ALLIED ENGINEERING DOCUMENTATION PUBLICATION

AEDP-11 (Edition 1)

NATO INTERNATIONAL STAFF - DEFENCE INVESTMENT DIV.

STANAG 7024 (Imagery Air Reconnaissance Tape Recorder Standard) Implementation Guide

MAY 2006

NORTH ATLANTIC TREATY ORGANIZATION

NATO STANDARDIZATION AGENCY (NSA)

NATO LETTER OF PROMULGATION

23 May 2006

1. AEDP-11 (Edition 1) - STANAG 7024 IMAGERY AIR RECONNAISSANCE TAPE RECORDER STANDARD - IMPLEMENTATION GUIDE - is a NATO UNCLASSIFIED publication.

2. AEDP-11 (Edition 1) is effective upon receipt.

for J. MAJ
Brigradier General, POL(A)
Director, NSA

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1. INTRODUCTION

1.1 Aim

This Allied Engineering Document Publication (AEDP) provides the North Atlantic Treaty Organisation (NATO) Imagery Air Reconnaissance Tape Recorder community with technical guidance on developing and testing implementations.

1.2 AEDP Scope

This document includes technical guidance information for developing and testing implementations of STANAG 7024. The sections of this document are as follows:

Annex A:	STANAG 7024 Configuration Management Plan
Annex B:	STANAG 7024 Test Plan
Annex C:	General Handling, Storage and Management of Air Reconnaissance Cassette Tapes
Annex D	Acknowledgments
Annex E:	List of References

1.3 Tape Formats in STANAG 7024

STANAG 7024 defines standard cassette and data formats for digital and analogue 8mm, digital 19mm, analogue 12.65mm, and digital 25.4mm cassette tapes. However, it should be pointed out that, to date, no manufacturer has taken up the 8mm option in annex B of the standard.

1.4 Point of Contact

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STANAG 7024 CONFIGURATION MANAGEMENT PLAN

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Introduction

A-1.1 Purpose

The purpose of this Annex is to provide the framework for the management of STANAG 7024 and all associated documents.

A-1.2 Related Documents

A-1.2.1 Included Documents

Documents included in this configuration management structure are as follows:

STANAG 7024	Imagery Air Reconnaissance Tape Recorder Standard
AEDP-11	STANAG 7024 Implementation Guide

Other as designated by the STANAG 7024 Custodian

A-1.2.2 Other Referenced Documents

AAP-3 Procedures for the Development, Preparation, Production, and the Updating of NATO Standardisation Agreements (STANAGs) and Allied Publications (APs)

A-1.3 Scope

This document provides the framework for configuration management of STANAG 7024 and all associated documents. The participating NATO member nations define their respective levels of participation and all NATO member nations have equal opportunity to have their respective positions voiced in the STANAG 7024 community. Decision made within this framework are subject to final approval of NATO NAFAG Joint Intelligence Surveillance and Reconnaissance Capability Group (JISRCG), in order to ensure the proper placement of STANAG 7024 within the overall NATO Imagery Interoperability Architecture (NIIA). Overall, the configuration management structure is consistent with the NATO guidelines defined in AAP-3, *Procedures for the Development, Preparation, Production, and the Updating of NATO Standardisation Agreements (STANAGs) and Allied Publications (APs)*. The key element of the configuration management process is the management of requests for change by individual nations.

A-1.4 Change Philosophy

STANAG 7024 comprises a series of industrial/commercial standards. It is not intended that these industrial/commercial standards should undergo incremental change. However, step-change is expected to the STANAG by the possible inclusion of new mature industrial or commercial standards.

A-2 STANAG Management Organisation

A-2.1 General

A-2.1.1 NATO Nation Responsibility

Each NATO member nation is responsible for funding its own participation. Although each NATO member nation can assign representatives to the STANAG activities defined herein, any assigned representatives are expected to be active participants.

A-2.1.2 Participation Requirements

Should the STANAG 7024 Custodian be unable to properly execute business due to repeated lack of participation at the meetings, the Custodian shall report the lack of participation to JISRCG and JISRCG shall request the JISRCG representative of the respective nation(s) to either withdraw from STANAG 7024 participation or appoint a new STANAG 7024 representative who will be able to fully participate.

A-2.1.3 Custodian/Chairman

The STANAG 7024 Custodian also serves as the chairman of all meetings of the configuration management functions. The Custodian is responsible for all STANAG 7024 activity. Specific duties include, but are not limited to the following tasks:

- Tracks changes and provides "official" copy for promulgation
- Reports to JISRCG on status
- Chairs STANAG 7024 Custodial Support Team (CST) meetings
- Responsible for Administrative Tasks (detailed in A-2.1.12)
- Assign administrative support as required

A-2.1.4 Tasking and Reporting Responsibility

The Custodian is the only individual to receive tasking from and report to JISRCG on STANAG 7024. This authority can be delegated to other members of the STANAG 7024 community, but responsibility for the tasking and reporting resides with the Custodian.

A-2.1.5 STANAG 7024 Custodial Support Team (7024 CST)

The Custodial Support Team decides on the changes to be made to STANAG 7024.

A-2.1.6 STANAG 7024 Representatives

The respective JISRCG Representative appoints representatives to the 7024 CST. Each NATO member nation can appoint a representative to the 7024 CST by providing the name, organisation, address, telephone and facsimile numbers, and electronic mail address of their 7024 CST member to the STANAG 7024 Custodian. (The STANAG 7024 Custodian will document the members of the 7024 CST and provide the information to the JISRCG Secretary for recording in the JISRCG decision sheet.) The national representative to the 7024 CST can be from government or industry as chosen by the JISRCG representative. The national representative to the 7024 CST is the official spokesman for all participants from that nation.

A-2.1.7 National Representative’s Responsibilities

Each national representative shall define procedures for establishing the respective national position on proposed changes. These procedures can use whatever process is appropriate to that nation, but ultimately the national representative will voice the official national position to the 7024 CST.

A-2.1.8 National Representative’s Delegation Authority

The authority of the national representative can be delegated to another individual from that nation in absence of the national representative. The delegation shall be in writing to the Custodian/chairman prior to the start of the meeting at which the delegation of authority is effective. The substitute representative shall have all authority and responsibility of the regular representative.

A-2.1.9 Other Participation

Other individuals from nations with representatives may participate at discretion of national representatives or the Custodian/chairman. The participants can be additional government personnel or contractor personnel. The intent of having additional personnel participate is to provide technical,

operational, or procedural expertise that may not be resident with the representatives and to allow participation by those who are developing systems using STANAG 7024.

A-2.1.10 JISRCG WEB Page

The JISRCG Secretary is responsible for maintaining the configuration management of the JISRCG web page on which STANAG 7024 is posted.

The Secretary will update the postings for past and upcoming meetings based on information provided by the Custodian. Once changes to STANAG 7024 are approved, the Secretary will post the revision to the JISRCG web page within 45 days of the meeting, unless other arrangements are agreed during the JISRCG meeting. The Secretary will maintain a list of the national representatives to the 7024 CST on the web page, based on the nominations made during the JISRCG meetings as documented in the JISRCG meeting decision sheets.

A-2.1.11 STANAG 7024 Administrative Support Team

There will be no permanent STANAG 7024 Administrative Support Team. Planning and maintenance activities for STANAG 7024 will be carried out by the Custodian or by staff appointed by the Custodian.

A-2.1.12 STANAG 7024 Administrative Tasks

Administrative tasks include:

- Prepare for meetings by identifying locations and dates for the meetings, preparing announcements, and preparing presentation materials and handouts.
- Presentation of recommended changes during the meetings.
- Track recommended changes submitted through 7024 CST channels.
- Prepare minutes of all meetings.
- Prepare revisions for distribution to JISRCG secretary and members.
- Perform the configuration management STANAG 7024, including maintaining the current version of document.
- Disseminate all proposed changes to the 7024 CST as they are received and logged.

A-2.1.13 Special Teams

The Custodian shall have the authority to convene special teams to examine major technical issues that are beyond the scope of routine change proposal activity. Technical issues of this type can include major changes to the format or development of future strategies for advanced data storage, interface and data download. The Custodian can chair the special team or select another member of the community to chair the special team and report on its progress. The members of the team will be appointed by the Custodian based on recommendations from the national representatives. The Custodian will identify any special teams, including the members, tasking, planned schedule, and expected products, to JISRCG.

A-2.2 <u>Change Identification</u>

A-2.2.1 Change Request Procedure

All representatives can submit change requests that change the content or structure of STANAG 7024. Other personnel requesting changes shall submit their requests through the respective national representatives. For persons from NATO nations without formal representatives on the 7024 CST, the change requests shall be submitted through their respective JISRCG representative.

A-2.2.2 Change Request Format

All change requests shall use a standard format, either by completing the form in Appendix 1 or electronic mail containing the same information and order as the form. The paper form can be

submitted either through the mail or by telefax. The change request is submitted to the appropriate national representative, who has disapproval authority over any proposed change from their respective nation prior to submission to the Custodian. Upon endorsement the change is forwarded to the Custodian. The Custodian logs the change request and disseminates the proposal for discussion and review if necessary.

A-2.2.3 Class of Changes

All change requests shall identify the proposed change as either Class 1 (amendments of substance) or Class 2 (editorial amendments). Class 1 changes are those identified as changes of substance in AAP-3 and affect technical compliance/interoperability requirements of systems. Class 2 changes are for administrative or editorial revisions or to clarify the usage of the STANAG. These changes are those identified as editorial amendments in AAP-3.

A-2.2.4 Configuration Management

Configuration Management, as defined in AAP-3, defines the top-level process. It specifies that once changes are produced, they should be forwarded to the NATO Standardisation Agency (NSA). AAP-3 does not specify the process within the sponsoring agency or for the Custodian to use in recording proposed changes and managing the change approval process. The primary purpose of this plan is to specify the process to be used by the STANAG 7024 Custodian.

The STANAG 7024 Configuration Management will be conducted at the discretion of the Custodian. The process is shown in Figure A.1 – Configuration Management Plan. Changes can be submitted at any time and are reviewed by the Custodian. The CST will only be required to agree on Class 1 changes, the Custodian will decide on class 2 changes.

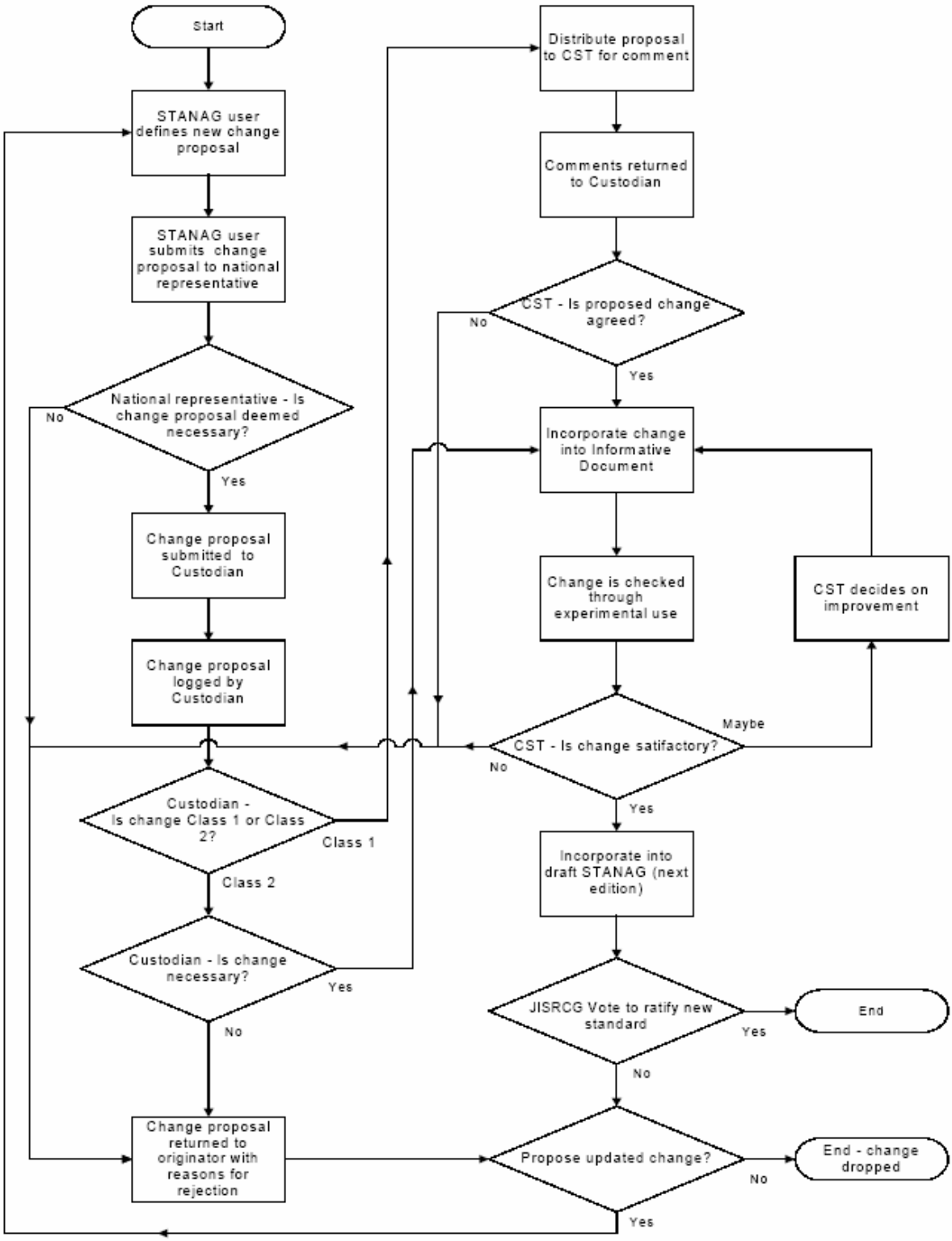

Figure A.1 – Configuration Management Plan

A-2.2.5 7024 CST Meetings

The 7024 CST shall meet as required at the discretion of the Custodian. In lieu of meetings, discussions may be conducted via email or teleconference chaired by the Custodian. Voting may be conducted by postal ballot if the Custodian considers a formal meeting unnecessary.

A-2.2.6 Procedure for Proposed Changes

Proposed changes are compiled and distributed to all national representatives no less than fourteen days prior to the meeting. The format of the change compilation is shown in Appendix 2. National representatives then distribute the proposed changes to other interested individuals from the respective nation. National representatives and others are directed to establish impact of the proposed changes. The respective national positions are determined by procedures established by each nation. If a nation is unable to attend a 7024 CST meeting, the nation may submit written comments to the Custodian prior to the 7024 CST meeting. The comments will be provided to all attendees for consideration during deliberations.

A-2.2.7 Discussion of Change Proposals

During the 7024 CST meeting, each proposed change is discussed. Change proposals are discussed under direction of the Custodian. Change proposals can be deferred pending additional investigation/review, for which the Custodian assigns responsibility for addition study/review, or changes can be voted independently or in groups at discretion of Custodian.

A-2.2.8 Voting on Change Proposals

Only the national representatives vote on final configuration decisions. Class 1 changes require unanimous consent of national representatives (or designated alternates) in attendance and voting. Class 2 changes may be decided by the Custodian.

A-2.2.9 Custodian's Options and Approval Authority

The Custodian can defer the decisions of the national representatives for JISRCG review, request additional discussion and review by the national representatives. The Custodian incorporates approved decisions into the STANAG.

A-2.2.10 Informative Document

A living document containing proposed changes while under review. It should be noted that the Informative Document is for experimental use and reference, it does not replace the Ratified standard.

A-2.2.11 JISRCG Meetings

The Custodian presents to JISRCG completed amendments to the STANAG along with a summary of the changes for ratification. Revisions with Class 1 changes are then submitted to the JISRCG Secretary to formally present the modifications to the nations for ratification. Revisions with only Class 2 changes are considered ratified with JISRCG approval. Regardless of the ratification process used, after ratification, the Secretary posts the revised STANAG to the JISRCG web page and submits it to the Chairman of the MAS for promulgation.

A-2.3 <u>Meeting Procedures</u>

A-2.3.1 Language

All meetings will be conducted in English. Those nations requiring the materials in different languages are responsible for translating the materials

A-2.3.2 Meeting Advance Notice

All meetings will be announced with a minimum of 60 days notice.

A-2.3.3 Quorum

The quorum for approving changes for submission to JISRCG is 2 nations formally represented by approved representatives or their alternates.

A-2.3.4 Meeting Minutes

Minutes of all formal meetings will be distributed within 14 days of the completion of the meeting. The minutes will include a record to document approved and disapproved changes, identify the status of all outstanding changes, and identify issues to be taken forward to JISRCG.

CHANGE PROPOSAL FORM

STANDARDISATION DOCUMENT CHANGE PROPOSAL

INSTRUCTIONS

1. Change proposals may be submitted on this form through either mail or telefax, or by electronic mail following the same order and content as this form.
2. Originator completes sections 1-16.
3. Originator forwards to the respective national representative. National representative is official representative to 7024 CST, or if none from the originator's nation, then the representative to JISRCG. (See the NATO NAFAG JISRCG Internet web page for names and addresses.)
4. National representative approves or rejects proposal from their nation by completing sections 17-25.
   - Approved proposals are forwarded to the STANAG 7024 Custodian.
   - Rejected proposals are annotated with the reason for disapproval and returned to the originator.

Note: This form may be used to submit changes to any document included in the STANAG 7024 data set. This form may not be used to request copies of these documents. The documents are available on the NATO NAFAG JISRCG Internet home page (www.nato.int/structur/AC/224/home.htm), or through normal NATO document distribution channels.

RECOMMENDED CHANGE: (continue on additional sheets as necessary) page | | of | |

1. Document Number:	2. Document Version/Release Number:	3. Document Date:

4. Document Title:

5. Proposed Change to: (Section, Paragraph, Line, Page)	6. Change Class: I | | II | | | | |

7. Current Wording:	8. Proposed Wording:

9. Reason/Rationale:

10. Originator's Name:	13. Originator's Telephone Number:
11. Originator's Organisation:	14. Originator's Telefax Number:
12. Originator's Mailing Address:	15. Originator's E-Mail Address:
	16. Date Submitted:
17. Nat'l Rep Name:	20. Nat'l Rep Telephone Number:
18. Nat'l Rep Organisation:	21. Nat'l Rep Telefax Number:
19. Nat'l Rep Mailing Address:	22. Nat'l Rep E-Mail Address:
	23. Date of Approval/Rejection:

24. Change Proposal: Approved |___| Rejected: |___|
25. Rejection Rationale:

Mail, Telefax, or E-Mail Change Proposals To: STANAG 7024 Custodian	26. Date Logged/initials:

CONSOLIDATED CHANGE

PROPOSAL REPORT FORMAT

CHANGE SUMMARY
Date

Notes:

1. Initials of initiator are shown in Source Column (SRC), and/or next to respective comments.
2. Changes from multiple sources on the same section are shown with the same number and sequential suffix letters in the # column.

#	LOCATION	SRC	OLD TEXT	NEW TEXT	COMMENTS
99-01					
99-02a					
99-02b					

STANAG 7024 Test Plan

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B-1 Introduction

B-1.1 Aim

To establish a STANAG 7024 Test Plan for achieving and sustaining compliance by all architectures taking advantage of STANAG 7024.

B-1.2 Scope

This document encompasses the following STANAG 7024 testing information:

- Test plan authorities.
- Testing responsibilities.

B-1.3 Related Documents

NIIA TEPP NATO ISR Interoperability Architecture Test and Evaluation Program Plan

B-1.4 Referenced Documents

STANAG 7024 Imagery Air Reconnaissance Tape Recorder Standard

B-1.5 Definitions

B-1.5.1 Validation Test

A test conducted to show that a standard is accurate, complete and understandable.

B-1.5.2 Compliance Test

A test conducted on a single implementation to show that the implementation complies with the provisions of the standard.

B-1.5.3 Interoperability Test

A test conducted on two or more implementations that show that when working together, the implementations can function together.

B-1.6 Applicability

Document validation testing is recommended and conducted at the discretion of the Custodian.
Compliance testing is **highly recommended** for all systems utilising and mandatory for compliance registration.
Interoperability testing is **highly recommended** for all systems.

B-2 Test Plan Responsibilities

The following bodies have the responsibility for participating in the STANAG 7024 evaluation program.

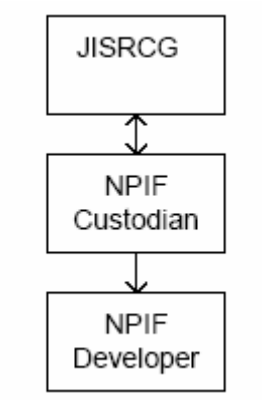

Figure B.1 – Test Program Organisational Relationships

B.2.1 NAFAG Air Group IV

JISRCG (under the NATO Air Force Armaments Group – NAFAG) manages the 7024 STANAG and related documents though the assignment of a Custodian.

B-2.1.2 STANAG 7024 Custodian

The JISRCG 7024 Custodian is the delegated NATO authority for the management oversight of the STANAG 7024 test program. The testing of the standard is embedded in the development and configuration management procedures that are within the responsibility of the STANAG 7024 Custodian. Because of the close relationship of configuration management and testing, the Custodian shall be responsible for the day-to-day oversight of the test program and maintaining configuration control of STANAG 7024. This includes the following responsibilities:

- Full authority and responsibility for the management of the Test Program.
- Produce and maintain the Test Program Plan.
- Arbitrate and advise any testing issues and direction.
- Assist in resolving functional and interoperability problems with compliant implementations.

B-2.1.3 Test Facilities

There is no requirement for a STANAG 7024 test facility.

B-2.1.4 STANAG 7024 Developer

The 7024 system developers should conduct testing in accordance with the test plan.

B-2.2 Point of Contact

B-2.2.1 STANAG 7024 Custodian

See 1.4.

B-3 STANAG 7024 Test Program

B-3.1 Overview

Figure B.2 gives an overview of the testing process.

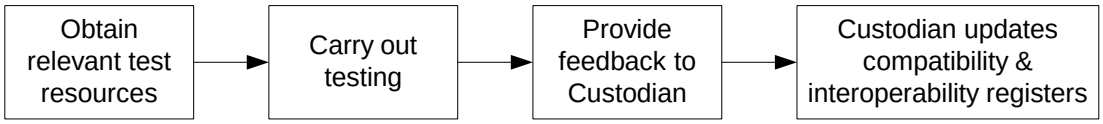

Figure B.2 – Test Overview

B-3.2 Test Program Responsibilities

B-3.2.1 STANAG 7024 Custodian

The STANAG 7024 Custodian has the following responsibilities:

- Publish and maintain a master register of 7024 compliant systems;
- Arbitrate any testing issues from validation or compliance testing.

B-3.2.2 Developer

A developer has the following responsibilities:

- Obtaining resources;
- Conduct testing;
- Submit test results to the 7024 Custodian.

B-3.3 Obtain Resources

The 7024 standard is based on commercial standards issued by the appropriate companies and international standards bodies. Hence it is the responsibility of the developers to obtain suitable test materials, equipment, and any test criteria additional to STANAG 7024 from the relevant industry or international standards body.

B-3.4 Compliance Test

The aim of compliance testing is to promote interoperability through the production of a list of compliant systems.

It is the responsibility of the system developers to assess compliance against the commercial and industrial standards as defined in STANAG 7024.

B-3.5 Interoperability Test

The aim is to produce a comprehensive database of interoperable NPIF systems to promote interoperability.

Interoperability testing shall be accomplished by the successful demonstration of the read-write cycle between two disparate groundstations/airsystems.

B-3.6 Feedback to Custodian

On completion, results should be submitted to the Custodian. The Custodian reserves the right to oversee or independently verify the testing of any STANAG 7024 system.

GENERAL HANDLING, STORAGE AND MANAGEMENT OF AIR RECONNAISSANCE CASSETTE TAPES

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C-1 Introduction

Magnetic tape remains the most cost effective storage medium for large quantities of imagery or data and may be reused numerous times. Modern magnetic tape coatings can accept intelligence and retain it for an indefinite period unless it is altered magnetically or until the recording medium deteriorates physically.

This document provides guidance on the procedures for handling, storage, transportation and management of air reconnaissance cassette tapes to help prevent needless performance degradation.

Air reconnaissance recorders are made by a wide range of manufactures for a broad range of missions. Their cassette tapes come in a wide range of shapes and sizes, and the tape material and construction also varies. Thus, as it is not practical to provide specific guidance for all air reconnaissance cassette tapes, this document serves to supplement, not replace, manufacturer's instructions. Always, read the manufacturers instructions before using the tape recorder.

C-2 Cassette Tapes

Magnetic tapes are composed of a flexible backing material, magnetic particles held in place by a binder compound, and a back coating. The composition and thickness of the backing material varies with the type of recorder and the stresses and strains that the environment and the recorder will place on it.

The recorded information is stored in magnetic particles that are encapsulated and held in place on the flexible backing material by a binder compound. The magnetic particles are orientated longitudinally or transversely depending on the recording technique to be used. The storage magnetic force required to record the information, information density (or frequency response), signal-to-noise ratios, and durability depend on the thickness of coating and the size of the magnetic particles.

The binder compound contains lubricants to reduce abrasion of the magnetic head; fungicides to inhibit fungus growth; plasticizers to maintain flexibility; anti-static agents to reduce dust attraction; and dispersants and wetting agents to evenly distribute the magnetic particles during manufacture.

The back coating resists abrasion and has a controlled coefficient of friction matched to the requirements of the tape transport mechanism. Fungicides inhibit fungus growth, plasticizers maintain flexibility, anti-static agents reduce dust attraction; and it is moderately compressible so that it absorbs distortion (caused by particles that may become entrapped between layers).

The cassette protects the tape and, as it provides part of the transport mechanism, it forms an integral part of the recording system. Thus, cassettes are manufactured to close tolerances.

C-3 Environment

The airborne reconnaissance environment is subject to vibration, acceleration, barometric pressure, humidity and temperature. Thus, specialist airborne reconnaissance recorders are manufactured to operate in this environment. However, as these parameters are different for each airborne platform and application, there is a range of airborne reconnaissance recorders and a range of cassette tapes to go with them.

C-3.1 Acceleration and Vibration

Acceleration dominates the airborne reconnaissance environment and the g forces induced by acceleration require that airborne reconnaissance recorders be constructed to function during and/or following exposure to these acceleration forces. In general, the requirement to maintain the precise relationship between tape and head is achieved by subjecting the tape to greater stresses and strains than it would be subject to in a recorder designed for ground operation. Vibration is a problem on reconnaissance aircraft that is overcome by anti-vibration mounting techniques.

On the ground, the acceleration damage is caused by sudden deceleration due to impact loads and the vibration likely to damage the tape or the cassette mechanism is usually restricted to the transit environment. Impact loads and vibration can generally be overcome by careful packing and choice of transport methods.

- Avoid mechanical loads that may damage or distort the cassette.
- Cassettes should be fitted into a rigid box containing adequate shock-absorbent material.
- The orientation of the cassettes inside the shipping or storage container should be such that the tape-reel axes are horizontal.
- The shipping box should be clearly marked to indicate its correct orientation.

C-3.2 Humidity

Humidity is moisture from humid atmosphere, rather than rain or immersion. Relative Humidity is the ratio of the amount of water vapour actually in the air (absolute humidity) compared to the amount of water vapour the air can hold at that temperature and pressure; expressed as a percentage. High relative humidity increases the tape's frictional characteristics, leading to greater head wear, and can also cause the tape to stick to the head. Low relative humidity causes the magnetic layer to shed, causing problems in record and playback modes.

In-flight problems caused by humidity are usually overcome through environmentally controlled enclosures. On the ground it is generally recommended that an operating humidity of 30 to 50% is maintained. However, individual manufactures specifications should be consulted.

The combination of humidity and temperature changes can cause condensation. The amount of water that may be held by a volume of air increases with temperature (under constant pressure). The Dew Point Temperature is defined as the temperature to which the air would have to cool (at constant pressure and constant water vapour content) in order to reach saturation, further cooling will cause condensation. Therefore, when recording tapes are introduced from a cold environment, into a warm environment, dew can form on the tape surface. If a dew-infected tape is loaded into a tape recorder, the condensation can cause the tape to stick to the head drum, which in turn peels off the magnetic layer from the tape. This situation will cause severe problems in the recording and playback of the tape, and to any subsequent tapes loaded into the recorder. Ideally recording cassettes should be allowed to stabilise to the reconnaissance aircraft's, or groundstation's, operating temperature for 24 hours prior to use.

In the airborne environment, many reconnaissance recorders are able to sense a dew-infected tape and reject it. Some even have heaters to dry the tape, however, this cycle takes time that will substantially delay aircraft turnaround. It should be noted that without power, a recorder's heaters will not be able to protect the tape from low temperature or moisture.

On the ground, great care should be taken to avoid transferring cassette tapes from cold to warm environments, especially when the warmer environment has a high relative humidity. This may require the tape to be conditioned within the groundstation to the temperature it will operate at in the aircraft before it is transferred to the aircraft. Tapes being transported from groundstation to aircraft (and vice versa), should be carried in an insulated carrying case to minimise exposure to extreme temperatures and humidity.

Many manufactures specify an ideal storage environment of and a relative humidity of 40% +/- 10%; these conditions should be aimed at for maximum life of the cassette tapes. In general, cassette tapes may be safely stored in non-ideal conditions; however, they will degrade at a rate faster than they would under ideal conditions and the less ideal the conditions, the greater the rate of degradation. Thus, humidity can range from 30 to 50% but the environment must be non-condensing (the cassette tapes should not have condensation in or on them).

Provided that they are properly conditioned before use, blank tapes can be transported for short periods (less than 10 days) at Relative Humidities 20% and 80%, non-condensing.

C-3.3 Temperature

High and low temperatures, may temporarily or permanently impair the performance of airborne reconnaissance tape recorders by changing the physical properties or dimensions of the material(s) composing the recorder mechanism. Low temperatures make the tape brittle and snapping can occur. High temperatures can warp the cassette shell and affect the tensile properties of the tape so that stretching can occur.

In-flight problems caused by temperature are usually overcome through environmentally controlled enclosures.

On the ground, the cassette tapes must be protected from extremes of temperature or exposure to direct sunlight. Rapid temperature changes combined with humidity can cause condensation inside the equipment or cassette tape that is the main cause of failure. Tapes being transported from groundstation to aircraft (and vice versa), should be carried in an insulated carrying case to minimise exposure to extreme temperatures. In general, it is recommended that cassette tapes are used at an ideal temperature of 21°C, but they can usually be safely used within the “people” range of temperatures of say between 10°C and 40°C. The range can be extended but the risk of the tape becoming brittle or stretching increases.

Cassette tapes can be stored at a much greater range of temperatures than they can be operated at. Although, practical research is limited, received wisdom is that recorded tapes should be stored at 2l°C +/- 2°C. Long periods at appreciably lower temperatures are likely to cause tape cracking and, although the Curie point (the temperature at which a magnetic material loses its magnetism) is unlikely to be reached, long periods at appreciably higher temperatures are likely to cause the tape to denature. Therefore, it is advisable to store cassette tapes at as near 2l°C as possible. If this is impracticable, then they should be stored within the “people” range of temperatures of say between 10°C and 40°C. It must be remembered that before using a tape that has been in store, it must me conditioned to the environment that it will be used in.

Provided that they are properly conditioned before use blank tapes can be transported for short periods (less than 10 days) at temperatures as low as -57ºC and as high as 60ºC.

C-3.4 Barometric Pressure

Barometric pressure reduces as the altitude of the reconnaissance aircraft increases. Many ground-based recorders use air bearings (e.g. between recording head and tape), but as the ambient air pressure reduces this technique is no longer viable. Although air pressure can be maintained by using pressure-controlled enclosures, it is common to forego the use of the head to tape air bearing, thus, causing extra stress on the tape.

In the ground environment, reduced barometric pressure is only likely to be experienced when the cassette tapes are transported by air and this will not cause any damage to the tape or cassette.

C-3.5 Magnetic Fields

The magnetic fields required to record or wipe magnetic tapes are high and, although the likelihood is small, extraneous sources of magnetic fields could be responsible for erasures.

On the aircraft the recorder is shielded, however the recorder must be demagnetised in accordance with the manufacturers schedule.

On the ground, as the strength of magnetic fields drops exponentially with distance, the best defence against magnetic sources is separation. Avoid areas likely to have strong magnetic fields when handling or storing recording tapes (sources include powerful electrical motors, loud speakers, monitors, radar, metal detectors, and any items containing high voltage transformers). Ground based recorders must be serviced and demagnetised in accordance with the manufacturers schedule.

C-3.6 Dirt

Dust or other foreign particles can build up on the tape, on record/replay heads and on the tape guide mechanism. Dirt can be minimised through the following practices:

- Do not touch the tape. Oils from the skin form as deposits on the recording surface leading to a reduction in the quality of recorded/replayed imagery.
- When operating in a field environment, the area should be kept clean.
- The tape recorder's doors should be kept closed when not loading cassettes.
- The recorder heads and tape transport mechanism should be regularly cleaned.
- Do not leave a recording tape partially wound after use, as this will allow the tape to slacken and dust particles to settle on the tape surface. Ensure that the tape is fully rewound and placed in its protective case prior to storage.
- Tapes being transported from groundstation to aircraft (and vice versa), should be carried in a sealed carrying case to minimise exposure to dirt and dust.
- Card / paper cases should not be used for storage, as they tend to introduce extra dust particles to the environment.
- When shipping the box must have a clean interior and construction that provides sealing to prevent the ingress of dirt and water.
- Avoid the build-up of static electricity by maintaining proper grounding procedures as static electricity attracts airborne contaminants.

C-3.7 Handling

Tapes are most likely to under go physical damage when being handled. Mechanical factors include:

Tape Wear. Do not leave the recorder in 'pause' or 'still motion' mode for long periods of time, as it causes excessive tape wear.

Slack Tape. Slack tape within a cassette can cause creases on the tape, edge damage, stretching and splitting leading to momentary loss of the recorded data (as the damage lifts the tape from the record/replay drum). Slack can occur with mishandling or if a tape is left in the recorder for a long period of time.

Improper Loading/Unloading. Incorrect cassette loading/unloading procedures can cause damage to the tape or slack within the tape. In some recorders, these problems can occur if the tape is loaded when the recorder is not powered up. To minimise this:

- Avoid using force when loading or removing cassettes into/from the recorder.
- Always load cassettes into the recorder the right way up and in the specified direction.
- Avoid repetitive loading/reloading without running the tape through the tape recorder.
- Always remove the tape from the recorder after use.

Improper Cassette Handling. Cassette tapes form an integral part of the recording system and are manufactured to close tolerances. They can be damaged internally and externally if mishandled. Therefore:

- Do not use damaged tapes.
- Do not drop or dismantle cassette tapes.
- Do not attempt to splice a tape – the splice may damage to the recording/playback heads and the adhesive used could damage the recorder mechanism.

Spooling. For cassette tapes in long-term store, or archive, some manufactures recommend that the tapes are spooled and rewound. The periods between carrying out this activity vary from manufacturer to manufacturer; however, if it is not carried out there can be a risk of bleed-through of the recorded data or the tape layers binding together within the pack.

C-4 Tape Management

To maintain the quality of the recorded data, tapes must be of the highest quality and handling procedures must be strictly followed.

All cassette tapes, used and unused, should be labelled and catalogued, the label should be located on the cassette and on its protective case (avoid using pencil on the label as it is likely to introduce graphite particles onto the tape). For blank tapes, the label should contain (at least) a unique serial number and details of previous use. There must be a control system for recorded tapes, the label and supporting cataloguing system must contain (at least) the information required to answer the basic reconnaissance questions of *what, where, and when*. Cassette tapes may be recorded once or reused:

1. Due to the punishment the tape receives in reconnaissance systems, the high value of the data held, the cost of missions and the low cost of cassette tapes – it is strongly recommend that a new tape is used for each recording. The resulting recording will be of a very high quality because the tape will be free from defects resulting from previous use or incorrect handling procedures.

2. A major advantage of magnetic tape is that it may be reused, although repeated use eventually degrades its quality. The number of times that the tape can be reused depends on quality requirements, the robustness of the tape, and the stresses put on it by the recorder. There must be a monitoring process for each tape that provides details of its use to enable its wear to be assessed. However, such a monitoring process will not highlight any other damage or quality degradation (e.g. use at excessive temperature, contamination or severe mechanical shock). Before a cassette tape is reused, it is recommended that a degausser/bulk formatter is used clear all data and background noise from the tape. If this is not done between each use, background noise will build up on the tape reducing recording quality. It is imperative that the appropriate degausser/bulk formatter is used and manufacturer's operating procedures strictly adhered to. Although reuse reduces the quantity of cassette tapes used, it increases the maintenance requirement and the equipment needed. Thus, it is strongly recommended that this approach is not used if the quality of recording is critical.

Acknowledgements

List of References

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