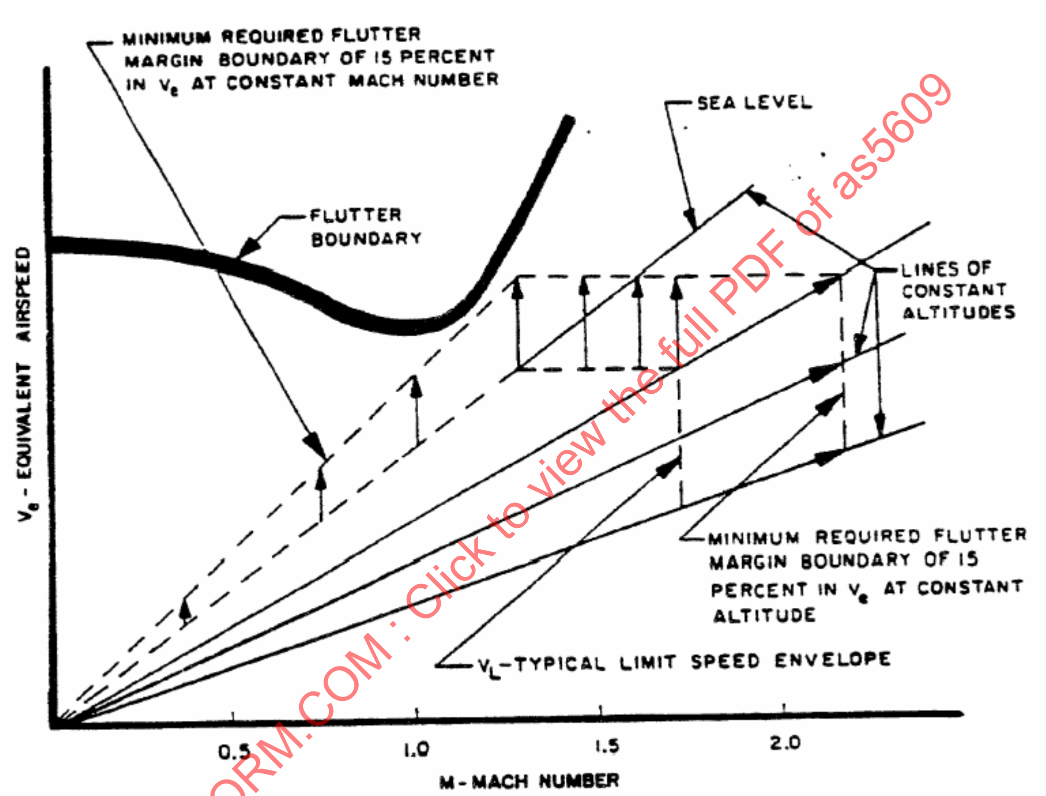


FIGURE 38 - Graphical Representation of Minimum Required Flutter Margin

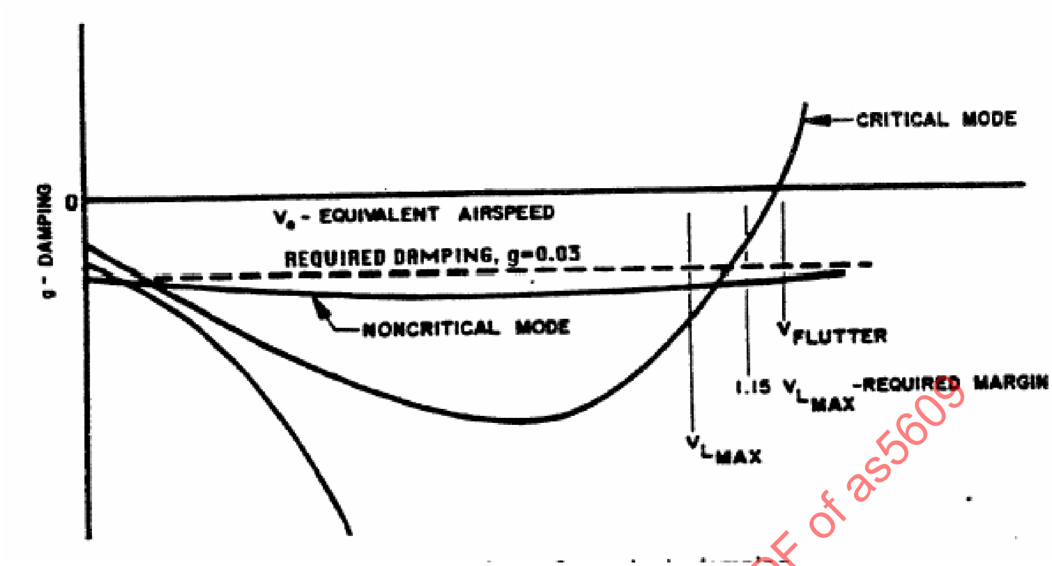


FIGURE 39 - Graphical Representation of Required Damping

---------- End Example

5.4 Ballistic Data:

For bombs, include ballistic tables or a reference to external documents where they can be found. The ballistic tables are to give details of free flow forward throw against release velocity, altitude and dive angle.

5.5 Store Post-Launch Separation Control:

E.g. wing engagement and maneuvering of the store in the airflow near field of the aircraft. This is important to define any breakaway maneuvers undertaken by the platform and to determine when a store and platform move basically in the same aerial segment with almost the same velocity after safe separation occurred. Specific separation characteristics or splash patterns shall be addressed.

The sequence of events/timing should adequately cover wings/actuator movements. This paragraph shall define the safe separation volume; i.e. when separation occurs, the store will not move outside a defined volume as it moves away from the aircraft. Generally, the drawing would show all perspectives necessary to define the volume, plus dimensions as appropriate. Also, there will be a need to state that the store must follow a path that means it never moves towards the aircraft once the separation has started.

5.5 (Continued):

The definition of the safe release envelope for the store will be derived from studies carried out by the aircraft and store design authorities. For certain store/station/aircraft combinations, it is necessary for the store to carry out active aerodynamic control during separation, to ensure that collision between them does not occur.

Actions carried out by the store must be defined in the ICD. The sequence of actions and their related timings are usually shown as a timeline, with supporting text to provide a full description. Below is an example of what may be included in the ICD.

Note that for those stores that perform no aerodynamic function during separation, the ICD must include a statement to this effect.

---------- Begin Example

All timings in Figure 40 are related to the time at which the store senses first movement. The nominal values for the time events T1 to T5 are as follows:

T1 = 40 ms T2 = 85 ms T3 = 800 ms T4 = 845 ms T5 = 950 ms

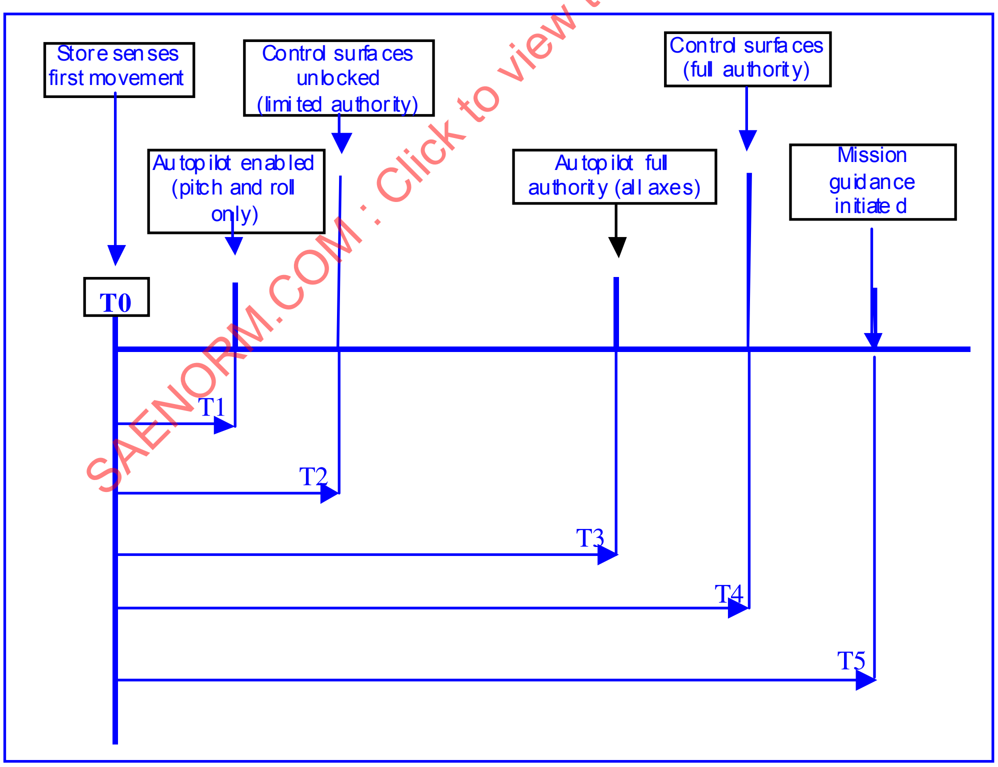


FIGURE 40 - Store Separation Timing

5.5 (Continued):

The pitch demand at T1 is for a fixed attitude of 10 degrees nose down with respect to the launcher/store line at the time of separation. The roll demand is for a fixed attitude of zero degrees with respect to the Z axis of the launcher at the time of separation. The yaw demand is locked at zero degrees.

Autopilot full authority at time T3 sets the demand for roll attitude to be zero degrees with respect to local earth axes and maintains the yaw demand at zero degrees.

Full aerodynamic control and mission guidance begins at time T5.

The aircraft is required to perform a 30 deg bank breakaway maneuver for 10 seconds after store release to provide de-confliction of the aircraft from the store operation.

---------- End Example

5.6 Envelopes:

---------- Begin Example

The general flight envelope is shown in Figure 41:

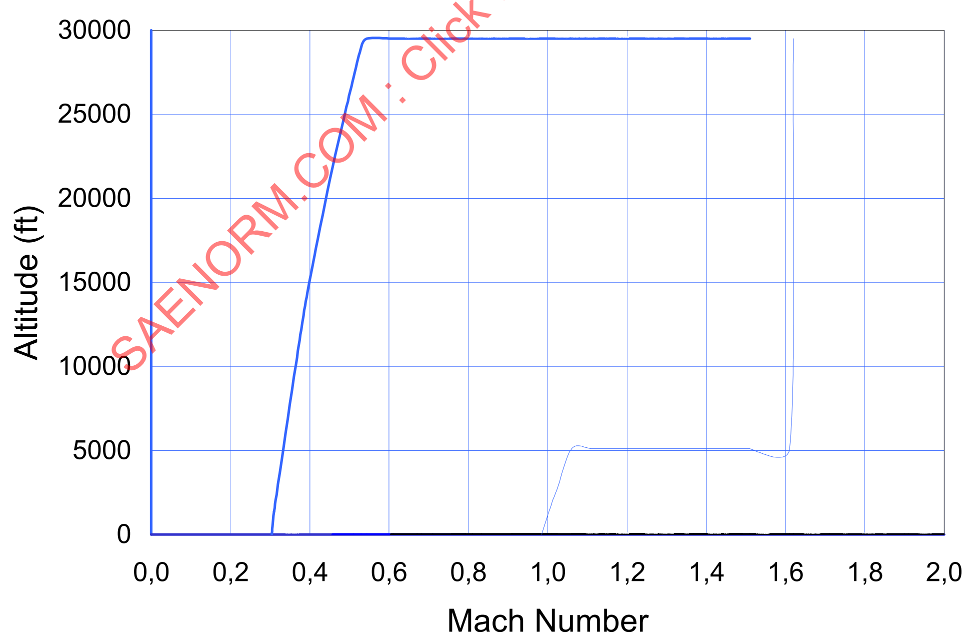


FIGURE 41 - Mach-Altitude Chart

---------- End Example

5.6.1 Carriage Envelope: The envelope for the carriage of store X on the aircraft carriage stations defined in 5.1 is detailed as follows:

---------- Begin Example

Speed	0 to xxxKEAS/Mxx (whichever is reached first)	(Note 1)
Altitude	0 to xkm	
Maneuvers	-ag to +bg for M<xx	(Note 2)
	-cg to +dg for M>yy	
Roll rate	±x rad/s	(Note 3)
Roll acceleration	±x rad/s^2	(Note 3)
Pitch rate	±x rad/s	(Note 3)
Pitch acceleration	±x rad/s^2	(Note 3)

Note 1: KEAS = Knots Equivalent Air Speed

Note 2: Linear interpolation is applied to maneuvers between Mxx and Myy, where M = Mach number

Note 3: Function of load factors shown in Figure xxx.

---------- End Example

5.6.2 Release Envelope: Safe release of the store from the aircraft is achieved throughout the envelope detailed below, in the flow fields defined in document xxx:

---------- Begin Example

Speed	x to yKEAS/Mxx (whichever is reached first)
Altitude	x to ykm
Maneuvers	-eg to +fg for M<xx
	-gg to +hg for M>yy
Roll rate	±x rad/s
Roll acceleration	±x rad/s^2
Pitch rate	±x rad/s
Pitch acceleration	±x rad/s^2

---------- End Example

5.6.3 Jettison Envelope: Safe jettison of the store from the aircraft is achieved throughout the envelope defined below, in the flow fields defined in document xxx :

---------- Begin Example

Speed	a to bKEAS/Mxx (whichever is reached first)
Altitude	a to bkm
Maneuvers	-kg to +lg for M<xx
	-mg to +ng for M>yy
Roll rate	±x rad/s
Roll acceleration	±x rad/s^2
Pitch rate	±x rad/s
Pitch acceleration	±x rad/s^2

---------- End Example

6. SYSTEM SAFETY:

The content of this part may be different for platform and store. For the platform data such as the carriage and release are important while for the store in addition to this the internal arming mechanisms and possible handling hazards are of interest. If applicable available standards shall be referenced in favor of new or weapon system specific definitions.

6.1 Ground Safety:

Safety regulations on the ground affecting the interface shall be identified. This should include the definition and listing of dangerous components, electrical installation, electromagnetic radiation, dangerous areas around the store and/or the platform and specific handling procedures such as following a hangfire and measures for fire fighting. Due to the derivation from specific stores, the structure from level 3 onwards is handled as an example.

In general, there are no hazards involved in handling, assembly or storing the store. However safety considerations shall include the following subjects:

1 Explosives
2 Compressed Air Systems (Cooling devices etc.)
3 Chemical Substances
4 Radiation Hazards
5 Rocket Motor Safety
6 Hangfire
7 Partially Activated Stores or Assemblies
8 Fire Accident

6.1.1 Dangerous Components: This section shall provide a list and detailed description of all dangerous components relevant for the interface and the operation of the store at the aircraft (e.g. a component list with identified hazardousness, location of the component, area where the danger occurs, numbers etc.).

---------- Begin Example

Any used dangerous components relevant for the interface shall be listed in this section

The dangerous components of the main assemblies are listed in the following Table 5. Locations of the components may be provided in a drawing.

TABLE 5 - List of Dangerous Components

Main Assembly	Component	Dangerous due to	Mass, Pressure
	Thermal Battery Gas Generator	Squib - Igniter - Solid Propellant	< y g z g abc g
Coolant Pressure Tank	Compressed Air	High Pressure	xyz bar (xyza psi)
	Thermal Battery	Squib	xyz g
	Booster Charge	Explosive	xyz g
Warhead	Ignition Distributor Booster Charge Main Bursting Charge	Explosive and Detonation Cords Explosive Explosive	xyz g xyz g xyz kg
Rocket Motor	Igniter Propellant	Metallic Oxidizing Agent Solid Propellant	xyz kg xyz kg

---------- End Example

6.1.2 Ammunition: This section shall list used ammunition and handling advice for explosives in general. Possible countermeasures shall be described.

---------- Begin Example

On signs of damage or improper handling, ammunition expertise has to be consulted.

The store contains the following main assemblies with explosives:

- Forward section with gas generator and thermal battery
- Warhead
- Rocket motor.

---------- End Example

6.1.3 Compressed Air: This section shall detail possible hazards caused by handling and application of compressed air during aircraft/store operation. Possible countermeasures shall be described.

---------- Begin Example

The highly compressed air applied to the sensor for testing may lead to dangerous situations. All compressed air-pipes, valves and connecting sleeves have to be in perfect condition, all compressed-air pipes have to be firmly installed and secured by safety strings.

---------- End Example

6.1.4 Chemical Substances: Any chemical substances not described in the other sections of this paragraph and possible hazards shall be identified and listed. Possible countermeasures shall be described.

---------- Begin Example

When using cleaning fluids, electrical connectors shall not be soaked with them. Otherwise this may lead to a malfunctioning of the store/main assemblies.

When handling chemical substances, the national and local operating safety and hazard instructions on the containers or packing have to be observed.

---------- End Example

6.1.5 Anti-Corrosive Coatings: Hazards caused by handling of anti-corrosive coatings shall be identified and listed in this section. Possible countermeasures shall be described.

---------- Begin Example

The agent for surface conversion consists of chromic acid and fluorides. The anti-corrosive coating is in powdery or liquid condition toxic, carcinogenic and caustic. Containers of tin, glass, lead or galvanized iron must not be used.

---------- End Example

6.1.6 Batteries: Danger related to the handling of batteries shall be identified and described. Possible countermeasures shall be stated and handling procedures shall be established.

---------- Begin Example

Activated thermal batteries are very hot.

Penetrating electrolytes contain substances that are damaging health.

The battery electrolyte (lithium) reacts strongly with water and generates flammable gases. Do not bring into contact with water. Lithium is flammable and caustic. If penetrating electrolyte is recognized, a safety mask and solvent-resisting gloves must always be worn when removing the electrolyte.

---------- End Example

6.1.7 Electrical Installations: Any hazards related to electromagnetic installations like stray voltage shall be identified and possible countermeasures shall be defined.

---------- Begin Example

Before carrying out maintenance measures and electrical tests the stores/main assemblies have to be properly grounded. Stray voltages getting to the warhead or rocket motor may lead to detonation or propellant ignition.

---------- End Example

6.1.8 Electromagnetic Radiation: Any hazards related to electromagnetic radiation shall be identified and possible countermeasures shall be defined.

---------- Begin Example

The store with all mounted protective caps and the main assemblies with mounted protective caps in their closed transport containers are regarded as electro-magnetically compatible.

The following safety distances are to be observed in handling and transportation (Distance from closest part of the store/main assembly or any metal parts connected with the store (e.g. aircraft)):

- to radiophones with a power < 2 W and a frequency > 100 MHz: 1.5 m
- to antennas with a power > 5 W: 3 m
- to antennas of coastal stations with a power > 5 W: 7 m
- to antennas of radar installations, e.g.: 71 m

---------- End Example

6.1.9 Dangerous Areas: Dangerous areas around the store when connected to the aircraft or after removal and operation on ground prior to loading shall be recognized and described. If this section is applicable, safety distance requirements shall be given.

---------- Begin Example

When the store or main assembly containing explosives is directly exposed to fire, only a short time is given (cook-off time) until the rocket motor or warhead is ignited or detonatesCook-off times and safety distances are listed in Table 6.

TABLE 6 - Definition of Dangerous Areas

Designation	Cook-off Time	Safety Distance
Store	xy sec	Approx. xyz m
Warhead	xy sec	Approx. xyz m
Rocket Motor	xy sec	Approx. xyz m

---------- End Example

6.1.10 Fire Fighting: Fire fighting information shall be given in this section. This includes description of hazardous areas (in excess of dangerous areas identified in 6.1.9) and ranges from the origin of the hazard. The kind of hazard shall be described in detail. This information is required by fire fighters to take action against an operative store.

---------- Begin Example

The following Table 7 lists hazard areas to be considered for Fire Fighting. The areas are visualized in Figure 42.

TABLE 7 - Hazardous Areas

Zone	Characteristics	Ranges	Area
A	Lethal, blast, fragments	xyz cm from the center of the warhead	xyz rad on each side of the store
B	Lethal, blast, fragments	xyz cm from the yellow warhead ribbon xyz m from the rocket motor nozzle	xyz rad on each side of the store xyz rad on each side of store roll axis
C	Fragments possible. Safest way of approach for fire fighting	No closer than xyz cm from the forward part of the rocket motor	From xyz to xyz rad on both sides of store roll axis
D	Lethal, fragments	xyz m	xyz rad each side
E	Lethal, forward thrust of the store	Not determined	xyz rad on each side

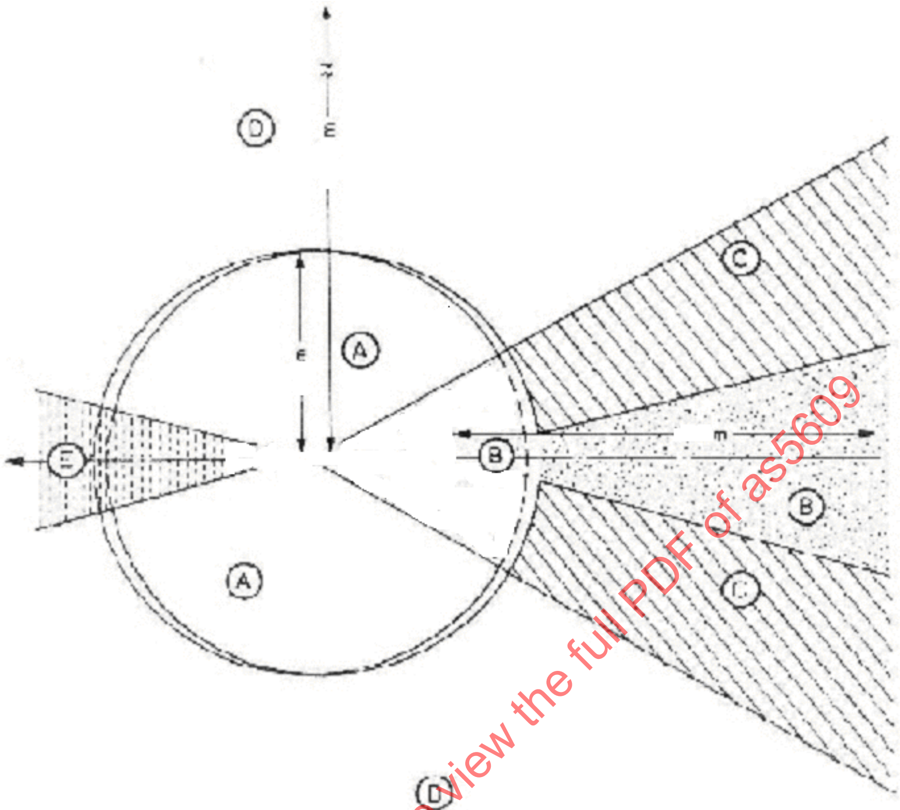


FIGURE 42 - Hazardous Areas for Fire Fighting

---------- End Example

6.1.11 Hangfire: Countermeasures in case of a hangfire and its handling on ground shall be specified in this section.

---------- Begin Example

In the case of hangfires, it is to be assumed that the thermal battery has been activated. The rocket motor igniter safety mechanism has not been armed.

The following Table 8 describes the status features and actions to take in the event that an platform carrying guided stores returns from a flight with the store still attached to its launcher, despite all measures having been taken to launch the store.

TABLE 8 - Procedures at Hangfire Occurrence

No.	Status	Features	Action
1	Rocket motor did not ignite Gas generator did not ignite	No combustion traces on the nozzle No soot traces on the exhaust valve	Wait at least 15 minutes Connect the guided missile, the platform and the recovery personnel to a common grounding point Disconnect the umbilical cable from the launcher and fit the cap onto the umbilical cable connector Rocket motor Type 1: Make safe by inserting the safety and arming key and turning to the SAFE position
2	Rocket motor ignited Gas generator did not ignite	Combustion traces on the exhaust nozzle No soot traces on the exhaust valve	Wait at least 15 minutes Connect the guided missile, the platform and the recovery personnel to a common grounding point Disconnect the umbilical cable from the launcher and fit the cap onto the umbilical cable connector
3	Rocket motor ignited Gas generator ignited	Combustion traces on the exhaust nozzle Soot traces on the exhaust valve	Wait at least 15 minutes Connect the guided missile, the platform and the recovery personnel to a common grounding point Disconnect the umbilical cable from the launcher

---------- End Example

6.2 Captive Flight Safety:

Safety measures for captive flights e.g. provision of correct mass, cg etc. compliance. Also covered is the ability of a store to be jettisoned.

---------- Begin Example

The aircraft is required to allow a selective and emergency jettison of the store without active store guidance (i.e. without guidance logic activated or store engine operational). The capability has to be qualified during the integration process. In case of a hangfire, the appropriate procedure is described in the following section.

---------- End Example

6.2.1 Hangfire During Captive Flight: Means to counter a hangfire during flight and appropriate countermeasures to be undertaken in-flight in case of a hangfire shall be identified and described in this section.

---------- Begin Example

An In Flight Operable Lock (IFOL) is provided by the Launcher to prevent launch of the store in case of inadvertent rocket motor ignition.

The Launcher provides the following safety features:

- A readily identifiable visual indication of the safe (locked) and unsafe (unlocked) condition, which is visible to ground crew without the use of ground equipment.
- An in flight operable safety lock (IFOL) which shall prevent release of the store in the case of an inadvertent rocket motor ignition. The locked condition of the IFOL shall isolate the Release Consent and Umbilical Retract signals.
- No single point failure or adjacent connector pin short shall result in an inadvertent Release Consent, Umbilical Retract or IFOL unlock signal.
- Rail Launcher BIT shall be possible if a store is fitted and shall not present any safety hazard or produce false signals to the store.

---------- End Example

6.3 Launch/Release/Jettison Safety:

Safety measures for launch/release/jettison affecting the interface. For some stores jettison may not be allowed.

Store safe separation actions such as store propulsion system arming operations (start of propulsion prior to release e.g. drop release), store arming operations, safe arming distance etc. shall be defined.

---------- Begin Example

The platform Store Control System is responsible for the management and sequencing of store selection, for arming and launch of the store. An unsafe condition must not appear in operating the store.

6.3 (Continued):

Potential weapon hazards and/or defects/failure modes which may cause or contribute to loss or damage of the platform, aircrew, overflown population, ground crew, property or third parties shall be identified by the platform manufacturer and the weapon supplier. An analysis of the identified store hazards and/or defects/failure modes shall be reported in a flight safety analysis/weapon hazard analysis by the weapon supplier and their associated risk defined.

---------- End Example

6.4 Hazards of Electro-Magnetic Radiation to Ordnance (HERO):

Hazards shall be identified and listed. Countermeasures shall be defined. This subject is typically covered in a different report and will be referenced through this section.

6.5 Personnel Safety:

If not already included in 6.1 through 6.3 like impact on personnel through Radiation (electrical radiation and radio activity), etc.

---------- Begin Example

To avoid personnel damage, electrical radiation shall not exceed the limits defined in ´xyz´. If the levels are exceeded, measures in accordance with ´xyz´ shall be undertaken to alert personnel on the site of operation.

---------- End Example

7. ENVIRONMENTAL CONSIDERATIONS:

This section defines the environmental considerations for store integration.

Because the ICD is not a specification or requirements document, the content of the following subsections is often referenced to a specification, a standards document or an applicable standards test procedure (e.g. MIL-STD-810 Environmental Test Methods). There are various distinctions in certain subsections possible e.g. between captive carriage conditions and launch or with respect to the severity of the environment and the resulting operational capabilities for the store (see next paragraph).

7.1 Introduction:

The content of the following paragraph and an overview is given in this section.

The following terms shall be used defining the severity of environmental influences:

a. Survive

The system, in addition to staying safe throughout and following exposure to the environment, will subsequently be capable of operating satisfactorily within its performance limits.

b. Operate

The system will survive exposure to, and function correctly within its performance limits during exposure to the specified environment.

c. Remain safe

The system will not endanger personnel or the platform or store when exposed to the specified environment, or subsequently during any handling and disposal; the store is not required to operate in or after exposure to the specific environment.

7.2 Environmental Condition:

The following data can be regarded from the store only viewpoint (carriage rack store) and from the platform viewpoint concerning the platform/store combination. Depending on integration progress, the content may evolve from store only environmental conditions to the overall platform/store environmental condition. Any influence from store to platform and vice versa is covered. From an integration viewpoint, in most cases the platform part defines the limitations of the overall system.

7.2.1 General: General environmental considerations on how the system is used e.g. a coarse description of an overall operational envelope can be included here.

7.2.2 Altitude and Ambient Pressure: The altitude and pressure the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum altitude and pressure values can be defined. Special precautions to prevent damage either to the store or the platform shall be identified. Reference may be given to the mission phase to which the values apply e.g. during captive carriage, in order to distinguish from a post launch phase with the equipment in non-operational or operational state.

---------- Begin Example

7.2.2.1 Altitude:

Maximum carriage altitude	20000 m

7.2.2.2 Ambient Pressure and Conditions: The ambient pressure and condition at the equipment installation area will be as in Table 9.

TABLE 9 - Ambient Pressure

Maximum ambient pressure	150 kPa
Minimum ambient pressure	1 kPa

---------- End Example

7.2.3 Dynamic Pressure Change: The dynamic pressure change the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Pressure rate change can be defined. Special precautions to prevent damage either to the store or the platform shall be identified. Reference may be given to the mission phase to which the values apply e.g. during captive carriage in order to distinguish from a post launch phase with the equipment in non-operational or operational state.

---------- Begin Example

TABLE 10 - Dynamic Pressure Change

Maximum pressure rate change increase	300 kPa
Maximum pressure rate change decrease	100 kPa

---------- End Example

7.2.4 Temperatures: Temperatures the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum extreme temperature values and temperature shock shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified. Temperature is often allocated with altitude like pressure in 7.2.2. The following subsections on level 4 are identified as an example; the ordering in an ICD is to the author's discretion.

---------- Begin Example

7.2.4.1 Temperature:

TABLE 11 - Temperature Requirements

High temperature extreme (non-operational)	+80 deg C
Low temperature extreme (non-operational)	-60 deg C
High temperature extreme (operational)	+60 deg C
Low temperature extreme (operational)	-50 deg C

Exposure to captive flight aerodynamic heating as defined by profile in accordance with figure tbd following ground soak at 49 degrees C.

Exposure to captive flight aerodynamic heating as defined by profile in accordance with figure tbd following ground soak at -54 degrees C with equipment in operational state.

7.2.4.2 Temperature/Altitude:

TABLE 12 - Temperature Altitude

IN FLIGHT OPERATION		GROUND SOAK			
		OPERATING		NON OPERATING	
MAX	MIN	MAX	MIN	MAX	MIN
External Bay: 100 °C per 40 min. at sea level and 110 °C at 40 kft per 30 sec. Up to 15 cm from leading edge: 95 °C per 40 min. at sea level and 122 °C at 50 kft per 40 sec	-41 °C	+85°C	-40 °C	+70 °C	-35 °C

7.2.4.3 Temperature Shock: The equipment can be exposed to sudden (within 5 minutes) atmospheric temperature changes over the range -54 degrees C to 71 degrees C or in accordance with a specific temperature shock profile (see figure tbd.).

---------- End Example

7.2.5 Humidity: Humidity the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum humidity values shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified.

Remark: Humidity is often regarded in conjunction with temperature and pressure and an allocated profile.

---------- Begin Example

The equipment does not suffer any degradation and is able to operate correctly during and after exposure to the humid environment as defined in the following Table 13 and Figure 43.

TABLE 13 - Humidity

Humidity	Pressure	Temperature
95%	Ambient	40 deg Celsius

The store performs without degradation after exposure to high relative humidity in accordance with the diurnal cycle defined in MIL-STD-210, Table VI, for up to 30 daily cycles during Alert Status. The store performs without degradation during and after exposure to the humidity conditions defined for a 10 percent risk per MIL-STD-210, Tables XXI through XXII, during captive carry and free flight.

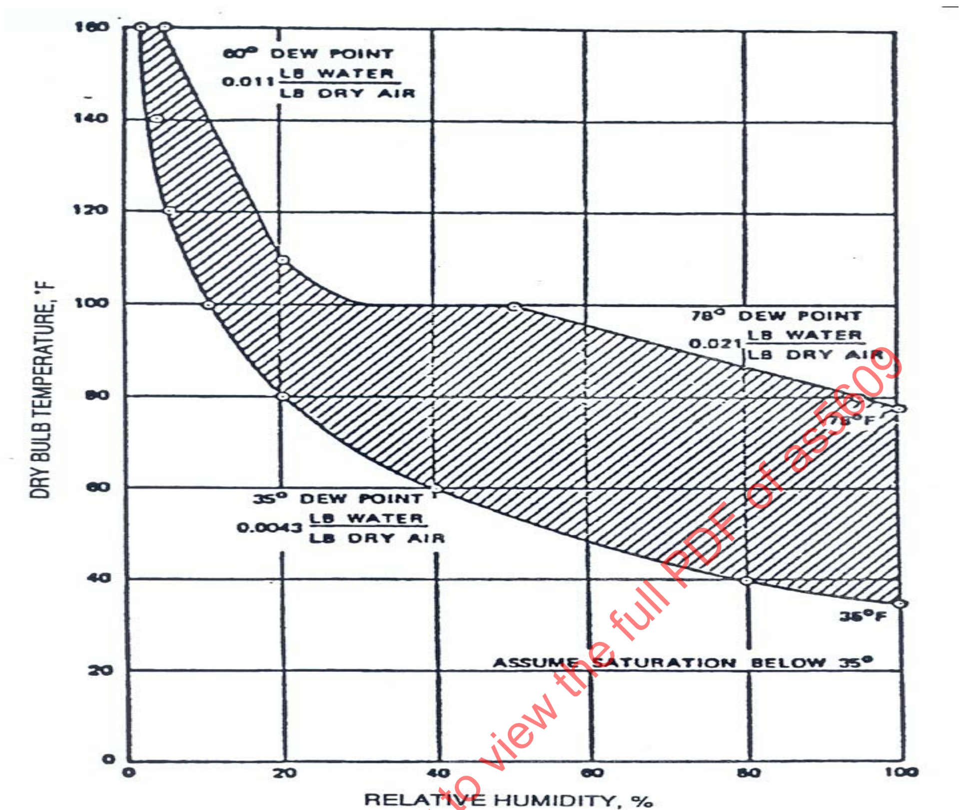


FIGURE 43 - Dew Point

---------- End Example

7.2.6 Solar Radiation: Solar radiation, the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Values of collocated peak temperature etc. will be defined. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

Materials exposed to direct sunlight would not deteriorate or degrade through the effects of ultraviolet light to affect maintainability performance or significantly affect reliability.

Illumination in 10 cycles of 8 hours duration each with exposure to 1120 W/m^2

---------- End Example

7.2.7 Fungus Resistance: Fungus resistance, the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum fungus resistance and exposure values and definition of the fungus type shall be given. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

Material, which are not nutrient for fungi is used. Where this is not feasible, suitable fungicidal agents or other means are used to protect materials.

The store performs without degradation after exposure to high relative humidity in accordance with the diurnal cycle defined in MIL-STD-210, Table VI, for up to 30 daily cycles during Alert Status.

The stores performs without degradation during and after exposure to the humidity conditions defined for a 10 percent risk per MIL-STD-210, Tables XIX through XXII, during captive carriage.

The store design will incorporate materials, which are non-nutritive, resist fungus growth, or are not affected by fungus growth.

---------- End Example

7.2.8 Salt Fog: Salt fog, the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum Salt fog values and test definition like equipment exposure times, drying period etc shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

The equipment does not suffer any degradation and is able to operate correctly during and after exposure to a salt fog solution of 5% + 1% for 48 hours.

---------- End Example

7.2.9 Rain - Rain Erosion: Rain - rain erosion the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum Rain - rain erosion values, rain impact, rain rate, wind velocity, droplet size, duration and temperature shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

Example 1:
Rainfall:
The amount of rainfall that the platform will be exposed to covers a 24 hour period as in Table 14:

TABLE 14 - Rain Rates

Amount	Mm	305	51	279*	178
Duration	H	11.92	0.08	11.00	1.0
Rate	mm/h	25.4	610	25.4	178
Drop Size	Mm	2.25	4.0	2.25	3.2

*Wind speed of 35 knots.

Example 2:
25 mm/hr for 10 minutes for captive carry and launch.
50 mm/hr for 1 hour on airfield and transportation

Rain Erosion:
The equipment is not adversely affected when subject to 2 mm diameter water droplets at an intensity of 25 mm/h and directed to exposed surfaces at 224 m/s for a duration of a minimum of 30 min.

---------- End Example

7.2.10 Hail: Hail intensity, the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum hail size, hail impact and speed shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

The equipment is qualified for the following hail conditions:

TABLE 15 - Hail Definitions

HAIL DIM (mm)	SPEED (m/s)	IMPACT-NORMAL (Joule)	IMPACT-TOTAL (Joule)
25	131	10.9	63

---------- End Example

7.2.11 Drip: Fluids dripping from overhead aircraft structures onto the store with/without performance deviations or damage (i.e. definition to survive, operate or remain safe) to the store shall be defined. Maximum drip/drip rates shall be defined. Special precautions to prevent damage either to the store or the platform shall be identified.

---------- Begin Example

The store shall withstand exposure to water dripping from overhead structure, equipment, in accordance with the 45 degree drip proof requirements of MIL-STD-108 Paragraph 4.3 without any performance degradation.

---------- End Example

7.2.12 Sand and Dust: Sand and dust the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum Sand and dust values e.g. minimum and maximum air velocity and particle size shall be defined. Special precautions to prevent from damage either to store or the platform (e.g. dust cover removal instant) shall be identified.

---------- Begin Example

The equipment does not suffer any degradation and is able to operate correctly during and after exposure to a sandy and dusty environment.

n detail, the equipment is not adversely affected when exposed to sand and dust levels 0.001-0.125 inch diameter particle size (0.00254-0.3175 mm), 100 knots relative velocity.

The store performs without degradation after exposure to blowing sand in concentrations up to 1.03 grams per cubic meter, with particle sizes between 74 and 350 micrometers in diameter, and wind speeds up to 35 knots for a period of up to 90 minutes.

The store performs without degradation after exposure to blowing dust in concentrations up to 1.03 grams per cubic meter, with particle sizes of less than 150 micrometers in diameter with 75 plus or minus 2 percent of the particles by weight less than 44 micrometers, and wind speeds, during tests, between 3 knots and 17 knots for 12 hours.

The store performs without degradation after exposure to blowing sand in concentrations up to 1.03 grams per cubic meter, with particle sizes between 74 and 350 micrometers in diameter, and wind speeds up to 220 knots at angles of attack from 0 to 14 degrees for up to 120 seconds.

---------- End Example

7.2.13 Icing/Freezing Rain: Icing, the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Minimum/maximum measures for icing and freezing rain shall be defined. Special precautions to prevent from damage either to store or the platform such as pre-mission de-icing shall be identified.

---------- Begin Example

Conditions:
25 mm/h for 10 min. (≅ 4.2 mm thickness built up over 10 minutes).
25 mm/h for 1 hr on airfield and handling

Pre-mission de-icing is required.

NOTE: During Air Carriage from Ma 0.5 to Ma 0.9 or more, the store surface is heated and thus any ice build up, which has not previously been removed on the ground, will be thawed.

No structural or system failure will result from ice built up. Ice built up has to be removed prior to take off and further built up is prevented by aerodynamic heating. Thus the requirements are considered compatible.

---------- End Example

7.2.14 Climatic Zones: The climatic zones the store can survive, operate in or remain safe shall be defined.

---------- Begin Example

The aircraft and store are capable of operation in climatic zones A1, A2, A2. C0, C2 as defined in STANAG 2895, Annex A

---------- End Example

7.2.15 Vibration: Vibration levels the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum vibration peak values in accordance with defined vibration profiles shall be given. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

Example 1:

The equipment withstands the following conditions
Power Spectrum:
Womax(Functional)=0.04 g^2/Hz)
Womax(Endurance; 1hr)=0.18 g^2/Hz
Duration: 1.0 hour per axis (3 axis)
and with the vibration test spectrum as defined in the following Figure 44:

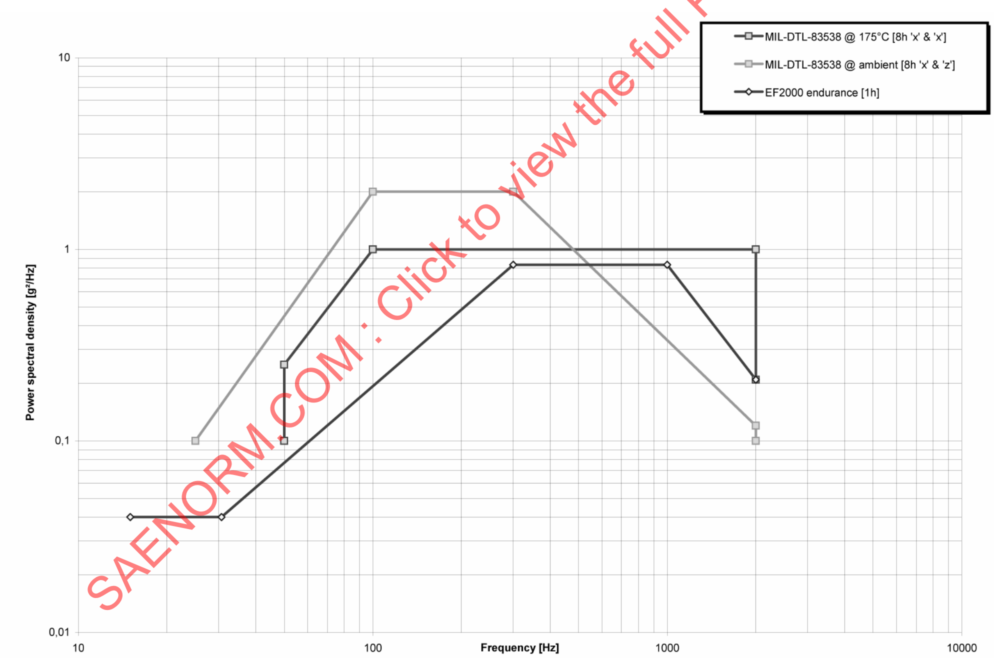


FIGURE 44 - Vibration Levels

7.2.15 (Continued):

Example 2

Lateral and vertical axes
Function: Test time at least 2 minutes/axis
Endurance: Test time 6 hours/axis. The unit shall be switched on. Function is not required during test but after, when vibrated with functional level

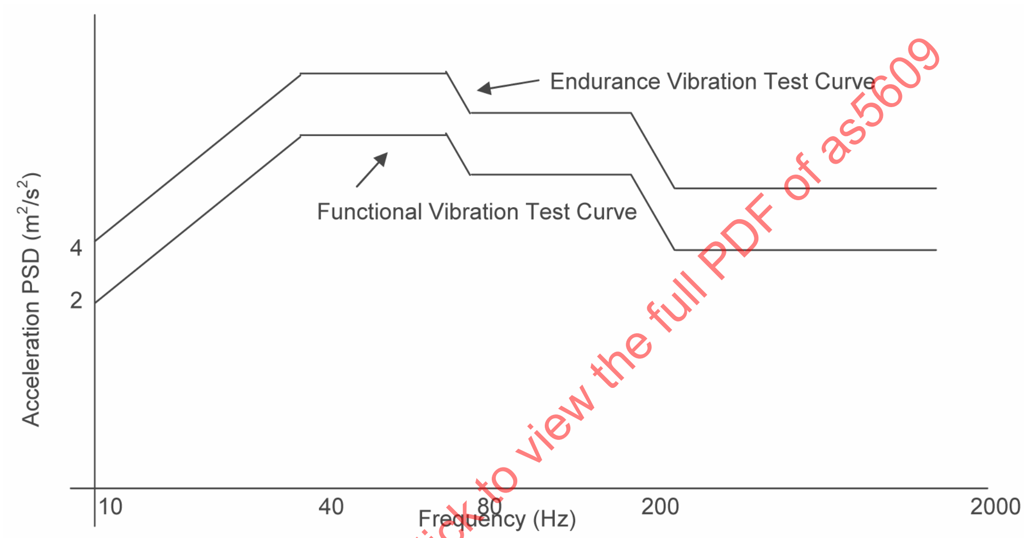


FIGURE 45 - Vibration Test Curves

---------- End Example

7.2.16 Gunfire Vibration: Gunfire vibration levels the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum gunfire vibration values caused by the on-board gun of the platform shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

The Gunfire Vibration Test is performed to assure that equipment mounted in an platform with onboard guns can withstand the vibration levels caused by the overpressure pulses emitting from the gun nozzle.

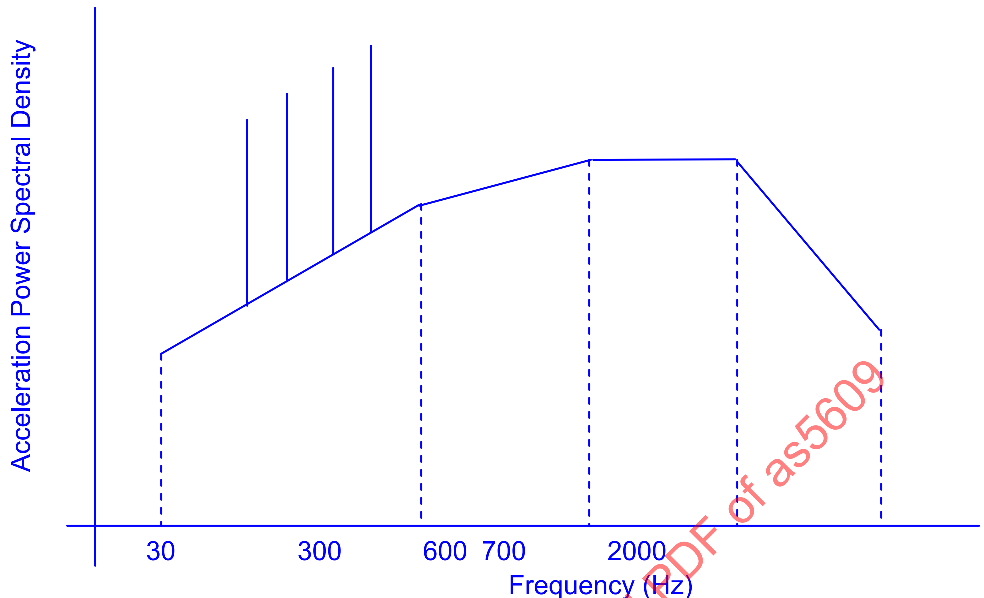


FIGURE 46 - Gunfire Vibration

---------- End Example

7.2.17 Mechanical Shock: Mechanical shock the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Shock values to sustain continued operation and performance e.g. during a defined number of arrested landings or catapult launches or hard landings shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

Example 1:

The Equipment withstands the relatively infrequent non-repetitive shock or transient vibrations encountered in handling, transportation and service environments.

Shock response spectrum requirement:

Two half sine shock pulse with a peak value of 300 m/s² (30 g) and a duration of 2.5 ms and with a peak value of 75 m/s² (7.5 g) and a duration of 40 ms are considered to cover the requirements.

Three shock pulses per test direction and shock type are required.

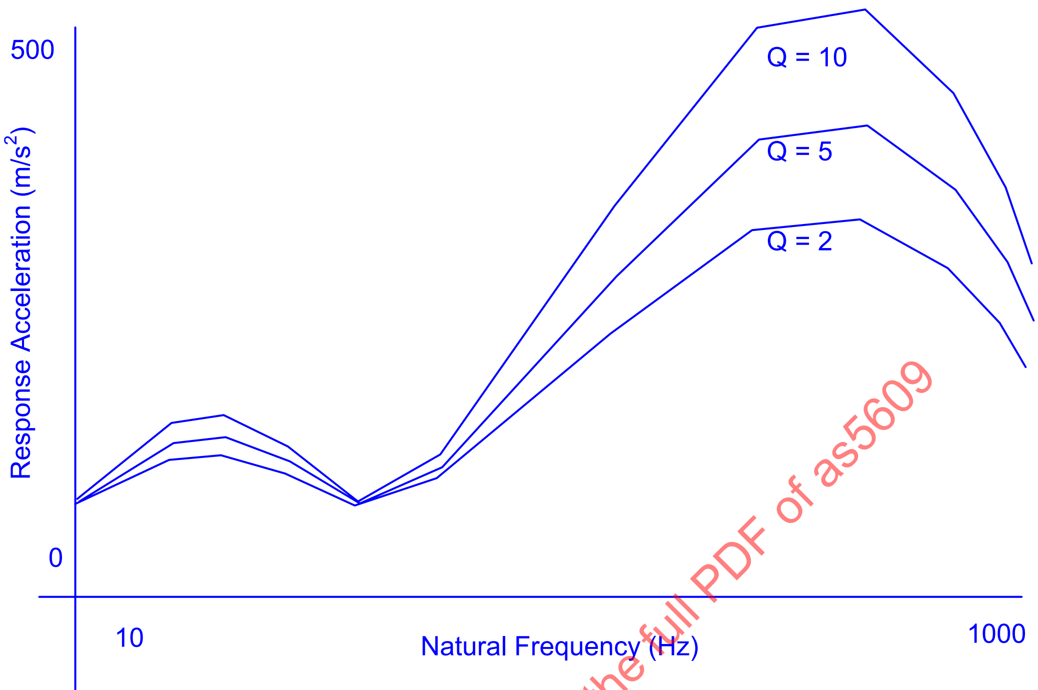


FIGURE 47 - Mechanical Shock Spectrum

Example 2:

Captive Flight: 6 g for 25 ms half sine longitudinal and 25 g for 20 ms half sine all axes perpendicular to the longitudinal axes.

Launch: 6 g for 1.2 ms half sine longitudinal and 35 g for 15 ms terminal saw-tooth any axis perpendicular to the longitudinal axis.

---------- End Example

7.2.18 Acoustic Noise: Acoustic noise, the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum acoustic noise values and defined noise spectrum shall be specified. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

7.2.18 (Continued):

Example 1

The equipment shall suffer no degradation and meet the requirements when subjected to the acoustic noise environment with the following Functional and Endurance spectra:

a. Functional Spectrum

Flat spectrum, with a constant 1/3 octave band level of 148 dB, in the frequency range 125-2500 Hz

1/3 octave band level reduction, with a 3 dB/octave slope, up to 8000 Hz and down to 100 Hz

For testing purpose the functional spectrum shall applied ½ hour before and after the execution of the Endurance Spectrum

b. Endurance Spectrum

Flat spectrum with a constant 1/3 octave band level of 153 dB, in the frequency range 125-2500 Hz

1/3 octave band level

The application time of endurance spectrum, for testing or fatigue analysis purpose is 3 hours. Levels may be reduced increasing the application time according to the following equation:

LI = L0+2.5 Log (T0=/TI)

Example 2

Internal mounted Equipment: 145 dB, 6hours.

External equipment 155 dB, 6 hours

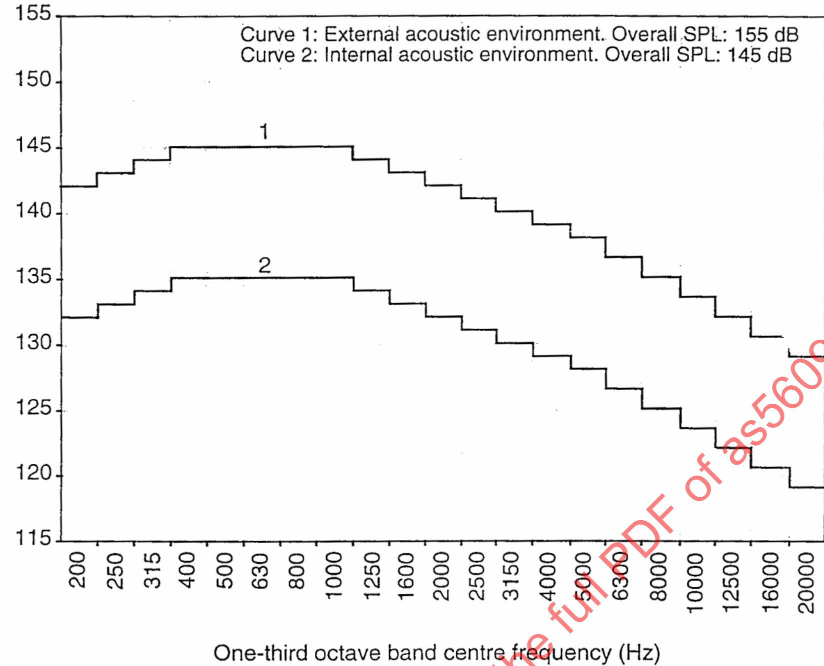


FIGURE 48 - Acoustic Noise Spectrum

---------- End Example

7.2.19 Linear Acceleration: Linear Acceleration the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum linear acceleration values shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

The Equipment/Store shall suffer no degradation when exposed to the following accelerations.

7.2.19 (Continued):

Example 1:

The levels of acceleration are as follows:

Direction	(g)
Fore	4.6
Aft	4.6
Lateral	13.6
Up	19.4
Down	14.2

(g) = 9.81 m/s²

Example 2:

At launch 15 g in longitudinal direction

Design Factors of Safety (FS) for all operational phases of the store are established as follows:

For captive flight, launching and free-flight prior to the point at which structural failure of the store would no longer endanger the launching PLATFORM

Ultimate FS = xyz
Yield FS = xyz

Analysis of the store's structure against the platform loads and evaluation of flight test results will contribute to clearance for carriage of AIM-9L on EF2000.

The platform requirement is that the equipment must (I) Survive and be fully functional afterwards and (II) operate with full performance under these conditions with the following g levels:

TABLE 16 - Linear Acceleration Levels for Survive an Operate Requirements

	Fore	Aft	Lat	Up	Down
I	4.7	4.7	14.1	19.8	14.6
II	3.6	3.6	10.8	15.2	11.3

Compatibility Statement The store test values are not fully compatible with the platform requirements. Analysis for captive flight shall take place against actual platform loads

---------- End Example

7.2.20 Angular Motion, Acceleration and Angular Rates: Angular motion, angular acceleration and angular rates the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum angular motion, acceleration and angular rates shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

In conjunction with the definition of the air carriage loads for carriage envelope, the platform and store are capable of operation up to the maximum values for angular motion on the relevant platform carriage stations as defined in Table 17:

TABLE 17 - Angular Rates and Accelerations

Angular Rates		Angular Accelerations	
Pitch	$\pm$ x r/s	Pitch	$\pm$ x r/s^2
Roll	$\pm$ x r/s	Roll	$\pm$ x r/s^2
Yaw	$\pm$ x r/s	Yaw	$\pm$ x r/s^2

---------- End Example

7.2.21 Radiation (nuclear): Nuclear Radiation, the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum, minimum nuclear radiation values shall be defined. Special precautions to prevent from damage either to store or platform shall be defined. If the platform or store is designed to survive in a nuclear environment this is the paragraph to describe the environment shall be identified.

---------- Begin Example

Nuclear Electromagnetic Pulse Requirements
The Equipment has to fulfil the requirement of the peculiar Platform requirement; for example

Test requirements to be applied for are in accordance with
- NEMP 1 Nuclear Electromagnetic Pulse, Current Injection Test

Nuclear Hardening Requirements as well as test requirements – defined for platform – are specified in a dedicated Specification.

---------- End Example

7.2.22 X-Ray Emissions: X-ray emissions a store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum values shall be defined. Special precautions to prevent damage either to the store or the platform shall be identified.

---------- Begin Example

Whenever the equipment is being operated on the aircraft, it shall not radiate X-ray energy greater than 0.5 milli-roentgen when measured at 5 cm from the surface of the equipment.

---------- End Example

7.2.23 Explosive Atmosphere: Explosive atmosphere, the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum explosive atmosphere values including the definition of the explosives and the explosive fuel used shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

The unit is constructed such that it does not produce internal or external arcs and/or sparks, during normal operation, unless these are contained within a hermetically sealed case.

If this is not possible the supplier shall prove the ability of his equipment to operate in an explosive atmosphere without causing an explosion.

Qualification is in accordance to a peculiar platform environmental requirement.

---------- End Example

7.2.24 Contamination: Contamination, in which the store/platform can withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe). Maximum and minimum contamination values shall be defined. These could be contamination caused by hydraulic fluid, de-icing fluid etc. These corrosive fluids may be defined in a table together with the concentration limits specifying margins for equipment deterioration and corrosion. Special precautions to prevent from damage either to store or the platform shall be identified.

---------- Begin Example

TABLE 18 - Contamination Sources

Equivalent National Specification	No	Fluid	Nato Code
AA-M-C 142(n) AA-M-C 141(d)	1 2	FUEL	F.40 F.34
AA-M-O 216 g	3	HYDRAULIC FLUID	H.515
MIL-S-8802 B	4	CABIN and FUEL TANK SEALING COMPOUND	------
	5	FIRE EXTINGUISHANT	------
	6	ENGINE & GEARBOX OIL	0160
TT-I-735(a) Am 2 (Grade B) O-M-232(e) Am.1 (Grade A)	7 8 9 10	DE-ICING FLUID	S 737 S 747
MIL-STD-810E Method 509.3	11	Sea Water	

---------- End Example

7.2.25 Bio and Chemical Hardening: Required bio and chemical hardening with which the store/platform is able to withstand/perform in with/without performance deviations or damage (i.e. definition to survive, operate or remain safe) shall be defined. Maximum and minimum hardening values shall be defined. Special precautions to prevent damage either to the store or the platform shall be identified.

---------- Begin Example

The life and operation of the platform and store are not adversely affected by exposure to the following contaminants, subject to completion of the routine maintenance procedures defined in Document xxx:

Table to list all contaminants, by category, name and definition in accordance with national/international standards

---------- End Example

7.2.26 TEMPEST: Tempest is a U.S. government code word that identifies a classified set of standards for limiting electric or electromagnetic radiation emanations from electronic equipment. If required, the ICD shall define specific measures to prevent inadvertent emissions.

---------- Begin Example

The interface shall be designed in a way to comply with the national tempest requirements. Bonding and shielding have to comply with MIL-STD-xyz. The equipment shall be designed and tested to the requirements of AMSG-720B or AMSG-788 as appropriate. As these requirements are usually classified, a specific example is NOT included here.

---------- End Example

7.2.27 NEMP: The platform and store shall be capable of surviving/remaining safe/continue to operate in the environment related to a nuclear strike. The electromagnetic aspects of a nuclear pulse can be found in 7.3.12.

---------- Begin Example

The platform will operate in and the store survive in the NEMP environment defined below:

1 Air blast
2 Thermal radiation
3 Initial nuclear radiation

---------- End Example

7.3 Electromagnetic Environmental Effects (E^3):

Describes the electromagnetic radiation the store/platform can withstand/perform in with/without performance deviations or damage. Maximum and minimum electromagnetic radiation values, frequency ranges, field strength and electrical characteristics shall be defined. Special precautions to prevent from damage either to store or the platform shall be identified. If the platform or store is required to survive high electromagnetic radiation then this paragraph will define this environment. Specific data to define electromagnetic environmental effects or to prevent from electromagnetic influence shall be addressed. Where applicable reference shall be made to available standards.

---------- Begin Example

7.3 (Continued):

Electromagnetic Compatibility Specification for Equipment

MIL-STD-461	Electromagnetic Interference Characteristics, Requirements for Equipment
MIL-STD-462	Electromagnetic Interference Characteristics, Measurements of
MIL-STD-463	Definition of Systems and Units, Electromagnetic Interference Technology
Defense Standard 59-41	(1986) Parts I-III Electromagnetic Compatibility of Equipment
MIL-STD-831	Test Reports, Preparation of
MIL-STD-1757A	Lightning Qualification Test Techniques for Aerospace Vehicles
MIL-B-5087	Bonding Electrical Lightning Protection

---------- End Example

7.3.1 Conducted Emissions, Power Lines: The limits of conducted emissions and limits for power leads shall be defined in this section. If appropriate, a compatibility statement can be given.

---------- Begin Example

The conducted emissions on all power leads to and from the item shall not exceed the limits specified in Figure 49 within the bandwidth 20 Hz to 100 MHz. The limits are comparable with MIL-STD 461C, CE01 and CE03.

Compatibility Statement:
tbd

---------- End Example

7.3.2 Conducted Emissions, Control and Signal Lines: The limits of conducted emissions and limits for control and signal lines shall be defined in this section. If appropriate, a compatibility statement can be given.

---------- Begin Example

The conducted emissions on all control and signal lines to and from the item shall not exceed the limits specified in Figure 49 within the bandwidth 20 Hz to 100 MHz. The limits are comparable with MIL-STD 461C, CE01 and CE03.

Compatibility Statement:
tbd

---------- End Example

7.3.3 Exported Spikes and Transients: Limits for spikes and transients are addressed in this section. If appropriate, a compatibility statement can be given.

---------- Begin Example

The amplitude and duration of transients appearing on DC power leads shall not exceed the limits specified Figure 50.

Compatibility Statement:
tbd

---------- End Example

7.3.4 Radiated Emissions, Electric Field: Limits for radiated emissions and the electric field around the interface shall be specified over a defined frequency range. If appropriate, a compatibility statement can be given.

---------- Begin Example

The electric field emissions from the item including interconnecting cables shall not exceed the limits specified in Figure 51 when using a bandwidth between 50 kHz to 18 GHz. The limits are comparable with MIL-STD 461C, RE02, Curve #2.

Compatibility Statement:
tbd

---------- End Example

7.3.5 Conducted Susceptibilities, Power Leads: Limits for conducted susceptibility shall be defined. If appropriate, a compatibility statement can be given.

---------- Begin Example

The item shall operate when subjected to continuous wave signals using the frequencies from 20 Hz to 50 kHz and amplitudes shown in Figure 52. The signals are comparable to MIL-STD 461C, CS01. The item shall remain safe when the voltage limit is increased by 6dB.

Specification requires the store to retain its full performance during and after encountering the EMC environment. With the enhanced voltage limits (+6 dB) the store is allowed to go into a fail-safe state and shall revert to full performance after removal of the enhanced voltage limits.

Compatibility Statement:
tbd

---------- End Example

7.3.6 Bulk Current Injection Test: If a bulk current injection test is required, the limits for the injected current into e.g. a cable shall be defined. If appropriate, a compatibility statement can be given.

---------- Begin Example

The item shall operate when subjected to signals specified Figure 53 and Figure 54 for “Non-safety Critical Equipment“ (Bulk Current Injection Method). The bandwidth used shall be between 50 kHz and 400 MHz.

The item shall remain safe when subjected to signals specified in Figure 53 and Figure 54 for “Safety Critical Equipment“ (Bulk Current Injection Method). The bandwidth used shall be between 50 kHz and 400 MHz.

The Specification requires the store to retain its full performance during and after encountering the EMC environment. With the enhanced voltage limits (+6 dB) the store is allowed to go into a fail safe state and shall revert to full performance after removal of the enhanced voltage limits.

Compatibility Statement:
tbd

---------- End Example

7.3.7 Imported Spikes and Transients: This section shall define imported spikes like waveform or values if applied to the power leads. If appropriate, a compatibility statement can be given.

---------- Begin Example

The item shall operate when the transients defined in Table 19 of the spike waveform specified in Figure 55 are applied to the power leads. The signals are comparable to MIL-STD 461C, CS06.

Compatibility Statement:
tbd.

---------- End Example

7.3.8 Radiated Susceptibility, Magnetic Induction Field: This section shall define equipment behavior in case of radiated susceptibility in the presence of a magnetic field. The waveform and/or signal limits shall be defined. If appropriate, a compatibility statement can be given.

---------- Begin Example

The item shall operate when subjected to the signal limits as specified below:

- Power Frequency Test (20 A/DC; 20 A/400 Hz)
- Spike Test (Spikes as defined in Table 20 and Figure 55)

The requirements are comparable to MIL-STD 461C, RS02.

Compatibility Statement:
tbd

---------- End Example

7.3.9 Radiated Susceptibility, Electric Field: This section shall define the behavior in case of radiated susceptibility in the presence of an electric field. The waveform and/or signal limits shall be defined. If appropriate, a compatibility statement can be given.

---------- Begin Example

The item shall operate when subjected to the continuous and modulated signals specified in Table 21. The signal levels for the electric field continuous wave are specified in Table 22 column "Operate". The bandwidth shall be 50 kHz to 40 GHz.

The item, either operational or non-operational shall survive when subjected to the continuous and modulated signals specified in Table 21. The signal levels for the electric field continuous wave are specified in Table 22 column "Survive". The bandwidth shall be 50 kHz to 18 GHz.

NOTE: Store integration to specific platforms may require the increase of the bandwidth for this testing up to 40 GHz as well, in order to obtain full clearance levels.

Compatibility Statement:
tbd

The item, either operational or non-operational shall remain safe when subjected to the electric field as defined in STANAG 4234.

Compatibility Statement:
tbd

---------- End Example

7.3.10 DC Magnetic Field Environment: This section defines the requirements for the equipment function in the presence of a close to DC magnetic field. If appropriate, a compatibility statement can be given.

---------- Begin Example

The item shall remain safe and should survive magnetic fields of up to 800 A/m with a reversing polarity at a rate of field changes of 1600 A/m/sec. The frequency is less than 1 Hz. During exposure to the magnetic fields the non-operational store is stored in the closed container.

Compatibility Statement:
tbd

---------- End Example

7.3.11 Compass Safe Distance: Compass safe distance is used to describe possible mutual influence of inertial equipment caused by electromagnetic radiation. If appropriate, a compatibility statement can be given.

---------- Begin Example

The magnetic field emitted by the operational or non-operational item shall not cause a compass deviation of more than x° when measured 1m away from the outer surface.

The compass safe distance of the store does not exceed 1 m when measured in accordance with document RTCA/DO-160C, section 15 Environmental Conditions and Test Procedures for Airborne Equipment.

Compatibility Statement:
tbd

---------- End Example

7.3.12 EMP: This section shall specify the robustness of the store or equipment against EMP. If appropriate, a compatibility statement can be given.

---------- Begin Example

The store shall operate in the free field EMP environment according to Figure 58 without degradation:

Compatibility Statement:
tbd

---------- End Example

7.3.13 Conducted Emissions, Antenna Terminal: This section shall specify tolerable emissions at the receiver inputs (antenna terminals) in the different modes (receive or transmit). If appropriate, a compatibility statement can be given.

---------- Begin Example

The conducted emissions appearing at the antenna terminals of receivers and transmitters (F0 < 1.2 GHz) shall be measured. Within the bandwidth 14 kHz to 40 GHz the measured emissions shall not exceed the following limits:

- Receiver/transmitter in standby mode:xydBµV
- Transmitter in transmit modeFigure 56

This requirement is identical to MIL-STD-461C, CE06 and MIL-STD-461D, CE106.

Compatibility Statement:
tbd

---------- End Example

7.3.14 Spurious and Harmonic Emissions: A transmitter shall not exceed the transmission values specified in this section. If appropriate, a compatibility statement can be given.

---------- Begin Example

The radiated emissions transmitted via the antenna of transmitters (F0 > 1.2 GHz) within the bandwidth 14 kHz to 40 GHz shall not exceed the limits specified Figure 56. This requirement is identical to MIL-STD-461C, RE03 and MIL-STD-461D, RE103.

Compatibility Statement:
tbd

---------- End Example

7.3.15 Inter-Modulation: This section shall specify maximum values for any inter-modulation products between different signals generated during the operation of equipment or stores. If appropriate, a compatibility statement can be given.

---------- Begin Example

The presence of inter-modulation products from two signals shall be determined at receivers and tuned amplifiers operating in the frequency range of 1 MHz to 40 GHz.

Inter-modulation products from two signals shall not be present in the frequency range of 30 Hz to 40 GHz at specified frequencies and out put levels of 2 signal generators when

- Signal generator 1 is set to 66 dB above the level obtained to produce the standard reference output.
- Signal generator 2 is set to 66 dB above the level obtained to produce the standard reference output

This requirement is identical to MIL-STD-461C, CS03 and MIL-STD-461D, CS103.

Compatibility Statement:
tbd

---------- End Example

7.3.16 Rejection of Unwanted Signals: The store or equipment shall be able to suppress unwanted signals in accordance with the values specified in this section. If appropriate, a compatibility statement can be given.

---------- Begin Example

The presence of input terminal spurious responses using two signals shall be determined at receivers and tuned amplifiers operating in the frequency range of 1 MHz to 40 GHz. The item shall not exhibit any undesired responses when subjected to the test signal specified in Figure 57. This requirement is identical to MIL-STD-461C, CS04 and MIL-STD-461D, CS104.

Compatibility Statement:
tbd

---------- End Example

7.3.17 Cross-Modulation: This section shall specify maximum values for any cross-modulation products between different signals generated during the operation of equipment or stores. If appropriate, a compatibility statement can be given.

---------- Begin Example

The presence of cross modulating products using two signals shall be determined at receivers and tuned amplifiers operating in the frequency range of 30 Hz to 40 GHz. The item shall not exhibit due to cross-modulation any malfunction, degradation or deviation from specified value with 2 signal generators running at frequencies adjusted to $f_1 = f_o$ and $f_2 = f_o$ + IF and output levels adjusted to Out_1 = 10 dB; Out_2 = 66 dB above the level obtained to produce the standard reference output. This requirement is identical to MIL-STD-461C, CS05 and MIL-STD-461D, CS105.

Compatibility Statement:
tbd

---------- End Example

7.3.18 Electrostatic Discharge: Means to allow for/prevent from electrostatic discharge/charge shall be defined in this section. If appropriate, a compatibility statement can be given.

---------- Begin Example

Bare store
The store shall not be damaged nor become unsafe when exposed to a discharge of 25 kV from a 100 pF capacitor through a 1500 ohm resistor (human body model) to the equipment case or structure.

Connector Contacts
Connector contacts exposed during flight line maintenance or ground handling shall withstand a discharge of 4 kV from a 100 pF capacitor through a 1500 ohm resistor without damage to the store.

See also Table 23

Compatibility Statement:
tbd

---------- End Example

7.3.19 Lightning Protection: Description of special measures for the store and/or the platform to protect against lightning strikes shall be included here. Data may contain maximum voltage or current levels, electrical field strength, etc, which can be withstood by the store or the platform in conjunction with applicable protection measures.

If appropriate, a compatibility statement can be given.

---------- Begin Example

Dedicated to platform requirements, for example

Platform EMC Specification to be applied with test requirements

- LEMP 1 Lightning, Slow Pulse Test
- LEMP 2 Lightning, Fast Pulse Test

The store shall comply with direct lightning effects in Figure 59, with indirect lightning effects in Figure 60 and Table 24 and for near lightning effects in Table 25.

Compatibility Statement:
tbd

---------- End Example

7.3.20 Figures for E^3 Subsection: The tables can be included in a separate section if required. The arrangement of the figures and tables in the ICD is to the authors discretion.

---------- Begin Example

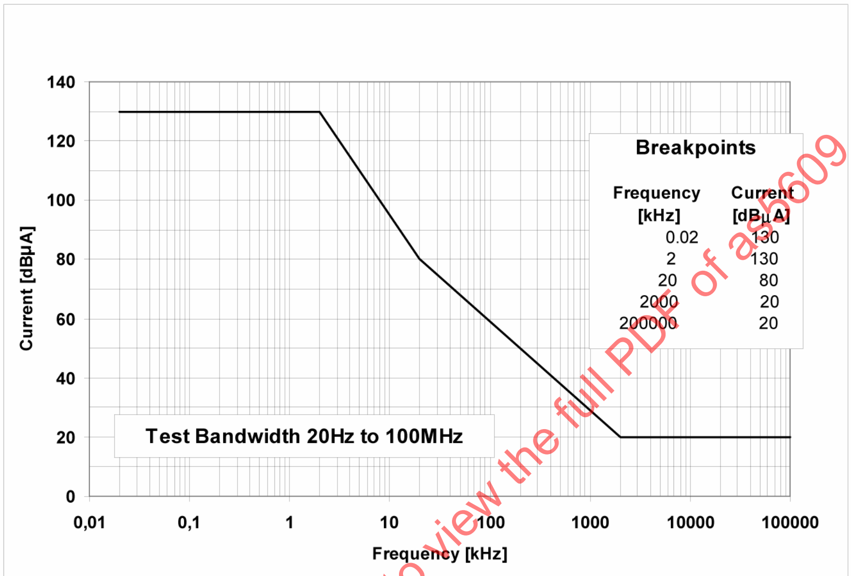


FIGURE 49 - Conducted Emissions, Limits for Power Leads/Control and Signal Lines

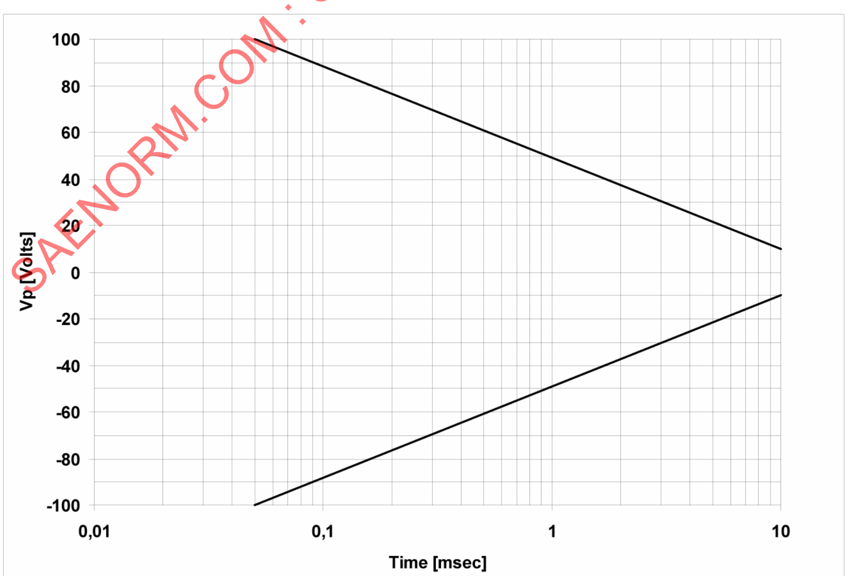


FIGURE 50 - Conducted Emissions, Limits for 28 Volt DC Supply Leads

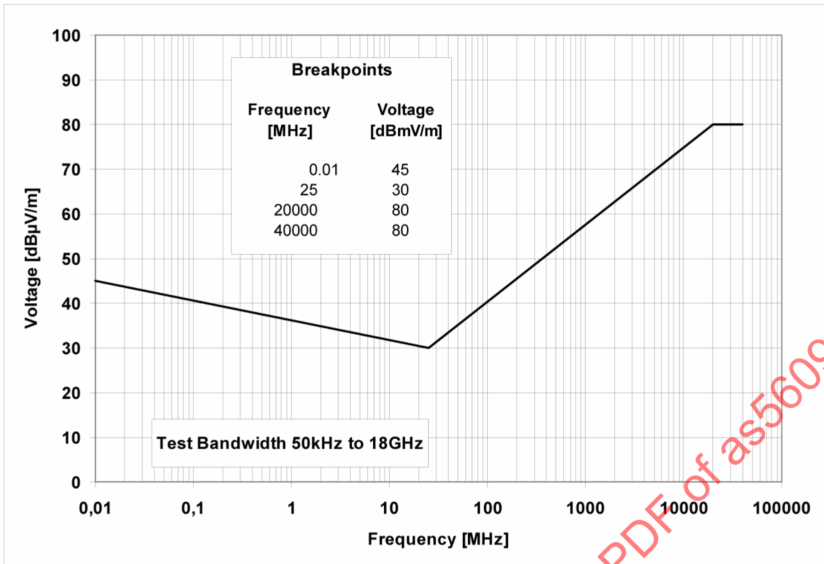


FIGURE 51 - Limits for Radiated Emission, Electric Fields

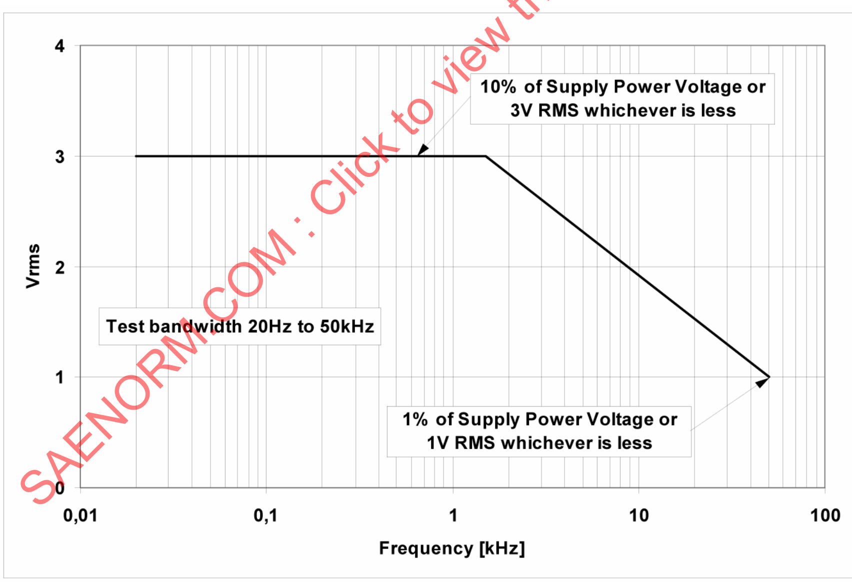


FIGURE 52 - Limits for Conducted Susceptibility, Power Leads

FIGURE 53 - Limits of Current Injected into Calibration Jig During Calibration

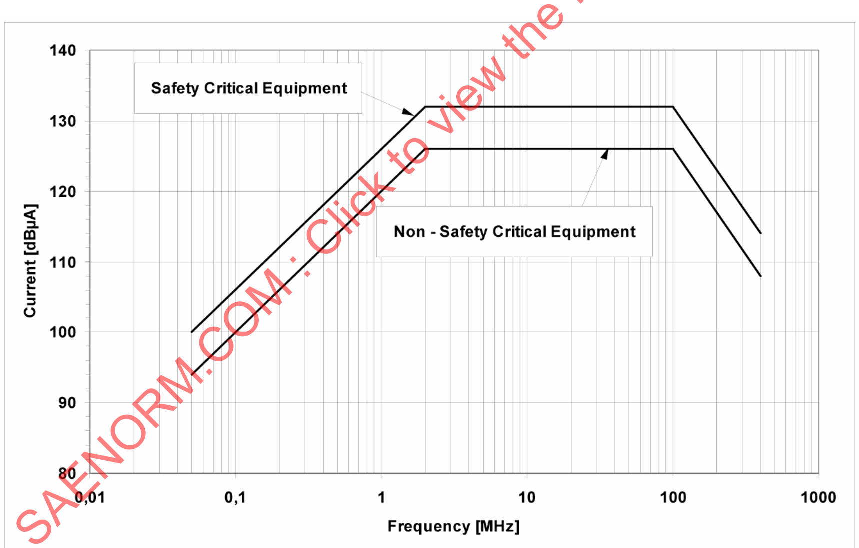


FIGURE 54 - Limits of Current Injected into a Cable During Test

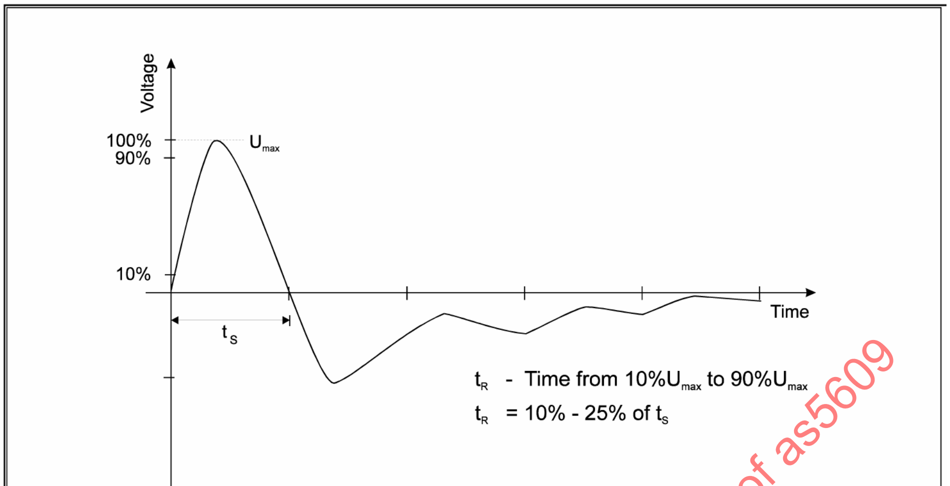


FIGURE 55 - Typical Spike Wave Form, Conducted Susceptibility

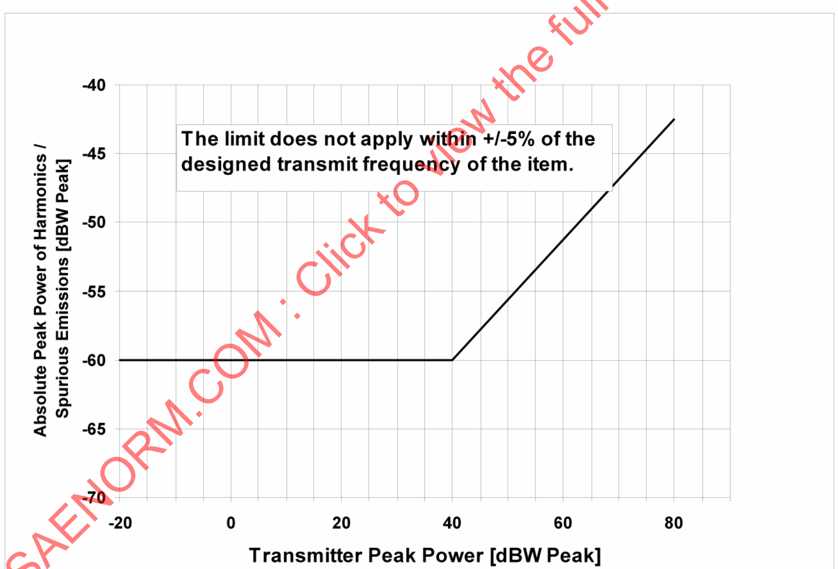
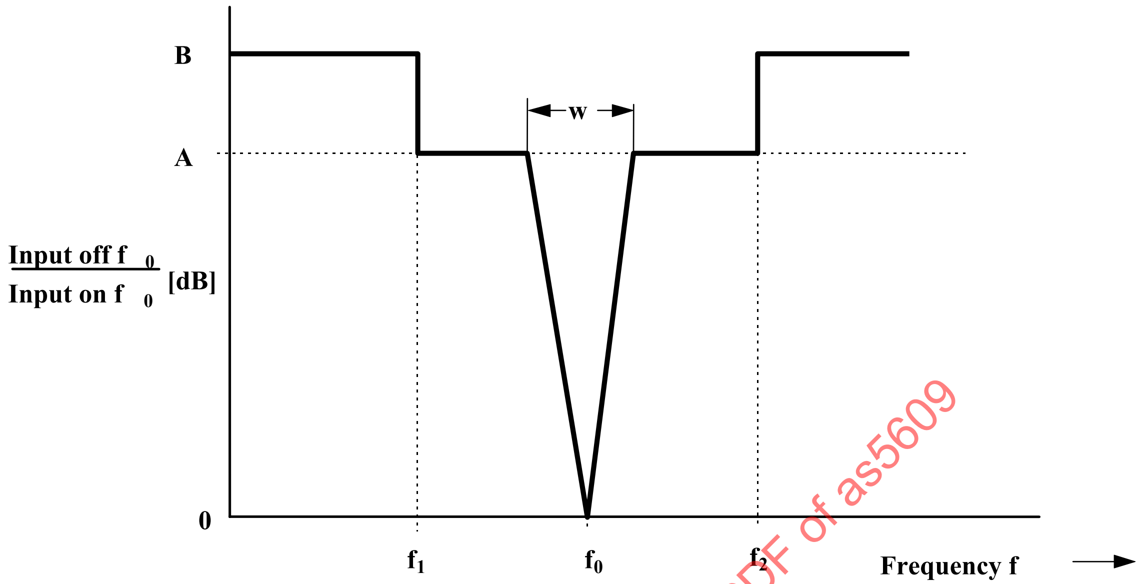


FIGURE 56 - Limits of Transmitter/Receiver Emissions



f_0	Selected frequency (defined in the item’s test plan); if no worst case frequency anticipated select band center.
f_1	Lowest tunable frequency of receiver band in use or lowest frequency of transmitter passband
f_2	Highest tunable frequency of receiver band in use or highest frequency of transmitter passband
w	Band of frequency excluded from the test defined by the bandwidth between the 80 dB points of the receiver selectivity curve; if not specified use f_0+/-5%.

Limits:

1. The limit at A is 66 dB above the input level required to produce the standard reference output. This limit shall not be used for transmitters.

2. The limit B shall be 0d Bm applied directly to the input terminals.

FIGURE 57 - Signals for Transmitter/Receiver Test Conducted Susceptibility

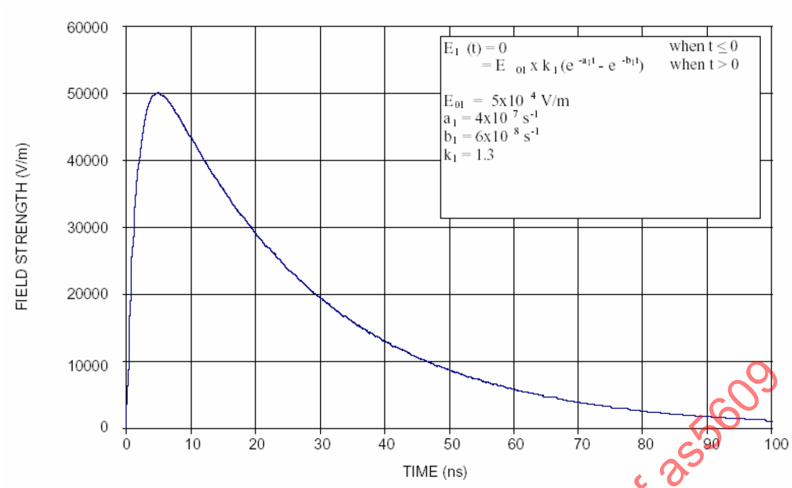


FIGURE 58 - Free-field EMP Environment

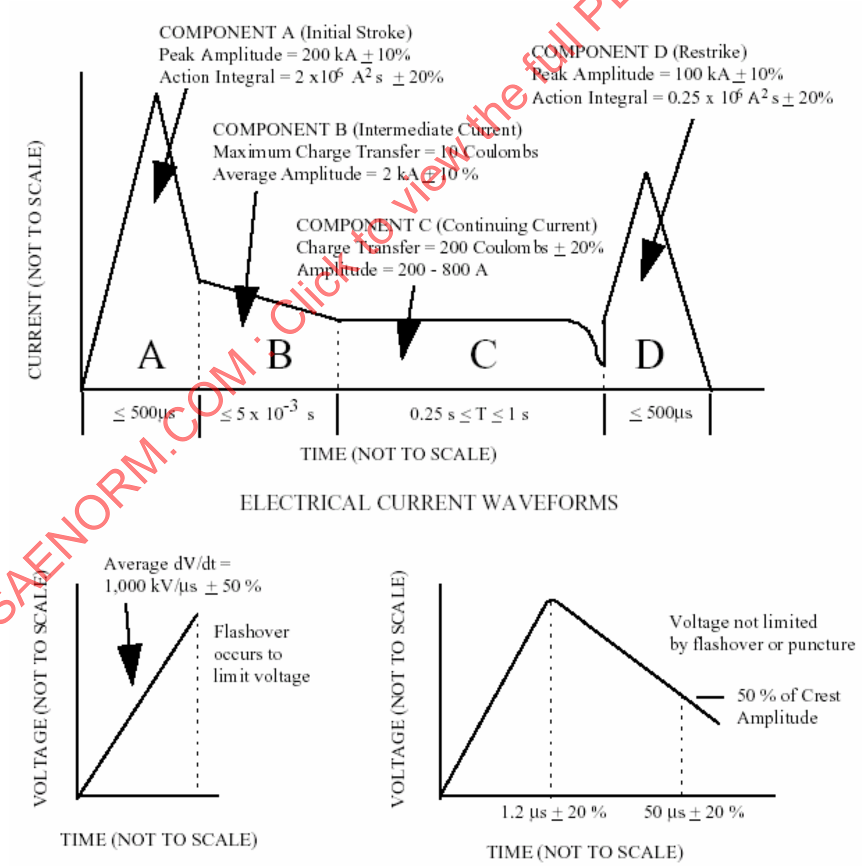


FIGURE 59 - Lightning Direct Effects Environment

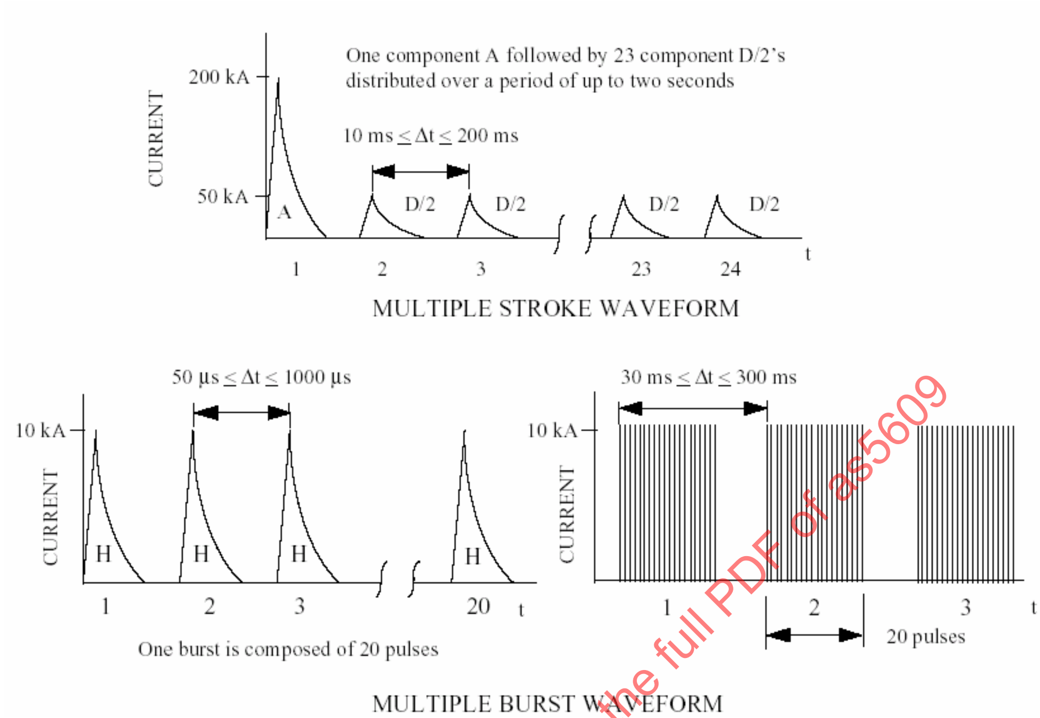


FIGURE 60 - Lightning Indirect Effects Environment

---------- End Example

7.3.21 Tables for E^3 Subsection:

---------- Begin Example

TABLE 19 - Spikes, Conducted Susceptibility

	U_{max}	t_S
	28 V DC Lines	
Slow Spike	+/-220 V	10 µsec
Fast Spike	+/-470 V	150 nsec

TABLE 20 - Spikes, Radiated Susceptibility

	U_{max}	t_S
	28 V DC Lines	
Slow Spike	+/-100 V	10 µsec
Fast Spike	+/-250 V	150 nsec

TABLE 21 - Electric Field Continuous Wave Characteristics

	Electric Field [V/m]	
Frequency Range	**Operate**	**Survive**
20 kHz - 1 GHz	200	200
1 GHz - 18 GHz	200	600
18 GHz - 40 GHz	200	600
NOTE:If higher peak values at certain frequencies are required for individual sections or units of the store the applicable electric fields are defined in the relevant specifications.		

TABLE 22 - Modulation Characteristics

Frequency Range [kHz]	Signal Characteristic/Modulation Type
50 kHz - 2 MHz	1. Continuous Wave 2. Amplitude Modulation, 100% square wave at 1 kHz pulse repetition frequency
2 MHz - 30 MHz	1. Continuous Wave 2. Amplitude Modulation, 100% square wave at 1 kHz pulse repetition frequency 3. Amplitude Modulation, 100% square wave at 1-3 Hz pulse repetition frequency
30 MHz - 1 GHz	1. Continuous Wave 2. Amplitude Modulation, 100% square wave at 1 kHz pulse repetition frequency
150 MHz - 225 MHz 580 MHz - 610 MHz 790 MHz - 1 GHz 1 GHz - 40 GHz	1. Continuous Wave 2. 100% Pulse Modulation, 1 kHz pulse repetition frequency, 1 µs pulse width, 3. Double Modulation consisting of 100% pulse modulation with pulse repetition frequency of 1 kHz (+/0.1 kHz) with a pulse duration of 1 µs (+/- 0.1 µs) together with a square wave modulation at 100% with a frequency of 0.5 (+/- 0.1) Hz

TABLE 23 - Electrostatic Discharge Parameters According to STANAG4235

ESD Parameters				
Applicability	Voltage	Capacitance	Resistance	Discharge Inductance
on outside contour of container with non-operational store stored inside	300 kV	1000 pF	≤1.0 Ohm	<20 µH
on operational and non-operational store and components	25 kV	500 pF	500 Ohm	<5 µH

TABLE 24 - Lightning Indirect Effects Waveform Patterns

Current Component	Description	$i(t) = I_o(\varepsilon^{-\alpha t} - \varepsilon^{-\beta t})$ t is time in seconds (s)		
		I_o (Amperes)	α (s^{-1})	β (s^{-1})
A	Severe stroke	218,810	11,354	647,265
B	Intermediate current	11,300	700	2,000
C	Continuing current	400 for 0.5 s	Not applicable	Not applicable
D	Restrike	109,405	22,708	1,294,530
D/2	Multiple stroke	54,703	22,708	1,294,530
H	Multiple burst	10,572	187,191	19,105,100

TABLE 25 - Electromagnetic Fields From Near Strike Lightning

Magnetic field rate of change @ 10 meters	2.2×10^9 A/m/s
Electric field rate of change @ 10 meters	6.8×10^{11} V/m/s

---------- End Example

7.4 Store Life Constraints:

The store life in the various conditions e.g. during storage or carriage flights shall be listed in this section. Any restrictions or investigative analysis shall be defined.

---------- Begin Example

Using the sortie profiles defined in document xxx, the air carriage life of the store is xxx hours. This is assumes that the store is carried on the under fuselage stations. For carriage on the wing stations, each air carriage hour is equivalent to xxx hours on the under fuselage stations.

---------- End Example

8. STORE/AIRCRAFT INTERFACE SPECIFIC:

8.1 Cooling:

Provisions required for cooling of the store (e.g. for stores with infrared devices or similar equipment) shall be identified. Special interface enhancements to provide cooling (cartridge etc.) shall be defined.

---------- Begin Example

This store requires cooling for on-board and pre-launch operation. A cooling gas generator is installed in each particular launcher.

---------- End Example

8.1.1 Cooling Line Connection:

Describes the arrangement, type and position of a special cooling device.

---------- Begin Example

This interface serves as a coolant line connection and is used by the launcher to facilitate the supply of coolant gas to the missile seeker from the launcher cooling system. It uses Pin xy to supply the coolant gas.

The gas generator installed in the launcher will be capable of sustaining a supply of pure air gas at an operating pressure of 17200 kPa ± 4140 kPa from -40 °C to +20 °C in order to maintain the store at its operational temperature. During steady-state conditions, the pressure will reach 19300 to 21700 kPa at 20 °C.

Coolant gas purity is of vital importance as impurities can clog the minute passages in the cooling system. The coolant gas used shall meet the requirements of Table 26. The cooling mechanism is shown in Figure 61.

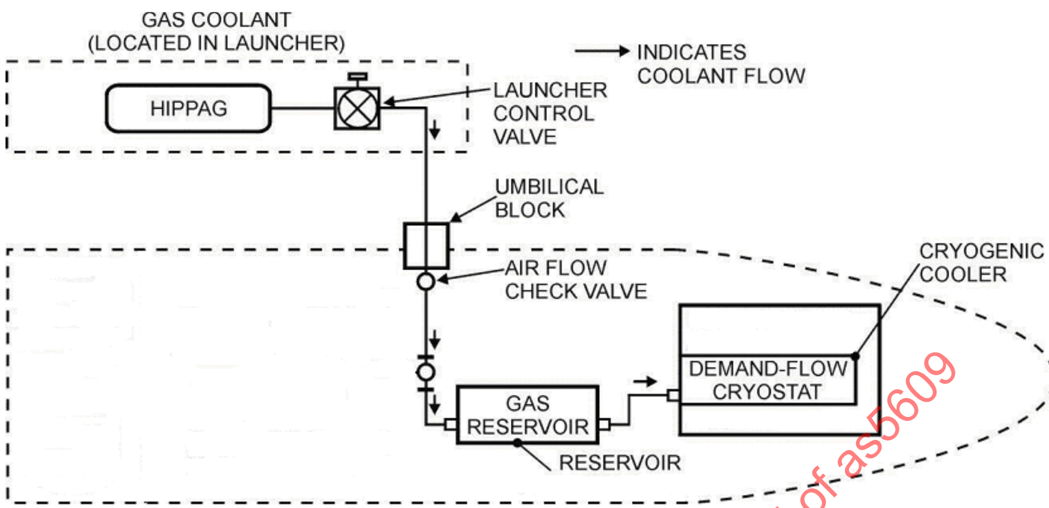


FIGURE 61 - Cooling Mechanism

---------- End Example

8.1.2 Cooling Medium and Constituents: Specifies the cooling fluid including purity.

---------- Begin Example

Store Purity Requirements

If air or nitrogen is used, the following purity requirements apply according to MIL-R-81202D.

TABLE 26 - Coolant Gas Purity Requirements

Impurity	Maximum permissible per Volume
H_2O	2 ppm
CO_2	2 ppm
Freon	3 ppm
Total Hydrocarbons	10 ppm
- Acetylene	1 ppm
- Methane	6 ppm
- other Hydrocarbons	3 ppm
Solid Particles	
- >10.0 microns	none
- 5.0 to 10.0 microns	max 100 per ft^3

---------- End Example

8.1.3 Pressure: The pressure requirement for the cooling gas or fluid shall be specified in this section

---------- Begin Example

The pressure requirement for the umbilical coolant line is

1000 – 2500 PSI (13800 – 26200 kPa).

---------- End Example

8.1.4 Flow Rate: The flow rate requirement for the coolant gas or fluid shall be specified

---------- Begin Example

Store Flow Rate Requirements

a. Cool Down

During the cool down phase the flow rate at the cryostat requires a coolant amount of 12 to 15 l/min during 20 to 40 seconds, depending on the pressure. At high temperature (65 °C) and an air pressure of 2500 PSI (17237 kPa), the flow rate of 15 l/min is required for 60 seconds.

b. Steady State Operation

The long term flow rate capability of air during missile operation after cool down shall not be less than

0.45 l/min at 1000 PSI (13800 kPa)
0.35 l/min at 2000 PSI (20700 kPa)
0.15 l/min at 3500 PSI (31000 kPa).

---------- End Example

8.1.5 Duration of Supply: When only a limited amount of cooling is available, the duration and on/off conditions for the coolant gas or fluid are required and shall be defined in this section.

---------- Begin Example

The generator is powered up directly after initialization of the store control system. The cooling gas valve stays closed. The gas flow to the store is provided if one of the following condition occurs:

MASS is switched to LIVE
MASS is switched to STAND-BY and the store is selected.

---------- End Example

8.2 Plume Data:

For all active stores, details of plume data including temperature and pressure profiles, blast pressure, static values of temperature and pressure at the exit, thrust versus time profiles, ratio of specific heat in the plume and composition to be inserted. Data is required to include both near and far field. Also, details of any emitted debris (such as desiccant containers etc) are to be included. May be necessary for the aircraft manufacturer to prevent from dispersion of plume through RAM air channels threatening crew or sensitive surfaces. The plume data for different temperatures may be covered in one figure or in separate sections at the authors´ discretion.

---------- Begin Example

8.2.1 Propellant and Plume Composition: The rocket motor has a total impulse of approximately xxx lb.-sec at sea level and ambient 21 °C temperature. The variation of thrust with grain temperature is shown in confidential figure xyz.

Altitude corrections are made using a nozzle exit area (A_E) of xyz ft^2.

$$\text{Thrust} = T_{SL} (1+(P_{SL}-P)A_E/T_{SL})$$

where

T_{SL} = Thrust at Sea Level

P_{SL} = Pressure at Sea Level

P = Pressure at Altitude

Composition of the missile propellant exhaust is presented in Table 27. The missile rocket plume characteristics are in static conditions shown in 8.2.1.1 and 8.2.1.2.

TABLE 27 - Propellant Exhaust Composition by Weight (Theoretical)

Composition	Weight, %
Water, H_2O	1.01
Hydrogen, H_2	3.46
Carbon Monoxide, CO	36.26
Nitrogen, N_2	7.94
Hydrogen Chloride, HCl	20.47
Aluminum Oxide, Al_2O_3	30.23

8.2.1.1 Exhaust Stream Pressure:

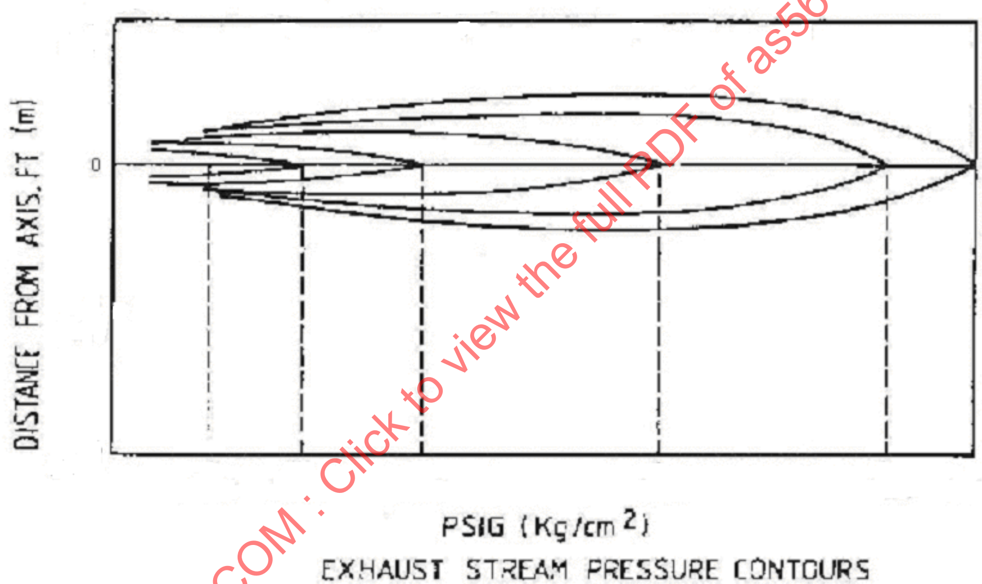


FIGURE 62 - Exhaust Stream Pressure

8.2.1.2 Exhaust Stream Temperature:

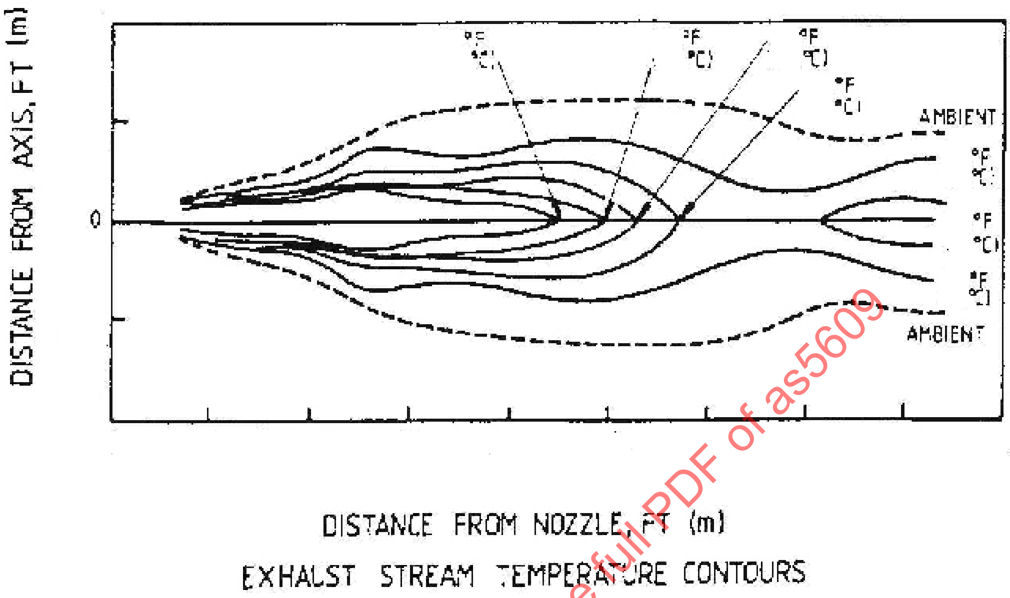


FIGURE 63 - Exhaust Stream Temperature

TABLE 28 - Propellant Thermal Properties

Thermal Properties	value	units	
π_K	TBD	% °C	(%°F)
K	TBD	W/(m-K)	(Btu/ft-hr °F)
α	TBD	%/°C	(%/°F)
ρ	TBD	gm/cm^3	(lb/in^3)
Where:			
π_K=Temperature Sensitivity of Pressure			
K=Thermal conductivity coefficient			
α=Thermal expansion coefficient			
ρ=Density			

---------- End Example

8.3 Signatures and Emissions:

If the aircraft is stealthy this data is important to estimate the increase in detection probability of the aircraft inclusive stores in order to take precautions. This section may comprise signatures and emissions covering the detectable electromagnetic and acoustic spectrum.

---------- Begin Example

The following data is required for the definition of the radar cross section:

1. Details of seeker head installation and any off boresight parking constraints.
2. RCS over frontal aspects, 50° cone off nose.
3. Any stealth requirements included in the store specification.

---------- End Example

8.4 Air Fuel Transmissions:

If required by the store, fuel type, consumption, duration shall be specified. This shall include special interface provisions etc.

---------- Begin Example

The store requires fuel type F40 according to the following values:

0.25 l/min full operation
0.15 l/min minimum operation
0.10 l/min idle

---------- End Example

9. POST LAUNCH INTERFACE:

This section covers the description of electromagnetic links between a store and platform after store release. Two possible approaches exist for the description of a possible data link interface. Only the non-functional aspects of the data link are described in this paragraph while the functional aspects are all covered in the respective functional section. The description of the messages is kept in the separate data entity description in Volume 2. The following description of a possible content is based on the first approach.

Data link is only one subject for post launch.

---------- Begin Example

This section covers the description of possible electromagnetic links between a store and platform after store release over the air. Possible hardwire connections are included in an example in A.9.3. All aspects for a post launch interface are considered in providing the whole frequency spectrum. The systems to be considered are:

1 Simple transmission with no or little intelligence involved (e.g. beam riding)
2 One way commands from aircraft to in-flight store
3 One way data transmissions from in-flight store to aircraft
4 Two-way control/data transmissions between aircraft and in-flight store.

---------- End Example

9.1 Overall System Architecture:

The overall system architecture for the post launch interface shall be described in this section. It shall point out the description of the communications concept for the combined system from a hardware-oriented point of view. The functional part shall be described in Volume 2 Section 3, the communication interface in Volume 2 Section 5.

---------- Begin Example

Figure 64 shows the overall system architecture.

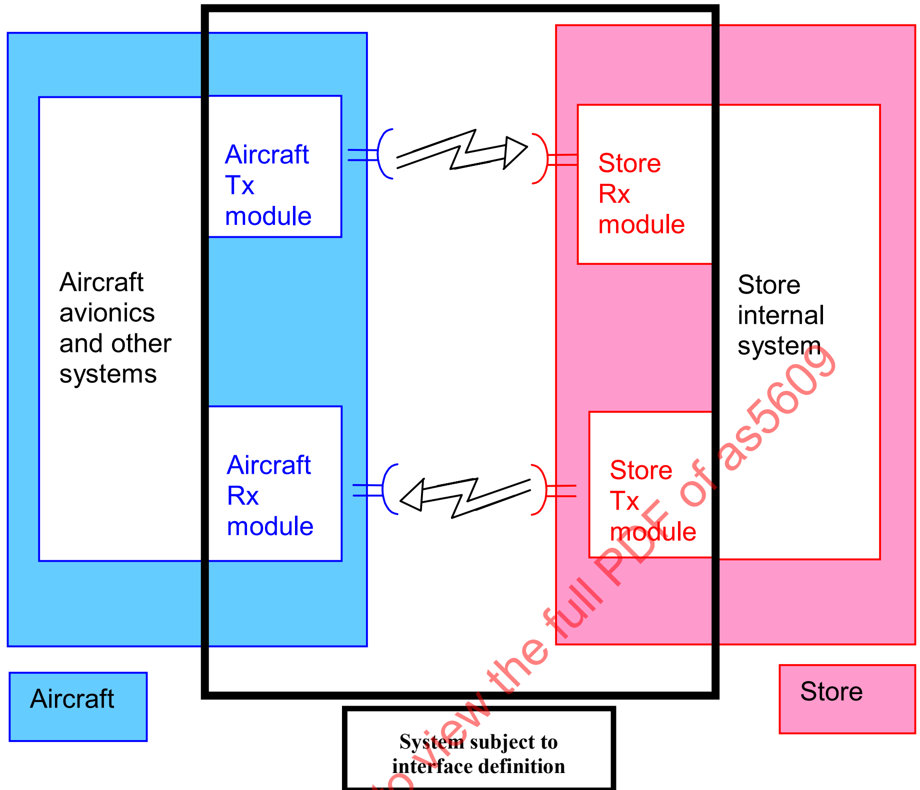


FIGURE 64 - Post Launch Interface Architecture

9.1 (Continued):

The aircraft and stores transmit (Tx) and Receive (Rx) modules are responsible for the transmission or reception of signals between aircraft and store. They have almost no function regarding the use of the intelligence by the aircraft or store and serve as a converter of to transfer the information from the aircraft or store over the air to the recipient. Any function is restricted to maintaining the communication link only. This definition is not valid where the communications link itself contributes directly to store or aircraft operations (i.e. direction finding by means of beam detection – semi-active radar homing).

---------- End Example

9.2 Interface Description:

A description of single and bi-directional aircraft and store transmissions post launch either common or unique (e.g. video connection from store to aircraft and radio for signals between aircraft and store) shall be given in this section. See also Volume 2 Section 3 Functional and Volume 2 Section 5 Post-Launch Communication Interface for reference and further specification.

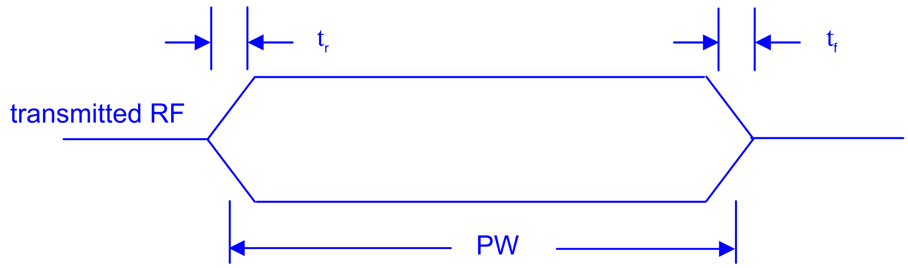
This section also includes an example for a possible non-radiating post-launch interface.

---------- Begin Example

9.2.1 Timing Requirements and Synchronization: Any Time synchronization used by the store to reduce lock-on time or improve estimates in space relative to the platform will be described in this section. Only the signal for time synchronization shall be described in this section, the functional aspects of time synchronization shall be described in the functional interface in Volume 2 section 3.

The intent to employ time synchronization is to reduce the stores time to search for the post-launch-link and consequentially the first post-launch-message.

9.2.2 Transfer Signal Characteristics/Post-Launch-Link Waveform: If the store must be controlled after launch over free space either in a simple or complex way, this paragraph describes e.g. the RF power, frequency, stability, bit rates etc., i.e. the electromagnetic signature of the data link signal. This could be split into two subsections where appropriate, one for the aircraft and one for the store or, if not feasible, the point where the measures are to be taken shall be defined.



t_r,t_f are measured between 10% and 90% voltage
PW is measured at 50% voltage

FIGURE 65 - Data Link Pulse Characteristic

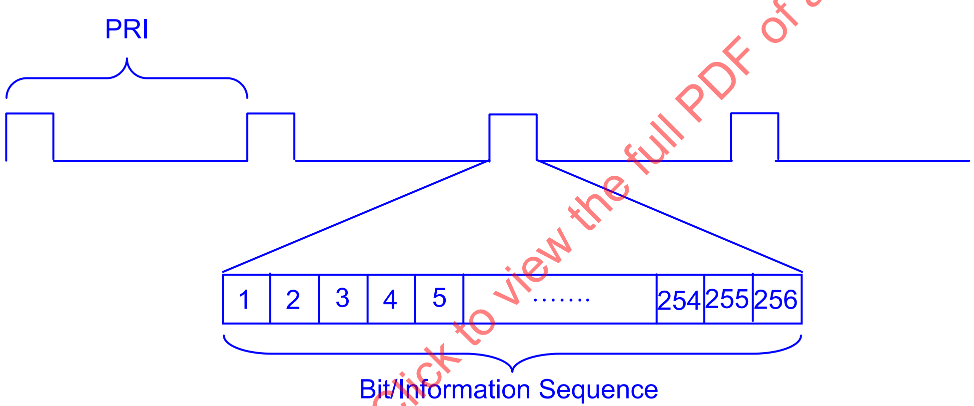


FIGURE 66 - PRI and Information Sequence

Uplink from Store to Platform: Video
- to be defined -

9.2.2.1 Platform Transmitter:

9.2.2.1.1 Introduction:

9.2.2.1.2 Transmission Characteristics: This subparagraph must include sufficient data for the store design authority to fully understand the characteristics of the signal as it arrives at the in-flight store. The characteristics described must clearly identify whether they refer to:

a. The worst case 'in the clear' scenario (i.e. no countermeasures experienced) as experienced at the maximum communication range for the store and therefore including environmental degradation;

or

b. The case where the transmitted energy has just achieved a coherent 'near field' pattern close to the transmitter and has therefore not suffered environmental degradation. In this instance, it is for the store designer to assess the impact of the environment on signal quality at distance.

Included in this subparagraph must be consideration of:

- Transmitter power (e.g. maximum, minimum, variations over short and long term)
- Polarization of transmissions
- Aerial polar diagrams (e.g. main beam and side lobes)
- Frequency characteristics (e.g. transmit frequency band, channel definitions, rate of change, harmonics/purity)
- Signal modulation (e.g. type, definition, depth, effect on frequency spectrum)
- Signal distortion (e.g. waveform, coherency, noise, spurious signals, jitter, stability
- Error handling (drift errors, random errors).

9.2.2.2 Platform Receiver:

9.2.2.2.1 Introduction: This subparagraph should define all of the characteristics associated with receiving the transmissions covered in 9.2.2.3.1. The information provided below should be limited to reception of the transmissions and to receiver actions necessary to maintain PLC.

9.2.2.2.2 Signal Receiver Characteristics: This subparagraph defines the capabilities of the platform receiver regarding the signal levels, noise, frequency band, polarization, etc.

9.2.2.3 Store Receiver:

9.2.2.3.1 Introduction: This subparagraph should define all of the characteristics associated with receiving the transmissions covered in 9.2.2.1. The information provided below should be limited to reception of the transmissions and to receiver actions necessary to maintain PLC.

Note that each of the following subparagraphs must include where appropriate, definitions of characteristics associated with TPC, if applicable to the system.

9.2.2.3.2 Signal Receiver Characteristics: This subparagraph defines the capabilities of the store receiver regarding the signal levels, noise, frequency band, polarization, etc.

9.2.2.4 Store Transmitter:

9.2.2.4.1 Introduction: This subparagraph describes the characteristics of the store transmitter.

Note that each of the following subparagraphs must include where appropriate, definitions of characteristics associated with TPC, if applicable to the system.

9.2.2.4.2 Transmission Characteristics: This subparagraph must include sufficient data for the platform design authority to fully understand the characteristics of the signal as it arrives at the platform. The characteristics described must clearly identify whether they refer to:

a. The worst case 'in the clear' scenario (i.e. no countermeasures experienced) as experienced at the maximum communication range for the store and therefore including environmental degradation;

or

b. The case where the transmitted energy has just achieved a coherent 'near field' pattern close to the transmitter and has therefore not suffered environmental degradation. In this instance, it is for the platform designer to assess the impact of the environment on signal quality at distance.

Included in this subparagraph must be consideration of:

(i) Transmitter power (e.g. maximum, minimum, variations over short and long term)

(ii) Polarization of transmissions

(iii) Aerial polar diagrams

(iv) Frequency characteristics (e.g. transmit frequency band, channel definitions, rate of change, harmonics/purity)

(v) Signal modulation (e.g. type, definition, depth, effect on frequency spectrum)

(vi) Signal distortion (e.g. waveform, coherency, noise, spurious signals, jitter, stability)

(vii) Error handling (drift errors, random errors).

---------- End Example

9.3 Non-Radiating Post-Launch Communications:

This section is only required, if a post launch interface is present.

9.3.1 Introduction: This section contains the overview of a non-radiating post launch interface e.g. communication via wire after release of the store. Although this may not be relevant for a fighter aircraft, it may be applicable to helicopters.

9.3.2 Overall System Architecture: This section contains the description of the system architecture of the non-radiating post launch interface.

---------- Begin Example

This section considers systems where a physical connection is retained between the platform and in-flight store for the purposes of PLC. The connection is typically of wire or fiber optic material and may be used for either one-way or two-way communications. Typically, such a system would use the following architecture as shown in Figure 67:

FIGURE 67 - Non-radiating Post-launch Interface Scheme

The ICD is usually restricted to interfaces between the platform system and the installed weapon system, and not to between parts of the weapon system itself. Using the above scheme as an example, the ICD is concerned with the interface (mechanical, electrical, functional, etc) between the platform avionics and the store-specific equipment.

In such a system, whilst there are distinct changes in most aspects of the interface when the weapon is launched from the platform, the change in functionality associated with introducing PLC will be limited, if any. Typical changes that could occur are likely to be restricted to the exchange of additional or alternative data on the interface that existed pre-launch. In such cases, the preferred method of defining the post-launch interface is to extend the definition of the pre-launch interface but delineating very clearly between the two phases of system operation.

9.3.2 (Continued):

It is therefore proposed that for 'non-radiating' PLC, this section of the ICD contains a simple statement to this effect and points clearly to the relevant paragraph elsewhere in the ICD for post-launch interface details (e.g. Volume 2 section 3 Functional or Volume 2 section 5 Post-Launch Communications Interface.

---------- End Example

10. SUPPORT INTERFACE:

10.1 Store and Aircraft Testing:

This section shall define all of the support information required for operation of the store and aircraft systems; from just before loading of the store through to the store launch sequence (or off-loading the store post a mission).

The content of this section should be arranged such that it can be referenced by other sections of the ICD so as to provide a single description for the support activities. This will prevent unnecessary repetition of identical or similar text in several places in the ICD that would be likely to be become contradictory or incorrect over a period of time as the ICD is updated. The boundary between what is included in this section and what is included in other sections of the ICD, e.g. Functional Description, will vary with system complexity, but the basic intention should be to not include the same description or information more than once.

10.1.1 Store Pre-load Testing: This section shall describe the tests that are carried out on the store before it is fitted to the aircraft - sometimes called 'alongside testing'. The tests will indicate whether or not the store is safe to fit to the aircraft. This section must also contain a cross-reference to the ICD Safety Section to describe safety related features of the test routine (personnel and equipment potential hazards) as well as the ramifications of any tests that fail. The section shall identify by reference the support equipment and test procedure that are to be used in the tests, including details for any interconnections between support equipment and store.

The in-service support philosophy for certain stores may enable the store to be taken from storage directly to the aircraft where they are functionally tested before fitting to the aircraft. If these tests are integral with the pre-load 'safe to load' tests, then they must be described in the ICD. If, however, the functional tests are separate from the safety tests, then they are not the subjects of an interface control document. In which case this section should be marked not applicable.

10.1.1 (Continued):

---------- Begin Example

Prior to upload of the XPZ missile to the aircraft, the missile will be tested using the Common Munition Test and Reload Unit (SERD 7865) utilizing cable 1760XY928 in accordance with Technical Order 34-1-1. The SERD 7865 incorporates safety features designed to meet the requirements defined in ICD Section TBD.

---------- End Example

10.1.2 Aircraft Testing: This section shall describe the testing carried out to check that the aircraft is ready for loading of the store. It shall include checks that the interface has no live power or signals present and that the aircraft circuits are in a safe condition for store loading. The ICD shall make reference to the appropriate test documents and support equipment, including details of any interconnections between support equipment and aircraft.

Where relevant, the ICD must include all activities associated with testing of launcher or carriage stores, preferably by referencing out to other documentation.

---------- Begin Example

Prior to upload of the XPZ missile to the aircraft, the aircraft will be tested using the Common MIL-STD-1760 Aircraft Store Interface Verification Unit (SERD 1760) utilizing cable 1760AC123 to verify the functionality of the aircraft interface and the absence of stray voltage in accordance with Technical Order 32-1-1.

---------- End Example

10.1.3 Store Testing on the Aircraft:

1. This section shall describe all of the tests that can be carried out on the store while it is fitted to the aircraft. The type of tests, methods of initiation, control and reporting, support equipment and test procedures shall be described. This section should be as complete as possible, such that it can be referenced by other sections in the ICD to provide a single description in the document of test aspects of store/aircraft operations. The ICD shall make reference to the appropriate test documents and support equipment, including details for any interconnections between support equipment and aircraft. Types of information that would covered in this section could include but not be limited to: Post load Testing/Checks - describes the tests that are carried out immediately after store loading onto the aircraft, to ensure that all interconnections have been correctly made and that the aircraft/store are operating together correctly.

2. Testing after store power application by the aircraft - describe any tests that are carried out, initiated either automatically or manually, following application of power to the store, whether on the ground or during aircraft flight. Identify what it is that initiates the test (ie aircrew action, automatically by aircraft avionics or as a result of store autonomous action) and all timings relevant to the test. All interface interactions are described. Aircraft and store actions on completion of the test are described, covering consideration of all possible test results. Where the test results are generated by the store but operational capability assessed by the aircrew or aircraft, then the ICD must define the criteria on which the capability is to be judged. Duty cycle and test repetition constraints are also described.

3. Launch Cycle Tests - describe all tests carried out as part of a launch sequence, initiated either automatically or as a result of direct actions by the aircrew. A full definition of all store/aircraft interactions on the interface must be included. The test criteria for successful completion of the launch are also to be defined in the ICD. For those instances where a launch test fails, the ICD must contain information regarding the safety of the store and aircraft and include a cross-reference to the Safety Section of the ICD for additional information.

4. Alert pre-takeoff Tests - It may be necessary for the aircraft and store to be tested routinely during extended periods of standby on the ground. If these tests are different from other types of tests, then they must be described also, containing detail to the same level as for tests described previously. If there are limits on the number of time a test maybe run in a ground alert environment, then the limitations are described here.

---------- Begin Example

10.1.3.1 Post-Load Tests and Checks: After upload of the XPZ missile, the missile will be inspected for damage and proper control surface attachment in accordance with TO 36-2-5-1. Prior to connection of the XPZ missile to the aircraft, the missile will be preloaded with mission planning data and tested using the Common Munitions Test and Reload Unit (SERD 7865) utilizing cable 1760XY928 in accordance with Technical Order 34-1-1. The SERD 7865 incorporates safety features designed to meet the safety requirements defined in ICD Section TBD. After successful completion of mission planned data load and subsequent Built In Test functions, the missile maybe connected to the aircraft in accordance with TO 34-1-1.

10.1.3.2 Test After Power Application: After completion of Warm Up Complete (22T/01/06=1), the XPZ missile automatically executes full Built In Test of the missile and reports the result in BIT Results (22T/07). Automatic BIT shall take a maximum of 28 seconds after Warm Up Complete (22T/01/06=1). If the BIT passes, the XYZ missile shall set BIT Successful (22T/01/09=1) within 40 milliseconds of BIT completion. If there is a BIT failure, the XYZ missile shall set BIT Successful (22T/01/09=0) and either Critical Failure (22T/01/10=1) or Degraded Fail (22T/01/11=1) to within 40 milliseconds of BIT completion to indicate the severity of the failure.

The aircraft may command the XPZ missile into BIT by setting the Critical Control 1 (11R/04) in accordance with MIL-SDT-1760 to command BIT. A manually initiated BIT shall take a maximum of 15 seconds from receipt of a valid command. Results of a manual BIT shall be reported the same as an automatic BIT. Manual BIT shall not be command more than once every 5 minutes to avoid overheating of the seeker servomotors.

10.1.3.3 Launch Testing: After receipt of a valid Commit To Separate Store, the XPZ missile shall perform Launch BIT. Launch BIT shall test the following functions:

- Flight Control Free Movement (moves flight surfaces + and - 5 Degrees in each direction then returns to center)
- Seeker Cooling is active
- Data Link is being received and checksums are valid

If Launch BIT is successful, then the launch count down will be allowed to proceed (see section TBD for Launch Countdown details). If the Launch BIT fails, the XPZ missile shall inhibit launch, safe all safety circuits, and set BIT Successful (22T/01/09=0) and Critical Failure (22T/01/10=1).

10.1.3.4 Alert pre-takeoff Tests: If the XPZ missile is mounted on the aircraft for extended periods of time sitting ready alert, the missile shall be inspected daily for damage and proper control surface attachment in accordance with TO 36-2-5-1. At least once per week the XPZ missile will be disconnected from the aircraft and tested using the Common Munition Test and Reload Unit (SERD 7865) utilizing cable 1760XY928 in accordance with Technical Order 34-1-1.

---------- End Example

10.2 Loading, Storage and Handling:

10.2.1 Aircraft Store Loading Provisions: This section shall identify the fixtures on the aircraft used as parts of the load/unload routines. Equivalent details for the store may be identified in the ICD Mechanical Section. However, they will be included with the details of the procedure for loading/unloading contained in separate documentation that must be referenced by this section of the ICD. Additional information (if any) provided in the ICD should be of a general nature only.

---------- Begin Example

The 34B5X Rotary Launcher for the B-63 has provisions for fast uploading of stores at austere bases. These provisions are defined in 63PP2167 Rotary Launcher Interface Control Document. Procedures for operation of the Rotary Launch Autonomous Loading Capability are in TO 26-1-1.

---------- End Example

10.2.2 Handling of the Store: This section shall cover any handling associated with routine operations of the store, including for instance, replenishment of consumables and replacement of video/film cassettes in reconnaissance equipment while mounted on the aircraft. This section of the ICD should be used only to introduce the actions necessary, but reference out to other documentation for the detailed procedures.

All other store handling, e.g. removal from the container is not the subject of an interface control document and should be covered elsewhere. Test related handling should be covered in the documentation referenced in the above paragraphs.

---------- Begin Example

The XPZ Missile cooling bottle maybe removed and replaced while the missile is still loaded on the aircraft. See TO 22-3-9 for detailed procedures for removal and replacement of the cooling bottle.

---------- End Example

APPENDIX B
VOLUME 2: LOGICAL INTERFACE
CONTROL DOCUMENT TEMPLATE

1. INTRODUCTION:

The introduction of the CICD shall give an overview of the document. Scope, updating rules, used terms and a general description are included. The whole ICD comprises 2 Volumes, Volume 1 contains the more stable parts of the integration process while this volume covers the logical and functional interface, which changes more often in the course of an integration. The introduction can be regarded as unique for both volumes, or, like in this example, for each volume separately. The introduction of the CICD volume 2 shall clearly define the subject interface, with a description of how related interfaces are being managed. The interface definition may be achieved by reference to volume 1.

---------- Begin Example

This Interface Control Document (ICD) has been developed to support interface definition for host aircraft integration of weapon xyz. This includes the support of the definition of required hardware and software updates to the aircraft, as well as to support the requirements development process for the weapon xyz development.

---------- End Example

1.1 Scope:

The purpose of this volume shall be addressed with a short description of the affected interface. An overview of the content of the following sections shall be given.

---------- Begin Example

Store X is installed on the aircraft by being fitted to launcher Z that is fitted to the wing pylon on aircraft Y. The interface controlled by this document is the interface between store X and launcher Z.

The interface between the aircraft and launcher Z is controlled by a separate ICD, document reference ABC.

Volume 2 contains the following sections:

Section 1 establishes the document scope and provides background information for the document user.

1.1 (Continued):

Section 2 identifies the applicable documents that are referred to in the ICD. It establishes the order of precedence of the applicable documents and identifies the version and requisite tailoring of the documents applicable to this ICD.

Section 3 provides the functional interface. It includes all requirements to operate the store on the aircraft like initialization, harmonization, alignment, general mission data transfer and general and special release procedures.

Section 4 defines the communication interface, i.e. standard protocols are referenced, and particular agreements have to be defined in this section.

Section 5 defines the post launch communication interface. The content is identical to section 4 for post launch applications.

Section 6 provides the signal format sheets for the communication over the interface. All logical data exchange over the information channels (see section 4, volume 1) shall be addressed in this section. A possible structure is proposed.

Section 7 provides the post launch signal format sheets for the communication over any post launch interface either over the air or wire. All post launch logical data shall be addressed in this section.

---------- End Example

1.2 Updating:

This section is used to document the update procedures of this volume e.g. applied change procedures, or the section shall be used to establish the change process.

---------- Begin Example

The ICD shall be updated on the design authority's discretion. The information about and the reception of any updates are under the responsibility of the user. The update procedure shall be control by the established Interface Control Process (ICP) as defined in document xyz.

---------- End Example

1.2.1 Information Accuracy: This section records information concerning handling of values during the generation process of the ICD e.g. marking of currently unconfirmed values, uncertain statements or uncertain definitions.

---------- Begin Example

Throughout this document and unless otherwise stated, when a value is quoted which is still unconfirmed, a ´TBC´ rating follows the quoted value.

A star rating as follows grades this TBC rating system:

TBC*detailed calculations but not yet finalized
TBC**simple calculations and/or previous experience
TBC***best estimate

---------- End Example

1.2.2 Definition of Terms: This section records the rules to specify use of wording in the document like “may”, “shall” etc.

---------- Begin Example

1.2.2.1 Utilization of Common Terms:

The word "shall" in the text expresses a mandatory requirement of the specification. Departure from such a requirement is not permissible without formal agreement between customer and the aircraft company.

The word "should" in the text expresses a recommendation or advice on implementing a requirement of the specification. The customer expects such recommendation or advice to be followed unless good reasons are stated for not doing so.

The word "must" in the text is used for a legislative or regulatory requirement (e.g. health and safety) with which both the customer and the aircraft company shall comply. It is not used to express a requirement of the specification

The word "will" in the text is used for the future tense. It does not express a requirement of the specification.

The word "may" in the text expresses a permissible practice or action. It does not express a requirement of the specification.

Plain text (i.e. text not containing the above key words) is used to state facts and to describe existing capabilities or features. Such text does not express a requirement of the specification.

1.2.2.2 Non-common Terms: Terms not specified in 1.2.2.1 are of informal nature and are not authoritative.

---------- End Example

1.3 General Description:

The system controlled by this interface shall be described. Subject to deletion if already covered by 1.1 or volume 1. In this case a reference shall be given.

---------- Begin Example

See volume 1 for a general description.

---------- End Example

2. APPLICABLE DOCUMENTS:

2.1 General:

This section shall give a list of the content of other documents that form a part of the interface definition and which are referenced within this ICD. The content depends on the use of the two volumes.

---------- Begin Example

The following documents, of the exact issue shown, form a part of this document to the extent specified herein. In the event of conflict between the document referenced herein and the contents of this document, see 2.6, Precedence.

---------- End Example

2.2 Specifications:

Aircraft or store related specifications relevant to the interface shall be listed in this section.

---------- Begin Example

- Equipment Specification for launcher interface box xxx-yyy-zzz
- System Specification for integration of weapon xyz SS-123
- System Software Requirement Specification SSRS-123

---------- End Example

2.3 Standards:

2.3.1 Military Standards: Aircraft or store related military standards relevant to the interface shall be listed in this section.

---------- Begin Example

- MIL-STD-1553: ´Aircraft Internal Time Division Command/Response Multiplex Data Bus´
- MIL-STD-1760D: ´Aircraft Store Electrical Interconnection System´
- STANAG 4586 (NATO Standardization Agreement) ´Leading the Way to NATO UAV Systems Interoperability´

---------- End Example

2.3.2 Civilian Standards: Aircraft or store related civilian standards relevant to the interface shall be listed in this section.

---------- Begin Example

- SAE Aerospace Information Report (AIR) ´AIR5532: Generic Aircraft-Store Interface Framework´
- SAE Aerospace Standard (AS) ´mnop´.

---------- End Example

2.4 Project Specific Documents:

Project handbooks, project specific and interface relevant technical notes shall be listed here.

---------- Begin Example

- MIL-HDBK-1760
- MIL-HDBK-1553

---------- End Example

2.5 Other Documents:

Supplier Documents, Plans, Configuration Procedures, Drawings

---------- Begin Example

- Drawing x
- Drawing y

---------- End Example

2.6 Precedence:

Defines the sequencing of documents including this ICD and which documents controls the others etc.

---------- Begin Example

In the event of conflict between requirements specified in this and referenced documents, the following order of precedence applies:

- Document 1
- Document 2
- Document 3

---------- End Example

3. FUNCTIONAL INTERFACE:

This section contains the functional description of the aircraft/store interface, with each topic being described from the perspective of the aircraft and of the store. The information defined in this section shall include the function and use of every analogue and digital information present on the interface. For those interfaces that include data bus communications, the descriptions must extend to every message; word and bit exchanged on the interface and listed in the information format sheets contained in Sections 6 and 7 of this volume of the ICD.

NOTE: The free-flight sections cover the functions of stores, which have a datalink to the platform and require functionality post launch either for guidance and control, terminal guidance target updates or target flexing information. The structure of this section is adapted to the needs of the post launch functional description and therefore deviates from the common structure of the other paragraphs. It is, however, distributed to allow the definition of states, modes and events in the substructure of the document.

The structure has been formulated to cater for the two different uses that exist today for ICDs, namely placing requirements on platform and store or providing a description of the agreed interface between the platform and store. It is envisaged that the differences can be accommodated by the emphasis placed by the author on either the paragraphs describing system operation, or the paragraphs describing the characteristics of the platform/store transmitter/receiver subsystems. All of the data included in any of the message formats that could be transmitted or received by either the platform or the store shall be defined. Information will include store identity codes, message lengths and word contents. Note that transmission of any communication control data must also be defined, e.g. change of transmission schedule, change in transmitter power, change to transmission frequencies, etc. If applicable, scheduling of different message types must be described.

The description of all aspects of the post launch interface in addition to the allocation within this section has been distributed between several sections in the CICD. These are namely Volume 1 Section 9 Post-Launch Interface where the general set-up and the signal characteristic is described while Section 5 of Volume 2 deals with the Post-Launch Communication Interface describing the general signal structure and signal control issues.

3.1 General:

Contains the general description of the partitioning of the functional requirements and a reference to the subparagraphs with a short description of the content.

---------- Begin Example

This section defines the functional interface between platform x and store y.

3.2 provides a baseline for the used data and definitions.

The relevant states and modes of the system for the interface are defined in 3.3.

3.4 gives the timeline of the overall system in a coarse view, while

3.5 describes the events in the required detail. It is assumed that the descriptive approach between 3.4 and 3.5. should be incremental, i.e. while 3.4 gives the overview, it has to be detailed in 3.5. A more detailed timeline in 3.5 compared to 3.4 is also suggested.

---------- End Example

3.2 Basic Mission Data and Definitions:

The section provides general information about the required data to be exchanged over the interface and the use of the agreed co-ordinate systems and definitions. The standard method by which all message bit, bytes and words will be reference shall be defined. All requirements shall be numbered for further referencing.

---------- Begin Example

The interface discussions in this section refer to these messages in order to provide an understanding of the communication between the host aircraft and the Store. The convention for referring to interface messages, words and bits is as follows: messages will be identified by brackets and will be formatted as follows [message number with an R or T/word number(s)/bit number(s)]. The message is indicated as a store-received message with an R suffix, and is a store-transmitted message with a T suffix. All host aircraft “shall“ are numbered as {as_xxx}, all store “shall“ are numbered as {ss_xxx}, host aircraft “may“ are numbered as {am_xxx}, all store “may“ are numbered as {sm_xxx}, where “xxx“ is incremented for each occurrence.

---------- End Example

3.2.1 Mission Data Overview: In this section, the author gives an overview of the mission data described and used in the following sections.

---------- Begin Example

Store XYZ shall {ws_xxx} support the messages in Table 1.

TABLE 1 - Message Traffic Summary

1553 Subaddress	MESSAGE NAME
1T	Store Description
2R	PTAM
3R	Time
6R	Navigation Uncertainty
9R	Moment Arm
12R	GPS Crypto Key
17R/T	Modify/Add Target Data
22T	Weapon Monitor
24R	Specific Weapon Control
24T	Specific Weapon Status
28R	Ground Test Control
28T	Ground Test Report
29R	Reprogramming Control
29T	Reprogramming Status

MDT MESSAGES	
Subaddress	Message Name
13R/T-001	Targeting Data
13R/T-005	Almanac
13R/T-007	AS Status/SV Config.
13R/T-010	Ephemeris #1
13R/T-011	Ephemeris #2
13R/T-026	GPS CNM

---------- End Example

3.2.2 Axis Systems and Parameter Definitions: Describes the co-ordinate systems to be used by store and/or platform and the basis for the systems e.g. WGS 84 and a reference to established standards. All systems used in this volume shall be described in this section while the instant of use will be addressed in the event description part. Examples are the ECEF system (see below), the North-East-Down coordinate frame, Local Level Wander Azimuth Coordinate Frame and the Body Coordinate Frame covering moment and lever arms for transfer alignment purposes. Earth models and altitude reference parameters are also covered in this section.

In addition to the geographic or platform relevant co-ordinate systems, this section shall cover aerodynamic axes.

---------- Begin Example

3.2.2.1 Earth Centered Earth Fixed Coordinate Frame (ECEF): The ECEF coordinate frame (as defined by WGS 84) is coincident with the X, Y, Z axes that define the WGS 84 Ellipsoid. Thus, the ECEF Z-axis (WGS 84 Z-axis) is the rotational axis of the WGS 84 Ellipsoid. The figure illustrates the ECEF coordinate frame. The ECEF X axis is defined as the intersection of the WGS 84 reference meridian plane and the plane of the mean astronomic equator, the reference meridian being parallel to the zero meridian defined by the Bureau International de l'Heure (BIH) on the basis of the longitudes adopted for the BIH stations. The ECEF Y-axis completes a right-handed earth-centered, earth-fixed orthogonal coordinate system, measured in the plane of the mean astronomic equator 90 degrees east of the X-axis.

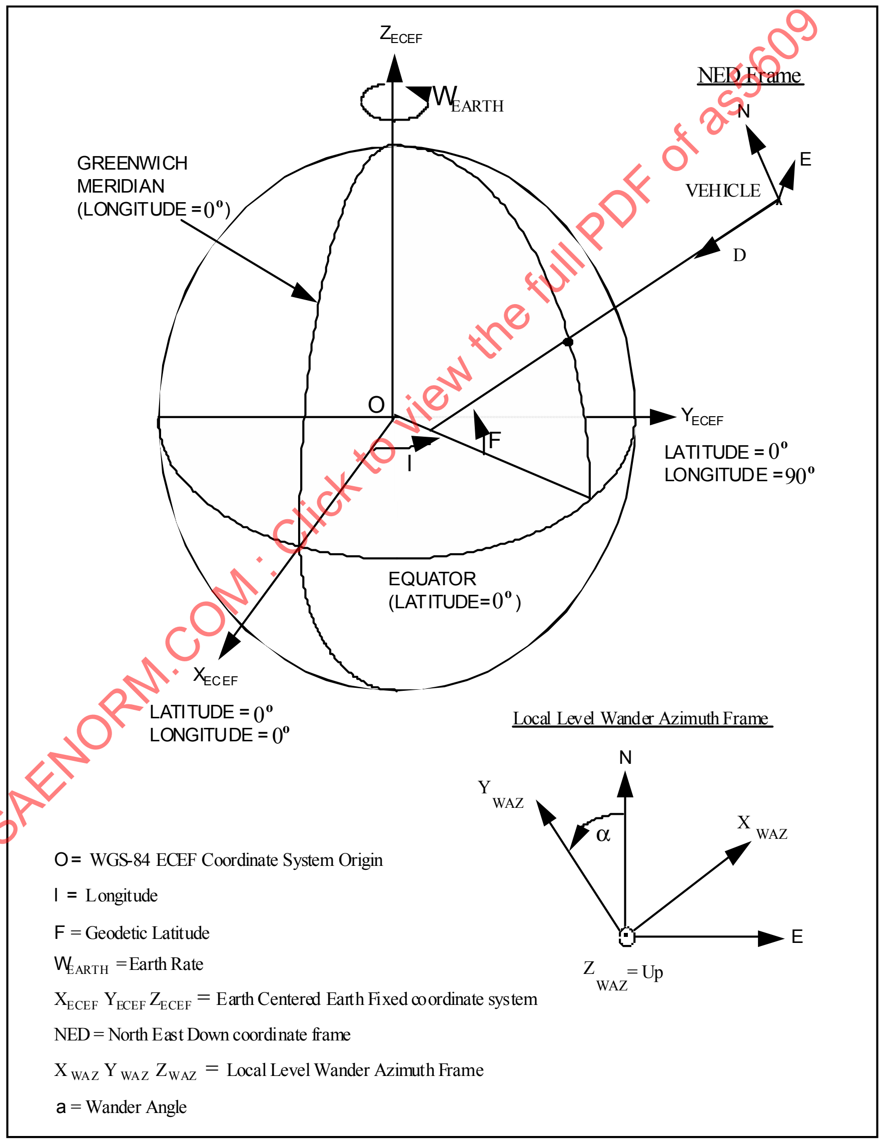


FIGURE 1 - Co-ordinate System Definition

3.2.2.2 …

---------- End Example

3.3 States and/or Modes of Operation:

The approach of the CICD format for functional requirements is to break down the requirements for the store/aircraft system incrementally from very top level systems operation down to the detailed requirements. The format of this document requires a top level description of store/aircraft modes and states in 3.3, followed by a breakdown of each mode/state into the sequence of events to achieve each entry and exit defined in 3.4, then the detailed requirements for each event is defined in 3.5. The examples for 3.3, 3.4, and 3.5 provide a example of a coherent breakdown from top level modes/states to detailed requirements.

Section 3.3.1 comprises the description of the system states and or modes for the store, the platform (if feasible and necessary) and/or the interaction of both. This includes the allowed transitions from one state and/or mode to the other, entry and exit conditions (alternate and normal). For some stores, they system operation may only contain modes or only states. For other stores, there may be states within modes or modes within states. The ICD format does not restrict the description of the system operation to modes or states, but allows the author the option of choosing which is best for describing their particular system. If the format is used for a store ICD, only the stores states and modes are affected, in case of a platform/store ICD then the platform modes/states may also need to be incorporated.

---------- Begin Example

Store XYZ has 5 major states as shown below:

a. Power Off

b. Initialization

c. Buit In Test

d. Store Ready for Release

e. Free Flight

3.3 (Continued):

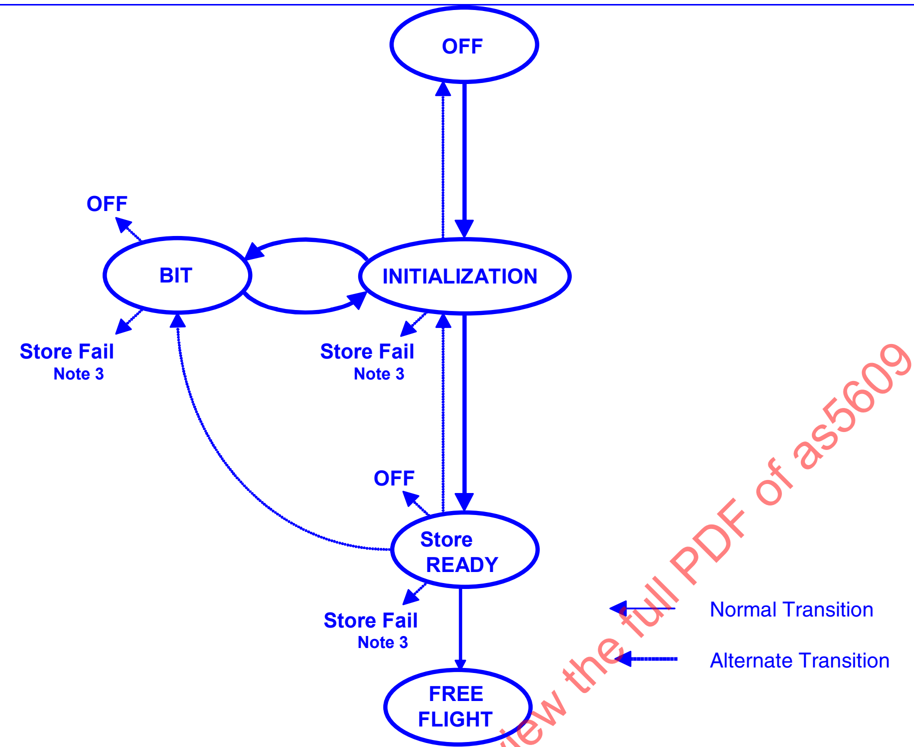
The initialization state contains three modes of operation as shown below. All other states do not contain specific modes.

a. Warm-up mode

b. Data Initialization

c. Alignment

3.3.1 Store State/Mode Description: The store XYZ transitions through a sequence of "states" starting with the OFF state (no electrical power applied), and proceeding through initialization state, BIT state, Ready state with a final transition to the free flight state. The store XYZ states serve as a convenient medium for defining the required store and aircraft functions to accomplish the system operation. Figure 1 depicts the allowable states associated with store XYZ operation. Table 1 shows the allowable state transitions.



Notes:
1. Sending a fire pulse in INIT or BIT states will result in a launch without valid targeting data
2. Sending a fire pulse in STORE READY state without prior transfer of Emitter Data or a Targeting Data designation will also result in a launch without target data.
3. "Store Fail" is not a store state, however it may be implemented via the aircraft as a system state.

FIGURE 2 - Weapon System State Diagram.

TABLE 2 - State Transition

FROM \ TO	OFF	INIT	BIT	STORE READY	FREE FLIGHT
OFF	-	N	X	X	X
INITIALIZATION	A	-	N	N	X
BIT	A	N	-	X	X
STORE READY	A	A	A	-	N
FREE FLIGHT	X	X	X	X	-

The following tables describe the functions of each state, and list the valid transitions into each state as well as the exits from each state.

TABLE 3 - INITIALIZATION State Activities

INITIALIZATION	State Activities
Transition into State	From: OFF State Pre-requisites: None Initialization Action: Apply 3 phase power From: BIT State Pre-requisites: Maintain 3 phase power Initialization Action: Automatic when BIT complete From: STORE READY State Pre-requisites: Maintain 3 phase power Initialization Action: Command Reset
State Modes and Functions	Warm-up Mode Entry Criteria: A/C applies 3-phase power Functions during mode: • Store completes power up initialization of the system • Store performs power-up BIT checks to verify system operation • GPS receiver warmed up • IMU gyros calibrated A/C initiates 1553 communication • Store provides Store Description to A/C Exit Criteria • All warm-up functions successfully completed Data Initialization Mode Entry Criteria: Successful transition out of warm-up mode Functions during mode: • A/C may command IBIT • A/C transfers Moment Arm, • A/C transfers Launcher Offset Compensation, • A/C transfers GPS initialization • A/C transfers Targeting data to store • A/C Synchronizes store clock • A/C designates selected target Exit Criteria Successful transfer of Moment Arm, Launcher offset, GPS, Targeting, target selection data and synchronization of the store clock. Alignment Mode Entry Criteria: Successful transition out of Data Initialization Mode Functions during mode:

INITIALIZATION	State Activities
	• A/C may command IBIT • A/C alignment data • A/C performs TXA maneuver • Store attempts GPS acquisition Exit Criteria Successful alignment of store IMU
Alternate Exit	OFF Remove power
Normal Exit	BIT Command BIT
Normal Exit	STORE READY All required initialization data received and READY [22T/03/2=1]

3.3.1 (Continued):

NOTE: Additional tables would be added to describe all states/modes, but for brevity of this document, only one state table is provided as an example. The author does not have to follow this specific table and figure format, but they do provide a example of an internationally accepted format.

---------- End Example

3.4 Sequence of Events:

As described in 3.3, the sequence of events is the second level of the breakdown of the system requirements. This section describes the sequencing and timelines of the nominal system operation of the interface and the possible deviations and failure cases on a top-level basis. The sequence of events described in this section produces the sequencing of the paragraphs in 3.5 containing the detailed event requirements. The author of the interface control document can adjust the detail of the description in this section, however to support readability it is suggested to provide at least two different grades of detail. One overall description where the main events or stated are described and the detailed communication structure between the platform and the store (maybe in the event description as shown in the example below).

In general, the description of events should address the pre-conditions for the entry of this state/mode event, triggers that enable entry into an event or exit from an event, activities that normally occur during the event time, optional activities that can occur during the event, and any inherent system delays associated with the event. These areas should also be reflected in the event timeline chart.

3.4 (Continued):

The following example is a continuation of the example from 3.3 breaking down the sequence of events for a single mode of the initialization state for brevity of this document. The example also provides some suggestions on symbology to be utilized in the event timeline chart. Due to the variety of stores providing a minimum of a functional interface to extensive functional integration, the following is considered as an example from level 3 structures down.

---------- Begin Example

3.4.1 Initialization State Events and Timeline Sequence: The initialization state contains three modes of operation as shown below.

a. Warm-up mode

b. Data Initialization

c. Alignment

The events leading up to entry, processes during and exit from these modes is described below.

3.4.1.1 Warm-Up Mode: Store XYZ enters the warm-up mode at the application of three phase power from the Off State or when power is interrupted. During the warm-up mode, the store initializes its systems and performs systems checks to verify it is ready for operation. At the completion of these checks, the weapon sets the warm-up complete bit and exits the warm-up mode automatically into the initialization mode. Figure 3 illustrates the normal sequence of events that occur during the warm-up mode. Note: The following chart is provided as an example. The author does not have to follow this specific figure format, but it does provide a example of an internationally accepted format.

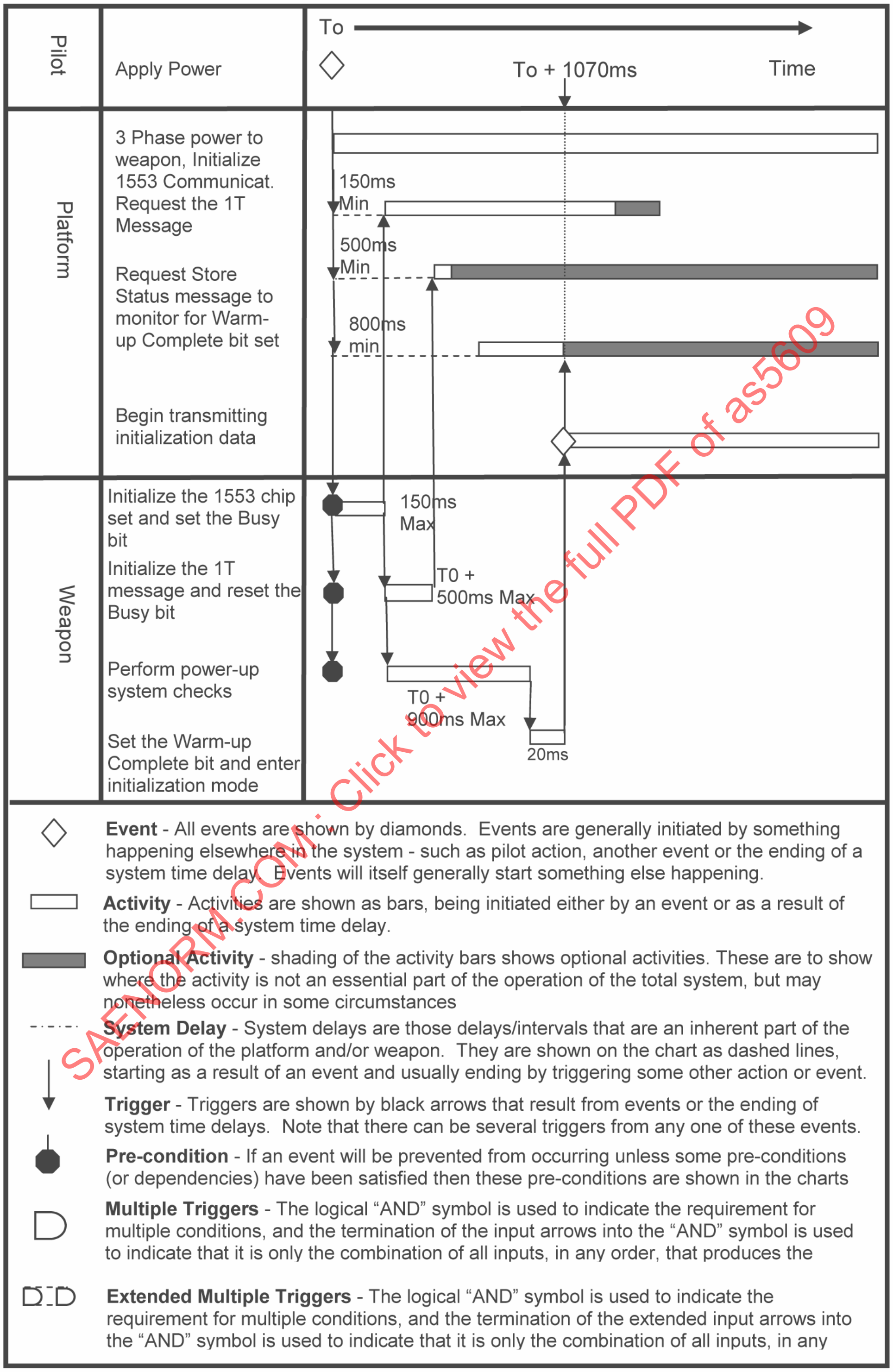


FIGURE 3 - Pictorial Representation of a Time Line for Launch Operations

3.4.1.2 Data Initialization Mode:

…

3.4.1.3 Alignment Mode:

…

3.4.2 Store Ready State Events and Timeline Sequence:

3.4.2.1 ABC Mode:

…

3.4.3 Free-flight State Events and Timeline Sequence: The free-flight state contains the following modes of operation:

a. Post-Launch data-link initialization mode

b. Post-Launch communication mode

c. Third party communications mode

d. …

3.4.3.1 Post Launch Data Link Initialization Mode:

…

---------- End Example

3.5 Event Description:

This section describes detail requirements of the events as outlined in the sequence of events paragraph. The following example is a continuation of the example from 3.4 breaking down the detailed requirements for only single event of the initialization state, warm-up mode for brevity of this document.

---------- Begin Example

3.5.1 Initialization State – Warm-up Mode: The store enters the Initialization State with the application of 3-phase, 400 Hz, 115VAC power, and remains in this state until it is commanded into another state (BIT or STORE READY), or power is removed.

3.5.1.1 Required Signals, Lines, Logical Information and Timelines for System Initialization: The power, discrete signal, and digital interfaces listed in the following sections are used during the Initialization process.

3.5.1.1.1 Power Lines: 3-phase, 400 Hz, 115 VAC power with ground connection is provided.

When 400 Hz, 115 VAC power is interrupted for more than 200 microseconds, the store may suffer a microprocessor reset and the erasure of its volatile memory, however the program instructions will remain intact. When power is restored, the store will re-enter the Initialization State.

3.5.1.1.2 Interlock: The interlock discrete is provided for the platform to monitor the electrically mated status of the umbilical connector between the store and the platform in accordance with the requirements of MIL-STD-1760.

3.5.1.1.3 MIL-STD-1553 Address and Data Lines: The electrical characteristics of the address interface are described in Volume 1, section 4.

MIL-STD-1553 dual redundant digital multiplex data buses are employed by the platform-to-store interface to transfer weapon commands and mission information required to control and monitor the store. The five binary coded address discrete are identified as Address Bit 0 (A_0) through Address Bit 4 (A_4). The address assignment is determined by:

$$ADDRESS = (A_4) \times 2^4 + (A_3) \times 2^3 + (A_2) \times 2^2 + (A_1) \times 2^1 + (A_0) \times 2^0$$

Where A_4 through A_0 are either logic 1 or logic 0

One additional discrete, defined as Address Parity, is set to the proper logic state to produce an odd number of Logic 1 states on the five address discrete and the one parity discrete. A connection to the Common Return line is used to establish the Logic 0 state.

TABLE 4 - RT-Addresses

A/C Station	RT-Addresses					
	A_4*	A_3*	A_2*	A_1	A_0	Decimal
Left inboard (wing) station	0	1	0	0	0	8
Left shoulder station	0	1	0	0	1	9
Right shoulder station	0	1	0	1	0	10
Right inboard (wing) station	0	1	0	1	1	11

NOTE:

This is a fixed setting for all stations. The address parity will be set in accordance to MIL-STD-1760.

Logical 0: connected to ground
Logical 1: open circuit

3.5.1.1.4 Restriction: MIL-STD-1553 contains a limitation on the use of the address discrete interface lines to a remote terminal. A remote terminal must contain a unique address so as not to interfere with other remote terminals during communications. The expected address range for a remote terminal is decimal address 0 through decimal address 30. Therefore, up to 31 unique addresses can be assigned on the data bus. The remote terminal address, decimal 31, is restrictive and should never be configured. Terminal address decimal 31 is used as a common address, if the broadcast mode is used. MIL-STD-1553 does not specifically require remote terminals to accept "broadcasted" messages as noted in the notices:

MIL-STD-1553B Notice 1 disallows the use of broadcast for Air Force applications.

MIL-STD-1553B Notice 2 allows the broadcast of mode commands to terminals but disallows other receive messages for all military services.

3.5.1.1.5 Logical Information: The following logical information is required for system initialization:

Warm-up Complete [22T/02/15]

Store Description Message 1T

MIL-STD-1553B Status Word, Busy Bit

3.5.1.1.6 Store Initialization Timeline: The following Figure 4 shows the sequence of message traffic required for store initialization.

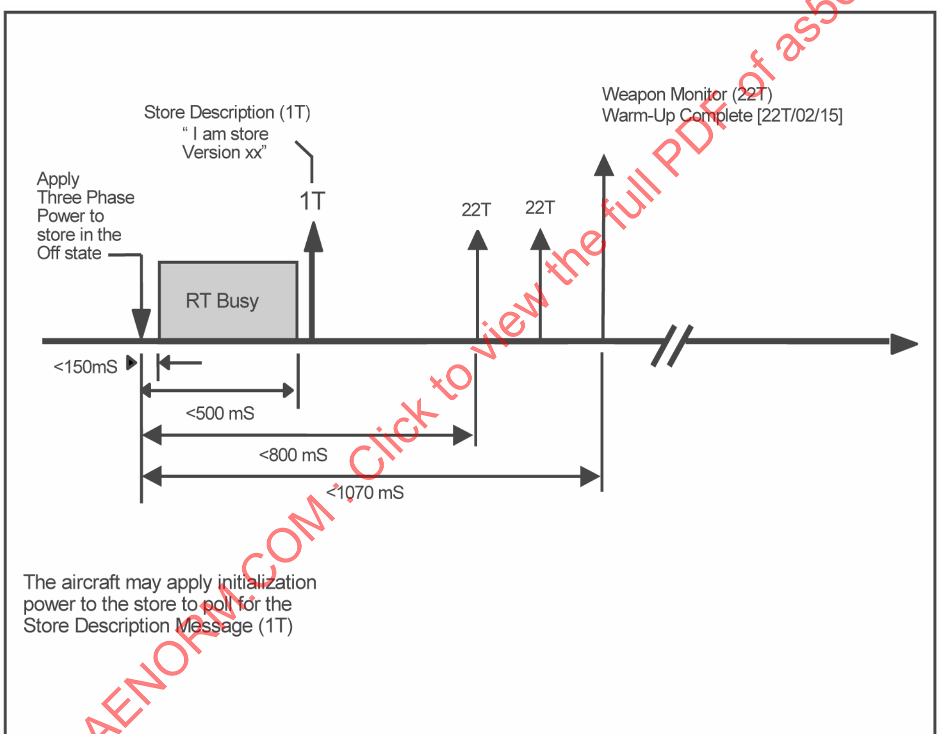


FIGURE 4 - Store Initialization and IBIT

NOTE: This is a different pictorial representation of a timeline opposed to section Figure 3 and is only provided if needed to emphasize details that are not apparent in Figure 3. Any scheme for timing diagrams could be used, as long as they are consistent throughout the document to facilitate readability.

3.5.1.2 Power Application: Store XYZ only utilizes 3 phase power for store initialization power. The aircraft may apply 3 phase and 28 V DC #1 in accordance with MIL-STD-1760 Initialization Process without damage to Store XYZ.

3.5.1.2.1 Platform Requirements: The platform shall {as_001} apply 115 VAC Initialization Power as defined in the specific platform annex. The platform may {am_001} apply 28 VDC #1 Initialization Power simultaneously or independently with 115 VAC Initialization Power as defined in the specific platform annex. The platform may {am_002} monitor the status of Interlock to monitor the mated status of the connection prior to applying 115 VAC Initialization Power.

3.5.1.2.2 Store Requirements: When 115 VAC Initialization Power is received from the platform, the store shall {ss_001} enter the Initialization State and begin required warm up of components and initiate power-up initialization checks of the store systems as required in the Store XYZ System Specification. Within 150 milliseconds of 115 VAC Initialization Power receipt, the store shall {ss_003} interrogate its address lines; accept the result as its digital multiplex data interface address.

3.5.1.3 Initialization of Communication: Table ??? provides a nominal sequence for the initialization of MIL-STD-1553 communications between the platform and Store XYZ.