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INTERNATIONAL STANDARD

Global maritime distress and safety system (GMDSS) – Part 4: Inmarsat-C ship earth station and Inmarsat enhanced group call (EGC) equipment – Operational and performance requirements, methods of testing and required test results

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (GMDSS) –

Part 4: Inmarsat-C ship earth station and Inmarsat enhanced group call (EGC) equipment – Operational and performance requirements, methods of testing and required test results

FOREWORD

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International Standard IEC 61097-4 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

The main changes with respect to the previous edition are:

– the IMO references and requirements have been updated to the new performance standards for enhanced group call equipment adopted in 2010 as resolution MSC.306(87). The new performance standards incorporate new requirements for an indication of ship's position which has not been updated (3.4.3) and an alarm for paper low condition (3.4.7).

These two requirements are, however, derived from Inmarsat documentation so there is no technical change to equipment;

– a new subclause has been added (3.7) concerning long-range identification and tracking (LRIT) to support IMO performance standards given in resolution MSC.263(84) adopted in 2008;

– references to Inmarsat documentation have been simplified by moving the content of Tables 1, 2, 4 and 5 into a new Annex C;

– the text has been editorially updated to conform to the ISO/IEC Directives.

The text of this standard is based on the following documents:

FDIS	Report on voting
80/659/FDIS	80/666/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 61097 series, published under the general title *Global maritime distress and safety system (GMDSS)*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (GMDSS) –

Part 4: Inmarsat-C ship earth station and Inmarsat enhanced group call (EGC) equipment – Operational and performance requirements, methods of testing and required test results

1 Scope

This part of IEC 61097 specifies the performance requirements and methods of testing for Inmarsat-C ship earth stations (SES) capable of transmitting and receiving direct-printing communications, and for enhanced group call (EGC) receivers, for use in the GMDSS and for use for long-range identification and tracking (LRIT). The available variants are:

Class 0: An EGC receiver, either stand-alone or an element of a GMDSS installation in accordance with the Inmarsat design and installation guidelines (DIGs) for GMDSS installations.

Class 1: A basic SES providing shore-to-ship and ship-to-shore message transfer only.

Class 2: As class 1 but with EGC as an alternative to shore-to-ship transfer using a shared receiver.

Class 3: As class 1 but with EGC using an independent receiver.

NOTE 1 The 34th session of the IMO Sub-Committee on Radiocommunications decided that class 2 equipment would be adequate to provide sufficient availability for the reception of maritime safety information for the GMDSS.

The standard complies with IMO performance requirements stated in the normative references, Inmarsat technical characteristics and test procedures, and IEC 60945 general requirements except where modifications are explicitly stated in this standard. Technical characteristics essential to GMDSS and LRIT operation as defined by the IMO are identified.

All text of this standard, whose wording is identical to that in IMO SOLAS Convention 1974 as amended in 1988 and Resolutions A.807(19), MSC.263(84) and MSC.306(87) is printed in *italics* and reference made to the Resolution/Recommendation and subclause number.

This standard covers equipment construction and testing. Matters relating to installation may also be found in the Inmarsat Maritime design and installation guidelines (see Bibliography). Those to be found in IMO Resolutions A.807(19), MSC.263(84) and MSC.306(87) are reproduced in Annex A.

Responsibility for type approval of Inmarsat-C and Inmarsat-EGC is vested in Inmarsat by IMO Resolutions A.807(19) and MSC.306(87) (see 3.2.1). Therefore, this standard does not reproduce Inmarsat test procedures in full, but refers to where they are given in Inmarsat documentation cited in the normative references to this standard (Annex C).

NOTE 2 For the purposes of this standard the terms Inmarsat-C, Inmarsat Standard-C, Standard-C refer to the same equipment.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60945:2002, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

IEC 61108 (all parts), *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS)*

IEC 61162-1, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners*

IMO, *International Convention for the safety of life at sea (SOLAS),1974 as amended*

IMO Resolution A.694(17):1991, *General requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigational aids*

IMO Resolution A.807(19):1995, *Performance Standards for INMARSAT-C ship earth stations capable of transmitting and receiving direct-printing communications as amended by Resolution MSC.68(68) Annex 4*

IMO Resolution MSC.263(84):2008, *Revised performance standards and functional requirements for the long-range identification and tracking of ships.*

IMO Resolution MSC.306(87):2010, *Revised performance standards for enhanced group call (EGC) equipment*

Inmarsat, *Inmarsat-C System definition manual (SDM) Volume 2 – Part 2, Application Note 2, Position reporting service*

Inmarsat, *Inmarsat-C System definition manual (SDM) Volume 2 – Part 2, Application Note 3, Application developers guide to data reporting and polling*

Inmarsat, *Inmarsat-C System definition manual (SDM) Volume 3 – Part 2, Chapter 2, Mobile earth station technical* requirements

Inmarsat, *Inmarsat-C System definition manual (SDM) Volume 3 – Part 2, Chapter 5, Ship earth station technical requirements*

Inmarsat, *Inmarsat-C System definition manual (SDM) Volume 3 – Part 2, Chapter 8, Technical requirements for an EGC receiver*

Inmarsat, *Recommended test procedures (RTP) for the type approval of Inmarsat-C mobile earth stations*

3 Performance requirements

3.1 Overview

Subclauses 3.2 through 3.4 of this standard describe performance requirements directly attributable to IMO Resolutions A.807(19) and MSC.306(87) as listed in the normative references. Subclause 3.5 is provided to highlight those requirements of IMO Resolution A.694(17) which are not included in the normal Inmarsat requirements for Inmarsat-C SES type approval. Subclause 3.6 describes other requirements which are required to make the equipment suitable for GMDSS applications. Subclause 3.7 describes performance requirements attributable to IMO Resolution MSC.263(84) for long-range identification and tracking.

3.2 Non-operational requirements

3.2.1 General

(A.807(19) A1.1/MSC.306(87) A1.1) The Inmarsat Standard-C ship earth station installation capable of transmitting and receiving direct-printing communications, and the enhanced group call equipment to be used in the GMDSS shall *comply with the general requirements set out in Assembly resolution A.694(17)* as detailed in IEC 60945 *and* this *IEC standard.*

(A.807(19) A2/MSC.306(87) 2) The ship earth station and the EGC equipment shall *be type-approved by Inmarsat and* shall *comply with the environmental conditions and electromagnetic compatibility requirements specified in IEC 60945*.

3.2.2 Warning of radiation hazard

(A.807(19) A4) In order to permit a warning of potential radiation hazards to be displayed in appropriate locations, a label shall *be attached to the radome indicating the distances external to the radome at which radiation levels of 100 W/m^2, 25 W/m^2 and 10 W/m^2 exist. However, the distances which are within the radome need not be indicated.*

NOTE Due to the low transmitted power of Inmarsat-C transmitters (less than 16 dBW) and the omnidirectional antenna used, this label is not normally required.

3.2.3 Power supply changeover

(See 5.2)

(A.807(19) A5.2/MSC.306(87) A4.2) Changing from one source of supply to another or any interruption of up to 60 s duration of the supply of electrical energy shall *not require the equipment to be manually re-initialized and* shall *not result in loss of received messages stored in the memory.*

3.3 Operational requirements for ship earth stations

3.3.1 Capabilities

(See 5.3.1)

The equipment shall comply with regulations IV/8 through IV/10 of SOLAS 1974, as amended, which prescribe the capabilities of Inmarsat ship earth stations to meet the GMDSS requirements for ships in the various sea areas. The four capabilities are:

– *(SOLAS IV/8.1.5.1/IV/9.1.3.3 and IV/10.1.4.3): means of initiating the transmission of ship-to-shore distress alerts.*
– *(SOLAS IV/10.1.1.1): transmitting and receiving distress and safety communications using direct-printing telegraphy.*
– *(SOLAS IV/10.1.1.2): initiating and receiving distress priority calls.*
– *(SOLAS IV/9.3.2/IV/10.1.1.4): transmitting and receiving general radiocommunications, using either radiotelephony or direct-printing telegraphy.*

NOTE In the case of this equipment only direct-printing telegraphy applies.

3.3.2 Ship station identity

(See 5.3.2)

(A.807(19) A3.1): No control external to the equipment shall *be available for alteration of the ship station identity.*

3.3.3 Distress alerting

(See 5.3.3)

(A.807(19) A3.2): It shall *be possible to initiate and make distress calls from the position from which the ship is normally navigated and from at least one other position designated for distress alerting.*

(A.807(19) A3.3): A distress alert shall *be activated only by means of a dedicated distress button. This button* shall *not be any key of an ITU-T digital input panel or an ISO keyboard provided on the equipment.*

(A.807(19) A3.4): The dedicated distress button shall*:*

1) *be clearly identified; and*
2) *be protected against inadvertent operation.*

(A.807(19) A3.5): The distress alert initiation shall *require at least two independent actions.*

(A.807(19) A3.6): The equipment shall *indicate the status of the distress alert transmission.*

(A.807(19) A3.7): It shall *be possible to interrupt and initiate distress messages at any time.*

It shall be possible to select the content of, but not initiate a distress alert using the equipment keyboard or other means, before depressing one of the dedicated buttons to initiate the distress alert. It shall also be possible to activate an undesignated (see Note) distress alert by depressing one of the buttons, at any time.

NOTE Undesignated – unspecified distress alert, i.e. the default setting. All other selectable alerts are "designated".

3.3.4 Position updating

(See 5.3.4)

(A.807(19) A3.8): Facilities shall *be provided to automatically update the ship's position and the time at which the position was determined from a suitable electronic position-fixing aid which may be an integral part of the equipment. For equipment which does not have an integral position-fixing aid, such facilities* shall *include a suitable interface conforming to* IEC 61162*.*

The integral electronic position-fixing aid shall comply with the applicable requirements of the IEC 61108 series.

As a minimum, the interface shall support the sentences GNS, RMC and ZDA described in IEC 61162-1.

(A.807(19) A3.9): Provision shall *also be made for manual entry of position information and of the time at which the position was determined.*

(A.807(19) A3.10): An alarm shall *be activated when no position data is received from the electronic position-fixing aid or, in the case of manual input, the position information is over 4 hours old. Any position information not updated for more than 24 hours* shall *be clearly identified.* See also 3.4.3.

NOTE Subclause 3.3.7, which is referenced in the Inmarsat-C SDM, is 3.3.3 in this edition of this standard.

3.4 Operational requirements for EGC receivers

3.4.1 Capabilities

(See 5.4.1)

The equipment shall comply with regulations IV/7 and IV/10 of SOLAS 1974, as amended, which prescribe the capabilities of EGC receivers to meet the GMDSS requirements for ships in the various sea areas. The two capabilities are:

– *(SOLAS IV/7.1.5): a radio facility for reception of maritime safety information by the Inmarsat enhanced group calling system.*
– *(SOLAS IV/10.1.1.3): an Inmarsat ship earth station capable of maintaining watch for shore-to-ship distress alerts, including those directed to specifically defined geographical areas.*

3.4.2 General

(See 5.4.2)

(MSC.306(87) A1.2): The equipment shall *be capable of producing a printed copy of received information. Received EGC messages may be stored, for later printing with an indication to the operator that the message has been received, except for the vital messages referred to in A.3.2 which* shall *be printed out upon receipt.*

(MSC.306(87) A1.3): The enhanced group call installation may be either separate or combined with other installations. Elements of other installations, e.g. the antenna, low noise amplifier and down converter of the ship earth system, may be shared for the reception of enhanced group call messages.

3.4.3 Position and area code updating

(See 5.4.3)

(MSC.306(87) A3.1): The equipment shall *provide a visual indication that the ship's position has not been updated during the last 12 hours. It* shall *only be possible to reset this indication by revalidating the ship's position.* See also 3.3.4.

(MSC.306(87) A3.2): Means shall *be provided to enter the ship's position and current and planned NAVAREA/METAREA codes manually so that area group calls can be received. Means* shall *also be provided to enter current and planned coastal warning service coverage areas and different classes of messages. Optionally, the ship's position, as determined by the navigational equipment may be entered automatically and the NAVAREA/METAREA code automatically derived therefrom.*

NOTE NAVAREAs and METAREAs are geographical sea areas established for the purpose of co-ordinating the broadcast of navigational and meteorological safety information. The world is currently divided into 21 areas (I to XXI). The boundaries are shown in the IMO International SafetyNET Manual.

3.4.4 Indication of receipt of priority message

(See 5.4.4)

(MSC.306(87) A3.3): Provision shall *be made for a specific aural alarm and visual indication at the position from which the ship is normally navigated to indicate receipt of a distress or urgency priority EGC message. It* shall *not be possible to disable this alarm and it* shall *only be possible to reset it manually and only from the position where the message is displayed or printed.*

3.4.5 Indication of tuning and synchronisation

(See 5.4.5)

(MSC.306(87) A3.4): The equipment shall *indicate when it is not correctly tuned or synchronized to the enhanced group call carrier.*

3.4.6 Printing selection

(See 5.4.6)

(MSC.306(87) A3.5): Any message shall *be printed regardless of the character error rate of its reception. The equipment* shall *print a low-line mark if a character is received corrupted.*

(MSC.306(87) A3.6): Acceptance or rejection of service codes shall *be under the operator's control except that equipment* shall *always receive navigational and meteorological warnings and forecasts, search and rescue information, and shore-to-ship distress alerts, which are directed to a fixed or absolute geographical area in which the ship is operating.*

NOTE The service codes (C_2) are described in the IMO International SafetyNET Manual. They have similar meanings as the subject indicator characters (B_2) in the NAVTEX system described in the IMO NAVTEX Manual and Recommendation ITU-R M.540.

(MSC.306(87) A3.7): Means shall *be provided to prevent the reprinting of a message once it has been received without error.*

3.4.7 Printing device

(See 5.4.7)

(MSC.306(87) A3.8): *The printing device* shall *be capable of printing at least the standard International Alphabet Number 5 (IA5) character set. Other character sets are optionally used according to ISO 2022 standards.*

(MSC.306(87) A3.9): The printing device shall *be able to print at least 40 characters per line.*

(MSC.306(87) A3.10): The signal processor and printing device shall *ensure that if a word cannot be accommodated in full on one line, it* shall *be transferred to the next line. The printing device* shall *automatically feed five lines after completing the printed messages.*

(MSC.306(87) A3.11): A local audible alarm shall *be sounded to give advanced warning of the printing device "paper low" condition. It* shall *not be possible to confuse the sound of the "paper low" alarm with that of the distress or urgency alarm caused by the reception of a distress or urgency priority message.*

3.5 Performance related requirements from IEC 60945

(See 5.5)

The equipment shall comply with those clauses of IEC 60945 appropriate to its equipment class. The subclauses of IEC 60945 referenced below, amend or augment the corresponding requirements of the Inmarsat-C SDM.

– 4.1 *General*
– 4.2 *Design and operation*
– 4.3 *Power supply*
– 4.4 *Durability and resistance to environmental conditions* (see 4.2)
– 4.5 *Interference* (see 4.2)
– 4.6 *Safety precautions*
– 4.7 *Maintenance*
– 4.8 *Equipment manuals*
– 4.9 *Marking and identification*

3.6 Other requirements

(See 5.6)

Message display facilities shall be suitable for displaying received distress-related messages. It is recommended that the display facilities should comply with the corresponding requirements for EGC receivers in 3.4.6 and 3.4.7.

Any programming material or software that forms part of the equipment and which is necessary for meeting the GMDSS requirements shall be permanently installed in the equipment. Any software needed to fulfil any distress and safety requirements of the GMDSS shall not be stored on any medium which can be accessed, modified or corrupted.

Any ancillaries associated with Inmarsat-C equipment, such as visual display units, keyboards and printers, shall be available immediately on demand to service GMDSS functional requirements. These ancillaries shall also be provided with fixing arrangements to prevent unauthorized removal or disconnection.

3.7 Long-range identification and tracking

3.7.1 General

(See 5.7.1)

Long-range identification and tracking of ships (LRIT) is a requirement of regulation V/19-1 of SOLAS 1974 as amended.

NOTE IEC 62729 contains general information on requirements and testing for LRIT.

For the purposes of LRIT the Inmarsat-C SES shall support the Inmarsat enhanced pre-assigned data reporting service (reserved access) the enhanced data reporting service (unreserved access), and the polling service.

NOTE Enhanced and enhanced pre-assigned data reporting offers additional capabilities and features over the Inmarsat data reporting service particularly; use of an internal data reporting checksum, inclusion of the ship earth station identification to ensure unambiguous identification of stations, an acknowledgement mechanism managing multiple assignments inside the ocean region and across ocean regions, changing reporting intervals, controlling and querying assignments and status request facility to ensure reliable transfer.

3.7.2 Capabilities

3.7.2.1 Transmission of information

(See 5.7.2)

(MSC.263(84) A4.1.1) Shipborne equipment shall *be capable of automatically and without human intervention on board the ship transmitting the ship's LRIT information at 6-hour intervals to an LRIT Data Centre*

(*MSC.263(84) A4.4.1) When a ship is undergoing repairs, modifications or conversions in dry-dock or in port or is laid up for a long period, the master or the Administration may reduce the frequency of the transmission LRIT information to one transmission every 24-hour period, or may temporarily stop the transmission of such information.*

NOTE LRIT Data Centres are set up by Governments, either individually or in cooperation with other Governments. Administrations decide to which LRIT Data Centre ships entitled to fly their flag are required to transmit the LRIT information. The LRIT information is described in Table 1.

This requirement is achieved by the reserved data reporting service using a Data Network Identity (DNID) and a Member Number to associate the LRIT information with an LRIT Data Centre. Information about the DNID and Member Number is downloaded by polling commands (see 3.7.2.2) under the control of an Administration.

There shall be no control external to the equipment to set up or remove DNIDs. However, facilities shall be provided to stop the transmission of LRIT information and to increase the intervals between transmissions to 24 h, by controls external to the equipment. Facilities shall

also be provided to re-enable the transmissions at 6 h intervals. These facilities shall be security protected so that access can be restricted to the master only.

3.7.2.2 Remote configuration

(MSC.263(84) A4.1.2) Shipborne equipment shall *be capable of being configured remotely to transmit LRIT information at variable intervals (Pre-scheduled position reports)*

The equipment shall be capable of being remotely configured to transmit LRIT information at intervals ranging from a minimum of 15 min to periods of 6 h to the LRIT Data Centre, irrespective of where the ship is located and without human interaction on board the ship.

The equipment shall also be capable of being remotely configured to stop the transmission of LRIT information.

This requirement is achieved by the polling service and by using control/query commands supported by the enhanced pre-assigned data reporting service. The equipment shall support polling command types 00H to 0BH as described in the Inmarsat-C SDM Volume 2, Part 2, Application Note 3.

Configuration information, as described in the Inmarsat-C SDM Volume 2, Part 2, Application Note 3 shall be stored in non-volatile memory to allow recovery after a power outage. There shall be provision within the non-volatile memory to store at least 64 16-bit DNIDs.

3.7.2.3 On-demand reports

(*MSC.263(84) A4.1.3)* Shipborne equipment shall *be capable of transmitting LRIT information following receipt of polling commands (On-demand position reports)*

NOTE 1 On-demand position reports means transmission of LRIT information as a result of either receipt of polling command or of remote configuration of the equipment so as to transmit at intervals other than the preset ones.

The equipment shall be capable of responding to a request to transmit LRIT information on demand without human interaction on board the ship, irrespective of where the ship is located.

This requirement is achieved by the polling and data reporting service.

The equipment shall transmit the LRIT information within 8 min of receiving the polling command.

NOTE 2 The worst case signalling exchange for a polling command takes 44 frames plus 1 min (7,3 min). MSC.263(84) A13 requires that on-demand information be provided to an LRIT data user within 30 min of the time that the LRIT data user requested the information.

3.7.3 Functionality

(See 5.7.3)

(*MSC.263(84) A4.2) In addition to the provisions specified in* 3.7.2*, the shipborne equipment* shall *provide the functionality specified in* Table 1.

Table 1 – Data to be transmitted from the shipborne equipment

Parameter	Comments
Identity of the ship	The identifier used by the shipborne equipment.
Position of the ship (latitude and longitude)	The Global Navigation Satellite System (GNSS) position (latitude and longitude) of the ship (based on the WGS 84 datum).
Date and time of the position provided	The date and time, indicated as Universal Coordinated Time (UTC), associated with the GNSS position. In the LRIT system this is known as Time Stamp 1.The equipment should be capable of transmitting the time associated with the GNSS position with each transmission of LRIT information.
NOTE The format of the data report is described in the Inmarsat-C SDM Volume 2, Part 2, Application Note 2. The enhanced data reporting protocol permits the 24-bit codes allocated to the ship earth station as "to-mobile" and "from-mobile" identifiers to be included, together with the 8-bit code identifier for the land earth station used. The category of the report is 01B (maritime position report). The latitude and longitude of the position is coded to an accuracy of 0,04 of a Minute. The Macro Encoded Message (MEM code) is set to 11 (time of position). The date is coded as current or next month and day. The time is coded as hour and minutes to an accuracy of 2 min.	

3.7.4 Communication system

(See 5.7.4)

(MSC.263(84) A4.3) The shipborne equipment shall *transmit the LRIT information using a communication system which provides coverage in all areas where the ship operates.*

The Inmarsat-C shipborne equipment operates in the coverage area defined by Inmarsat which comprises the Pacific Ocean Region, Atlantic Ocean Region-West, Atlantic Ocean Region-East and Indian Ocean Region.

NOTE Each 16-bit Data Network Identity (DNID) is associated with the 8-bit code of a land earth station (LES). In order for an equipment to continue transmitting after a change of Ocean Region it is necessary for the equipment to have stored DNID/LES pairs of codes relevant to all Ocean Regions.

4 Technical characteristics

4.1 Overview

(See 5.8.1)

IMO Resolutions A.807(19) and MSC.306(87) appoint Inmarsat as the type approval authority for Inmarsat-C SES and Inmarsat-EGC (see 3.2.1). The Inmarsat-C SDM is, therefore, the primary source of technical characteristics for Inmarsat-C SES and EGC receivers for use in the GMDSS, but the following amendments and additions shall apply.

4.2 Environmental and electromagnetic compatibility requirement

(See 5.8.2)

Models of Inmarsat-C SESs and EGC receivers which are to be submitted for type approval for GMDSS use within the Inmarsat system shall be designed so as to operate over the following range of environmental conditions, which are consistent with the requirements as indicated of either

a) Inmarsat-C SDM, Volume 3, Part 2, Chapter 5 + Annex A (referred to below as "Inmarsat"), or,

b) Inmarsat modified by IEC 60945 using the most stringent combined set of conditions, or,

c) IEC 60945.

Table 2 provides a summary of the Inmarsat environmental requirements as modified by IEC 60945. Annex C describes the tests to which the various environmental conditions are applied.

Table 2 – Environmental conditions

	Condition	Comment
a)	Ambient temperature	"Inmarsat" modified by 8.2/8.4 of IEC 60945
b)	Relative humidity	“Inmarsat” modified by 8.3 of IEC 60945
c)	Spray	"Inmarsat" modified by 8.8 of IEC 60945
d)	Ice	"Inmarsat"
e)	Precipitation	"Inmarsat" modified by 8.8 of IEC 60945
f)	Wind	"Inmarsat"
g)	Solar radiation	"Inmarsat"
h)	Prime power variations	
	AC mains supply	"Inmarsat"
	DC mains supply	"Inmarsat"
	Battery supply	"Inmarsat" modified by 4.3.2 of IEC 60945
j)	Vibration	“Inmarsat” modified by 8.7 of IEC 60945
k)	Antenna inclinations	"Inmarsat"
l)	Induced acceleration	"Inmarsat"
m)	Velocity	"Inmarsat"
	Corrosion	8.12 of IEC 60945
NOTE The letters a) to m) directly mirror the lettering used in the Inmarsat-C SDM, Volume 3, Part 2, Chapter 5, section 11.2.		

All Inmarsat-C equipment covered by this standard shall comply with the electromagnetic compatibility requirements detailed in the tests in IEC 60945, Clauses 9 and 10.

4.3 Radiated spurious emissions

The radiated spurious emission requirement is described in Annex B.

5 Methods of testing and required test results

5.1 Overview

5.1.1 General

All tests carried out under Inmarsat control as per the applicable Inmarsat SDM will be acceptable and need not be repeated for compliance with this standard.

NOTE Inmarsat test items given below relate to Inmarsat recommended test procedures (RTP) as described in Annex C. The given order of tests is logical regarding equipment build state and test location, but is not critical and may be changed if required.

5.1.2 Performance requirements

The equipment shall be tested for compliance with the performance requirements described in Clause 3 using the methods prescribed in 5.2 through 5.6.

5.1.3 Technical characteristics

The equipment shall be tested for compliance with the technical characteristics listed in Clause 4 using the methods prescribed in the Inmarsat documentation, but using the environmental conditions defined in Table 2, as indicated in 5.7.

5.2 Tests of non-operational requirements

(See 3.2)

With the equipment operating normally, and with a received message stored in the equipment, the power shall be removed for a period of 60 s, and then restored. On restoration of the power the equipment shall continue to operate normally, remain logged to the previous ocean region, and the stored message shall contain no additional errors.

5.3 Tests of operational requirements for ship earth stations

5.3.1 Capabilities

(See 3.3.1)

Compliance with the SOLAS regulations is checked by Inmarsat testing particularly:

– Inmarsat test item S8-B (Distress alert activation), for means of initiating the transmission of ship-to-shore distress alerts;

– Inmarsat test items; 7-A (character codes), S7-B (display devices), 7-C (keyboard), 22-A (to-mobile message transfer), 23-A (distress alert transmission) and 23-B (distress alert message transfer) for transmitting and receiving distress and safety communications, distress priority calls and general radiocommunications.

5.3.2 Ship station identity

(See 3.3.2)

Check by inspection of the equipment and the manufacturer's documentation that no external control is available for alteration of the ship station identity.

5.3.3 Distress alerting

(See 3.3.3)

Check by inspection of the equipment and the manufacturer's documentation that a dedicated distress button is provided which is capable of being installed at a position on a ship from which the ship is normally navigated. Check that provisions have been made for a further dedicated button for use with the equipment suitable for installation on a ship at another position.

Check that the design and operation of the distress button conforms to the requirements and tests given for distress alert in 4.2.1.8 of IEC 60945.

Check that it is possible to select the content of a distress alert before initiating a distress alert but check also that it is possible to initiate a distress alert without selecting any content and that in this case the alert is undesignated.

NOTE The function of the distress alert activation is checked by Inmarsat test item S8-B.

5.3.4 Position updating

(See 3.3.4)

If the equipment includes a Global Navigation Satellite System receiver check by inspection of manufacturer's documentation that the position accuracy (static and dynamic), speed over the

ground (SOG) accuracy, course over the ground (COG) accuracy, update rate, interference susceptibility and status indication comply with the requirements of the IEC 61108 series.

If the equipment has an interface for obtaining position information check that this supports the sentences GNS, RMC and ZDA described in IEC 61162-1.

Check that facilities are provided for manual entry of position.

By inhibiting the signal from a position fixing aid (internally provided or externally provided through an interface) check that a warning is activated when no position data is received.

Check with a manual entry of position that a warning is activated after 4 h.

Check by not updating the position information in the equipment for 24 h that there is an indication that the position is over 24 h old.

NOTE See also 5.4.3 which tests for a further indication if the equipment includes an EGC receiver.

5.4 Tests of operational requirements for EGC receivers

5.4.1 Capabilities

(See 3.4.1)

Compliance with the SOLAS regulations is checked by the tests in 5.4.2 to 5.4.7.

5.4.2 General

(See 3.4.2)

The operation of the equipment is checked by Inmarsat testing particularly Inmarsat test items: E-4B (output devices), E-4D (memory capacity), E-4E (receiver addressing) and E-5A (distress messages).

Inspect the configuration of the receiver and note whether it is stand alone or combined with other equipment.

5.4.3 Position and area code updating

(See 3.4.3)

Check by not updating the position information in the equipment for 12 h that there is an indication that the position is over 12 h old. Check that this indication can only be reset by revalidating the position.

Check by inspection of the equipment that facilities are provided to manually enter NAVAREA/METAREA codes, coastal warning areas and subject indicators (type of message) for coastal warnings.

5.4.4 Indication of receipt of priority message

(See 3.4.4)

Compliance with the requirements for the alarm and indications is checked by Inmarsat test item E-5A (distress messages).

5.4.5 Indication of tuning and synchronisation

(See 3.4.5)

Compliance with the requirement for an indication when the equipment is not correctly tuned or synchronised is checked by Inmarsat test item E2-C (receiver tuning).

5.4.6 Printing selection

(See 3.4.6)

Compliance with the requirements for acceptance or rejection of EGC service code types is checked by Inmarsat test item E4-E (receiver addressing).

Compliance with the requirements for printing of messages is checked by Inmarsat test item E4-F (error detection) plus the following tests in the sequence given.

a) A numbered message is received twice: print-out shall be made only from the first reception.

b) A message with the same sequence number as in test 1 above, is received, but with one character changed: no print-out shall be made.

c) The same message with a new sequence number shall be received, but with one character error: print-out shall be made with that character replaced by a low line-mark.

d) The message as in test c) above, with the same sequence number shall be received correctly: print-out shall be made.

5.4.7 Printing device

(See 3.4.7)

Compliance with the requirements for printing devices is checked by Inmarsat test item E4-B (output devices).

5.5 Tests of performance related requirements from IEC 60945

(See 3.5)

The tests for the requirements of IEC 60945 are detailed in IEC 60945.

5.6 Tests of other requirements

(See 3.6)

Check the requirements by inspection of the equipment and the manufacturer's documentation.

5.7 Long-range identification and tracking

5.7.1 General

(See 3.7.1)

Check by inspection of the manufacturer's documentation that the equipment supports the enhanced pre-assigned data reporting service, the enhanced data reporting service and polling.

5.7.2 Capabilities

(See 3.7.2)

Check by inspection of the manufacturer's documentation that the operation of the equipment for polling and data reporting has been tested by Inmarsat.

Check by observation of the equipment that facilities exist to remotely program the equipment to transmit LRIT information at 6 h intervals.

Check by observation of the equipment that there is no control external to the equipment to set up or remove DNIDs. Check by inspection of manufacturer's documentation that non-volatile memory is provided in the equipment to store 64 DNIDs with associated configuration information.

Check by observation that there are facilities to stop the transmission of LRIT information, to increase the intervals between transmissions to 24 h and to re-enable the transmissions at 6 h intervals. Confirm by observation that the operation of the facilities is protected by unathorised access such as by a password or a key-lock.

Check by inspection of manufacturer's documentation that facilities exist to remotely configure the equipment to transmit LRIT information at intervals ranging from 15 min to 6 h, and to stop the transmission of LRIT information.

Check by inspection of manufacturer's documentation that the equipment will transmit LRIT information following receipt of a polling command and supports polling command types 00H to 0BH.

5.7.3 Functionality

(See 3.7.3)

Check by inspection of manufacturer's documentation that the format of the data report is a maritime position report as described in the Inmarsat-C SDM, Volume 2, Part 2, Application Note 2. Check that the "from mobile" identifier is used for the identity of the ship and that MEM code 11 is used for time of position.

Check by observing a data report that the transmitted position and date and time conform to the data provided by the source of position updating (3.3.4).

5.7.4 Communication system

(See 3.7.4)

For this test a simulator of the LRIT system is required or the international LRIT system may be used.

Instruct the equipment:

- to transmit to a LRIT Data Centre. Confirm that the equipment transmits the LRIT data at intervals of 6 h;
- to transmit LRIT information at 15 min intervals. Confirm that the equipment transmits at 15 min intervals;
- to transmit LRIT information at 60 min intervals. Confirm that the equipment transmits at 60 min intervals;
- with a polling command. Confirm that the equipment transmits the LRIT information within 8 min of receiving the polling command;
- to stop the transmission of LRIT information. Confirm that no information is transmitted within a 90 min period.

Use the facilities locally provided on the equipment:

- to stop the transmission of LRIT information. Confirm that no information is transmitted within a 90 min period;
- to increase the intervals between transmissions to 24 h. Confirm that transmissions are made at 24 h intervals;
- to reset the intervals between transmissions to 6 h. Confirm that transmissions are made at 6 h intervals.

Using a simulator or the LRIT system, cause the equipment to change Ocean Region or satellite. Confirm that the equipment continues to transmit LRIT information after the change of Region.

Remove the source of power from the equipment for 24 h. Confirm that the equipment automatically resumes the transmission of LRIT information when the power is restored.

NOTE This test may be combined with an IMO conformance test as described in IMO Circular MSC.1/Circ.1307.

5.8 Tests of technical characteristics

5.8.1 Inmarsat tests

(See 4.1)

The tests in the Inmarsat Recommended Test Procedures (RTP) corresponding to the technical requirements in the Inmarsat System Definition Manual (SDM) are summarised in Annex C.

There are two series of tests. Phase I tests use a simulator to generate suitable signals as produced by an Inmarsat network coordination station and a land earth station together with a simulator to produce the characteristics of the radio transmission channel. Phase II tests are conducted by operating the equipment in the Inmarsat system.

5.8.2 Tests for environmental and electromagnetic compatibility

(See 4.2)

The tests for environmental and electromagnetic compatibility are given in IEC 60945, Clauses 8, 9 and 10.

For the purposes of IEC 60945 the following terms apply.

Performance test – a measurement of transmitter power output and frequency response and a measurement of receiver noise temperature and tuning to Inmarsat standards.

Performance check – successful transmission of a distress alert, distress priority message and reception of maritime safety information.

Annex A
(normative)

Requirements relating to installation

A.1 General

This annex reproduces those requirements relating to installation as extracted from IMO Resolutions A.807(19), MSC.263(84) and MSC.306(87).

A.2 Source of electrical energy

(A.807(19) A5.1 and MSC.306(87) A4.1) The ship earth station and the enhanced group call equipment shall *normally be powered from the ship's main source of electrical energy. In addition, it* shall *be possible to operate the ship earth station, the enhanced group call equipment and all other equipment necessary for its normal functioning, including the antenna tracking system, where provided, from an alternative source of energy.*

(*MSC.263(84) A4.1.5)* The LRIT system shall *be supplied with energy from the main and emergency source of electrical power.*

A.3 Siting of antennas

(A.807(19) A6.1 and MSC.306(87) A5.1 and 5.3) Where an omnidirectional antenna is used it shall*, if practicable, be sited in such a position that no obstacle likely to degrade significantly the performance of the equipment appears in the fore and aft directions down to –5 ° and in the port and starboard directions down to –15 °. For omnidirectional antennas, objects, especially those within 1 m of the antenna, which cause a shadow sector of more than 2 °, are likely to degrade significantly the performance of the equipment.*

(A.807(19) A6.2 and MSC.306(87) A5.2 and 5.4) Where a stabilized directive antenna is used it shall*, if practicable, be sited in such a position that no obstacle, likely to degrade significantly the performance of the equipment, appears in any azimuth down to –5 °. For directive antennas with a gain of approximately 20 dB, objects, especially those within 10 m of the antenna, which cause a shadow sector of greater than 6 °, are likely to degrade significantly the performance of the equipment.*

A.4 Long-range identification and tracking

(MSC.263(84) A4.4) The shipborne equipment shall be set to automatically transmit the ship's LRIT information at 6-hour intervals to the LRIT Data Centre identified by the Administration, unless the LRIT Data User requesting the provision of LRIT information specifies a more frequent transmission interval.

A.5 Requirements

It shall be confirmed that the equipment installation handbook contains appropriate information.

Annex B
(normative)

Radiated unwanted emissions

B.1 Unwanted emissions 30 MHz to 1 000 MHz

The unwanted emissions over the frequency range 30 MHz to 1 000 MHz shall not exceed the limits in Table B.1 at a measuring distance of 10 m.

Table B.1 – Limits of unwanted emissions up to 1 000 MHz

Frequency MHz	**Quasi-peak limits** dB(μV/m)
30 to 230	30
230 to 1 000	37
The lower limit should apply at the transition frequency.	

B.2 Unwanted emissions above 1 000 MHz

The unwanted emissions Equivalent Isotropically Radiated Power (EIRP) above 1 000 MHz and outside the bands 1 626,5 MHz to 1 645,5 MHz and 1 656,6 MHz to 1 660,5 MHz, in the measurement bandwidth and in all directions shall not exceed the limits of Table B.2.

Table B.2 – Limits of unwanted emissions above 1 000 MHz

Frequency range [a] MHz	Carrier-on [b]		Carrier-off [c]	
	EIRP limit dBpW	Measurement bandwidth kHz	EIRP limit dBpW	Measurement bandwidth kHz
1 000 to 1 525	49	100	48	100
1 525 to 1 559	49	100	17	3
1 559,0 to 1 580,42	50	1 000	50	1 000
1 580,42 to 1 605,0	50	1 000	50	1 000
1 605,0 to 1 610,0	[d]	100	[e]	100
1 610,0 to 1 626,0	74	100	48	100
1 626 to 1 626,5	84	3	48	100
1 645,5 to 1 645,6	104	3	57	3
1 645,6 to 1 646,1	84	3	57	3
1 646,1 to 1 655,9	74	3	57	3
1 655,9 to 1 656,4	84	3	57	3
1 656,4 to 1 656,5	104	3	57	3
1 660,5 to 1 661	84	3	48	100
1 661 to 1 690	74	100	48	100
1 690 to 3 400	49 [f]	100	48	100
3 400 to 10 700	55 [g]	100	48	100
10 700 to 21 200	61	100	54	100
21 200 to 40 000	67	100	60	100

[a] The lower limits should apply at the transition frequencies.

[b] Carrier-on is defined as the state when the ship earth station is authorised by the Network Coordination Station to transmit and when it transmits a signal.

[c] Carrier-off is defined as the state when the ship earth station is either authorised by the Network Coordination Station to transmit but when it does not transmit any signal, or when it is not authorised by the Network Coordination Station to transmit.

[d] Linearly interpolated from 40 dBpW in 100 kHz at 1 605,0 MHz to 74 dBpW in 100 kHz at 1 610,0 MHz.

[e] Linearly interpolated from 40 dBpW in 100 kHz at 1 605,0 MHz to 74 dBpW in 100 kHz at 1 610,0 MHz.

[f] In the band 3 253,0 MHz to 3 321,0 MHz the maximum EIRP in one, and only one, 100 kHz measurement bandwidth should not exceed 82 dBpW. Elsewhere in this band the power limit in this table should be applied.

[g] In each of the bands 4 879,5 MHz to 4 981,5 MHz, 6 506,0 MHz to 6 642,0 MHz and 8 132,5 MHz to 8 302,5 MHz the maximum EIRP in one, and only one, 100 kHz measurement bandwidth should not exceed 72 dBpW. In the band 9 759,0 MHz to 9 963,0 MHz the maximum power in one, and only one, 100 kHz measurement bandwidth should not exceed 61 dBpW. Elsewhere in these bands the power limit in this table should be applied.

B.3 Unwanted emissions within the bands with carrier-on

The EIRP of the unwanted emissions in any 3 kHz bandwidth within the bands 1 626,5 MHz to 1 645,5 MHz and 1 656,5 MHz to 1 660,5 MHz shall not exceed the limits in Table B.3.

Table B.3 – Limits of unwanted emission within the operating band with carrier-on

Offset from the edge of the band of the nominated bandwidth kHz	**Maximum EIRP** dBpW
0	117
100	104
200	84
greater than 700	74
NOTE 1 Carrier-on is defined as the state when the ship earth station is authorised by the Network Coordination Station to transmit and when it transmits a signal. NOTE 2 Nominated bandwidth is the bandwidth of the ship earth station radio frequency transmission nominated by the manufacturer. The nominated bandwidth is wide enough to encompass all spectral elements of the transmission which have a level greater than the specified unwanted emissions limits. The nominated bandwidth is wide enough to take account of the transmit carrier frequency stability. The nominated bandwidth is within the transmit frequency band within which the ship earth station operates.	

B.4 Unwanted emissions within the bands with carrier-off

The EIRP spectral density of any emission within the bands 1 626,5 MHz to 1 645,5 MHz and 1 656,5 MHz to 1 660,5 MHz shall not exceed 57 dBpW in any 3 kHz band.

NOTE Carrier-off is defined as the state when the ship earth station is either authorised by the Network Coordination Station to transmit but when it does not transmit any signal, or when it is not authorised by the Network Coordination Station to transmit.

Annex C
(informative)

Inmarsat RTP schedule of tests

Table C.1 – Phase I Inmarsat-C schedule of tests

Inmarsat RTP Table							
Item test designation		**A**	**T**	**H**	**P**	**V**	**Inmarsat SDM Volume 3, Part 2, Chapter 2**
1	**Antenna**						
1-A	Gain profile	X					3.2.1, 3.3.1, 3.4.1
1-B	Polarization and axial ratio	X					3.2.2, 3.2.3
2	**Receiving system**						
2-A	Noise temperature	X					3.3.1
2-B	G/T calculations						3.3.1
2-C	Tuning	X	X				3.3.4, 6.3.1
2-D	Selectivity	X	X	X			4.3
3	**Transmitting system**						
3-A	Output power and frequency response	X	X	X	X		3.4.1, 3.4.9
3-B	EIRP calculations						3.4.1
3-C	Transmitted spectrum	X					3.4.2
3-D	Transmitter off power level	X	X	X	X		3.4.3
3-E	Spurious outputs	X	X	X		X	3.4.4[a)]
3-F	Harmonic outputs	X	X				3.4.5
3-G	Phase noise	X	X			X	3.4.6
3-H	Tuning	X	X				3.4.7
3-I	Frequency accuracy and stability	X	X	X	X		3.4.8
4	**Receiver performance**						
4-A	Packet error rate	X	X	X	X	X	3.3.3, 4.4, 4.5
4-B	Carrier and frame acquisition	X	X	X	X	X	4.4, 4.6
5	**Transmitter performance**						
5-A	Modulation characteristics	X	X		X		5.1
5-B	First-generation operation	X					5.2
S5-C	Signalling channel characteristics	X					5.3
5-D	Message channel characteristics	X					5.4
S5-G	2 digit special access code – Sig	X					
S5-H	2 digit special access code – Msg	X					
6	**Access control**						
6-A	General access control	X					6.1
6-A/1	Polling and data reporting	X					4 Chapter 3
6-B	TDMA synchronization	X	X				6.2.1
6-C	Random access	X					6.2.2
6-D	Common channel selection	X					6.3
6-E	Region registration procedures	X					6.5
6-F	Idle and busy conditions	X					6.6

Inmarsat RTP Table							
Item test designation		**A**	**T**	**H**	**P**	**V**	**Inmarsat SDM Volume 3, Part 2, Chapter 2**
7	**Message processing**						
7-A	Character codes	X					7.2
S7-B	Display devices	X	X	X	X	X	7.3 Chapter 5
7-C	Keyboard	X	X	X	X	X	7.4
S7-D	SES memory capacity	X	X		X		7.5 Chapter 5
7-E	DCE/DTE interface characteristics	X	X		X		7.6.1
7-F	Control codes	X					7.6.3
8	**Distress alerting functions** [b]						
S8-A	Distress message generator	X					8.2 Chapter 5
S8-B	Distress alert activation	X	X	X	X	X	8.3 Chapter 5
9	**Testing functions**						
9-A	Fail safe and monitoring	X	X				9.1, 9.2
S9-B	Performance verification and Commissioning	X					9.3 Chapter 5
10	**Electromagnetic compatibility**						
10-A	Mains conducted spurious emissions	X					10.2
11	**Physical characteristics**						
11-A	Vibration frequency response	X					11.2 Chapter 5
11-B	Rain test	X					11.2 Chapter 5

NOTE See Table 2 for variations of environmental conditions.

[a] Replaced by Annex B.

[b] There are 12 further tests in Annex A of the Inmarsat RTP required for distress calling, as follows.

A: normal ambient temperature (15 °C to 35 °C)

T: extreme temperature (−35 °C to +55 °C externally mounted equipment (EME), −15 °C to +55 °C internally mounted equipment (IME))

H: relative humidity (95 % at 40 °C)

P: primary power (a.c. frequency ±6 %, voltage ±10 %, d.c. voltage $\frac{+10}{-20}$ %, battery voltage $\frac{+35}{-20}$ %)

V: vibration (5 Hz to 12,5 Hz 1,6 mm, 12,5 Hz to 25 Hz 0,38 mm, 25 Hz to 50 Hz 0,1 mm, externally mounted equipment (EME) 2 Hz to 5 Hz 2,54 mm peak amplitude).

NOTE See Table 2 for variations of environmental conditions.

Table C.2 – Phase I EGC receiver schedule of tests

Inmarsat RTP Table							
Item test designation		**A**	**T**	**H**	**P**	**V**	**Inmarsat SDM Volume 3, Part 2, Chapter 2**
E1	**Antenna**						
1-A	Antenna gain profile	X					3.2
1-B	Polarization and axial ratio	X					3.2
E2	**Receiving system**						
2-A	Noise temperature	X					3.3
2-B	G/T calculations						3.3
E2-C	Receiver tuning	X	X				3.3
2-D	Receiver selectivity	X	X	X			4.3
E3	**Receiver performance**						
3-A[a)]	Packet error rate	X	X	X	X	X	4.5 Chapter 8
E4	**Message processing**						
4-A[a)]	Character codes	X					7.2 Chapter 8
4-B[a)]	Output devices	X	X	X	X	X	7.3 Chapter 8
4-C[a)]	Keyboard	X	X	X	X	X	7.4
E4-D	Memory capacity	X					7.5 Chapter 8
E4-E	Receiver addressing	X					7.7 Chapter 8
E4-F	Error detection	X					7.7.5 Chapter 8
E4-G	Sequence numbering handling	X					7.7.4 Chapter 8
E5	**Distress alerting functions**						
E5-A	Distress messages	X					7.7.6 Chapter 8
E6	**Electromagnetic compatibility**						
6-A[a)]	Mains conducted spurious emissions	X					10
E7	**Physical characteristics**						
7-A[a)]	Vibration frequency response	X					11 Chapter 8
7-B[a)]	Rain test	X					11 Chapter 8

NOTE See Table 2 for variations of environmental conditions.

a) Equivalence between test items in Table C.1 and Table C.2: 3Aa) = 4A, 4Aa) = 7A , 4Ba) = 7B , 4Ca) = 7C, 6Aa) = 10A, 7Aa) = 11A, 7Ba) = 11B

A: normal ambient temperature (15 °C to 35 °C)

T: extreme temperature (−35 °C to +55 °C externally mounted equipment (EME), −15 °C to +55 °C internally mounted equipment (IME))

H: relative humidity (95 % at 40 °C)

P: primary power (a.c. frequency ±6 % voltage, ±10 %, d.c. voltage $\frac{+10}{-20}$ %, battery voltage $\frac{+35}{-20}$ %)

V: vibration (5 Hz to 12,5 Hz 1,6 mm, 12,5 Hz to 25 Hz 0,38 mm, 25 Hz to 50 Hz 0,1 mm, externally mounted equipment (EME) 2 Hz to 5 Hz 2,54 mm peak amplitude)

Table C.3 – Phase II schedule of tests

Inmarsat RTP Table							
Item test designation		**A**	**T**	**H**	**P**	**V**	**Inmarsat SDM Volume 3, Part 2, Chapter 2**
	Basic access tets						
21-A	Ocean Region registration	X					
21-B	Performance verification	X					
	Message transfer tests						
22-A	To-mobile message transfer	X					
22-B	From-mobile message transfer						
22-C	Off-line operation	X					
22-D	Forced clearing	X					
	Distress alerting tests						
23-A	Distress alert transmission	X					
23-B	Distress priority message transfer						
	Log-in and log-out						
24-A	Log-out and log-in	X					
	Optional capability tests						
25-A	Alternate network service	X					
25-B	Alternate network service: X,400	X					

A: normal ambient temperature (15 °C to 35 °C)

T: extreme temperature (−35 °C to +55 °C externally mounted equipment (EME), −15 °C to +55 °C internally mounted equipment (IME))

H: relative humidity (95 % at 40 °C)

P: primary power (a.c. frequency ±6 % voltage, ±10 %, d.c. voltage $^{+10}_{-20}$ %, battery voltage $^{+35}_{-20}$ %)

V: vibration (5 Hz to 12,5 Hz 1,6 mm, 12,.5 Hz to 25 Hz 0,38 mm, 25 Hz to 50 Hz 0,1 mm, externally mounted equipment (EME) 2 Hz to 5 Hz 2,54 mm peak amplitude)

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[1] To be published.

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