

Australian/New Zealand Standard™

Maritime survivor locating systems (MSLS)

Part 3: Maritime survivor locating devices (MSLD)—Operating on 156.575 MHz and/or 161.975 MHz/162.025 MHz (RTCM 11901.1:2012, MOD)



AS/NZS 4869.3:2015

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee RC-004, Radiocommunications Equipment—Maritime and Safety of Life. It was approved on behalf of the Council of Standards Australia on 14 April 2015 and on behalf of the Council of Standards New Zealand on 17 April 2015. This Standard was published on 30 April 2015.

The following are represented on Committee RC-004:

Australian Communications and Media Authority
Australian Industry Group
Australian Maritime Safety Authority
Australian Radio Communications Industry Association
Australian Volunteer Coast Guard Association
Civil Aviation Safety Authority
Department of Defence (Australian Government)
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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee RC-004, Radiocommunications Equipment—Maritime and Safety of Life.

The objective of this Standard is to provide the essential requirements for maritime survivor locating devices (MSLD) that use the digital selective calling frequency of 156.525 MHz, and also automatic identification system frequencies of 161.975 MHz and 162.025 MHz, that are described in the adopted RTCM standard.

This Standard includes environmental, operational and radiofrequency requirements. These specifications are required by both the appropriate national spectrum management authority and maritime safety authority in each country.

This Standard is an adoption with national modifications and has been reproduced from the Radio Technical Commission For Maritime Services standard, RTCM 1190.1:2012, *RTCM Standard 1190.1 for Maritime Survivor Locating Devices (MSLD)*, which incorporates Amendment 1 (2014), and has been varied as indicated to take account of Australian/New Zealand conditions. The modifications are specified in Appendix ZZ.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian/New Zealand Standard</i>	
IEC		AS	
60529	Degrees of protection provided by enclosures (IP Code)	60529	Degrees of protection provided by enclosures (IP Code)
61097	Global maritime distress and safety system (GMDSS)	AS/NZS 4415	Radiotelephone transmitters and receivers for the maritime mobile service operating in the VHF bands—Technical characteristics and methods of measurement
61097-7	Part 7: Shipborne VHF radiotelephone transmitter and receiver—Operational and performance requirements, methods of testing and required test results	4415.1	Part 1: Shipborne equipment and limited coast stations (including DSC) (IEC 61097-7:1996, MOD)

Only normative references that have been adopted as Australian or Australian/New Zealand Standard have been listed.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the annex or appendix to which they apply. A ‘normative’ annex or appendix is an integral part of a Standard, whereas an ‘informative’ annex or appendix is only for information and guidance.

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AUSTRALIAN/NEW ZEALAND STANDARD

Maritime survivor locating systems (MSLS)**Part 3:**

Maritime survivor locating devices (MSLD)—Operating on 156.575 MHz and/or 161.975 MHz/162.025 MHz (RTCM 11901.1:2012, MOD)

1 Scope

This document specifies the minimum functional and technical requirements for a Maritime Survivor Locating Device (MSLD) system.

MSLD Alerting Units (AUs) are intended to be carried by individuals engaged in on-deck activities on vessels, or in activities on shore where falls into the water are a risk, or in other marine activities where location of persons may be required.

The purpose of the AU is to send a local alert primarily to a mating Base Unit (BU) on one's own vessel or facility, and possibly also to other BUs on other vessels nearby. The MSLD system is not intended to perform the functions of an Emergency Position Indicating Radio Beacon (EPIRB). The AU may also serve as a locating beacon to assist in the individual's recovery.

The AU typically consists of a transmitter module, an integral antenna, and a power source, all contained in a wearable watertight case. The AU is typically used in conjunction with a mating BU on a vessel, but may be used with an existing receiver suited for the purpose. In addition, the system includes a Locating Function (LF) to aide in the search and rescue of the individual, which may or may not be part of the BU.

The MSLD system operates on a radio frequency authorized for this type of service.

The body of this standard is organized into two main parts:

- Common requirements for all MSLDs (Sections 1 through 8).
- Requirements for specific types of MSLDs (Annexes A through E).

2 Normative References

The following referenced documents are indispensable for the application of this document to the extent specified herein. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60529 - *Degrees of protection provided by enclosures (IP Code)*

IEC 60945 - *Maritime navigation and radio communication equipment and systems general requirements - methods of testing and required test results (2002-08)*

IEC 61097-3 - *Global maritime distress and safety system (GMDSS) - Part 3: Digital selective calling (DSC) equipment - Operational and performance requirements, methods of testing and required testing results*

IEC 61097-7 - *Global maritime distress and safety system (GMDSS) - Part 7: Shipborne VHF radiotelephone transmitter and receiver - Operational and performance requirements, methods of testing and required test results*

IEC 61108-1 - *Maritime navigation and radio communication equipment and systems - Global navigation satellite systems (GNSS) - Part 1: Global positioning system (GPS) - Receiver equipment - Performance standards, methods of testing and required test results (2003-07)*

IEC 62238 – *Maritime navigation and radiocommunication equipment and systems - VHF radiotelephone equipment incorporating Class 'D' Digital Selective Calling (DSC) - Methods of testing and required test results*

ITU-R M.493-13 - *Digital selective-calling system for use in the maritime mobile service*

ITU-R M.690-1 - *Technical characteristics of emergency position-indicating radio beacons (EPIRBs) operating on the carrier frequencies of 121.5 MHz and 243 MHz*

ITU-R M.693 – *Technical characteristics of VHF emergency position-indicating radio beacons using digital selective calling (DSC VHF EPIRB)*

ITU-R M.821-1 - *Optional expansion of the digital selective-calling system for use in the maritime mobile service*

ITU-R SM.332-4 - *Selectivity of receivers*

ITU-R M.1371-4 – *Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile band.*

3 Definitions and Abbreviations

3.1 Marine Survivor Locating Device (MSLD)

A Marine Survivor Locating Device is part of a system consisting of at least one Alerting Unit (AU), at least one Base Unit (BU), and a Locating Function (LF). All MSLD systems shall provide as a minimum these functions:

- 1) Alert – The AU shall be capable of sending an RF signal to alert the BU and,
- 2) Alarm – The BU shall provide an on-board alarm to notify crew or nearby personnel of an overboard situation and,
- 3) Locate – The BU or other on-board component of the MSLD system shall provide some means for crew or nearby personnel to locate a person overboard.

3.2 Alerting Unit (AU)

A device carried or worn by a person which communicates by radio with a local base unit to indicate that the person has experienced an alerting condition such as: a) entering a body of water, or b) venturing beyond RF coverage range, or c) venturing outside a defined area.

3.3 Base Unit (BU)

A device that receives the radio signals from one or more AUs indicating that a person wearing the AU has experienced one or more of the alerting conditions above.

3.4 Locating Function (LF)

Some means for crew or nearby search and rescue personnel to determine a course to recover a person wearing an AU. This function may be satisfied by multiple means (e.g. RF transmission of location information from the AU, by visual light emanating from the AU, by homing in on an RF distress signal emanating from the AU). Additionally, for an AU with an RF homing transmitter, a radio direction finder Locating Unit (LU) either integral to or separate from BU may be used.

3.5 shall

describes attributes which RTCM considers necessary to meet the standard

NOTE – The use of the term "shall" is not intended to limit the possibility of amending the standard through the language of a regulation or contract which incorporates this Standard by reference. If an MSLD is produced to such an amended standard, any claim of compliance with this Standard on the MSLD or in its documentation, shall also describe the modification.

3.6 should

describes attributes recommended by RTCM, but not mandatory to claim compliance with this Standard

3.7 Abbreviations

AIS	Automatic Identification System
AU	Alerting Unit
BU	Base Unit
BUR	Base Unit Repeater
DSC	Digital Selective Calling
EIRP	Effective Isotropic Radiated Power
EMC	Electro Magnetic Compatibility
emf	electromotive force
EPFS	Electronic Position Fixing System
EPIRB	Emergency Position Indicating Radio Beacon
EUT	Equipment under Test
GHz	Gigahertz
GNSS	Global Navigation Satellite System
HDOP	Horizontal Dilution of Precision
IEC	International Electrotechnical Commission
ITU	International Telecommunication Union
kHz	Kilohertz
LF	Locating Function
LU	Locating Unit
MHz	Megahertz
MOB	Man Overboard
MSLD	Marine Survivor Locating Device
PEP	Peak Envelope Power
PERP	Peak Effective Radiated Power
PLL	Phase Locked Loop
RDF	Radio Direction Finder
RF	Radio Frequency
RMS	Root Mean Squared
RSSI	Received Signal Strength Indicator
SAR	Search and Rescue
SART	Search and Rescue Transponder
SOTDMA	Self-Organizing TDMA
SV	Space Vehicle
TDMA	Time Division Multiple Access
TTFF	Time to First Fix
VHF	Very High Frequency (radio band)
VDL	VHF Datalink
UTC	Universal Time Coordinated

4 Performance Requirements

The performance requirements in this section apply to all types of MSLD systems.

4.1 AU Controls and Indicators

All AU controls and indicators shall be:

- clearly and durably marked
- designed to prevent inadvertent activation

All AU controls and indicators should be:

- few in number
- kept simple to permit ease of operation.

The various modes of the controls should be readily apparent by visual observation.

AUs shall be designed for manual activation.

AUs should be designed for both manual and automatic activation.

Not less than two simple, independent actions shall be required for manual activation of the AU. Examples of independent actions include protection of a switch by a removable cover, or two independent switches.

All AU controls necessary for the correct operation of the AU shall be so designed that personnel wearing appropriately sized 5mm or more neoprene gloves can activate the AU.

A positive visual and/or audible indication that the AU is activated shall be provided.

4.1.1 User controls for AUs with only manual activation

AUs provided with only manual activation shall have as a minimum, clearly marked integral manual controls to operate the device in the following modes:

- ON** In the **ON** mode, the AU is manually activated.
- TEST** See paragraph 4.2.
- OFF** In the **OFF** mode, the AU is deactivated.

4.1.2 User Controls for AUs with both manual and automatic activation

AUs provided with both automatic and manual activation shall have, as a minimum, clearly marked integral manual controls to operate the device in the following modes:

READY or ARMED

In the **READY or ARMED** mode, the AU is normally deactivated, but automatically activates when the unit experiences an alerting condition as defined in Section 3.2. Once activated the unit should remain activated until it is switched to the **OFF** position or manually reset to the **READY or ARMED** mode.

- ON** In the **ON** mode, the AU is activated continuously, regardless of whether in or out of the water. This function must be provided by a separate mechanism in addition to the automatic actuator provided in the **READY or ARMED** mode. It is not sufficient to require the user to short the water contacts (or otherwise simulate automatic activation) for the function of manual activation.

- TEST** See paragraph 4.2.
- OFF** In the **OFF** mode, the AU is deactivated.

4.1.3 Function of the ON control

Transmission of the alert signal shall begin within 30 seconds of switching the control to the ON position. Consideration should be given to delaying transmission of the alert for some initial period not to exceed 30 seconds, to allow users to deactivate the device in the case of an inadvertent activation.

4.1.4 Indicators

4.1.4.1 Alerting

A visual and/or audible indicator detectable by the user shall commence within 5 seconds of the device being activated (both manually and/or automatically), and shall continue until the AU is no longer transmitting its alerting signal. The visual indicator should be visible in direct sunlight, low light, and no light conditions. The audible indicator should have a distinctive alarm tone with a minimum sound output of 85 dBA when measured 10 cm from the AU.

4.1.4.2 Self-test

A visual and/or audible indicator or indicators shall be provided to signal that a self-test was either successful or not successful. If the self-test takes longer than 5 seconds, a different indication should be given that the self-test is in progress.

4.1.5 Water activation function

The optional AU water-activation function should be protected against inadvertent activation from salt-water spray or rain.

4.2 Self-test function

The AU shall include a functional self-test designed to test as a minimum the following items under a full-load condition:

- battery, and
- RF output

The self-test shall be functional throughout the operating temperature range.

The manufacturer shall verify at the minimum: ambient and maximum operating temperatures, that the self-test pass/fail indicator(s) correctly identifies(y) any failure condition that has been detected by any of the self-test functions.

4.2.1 Battery self-test

The manufacturer shall verify during the battery self-test: ambient and maximum operating temperatures, that the AU battery experiences full-load current drain.

The battery self-test shall indicate when the battery is no longer capable of providing the minimum operating time.

4.2.2 RF self-test

The RF self-test shall include the connection of the transmitter to the antenna or an equivalent dummy load.

During the self-test function, the AU shall transmit in such a way that it will not cause a distress alert.

If the AU includes a 121.5 MHz radio-locating device, the signal transmitted during the self-test should not exceed 3 audio sweeps or 1 second, whichever is greater.

The means of activating the self-test feature should prevent the test signal from being continuously activated.

4.3 Buoyancy

Unless the AU is intended to be incorporated into a buoyant device, it should have sufficient positive buoyancy to float in fresh water and to operate while floating in fresh or salt water.

4.4 Environmental factors

The AU shall not be activated accidentally or damaged by:

- a) dry heat
- b) damp heat
- c) low temperature
- d) thermal shock
- e) drop onto hard surface
- f) drop into water
- g) vibration sweep
- h) water immersion (intrusion into the device)
- i) solar radiation
- j) oil contamination
- k) corrosion

The electronic components should be protected to prevent malfunction under prolonged conditions of high humidity, including condensation.

5 Construction Requirements

5.1 General

The AU shall be wearable, or arranged to be attached to the user's clothing or Personal Floatation Device (PFD) without interfering with the user's activities. The AU should be provided with adequate means of attachment to the user in its "operational" position.

The AU should be designed for "hands free" operation, so that the user is not required to hold the unit out of the water for operation after activation.

The external design of the AU should avoid sharp edges or points to prevent injury or damage to equipment.

5.2 Battery

The AU shall have its own battery or batteries and should not depend upon any external source of power for its operation when activated. The batteries shall be an integral part of the equipment.

5.2.1 Battery hazards

The AU shall not be hazardous to personnel handling it, operating it, or performing manufacturer-approved servicing of it nor shall it release toxic or corrosive products outside the AU case:

- a) during or subsequent to storage at temperatures between -55° C and +75° C;
- b) during a full or partial discharge at any rate up to and including an external short circuit;
- c) during a charge or forced discharge of a cell or cells by another cell or cells within the battery; and
- d) after a full or partial discharge.

All AUs should be safe with respect to reversal of polarity, shorting, and the effects of self-heating, cell-to-cell charging, and forced discharging.

5.2.2 Battery life for primary battery

The AU manufacturer should establish a useful life and an expiration date for primary (non-rechargeable) batteries. The useful life is the period of time after the date of battery manufacture that the battery will continue to meet the input power requirements of the MSLD system (as defined in the appropriate Annex), over the entire specified operating temperature range. The following losses must be included (at a temperature of $+20^{\circ}\text{C} \pm 5^{\circ}\text{C}$):

- a) Testing, as recommended by the manufacturer or as required by the regulatory authority, whichever is the more demanding.
- b) Self-discharge of the battery pack.
- c) Standby loads, including any current drain in the READY mode of an AU.

The battery replacement date marked on the AU should be the date of battery installation in the AU plus no more than 50% of the rated life of the battery, provided that the battery cells are no older than 25% of the rated life of the battery.

5.2.3 Battery replacement

Replacement of the battery, if user-replaceable, should be possible with relative ease, and any interface connections required should be such as to prevent reversed polarity or incorrect installation. Provision should be made to ensure watertight integrity upon replacement of the battery.

5.3 Labeling

5.3.1 Battery

The MSLD documentation should include instructions on AU battery replacement intervals.

All batteries in the AU and BU (if used) should use polarized connectors or wires to battery connectors uniquely color coded. The wire to the most positive (+) terminal should be RED; the wire to the most negative (-) terminal should be BLACK. YELLOW, GREEN, and/or BLUE color coding (if used) should be used for wires connecting intermediate voltage levels in multi-voltage battery packs.

5.3.2 Identification and instructions

All labeling on the exterior of the AU shall be resistant to deterioration by prolonged exposure to sunlight, and shall not be unduly affected by seawater or oil, and shall be abrasion resistant. The outside of the AU shall be marked indelibly and legibly with the following:

- a) Concise markings for operating controls as specified in Sections 4.1.1 or 4.1.2, including how to turn the AU on and how to clear an alarm.
- b) Self-test instructions.
- c) The name and address of the manufacturer.
- d) The AU type number or model identification under which it was type tested.
- e) The serial number or identification number of the AU.
- f) Battery safety warning and disposal statement, if applicable.
- g) Storage and operating temperature range of the AU.
- h) Regulatory authority markings, if required.
- i) Compass safe distance.
- j) Warning to only activate device in an emergency.
- k) If a GNSS receiver is included, a warning to not block the antenna.

6 Optional Performance Features

6.1 Lifesaving Equipment

The MSLD may include functions that remotely launch lifesaving equipment from the vessel, either automatically or by remote command.

6.2 Vessel Control

The MSLD may provide remote control of such vessel functions as steering, engine operation, and others as appropriate

7 Documentation

The manufacturer shall provide an operation manual including the following:

- a) Intended use of the MSLD system.
- b) Complete instructions for testing and operating the MSLD system.
- c) Information explaining the BU and LF system compatibility requirements.
- d) Cautions and recommendations to prevent false alarms.
- e) General battery information (e.g., battery replacement instructions, battery type, safety information regarding battery use and disposal).
- f) Information on when battery replacement is required.
- g) Information related to the requirements of preventive maintenance.
- h) Minimum operating life time, operating, and stowage temperature ranges.
- i) Information explaining the requirement and procedure for licensing and registering MSLDs, as appropriate.
- j) Information relating to the shipment of the MSLD.
- k) Instructions on actions to be taken in the case of false alarms.

NOTE: In the case of accidental activation involving transmission of a 121.5 MHz signal, the user should deactivate the MSLD and notify the appropriate search and rescue authorities (e.g., U.S. Coast Guard or Rescue Coordination Center serving the geographic area) at the earliest possible time.

- l) If a 121.5 MHz signal is transmitted during the self-test, information noting that the self-test should be performed only within the first 5 minutes of any hour and should not exceed 3 audio sweeps or 1 second, whichever is longer.
- m) A warning to the effect that the device should only be activated in an emergency.
- n) Instructions for fitting / attaching the AU to the user and for correct operation in the water in an emergency.
- o) Instructions for BU installation, testing, use, and maintenance.

8 Performance Tests

8.1 Alerting Unit (AU)

8.1.1 Test conditions

Tests should be carried out under normal test conditions, unless otherwise stated.

8.1.1.1 Normal test conditions

Normal temperature and humidity conditions for tests should be any convenient combination of temperature and humidity within the following ranges:

Temperature: +15 °C to +35 °C

Relative humidity: 20 % to 75 %

8.1.1.2 Extreme test conditions

For tests at extreme temperatures, measurements should be made in accordance with the procedure specified in IEC 60945.

Applicable temperature range: -20 °C to +55 °C

8.1.1.3 Power supply

Electrical power should be supplied during performance tests normally by the batteries which form a part of the equipment.

8.1.1.4 Additional facilities

If the equipment contains any additional facilities such as electronic position fixing equipment, they should be operational for the duration of all tests, except if specified otherwise.

8.1.1.5 Audible and visual indications

During testing, all audible and/or visual indications should be operational.

8.1.1.6 Test radio transmissions

Care should be taken not to transmit distress signals on distress and safety frequencies without proper authorization.

8.1.2 Tests for durability and resistance to environmental conditions

The AU should be subjected to the tests for durability and resistance to environmental conditions in IEC 60945 applying to portable equipment. All tests should be performed on a single item of equipment. The tests should be carried out in the order given in IEC 60945.

8.1.3 Buoyancy test

Unless the AU is designed exclusively for incorporation in a buoyant device, it should be demonstrated to float in calm fresh water. If the AU is provided with a pouch or similar package that is not permanently affixed, the AU should be removed before conducting this test. Under conditions normally encountered in the maritime environment, the AU should have sufficient positive buoyancy to float with at least 5% reserve buoyancy.

8.1.4 Controls and indicators tests

8.1.4.1 Function

Function of the controls and indicators as required in 4.1 through 4.1.4.2 shall be verified by observation and by someone wearing the gloves specified in Section 4.1.

8.1.4.2 Controls durability

All manual controls should be operated for at least 500 cycles, without failure of the mechanism

8.1.4.3 Audible and visual indications

During testing, all audible and/or visual indications shall be detectable by the wearer when installed according to manufacturer's recommendations.

8.1.5 Activation tests

8.1.5.1 Water activation test (for automatically-activated types only)

With the control in the **READY** mode, the AU should be floated in a 0.1 % salt solution and should activate within 60 seconds after being placed in the water. The salt used for the test should be sodium chloride (NaCl) containing, when dry, not more than 0.1 % sodium iodide and 0.03 % total impurities. The salt solution concentration should be (0.1 ± 0.01) % by weight. The solution should be prepared by dissolving 1 ± 0.1 parts by weight of salt in 1,000 parts by weight of distilled or demineralized water.

8.1.5.2 Rain/spray non-activation test

The AU should be mounted in a position simulating its normal operational position. The unit should be subjected to a simulated water spray in accordance with IEC 60529 (IP03) for a period of 10 minutes, except that the water used shall be a 3.5% salt solution. The AU should not activate at any time during this test. The salt water used for this test can either be normal sea water extracted from an area of sea not near a river or sewage outlet or subject to rain water or snow runoff, or can be made up using a solution of Sodium Chloride (NaCl) containing not more than 0.1% total impurities dissolved in distilled or demineralized water. The salt solution concentrate should be 3.5% +/- 0.5% by weight.

8.1.6 Test of the self-test mode

The self-test should be performed successfully at the minimum operating temperature (or colder), at the ambient temperature, and at the maximum operating temperature (or hotter).

8.1.7 Battery capacity and low-temperature test

Using a fresh battery pack, the AU should be activated under normal test conditions for a period of time as stated by the manufacturer to be equivalent to the loss of battery capacity due to self-testing, stand-by loads as well as battery-pack self-discharge during the useful life of the battery pack. The manufacturer should substantiate the method used to determine this time.

The AU should be placed in a chamber at normal test conditions. Then the temperature should be reduced to and maintained at $-20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for a period of 10 h. The unit should be activated within 30 min after the end of the 10 h period and should then be kept working continuously at that temperature for the period identified as the minimum operating time in the applicable annex.

Throughout the test period, the AU should function at the required power level and frequency as defined in the applicable annex.

8.1.8 Spurious and out-of-band emissions

The AU should be tested to determine that it conforms to the spurious and out-of-band emission limitations established by IEC 60945¹.

8.2 Base Unit (BU)

8.2.1 Tests for durability and resistance to environmental conditions

The BU should be subjected to the tests for durability and resistance to environmental conditions in IEC 60945 as declared by the manufacturer. A BU or any part of a BU intended for installation on an open deck should instead be subjected to the tests applying to exposed equipment. All tests should be performed on a single item of equipment. The tests should be carried out in the order given in IEC 60945.

8.2.2 Compass safe distance test

The BU should be subjected to the compass safe distance test in IEC 60945.

8.2.3 Conducted interference test

If there is a connection between the ship's power system and the BU, the equipment should, in addition, be tested for immunity to conducted radio frequency interference in accordance with IEC 60945.

8.3 Locating Unit (LU)

If an LU separate from the BU is provided as part of the MSLD system, it should be subjected to the tests for durability and resistance to environmental conditions in IEC 60945 applying to protected equipment. An LU or any part of an LU intended for installation or use on an open deck

¹ The regulatory authority certifying the alerting unit where it is to be sold may have stricter limitations.

should instead be subjected to the tests applying to exposed equipment. All tests should be performed on a single item of equipment. The tests should be carried out in the order given in IEC 60945.

8.3.1 Compass safe distance test

The LU should be subjected to the compass safe distance test in IEC 60945.

8.3.2 Conducted interference test

If there is a connection between the ship's power system and the LU, the equipment should, in addition, be tested for immunity to conducted radio frequency interference in accordance with IEC 60945.

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Annex A (normative)

DSC type MSLD

A.1 Operational Scenario

The DSC-type MSLD system is designed to work as a component of the Digital Selective Calling (DSC) system integral to many VHF marine radios.

A victim is unexpectedly and inadvertently in the water or unable to return to the vessel or facility from which they departed due to weather, sea conditions, injury, fatigue, or other conditions.

Victims may be recovered by their own vessel, a dedicated small boat or aircraft from their own vessel.

Victims may potentially be in the water for up to 12 hours before they are recovered. Quick recovery of the victim is generally expected, however the victims may become separated from their vessel by strong currents in the area, or the vessel's high operating speed and/or lack of maneuverability.

Transmitter-operating times should be sufficient to allow for outside assistance.

A.2 System Components

A.2.1 Alerting unit (AU)

The AU shall be capable of immediately indicating its location and updating its position and transmitting this position to the BU at regular intervals. This may be achieved by several means, however if the AU incorporates a GNSS receiver, the GNSS receiver shall not be the only method of locating.

If the AU uses DSC messages addressed to 'all ships' as the alerting mechanism, the AU shall be fitted with a GNSS receiver to provide location in the transmitted message and a DSC receiver solely for the purpose of receiving acknowledgments of distress calls.

A.2.2 Base unit (BU)

The BU is a Class A or Class D DSC receiver, as defined in Recommendation ITU-R M.493-13 Annex 2, that decodes and displays the GNSS position of the AU. The Class A receiver shall comply with IEC 61097-3 and IEC 61097-7 and the Class D receiver shall comply with IEC 62238.

A.2.3 Locating unit (LU, Optional)

The Locating Function (LF) is normally provided by the integral GNSS receiver in the AU. However this function can be provided by a 121.5 MHz Direction Finder, or an integral part of the BU, or supplied as a separate standalone component. The Direction Finder shall be capable of providing a bearing to the AU and may indicate distance to the AU based upon Received Signal Strength (RSSI).

A.3 Performance Characteristics

A.3.1 Operating time

The AU shall operate for a minimum of 12 h. The BU (and LU if separate and applicable) should be capable of continuous operation for the same period either from the ship's power supply or through the incorporation of rechargeable batteries capable of being recharged from the ship's supply.

A.3.2 Interoperability

The AU shall be capable of communicating with nearby vessels using non-proprietary communications in accordance with ITU-R M.493-13, M.693 and M.821-1. The AU 121.5 MHz Homing signal (if applicable) shall be compliant with the relevant parts of ITU-R M.690-1.

A.3.3 Operational functions

As defined in the main body of this standard.

In addition, AUs using DSC messages addressed to all ships as the alerting mechanism shall be fitted with a visual indicator to indicate reception of a DSC distress alert acknowledgment message. This indicator shall be visible by the user when worn in the expected configuration in direct sunlight, low light and no light conditions.

A.3.4 Unique identifier (user ID)

The DSC MSLD AU shall have a unique identifier to ensure the integrity of the VHF data link.

The user ID for a DSC MSLD AU is 972xxyyyy, where xx = manufacturer ID 01 to 99¹; yyyy = the sequence number 0000 to 9999. When a manufacturer reaches sequence number 9999, they shall revert to sequence number 0000 and commence duplicating sequence numbers.

The manufacturer ID xx = 00 is reserved for test purposes. The unique identifier used for the purposes of type approval to this standard shall be in the format 97200yyyy.

After being programmed by the manufacturer, it shall not be possible for the user to change the unique identifier of the DSC MSLD AU.

The configuration method for the unique identifier shall be as defined by the manufacturer and shall be held in non-volatile memory.

A.3.5 DSC and AIS Combination MSLD Devices

If a manufacturer chooses to build an MSLD system that functions as both a DSC MSLD and an AIS MSLD (refer to Appendix E for detail), the AU transmitting both DSC and AIS messages shall transmit one common user ID.

If a conflict occurs during AIS and DSC transmission time occurs, the AIS transmission shall be given priority and the DSC transmission shall be delayed.

Note: For an AU fitted with DSC and AIS transmitters, the DSC receiver may be turned off for the period when the AIS transmitter is active.

A.3.6 Alerting signal

A DSC message shall be used for alerting the BU.

A.3.7 AU using DSC 'all ships' messages (open loop alerts)

On initial activation, the AU shall transmit a DSC message indicating Man Overboard (MOB).

The message shall be formatted as a Distress Alert as specified in line 1, table 4.1 of ITU-R M.493-13. The nature of distress field shall be set to symbol 110 (man overboard) and the subsequent communications field set to symbol 126 (no information).

¹ The manufacturer ID can be obtained from CIRM, 202 Lambeth Road, London SE1 7JW, UK. Telephone: +44 (0) 20 3411 8345. E-mail: secgen@cirm.org. Web-site: www.cirm.org.

As the integral GNSS receiver will not be able to provide an accurate time and position from switch on, the position (message 2) and time (message 3) fields in the initial DSC message shall be replaced by the digits 9 and 8 respectively, in accordance with ITU-R M.493-13, paragraphs 8.2.3.4 and 8.2.4.3.

As soon as the integral GNSS receiver is able to provide an accurate position and time, the AU shall transmit a further Distress Alert with the position and time from the GNSS receiver automatically inserted into the message. The position expansion sequence of ITU-R M.821 shall also be used.

After this transmission, the DSC receiver in the AU shall turn on and monitor the DSC channel for acknowledgment messages. The DSC receiver may be turned off after reception of an acknowledgement message or after 2 minutes operation, whichever is the first to occur.

If a DSC Distress Alert acknowledgement message, formatted in accordance with table 4.2, line 1 of ITU-R M.493-13 is received by the AU, the DSC transmitter shall be switched off and not make any further transmissions. The indicator referred to in paragraph A.3.3 shall turn on.

If a DSC Distress Alert acknowledgment message is not received, the AU shall operate with a duty cycle of at least one message every 5 minutes for a period of 30 min, i.e. at least one transmission every 5 minutes for a 30 minute period (a minimum of 6 transmissions). The actual transmitter duty cycle shall be a randomly selected time of between 4.9 and 5.1 minutes. After each transmission, the DSC receiver shall turn on and monitor the DSC channel for acknowledgment messages. The DSC receiver may be turned off after reception of an acknowledgement message or after 2 minutes operation, whichever is the first to occur.

After 30 minutes have elapsed, the duty cycle may then change to 10 min. This will continue until an acknowledgment message is received, the batteries are exhausted or the MSLD transmitter is switched off. The actual transmitter duty cycle shall be a randomly selected time of between 9.9 and 10.1 minutes. After each transmission, the DSC receiver shall turn on and monitor the DSC channel for acknowledgment messages. The DSC receiver may be turned off after reception of an acknowledgement message or after 2 minutes operation, whichever is the first to occur.

If an acknowledgment message is received during these transmission cycles, the DSC transmitter shall be switched off and not make any further transmissions. The indicator referred to in A.3.3 shall turn on.

AU operation is summarized in the following table:

Table A.1 – Summary of DSC MSLD Operation

Time/event	Action	Comments
Initial switch on	- DSC Distress alert sent - GNSS rx on	Position and time fields replaced with digits 9 and 8 respectively.
GNSS lock	- Distress Alert with GNSS position and time sent - DSC rx on	DSC receiver may be turned off 2 minutes after each transmission or once an acknowledgement has been received
DSC Ack message received	- Indicator LED turns on - DSC rx off	Indicator to let user know their message has been received.

Time/event	Action	Comments
DSC Ack message not received		Beacon continues with a duty cycle of a DSC message at least every 5 mins for 30 mins, and then may be reduced to every 10 mins. The transmitter duty cycles shall be a randomly selected times of between 4.9 and 5.1 and 9.9 and 10.1 minutes respectively. DSC receiver may be turned off 2 minutes after each transmission or once an acknowledgement has been received This will continue until an acknowledgment message is received, the batteries are exhausted or the AU is switched to OFF.

A.3.8 AU using DSC individual station relay messages (closed loop alerts)

All messages shall be in accordance with ITU-R M.493-13. The message shall be a distress relay on behalf of another ship as specified in table 4.3 of ITU-R M.493-13.

Format Specifier – 120 distress relay

Address – Own ship MMSI

Category – 112

Self-Identification = Own ship MMSI or MSLD MMSI where applicable

Messages

Message 0 – ID

Message 1 – 110 (MOB)

Message 2- Position (if used)

Message 3 – Time (if used)

Message 4 – 100
End of Sequence 117

The above message format shall be transmitted once every 5 min for a period of 30 min. If after this period of time the AU has not been disabled then the DSC message shall change to a message calling a group in accordance with ITU-R M.493-13.

A.3.9 Position Data

The AU shall be capable of immediately indicating its location and updating its position, and transmitting this position to the BU at regular intervals. This may be achieved by several means, however if the AU incorporates a GNSS receiver, the GNSS receiver shall not be the only method of locating. The GNSS receiver shall be compliant with IEC 61108-1. The AU shall only transmit valid position data as defined by IEC 61108-1. The following Update Procedure shall apply.

The Time To First Fix (TTFF) of the GNSS receiver in the AU shall be less than 5 minutes regardless of the start configuration of the GNSS. If a valid GNSS fix has not been obtained, then the Position field in the DSC messages shall be replaced with the digit 9 repeated as necessary (and if applicable the Time field shall be replaced with the digit 8). If and when a valid GNSS fix has been obtained then the AU commences the transmission of DSC messages containing Position (and Time) as detailed above. The same GNSS position shall be transmitted for a minimum of 2 consecutive bursts without changing.

Once a fix has been obtained it shall be updated no more often than once every 10 minutes but at least once every 20 minutes and the new position shall then be encoded and transmitted for at least the next 2 consecutive bursts, whereupon the sequence repeats. If valid GNSS updates cannot be maintained, after an initial fix, then the last valid encoded position (and time) shall continue to be transmitted for a period of 3 hours. If within this time a valid fix is obtained then the new updated position shall be transmitted as described above. If however after 3 hours a valid fix has not been obtained, then the DSC message shall revert to the default values (of 9's and 8's) as if no valid fix had been obtained, until a valid fix is obtained.

A.3.10 Frequency and type of signal

156.525 MHz +/- 10 parts per million.

Phase Modulated G2B class of emissions (Channel 70 DSC)

The necessary bandwidth should be less than 16 kHz.

Frequency modulation with a pre-emphasis characteristic of 6 dB/octave (phase modulation) with a modulating sub-carrier shall be used.

A sub-carrier of 1700 Hz with frequency shift between 1300 Hz +/-10 Hz and 2100 Hz +/-10 Hz shall be used.

The modulation rate shall be 1200 baud and the index of modulation shall be 2.0 +/-10%.

A.3.11 Mandatory data included

As defined in ITU-R M.493-13

A.3.12 Optional data included

None

A.3.13 Radiated power output

Not less than 100 mW and not to exceed 500 mW vertically polarized

A.3.14 Radio locating signal (if applicable)

The radio locating signal shall consist of an Amplitude Modulated Continuous Swept Tone at 121.5 MHz to allow for a direction finder or similar type of Search and Rescue (SAR) equipment to locate the AU.

A.3.15 Frequency and type of emission

121.5 MHz +/- 50 parts per million

Double Sideband full carrier Amplitude Modulated (3K20A3X)

Emissions shall include a clearly defined carrier frequency component distinct from the modulation sideband components. At least 30% of the emitted power shall be contained within 250 parts per billion of the actual carrier frequency.

Transmitter Duty Cycle Continuous, except that transmissions may be interrupted for a maximum of 1 second to permit the transmission of DSC messages.

Modulation – an audio swept signal upward or downward by not less than 700 Hz in the range 300 to 1600 Hz

Modulation Duty Cycle – 33% to 55%

Modulation Factor – between 0.85 and 1.0

Sweep Repetition Rate – 2 Hz to 4 Hz

A.3.16 Radiated power output

Not less than 25mW, not to exceed 100mW PERP

A.3.17 Method of Measurement of Frequency, Modulation and Radiated Power Output

The following test procedure is considered satisfactory for performing the subject test; however, it is recognized that alternate procedures may be performed. Such alternate procedures may be used if the test provider can show that they provide equivalent information.

Frequencies of 121.6, 121.65, 121.7, 121.75, 121.85, or 121.9 MHz should be used for testing outside of a screen room to avoid radiation at 121.5 MHz

The tests may be performed in any sequence and in conjunction with other electrical tests. In all cases, the tests should be conducted after the Equipment under Test (EUT) has been ON for at least 15 minutes.

A.3.17.1.1 Carrier Frequency Test

The carrier frequency test may be performed with a frequency counter or a spectrum analyzer. The carrier frequency, measured at the minimum and maximum operating temperatures, should be 121.5 MHz ± 50 parts/million.

A.3.17.1.2 Modulation Characteristics

The transmitter duty cycle, modulation frequency, modulation duty cycle, modulation factor, and sweep repetition rate may all be determined in a manner described below by observing the detected RF signal with a storage oscilloscope.

- a) Transmitter Duty Cycle. Observe the transmitted signal and determine that the carrier is not interrupted (except in the case of a Morse or Voice encoded EUT).
- b) Modulation Frequency and Sweep Repetition Rate. Observe the modulation envelope and determine the upper and lower audio-frequency sweep limits and sweep repetition rate.
- c) Modulation Duty Cycle. Modulation duty cycle is the ratio of the positive modulation peak duration to the period of the instantaneous fundamental audio modulation frequency, observed at the half-amplitude points on the modulation envelope using the following formula (see Figure A.1):

$$\text{Duty Cycle} = \frac{A}{B} \times 100\%$$

The modulation duty cycle should be measured near the start, midpoint, and end of the modulation sweep period.

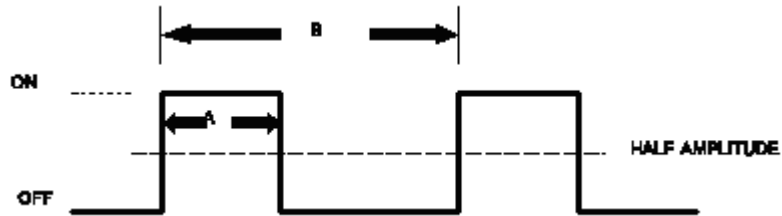


Figure A.1 – Typical Modulation Waveform

- d) Modulation Factor. The modulation factor should be defined with respect to the maximum and minimum amplitudes of the modulation envelope by the following formula (see Figures A.2 and A.3):

$$\text{Modulation Factor} = \frac{A - B}{A + B}$$

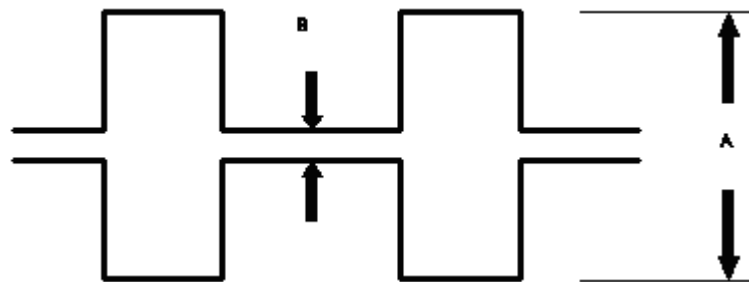


Figure A.2 – Typical Full-Wave Modulation Envelope

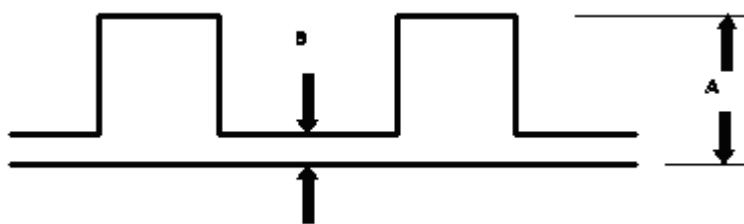


Figure A.3 – Typical One-Half Wave Modulation Envelope

- e) As a minimum, if included, Morse or Voice encoded units may be verified by aural decoding and verification of the AU transmitted GNSS position compared to a known reference point. The Time to First Fix (TTFF) and thus transmission of encoded data shall be measured from the time the EUT is first activated. The received aural signal shall be clear and unambiguous. In addition, the Morse code rate and modulation frequency shall also be measured, or on Synthetic Voice transmissions the AM Index and transmitted modulation distortion shall be checked. The EUT shall then be moved in position by at least one mile and the update rate of the encoded position and the accuracy of the new location shall be checked. Finally the GNSS receiver in the EUT shall be masked so that it can no longer receive updates and the maintenance of the GNSS data in the transmitted message shall be established, the receiver shall then be unmasked and the renewed presence of transmitted data shall be confirmed within 5 minutes + 1 transmission cycle.

A.3.17.1.3 Peak Effective Radiated Power

The Peak Effective Radiated Power (PERP) is the Peak Envelope Power (PEP)¹ multiplied by the gain of the antenna.

This test is only required to be performed at ambient temperature and should use an EUT that has been ON for a minimum of 91.7% of its stated operational life. If the test length exceeds the remaining 8.3% of operational life, the battery may be replaced with another which has been preconditioned with at least 91.7% of its stated operational life discharged.

The measurement procedure consists of a determination of 12 values of PERP made by direct measurement of radiated power. The measurements are taken at an azimuth angle of $30^\circ \pm 3^\circ$. All PERP measurements should be made at the same elevation angle; the elevation used should be the angle between 5° and 20° for which the EUT exhibits a maximum antenna gain. The median value of PERP should be between 25 mW and 100 mW; the ratio of maximum to minimum of the 11 highest values of PERP should not exceed 2 to 1 (3-dB).

A.3.17.1.4 Radiated Power Test Condition

The test site should be on level ground which has uniform electrical characteristics. The site should be clear of metal objects, overhead wires, etc., and as free as possible from undesired signals such as ignition noise or other RF carriers. The distance from the EUT, or the search antenna to reflecting objects should be at least 30 m. The EUT should be placed in the center of a ground plane with a radius of no less than $75 \text{ cm} \pm 5 \text{ cm}$. The EUT should be positioned vertically.

The ground plane should be resting on the ground and should be extended so that it completely encloses and presents a snug fit to the EUT.

Measurement of the radiated signals should be made at a point 5 m or more from the EUT. At this point, a wooden pole or insulated tripod with a movable horizontal boom should be arranged so that a search antenna can be raised and lowered through an elevation angle of 5° to 20° . The search antenna should be mounted on the end of the boom with its cable lying horizontally on the boom and run back to the supporting mast. The other end of the search antenna cable should be connected to a spectrum analyzer located at the foot of the mast.

A.3.17.1.5 Method of Measurement

The elevation angle between 5° and 20° which produces a maximum gain is determined with the EUT at an arbitrary azimuth. The PEP should be measured and the elevation angle should be noted and should remain fixed for the remainder of the test. The remaining 11 measurements of PERP may be obtained by rotating the EUT in increments of $30^\circ \pm 3^\circ$. For each measurement the EUT PERP should be computed using the following equation:

$$PERP = \text{LOG}^{-1} \frac{P_{\text{REC}} - G_{\text{REC}} + L_{\text{C}} + L_{\text{P}}}{10}$$

Where:

P_{rec}	=	Measured Power level from spectrum analyzer (dBm)
G_{rec}	=	Antenna gain of search antenna (dB)
L_{c}	=	Receive system attenuator and cable loss (dB)
L_{p}	=	Free space propagation loss (dB)

¹ PEP is the RMS power supplied to the antenna by the transmitter measured at the highest crest of the modulation envelope.

A.3.18 Battery

The battery should be capable of operating the MSLD at the required radiated power output for at least 12 hours, see paragraph 6.2.

A.4 Performance Tests - DSC Transmitter

All tests on the AU shall be carried out with the output power set at its maximum, except where otherwise stated. When tests are carried out with an Artificial Antenna, this shall be a non-reactive, non-radiating 50 ohm load.

A.4.1 Frequency error

The frequency error is the difference between the measured carrier frequency and its nominal value.

A.4.2 Method of measurement

The carrier frequency shall be measured in the absence of modulation, with the transmitter connected to an artificial antenna and tuned to channel 70. Measurements shall be made under normal test conditions (subclause 8.1.1.1) and under extreme test conditions (subclause 8.1.1.2). This test shall be carried out with the output power set at both maximum and minimum (if applicable).

A.4.3 Limits

The frequency error shall be within ± 1.5 kHz.

A.4.4 Carrier power

The carrier power is the mean power delivered to the artificial antenna during one radio frequency cycle in the absence of modulation. The rated output power is the carrier power declared by the manufacturer.

A.4.5 Method of measurement

The transmitter shall be connected to an artificial antenna and the power delivered to this artificial antenna shall be measured. The measurements shall be made on channel 70, under normal test conditions (subclause 8.1.1.1) and under extreme test conditions (subclause 8.1.1.2).

A.4.6 Limits

A.4.6.1.1 Normal test conditions

With the output power set at maximum, the carrier power shall remain between 0.1 W and 0.5 W and be within ± 1.5 dB of the rated output power under normal test conditions. The output power shall never however drop below 0.1 W.

A.4.6.1.2 Extreme test conditions

With the output power set at maximum, the carrier power shall remain between 0.1 W and 0.5 W and be within +2 dB, -3 dB of the rated output power under extreme conditions. The output power shall never however drop below 0.1 W.

A.4.7 Adjacent channel power

The adjacent channel power is that part of the total power output of a transmitter under defined conditions of modulation which falls within a specified passband centered on the nominal frequency of either of the adjacent channels. This power is the sum of the mean power produced by the modulation hum and noise of the transmitter.

A.4.8 Method of measurement

The adjacent channel power can be measured with a power measuring receiver (referred to in this subclause as the "receiver" – see A.6) which conforms to ITU-R Recommendation SM 332-4:

- a) The transmitter shall be operated with the output power at maximum under normal test conditions. The output of the transmitter shall be linked to the input of the "receiver" by a connecting device such that the impedance presented to the transmitter is 50 ohms and the level at the "receiver" input is appropriate.
- b) With the transmitter unmodulated, the tuning of the "receiver" shall be adjusted so that a maximum response is obtained. This is the 0 dB response point. The "receiver" attenuator setting and the reading of the meter shall be recorded.
- c) The tuning of the "receiver" shall be adjusted away from the carrier so that the "receiver" -6 dB response nearest to the transmitter carrier frequency is located at a displacement from the nominal carrier frequency of 17 kHz.
- d) The transmitter shall be modulated with 1.25 kHz at a level which is 20 dB higher than that required to produce ± 3 kHz deviation.
- e) The "receiver" variable attenuator shall be adjusted to obtain the same meter reading as in step b) or a known relation to it.
- f) The ratio of adjacent channel power to carrier power is the difference between the attenuator settings in steps b) and e), corrected for any differences in the reading of the meter.
- g) The measurement shall be repeated with the "receiver" tuned to the other side of the carrier.

The measurement may be made with the transmitter modulated with normal test modulation, in which case this fact shall be recorded with the test results.

A.4.9 Limits

The adjacent channel power shall not exceed a value of 70 dB below the carrier power of the transmitter without any need to be below 0.2 μ W.

A.4.10 Conducted spurious emissions conveyed to the antenna

Conducted spurious emissions are emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions.

A.4.11 Method of measurement

Conducted spurious emissions shall be measured with the unmodulated transmitter connected to the artificial antenna. The measurements shall be made over a range from 9 kHz to 2 GHz, excluding the channel on which the transmitter is operating and its adjacent channels. The measurements for each spurious emission shall be made using a tuned radio measuring instrument or a spectrum analyzer.

A.4.12 Limit

The power of any conducted spurious emission on any discrete frequency shall not exceed 0.25 μ W.

A.4.13 Cabinet radiation and conducted spurious emissions other than those conveyed to the antenna

Cabinet radiation consists of emissions at frequency, radiated by the equipment cabinet and structures.

Conducted spurious emissions other than those conveyed to the antenna are emissions at frequencies, other than those of the carrier and the sideband components resulting from the wanted modulation process, which are produced by conduction in the wiring and accessories used with the equipment.

A.4.14 Method of measurement

On a test site, detailed in A.4.14.1.1.1, the equipment shall be placed at the specified height on a non-conducting support and in position closest to normal use as declared by the manufacturer. The transmitter antenna connector shall be connected to an artificial antenna. The test antenna shall be orientated for vertical polarization and the length of the test antenna shall be chosen to correspond to the instantaneous frequency of the measuring receiver. The output of the test antenna shall be connected to a measuring receiver. The transmitter shall be switched on without modulation, and measuring receiver shall be tuned over the frequency range 30 MHz to 2 GHz, except for the channel on which the transmitter is intended to operate and its adjacent channels.

At each frequency at which a spurious component is detected:

- a) The test antenna shall be raised and lowered through the specified range of heights until a maximum signal level is detected on the measuring receiver.
- b) The transmitter shall be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
- c) The maximum signal level detected by the measuring receiver shall be noted.
- d) The transmitter shall be replaced by a calibrated antenna (substitution antenna) and calibrated RF source.
- e) The substitution antenna shall be orientated for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the spurious component detected.
- f) The substitution antenna shall be connected to a calibrated signal generator.
- g) The frequency of the calibrated signal generator shall be set to the frequency of the spurious component detected.
- h) The input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver, if necessary.
- i) The test antenna shall be raised and lowered through the specified range of heights to ensure that the maximum signal is received.
- j) The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver that is equal to the level noted while the spurious component was measured, corrected for the change of input attenuator setting of the measuring receiver.
- k) The input level to the substitution antenna shall be recorded as power level, corrected for the change of input attenuator setting of the measuring receiver.
- l) The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.
- m) The measure of the effective radiated power of the spurious components is larger of the two power levels recorded for spurious component at the input to the substitution antenna, corrected for the gain of the antenna if necessary;
- n) The measurements shall be repeated with the transmitter on stand-by.

A.4.14.1.1.1 Radiated measurements**A.4.14.1.2 Test sites and general arrangements for measurements involving the use of radiated fields****A.4.14.1.2.1 Outdoor test site**

The outdoor test site (Figure A.4) shall be on a reasonably level surface or ground. At one point on the site, a ground plane of at least 5 m diameter shall be provided. In the middle of this ground plane, a non-conducting support, capable of rotation through 360° in the horizontal plane, shall be used to support the test sample at 1.5 m above the ground plane. The test site shall be large enough to allow the erection of a measuring or transmitting antenna at a distance of $\lambda/2$ or 3 m whichever is the greater. The distance actually used shall be recorded with the results of the tests carried out on the site.

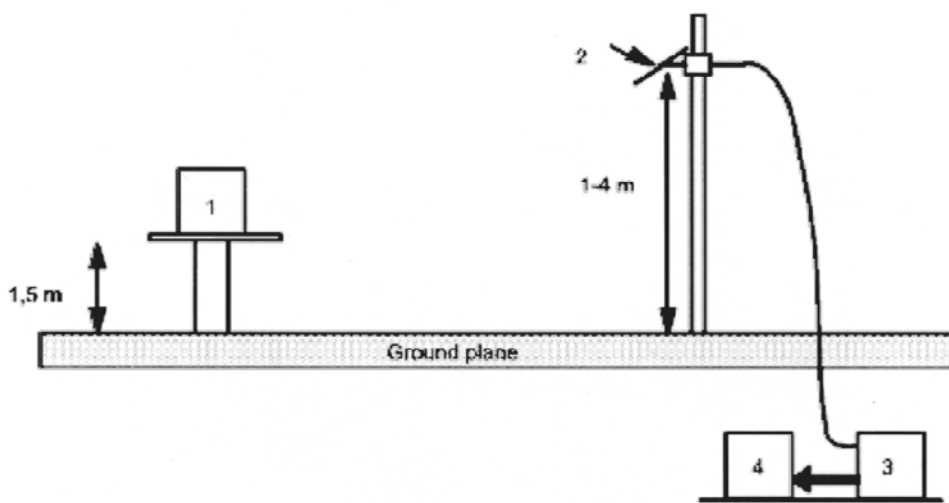


Figure A.4 – Outdoor Test Site

Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site and ground reflections do not degrade the measurements results.

A.4.14.1.2.2 Test antenna

The test antenna is used to detect the radiation from both the test sample and the substitution antenna, when the site is used for radiation measurements; where necessary, it is used as a transmitting antenna, when the site is used for the measurement of receiver characteristics. This antenna is mounted on a support such as to allow the antenna to be used in either horizontal or vertical polarization and for the height of its centre above ground to be varied over the range 1 to 4 m. Preferably, a test antenna with pronounced directivity should be used. The size of the test antenna along the measurement axis shall not exceed 20% of the measuring distance.

For receiver and transmitter radiation measurements, the test antenna is connected to a measuring receiver, capable of being tuned to any frequency under investigation and of measuring accurately the relative levels of signals at its input. For receiver radiated sensitivity measurements the test antenna is connected to a signal generator.

A.4.14.1.2.3 Substitution antenna

When measuring in the frequency range up to 1 GHz, the substitution antenna shall be a $\lambda/2$ dipole, resonant at the frequency under consideration, or a shortened dipole, calibrated to the $\lambda/2$ dipole. When measuring in the frequency range above 4 GHz a horn radiator shall be used. For measurements between 1 and 4 GHz either a $\lambda/2$ dipole or a horn radiator may be used. The center of this antenna shall coincide with the reference point of the test sample it has replaced.

This reference point shall be the volume centre of the sample when its antenna is mounted inside the cabinet, or the point where an external antenna is connected to the cabinet.

The distance between the lower extremity of the dipole and the ground shall be at least 0.3 m.

The substitution antenna shall be connected to a calibrated signal generator when the site is used for spurious radiation measurements and transmitter effective radiated power measurements. The substitution antenna shall be connected to a calibrated measuring receiver when the site is used for the measurement of receiver sensitivity.

The signal generator and the receiver shall be operating at the frequencies under investigation and shall be connected to the antenna through suitable matching and balancing networks.

NOTE: The gain of a horn antenna is generally expressed relative to an isotropic radiator.

A.4.14.1.2.4 Optional alternative indoor site

When the frequency of the signals being measured is greater than 80 MHz, use may be made of an indoor site. If this alternative site is used, this shall be recorded in the test report.

The measurement site may be a laboratory room with a minimum area of 6 m by 7 m and at least 2.7 m in height (Figure A.5).

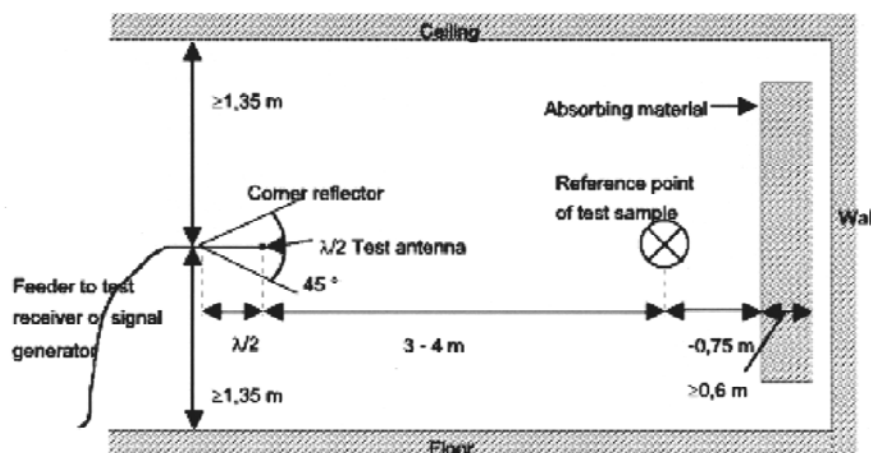


Figure A.5 – Indoor site arrangement (shown for horizontal polarization)

Apart from the measuring apparatus and the operator, the room shall be as free as possible from reflecting objects other than the walls, floor and ceiling.

The potential reflections from the wall behind the equipment under test are reduced by placing a barrier of absorbent material in front of it. The corner reflector around the test antenna is used to reduce the effect of reflections from the opposite wall and from the floor and ceiling in the case of horizontally polarized measurements. Similarly, the corner reflector reduces the effects of reflections from the side walls for vertically polarized measurements. For the lower part of the frequency range (below approximately 175 MHz) no corner reflector or absorbent barrier is needed. For practical reasons, the $\lambda/2$ antenna in Figure A.5 may be replaced by an antenna of constant length, provided that this length is between $\lambda/4$ and λ at the frequency of measurement and the sensitivity of the measuring system is sufficient. In the same way the distance of $\lambda/2$ to the apex may be varied.

The test antenna, measuring receiver, substitution antenna and calibrated signal generator are used in a way similar to that of the general method.