

BY ORDER OF THE COMMANDER

SMC Tailoring SMC-T-001
8 August 2008



Supersedes:
New issue

Air Force Space Command

**SPACE AND MISSILE SYSTEMS CENTER
TAILORING**

**TAILORING INSTRUCTIONS
FOR MIL-STD-1472F**

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

FOREWORD

1. This tailoring document defines the Government's requirements and expectations for contractor performance in defense system acquisitions and technology developments.
2. This new-issue SMC tailoring comprises the text of The Aerospace Corporation report number TOR-2003(8583)-01, entitled *Evaluation of Mil-Std-1472F*.
3. Beneficial comments (recommendations, changes, additions, deletions, etc.) and any pertinent data that may be of use in improving this document should be forwarded to the following addressee using the Standardization Document Improvement Proposal appearing at the end of this document or by letter:

Division Chief, SMC/EAE
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4. This tailoring document has been approved for use on all Space and Missile Systems Center/Air Force Program Executive Office - Space development, acquisition, and sustainment contracts.


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SMC
Specifications & Standards Re-vitalization

Human Factors

Military Standard 1472 F
DOD Design Criteria: Human Engineering

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17 January 2003

As part of its Systems Engineering Revitalization effort, the Space and Missile Systems Center is reintroducing the use of specifications and standards in defining its program technical baselines. The Center Commander issued a policy letter in January of 2003 that embraces the use of government, industry and professional society specifications and standards in program baselines. SMC has compiled a priority list of specifications and standards from various sources and is in the process of reviewing these to determine which can be used as is or need to be modified or rewritten. In the near term, these specs and standards will be issued as interim reports. In the longer term, they may be formally issued as military specifications or standards or through various professional societies.

This briefing summarizes the analysis and recommendations for the HUMAN FACTORS technology area. Human factors is the systems science encompassing knowledge about human performance and the assignment of appropriate functions for humans and machines, whether people serve as operators, maintainers, or users in the system. And, it advocates systematic use of such knowledge to achieve compatibility in the design of interactive systems of people, machines, and environments to ensure their effectiveness, safety, and ease of performance.

Human factors is also called Human Engineering, Human Systems Integration (HSI), Man-Machine Interface (MMI), Human-Machine Interface (HMI), and in the case of software interfaces – Human Computer Interface (HCI).

Human Factors

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Brian Shaw, Manager of Human Systems Integration (now a Senior Project Engineer in the Space Based Surveillance Division) at The Aerospace Corporation, was the team lead. Other members of the team included Jim Faust, of Northrop Grumman Corporation, Carl Bargar and Barry Portner, both of BD Systems.

Military Standard 1472 F

- ◆ **Department of Defense Design Criteria: Human Engineering**, dated 23 August 1999
 - SUPERSEDING MIL-STD-1472E dated 31 March 1998
- ◆ **General Applicability**
 - Approved for use by all Departments and Agencies of the Department of Defense.
 - Comprises criteria, principles and practices to be applied in the design of military systems, equipment, and facilities.
 - Achieve required performance by operator and maintenance personnel.
 - Minimize skill and personnel requirements and training time.
 - Achieve required reliability of personnel-equipment combinations.
 - Foster design and interface standardization within and among systems.

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Military Standard 1472 is the Department of Defense's principal source of human engineering design criteria. The current version is Mil-Std 1472F, dated August 1999.

Since these criteria cover the full breadth of military systems, they are necessarily broad in scope. Quite a bit of emphasis in 1472 is focused on tactical, fielded systems. Much of this is not directly applicable to space systems that operate in an office-type environment. Similarly, space system designs are primarily commercial computer-based systems and can not benefit from, say, 1472 guidance on hardware-based knob and dial design guidance. This indicates that tailoring of Mil-Std 1472 is warranted and required. Recommendations for tailoring Mil-Std-1472 for space system development programs are identified in this briefing.

As part of the tailoring process it is critical to identify the currently available commercial guidance, especially in the area of software interfaces and human computer interface. Commercial industry in this area tends to progress at a fast rate. Mil-Std 1472 is not as current in Human Computer Interface as are other government/industry documents that focus specifically on the HCI specialty area. These recommendations will be identified in this briefing.

Military Standard 1472 F

- ◆ Applicable AFSPC/SMC System Types
 - Satellite command-and-control ground systems
 - Mission data processing systems
 - Launch systems

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Human factors is fully applicable to three of the four major space segments:

- Ground Segment, specifically the command-and control systems
- User Segment, including mission data processing and GPS user equipment
- Launch Segment, specifically the space vehicle processing and launch equipment/process and facility design aspects.

The only segment that does not have significant human factors issues is the Space Segment. There are limited examples of situations where human factors should specifically be addressed during satellite design. For example, in the SBIRS GEO satellite there is a jumper that must be removed manually before launch, or the satellite will not reach orbit and the mission will be lost. This is a potential single-point failure that human factors can address to help assure mission success. The degree to which human factors applies to the space segment will increase if on-orbit repair/modification capability becomes a trend.

Mil-Std-1472 F Assessment

- ◆ Strengths
 - Human engineering, user-system interface, life support, and biomedical factors that affect human performance
 - Tactical/fielded systems
- ◆ Significant Weaknesses
 - Human Engineering process and design artifacts
 - Workplace design integrating commercial office equipment
 - Human Computer Interface
 - Integration of commercial off-the-shelf software
 - Conformance with DOD/AFSPC standardization efforts
 - ◆ Specifically, Joint Technical Architecture, Common Operating Environment, SMC Standard Practice for Human Computer Interface

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Mil-Std 1472 covers the breadth of design issues associated with human engineering, user-system interface, life support, and biomedical factors that impact human performance. Emphasis is placed on the design of development of tactical, fielded equipment/systems rather than office-type systems that rely heavily on commercially available components.

Although several generic significant weakness areas are identified in Mil-Std 1472, that is not to imply that adequate guidance in these areas are not available. In fact, each of these areas identified as Mil-Std 1472 weaknesses are specified in other DOD, government, or industry documents.

Mil-Std-1472 F Assessment

- ◆ Applicable AFSPC/SMC System Types
 - Satellite command-and-control ground systems
 - Mission data processing systems
 - Launch systems
- ◆ Mil-Std 1472 does not fully meet the needs of AFSPC/SMC
 - Areas of inapplicability should be tailored out.
 - Human Engineering **process** must be addressed.
 - Significant deficiencies in Human Computer Interface must be replaced with current guidance.
 - SMC requirements must support specific DOD and SMC standardization goals for Human Computer Interface.

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As mentioned earlier, Mil-Std 1472 has applicability to three aspects of space systems: satellite ground systems, user equipment, and launch systems.

Mil-Std 1472F, alone, is inadequate to cover the entire human factors needs of AFSPC/SMC systems.

The specific actions that must be taken to rectify this deficiency includes tailoring the current content of Mil-Std 1472 and supplementing areas where 1472 guidance is missing/inadequate with other government/commercial guidance. Both approaches are recommended in the tailoring portion of this briefing.

Recommended Tailoring (1 of 4)

- ◆ Section 4: General Requirements
 - Delete subsection 4.14 (Aircrew)
- ◆ Section 5.3: Audio Displays
 - Delete subsection 5.35 - Verbal warning signals
 - Delete subsection 5.3.11.2 - Sound-powered telephones
 - Delete subsection 5.3.13 - Speech displays
 - Delete subsection 5.3.14 - Speech intelligibility
- ◆ Section 5.10: Equipment for remote handling
 - Delete in entirety

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Several human engineering criteria are clearly inapplicable to space systems and should be tailored out of Mil-Std 1472 when used on AFSPC/SMC programs. These technologies are used in other domain areas, but not space systems.

In the situation of ground processing for launch systems, reconsideration of Mil-Std 1472's section 5.10 might be worth evaluating. If remote handling is used in launch vehicle processing, human engineering criteria are likely warranted for inclusion.

Recommended Tailoring (2 of 4)

- ◆ Section 5.11: Small systems and equipment
 - Delete in entirety for non-tactical, non-portable systems
 - Delete all except 5.11.1 (Portability and load carrying) for tactical or portable/transportable/mobile systems
- ◆ Section 5.12: Ground/shipboard vehicles
 - Delete in entirety for fixed-site systems
 - Delete subsection 5.12.9 (Automotive subsystems) for portable/transportable/mobile systems

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AFSPC/SMC systems rarely involve the human engineering considerations described in Mil-Std 1472's sections 5.11 and 5.12. Exceptions may exist, however, such as fieldable user equipment such as GPS receivers or mobile command-and-control systems. For procurement of these types of systems, the applicable human engineering criteria are likely warranted for inclusion.

Recommended Tailoring (3 of 4)

- ◆ Section 5.14: User-computer interface
 - Delete in entirety; Replace with:
 - ISO 9241
 - DOD Joint Technical Architecture Section 5: Human Computer Interface, as compliance
 - DOD Human Computer Interface Style Guide, as guidance.
 - Common Operating Environment (COE) User Interface Specification, as compliance when COE Level 5 is required, otherwise as guidance.
 - SMC Standard Practice: Human Computer Interface Display Conventions for Space System Operations, as compliance.

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Mil-Std-1472, historically, has never been very strong in the area of human computer interface. And, with the rapid evolution of this area throughout the 1990's the guidance in 1472 has become increasingly incomplete. The DOD community, however, has maintained an emphasis on the need for developing Human Computer Interface guidance/criteria but not specifically within the human engineering standards development forum.

Although the International Standards Organization standard ISO 9241 covers most of the human engineering areas in Mil-Std 1472, it has a more up-to-date consideration of Human-Computer Interface issues. DOD guidance for Human Computer Interface has been coordinated through the Joint Technical Architecture (JTA) and is described in the DOD Human Computer Interface Style Guide. This document is required by JTA Versions 4.0 and below. If JTA Version 5.0 is to be put on contract, separate inclusion of the DOD HCI Style Guide should be considered. When COE compliance at level 5 or above is required, the COE User Interface Specification is required.

AFSPC and SMC coordinated, authored, and approved for use by all programs a set of Human Computer interface conventions. This document is required for all SMC programs per SMC/AXE direction. Refer to the Preface and Foreword of that document for details.

Recommended Tailoring (4 of 4)

Section 5.15: Visual display terminals

- Delete in entirety; Replace with ISO 9241
 - Pending adoption of BSR/HFES 100 (31 March 2002)

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The human engineering criteria for Visual Display Terminals (VDTs) in Mil-Std 1472 is outdated. The same situation exists for the 1988 version of the Human Factors and Ergonomics Society (HFES) standard for VDTs.

ISO 9241 currently provides VDT guidance that is reasonably up to date. A new version of the HFES VDT guidance is in review and pending approval. If approved, that document should be considered for inclusion on SMC contracts.

Additional Recommendation

- ◆ Cite documents for human engineering process, as guidance
 - ISO 13407. *Human centred design processes for interactive systems*, dated 1999.
 - Electronics Industries Alliance (EIA) Engineering Bulletin *Human Engineering – Principles and Practices* (report # HEB 1), dated June 2002.
- ◆ Human engineering products to be in CDRL list
 - Human Engineering Program Plan
 - Human Engineering Design Approach Document – Operator & Maintainer [DI-HFAC-80746A & B].
 - Critical Task Analysis Report [DI-HFAC-81399A].

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Since Mil-Std 1472 is design criteria, it does not include human engineering process guidance. Historically, human engineering process was levied on contracts using Mil-Handbook 46855.

Two industry documents contain the “state-of-the-art” human engineering process: ISO 13407 and EIA’s HB-1. Used together, these documents provides an improvement upon Mil-Handbook 46855. EIA’s HB-1 reiterates the most important concepts in the Mil-Handbook and ISO 13407 formalizes the need for operator/user involvement in a design process.

Document List

- ♦ Mil-Std-1472 F: *Department of Defense Design Criteria: Human Engineering*. August 1999.
- ♦ ISO 9241: *Ergonomic requirements for office work with visual display terminals (VDTs)*. 1992
- ♦ DOD Joint Technical Architecture Section 5: Human Computer Interface (Version 4 or current approved version).
- ♦ Department Of Defense Technical Architecture Framework For Information Management, Volume 8: *DOD Human Computer Interface Style Guide*, Version 3.0. 30 April 1996.
- ♦ Common Operating Environment (COE) *User Interface Specification*, Version 4.0. October 1999.
- ♦ SMC Standard Practice *Human Computer Interface Display Conventions for Space System Operations* (Report # HM-RB-2001-1). 14 January 2001.
- ♦ BSR/HFES100. *Human Factors Engineering of Computer Workstation*. Santa Monica, CA: Human Factors Society. 31 March 2002.

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Further information on Human Systems Integration can be obtained from the following sources:

- The Aerospace Corporation's Human Systems Integration Section
email: hsi@aero.org
- SMC/AXE's HSI resources web site (including links to other useful sites)
http://ax.losangeles.af.mil/chief_engineer/hmi/index.html
- The Aerospace Institute
Space Systems Design (Course # S2020)
Software Acquisition and Engineering in Today's World
(Course # TBD)

Further information on SMC/AX's systems engineering re-vitalization can be obtained from the following source:

- SMC/AX Systems Engineering Re-vitalization web site
http://ax.losangeles.af.mil/se_revitalization/main.htm

SMC Standard Improvement Proposal

INSTRUCTIONS

1. Complete blocks 1 through 7. All blocks must be completed.
2. Send to the Preparing Activity specified in block 8.

NOTE: Do not be used to request copies of documents, or to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements. Comments submitted on this form do not constitute a commitment by the Preparing Activity to implement the suggestion; the Preparing Authority will coordinate a review of the comment and provide disposition to the comment submitter specified in Block 6.

**SMC STANDARD
CHANGE
RECOMMENDATION:**

1. Document Number

2. Document Date

3. Document Title

4. Nature of Change

(Identify paragraph number; include proposed revision language and supporting data. Attach extra sheets as needed.)

5. Reason for Recommendation

6. Submitter Information

a. Name

b. Organization

c. Address

d. Telephone

e. E-mail address

7. Date Submitted

8. Preparing Activity

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