NORTH ATLANTIC TREATY ORGANIZATION
ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD

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27 November 1998 MAS/450-AIR/4184

STANAG 4184 AIR (EDITION 3) - MICROWAVE LANDING SYSTEM (MLS)

References:
a. AC/224-D/846(Rev), AC/224(AG/5)D/41(Rev.) (Edition 3) (1st Draft)
b. MAS/30-AIR/4184 dated 21 January 1994 (Edition 2)

1. The enclosed NATO Standardization Agreement which has been ratified by nations as reflected in page iii is promulgated herewith.

2. References listed above are to be destroyed in accordance with local document destruction procedures.

3. AAP-4 should be amended to reflect the latest status of the STANAG.

ACTION BY NATIONAL STAFFS

4. National staffs are requested to examine page iii of the STANAG and, if they have not already done so, advise the Defence Support Division of their intention regarding its ratification and implementation.

A. GRØNHEIM
Major General, NOAF
Chairman MAS

Enclosure:
STANAG 4184 (Edition 3)

STANAG 4184
(Edition 3)
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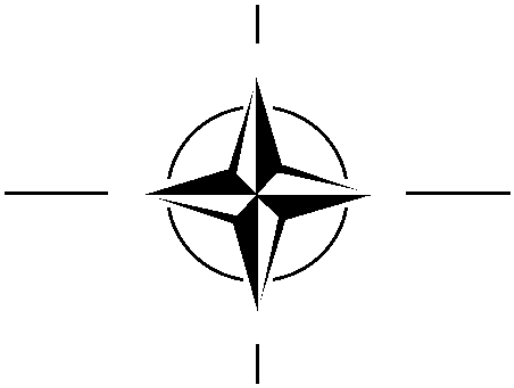
NORTH ATLANTIC TREATY ORGANIZATION
(NATO)



MILITARY AGENCY FOR STANDARDIZATION
(MAS)

STANDARDIZATION AGREEMENT

(STANAG)

SUBJECT: MICROWAVE LANDING SYSTEM (MLS)

Promulgated on 27 November 1998

A. GRØNHEIM
Major General, NOAF
Chairman, MAS

RECORD OF AMENDMENTS

No.	Reference/Date of Amendment	Date Entered	Signature

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Chairman MAS under the authority vested in him by the NATO Military Committee.

2. No departure may be made from the agreement without consultation with the tasking authority. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.

3. Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

DEFINITIONS

4. Ratification is "The declaration by which a nation formally accepts the content of this Standardization Agreement".

5. Implementation is "The fulfilment by a nation of its obligations under this Standardization Agreement".

6. Reservation is "The stated qualification by a nation which describes that part of this Standardization Agreement which it cannot implement or can implement only with limitations".

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

7. Page ii gives the details of ratification and implementation of this agreement. If no details are shown, it signifies that the nation has not yet notified the tasking authority of its intentions. Page iii (and subsequent) gives details of reservation and proprietary rights that have been stated.

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NATO STANDARDIZATION AGREEMENT
STANAG 4184

MICROWAVE LANDING SYSTEM (MLS), Edition 3

ANNEXES:

A. Minimum and Desired Capabilities of A Military Microwave Landing System.

B. Definitions for Military Use of Auxiliary 'C' Data Words.

C. Minimum and Desired Capabilities of A Tactical Microwave Landing Systems (TMLS).

RELATED DOCUMENTS:

A. International Civil Aviation Organization (ICAO) International Standards and Recommended Practices and Procedures For Air Navigation Services, Aeronautical Telecommunications, Annex 10 to the Convention on International Civil Aviation, Volume I, Part I (hereafter referred to as SARPS).

B. ICAO Annex 10 SARPS Attachment G to Part I - Information and Material for Guidance in the Applications of MLS Standards and Recommended Practices in Annex 10.

INTRODUCTION

1. STANAG 4184, Edition 2 required that NATO Precision Approach Radars (PAR) be replaced with the MLS. This requirement was instituted in order to ensure interoperability between NATO military and civil systems and was derived from the ICAO decision to standardize on MLS. In 1995, ICAO reversed this decision, allowing nations to individually adopt new systems based on national requirements. This document supersedes Edition 2 and provides direction with respect to standardization and interoperability for those nations choosing the MLS option in whole or in part. The NATO requirement to replace PAR with MLS is now optional.

AIM

2. The aim of this agreement is to provide for interoperability of MLS precision landing systems during military operations at specified airfields or tactical airstrips by:

(a) Providing technical and operational guidance on deployment of MLS ground based and airborne systems, in a living document with wide availability and subject to periodic review.

(b) Defining the terms "Microwave Landing System or MLS" and "Tactical MLS" for NATO use and standardizing the MLS signal-in-space for NATO.

(c) Allowing individual nations to proceed with their own MLS programmes with the assurance that such programmes will produce equipment which meets NATO military requirements and is interoperable with the equipment of other NATO nations.

(d) Assuring that NATO military aircraft and civil aircraft equipped with MLS can recover at NATO military airfields or tactical/expeditionary sites which provide MLS services in adverse weather and, when operations require, that NATO military aircraft can recover in adverse weather at civil MLS equipped airfields.

(e) Defining a set of minimum MLS characteristics and capabilities which could serve as the basis of a NATO Staff Target for any cooperative development and acquisition programme.

AGREEMENT:

3. Participating nations agree:

(a) That only airborne and ground equipment interoperable with ICAO MLS described in Related Document A shall be referred to as MLS equipment within NATO.

(b) That MLS fixed base ground equipment shall provide minimum operational and technical performance characteristics in conformance with related Document A, current at the time of procurement, as modified by Annex A to this STANAG. Changes to related Document A should be reviewed and, if appropriate, added as later modifications to the equipment while ensuring backwards compatibility with older generation receivers.

(c) That the latest version of Related Document B (guidance material for MLS) provides guidance for specific MLS applications.

(d) That MLS avionics shall be able to fly at least ILS “look alike”approaches. .It is desirable that MLS avionics be able to fly computed centerline approaches but that this capability is not mandatory. A computed centreline approach is a straight-in approach flown to the centreline of a runway where the azimuth antenna is offset from that centreline (or in aTactical MLS collocated configuration). The approach path is defined by the ground station data word content, in addition to azimuth, elevation and DME range information.

(e) That DME shall be the standard ranging source for use with MLS and shall be present at each MLS location. DME/N is the minimum requirement in this role. However, use of DME/P is recommended as it will enhance operational capability and flexibility.

(f) That DME ground equipment deployed for use with an MLS shall provide minimum operational and technical performance characteristics in conformance with related Document A, current at the time of procurement.

(g) That all DME avionics deployed for use with MLS will be compatible with ICAO standard DME ground systems described at related Document A.

(h) To exchange information on the development of airborne and ground equipments for NATO military use.

(i) To share information on the feasibility of shipboard landing systems using the signal structure in Related Document A.

(j) That usage/implementation of national systems such as the ICAO ILS is unaffected by this agreement.

(k) To transmit Auxiliary 'C' Data Words using only those definitions at Annex B, if they wish to implement this facility. However, transmission of these 'C' words is not mandatory.

(l) That MLS ground equipment referred to as STANAG 4184 defined "Tactical" systems will meet the definition at Annex C.

(m) Not to implement any of the system capabilities outlined in Annex B without an interoperable mode until detailed specifications are jointly agreed to, and incorporated in this STANAG, as these capabilities require changes in airborne receivers. Nations developing such capabilities are invited to present them to the NATO NAFAG for standardization.

IMPLEMENTATION OF THE AGREEMENT

4. This STANAG is considered implemented when a nation has issued the necessary orders/instructions to their subordinate forces placing the concepts based on this agreement into effect.

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MINIMUM AND DESIRED CAPABILITIES OF A
MILITARY MICROWAVE LANDING SYSTEM

1. General

(a) The minimum MLS landing capability for military landing fields shall enable approaches to ICAO Category I minima to both directions of the main instrument runway except where prevailing weather conditions, presence of an alternative system, or presence of a suitable diversion capability make installation of a second system unnecessary. Ground equipment integrity, availability and continuity of service shall be, at a minimum, as stated for Level 2 in the ICAO Annex 10 SARPS.

(b) The minimum requirement for the signal-in-space characteristics, angle and data functions of a military airfield MLS shall be the same as those provided by an ICAO Annex 10 SARPS basic MLS equipment configuration which includes a DME as the standard ranging source.

(c) The following capability matrix lists minimum and desired operational and technical characteristics, deviating from ICAO MLS characteristics. The listed characteristics having an operational implication, are mainly the result of less demanding military operational requirements with respect to the ICAO operational requirements. However, the listed characteristics are such as to allow for compatibility with ICAO MLS equipment.

(d) It is desirable that nations maintain a capability to restore approach guidance accuracy to at least ICAO Category I minima, to at least one runway end, within twelve hours of sustaining incapacitating battle damage. A minimum range of 15 nm is acceptable for a restored MLS runway.

(e) Modifications to add new military operational capabilities which go beyond the ICAO operational requirements shall not result in a loss of a backward compatibility with ICAO MLS equipment. This does not preclude the addition of capabilities beyond those of ICAO requirements.

(f) No provision is made in this STANAG for ascertaining the presence of enemy jamming or deception. The standard MLS receiver is somewhat resistant, but not immune, to jamming or deception. Geometric factors require an enemy seeking to jam or deceive an MLS receiver to use either an easily detectable high power jammer or to operate a clandestine low power jammer within a few kilometres of the approach end of an instrumented runway. Where control of the airbase environs cannot be assured, nations should consider patrolling areas for enemy activity or equipping aircraft to detect unwanted signals.

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SUBJECT	MINIMUM ACCEPTABLE CAPABILITY	DESIRED CAPABILITY	REMARKS/ RATIONALE
MLS Configuration (ICAO Annex 10 SARPS Para 3.11.3)	As it stands in the ICAO Annex 10 SARPS	As it stands in the ICAO Annex 10 SARPS Para 3.11.3.3	Where there is an operational requirement, MLS can be expanded with back azimuth equipment.
Signal-in-space Characteristics (ICAO Annex 10 SARPS Para 3.11.4)	As it stands in the ICAO Annex 10 SARPS	As it stands in the ICAO Annex 10 SARPS plus ability to reduce output power	Optional auxiliary data to be in accordance with Annex B
Coverage Approach Azimuth (ICAO Annex 10 SARPS Para 3.11.5.2.2.1)	Approach Region (a) Horizontally: Within a sector plus or minus 40 degrees about the runway centreline originating at the threshold and extending in the direction of the approach to 20 NM from the runway threshold. (b) Vertically: As it stands in the ICAO Annex 10 SARPS	Approach Region (a) Horizontally: As it stands in the ICAO Annex 10 SARPS, plus an adjustable approach sector angular coverage with the maximum sector size allowing approaches to adjacent runways and taxiways. (b) Vertically: As it stands in the ICAO Annex 10 SARPS, plus an adjustable approach sector angular coverage with the maximum sector size allowing approaches to adjacent runways and taxiways.	In order to enhance capability for approaches to adjacent runways and taxiways it can be advantageous to extend approach azimuth coverage. The precision of these approaches will be a function of the pattern obtained out of the zone of the main runway.
Approach Azimuth (ICAO Annex 10 SARPS Para 3.11.5.2.2.1)	Runway Region No requirement for coverage.	Runway Region (a) Horizontally : As it stands in the ICAO Annex 10 SARPS with extension laterally to include taxiways and/or runways to either side of the primary runway.	

SUBJECT	MINIMUM ACCEPTABLE CAPABILITY	DESIRED CAPABILITY	REMARKS/RATIONAL
Minimum Proportional Sector (ICAO Annex 10 SARPS Para 3.11.5.2.2.1.6)	As it stands in ICAO Annex 10 SARPS	(b) Vertically: As it stands in the ICAO Annex 10 SARPS Note: Where intervening obstacles penetrate the horizontal surface it is intended that guidance need not be provided at less than line of sight height in the relevant azimuth sector. A Proportional Sector equal in angular size to the Approach Region sector coverage.	
Elevation Coverage (ICAO Annex 10 SARPS Para 3.11.5.3.2)	As it stands in ICAO Annex 10 SARPS	As it stands in ICAO Annex 10 SARPS plus an adjustable lateral approach sector angular coverage with the maximum sector size equal to the angular scan limits of the approach azimuth ground equipment.	
Touch Down Point	Fixed touch down point e.g defined by basic and Auxiliary A data words	Flexible touchdown point e.g. pilot selectable.	The nominal touchdown point is determined by the Basic and Auxiliary A data word content. Given a change in the data words, calculation of touchdown point is automatic given a computed centreline approach capable receiver. For a pilot selectable touch down point, a more complex RNAV capable system would be required.

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SUBJECT	MINIMUM ACCEPTABLE CAPABILITY	DESIRED CAPABILITY	REMARKS/RATIONAL
Silent Mode	Manual control on the ground.	Activation by manual mode and by aircraft interrogation e.g DME or IFF (authenticated mode optional)*	Authenticated DME/P could provide anti-radiation missile protection.

* These capabilities can be incorporated into MLS equipment and serve useful military purposes but require software or hardware in the aircraft which is not available if the aircraft was fitted to interpret an ICAO standard system. Nations should not implement these capabilities without an interoperable mode of operation until the technical means are agreed to among nations and incorporated in the STANAG. Nations are invited to develop these capabilities and submit them for standardization. Care should be taken in developing these features to preserve an MLS signal-in-space which can be interpreted without ambiguity by a civil receiver.

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DEFINITIONS FOR USE IN AUXILIARY 'C' DATA WORDS

1. The transmission of auxiliary 'C' data words is not compulsory. However, if any nation decides to implement this facility, the words C45-C64 should be used, and the data stream and refresh values should be in accordance with the following table.

Word	Description	Bits	Range of Values	Least Sig. Bit	Bit No.
C45	**AIRFIELD STATE**			Refresh at 0.1 HZ	
	PREAMBLE	12	(See Note 1)	--	I_{01}-I_{12}
	Address	8		--	I_{13}-I_{20}
	Runway Braking - First Third	6	(See Note 2)	--	I_{21}-I_{26}
	Runway Braking - Middle Third	6	(See Note 2)	--	I_{27}-I_{32}
	Runway Braking - Last Third	6	(See Note 2)	--	I_{33}-I_{38}
	NBC State	4	(See Note 3)	--	I_{39}-I_{42}
	Base Defence Zone	4	(See Note 4)	--	I_{43}-I_{46}
	Air Raid State	2	(See Note 5)	--	I_{47}-I_{48}
	Barrier State	1	(See Note 6)	--	I_{49}
	Cable State	2	(See Note 7)	--	I_{50}-I_{51}
	Minimum Landing Fuel	9	100-51,200 lbs	100 lbs	I_{52}-I_{60}
	Meteorological Visibility	9	0-51.2 kms	100 m	I_{61}-I_{69}
	PARITY	7	(See Note 8)	--	I_{70}-I_{76}
C46	**PRIMARY AIRFIELD WEATHER AND DIVERSION AIRFIELD DATA**			Refresh at 0.1 HZ	
	PREAMBLE	12	(See Note 1)	--	I_{01}-I_{12}
	Address	8		--	I_{13}-I_{20}
	Diversion Airfield	20	(See Note 9)	--	I_{21}-I_{40}
	Primary Airfield Altimeter Setting	10	950.0 - 1050.0 mb	0.1 mb	I_{41}-I_{50}
	Primary Airfield Cloud Ceiling	7	0 - 1000 m	10 m	I_{51}-I_{57}
	Cloud Cover	3	(See Note 10)	--	I_{58}-I_{60}
	Airfield Colour State	3	(See Note 11)	--	I_{61}-I_{63}
	Type of Weather	6	(See Note 11)	--	I_{64}-I_{69}
	PARITY	7	(See Note 8)	--	I_{70}-I_{76}

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Word	Description	Bits	Range of Values	Least Sig Bit	Bit No.
C47	**RUNWAY/SITE DAMAGE AND MODIFIED LANDING AND TOUCHDOWN PARAMETERS**			Refresh at 0.1 HZ	
	PREAMBLE	12	(See Note 1)	--	I_{01}-I_{12}
	Address	8		--	I_{13}-I_{20}
	Touchdown Offset - Runway C/Line	13	0 - 8191 m	1 m	I_{21}-I_{33}
	Available Runway Length	13	0 - 8191 m	1 m	I_{34}-I_{46}
	Touchdown Point wrt to Centreline	2	(See Note 12)	--	I_{47}-I_{48}
	Available Runway Width	7	0 - 127 m	1 m	I_{49}-I_{55}
	LCN Conditions	14	(See Note 13)	--	I_{56}-I_{69}
	PARITY	7	(See Note 8)	--	I_{70}-I_{76}
C48	**PREFERRED APPROACH PROCEDURE, CIRCUIT AND AIRFIELD MOVEMENT DATA**			Refresh at 0.1 Hz	
	PREAMBLE	12	(See Note 1)	--	I_{01}-I_{12}
	Address	8		--	I_{13}-I_{20}
	Preferred RNAV Procedure	20	(See Note 14)	--	I_{21}-I_{40}
	Preferred Straight-in Glidepath	7	2° - 14.7°	0.1°	I_{41}-I_{47}
	Preferred Straight-in Magnetic Heading	9	0 - 359°	1°	I_{48}-I_{56}
	Taxi Pattern/Ramp Parking Code	6	(See Note 20)	--	I_{57}-I_{62}
	Circuit Direction	1	(See Note 21)	--	I_{63}
	Number of Aircraft in Circuit	6	0 - 63	1	I_{64}-I_{69}
	PARITY	7	(See Note 8)	--	I_{70}-I_{76}
C49	**PHYSICAL AND JAMMING/SPOOFING (J/S) THREATS**			Refresh at 0.1 Hz	
	PREAMBLE	12	(See Note 1)	--	I_{01}-I_{12}
	Address	8		--	I_{13}-I_{20}
	Threat #1 - Range from Rwy Threshold	9	0.1 - 51.2 nm	0.1 nm	I_{21}-I_{29}
	Threat #1 - Brg from RWY Threshold	9	0 - 359°	1°	I_{30}-I_{38}
	Threat #1 - Type	5	(See Note 15)	--	I_{39}-I_{43}
	Threat #2 - Range from Rwy Threshold	9	0.1 - 51.2 nm	0.1 nm	I_{44}-I_{52}
	Threat #2 - Brg from RWY Threshold	9	0 - 359°	1°	I_{53}-I_{61}
	Threat #2 - Type	5	(See Note 15)	--	I_{62}-I_{66}
	SPARE	3	--	--	I_{67}-I_{69}
	PARITY	7	(See Note 8)	--	I_{70}-I_{76}

Word	Description	Bits	Range of Values	Least Sig. Bit	Bit No.
C50	**PHYSICAL AND JAMMING/SPOOFING (J/S) THREATS**			Refresh at 0.1 HZ	
	PREAMBLE	12	(See Note 1)	--	I_{01}-I_{12}
	Address	8			I_{13}-I_{20}
	Threat #3 - Range from Rwy Threshold	9	0.1 - 51.2 nm	0.1 nm	I_{21}-I_{29}
	Threat #3 - Brg from RWY Threshold	9	0 - 359°	1°	I_{30}-I_{38}
	Threat #3 - Type	5	(See Note 15)	--	I_{39}-I_{43}
	Threat #4 - Range from Rwy Threshold	9	0.1 - 51.2 nm	0.1 nm	I_{44}-I_{52}
	Threat #4 - Brg from RWY Threshold	9	0 - 359°	1°	I_{53}-I_{61}
	Threat #4 - Type	5	(See Note 15)	--	I_{62}-I_{66}
	SPARE	3	--	--	I_{67}-I_{69}
	PARITY	7	(See Note 8)	--	I_{70}-I_{76}
C51	**PHYSICAL AND JAMMING/SPOOFING (J/S) THREATS**			Refresh at 0.1 Hz	
	PREAMBLE	12	(See Note 1)	--	I_{01}-I_{12}
	Address	8			I_{13}-I_{20}
	Threat #5 - Range from Rwy Threshold	9	0.1 - 51.2 nm	0.1 nm	I_{21}-I_{29}
	Threat #5 - Brg from RWY Threshold	9	0 - 359°	1°	I_{30}-I_{38}
	Threat #5 - Type	5	(See Note 15)	--	I_{39}-I_{43}
	J/S Threat #1 - Type	5	(See Note 16)	--	I_{44}-I_{48}
	J/S Threat #1 - Brg from Threshold	9	0 - 359°	1°	I_{49}-I_{57}
	J/S Threat #1 - Band/Equipment	6	(See Note 17)	--	I_{58}-I_{63}
	SPARE	6	--	--	I_{64}-I_{69}
	PARITY	7	(See Note 8)	--	I_{70}-I_{76}
C52	**PHYSICAL AND JAMMING/SPOOFING (J/S) THREATS**			Refresh at 0.1 Hz	
	PREAMBLE	12	(See Note 1)	--	I_{01}-I_{12}
	Address	8		--	I_{13}-I_{20}
	J/S Threat #2 - Type	5	(See Note 16)	--	I_{21}-I_{25}
	J/S Threat #2 - Brg from Threshold	9	0 - 359°	1°	I_{26}-I_{34}
	J/S Threat #2 - Band/Equipment	6	(See Note 17)	--	I_{35}-I_{40}
	J/S Threat #3 - Type	5	(See Note 16)	--	I_{41}-I_{45}
	J/S Threat #3 - Brg from Threshold	9	0 - 359°	1°	I_{46}-I_{54}
	J/S Threat #3 - Band/Equipment	6	(See Note 17)	--	I_{55}-I_{60}
	SPARE	9	--	--	I_{61}-I_{69}
	PARITY	7	(See Note 8)	--	I_{70}-I_{76}

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ord	escription	its	ange of Values	east Sig. Bit	it No.
53	**HYSICAL AND JAMMING/SPOOFING (J/S) THREATS**			Refresh at 0.1 HZ	
	REAMBLE	2	See Note 1)	-	$_{01}$-I$_{12}$
	ddress	8			$_{13}$-I$_{20}$
	/S Threat #2 - Type	5	See Note 16)	-	$_{21}$-I$_{25}$
	/S Threat #2 - Brg from Threshold	9	- 359°	°	$_{26}$-I$_{34}$
	/S Threat #2 - Band/Equipment	6	See Note 17)	-	$_{35}$-I$_{40}$
	/S Threat #3 - Type	5	See Note 16)	-	$_{41}$-I$_{45}$
	/S Threat #3 - Brg from Threshold	9	- 359°	°	$_{46}$-I$_{54}$
	/S Threat #3 - Band/Equipment	6	See Note 17)	-	$_{55}$-I$_{60}$
	PARE	9	-	-	$_{61}$-I$_{69}$
	ARITY	7	See Note 8)	-	$_{70}$-I$_{76}$
54	**UNWAY/SITE DAMAGE AND MODIFIED LANDING AND OUCHDOWN PARAMETERS (RX INFORMATION)**			efresh at 1 Hz	
	REAMBLE	2	See Note 1)	-	$_{01}$-I$_{12}$
	ddress	8		-	$_{13}$-I$_{20}$
	-Coord of Alternative Touchdown	4	/- 8191 m	m	$_{21}$-I$_{34}$
	-Coord of Alternative Touchdown	4	/- 8191 m	m	$_{35}$-I$_{48}$
	-Coord of Alternative Touchdown	2	/- 8191 m	m	$_{49}$-I$_{60}$
	PARE	9	See Notes 18,19)	-	$_{61}$-I$_{69}$
	ARITY	7	See Note 8)	-	$_{70}$-I$_{76}$

SHIP-BASED/CARRIER OPERATIONS

C55 - C59 These words are reserved for future use in ship-based applications. At this time, mot enough is known about the requirements for these data words to be specified. However, it is expected that data rates of up to 13 Hz will be required.

C60-C64 These words are reserved for future expansion as decided by NATO.

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NOTES ON THE TABLE OF NATO MLS AUXILIARY 'C' DATA WORDS.

1. The 12 data bits of the Preamble are preceded by a 0.832 millisecond interval (13 clock pulses) of Continuous Wave for carrier acquisition. (See Table A-1 of ICAO Annex 10). It is also noted that any transmission sequence which includes auxiliary data must first be free from the effects of synchronous interference as noted in ICAO Annex 10.

2. The 6-bit code for the runway braking item represent braking conditions on the runway for first, middle and last third of the runway, with the first third commencing at the runway threshold. The bit pattern defined in the table represents the following braking conditions, which are derived form ICAO, NATO STANAG 3634, and US Military Methods.

Runway Braking Conditions (by bit number and description)							
$I_{21,27,33}$ (0)	$I_{22,28,34}$ (1)	$I_{23,29,35}$ (2)	$I_{24,30,36}$ (3)	$I_{25,31,37}$ (4)	$I_{26,32,38}$ (5)	Braking Action (Bits 0,1 ,2)	Descriptive Data (Bits 3,4,5)
0	0	0	0	0	0	Poor	Wet Runway
0	0	1	0	0	1	Medium/Poor	Slush on Runway
0	1	0	0	1	0	Medium	Loose Snow on Runway
0	1	1	0	1	1	Medium/Good	Packed Snow on Runway
1	0	0	1	0	0	Good	Ice on Runway
X	X	X	1	0	1	N/A	Patchy Conditions
X	X	X	1	1	0	N/A	Runway Sanded
X	X	X	1	1	1	N/A	Dry

3. The 4-bit code for the Nuclear, Biological and Chemical (NBC) state of the runway are defined in accordance with NATO STANAG 2047, as follows:

0001 - All Clear
1000 - Imminent Air Attack
0101 - Imminent Arrival, or presence of Chemical or Biological Elements or Radiological Hazards

All other code are spare

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4. The 4-bit code for Base Defence Zone are defined as follows:

0001	-	Inactive
1111	-	Active

All other codes are spare

5. The 2-bit code for the Air Raid State is defined in accordance with NATO Publication ATAP 40, as follows:

00	-	Red - Imminent or in Progress
01	-	Yellow - Likely
11	-	White - Not Probable

6. The 1-bit code for Barrier State is defined as follows:

0	-	down
1	-	up

7. The 2-bit code for Cable State is defined as follows:

00	-	down
01	-	up
10	-	non-existent
11	-	Not defined

8. The parity bits are chosen to satisfy the equations noted in ICAO Annex 10, Table A-10, Note 1.

9. The Diversion Airfield is identified by up to 4 alpha letters, coded in accordance with ICAO Annex 10, Part 1, paragraph 3.11.4.8.3

10. The 3-bit code for Cloud Cover is defined as follows:

000	-	SKC	- Sky Clear
001	-	NSC	- No Significant Clouds
010	-	SCT	- Scattered
011	-	BKN	- Broken
100	-	OVC	- Overcast
101	-	CB	- Cumulonimbus
110	-	TCU	- Towering Cumulus
111	-	Spare	

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11. The 3-bit code for Airfield Colour State is used by UK, US, Netherlands, Canada and Germany, and is defined as follows:

Airfield Colour State					
I_{61}	I_{62}	I_{63}	Colour	Visibility	Cloud Ceiling
0	0	0	Blue	8 km	2500 ft AGL
0	0	1	White	5 km	1500 ft AGL
0	1	0	Green	3.7 km	700 ft AGL
0	1	1	Yellow 1	2.5 km	500 ft AGL
1	0	0	Yellow 2	1.5 km	300 ft AGL
1	0	1	Amber	0.9 km	200 ft AGL
1	1	0	Red	< 0.9 km	< 200 ft AGL
1	1	1	Black	Not Usable	Not Usable

The 6-bit code for type of weather follows the convention of WMO - No. 306, Manual of Codes, as follows:

00 = Thunderstorm
01 = Rain
02 = Rain Showers
03 = Drizzle .
04 = Freezing Rain
05 = Freezing Drizzle
06 = Snow
07 = Snow Grains
08 = Ice Crystals
09 = Ice Pellets
10 = Snow Showers
11 = Snow Pellets
12 = Hall
13 = Fog/Ice Fog
14 = Mist
15 = Shallow Fog
16 = Fog Patches
17 = Freezing Fog
18 = Haze
19 = Smoke
20 = Blowing Snow
21 = Drifting Snow
22 = Blowing Dust
23 = Drifting Dust
24 = Blowing Sand
25 = Drifting Sand
26 = Dust storm
27 = Sandstorm
28 =Volcanic Ash
29 = Squall
30-63 = Spare Codes

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12. The 2-bit code for Revised Touchdown Point Location in relation to runway centreline is defined as follows:

00	-	Non-Standard Site Heliport Operations
01	-	Right of Runway Centreline as seen by the pilot on approach
10	-	No Change. The pilot will land on the runway centreline
11	-	Left of Runway Centreline as seen by the pilot on approach

13. The 14-bit code for Revised Runway Loading Conditions (LCN) is defined based on ICAO Standard ACN/PCN systems as follows:

First 8 Bits - Pavement Classification Number 0 to 200 in increments of 1

Next 2 bits - Maximum Tire Pressure as follows:

00	-	W - High, No Limit
01	-	X - Medium, Limit up to 217 psi
10	-	Y - Low, Limited to 145 psi
11	-	Z - Very Low, limited to 73 psi

Last 4 bits - Spare

14. The preferred MLS RNAV Approach Procedure for the 20-bit field is defined by the 12-bit Preamble and 8-bit Address codes defined for the RNAV procedure in Auxiliary Data Word B structures. Refer to ICAO Annex 10, Table A-15, 'Procedure Descriptor Words'.

15. The 5-bit code for Physical Threat Type is defined as follows:

00000 - AAA - Air-to-Air Artillery
00001 - SAM - Surface to Air Missile
00010 - AI - Air Interceptor
00011 - SAF - Small Arms Fire
other codes are spare

16. The 5 bit code for Jamming/Spoofing Threat Type is defined as follows:

00000	- CW	00101	- HF Comms
00001	- Pulse	00110	- VHF Navigation
00010	- Spoofing Threat	00111	- UHF Navigation
00011	- UHF Comms	01000	- L Band Navigation
00100	- VHF Comms	All other codes are spare	

17. The 6-bit code for Jamming/Spoofing Band and/or Specific Equipment Type is defined based on the ARINC Frequency Spectrum definitions, and specific Applications as follows:

0 = A	7 = H
1 = B	8 = 1
2 = C	9 = J
3 = D	10 = K
4 = E	11 = L
5 = F	12 = M
6 = G	

Other codes are spare

18. The origin of the coordinate system is the MLS Datum Point. The X-axis is horizontal and lies in the vertical plane containing the runway centerline, with a positive number representing a location toward the approach reference datum. The Y-axis is horizontal and perpendicular to the X-axis, with a positive number representing a location to the left of runway centreline as viewed from the Datum Point looking toward the approach reference datum. The Z-axis is vertical with a positive number representing a location above the MLS datum point.

19. The convention for coding the most significant bit as the sign bit is as follows: 0 = positive. 1 = negative. The other bits of the field represent the absolute value.

20. The taxi pattern ramp parking code data bits are defined by National authorities and may include such items as Ramp Parking Spot Areas or Numbers, using the 6 bits.

21. The circuit direction is defined as 0 = right and 1 = left as seen from the pilot on final approach.

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MINIMUM AND DESIRED CAPABILITIES OF A
TACTICAL MICROWAVE LANDING SYSTEM (TMLS)

1. A TMLS ground system shall provide an MLS signal-in-space which conforms to the minimum requirements necessary to achieve MLS interoperability as defined in ICAO Annex 10 SARPS. As a minimum it shall meet Category I accuracy (ILS Standard) and integrity.

2. When packaged for transport, the size is not to exceed 2 m x 2 m x 2.5 m and the weight shall not exceed 1000 kilograms. Minimum coverage volume shall be 0.9 to 15 degrees in elevation and $\pm$ 40 degrees in azimuth out to a range of at least 15 nautical miles; no clearance, out of coverage indications (OCI), or back azimuth (BAZ) RF transmissions are required.

3. The TMLS shall be capable of operating to full specification and be ready for flight checking within two hours of arriving at an unprepared site. It is desirable that it be equipped with an integral power supply capable of operating the equipment continuously for a minimum of four hours. The equipment shall be capable of being packed/unpacked and loaded/unloaded in separate transportable units by three persons without any extra ground equipment.

4. It is desirable that the TMLS be able to operate in silent mode awaiting interrogation by an aircraft DME interrogator.