Recommendation T/R 34-01
(The Hague 1972, revised at Malaga-Torremolinos 1975, Stockholm 1977, Ostend 1979, Brussels 1980, Innsbruck 1981, Vienna 1982, Cannes 1983, Nice 1985, Odense 1986 and Copenhagen 1987)

# SPECIFICATIONS FOR MARITIME MOBILE RADIO EQUIPEMENT[1])

Recommendation proposed by the "Radiocommunications" Working Group T WG 3 (R)

*Text of the revised Recommendation adopted by the "Telecommunications" Commission:*

"The European Conference of Postal and Telecommunications Administrations,

*considering*

(a) that within Europe there is an increasing volume of radio communications with coastal stations and of trade in maritime mobile radio equipment,

(b) that the different characteristics required for maritime mobile radio equipment in each country are causing serious difficulties for Administrations and for the manufacturers of such equipment,

(c) that it is therefore highly desirable to harmonise the various national specifications within Europe, including the methods of measurement, for maritime mobile radio equipment,

(d) that it is desirable for information on type approval tests carried out in the various countries to be exchanged between the Administrations where the latter so request,

(e) that mutual recognition of type approval certificates is the evident objective,

(f) that it is necessary to consider the technical characteristics of each of the categories of maritime mobile radio equipment which have to comply with the Radio Regulations and the Convention for the Safety of Life at Sea,

*recommends*

1. that the CEPT members adopt and incorporate, as soon as is practically feasible, the contents of the Annexes to this Recommendation in their national specifications for maritime mobile radio equipment. It is, however, acknowledged that the characteristics currently contained in the Annexes are not necessarily sufficient to constitute complete satisfactory specifications,

2. that work on harmonising the various national specifications of the Member Administrations should proceed as appears necessary."

- Annex I: Specifications for single-sideband radiotelephone transmitters and receivers in the maritime mobile service operating in medium- and high-frequency bands
- Annex II: Specifications for radiotelephone transmitters and receivers in the maritime mobile service operating in medium- and high-frequency bands
- Annex III: Specifications for a watchkeeping radiotelephone receiver on the distress frequency 2182 kHz
- Annex IV: Specifications for radiotelephone alarm generators
- Annex V: Specifications for radiotelegraph alarm transmitters
- Annex VI: Environmental tests for maritime radio equipment

[1]) Additional information concerning the current implementation of this Recommendation is provided in the Appendices.

- Annex VII: Technical specifications for main receivers in the maritime mobile service
- Annex VIII: Technical specifications for the maritime main transmitter
- Annex IX: Technical specifications for the radiotelegraph auto alarm receiver
- Annex X: Technical specifications for narrow-band direct-printing telegraph equipment for receiving meteorological or navigational information (NAVTEX receiver)
- Annex XI: Technical specifications for emergency position-indicating radio beacons (EPIRBs) operating on the frequencies 121.5 MHz and 243 MHz
- Annex XII: Performance specifications for portable UHF radiotelephone equipment for on board communications for sea-going ships
- Annex XIII: Performance specifications for equipment for the generation, transmission and reception of digital selective calls in the maritime MF/HF and VHF mobile service

# Annex I

# Specifications for single-sideband radiotelephone transmitters and receivers in the maritime mobile service operating in medium- and high-frequency bands

*Note:*

Text approved by the "Telecommunications" Commission at Stockholm (1977), amended at Ostend (1979), Innsbruck (1981), Vienna (1982) and Nice (1985).

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## 1. INTRODUCTION

These specifications set out the minimum characteristics required for single-sideband radiotelephone transmitters and receivers used on board ships and operating in the medium- and high-frequency bands allocated to the maritime mobile service by the Radio Regulations. The characteristics take into account the provisions of the Radio Regulations and the Convention for the Safety of Life at Sea (1974).

## 2. GENERAL CONDITIONS

### 2.1. Construction

2.1.1. The mechanical and electrical construction and finish of the equipment shall conform in all respects with good engineering practice and the equipment shall be suitable for use on board ships at sea.

2.1.2. All controls shall be of sufficient size to enable the usual control functions to be performed and the number of controls shall be the minimum necessary for satisfactory operation.

2.1.3. All controls, instruments, monitoring devices and input/output points shall be clearly indicated. A label indicating the type of equipment submitted for the type approval tests shall be affixed to the equipment so as to be clearly visible in the normal operating position.

2.1.4. Full technical documentation shall be provided with the equipment.

2.1.5. Measures shall be taken to ensure correct operation when duplex is used and precautions shall be taken to prevent harmful electrical or acoustic feedback which might produce a build-up of oscillations.

2.1.6. All parts of the equipment to be checked during inspection or maintenance operations shall be readily accessible. The components shall be readily identifiable either from markings on the equipment or from its technical description.

2.1.7. The brightness of any equipment lighting which might impair navigation shall be capable of being reduced to zero.

### 2.2. Controls (General)

2.2.1. The transmission and reception frequencies shall be capable of being selected independently of each other.

2.2.2. A switch shall be provided for changing over the equipment from reception to transmission and vice versa without it being necessary to use any other control. If manual switching is used, the control for the switching device shall be located on the microphone or the telephone handset. When this switch is in the released position, the equipment shall be in reception mode.

2.2.3. Whatever the frequency on which the transmitter is operating, it shall be capable of being made ready to operate on any other frequency in the same maritime mobile service band within no more than 15 seconds.

Where transmitters are designed to operate in two or more maritime mobile service bands, a maximum 30 seconds may ballowed as the time necessary to change from operating in one maritime mobile service band to operating on any chosen frequency in another band covered by the transmitter and allocated to this service. However, the time allowed for switching the transmitter from operation on any given frequency in any of the bands which it can cover, to operation on 2,182 kHz shall in no case be more than 15 seconds.

These requirements shall also be fulfilled by the receiver.

*Note.* It is desirable to reduce this time to 15 seconds and the Administrations should encourage the development of equipment which will enable the time of 15 seconds to be adopted in the specifications as quickly as possible.

2.2.4. Markings shall be provided for identifying all the settings and controls necessary to make the transmitter and receiver ready to operate on 2,182 kHz, so that this operation can easily be performed.

2.2.5. Markings shall be provided for identifying all the settings and controls necessary to make the transmitter and receiver ready to operate on 2,182 kHz, so that this operation can easily be performed.

2.3. **Safety precautions**

2.3.1. Measures shall be taken to protect the equipment against the effects of overcurrent or overvoltage and against an excessive temperature increase in any part of the equipment as a result of a breakdown of the cooling system.

2.3.2. Measures shall be taken to prevent damage to the equipment if the power source produces transient voltage variations, and to prevent any damage that might arise from an accidental reversal of polarity at the power source.

2.3.3. Measures shall be taken to ensure that the accessible parts of the equipment are earthed, but this shall not result in any terminal of the electrical power source being earthed.

2.3.4. All components and wiring in which the DC or AC voltage (other than radio-frequency voltage) produce, singly or in combination, a peak voltage in excess of 50 volts, shall be protected against any accidental access and shall automatically be isolated from all electrical power sources if the protective covers are removed. Alternatively, the equipment shall be constructed in such a way as to prevent access to components operating at such voltages unless an appropriate tool is used such as a nut-spanner or screwdriver. Conspicuous warning labels shall be affixed both inside the equipment and on the protective covers.

2.3.5. The information in any memory system shall be preserved for at least ten seconds in the event of any power cut.

2.4. **Classes of emission and frequencies**

2.4.1. *Classes of emission*

2.4.1.1. The equipment shall permit transmission, reception or both transmission and reception in the upper sideband, of signals in all the following classes of emission:

J3E single-sideband telephony where the carrier power is at least 40 dB lower than the peak envelope power;

H3E single-sideband telephony where the carrier power is 4.5 to 6 dB lower than the peak envelope power.

2.4.1.2. The receiver shall also permit the reception of signals in the following classes of emission:

A3E double-sideband telephony with full carrier;

R3E single-sideband telephony with reduced carrier.

2.4.1.3. The transmitter may also permit the transmission of signals in the R3E class of emission in the upper sideband, with reduced carrier (carrier 16 to 20 dB lower than the peak envelope power).

2.4.1.4. The frequencies shall be designated by the value of the carrier which shall be indicated on the equipment.

2.4.2. *Frequency bands*

2.4.2.1. Medium-frequency bands

The equipment shall permit transmission, reception or both transmission and reception in the appropriate frequency bands between 1,605 kHz and 4,000 kHz allocated to the maritime mobile service by the Radio Regulations.

*Note.* In Region 1, the medium-frequency bands allocated to the maritime mobile service extend only as far as 3,800 kHz. In Region 3, these bands extend to 3,900 kHz and in Region 2 to 4,000 kHz.

2.4.2.2. High-frequency bands

The equipment shall permit transmission, reception or both transmission and reception in the appropriate frequency bands between 4 MHz and 28 MHz allocated to the maritime mobile service by the Radio Regulations.

2.4.2.3. It shall be possible to switch by means of a single operation from one class of emission to any other for which the transmitter is designed.

## 3. TEST CONDITIONS, POWER SUPPLY AND AMBIENT TEMPERATURES

3.1. **Normal and extreme test conditions**

Type approval tests shall be made under normal test conditions and also, where stated, under extreme conditions. The test conditions and procedures are described in paragraphs 3.2. to 3.5. below.

3.2. **Test power source**

During type approval tests, the equipment's power supply shall be provided by a test power source capable of producing normal and extreme test voltages as specified in paragraphs 3.3.2. and 3.4.2.

During the tests, the power source voltage shall be maintained within a tolerance of ± 3% relative to the voltage level at the beginning of each test.

3.3. **Normal test conditions**

3.3.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be fixed by any convenient combination of temperature and humidity within the following limits:

— temperature +15° C to +35° C

— relative humidity 20% to 75%.

*Note.* When it is impracticable to carry out the tests under the conditions specified above, a note stating the actual temperature and relative humidity during the tests shall be added to the test report.

3.3.2. *Normal test power supply*

3.3.2.1. Mains voltage and frequency

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of these specifications, the nominal mains voltage shall be the declared voltage or any of the declared voltages for which the equipement is indicated as having been designed. The frequency of the test power source used instead of the AC mains shall be 50 Hz ± 1 Hz.

3.3.2.2. Power source from an accumulator

Where the equipment is designed to operate from an accumulator, the normal test voltage shall be the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.3.2.3. Other power sources

For operation from other power sources, the normal test voltage shall be fixed by agreement between the equipment manufacturer and the authority conducting the tests.

3.4. **Extreme test conditions**

3.4.1. *Extreme temperatures*

For tests at extreme temperatures, measurements shall be made in accordance with the methods defined in paragraph 3.5.; the lower temperature shall be 0° C and the upper temperature +40° C.

3.4.2. *Extreme test power supply values*

3.4.2.1. Mains voltage and frequency

The extreme test voltages for equipment to be connected to the AC mains shall be the nominal mains voltage ± 10%.

The frequency of the test power source shall be 50 Hz ± 1 Hz.

3.4.2.2. Power source from an accumulator

Where the equipment is designed to operate from an accumulator, the extreme test voltages shall be 1.3 or 0.9 times the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.4.2.3. Other power sources

For operation from other power sources, the normal test voltage shall be fixed by agreement between the equipment manufacturer and the authority conducting the tests.

3.5. **Procedure for tests at extreme temperatures**

Before measurements are made, the equipment shall have reached thermal equilibrium in the test chamber.

The equipment shall be switched off during the temperature stabilizing period. The sequence of measurements shall be chosen and the humidity content in the test chamber shall be controlled so that excessive condensation does not occur.

3.6. **Environmental tests**

Before starting the environmental tests, the equipment shall be tested under the other conditions required in these specifications, except the test for vibration-induced frequency modulation mentioned in paragraph 5.4. which shall be carried out during the vibration tests. Where electrical tests are required, they shall be carried out at the normal test voltage.

Where the expression "verification of characteristics" is used, this shall be taken to mean a visual inspection and simple, functional electrical tests to demonstrate that the equipment is in working order and that there is no visible damage or deterioration.

The results of verifications of characteristics shall be included in the test report.

The following tests shall be conducted under the environmental conditions specified in Annex VI to Recommendation T R 34-01 E "Environmental tests for maritime radio equipment":
Vibration, paragraph 4.
Dry-heat cycle, paragraph 5.2.
Damp-heat cycle, paragraph 6.
Low-temperature cycle, paragraph 7.2.
Corrosion cycle, paragraphs 10.1. and 10.2.

3.7. **Warm-up time**

3.7.1. The equipment shall be capable of operating on 2,182 kHz within 30 seconds after being switched on.

3.7.2. The equipment shall be capable of operating in accordance with the technical requirements of these specifications one minute after being switched on, except in cases covered by paragraph 3.7.3.

3.7.3. If the equipment contains parts which have to be heated in order to operate correctly, e.g. crystal enclosures, a warm-up time of 30 minutes will be allowed, reckoned from the moment at which voltage is supplied to such circuits. After that time, the technical requirements of these specifications shall be met.

3.7.4. Where paragraph 3.7.3. applies, the power supply for the heating circuits shall be devised to be capable of remaining connected when the other power sources connected to the equipment or the other internal power sources are switched off. If the equipment is provided with a special switch, the switch's function shall be clearly indicated and the instructions for use shall specify that these circuits should normally be left connected to the power supply. A visual indication that the power supply is connected to such circuits shall be provided on the front panel.

3.7.5. If it is necessary to delay the voltage supply to any part of the transmitter after it has been switched on, this shall be done automatically.

## 4. TRANSMITTER

### 4.1. General

4.1.1. *Class of emission on the distress frequency 2,182 kHz*

4.1.1.1. When the distress frequency 2,182 kHz is selected, the H3E class of emission shall be selected automatically.

4.1.1.2. To permit the use of the R3E or J3E classes of emission, the automatic selection of the H3E class of emission may be suppressed once the 2,182 kHz frequency has been selected.

4.1.2. *Radiotelephone alarm signal generator*

4.1.2.1. Transmitters equipped for the frequency band 1,605-4,000 KHz shall be capable of using a radiotelephone alarm signal generator conforming to the technical requirements of Annex IV to this Recommendation.

4.1.2.2. The radiotelephone alarm signal generator should preferably be an integral part of the transmitter.

4.1.3. *Minimum number of operating frequencies*

4.1.3.1. 1,605-4,000 kHz:

The transmitter shall be capable of operating on at least 9 frequencies in the 1,605-4,000 kHz band (including the 2,182 kHz frequency). This obligation may be waived in the case of transmitters intended for use on ships which, according to the Convention on Safety of Life at Sea, do not have to be equipped with a radiotelephone installation.

4.1.3.2. 4-28 MHz:

The transmitter shall be capable of operating on at least 4 frequencies in each of the bands allocated to the maritime mobile service by the Radio Regulations. This obligation may be waived in the case of frequency bands that are not required for the type of operation.

4.1.4. Frequency synthesizers fitted in narrow-band direct printing radiotelephone transmitters or combined radiotelephone radiotelegraph transmitters shall transmit or be capable of transmitting according to a pre-set programme on the frequencies assigned to the ship.

4.2. **Frequency precision and stability**

4.2.1. *Frequency precision*

After the warm-up time specified in paragraph 3.7., the measured transmitter carrier frequency at any time shall be within ±40 Hz relative to the nominal frequency.

These limits shall be adhered to under normal test conditions (paragraph 3.3.) and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

4.2.2. *Spurious frequency modulation*

Any spurious frequency modulation of the carrier shall be low enough not to produce an inconvenient distortion.

4.3. **Artificial antenna**

4.3.1. In the type approval tets the transmitter shall meet the technical requirements of these specifications when connected to the artificial antenna described below. This does not in any way imply that the transmitter has to operate solely with antennas possessing these characteristics.

4.3.2. 1,605-4,000 kHz:

The artificial antenna shall comprise a resistance of 10 ohms and a capacitance of 250 pF connected in series.

4.3.3. 4-28 MHz:

The artificial antenna shall comprise a resistance of 50 ohms.

4.4. **Output power**

4.4.1. *Rated power: definition and measurement conditions*

The rated peak envelope power shall be stated by the manufacturer and all the requirements laid down by these specifications for that value of power shall be met.

For any power value not exceeding this rated value, the intermodulation level shall be no more than −25 dB relative to the power of one of the two fundamental radio-frequency components of equal amplitude produced at the transmitter output by simultaneously applying two audio-frequency test signals to the input, the tests being carried out in accordance with CCIR Recommendation 326-2. The tests shall be conducted under normal test conditions (paragraph 3.3.) and under extreme conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

Modulation level limiter systems or automatic modulation level control systems shall be in normal operating condition. This test may be repeated at the request of the authority conducting the tests, cutting out any modulation level limiter system or automatic modulation level control system.

4.4.2. *Voice-activated modulation*

The transmitter shall be capable of delivering full power and of being fully modulated when the operator speaks normally into the microphone supplied with the equipment.

4.4.3. *Power values imposed: 1,605-4,000 kHz*

On any frequency in the 1,605-4,000 kHz band, the rated peak envelope power shall be no less than 60 watts and no more than 400 watts.

*Note.* It is left to the discretion of the Administrations concerned to authorise transmitters more powerful than 400 watts (see also paragraph 4.11.1.).

4.4.4. *Power values imposed: 4-28 MHz*

On any frequency in the maritime bands between 4 and 28 MHz for which the transmitter is intended to operate, the rated peak envelope power shall be more than 60 watts but no more than 1.5 kW.

4.5. **Automatic level control, limiter or combined level control/limiter**

The transmitter shall be fitted with an automatic level control, modulation limiter or a combined level control/limiter capable of operating in all the specified classes of emission.

4.5.1. *Method of measurement*

The transmitter shall be modulated, at a power level between 0 and −1 dB relative to the rated peak envelope power, by a test signal composed of 4 audio-frequencies of equal amplitude between 350 Hz and 2,700 Hz, applied to the transmitter input. The modulating audio-frequencies shall not be harmonically related and shall be separated from each other by at least 100 Hz.

The level of the test signal shall be varied while simultaneously measuring the peak voltage of the input signal and the corresponding value of the peak envelope power at a sufficient number of points to enable a graph to be drawn of the output power as a function of the level of the input signal. This graph shall fit within Figure I-1 (T/R 34-01) so that it reaches the upper limit at a minimum two points, while not exceeding it at any point. The input signal level corresponding to an output power 10 dB below the rated output power shall be noted.

*Note.* To ensure that the measurements are reproducible, particularly when the input signal is composed of other audio-frequency combinations, the rated output power should be adjusted using the graph produced for the automatic level control, limiter or combined level control limiter. The first point shall be defined by the input signal whose peak voltage corresponds to a peak envelope power 10 dB below the rated output power, then increase the input signal level by the dB difference between the input voltages corresponding to the rated output power and to the first point.

4.5.2. *Limits imposed*

The graph shall fit within the limits fixed by Figure I-1 (T/R 34-01).

4.6. **Audio-frequency response**

4.6.1. *Definition and method of measurement*

The audio-frequency response is the output power variation as a function of the modulating audio-frequency. The response shall be measured under conditions which ensure that the result is not affected by any automatic level control or limiter. In class of emission J3E, the output power at the highest point of the response curve shall be at least 6 dB below the rated output power.

4.6.2. *Limits imposed*

The audio-frequency response curve shall fit within the shaded lines in Figure I-2 (T/R 34-01).

4.7. **Spurious emission power**

4.7.1. The rated power of the transmitter is obtained by applying a two-tone modulation signal with the frequency separation between the tones being such that all intermodulation products are rejected at frequencies at least 1,500 Hz away from the assigned frequency. Under these conditions, the power of any spurious emission supplied to the artificial antenna on any discrete frequency shall conform to the requirements in the Table below. Reference shall also be made to paragraph 6 in Appendix 17 to the Radio Regulations. Any modulation level limiter system or automatic modulation level control system shall be in normal operation at the time.

| Separation $\Delta$ in kHz between the frequency of the unwanted emission and the assigned frequency | Minimum attenuation below peak envelope power |
|---|---|
| $1.5 < \Delta \leqslant 4.5$ | 31 dB |
| $4.5 < \Delta \leqslant 7.5$ | 38 dB |
| $7.5 < \Delta$ | 43 dB without exceeding the power of 50 mW |

The assigned frequency shall be 1,400 Hz higher than the carrier frequency.

4.7.2. Spurious emissions including transmitter noise shall not reach a level capable of significantly affecting the operation of an associated receiver when duplex is used.

4.8. **Noise and hum power**

With the audio-frequency input terminals on open circuit or short circuit, the total noise and hum power measured in the artificial antenna within the necessary transmitter bandwidth shall be at least 40 dB less than the peak envelope power.

4.9. **Continuous operation**

With the rated transmitter power being obtained by applying two audio-frequency sinusoidal signals producing radio-frequency components of equal amplitude at the output, the transmitter shall be capable of continuous operation for 15 minutes without any appreciable reduction of power and without any harmful phenomenon occurring.

4.10. **Transmitter protection**

4.10.1. *Transmitter terminals on open circuit or short circuit*

With the rated transmitter output power being obtained by simultaneously applying two equal-level modulation signals, no damage shall occur when the antenna terminals are placed on open circuit or short circuit for 5 minutes in each case.

4.10.2. *Start-up*

If it is necessary to delay the voltage supply to any part of the transmitter after it has been switched on, this shall be done automatically.

4.11. **Command and control equipment**

4.11.1. *Reduction of output power*

If the rated output power is more than 150 watts, the equipment shall have the facility for reducing the output power to no more than 60 watts.

Where a combined transmitter is intended to operate both in medium-frequency and in high-frequency bands and has a peak envelope power capability in excess of 400 watts, the output power shall be limited by an automatic device to 400 watts when the equipement is transmitting in the medium-frequency radiotelephone waveband.

An alternative possibility, left to the discretion of the Administration concerned, is for a clear indication to be provided so that the power can be reduced to 400 watts by manual control when the equipment is transmitting in the medium-frequency radiotelephone waveband (see also paragraph 4.4.3.).

4.11.2. *Tuning control*

The transmitter shall have a sufficient number of tuning devices to permit rapid and precise tuning. If the output power can be adjusted manually, a monitoring device shall indicate that the transmitter has reached its rated output power.

The failure of any monitoring device shall not open the antenna circuit or cause any significant change in the operation of the transmitter.

4.11.3. *Measurement of current in the antenna*

Transmitters operating in the medium-frequency waveband shall have a device for measuring the amperage current in the antenna on 2,182 kHz. A simple antenna current indicator may be authorised when the transmitter is intended for use on ships which under national regulations do not have to be equipped with a radiotelephone installation.

4.11.4. *Transmission at sufficient power on 2,182 kHz*

It is desirable to ensure transmission at sufficient power on the distress frequency 2,182 kHz, particularly when "fine" manual tuning is possible. Administrations are requested to include in the test reports the maximum and minimum power obtained on this frequency, whatever the "fine-tuned" setting.

4.11.5. *Defective automatic tuning system*

Where the transmitter is fitted with an automatic tuning system it shall be possible, if the system breaks down, to tune to 2,182 kHz rapidly by manual control.

5. **RECEIVER**

5.1. **General**

5.1.1. *Tuning systems for medium-frequency receivers*

For receivers operating in medium-frequency wavebands (see paragraph 2.4.2.1.), one of the following tuning systems shall be used (see also paragraph 5.3.).

5.1.1.1. Step-by-step tuning using a synthesizer

Where the minimum synthesizer step is greater than 10 Hz, continuous tuning covering each step shall be possible. The means of controlling step-by-step tuning shall be such as to enable the receiver tuning to be varied over a frequency range without having to display each frequency one by one.

5.1.1.2. Continuous tuning in the appropriate bands covering all the specified ranges.

5.1.1.3. Reception on at least 23 pre-set frequencies, including the distress frequency 2,182 kHz.

5.1.2. *Tuning systems for high-frequency receivers*

For receivers operating in frequency bands between 4 MHz and 28 MHz in accordance with paragraph 2.4.2.2., one of the following tuning systems shall be used (see also paragraph 5.3.):

5.1.2.1. Step-by-step tuning using a synthesizer

Where the minimum synthesizer step is greater than 10 Hz, continuous tuning covering each step shall be possible. The means of controlling step-by-step tuning shall be such as to enable the receiver tuning to be varied over a frequency range without having to display each frequency one by one.

5.1.2.2. Continuous tuning in the appropriate bands covering all the specified ranges.

5.1.2.3. Reception on at least 30 pre-set frequencies.

5.2. **General measurement conditions**

5.2.1. *Impedance of the test signal sources*

5.2.1.1. For the purpose of the type approval tests, the receiver shall meet the requirements of these specifications when connected in accordance with paragraphs 5.2.1.2. and 5.2.1.3. This does not in any way imply that the receiver should only operate satisfactorily with antennas whose impedances have these characteristics.

5.2.1.2. The test signal shall be supplied by a source with an internal resistance of 50 ohms, except in the cases specified in paragraph 5.2.1.3.

5.2.1.3. At the request of the manufacturer and with the approval or at the instigation of the authority conducting the tests, an artificial antenna comprising a resistance of 10 ohms in series with a 250 pF capacitor may be used on frequencies lower than 4 MHz.

5.2.2. *Test signals applied to the receiver input*

5.2.2.1. Sources of test signals to be applied to the receiver input shall be connected via a network such that the impedance presented to the receiver input is equal to the impendance of the artificial antennas defined in paragraphs 5.2.1.2. and 5.2.1.3. respectively. This requirement shall be met, irrespective of whether one or more test signals are applied to the receiver simultaneously. If there are two or more test signals, precautions shall be taken to prevent any undesirable effect resulting from an interaction between the signals in the generators or from other sources.

5.2.2.2. The levels of the test signals shall be expressed in terms of the e.m.f. at the output terminals of the source including the associated networks mentionned in paragraph 5.2.2.1.

5.2.3. *Normal test signals*

Unless stated otherwise, the normal radio-frequency test signals applied to the receiver input shall be as follows:

5.2.3.1. Class of emission A3E and H3E

Double-sideband signal modulated at the 800 Hz frequency with a modulation factor of 30%.

5.2.3.2. Class of emission J3E and R3E

Unmodulated 1,000 ± 3 Hz signal above the carrier frequency to which the receiver is tuned.

5.2.4. *Receiver output*

5.2.4.1. The output power shall be measured in a resistance equal or very close to the modulus of impedance of the headset or loudspeaker, as the case may be.

5.2.4.2. The normal output power used in these specifications shall be measured at a frequency of 1,000 Hz or 800 Hz and shall be as follows:
(a) for reception by headset: 1 mW;
(b) for reception by loudspeaker: 50 mW.

5.2.4.3. The receiver shall be capable of providing an output power of 500 mW in the loudspeaker with a harmonic level not exceeding 10%.

5.2.5. *Selection of test frequencies and receiver setting*

Unless stated otherwise, the tests shall be made on one or more frequencies in each of the bands allocated to the maritime mobile service, including the 2,182 kHz frequency.

5.3. **Tuning error and tuning drift**

5.3.1. *Definitions*

The tuning error is the difference between the frequency indicated on the receiver and the carrier frequency of a signal applied to the receiver input which the receiver is designed to receive.

Drift is the tuning variation over a period of time without re-setting the receiver.

5.3.2. *Method of measuring the tuning error*

Measurements shall be made in the J3E mode of operation. A radio-frequency test signal representing the nominal carrier frequency plus 1,000 Hz shall be applied to the receiver input, the precision of the test signal frequency being ± 3 Hz. With the speech clarifier (if there is one) being set in the middle of the range which it covers, the receiver shall be adjusted so that the corresponding carrier frequency is read on the receiver frequency indicator. The frequency at the output shall then be measured and the difference between 1,000 Hz and the frequency measured at the output shall be determined. For receivers with step-by-step tuning using a synthesizer, this value shall be noted as being the tuning error.

For receivers with continuous tuning, the test shall be repeated after actuating the control sufficiently to re-engage the mechanism, after which the control shall be re-set to the nominal value of the carrier frequency selected, moving in the opposite direction to that used for the first measurement.

This operation shall be repeated a number of times, the tuning error of the receiver being determined by taking the mean square value of all the results thus obtained.

If a method of calibration is provided by the manufacturer, it may be applied once for each frequency band in which the receiver is to operate. Measurements shall be made at a sufficient number of frequencies to determine the tuning error in all the frequency ranges for which the receiver is designed. Measurements shall be made under normal test conditions and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

5.3.3. *Limits imposed on the tuning error*

For step-by-step tuning, the tuning error shall not exceed 50 Hz. For continuous tuning, the tuning error shall not exceed 150 Hz.

5.3.4. *Method of measuring the tuning drift*

Measurements shall be made in the J3E mode of operation. For receivers with continuous tuning, a test signal at an appropriate frequency shall be applied and tuned so that the frequency of the signal at the output is 1,000 Hz. For receivers with step-by-step tuning, an unmodulated radio-frequency test signal representing the nominal frequency plus 1,000 Hz shall be applied to the receiver input, the precision of the test signal frequency being ± 3 Hz. The receiver speech clarifier shall be set in a position close to the middle of the range which it covers. The frequency at the input shall be kept constant and the frequency at the output shall then be measured at appropriate intervals, the results being used to determine the tuning drift.

During these measurements the ambient temperature shall be kept constant (± 3° C). Measurements shall be made under normal test conditions (paragraph 3.3.) and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

5.3.5. *Limits imposed for tuning drift*

During any 15-minute period subsequent to the warm-up time defined in paragraph 3.7., the difference between the frequency at the output at any one time and the frequency at the output at the start of the 15-minute period shall not exceed 20 Hz.

5.4. **Vibration-induced frequency modulation**

5.4.1. *Definition*

Vibration-induced frequency modulation is the frequency deviation which may be produced at the output when the fully-fitted receiver is subjected to vibrations in a specified range of frequencies and amplitudes.

5.4.2. *Method of measurement*

The receiver fitted complete with its protective covers and dampers (if provided) shall be placed in its normal operating position on a vibrating table. The receiver shall then be switched on, put in the reception mode for the J3E class of emission and, after the warm-up time allowed by paragraph 3.7., a radio-frequency test signal as described in paragraph 5.2.3.2. shall be applied to the receiver input at a level of +60 dBμV. The receiver shall be set for the normal output level at 1,000 Hz. The table shall be vibrated as described in the specifications for environmental tests (Annex VI to Recommendation T/R 34-01 E). Any frequency deviation of the output signal during this test shall be measured, using an appropriate discriminator. In the course of the test, care shall be taken to avoid measurement errors that might arise from tuning drift.

5.4.3. *Limit imposed*

The peak frequency deviation shall not exceed ±20 Hz.

5.4.4. *Speech clarifier for J3E reception*

The receiver tuning system shall enable the frequency error to be reduced to 5 Hz or less. This may be achieved by means of a fine-tuning control or speech clarifier.

The fine-tuning or clarifier control movement and the range covered shall be sufficient to permit easy adjustment.

The frequency range of the fine tuner or speech clarifier shall be no less than ±150 Hz and no more than ±500 Hz.

## 5.5. Intermediate-frequency and audio-frequency passbands

5.5.1. *Definition*

A passband, measured at the receiver output, is the frequency band within which the attenuation relative to the peak response does not exceed 6 dB.

5.5.2. *Method of measurement*

5.5.2.1. Classes of emission J3E/R3E

With the automatic gain control inoperative, an unmodulated radio-frequency test signal shall be applied to the receiver input as indicated in paragraph 5.2.2.

The frequency of the test signal shall be varied, measuring its voltage and the voltage of the audio-frequency output signal on a sufficient number of frequencies to determine the audio-frequency passband.

When starting the measurements, the clarifier (if any) for the receiver may be moved in order to adjust the tuning, but after this has been done, the clarifier setting shall be in the middle third of its adjustment range. In the course of the test, the position of the receiver tuning controls shall not be re-set.

5.5.2.2. Classes of emission A3E/H3E

A test signal shall be applied to the receiver input at a level of +60 dBμV, modulated at 1,000 Hz with a modulation factor of 30% and the receiver shall be set for the normal output power. The modulation frequency shall then be varied while maintaining a constant modulation factor of 30%, and the output level corresponding to each modulation frequency shall be measured.

5.5.3. *Limits imposed*

5.5.3.1. Classes of emission J3E R3E

The audio-frequency passband shall be larger than 350 Hz to 2,700 Hz.

5.5.3.2. Classes of emission A3E H3E

The audio-frequency passband shall be larger than 350 Hz to 2,700 Hz. The attenuation relative to the peak response shall be no less than 20 dB at 6 k Hz.

## 5.6. Maximum usable sensitivity

5.6.1. *Definition*

The maximum usable sensitivity is the minimum level of a radio-frequency input signal with the modulation specified, which produces at the receiver output a chosen value of the signal-noise-distortion to noise ratio (abbreviated to SND N) or the signal-noise-distortion to noise-distortion ratio (abbreviated to SND ND) and, at the same time, an output power no lower than the normal power.

5.6.2. *Methods of measurement*

With the automatic gain control operative, the tests shall be carried out with the receiver being adjusted through each frequency range and in each class of emission for which it is designed. The test signals applied to the receiver shall be the normal test signals specified in paragraph 5.2.3.

For each test, the input level of the test signal shall be set to produce the SND/N or SND/ND ratio of 20 dB at the receiver output and, at the same time, at least the normal output power. The input level measured is the maximum usable sensitivity.

5.6.3. *Limits imposed*

The maximum usable sensitivity shall be better than the values shown in the Table below:

| Range of frequencies and class of emission | 50-ohm source of test signals (paragraph 5.2.1.2.) | 10-ohm/250 pF source of test signals (paragraph 5.2.1.3.) |
|---|---|---|
| | Maximum level of input signal dBμV | Maximum level of input signal dBμV |
| 1,605-4,000 kHz | | |
| J3E/R3E | +16 | +16 |
| A3E/H3E | +30 | +30 |
| 4-28 MHz | | |
| J3E/R3E | +11 | |

5.7. **Adjacent channel signal-selectivity**

5.7.1. *Definition*

The adjacent channel signal-selectivity is defined as being the receiver's ability to discriminate between the wanted signal (to which the receiver is tuned) and unwanted signals (on frequencies generally outside the passband), with the wanted signal and the unwanted signals acting simultaneously. For the purpose of these specifications, the adjacent channel signal-selectivity is defined as the ratio at the receiver input of the level of a specified unwanted signal to the level of a specified wanted signal, which corresponds to a reduction in the SND/N or SND/ND ratio from 20 dB to 14 dB.

5.7.2. *Method of measurement*

The arrangement used for applying two test signals to the receiver input shall conform to paragraph 5.2.2. The automatic gain control shall be switched on.

The wanted signal shall conform to paragraph 5.2.3. The unwanted signal shall be modulated by a frequency of 400 Hz with a modulation factor of 30%.

The receiver shall be set for normal output power on the wanted frequency, so as to produce a SND/N or SND/ND ratio of 20 dB.

The level of the unwanted signal shall be increased (from a low level) until the SND/N or SND/ND ratio falls from 20 dB to 14 dB.

5.7.3. *Limits imposed*

The adjacent channel signal-selectivity shall exceed the values shown in the following Tables:

Class of emission J3E/R3E:

| Separation between the carrier frequency of the unwanted signal and the carrier frequency of the wanted signal | Adjacent channel signal-selectivity |
|---|---|
| −1 kHz and +4 kHz | 40 dB |
| −2 kHz and +5 kHz | 50 dB |
| −5 kHz and +8 kHz | 60 dB |

Class of emission A3E/H3E:

| Separation between the carrier frequency of the unwanted signal and the carrier frequency of the wanted signal | Adjacent channel signal-selectivity |
|---|---|
| −10 kHz and +10 kHz | 40 dB |
| −20 kHz and +20 kHz | 50 dB |

5.8. **Two-signal selectivity tests (blocking and cross-modulation)**

5.8.1. *Definitions*

Blocking is a change (generally a reduction) in the wanted-signal output power of a receiver or a reduction of the SND N or SND ND ratio due to an unwanted signal on another frequency.

Cross-modulation is the carrying over to the wanted signal of the modulation of a modulated unwanted signal transmitted on another frequency.

5.8.2. *Methods of measurement*

5.8.2.1. The tests shall be conducted with the automatic gain control switched on, the RF IF gain control at maximum and any input attenuator set to minimum attenuation. The measurements shall be made while applying two test signals simultaneously to the receiver input. One of the test signals shall be the wanted signal to which the receiver is tuned, the other being the unwanted signal.

5.8.2.2. The measurements shall be made with the level of the wanted input signal at +60 dBμV. The blocking measurement shall be repeated with the wanted signal at a level equal to the maximum usable sensitivity of the receiver.

5.8.2.3. The wanted signal at the receiver input shall be the normal test signal specified in paragraph 5.2.3.

5.8.2.4. The receiver shall be set so that application of the wanted signal produces normal power at the output.

5.8.2.5. The unwanted signal shall be at a frequency 20 kHz away from the wanted signal frequency.

5.8.2.6. For the blocking tests, the unwanted signal shall be unmodulated. The input level of the unwanted signal shall be adjusted to produce a 3 dB change in the output level of the wanted signal or a 6 dB reduction of the SND/N or SND/ND ratio, whichever occurs first. The input level of the unwanted signal when this prerequisite is met, defines the blocking level.

In making the above measurements, precautions should be taken to prevent the results from being appreciably affected by output-signal components caused by distortion.

5.8.2.7. For the cross-modulation tests, the unwanted signal shall be modulated by 400 Hz with a modulation factor of 30%. The input level of the unwanted signal shall be increased until the total power of the unwanted signal at the receiver output as a result of cross-modulation is 30 dB below the level of the wanted signal. When this prerequisite is met, the input level of the unwanted signal defines the cross-modulation level.

5.8.3. *Limits imposed*

5.8.3.1. Blocking

(a) With the level of the wanted signal at +60 dBμV, the level of the unwanted signal shall be no less than +100 dBμV.

(b) With the level of the wanted signal equal to the maximum usable sensitivity, the level of the unwanted signal shall be at least 65 dB above the level of the maximum usable sensitivity.

5.8.3.2. For cross-modulation, the level of the unwanted signal shall be no less than +90 dBμV.

5.9. **Intermodulation**

5.9.1. *Definition*

Intermodulation is a process whereby signals result from the simultaneous application of two or more (generally unwanted) signals to a non-linear circuit.

5.9.2. *Method of measurement*

5.9.2.1. Class of emission J3E

With the automatic gain control (AGC) switched on, the RF IF gain control at maximum and any input attenuator set to minimum attenuation, an unmodulated input signal at a frequency 1,000 Hz above the tuning frequency of the receiver shall be applied to the receiver input at a level of +30 dBμV, with the audio-frequency gain control set so as to produce normal output power.

The wanted signal shall then be suppressed and two equal-level unmodulated signals shall be applied simultaneously to the receiver input. Neither of the two signals shall be at a frequency less than 30 kHz away from the wanted signal frequency. (The receiver input frequencies which are likely to produce harmful intermodulation products are contained in CCIR Recommendation 332-4, paragraph 6.4.) In selecting the frequencies used for these measurements, care shall be taken to avoid those on which spurious responses are produced. The input levels of the two signals in combination shall remain equal and shall be adjusted so that the receiver output power resulting from the combined signals is equal to the normal output power. If the above input levels cannot be determined precisely from the "output level/input level" characteristic, it shall simply be ascertained that the AGC operating conditions are the same as when the wanted signal was applied, using the AGC voltage, for example, as a reference.

5.9.3. *Limits imposed*

The level of each of the two signals which combine to produce the normal output power shall be no less than +80 dBμV.

5.10 **Spurious response selectivity**

5.10.1 *Definition*

The spurious response protection ratio is the ratio of the input level of the unwanted signal on the spurious response frequency to the input level of the wanted signal when the wanted and unwanted signals each separately produce the same SND/N or SND/ND ratio at the receiver output.

5.10.2. *Method of measurement*

The receiver shall be set as provided in paragraph 5.6. (sensitivity test), the position of the receiver controls remaining unchanged throughout the course of the test. The carrier frequency of the input signal shall then be varied in order to find the spurious responses. Whenever a spurious response is obtained, the carrier frequency of the input signal shall be adjusted so as to provide maximum power at the output. The input level shall then be adjusted so as to produce a SND/N or SND/ND ratio of 20 dB at the receiver output. The ratio between the input level of each spurious signal and the input level of the wanted signal producing the same SND/N or SND/ND ratio shall then be determined.

5.10.3. *Limits imposed*

The spurious response protection ratio on the intermediate frequency, image frequency and any other frequencies of spurious responses shall be no less than 70 dB.

5.11. **Harmonic output level**

5.11.1. *Definition*

The harmonic level at a receiver output is the total r.m.s. voltage of all the harmonic components of the modulation frequency which are produced at the receiver output as a result of non-linearity effects in the receiver. For this test, the harmonic level is expressed as a percentage of the total r.m.s. voltage obtained at the output when a single sinusoidal modulation signal is applied.

5.11.2. *Methods of measurement*

This test shall be conducted both at the rated power (stated by the manufacturer and approved by the authority conducting the tests) and the normal test power. The test signal defined in paragraph 5.2.3. shall be applied to the receiver input.

The level of the input signal shall be varied between +30 dBμV and +80 dBμV, with the output level being kept at the normal power value, then at the rated output power. The harmonic level shall be measured.

5.11.3. *Limits imposed*

The harmonic level shall not exceed 10% at the rated output power and 5% at the normal output power.

5.12. **Audio-frequency intermodulation**

5.12.1. *Definition*

Audio-frequency intermodulation is a process whereby signals are produced from two or more wanted signals simultaneously present in the demodulator or audio-frequency amplifier of a receiver. It is expressed as the ratio of the level of each of the intermodulation components to the level of one of the two equal-amplitude test signals.

5.12.2. *Method of measurement*

With the automatic gain control operative, the manual high- and intermediate-frequency gain controls, if any, at maximum and any input attenuator set to minimum attenuation, an unmodulated signal at a frequency 1,100 Hz above the tuning frequency of the receiver shall be applied to the receiver input at a level of +60 dBμV. A second unmodulated signal at a frequency 1,700 Hz above the tuning frequency of the receiver shall also be applied and its level adjusted so that the 1,100 Hz and 1,700 Hz audio-frequency signals at the receiver output have an equal amplitude.

The total output power of the receiver shall be adjusted to its normal value (paragraph 5.2.4.) by means of the audio-frequency gain control.

The audio-frequency intermodulation shall then be measured.

5.12.3. *Limits imposed*

No intermodulation component may exceed −25 dB relative to the output level of one of the two wanted signals.

5.13. **Spurious emissions**

5.13.1. *Definition*

Spurious emissions are radio-frequency emissions of any kind which are produced in the receiver and radiated, whether conveyed to the antenna or other conductors linked to the receiver, or whether radiated directly by the receiver.

5.13.2. *Methods of measurement*

Spurious emissions radiated by the antenna shall be measured by connecting a 50-ohm resistance and searching for signals produced at the resistance terminals. The measurements shall extend over a range from 9 kHz to 2 GHz.

5.13.2a. Where tests on the receiver have been made using the artificial antenna described in paragraph 5.2.1.3., a network comprising a 10-ohm resistance in series with a 250 pF capacitance shall be used instead of the 50-ohm resistance mentioned in paragraph 5.13.2. above.

5.13.3. *Limits imposed*

The power of any discrete component measured in the artificial antenna shall not exceed 1 nanowatt ($1 \times 10^{-9}$ watt).

5.14. **Spurious signals originating internally**

Spurious signals originating internally shall not produce, at the receiver output, an audio-power more than 10 dB (with the bandwidth corresponding to the single-sideband) above the intrinsic sound level of the receiver, measured with the antenna connected. No internal spurious signal shall be produced on any of the distress frequencies or in their associated guard bands.

5.15. **Gain control**

5.15.1. *Manual and automatic gain control*

The receiver shall be provided with a manual audio-frequency gain control and a manual radio-frequency and/or intermediate-frequency gain control. An automatic gain control (AGC) capable of operating satisfactorily with signals in the classes of emission and frequency ranges specified in paragraph 2.4.1.1. shall be fitted in the receiver. This control shall be capable of being switched off.

5.15.2. *Tests and limits imposed*

5.15.2.1. For the purpose of verifying the characteristics of the manual RF IF control, tests shall be made with the automatic gain control switched off and the receiver adjusted within each frequency range for which it is designed.

The input signal shall be the appropriate normal test signal specified in paragraph 5.2.3.

For each test, the level of the input signal shall be equal to the maximum usable sensitivity, measured in accordance with paragraph 5.6., and the output power shall be set to the normal output power value. The input level shall be increased by 20 dB and the output power reduced to the normal output power value by means of the manual RF IF control.

The SND N or SND ND ratio shall then increase by at least 15 dB.

5.15.2.2. For the purpose of verifying the characteristics of the automatic gain control, tests shall be made with the receiver being adjusted within each band of the maritime mobile service. The input signal shall be the appropriate normal test signal specified in paragraph 5.2.3.

For each test, the level of the input signal shall be equal to the maximum usable sensitivity, measured in accordance with paragraph 5.6. The input level shall then be increased by 20 dB.

The SND/N or SND/ND ratio shall then increase by at least 15 dB.

When making the above measurements, precautions shall be taken so that the components from distortion in the output signal do not appreciably affect the results.

5.15.2.3. Once the test conditions specified in paragraph 5.15.2.2. have been fulfilled, the receiver shall be adjusted to provide an output level 10 dB below the normal output power. The input level shall then be increased by 70 dB.

The resulting increase in output power shall not exceed 10 dB.

5.15.3. *Time constant of the AGC (forward and reverse action time)*

5.15.3.1. Definitions

AGC forward action time: the time which elapses between the moment when the level of the input signal is suddenly increased by a specified quantity and the moment when the output signal attains a new state of equilibrium and stays there to within 2 dB.

AGC reverse action time: the time which elapses between the moment when the input signal suddenly decreases by a specified quantity and the moment when the output signal attains a new state of equilibrium and stays there to within 2 dB.

5.15.3.2. Method of measurement

A test signal (see paragraph 5.2.3.) shall be applied to the receiver input in the J3E mode of operation via an attenuator comprising a 30 dB single-step switch, the corresponding audio-frequency output signal being shown on an oscilloscope.

The input level shall be adjusted to produce a SND/N or SND/ND output signal of 20 dB and the output level shall be adjusted to 10 dB below the normal output power. The attenuator shall then be switched so that the level of the input signal increases by 30 dB.

The forward action time shall then be measured. The attenuator shall then be switched so that the input signal returns to its initial value.

The reverse action time shall then be measured.

5.15.3.3. Limits imposed

Forward action times: not exceeding 10 ms.
Reverse action time: 1-4 s.

5.16. **Protection of input circuits**

The receiver shall not suffer any damage when an unmodulated radio-frequency test signal representing the carrier is applied to the receiver input at a level of 30 r.m.s. volts for a period of 15 minutes under the conditions described in paragraph 5.2.2. on any frequency in the range for which the receiver is designed. The receiver shall operate normally without having to be re-set, after the test signal has been suppressed.

In order to provide protection against damage due to electrostatic voltage which may occur at the receiver input, the resistance to the direct current between the antenna terminal and the casing shall not exceed 100 kΩ.

## Appendix to Annex I

This Table is provided as a guide for choosing the selectivities required for the various bandwidths.

| Class of emission | Frequency separation relative to the carrier (kHz) | |
|---|---|---|
| | J3E R3E | A3E H3E |
| Minimum passband (−6 dB) | +0.35 to +2.7 | −2.7 to +2.7 |
| Minimum attenuation 20 dB | +3.2 | −6<br>+6 |
| Minimum attenuation 30 dB | | |
| Minimum attenuation 40 dB | −0.25<br>+3.5 | |
| Minimum attenuation 60 dB | −0.5<br>+3.8 | −10<br>+10 |

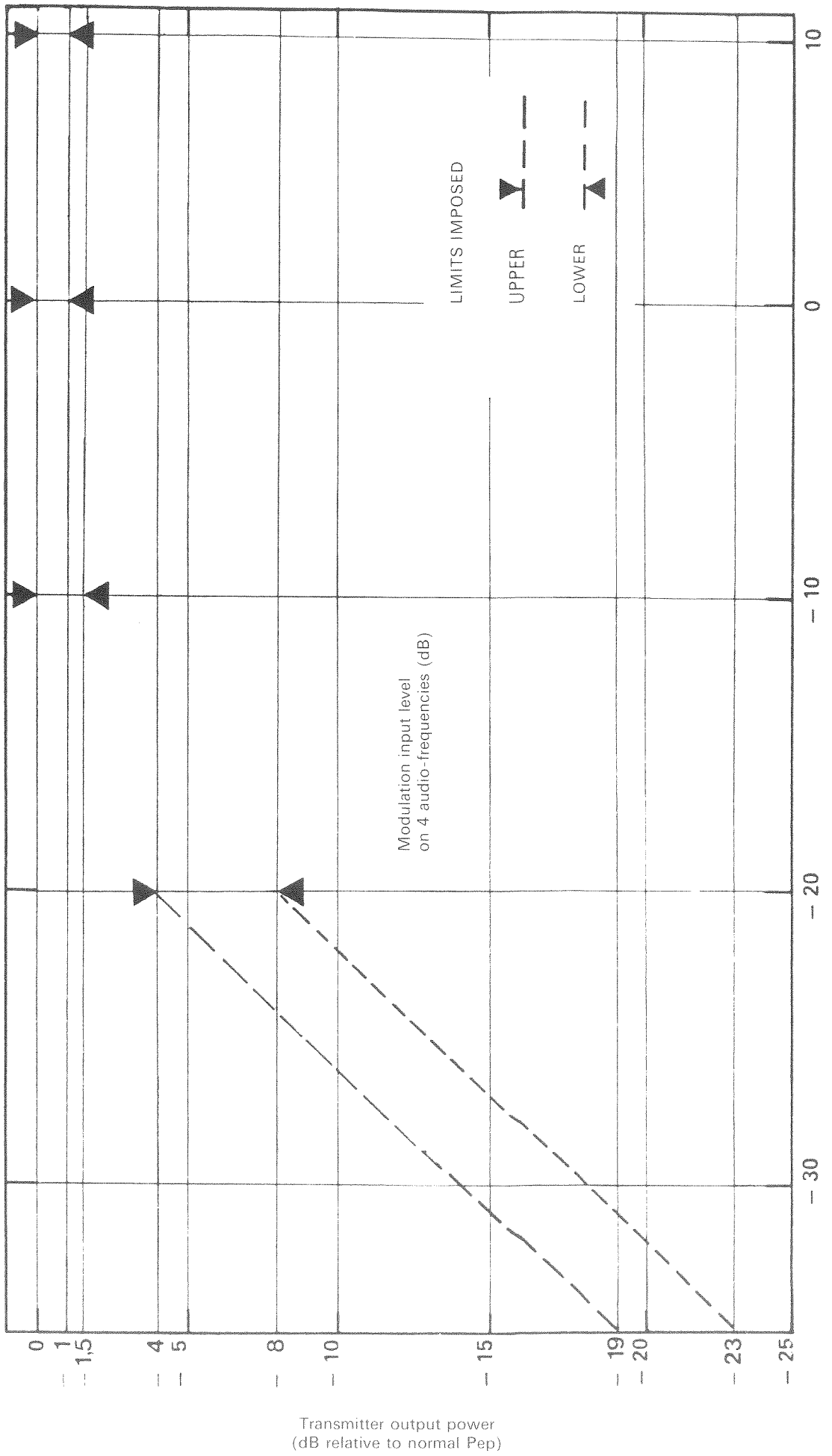


Figure I-1 (T/R 34-01). Limitation characteristic, compression characteristic or the two effects combined.

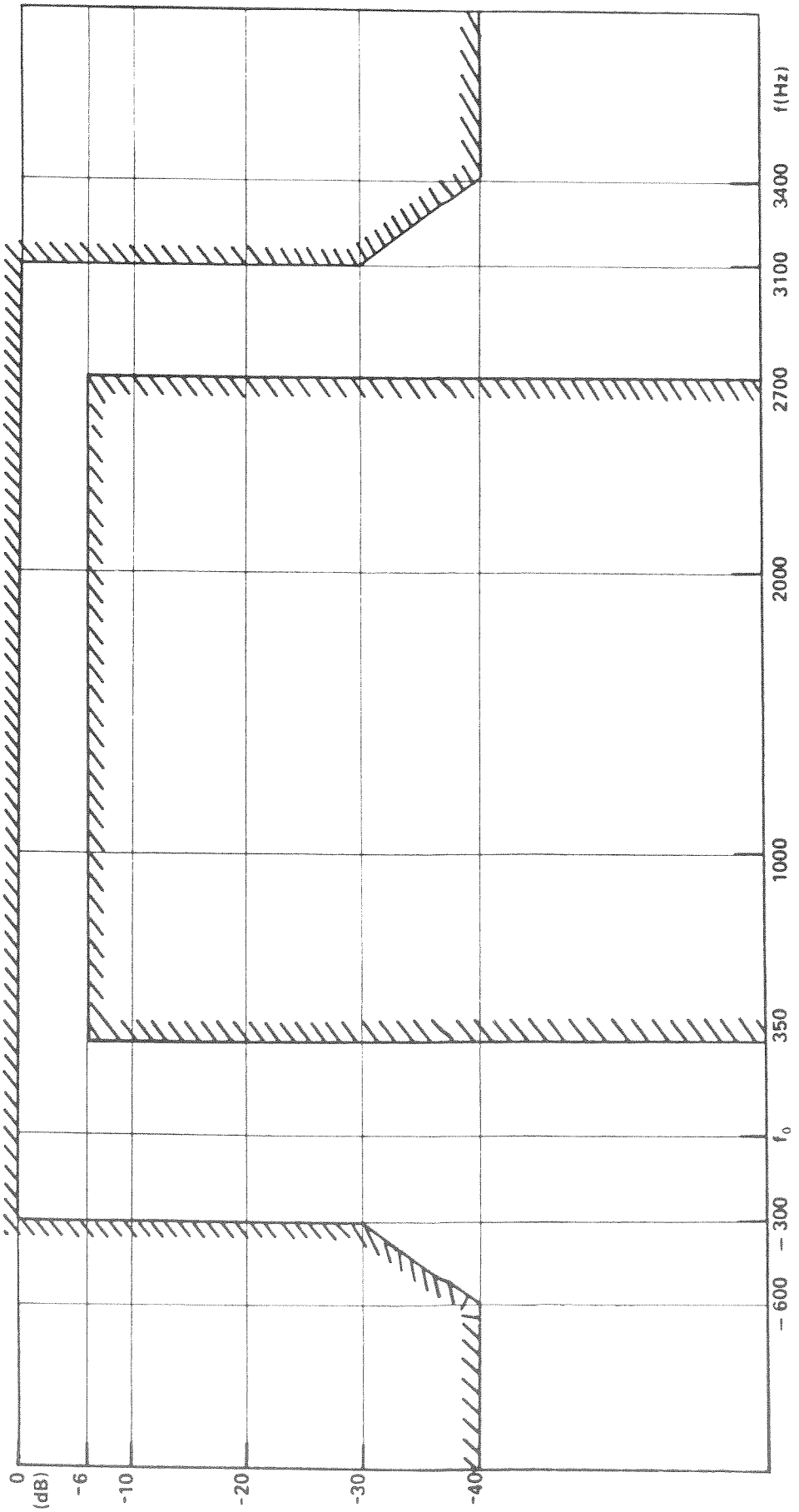


Figure I-2 (T/R 34-01). Audio-frequency response.

## Additional information to be used with Annex I to Recommendation T/R 34-01 (amended at Nice 1985)

This Appendix contains additional information concerning national derogations and options available for the implementation of Recommendation T R 34-01.

| Paragraph | Administration | Description of variations | Reason for variations |
|---|---|---|---|
| | Norway | The revised Annex I has not been implemented yet. | |
| 2.1.3. | Greece | The labelling shall be in Greek if possible. | |
| | Fed. Rep. of Germany | The labelling shall be in German, English or shall use standard international symbols. | Conditions contained in other national specifications. |
| 2.1.4. | Greece | The technical documentation shall be in Greek or English. | |
| 2.1.5. | Fed. Rep. of Germany | Does not apply to equipment on board sports or pleasure boats. In this case, the equipment may use half duplex. | Cost reasons. |
| 2.1.7. | Fed. Rep. of Germany | Does not apply to equipment not for installation on the bridge of a ship. | Cost reasons. |
| 4.1.1.2. | Spain | Not allowed. | Some receivers automatically select class H3E when switched to 2,182 kHz. |
| 4.1.2.2. | Spain | The radiotelephone alarm signal generator shall be an integral part of the equipment. | |
| | | Since 1980, the test on the alarm signal generator has to be made with the transmitter operating with an artificial antenna on a frequency other than 2,182 kHz. | SOLAS 1974, ch. IV, Rule 16d. |
| 4.1.2.2. | United Kingdom (MPT 1224) Ireland (R 58) France | The alarm signal generator *shall be an integral part* of the transmitter. | CEPT: The radiotelephone alarm signal generator *should preferably* be an integral part of the transmitter. |
| 4.1.4. | Fed. Rep. of Germany | Synthesizers do not have to be programmable in all cases. | Cost reasons. |

| Paragraph | Administration | Description of variations | Reason for variations |
|---|---|---|---|
| 4.1.4. | Sweden | Synthesizers do not have to be programmable in all cases. | A Swedish holder of the general radiotelephone operator's certificate has to be as capable of frequency tuning as the holder of a radiotelegraph operator's certificate. |
| 4.3.3. | Fed. Rep. of Germany | For the time being, measurements are made with a 60-ohm artificial antenna. | The 60-ohm antenna is available. |
| 4.4.3. and 4.11.1. | Spain | In the 1,605-4,000 kHz band, power reduction to 400 W has to be automatic. | To prevent human error or infringements which cannot be proven. |
| 4.4.3. | Greece | The rated power shall be no less than 100 W and no more than 400 W. | |
| 4.4.4. | Greece | The rated power shall be no less than 100 W and no more than 1.5 kW. | |
| 4.10.1. | Spain | In these cases, the transmitter may be automatically switched off, provided the protective device does not operate until after 15 seconds or is automatically reconnected within less than 60 seconds after the short circuit or open circuit has ceased to exist.<br>Additional requirement: all frequency-determining elements shall be inviolably sealed. | |
| 4.11.3. | United Kingdom Ireland | 4.11.3. 2nd line.<br>A fault in this measuring instrument shall not cause a break in the antenna circuit. (To prevent having the measuring instrument in series with the antenna, for example.) | CEPT:<br>No equivalent rule. |
| 4.11.4. | United Kingdom Ireland | For all "fine-tuned" settings, a minimum power of 60 watts shall be obtained (as in 4.4.3.). | CEPT:<br>Only the maximum and minimum power values have to be noted. |
| 5.5. | Fed. Rep. of Germany | The method of measurement uses single-singnal selectivity. | The FRG view is that single-signal selectivity measurement is an important and simple indication of the minimum attenuation outside the passband. |
| 5.6.2. | France | The method of measurement uses a "signal/noise" ratio instead of SND/ND or SND/N. | Difficulty of measuring the signal/noise in class J3E. |

| Paragraph | Administration | Description of variations | Reason for variations |
|---|---|---|---|
| 5.6.3. | Fed. Rep. of Germany | 1,605-4,000 kHz.<br>With the 50-ohm antenna, the maximum usable sensitivity shall be better than:<br>+11 dBμV for classes of emission R3E and J3E;<br>+25 dBμV for classes of emission A3E and H3E. | |
| 5.7. | France | See paragraph 5.6.2. | |
| 5.8. | France | See paragraph 5.6.2. | |
| 5.15. | France | See paragraph 5.6.2. | |
| | Fed. Rep. of Germany | In addition to the requirements in the specifications, the design and technology used in the equipment have to conform to the following standards:<br>"VDE 0560, Specifications for capacitors, Part 7, radio interference suppression capacitors."<br>"VDE 0804, Specifications for communications equipment."<br>"VDE 0766, Requirements for radio transmitters."<br>"VDE 0874, VDE guidelines for radio interference suppression."<br>"VDE 0875, Specifications for suppression of radio interference caused by electrical equipement and systems--safety requirements." | Regulations of the German Electrotechnical Commission within the DIN (DEK). |
| | | "Regulation on protection against harmful effects caused by X-rays (X-Ray Regulation-Röv)." | |
| | | "Guidelines on permissible noise levels on board sea-going ships."<br>[VDE = Association of German Electrical Engineers] | Regulation of the "Seeberufsgenossenschaft" [Seafarer's Association]. |

# Annex II

# Specifications for radiotelephone transmitters and receivers in the maritime mobile service operating in VHF bands

*Note:*

Text approved by the "Telecommunications" Commission at Malaga-Torremolinos (1975), amended at Ostend (1979), Vienna (1982), Cannes (1983) and Nice (1985).

Table of contents

## 1. INTRODUCTION

1.1. These specifications define the minimum technical characteristics required for VHF transmitters and receivers for use on board ships at sea and operating in the bands between 156 and 174 MHz allocated to the maritime mobile service by the Radio Regulations. (See Radio Regulations, 1979 edition, Appendices 18 and 19.)

These specifications are also recommended for use as the basis for the technical characteristics of equipment operating on board ships used only on inland waterways.

These specifications do not apply to:
- portable equipment or equipment for the transmission of signals other than speech,
- multiple watch-keeping devices on receivers.

The numbers in parentheses refer to notes at the end of this document.

1.2. The VHF maritime mobile service uses both single-frequency and two-frequency channels. For two-frequency channels the Radio Regulations require a separation of 4.6. MHz between the transmitting frequency and the reception frequency.

The VHF maritime mobile service covers:
1. calling, distress and safety traffic
2. intership communications
3. communications for port operations and ship movement
4. public correspondence

## 2. GENERAL CONDITIONS

### 2.1. Construction

2.1.1. The mechanical and electrical construction and finish of the equipment shall conform in all respects to good engineering practice and the equipment shall be suitable for use on board ships at sea.

2.1.2. All controls shall be of sufficient size to enable the usual control functions to be easily performed and the number of controls should be the minimum necessary for simple and satisfactory operation.

2.1.3. All controls, instruments, indicators and input/output points shall be clearly labelled. A label indicating the type of equipment submitted for the type approval tests shall be affixed to the equipment so as to be clearly visible in the normal operating position. Details concerning the power source to be used for the equipment shall also be clearly indicated.

2.1.4. All parts of the equipment to be checked during inspection or maintenance operations shall be readily accessible. The components shall be readily identifiable.

2.1.5. Full technical documentation shall be supplied with the equipment.

2.1.6. The equipment shall have a channel selector indicating the designator, as shown in the Table in the Radio Regulations, of the channel at which the installation is set. The channel designator shall be legible irrespective of the external lighting conditions.

2.1.7. The equipment shall be capable of operating on single-frequency or two-frequency channels with manual control. It may also be capable of operating on two-frequency channels without manual control.

2.2. **Control**

2.2.1. The equipment shall have the following controls:

- on/off switch for the entire installation with a visual indication that the installation is in operation;
- a handset with a manual non-locking carrier alternation control;
- on/off switch for the loudspeaker;
- a channel selector on which the calling, distress and safety channel (channel 16) is clearly marked. Operation on channels 75 and 76 (the guardband for channel 16) shall be prevented by appropriate means;
- a switch for reducing transmitter output power to no more than 1 watt;
- an audio-frequency power volume control;
- a squelch control;
- a control for reducing the brightness of any equipment illumination to zero.

A visual indication that the carrier is being transmitted may be provided.

2.2.2. The equipment shall also meet the following requirements:

- the user shall not have access to any control which, if wrongly set, might impair the technical characteristics of the equipment;
- if the accessible controls are located on a separate console and if there are two or more control consoles, one of the consoles shall have priority over the others. If there are two or more control consoles, the operation of one console shall be indicated on the other consoles;
- on channels 15 and 17, the reduction of carrier power to no more than 1 watt shall be done automatically.

2.3. **Loudspeaker and handset**

2.3.1. The equipment shall be fitted with a telephone handset and an integral loudspeaker or a socket for an external loudspeaker.

2.3.2. It shall be possible to switch off the loudspeaker without causing a variation in the audio-frequency power provided to the handset.

2.3.3. During transmission in simplex operation, the receiver output shall not emit any signal.

2.3.4. During transmission in duplex operation, only the handset shall be operative. Precautions shall be taken to prevent harmful electrical or acoustic feedback which might produce a build-up of oscillations.

2.4. **Switchover time**

The switching system shall be such that the time necessary to change over from using one of the channels to using any other channel to another does not exceed 5 seconds.

The time necessary to change over from transmission to reception and vice versa shall not exceed 0.3 of a second.

2.5. **Safety precautions**

2.5.1. Measures shall be taken to protect the equipment against the effects of overcurrent or overvoltage.

2.5.2. Measures shall be taken to prevent damage to the equipment if the electrical power source produces transient voltage variations and to prevent any damage that might arise from an accidental reversal of polarity at the electrical power source.

2.5.3. Measures shall be taken to ensure that the casing of the equipment is earthed, but this shall not result in any terminal of the electrical power source being earthed.

2.5.4. All components and wiring in which the DC or AC voltage (other than radio-frequency voltage) produced, singly or in combination, peak voltage in excess of 50 volts, shall be protected against any accidental access and shall be automatically isolated from all electrical power sources if the protective covers are removed. Alternatively, the equipment shall be constructed in such a way as to prevent access to components operating at such voltages unless an appropriate tool is used such as a nut-spanner or screwdriver. Conspicuous warning labels shall be affixed both inside the equipment and on the protective covers.

2.5.5. No damage to the equipment shall occur when the antenna terminals are placed on open circuit or short circuit for a period of at least 5 minutes.

2.6. **Class of emission and modulation characteristics**

2.6.1. Only frequency modulation with a pre-emphasis of 6 dB per octave (phase modulation) shall be used.

2.6.2. The equipment shall be designed to operate satisfactorily with a channel separation of 25 kHz.

2.6.3. The frequency deviation corresponding to 100% modulation shall approach ±5 kHz as nearly as practicable.

In no event shall the frequency deviation exceed ±5 kHz.

2.6.4. It shall not be possible to transmit until the frequency has stabilised within the specified limits.

2.7. **Number of channels**

The number of channels required should be covered by a specification laid down by each Administration.

The maximum number of channels for which the equipment is fitted shall be indicated in the test report.

2.8. **Frequency bands**

2.8.1. Equipment designed to operate solely on single-frequency channels shall be capable of operating throughout the 156.300 MHz to 156.875 MHz band.

2.8.2. In addition, equipment designed to operate on both single-frequency and two-frequency channels shall also be capable of operating with a 4.6 MHz separation between the transmitting and reception frequencies, within the following bands:
156.025 MHz to 157.425 MHz for transmission, and
160.625 MHz to 162.025 MHz for reception.

## 3. TEST CONDITIONS, POWER SUPPLY AND AMBIENT TEMPERATURES

3.1. **Normal and extreme test conditions**

Type approval tests shall be made under normal test conditions and also, where stated, under extreme conditions. The test conditions and procedures are described in paragraphs 3.2. to 3.5. below.

3.2. **Test power source**

During type approval tests, the equipment's power supply shall be provided by a test power source capable of producing normal and extreme test voltages as specified in paragraphs 3.3.2. and 3.4.2. The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For test purposes, the power source voltage shall be measured at the input terminals of the equipment.

During the tests, the power source voltage shall be maintained within a tolerance of ±3% relative to the voltage level at the beginning of each test.

3.3. **Normal test conditions**

3.3.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be any suitable combination of temperature and humidity within the following limits:

— temperature +15° C to +35° C
— relative humidity 20% to 75%.

*Note.* When it is impracticable to carry out the tests under the conditions specified above, a note stating the actual temperature and relative humidity during the tests shall be added to the test report.

3.3.2. *Normal power supply*

3.3.2.1. Mains voltage and frequency

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of these specifications, the nominal mains voltage shall be the declared voltage or one of the declared voltages for which the equipement is indicated as having been designed. The frequency of the test power source shall be 50 Hz ±1 Hz.

3.3.2.2. Power source from a battery

Where the equipment is designed to operate from an accumulator battery, the normal test voltage shall be the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.3.2.3. Other power sources

For operation from other power sources or other batteries, the normal test voltage shall be determined by agreement between the manufacturer and the authority conducting the tests.

3.4. **Extreme test conditions**

3.4.1. *Extreme temperatures*

For tests at extreme temperatures, measurements shall be made in accordance with paragraph 3.5., at a lower temperature of −15° C and an upper temperature of +55° C.

3.4.2. *Extreme test power supply values*

3.4.2.1. Mains voltage and frequency

The extreme test voltages for equipment to be connected to the AC mains shall be the nominal mains voltage ±10%.

The frequency of the test power source shall be 50 Hz ±1 Hz.

3.4.2.2. Power source from an accumulator battery

Where the equipment is designed to operate from an accumulator battery, the extreme test voltages shall be 1.3 or 0.9 times the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.4.2.3. Other power sources

For equipment operation from other power sources, the extreme test voltage shall be determined by agreement between the equipment manufacturer and the authority conducting the tests.

3.5. **Procedure for tests at extreme temperatures**

The power supply to the equipment shall be switched off during the temperature-stabilising periods except in tests specified in paragraph 3.7.2.

Before conducting tests at the upper temperatures, the equipment shall be placed in the test chamber and left until thermal equilibrium is reached. The equipment shall then be switched on for half an hour in the transmit condition; the equipment shall meet the specified requirements during and after this period.

For tests at the lower temperatures, the equipment shall be left in the test chamber until thermal equilibrium is obtained and shall then be switched to the standby or receive position for one minute, after which the equipment shall meet the specified requirements.

3.6. **Environmental tests**

Before commencing the environmental tests the equipment shall be tested under the other conditions required in these specifications. Where electrical tests are required, they shall be carried out at the normal test voltage.

Where the expression "verification of characteristics" is used, this shall be taken to mean a visual inspection and simple electrical and functional tests to demonstrate that the equipment is in working order and that there is no visible damage or deterioration.

The results of verifications of characteristics shall be included in the test report.

The following tests shall be conducted under the environmental conditions specified in Annex VI to this Recommendation, "Environmental tests for maritime radio equipment":

- Vibrations, paragraph 4.
- Dry-heat cycle, paragraph 5.2.
- Damp-heat cycle, paragraph 6.
- Low-temperature cycle, paragraph 7.2.
- Corrosion tests, paragraphs 10.1. and 10.2.

## 4. GENERAL MEASUREMENT CONDITIONS

### 4.1. Arrangements for test signals applied to the receiver input

Test signal generators shall be connected to the receiver in such a way that the impedance presented to the receiver input is 50 ohms. This requirement shall be met, irrespective of whether one or more test signals are applied to the receiver simultaneously.

The levels of the test signals at the input shall be expressed in terms of the e.m.f. at the output terminals which shall be connected to the receiver.

The effects of any intermodulation products and noise produced in the test signal generators should be negligible.

### 4.2. Receiver mute or squelch facility

Unless stated otherwise, the receiver mute or squelch facility shall be made inoperative for the duration of the type approval tests.

### 4.3. Normal test modulation

For normal test modulation, the modulation frequency shall be 1 kHz and the frequency deviation shall be ±3 kHz. The test signal shall be largely free from spurious amplitude modulation.

### 4.4. Artificial antenna

When the tests are conducted with an artificial antenna, this shall be a 50-ohm non-reactive, non-radiating load.

### 4.5. Arrangements for test signals applied to the input

For the purpose of these specifications, the audio-frequency modulation signal applied to the transmitter shall be produced by a signal generator applied to the connection terminals of the microphone insert unless otherwise stated.

### 4.6. Tests on equipment with a duplexing filter

If the equipment has an integral duplexing filter or a separate associated duplexing filter, the characteristics of these specifications shall be met, with the measurements being made using the antenna output of the filter.

### 4.7. Test channels

Type approval tests shall be made, where necessary, on the highest channel and the lowest channel of the equipment's frequency band (see paragraph 2.8.) and on channel 16 (safety).

### 4.8. Extended usage tests

The following extended usage tests shall be made:

- a 24-hour period of reception only,
- followed by four 30-minute periods of transmission separated by 5-minute periods of reception only.

The other tests in these specifications shall then be conducted in order to verify whether the equipment meets all the technical requirements mentioned in paragraphs 5., 6. and 7.

## 5. TRANSMITTER

### 5.1. Frequency error

5.1.1. *Definition*

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

5.1.2. *Method of measurement*

The carrier frequency shall be measured in the absence of modulation, with the transmitter connected to an artificial antenna (paragraph 4.4.). Measurements shall be made under normal test conditions (paragraph 3.3.) and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

5.1.3. *Limit*

The frequency error shall not exceed 1.5 kHz.

### 5.2. Transmitter carrier power

5.2.1. *Definitions*

The transmitter carrier power is the mean power delivered to the artificial antenna during a radio-frequency cycle in the absence of modulation.

The rated output power is the transmitter carrier power declared by the manufacturer.

5.2.2. *Method of measurement*

The transmitter shall be connected to an artificial antenna (paragraph 4.4.) and the power delivered to this artificial antenna shall be measured. The measurements shall be made under normal test conditions (paragraph 3.3.) and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

5.2.3. *Limits*

The transmitter carrier power measured under normal test conditions, with the switch controlling the output power (see paragraph 2.2.) being set at maximum, shall not differ by more than 1.5 dB from the rated output power.

With the switch controlling the output power being set at maximum the transmitter carrier power shall remain between 6 and 25 watts for all test conditions.

With the switch controlling output power being set at minimum, the transmitter carrier power shall remain between 0.1 and 1 watt for all test conditions.

5.3. **Frequency deviation**

5.3.1. *Maximum permissible deviation*

5.3.1.1. Definition

For the purpose of these specifications, the maximum permissible deviation is the maximum permissible difference between the instantaneous frequency of the modulated radio-frequency signal and the carrier frequency taken in isolation.

5.3.1.2. Method of measurement

The frequency deviation shall be measured at the transmitter output with the transmitter connected to an artificial antenna (paragraph 4.4.), using a deviation meter capable of measuring the maximum deviation, including that due to any harmonics and intermodulation products which may be generated in the transmitter.

The modulation frequency shall be varied between the lowest frequency considered appropriate and 3 kHz. The level of this test signal shall be 20 dB above the level of the normal test modulation (paragraph 4.3.).

5.3.1.3. Limits

The value of the maximum permissible frequency deviation shall be ± 5 kHz.

5.3.2. *Reduction in frequency deviation at modulation frequencies above 3 kHz*

5.3.2.1. Method of measurement

The transmitter shall operate under normal test conditions (paragraph 3.3.) delivering to a load as specified in paragraph 4.4. The transmitter shall be modulated by the normal test modulation (paragraph 4.3.). With the input level of the modulation signal being kept constant, the modulation frequency shall be varied between 3 kHz and 25 kHz and the frequency deviation shall be measured.

5.3.2.2. Limits

For modulation frequencies between 3 kHz and 6 kHz, the frequency deviation shall not exceed the frequency deviation with a modulation frequency of 3 kHz. For a modulation frequency of 6 kHz, the frequency deviation shall not exceed ± 1.5 kHz.

For modulation frequencies between 6 kHz and 25 kHz, the frequency deviation shall not exceed the figure shown by a line representing the frequency deviation (in decibels) as a function of the modulation frequency, starting at the point where the modulation frequency is 6 kHz and the frequency deviation ± 1.5 kHz and inclining at 14 dB per octave, with the frequency deviation diminishing as the modulation frequency increases.

5.4. **Limitation characteristics of the transmitter modulator**

5.4.1. *Definition*

This characteristic expresses the capability of the transmitter of being modulated with a deviation approaching the maximum permissible deviation specified in paragraph 5.3.1.3.

5.4.2. *Method of measurement*

A modulation signal at a frequency of 1,000 Hz shall be applied to the transmitter, its level being set so that the frequency deviation is ± 1 kHz. The level of the modulation signal shall then be increased by 20 dB and the deviation shall again be measured. This test shall be conducted under normal test conditions (paragraph 3.3.) and under extreme test conditions (paragraph 3.4.1. and 3.4.2. applied simultaneously).

5.4.3. *Limits*

The frequency deviation shall be contained between ±3.5 kHz and ±5 kHz.

5.5. **Sensitivity of the modulator, including microphone**

5.5.1. *Definition*

This characteristic expresses the capability of the transmitter of being adequately modulated when an audio-frequency signal corresponding to the normal mean speech level is applied to the microphone.

5.5.2. *Method of measurement*

An audio-frequency signal of 1,000 Hz shall be applied to the microphone, the loudness level being 94 dB relative to $2 \times 10^{-5}$ Pascal at the diaphragm, and the resulting deviation shall then be measured.

5.5.3. *Limits*

The frequency deviation shall be between ±3 kHz and ±4.5 kHz.

5.6. **Audio-frequency response of the transmitter**

5.6.1. *Definition*

The audio-frequency response of the transmitter expresses the ability of the transmitter to operate without excessive degradation of its frequency response as a function of the modulation frequency.

5.6.2. *Methods of measurement*

Two methods of measurement giving very similar results may be used. The method used shall be stated in the test report.

5.6.2.1. Constant deviation method

A modulation signal at a frequency of 1,000 Hz shall be applied to the transmitter. Its signal shall be set so that the frequency deviation is ±1 kHz.

The modulation frequency shall then be varied between 300 Hz and 3,000 Hz, with the level of the modulating signal being adjusted to produce a constant frequency deviation of the high-frequency signal which is equal to the value specified above.

The amplitude characteristic of the audio-frequency modulation signal as a function of the frequency shall be varied within the limits specified in paragraph 5.6.3.1. below, by 6 dB per octave starting from the 1,000 Hz point specified above, the amplitude decreasing as the frequency increases.

5.6.2.2. Constant input level method

A modulation signal at a frequency of 1,000 Hz shall be applied to the transmitter. Its level shall be set so that the frequency deviation is ±1 kHz.

The modulation frequency shall then be varied between 300 Hz and 3,000 Hz, with the level of the audio-frequency signal being kept constant and equal to the value specified above.

5.6.3. *Limits*

5.6.3.1. Constant deviation method

The amplitude of the audio-frequency modulation signal shall not differ from the characteristic stated in paragraph 5.6.2.1. by more than −1 dB or +3 dB.

5.6.3.2. Constant input level method

The modulation index (ratio of the frequency deviation to the modulation frequency) shall be constant and equal to its value at 1,000 Hz, to within +1 dB or −3 dB.

5.7. **Harmonic distortion of the emission**

5.7.1. *Definition*

The harmonic distortion of the emission modulated by an audio-frequency is defined as the ratio, expressed as a percentage, of the r.m.s. voltage of all the harmonic components of the fundamental frequency to the total r.m.s. voltage of the signal after linear demodulation.

5.7.2. *Method of measurement*

The high-frequency signal produced by the transmitter shall be applied via an appropriate coupling device to a linear demodulator with a de-emphasis network of 6 dB per octave.

5.7.2.1. Normal test conditions

Under normal test conditions (paragraph 3.3.) the high-frequency signal shall be modulated successively at frequencies of 300 Hz, 500 Hz and 1,000 Hz with a constant modulation index of 3.

The distortion of the audio-frequency signal shall be measured at all the frequencies specified above.

5.7.2.2. Extreme test conditions

Under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously), the measurements shall be made at 1,000 Hz with a frequency deviation of $\pm 3$ kHz.

5.7.3. *Limits*

The harmonic distortion shall not exceed 10%.

5.8. **Adjacent channel power**

5.8.1. *Definition*

The adjacent channel power is that part of the total output power of a transmitter, under defined conditions of modulation, emitted within the passband of a receiver of the type normally used in the network and operating in either of the adjacent channels. This power is the sum of the mean power produced by the modulation process and by the residual modulation caused by transmitter hum and noise.

5.8.2. *Methods of measurement*

5.8.2.1. General remarks

Two methods are proposed which give equivalent results. The method used shall be stated in the test report.

5.8.2.2. Method of measurement using a power measuring receiver

The adjacent channel power may be measured with a power-measuring receiver conforming to the requirements of paragraph 5.8.2.3. (This apparatus is referred to in paragraphs 5.8.2.2. and 5.8.2.3. as "the receiver".)

The transmitter shall be operated under normal test conditions (paragraph 3.3.) at maximum power and at reduced power. The transmitter output shall be connected to the input of the "receiver" by a device such that the impedance presented to the transmitter is equal to that of the artificial antenna specified in paragraph 4.4. and the level at the "receiver" input is appropriate.

The transmitter shall be modulated at 1,250 Hz at a level which is 20 dB higher than that producing a frequency deviation of $\pm 3$ kHz. The "receiver" shall be tuned to the nominal frequency of the transmitter and the variable attenuator of the "receiver" shall be adjusted to obtain a p dB value which, according to the reading on a measuring apparatus, produces a level in the order of 5 dB above the noise level of the "receiver".

The "receiver" shall then be tuned to the nominal frequency of one of the adjacent channels and the variable attenuator shall be adjusted to a q dB value so as to obtain the same meter reading as previously.

The ratio of the carrier power to the adjacent channel power is the difference between the p and q values displayed on the attenuator. The adjacent channel power is determined by dividing the carrier power, as determined in accordance with paragraph 5.2., by this ratio.

The measurement shall be repeated for the other adjacent channel.

5.8.2.3. Characteristics of the power-measuring receiver

The power-measuring receiver shall comprise a mixer, crystal filter, variable attenuator, amplifier and an r.m.s. voltmeter all connected in a chain, and a local oscillator. The local oscillator may be a signal generator.

The bandwidth of the filter shall be as shown by the following table:
Between two points corresponding to an attenuation of 6 dB: 16 ± 1.6 kHz
Between two points corresponding to an attenuation of 70 dB: 35 ± 3.5 kHz
Between two points corresponding to an attenuation of 90 dB: 50 ± 5 kHz

The attenuator shall produce an attenuation of at least 80 dB, with a 1 dB step. However, in order to provide possibilities for later specifications, an attenuation of 90 dB or more is recommended. The noise factor of the amplifier shall be better than 4 dB. The amplitude-frequency characteristic of the amplifier shall not vary by more than 1 dB throughout the 16 kHz bandwidth.

If the attenuation of the quartz filter is lower than 90 dB outside the 50 kHz range specified above, the amplitude-frequency characteristic of the amplifier shall be such that the resultant of the attenuation values of the quartz filter and the amplifier shall be no less than 90 dB.

The r.m.s. voltmeter shall indicate, at its maximum deviation, the r.m.s. value of non-sinusoidal signals with a peak amplitude to r.m.s. value ratio of up to at least 10:1.

The equipment used for the measurements shall be such that the results of the power measurements do not differ by more than 1.5 dB from the actual value when the level at the "receiver" input is increased by 100 dB above the lowest measurable level.

The noise level of the local oscillator shall not exceed −90 dB relative to the level of the local oscillator carrier in a 16 kHz bandwidth whose centre frequency is 25 kHz away from the carrier frequency.

5.8.2.4 Method of measurement using a spectrum analyser

The adjacent channel power may be measured with a spectrum analyser conforming to the requirements of paragraph 5.8.2.5. The transmitter shall be operated under normal test conditions (paragraph 3.3.) at maximum power and at reduced power. The output of the transmitter shall be connected to the input of a spectrum analyser by a device such that the impedance presented to the transmitter is equal to that of the artificial antenna conforming to paragraph 4.4. and the level at the analyser input is appropriate.

The transmitter shall be modulated by 1,250 Hz at a level 20 dB above the level which produces a frequency deviation of ± 3 kHz.

The spectrum analyser shall be adjusted so that the transmission spectrum, including the part which lies within the adjacent channels, is displayed.

The adjacent channel power shall be determined by calculating the sum total of the power levels of all the components, including noise, within the 16 kHz bandwidth. Measurements shall be made in each of the adjacent channels.

5.8.2.5. Characteristics of the spectrum analyser

The characteristics of the spectrum analyser shall meet the following requirements:

It shall be possible, using a resolution bandwidth of 1 kHz, to measure the amplitude of a signal or noise at a level 3 dB or more above the noise level of the spectrum analyser as displayed on the screen, to an accuracy of approximately ± 2 dB, in the presence of a signal with a frequency displacement of 10 kHz, at a level 90 dB above the level of the signal to be measured.

The accuracy of relative amplitude measurements shall be within ± 1 dB.

It shall be possible to adjust the spectrum analyser so that two components with a frequency difference of 1 kHz may be displayed separately.

5.8.3. *Limit*

The power emitted in the adjacent channel shall not exceed a value 70 dB below the transmitter carrier power without it being necessary to go below 0.2 microwatt.

5.9 **Spurious emissions conveyed to the antenna by conduction**

5.9.1. *Definition*

Conducted spurious emissions are emissions whose power is conveyed by conduction to the antenna or artificial antenna at any frequencies other than those of the carrier and the sideband components resulting from the normal process of modulation.

5.9.2. *Method of measurement*

Conducted spurious emissions shall be measured with the unmodulated transmitter connected to the artificial antenna (paragraph 4.4.).

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 analyser. The measurements shall be repeated with the transmitter modulated by the normal test modulation (paragraph 4.3.).

5.9.3. *Limit*

The power of any conducted spurious emission in any discrete component shall no exceed 2.5 microwatts.

5.10. **Cabinet radiation and conducted spurious emissions other than those conveyed to the antenna**

5.10.1 *Definition*

Cabinet radiation consists of emissions at any frequencies, other than those of the carrier and the sideband components resulting from the wanted modulation process, which are radiated by the equipment cabinet and structures. Conducted spurious emissions other than those conveyed to the antenna are emissions at any 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.

5.10.2. *Methods of measurement*

The methods of measurement are under study.

5.10.3. *Limits*

Cabinet radiation and conducted spurious emissions as defined above shall be minimal so as not to produce interference affecting other electronic equipment, particularly in the 100 kHz to 1,000 MHz frequency band.

The limits shall be fixed when the method of measurement has been defined.

5.11. **Residual modulation of the transmitter**

5.11.1. *Definition*

The residual modulation of the transmitter is defined as the ratio, in dB, of the audio-frequency noise power produced after demodulation of the high-frequency signal and in the absence of wanted modulation, to the audio-frequency power produced by the normal test modulation when applied to the transmitter.

5.11.2. *Method of measurement*

The normal test modulation defined in paragraph 4.3. shall be applied to the transmitter. The high-frequency signal produced by the transmitter shall be applied, via an appropriate coupling device, to a linear demodulator with a de-emphasis network of 6 dB per octave.

Precautions shall be taken to avoid the effects of emphasising the low audio-frequencies produced by internal noise.

The signal shall be measured at the demodulator output using an r.m.s. voltmeter with a psophometric telephone filtering network such as described in CCITT Recommendation P.53.

The modulation shall then be switched off and the level of the residual audio-frequency signal at the output shall be measured again.

5.11.3. *Limit*

The residual modulation shall not exceed −40 dB.

6. **Receiver**

6.1. **Harmonic distortion and rated audio-frequency output power**

6.1.1. *Definition*

The harmonic distortion at the receiver output is defined as the ratio, expressed as a percentage, of the total r.m.s. voltage of all the harmonic components of the modulation audio-frequency to the total r.m.s. voltage of the signal delivered by the receiver.

The rated audio-frequency output power is the value stated by the manufacturer as being the maximum power available at the output, for which all the requirements of these specifications are met.

6.1.2. *Methods of measurement*

Test signals at levels of +60 dB and +100 dB relative to 1 microvolt, at a carrier frequency equal to the nominal frequency of the receiver and modulated by the normal test modulation (paragraph 4.3.) shall be applied in succession to the receiver input under the conditions specified in paragraph 4.1.

For each measurement, the receiver's audio-frequency power control shall be set so as to obtain, in a resistive load which simulates the receiver's operating load, the rated audio-frequency output power (paragraph 6.1.1.). The value of this load shall be stated by the manufacturer.

Under normal test conditions (paragraph 3.3.) the test signal shall be modulated successively at 300 Hz, 500 Hz and 1,000 Hz with a constant modulation index of 3 (ratio between the frequency deviation and the modulation frequency). The harmonic distortion and audio-frequency output power shall be measured at all the frequencies specified above.

Under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously), the tests shall be made at the receiver's nominal frequency and at the nominal frequency 1.5 kHz. For these tests, the modulation shall be 1,000 Hz and the frequency deviation shall be ± 3 kHz.

6.1.3. *Limits*

The rated audio-frequency output power shall be at least:
- 500 mW in a loudspeaker,
- 1 mW in the handset earphone.

The harmonic distortion shall not exceed 10%.

6.2. **Receiver response**

6.2.1. *Definition*

The receiver response is defined by the variation in the receiver's audio-frequency output level as a function of the modulation frequency of the high-frequency signal applied to its input at a constant deviation.

6.2.2. *Method of measurement*

A test signal of 60 dB relative to 1 microvolt, at a carrier frequency equal to the nominal frequency of the receiver, shall be applied to the receiver input under the conditions specified in paragraph 4.1.

The receiver's audio-frequency power control shall be set so as to produce a power level equal to 50% of the rated output power (paragraph 6.1.) when the normal test modulation is applied in accordance with paragraph 4.3. This setting shall not be altered during the test.

The frequency deviation shall then be reduced to ± 1 kHz. The frequency deviation shall be kept constant while the modulation frequency is varied between 300 Hz and 3,000 Hz and the output level shall then be measured.

The measurement shall be repeated with a test signal at the same frequency as the nominal frequency of the receiver ± 1.5 kHz.

6.2.3. *Limits*

The receiver response shall not deviate by more than +1 dB or −3 dB from the characteristic giving the output level as a function of the audio-frequency decreasing by 6 dB per octave and meeting the point determined by the measurement at 1,000 Hz specified above.

6.3. **Maximum usable sensitivity**

6.3.1. *Definition*

The maximum usable sensitivity of the receiver is the minimum level of the signal (e.m.f.) at the nominal frequency of the receiver which, when applied to the receiver input with normal test modulation (paragraph 4.3.), will produce:
- in all cases, an audio-frequency output power equal to 50% of the rated output power (paragraph 6.1.) and
- either a SND/N ratio or a SND/ND ratio of 20 dB, measured at the receiver output through a psophometric telephone filtering network such as described in CCITT Recommendation P.53.

6.3.2. *Method of measurement*

A test signal at a carrier frequency equal to the nominal frequency of the receiver, modulated by the normal test modulation (paragraph 4.3.) shall be applied to the receiver input. An audio-frequency load and a measuring instrument for measuring, through a psophometric network as specified in paragraph 6.3.1., the SND/N ratio or the SND/ND ratio shall be connected to the receiver output terminals.

The level of the test signal shall be set so as to produce a SND/N ratio or a SND/ND ratio of 20 dB, using the psophometric network and with the receiver's audio-frequency power control adjusted to produce 50% of the rated output power. Under these conditions, the level of the test signal at the input is the maximum value of the usable sensitivity.

The measurements shall be made under normal test conditions (paragraph 3.3.) and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

A receiver output power variation of ±3 dB relative to 50% of the rated output power may be allowed for sensitivity measurements under extreme test conditions. The test report shall state which of the methods SND/N or SND/ND has been used.

6.3.3. *Limits*

The maximum usable sensitivity shall not exceed +6 dB relative to one microvolt under normal test conditions and +12 dB relative to one microvolt under extreme test conditions.

## 6.4. Co-channel rejection

6.4.1. *Definition*

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without the degradation due to the presence of an unwanted modulated signal exceeding a given limit, the frequency of each of the signals being within the wanted channel on the receiver.

6.4.2. *Method of measurement*

The two signals shall be applied to the receiver input as specified in paragraph 4.1. The frequency of the wanted signal shall be the nominal frequency of the receiver and it shall be modulated by the normal test modulation (paragraph 4.3.).

The unwanted signal shall be modulated at 400 Hz with a frequency deviation of ±3 kHz. Initially, its frequency shall also be the nominal frequency of the receiver under test.

Initially, the unwanted input signal shall not be applied and the wanted input signal shall be set to the value corresponding to the maximum usable sensitivity (paragraph 6.3.). The unwanted signal shall then be applied and its carrier frequency adjusted between ±3 kHz around the nominal frequency of the receiver to a value corresponding to the maximum degradation of the SND/ND ratio or the SND/N ratio at the receiver output; its input level shall be adjusted so as to reduce these ratios from 20 dB to 14 dB (with psophometric filter).

The co-channel rejection ratio shall be the ratio, in dB, of the level of the unwanted signal to that of the wanted signal at the receiver input when the above-mentioned reduction of the SND/ND ratio or SND/N ratio is obtained.

6.4.3. *Limits*

The co-channel rejection ratio on the wanted channel shall be maintained between −8 dB and 0 dB.

## 6.5. Adjacent channel selectivity

6.5.1. *Definition*

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without the degradation due to the presence of an unwanted modulated signal exceeding a given limit, with the frequency of the unwanted signal being 25 kHz away from the frequency of the wanted signal.

6.5.2. *Method of measurement*

The two signals shall be applied to the receiver input as specified in paragraph 4.1. The wanted signal shall be at the nominal frequency of the receiver and shall be modulated by the normal test modulation (paragraph 4.3.). The unwanted signal shall be modulated at 400 Hz, with a frequency deviation of ±3 kHz and its frequency shall be the same as that of the upper adjacent channel.

Initially, the unwanted signal shall not be applied and the level of the wanted input signal shall be adjusted to the value corresponding to the maximum usable sensitivity (paragraph 6.3.). The unwanted signal shall then be applied and its input level adjusted until the SND/ND ratio or the SND/N ratio at the receiver output (with psophometric filter) is reduced from 20 dB to 14 dB.

This measurement shall be repeated with an unwanted signal at the frequency of the lower adjacent channel. The adjacent channel selectivity shall be expressed as the lesser value of the ratios, in dB, of the level of the unwanted signal to the level of the wanted signal obtained for the upper and lower adjacent channels.

These measurements shall be made under normal test conditions (paragraph 3.3.) and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

6.5.3. *Limits*

The adjacent channel selectivity shall be no less than 70 dB under normal test conditions and no less than 60 dB under extreme test conditions.

## 6.6. Spurious response rejection

6.6.1. *Definition*

The spurious response rejection is a measure of the capability of the receiver to discriminate between a wanted modulated signal at the nominal frequency and an unwanted signal at any other frequency at which a response is obtained.

6.6.2. *Method of measurement*

Two signals shall be applied to the receiver input as specified in paragraph 4.1. The wanted signal shall be at the nominal frequency of the receiver and shall be modulated by the normal test modulation (paragraph 4.3.). Initially, the unwanted signal shall not be applied and the level of the wanted input signal shall be adjusted to the value corresponding to the maximum usable sensitivity (paragraph 6.3.).

The unwanted signal shall then be applied, modulated at 400 Hz with a frequency deviation of 3 kHz and an input level of 90 dB relative to 1 microvolt. The frequency shall then be varied within the 100 kHz to 1,000 MHz range. For each frequency at which a response is obtained, the input level shall be adjusted until the SND/ND ratio or the SND/N ratio at the receiver output (with psophometric filter) is reduced from 20 dB to 14 dB.

The spurious response rejection ratio shall be expressed as the ratio, in dB, of the level of the unwanted signal to the level of the wanted signal at the receiver input, when the above-mentioned reduction of the SND/ND ratio or the SND/N ratio is obtained.

6.6.3. *Limit*

The spurious response rejection ratio shall be no less than 70 dB on any frequency with a displacement from the nominal frequency of the receiver exceeding the adjacent channel separation.

## 6.7. Intermodulation response rejection

6.7.1. *Definition*

The intermodulation response rejection is a measure of the capability of a receiver to inhibit the generation of in-band signals caused by the presence of two or more signals at frequencies other than that of the wanted signal.

6.7.2. *Method of measurement*

Two signal generators A and B shall be connected to the receiver as specified in paragraph 4.1.

Initially, signal generator B shall be switched off. The signal from generator A shall be at the nominal frequency of the receiver and shall be modulated by the normal test modulation (paragraph 4.3.). The level of the signal from generator A applied to the receiver input shall be adjusted to the value corresponding to the maximum usable sensitivity (paragraph 6.3.).

This level shall be noted. The frequency of signal generator A shall then be adjusted to a frequency with a displacement (above or below) from the nominal frequency which is twice the adjacent channel separation. Signal generator B shall then be switched on. It shall not be modulated and its frequency shall be adjusted to a frequency with a displacement (above or below) from the nominal frequency equal to the adjacent channel separation. The output levels of the two signal generators shall be kept equal and increased until a SND/ND ratio or a SND/N ratio of 20 dB (with psophometric filter) is again obtained at the receiver output.

The frequency of signal generator A may, if necessary, be modified slightly to obtain the maximum values of the SND/ND or SND/N ratios. The levels of the two test signals shall be re-adjusted in order to regain the ratio of 20 dB.

The ratio, in dB, of the output levels of the two signal generators to the previously noted level of signal generator A alone at the nominal frequency of the receiver, is the intermodulation rejection response ratio.

6.7.3. *Limit*

The intermodulation rejection response ratio shall be no less than 70 dB.

6.8. **Blocking or desensitisation**

6.8.1. *Definition*

Blocking is a variation (generally a reduction) of the wanted output power of the receiver or a reduction of the SND/ND ratio or the SND/N ratio due to an unwanted signal on another frequency.

6.8.2. *Method of measurement*

Two signals shall be applied to the receiver input as specified in paragraph 4.1. The wanted modulated signal shall be at the nominal frequency of the receiver and shall be modulated by the normal test modulation (paragraph 4.3.). Initially, the unwanted signal shall not be applied and the level of the wanted input signal shall be adjusted to a value exceeding 6 dB relative to 1 microvolt.

The audio-frequency output power resulting from the application of the wanted signal shall be adjusted to a value equal to 50% of the rated output power.

The unwanted signal shall not be modulated, and its frequency shall be varied between +1 MHz and +10 MHz and between −1 MHz and −10 MHz relative to the nominal frequency of the receiver. The level of the unwanted input signal on all the frequencies in the ranges specified above shall be such that the unwanted signal causes:

a) a 3 dB reduction in the output level of the wanted signal, or
b) a reduction of the SND/ND ratio or the SND/N ratio at the receiver output (with psophometric filter) to 14 dB;

either a) or b) may occur first.

The input is the blocking level for the frequency concerned.

6.8.3. *Limit*

The blocking level for any frequency in the ranges specified in paragraph 6.8.2. above shall be no less than +90 dB relative to 1 microvolt, except for frequencies on which spurious responses have been found (paragraph 6.6.).

6.9. **Spurious emissions**

6.9.1. *Conducted spurious emissions*

6.9.1.1. Definition

Conducted spurious emissions are emissions at any frequencies whose power is conveyed by conduction to the antenna or artificial antenna.

6.9.1.2. Method of measurement

Conducted spurious emissions shall be measured in the artificial antenna defined in paragraph 4.4.

The measurements shall be made over the range from 9 kHz to 2 GHz. The measurement for each spurious component shall be made using a tuned radio measuring instrument or a spectrum analyser.

6.9.1.3. Limit

The power of any conducted spurious emission at any discrete frequency shall not exceed 2 nanowatts.

6.9.2. *Cabinet radiation*

Under study.

6.10. **Amplitude response of the receiver limiter**

6.10.1. *Definition*

The amplitude response of the receiver limiter is the relationship between the radio-frequency input level of a specific modulated signal and the audio-frequency level at the receiver output.

6.10.2 *Method of measurement*

A test signal at the nominal frequency of the receiver modulated by the normal test modulation (paragraph 4.3.) at a level of +6 dB relative to one microvolt shall be applied to the receiver input and the audio-frequency output level shall be adjusted to a level 6 dB lower than the rated output power (paragraph 6.1.). The level of the input signal shall be increased to +100 dB relative to one microvolt and the audio-frequency output level shall be measured again.

6.10.3. *Limit*

When the radio-frequency input level is varied as specified, the variation between the maximum and minimum value of the audio-frequency output level shall not exceed 3 dB.

6.11. **Receiver noise and hum level**

6.11.1. *Definition*

The receiver noise and hum level is defined as the ratio, in dB, of the audio-frequency power of the noise and hum resulting from spurious effects of the power supply system or from other causes, to the audio-frequency power produced by a high-frequency signal of average level, modulated by the normal test modulation and applied to the receiver input.

6.11.2. *Method of measurement*

A test signal with an electromotive force of 30 dB relative to 1 microvolt at a carrier frequency equal to the nominal frequency of the receiver, and modulated by the normal test modulation specified in paragraph 4.3., shall be applied to the receiver input. An audio-frequency load and a psophometric filtering network (paragraph 6.3.1.) shall be connected to the output terminals of the receiver. The audio-frequency power control shall be set so as to produce the rated output power level conforming to paragraph 6.1.

The output signal shall be measured by an r.m.s. voltmeter.

The modulation shall then be switched off and the audio-frequency output level measured again.

6.11.3. *Limit*

The receiver noise and hum level shall not exceed −40 dB.

6.12. **Operation of receiver mute or squelch facility**

6.12.1. *Definition*

The purpose of the receiver mute or squelch facility is to make the receiver silent when the level of the signal at the receiver input is less than a given value.

6.12.2. *Method of measurement*

a) When the receiver mute facility is switched off, a test signal of +30 dB relative to 1 microvolt, at a carrier frequency equal to the nominal frequency of the receiver and modulated by the normal test modulation specified in paragraph 4.3., shall be applied to the input terminals of the receiver. An audio-frequency load and a psophometric filtering network (paragraph 6.3.1.) shall be connected to the output terminals of the receiver. The receiver's audio-frequency power control shall be set so as to produce the rated output power defined in paragraph 6.1.
The output signal shall be measured with the aid of an r.m.s. voltmeter.
The input signal shall then be suppressed, the receiver mute facility switched on and the audio-frequency output level measured again.

b) When the receiver mute facility is switched off again, a test signal modulated by the normal test modulation shall be applied to the receiver input at a level of +6 dB relative to 1 microvolt and the receiver shall be set to produce 50% of the rated output power.
The level of the input signal shall then be reduced and the receiver mute circuit shall be switched on. The input signal shall then be increased until the above-mentioned output power is reached. The SND/ND and SND/N ratio and the input level shall then be measured.

6.12.3. *Limits*

Under the conditions specified in paragraph 6.12.2. a), the audio-frequency output power shall not exceed −40 dB relative to the rated output power.

Under the conditions specified in paragraph 6.12.2. b), the input level shall not exceed +6 dB relative to 1 microvolt and the SND/ND or SND/N ratio shall be at least 20 dB.

In the case of a continuously adjustable receiver mute facility, the input signal shall not exceed +40 dB relative to 1 microvolt when the control is set at maximum (provisional figure).

## 7. DUPLEX OPERATION

If the equipment is designed for duplex operation, it shall be provided with a duplex filter when it is submitted for tests and the following additional measurements shall be made to ensure satisfactory duplex operation.

7.1. **Receiver desensitisation with simultaneous transmission and reception**

7.1.1. *Definition*

Desensitisation is the degradation of receiver sensitivity as a result of a transfer of power from the transmitter to the receiver due to coupling effects. It is expressed as the difference, in dB, between the levels of maximum usable sensitivity with and without simultaneous transmission.

7.1.2. *Method of measurement*

The transmitter and the receiver shall be connected to a duplex filter with the filter's antenna output being connected, via a coupling device, to the artificial antenna specified in paragraph 4.4.

A test signal generator modulated by the normal test modulation (paragraph 4.3.) shall be connected to the coupling device in such a way as to avoid modifying the impedance match.

The transmitter shall be switched on and modulated at 400 Hz with a modulation index of 3, the switch controlling output power being set at maximum.

The receiver sensitivity shall then be measured in accordance with paragraph 6.3. The level of the test signal at the input under these conditions is the maximum usable sensitivity with simultaneous transmission and reception. The desensitisation value shall be calculated in accordance with paragraph 7.1.1.

7.1.3. *Limits*

The desensitisation shall not exceed 3 dB. The maximum usable sensitivity with simultaneous transmission and reception shall not exceed the limits specified in paragraph 6.3.3.

7.2. **Receiver spurious response rejection**

The receiver spurious response rejection shall be measured in accordance with paragraph 6.6.2. and paragraph 7.1.2. except that the transmitter shall not be modulated. The transmitter shall be switched on with the switch controlling output power at the maximum setting.

The limit specified in paragraph 6.6.3. shall also apply in this case.

## 8. ACCURACY OF MEASUREMENT

The accuracy required for the measurement of the following parameters shall be as shown in the list below:

| | | |
|---|---|---|
| 8.1.1. | DC voltage | ± 3% |
| 8.1.2. | AC mains voltage | ± 3% |
| 8.2.1. | Audio-frequency voltage and power | ± 0.5 dB |
| 8.2.2. | Audio-frequency | ± 1% |
| 8.2.3. | Distortion and noise of audio-frequency generators | 1% |
| 8.3.1. | Radio-frequency | ± 50 Hz |
| 8.3.2. | Radio-frequency voltage | ± 2 dB |
| 8.3.3. | Radio-frequency field strength | ± 3 dB |
| 8.3.4. | Radio-frequency carrier power | ± 10% |
| 8.4.1. | Impedance of artificial loads, combining units, wiring, plugs, attenuators, etc. | ± 5% |
| 8.4.2. | Internal impedance of generators and input impedance of measuring receivers | ± 10% |
| 8.4.3. | Attenuation of attenuators | ± 0.5 dB |
| 8.5.1. | Temperature | ± 1° C |
| 8.5.2. | Humidity | ± 5% |

## Additional information to be used with Annex II to Recommendation T/R 34-01 (amended at Nice 1985)

This Appendix contains additional information concerning national derogations and options available for the implementation of Recommendation T/R 34-01.

| Paragraph | Administration | Description of variations | Reason for variations |
|---|---|---|---|
| 1.1. | Denmark | A double watch is permitted provided that one of the channels is channel 16 and that this channel always has priority. Scanning of more than two channels is not allowed. | |
| | Norway | A double watch is permitted provided that channel 16 is one of the channels. Channel 16 must have priority. | |
| 2.1.3. | Greece | The labelling shall be in Greek if possible. | |
| | Fed. Rep. of Germany | The labelling shall be in German, English or shall use standard international symbols. | Conditions contained in other national specifications. |
| 2.1.5. | Greece | The technical documentation shall be in Greek or English. | |
| 2.3.1. | Greece | The equipment shall be fitted with an automatic system permitting a watch by loudspeaker on channel 16 when the handset is in its normal rest position, irrespective of the channel selector setting. | |
| 2.5.3. | United Kingdom (MPT 1252) Ireland (R 81) | Measures shall be taken to ensure that all accessible metal parts of the equipment are earthed. (For equipment such as a receiver with a plastic casing and earthed push-buttons and jack-plug sockets.) | CEPT: Measures shall be taken to ensure that the casing of the equipment is earthed... |
| 2.7. | France | In accordance with T/R 34-01 a minimum number of channels is specified. | Operating conditions. |
| | Norway | At least 24 channels are required. | |
| | United Kingdom | 1.3. | |
| | Ireland | Transmission and reception on a least 6 channels. | |

| Paragraph | Administration | Description of variations | Reason for variations |
|---|---|---|---|
| 3.4.1. | United Kingdom Ireland | The lower and upper extreme temperatures are 0° C and 40° C. | CEPT: The lower and upper temperatures are −15° C and 55° C. |
| 3.7.1. | United Kingdom Ireland | The equipment shall be operational one minute after being switched on and it shall meet all the requirements of the specifications after 5 minutes. | CEPT: The equipment shall be operational and meet the requirements of the specifications one minute after being switched on. |
| 5.2.3. | Greece | A power level of between 10 and 25 watts is required instead of "between 6 and 25 watts". | |
| 5.8.2.4. | France | This method is used in preference. | The use of a spectrum analyser is preferred to the use of a receiver. |
| 5.10.3. | United Kingdom Ireland | Cabinet radiation shall not exceed 2.5 microwatts. | CEPT: Cabinet radiation shall be minimal. |
| 6.12. | Spain | An unmodulated signal is used to unblock the mute or "squelch" facility. The input signal must not exceed 1.5 microvolt. | |
| 6.12.3. | United Kingdom Ireland | If the mut or "squelch" facility is continuously adjustable, the input level shall not exceed +30 dBμV when the control setting is at maximum sensitivity. | CEPT: if the mute or "squelch" facility is continuously adjustable, the input level shall not exceed +40 dBμV when the control seeting is at maximum sensitivity. |
| 7.1.3. | Spain | The limit is not specified. However, a maximum of 3 dB is permitted. | |
| | Denmark | National specifications recommend that the equipment should be fitted with an automatic system permitting a watch to be kept on channel 16 when the handset is in its normal position. | |
| | United Kingdom Ireland | Independent selection of transmission and reception frequencies shall not be possible. | CEPT: No equivalent condition. |
| | Fed. Rep. of Germany | Use of duplex and semi-duplex modes.<br><br>For public correspondence and port operations the following provisions shall apply: | Operating condition. |

| Paragraph | Administration | Description of variations | Reason for variations |
|---|---|---|---|
| | Fed. Rep. of Germany | Radiotelephone stations on board passenger ships on inland waterways and ships of 300 grt and above shall be equipped for public correspondence in duplex mode. | |
| | | All other vessels, including vessels on inland waterways, may use the semi-duplex mode for public correspondence, but the use of the duplex mode is strongly recommended. | |
| | | In addition to the requirements in the specifications, the design and technology used in the equipment have to conform to the following standards: | |
| | | "VDE 0560, Specifications for capacitors, Part 7, radio interference suppression capacitors." | Regulations of the German Electrotechnical Commission within the DIN (DEK). |
| | | "VDE 0804, Specifications for communications equipment." | |
| | | "VDE 0874, VDE guidelines for radio interference suppression." | |
| | | "VDE 0875, Specifications for suppression of radio interference caused by electrical equipement and systems—safety requirements." | |
| | | "Regulation on protection against harmful effects caused by X-rays (X-Ray Regulation-RöV)." | National Regulation. |
| | | "Guidelines on permissible noise levels on board sea-going ships." | Regulation of the "Seeberufsgenossenschaft". |
| | | Conducted spurious emissions in the 150 kHz to 30 MHz frequency band. | National specifications contained in the VDE Regulations of the German Electrotechnical Commission within the DIN (DEK). |

# Annex III

# Specifications for a watchkeeping radiotelephone receiver on the distress frequency 2,182 kHz

*Note:*

Text approved by the "Telecommunications" Commission at Stockholm (1977), amended at Ostend (1979), Innsbruck (1981), Vienna (1982), Cannes (1983) and Nice (1985).

Table of contents

## 1. INTRODUCTION

These specifications are the minimum technical characteristics for a ship's radiotelephone receiver, including power sources or converters, intended for keeping watch by means of a loudspeaker on the international distress and calling frequency 2.182 kHz. The equipment shall comprise the following:

a) a receiver;
b) a loudspeaker;
c) a filtering device, with a supplementary or substitute muting device to silence the loudspeaker in the absence of the signals specified in paragraph 6.2.;
d) a device, which may be provided as an additional item, for disconnecting the filter, muting device or both during periods of radiotelephone silence.

The numbers in parentheses refer to notes at the end of this document.

## 2. GENERAL CONDITIONS

### 2.1. Construction

2.1.1. The mechanical and electrical construction and finish of the equipment shall conform in all respects with good engineering practice and the equipment shall be suitable for use on board ships at sea.

2.1.2. All controls shall be of sufficient size to enable the usual control functions to be easily performed.

2.1.3. All controls, instruments, monitoring devices and input/output points shall be clearly labelled. A label indicating the type of equipment submitted for the type approval tests shall be affixed to the equipment so as to be clearly visible in the normal operating position. Details concerning the power source to be used for the equipment shall also be clearly indicated.

2.1.4. All parts of the equipment to be checked during inspection or maintenance operations shall be readily accessible.

2.1.5. Full technical documentation shall be provided with the equipment.

2.1.6. The components shall be readily identifiable either from markings on the equipment itself or from the technical documentation.

2.1.7. The brightness of any equipment lighting shall be capable of being reduced to zero.

### 2.2. Controls

The only controls on the outside of the apparatus shall be the following:

— on/off switch with a visual indication that the installation is in operation;
— a volume control for adjusting the audio-frequency power as described in paragraph 4.11.1.;
— a control for reducing brightness as described in paragraph 2.1.7.;
— a muting device control or controls where paragraph 6. applies;
— a filter control where paragraph 5.1. applies;
— a control for the device described in paragraph 6.4. if it applies.

### 2.3. Safety precautions

2.3.1. Measures shall be taken to protect the equipment against the effects of overcurrent or overvoltage.

2.3.2. Measures shall be taken to prevent damage to the equipment if the power source produces transient voltage variations, and to prevent any damage that might arise from an accidental reversal of polarity at the power source.

2.3.3. Measures shall be taken to ensure that the casing of the equipment is earthed, but this shall not result in any terminal of the electrical power source being earthed.

2.3.4. All components and wiring in which the DC or AC voltage produce, singly or in combination, a peak voltage in excess of 50 volts, shall be protected against any accidental access and shall automatically be isolated from all electrical power sources if the protective covers are removed. Alternatively, the equipment shall be constructed in such a way as to prevent access to components operating at such voltages unless an appropriate tool is used such as a nut-spanner or screwdriver. Conspicuous warning labels shall be affixed both inside the equipment and on the protective covers.

## 3. TEST CONDITIONS, POWER SUPPLY AND AMBIENT TEMPERATURES

### 3.1. Normal and extreme test conditions

Type approval tests shall be made under normal test conditions and also, where stated, under extreme conditions. The test conditions and procedures are described in paragraphs 3.2. to 3.5. below.

### 3.2. Test power source

During type approval tests, the equipment's power supply shall be provided by a test power source capable of producing normal and extreme test voltages as specified in paragraphs 3.3.2. and 3.4.2.

During the tests, the power source voltage shall be maintained within a tolerance of ± 3% relative to the voltage level at the beginning of each test.

### 3.3. Normal test conditions

3.3.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be fixed by any convenient combination of temperature and humidity within the following limits:

— temperature +15°C to +35°C
— relative humidity 20% to 75%

*Note.* When it is impracticable to carry out the tests under the conditions specified above, a note stating the actual temperature and relative humidity during the tests shall be added to the test report.

3.3.2. *Normal test power supply*

3.3.2.1. Mains voltage and frequency

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of these specifications, the nominal mains voltage shall be the declared voltage or any of the declared voltages for which the equipement is indicated as having been designed.

The frequency of the test power source used instead of the AC mains shall be 50 Hz ± 1 Hz.

3.3.2.2. Power source from a battery

Where the equipment is designed to operate from an accumulator battery, the normal test voltage shall be the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.3.2.3. Other power sources

For equipment using other power sources, the normal test voltage shall be determined by agreement between the manufacturer and the authority conducting the tests.

3.4. **Extreme test conditions**

3.4.1. *Extreme temperatures*

For tests at extreme temperatures, measurements shall be made in accordance with paragraph 3.5., at a lower temperature of 0 °C and an upper temperature of +40 °C.

3.4.2. *Extreme test power supply values*

3.4.2.1. Mains voltage and frequency

The extreme test voltages for equipment to be connected to the AC mains shall be the nominal mains voltage ± 10%.

The frequency of the test power source shall be 50 Hz ± 1 Hz.

3.4.2.2. Power source from an accumulator battery

Where the equipment is designed to operate from an accumulator battery, the extreme test voltages shall be 1.3 or 0.9 times the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.4.2.3. Other power sources

For equipment using other power sources, the extreme test voltages shall be determined by agreement between the equipment manufacturer and the authority conducting the tests.

3.5. **Procedure for tests at extreme temperatures**

Before measurements are made, the equipment shall have reached thermal equilibrium in the test chamber.

During the temperature-stabilizing period, the equipment shall be switched off. The sequence of measurements shall be chosen and the humidity content in the test chamber shall be controlled so that excessive condensation does not occur.

3.6. **Environmental tests**

3.6.1. *General*

The following tests shall be conducted under the environmental conditions specified in Annex VI to this Recommendation, "Environmental tests for maritime radio equipment".

Before commencing the environmental tests, the tests for the other technical requirements in these specifications shall be carried out. Where electrical tests are required, they shall be caried out at the normal test voltage.

Where the expression "verification of characteristics" is used, it means simple electrical and functional tests to demonstrate that the equipment is in working order. The results of verifications of characteristics shall be included in the test report.

3.6.2. *Vibration*

(Test to be carried out in accordance with paragraph 4. in Annex VI to this Recommendation.)

3.6.3. *Dry-heat cycle*

(Sheltered equipment, see paragraph 5.2. in Annex VI to this Recommendation.)

During these tests, it is acknowledged that the equipment's characteristics may be diminished, but the sensitivity shall be verified with particular care.

3.6.4. *Damp-heat cycle*

(Test to be carried out in accordance with paragraph 6. in Annex VI to this Recommendation.)

During these tests, it is acknowledged that the equipment's characteristics may be diminished, but the sensitivity shall be verified with particular care.

3.6.5. *Low-temperature cycle*

(Sheltered equipment, see paragraph 7.2. in Annex VI to this Recommendation.)

During these tests, it is acknowledged that the equipment's characteristics may be diminished, but the sensitivity shall be verified with particular care.

3.6.6. *Corrosion tests*

(See paragraphs 10.1. and 10.2. in Annex VI to this Recommendation.)

3.7. **Warm-up time**

The equipment shall meet the requirements of these specifications one minute after being switched on.

## 4. RECEIVER

### 4.1. General

4.1.1. *Classes of emission and frequency*

The receiver shall be fixed-tuned and shall be capable of receiving class A2A, H2A, A3E and H3E emissions on the 2,182 kHz frequency by means of an envelope detector.

4.1.2. *Artificial antenna*

For the type approval tests the receiver shall meet the requirements of these specifications when connected to an artificial antenna comprising a resistance of 10 ohms and a capacitance of 250 pF connected in series. This does not in any way imply that the receiver can operate solely with antennas possessing these characteristics.

4.1.3. *Test signals applied to the receiver input*

4.1.3.1. Test signal generators shall be connected to the receiver input via a network such that the impedance presented to the receiver input is equal to the impedance of the artificial antenna defined in paragraph 4.1.2.

This requirement shall be met, irrespective of whether one or more test signals are applied to the receiver simultaneously.

4.1.3.2. The levels of the test signals at the input shall be expressed in terms of the e.m.f. at the output terminals of the generators including the associated network decribed in paragraph 4.1.3.1.

4.1.4. *Receiver output*

4.1.4.1. The output power of the receiver shall be measured in a resistance approximately equal to the modulus of impedance of the loudspeaker.

4.1.4.2. The normal output power used in these specifications shall be mesured at a frequency of 1,000 Hz and shall be 50 mW.

4.1.4.3. The rated output power stated by the manufacturer shall be at least 500 mW.

*Note.* An appreciably higher output power may be necessary in a noisy environment.

4.2. **Maximum usable sensitivity**

4.2.1. *Definition*

The maximum usable sensitivity is the minimum level of a radio-frequency signal with the modulation indicated, which produces at the receiver output a given value of the signal-noise-distortion to noise ratio (abbreviated to SND/N) and, at the same time, an output power at least equal to the value specified.

4.2.2. *Method of measurement*

A class A2A signal on the frequency 2,182 kHz, modulated at 1,000 Hz with a modulation factor of 30% shall be used. For each test, the input level of the test signal shall be adjusted so that a SND/N ratio of 10 dB is obtained and, at the same time, 500 mW of power is provided at the output. The level measured at the input is the maximum usable sensitivity. Measurements shall also be made under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

4.2.3. *Limits imposed*

The maximum usable sensitivity shall be better than +20 dB relative to 1 microvolt.

4.3. **Audio-frequency passband**

4.3.1. *Definition*

The audio-frequency passband is the frequency band within which the attenuation relative to the maximum level does not exceed 6 dB.

4.3.2. *Method of measurement*

A class A2A signal, modulated at 1,000 Hz with a modulation factor of 30% shall be applied to the receiver input at a level of +60 dB relative to 1 microvolt and the receiver shall be set for the normal output power. The modulation frequency shall then be varied while maintaining a constant modulation factor of 30%, and the output level corresponding to each modulation frequency shall be measured.

4.3.3. *Limits imposed*

The audio-frequency passband shall extend at least from 350 Hz to 2,700 Hz. At 6 kHz, the attenuation relative to the maximum amplitude shall be no less than 20 dB.

## 4.4. Two-signal selectivity test for adjacent channel signal-selectivity

4.4.1. A two-signal selectivity test for adjacent channel signal-selectivity is an important indication of effective selectivity, defined as being the receiver's ability to discriminate between the wanted signal and unwanted signals (on frequencies generally outside the passband) at levels that may produce non-linearity effects, with the wanted signal and the unwanted signals acting simultaneously. For the purpose of these specifications, the adjacent channel signal-selectivity is defined as the ratio at the receiver input of the level of unwanted signals to the level of specified wanted signals, when the unwanted signals produce a reduction in the SND/N ratio from 20 dB to 14 dB.

4.4.2. *Method of measurement*

The arrangement used for applying two test signals to the receiver input shall conform to paragraph 4.1.3. The automatic gain control shall be switched on. The wanted signal shall be a class A2A signal on the 2,182 kHz frequency, modulated at 1,000 Hz with a modulation factor of 30%.

The receiver shall be set for normal output power with a SND/N ratio of 20 dB.

An unwanted class A2A signal, modulated at 400 Hz with a modulation factor of 30%, shall then be applied to the receiver input. The level of the unwanted signal shall be increased from a low level until the SND/N ratio is reduced from 20 dB to 14 dB.

4.4.3. *Limits imposed*

The adjacent channel signal-selectivity shall exceed the values shown in the following Table:

| Frequency of the unwanted signal relative to 2,182 kHz | Adjacent channel signal-selectivity |
|---|---|
| −10 kHz and +10 kHz | 40 dB |
| −20 kHz and +20 kHz | 50 dB |

## 4.5. Two-signal selectivity tests (blocking and cross-modulation)

4.5.1. *Definitions*

Blocking is a change (generally a reduction) in the output power or a reduction of the SND/N ratio of a receiver due to an unwanted signal on another frequency.

Cross-modulation is the transfer to the wanted signal of the modulation of a modulated unwanted signal transmitted on another frequency.

Blocking and cross-modulation often occur simultaneously.

4.5.2. *Methods of measurement*

The tests shall be conducted with the automatic gain control switched on. The measurements shall be made while applying two test signals simultaneously to the receiver input. One of the test signals shall be the wanted signal and the other shall be the unwanted signal.

The wanted signal shall be a class A2A signal on the carrier frequency 2,182 kHz, modulated at 1,000 hZ with a modulation factor of 30%.

4.5.2.1. The tests shall be made with the level of the wanted signal at +60 dB relative to 1 microvolt.

4.5.2.2. For the blocking test, the receiver shall be set so that the wanted signal produces normal power at the output. An unwanted signal shall then be applied, at a frequency ±20 kHz away from the wanted signal frequency. The level of the unwanted signal shall be increased until it produces a 3 dB change in the output level of the wanted signal or a 6 dB reduction of the SND/N ratio, whichever occurs first. When this prerequisite is met, the input level of the unwanted signal is the blocking level.

4.5.2.3. For the cross-modulation test, the receiver shall be set so that the wanted signal produces normal power at the output. With the modulation of the wanted signal being suppressed, an unwanted class A2A signal shall be applied at a frequency ±20 kHz away from the wanted signal frequency, modulated at 400 Hz with a modulation factor of 30%.

The input level of the unwanted signal shall be increased until the total power of the unwanted signal at the receiver output as a result of cross-modulation is 30 dB below the level of the wanted signal. When this prerequisite is met, the input level of the unwanted signal is the cross-modulation level.

4.5.3. *Limits imposed*

4.5.3.1. Blocking

With the level of the wanted signal at +60 dB relative to 1 microvolt, the level of the unwanted signal shall be no less than +100 dB relative to 1 microvolt.

4.5.3.2. For cross-modulation, the level of the unwanted signal shall be no less than +90 dB relative to 1 microvolt.

4.6. **Intermodulation**

4.6.1. *Definition*

Intermodulation is a process whereby signals result from the simultaneous application of two or more (generally unwanted) signals to a non-linear circuit.

4.6.2. *Method of measurement*

With the automatic gain control switched on, a class A2A test signal on the 2,182 kHz frequency, modulated at 1,000 Hz with a modulation factor of 30%, shall be applied to the receiver input at a level of +30 dB relative to 1 microvolt, and the audio-frequency gain control shall be set so as to produce normal output power. The setting of the audio-frequency gain control shall not be altered during the course of this test. The wanted signal shall then be suppressed and two unwanted signals shall be applied simultaneously to the receiver input. The signal closer in frequency to the wanted signal frequency shall be unmodulated. The other unwanted signal shall be a class A2A signal modulated at 1,000 Hz with a modulation factor of 30%.

Neither of the two signals shall be at a frequency less than 30 kHz away from the wanted signal frequency (the receiver input frequencies which are likely to produce harmful intermodulation products are contained in CCIR Recommendation 332-3, paragraph 6.4.). In selecting the frequencies used for these measurements, care shall be taken to avoid those on which spurious responses are produced. The input levels of the two signals in combination shall remain equal and shall be adjusted so that the receiver output power resulting from the combined signals is equal to the normal output power.

If the above input levels cannot be determined precisely from the "output level/input level" characteristic, it shall simply be ascertained that the operating conditions of the automatic gain control are the same as when the wanted signal was applied, using the voltage of the automatic gain control, for example, as a reference.

4.6.3. *Limits imposed*

The level of each of the two signals which combine to produce the normal output power shall be no less than +80 dB relative to 1 microvolt.

4.7. **Spurious response selectivity**

4.7.1. *Definition*

The spurious response protection ratio is the ratio of the input level of the unwanted signal on the spurious response frequency to the input level of the wanted signal when the wanted and unwanted signals each separately produce the same SND/N ratio at the receiver output.

4.7.2. *Method of measurement*

A class A2A signal on the 2,182 kHz frequency, modulated at 1,000 Hz with a modulation factor of 30%, shall be applied to the receiver input at a level producing a SND/N ratio of 10 dB. The carrier frequency of the input signal shall then be varied in order to find the spurious responses. Whenever a spurious response is obtained, the carrier frequency of the input signal shall be adjusted so as to provide maximum power at the output. The input level shall then be adjusted so as to produce a SND/N ratio of 10 dB at the receiver output. The ratio between the input level of each spurious signal and the input level of the wanted signal shall then be determined.

4.7.3. *Limits imposed*

The protection ratio on any spurious frequency shall be no less than 60 dB.

4.8. **Harmonic distortion**

4.8.1. *Definition*

The harmonic distortion at the receiver output is defined as the ratio, expressed as a percentage, of the total r.m.s. voltage of all the harmonic components of the modulation audio-frequency to the total r.m.s. voltage of the signal delivered by the receiver.

4.8.2. *Method of measurement*

A class A2A signal on the 2,182 kHz frequency, modulated at 1,000 Hz with a modulation factor of 30%, shall be applied to the receiver input at successive levels of +40 dB and +80 dB relative to 1 microvolt.

The audio-frequency gain control shall be set so as to obtain the rated power. For each input level value, the modulation factor shall be increased from 30% to 80% while using the audio-frequency gain control to keep the output power at its rated value.

4.8.3. *Limits imposed*

At a modulation factor of 30%, the harmonic distortion shall not exceed 15%.

4.9. **Conducted spurious emissions**

4.9.1. *Definition*

Conducted spurious emissions are emissions at any frequencies which are conveyed to the antenna or artificial antenna.

4.9.2. *Method of measurement*

Conducted spurious emissions shall be measured at the resistance terminals of the artificial antenna defined in paragraph 4.1.2.

Each spurious emission shall be measured by means of a tuned radio-frequency measuring instrument or a spectrum analyser. The measurements shall extend over a range from 9 kHz to 2 GHz.

4.9.3. *Limits imposed*

The power of any discrete component measured in the artificial antenna shall not exceed 1 nanowatt ($1 \times 10^{-9}$ watt).

4.10. **Automatic gain control**

A satisfactorily operating automatic gain control shall be fitted in the apparatus. It shall be designed to inhibit any excessive noise at the receiver output in the absence of input signals.

4.10.1. *Methods of measurement*

4.10.1.1. For the low-level AGC test, a class A2A signal on the 2,182 kHz frequency, modulated at 1,000 Hz with a modulation factor of 30%, shall be applied to the input. The input level shall be adjusted to produce a SND/N ratio of 10 dB.

The audio power control shall be set so as to produce the normal output power. The input level shall then be increased by 20 dB and the SND/N ratio measured.

4.10.1.2. For the high-level AGC test, a class A2A signal on the 2,182 kHz frequency, modulated at 1,000 Hz with a modulation factor of 30%, shall be applied to the input. The input level shall be adjusted to produce a SND/N ratio of 10 dB. The audio power control shall be set so as to produce an output level 10 dB below the normal power.

The input level shall then be increased by 70 dB and the output power variation measured.

4.10.2. *Limits imposed*

4.10.2.1. Under the conditions specified in paragraph 4.10.1.1., the SND/N ratio shall be no less than 25 dB.

4.10.2.2. Under the conditions specified in paragraph 4.10.1.2., the output power shall not increase by more than 10 dB.

4.11. **Audio-frequency gain controls**

4.11.1. The receiver shall be equipped with a manual control for varying the audio output power between the maximum and a low but audible level.

4.11.2. It shall be possible to adjust the lower output level value by means of a preset control not accessible to the operator. In whatever combination the settings of the manual and preset gain controls are placed, the output power shall be no lower than 1 mW when the usable sensitivity level measured in accordance with paragraph 4.2. is applied to the input.

4.11.3. With the manual volume control set at minimum, the preset control shall enable the output power to be varied by at least 12 dB.

4.12. **Protection of receiver circuits**

4.12.1. Measures shall be taken to protect the receiver and suppress its output power when the on-board radio-telephone transmitter is transmitting on the 2,182 kHz frequency.

4.12.2. The receiver shall not suffer any damage as a result of applying, under the conditions specified in paragraph 4.1.3., a radio-frequency test signal at a level of 30 r.m.s. volts for a period of 15 minutes on any frequency in the 100 kHz to 28 MHz range.

When the test signal ceases to be applied, the receiver shall operate without having to be reset.

4.12.3. The receiver shall also be protected against damage due to electrostatic voltage which may occur at its input.

## 5. FILTERING DEVICE

### 5.1. Filter response at 1,300 Hz and 2,200 Hz

If the equipment is designed to have a selective response on the alarm signal frequencies 1,300 Hz and 2,200 Hz, it shall meet the specifications of paragraph 5.3. when placed under those conditions. In this case, an indication shall be given on the equipment and it shall be possible to return it quickly and easily to the setting at which the response is normal as defined in paragraph 4.3.3.2.

### 5.2. Method of measurement

With the filtering device switched off, a class A2A signal on the 2,182 kHz frequency, modulated at 1,000 Hz with a modulation factor of 30%, shall be applied to the receiver input at a level of 60 dB relative to 1 microvolt. The receiver output power shall be adjusted to its normal value. The equipment shall then be set at "filtered" and while keeping a constant modulation factor of 30%, the output level corresponding to each modulation frequency shall be measured. The measurements shall also be made under the extreme test conditions defined in paragraph 3.4.

### 5.3. Limits imposed

With the equipment set at "filtered", the maximum response levels shall not differ by more than 6 dB from the normal output power or by more than 3 dB from each other.

The response curves for each filter section shall be within the limits indicated by Figure III-1 (T/R 34-01).

## 6. MUTING DEVICE

### 6.1. General

The apparatus may be equipped with a muting device to silence the loudspeaker unless one of the signals defined below is received:

a) a radiotelephone alarm signal (see paragraph 6.2.1.1.);
b) a signal preceding an urgent notice to mariners (see paragraph 6.2.1.2.);
c) in addition, the muting device may also respond to the EPIRB signals defined by the Radio Regulations (Nos. 3256 and 3257), provided the signal consists of intervals with and without modulation, each having a nominal duration of one second (see paragraph 6.2.1.3.).

On receiving one of signals a) or b) or, if the case arises, signal c), the muting device shall automatically cut out and the receiver shall operate over the whole of the audio-frequency passband until the muting device is manually reset.

If the apparatus is equipped with this device, it shall be possible to switch it on or to restore normal operation quickly and easily by means of a control at the disposal of the operator. A manual control shall also enable the muting device to be switched back on after cutting out.

6.2. **Operation of the muting device**

6.2.1. *Methods of measurement*

With the muting device switched off, a class A2A signal on the carrier frequency 2,182 kHz, modulated at 1,000 Hz with a modulation factor of 30%, shall be applied to the receiver input at the same level as the measured sensitivity level. The audio-frequency gain control shall be set for normal output power, after which the tests described below shall be conducted with the muting device switched on.

6.2.1.1. Response to the radiotelephone alarm signal

A class A2A test signal modulated at 70% by the radiotelephone alarm signal shall be applied to the receiver input. Its level shall be below the level required for the muting device to cut out. While increasing the level of the input signal, the output power shall be measured until it reaches at least −6 dB relative to the normal power. The input level for which this result is obtained shall be noted.

The test shall be repeated for any combination of the extreme values of permitted tolerances applicable to the radiotelephone alarm signal, as specified below:

- frequency: 1,300 Hz ± 20 Hz; 2,200 Hz ± 35 Hz
- duration of each tone: 250 milliseconds ± 50 milliseconds
- interval between tones: 0 to 50 milliseconds

6.2.1.2. Response to the notice to mariners signal

A class A2A test signal on a carrier frequency of 2,182 kHz, modulated at 70% by a notice to mariners signal shall be applied to the receiver input. Its level shall be below the level required for the muting device to cut out. While increasing the level of the input signal, the output power shall be measured until it reaches at least −6 dB relative to the normal power. The input level for which this result is obtained shall be noted.

The test shall be repeated for any combination of the limits specified below:

- modulation frequency: 2,200 Hz ± 35 Hz
- modulation activation time: 250 ms ± 50 ms
- modulation interruption time: 250 ms ± 50 ms

6.2.1.3. Response to the EPIRB 1,300 Hz signal

A class A2A signal on a carrier frequency of 2,182 kHz, modulated at 1,300 Hz with a modulation factor of 30% shall be applied to the receiver input according to the following sequence: the modulated signal shall be applied to the receiver input for one second, followed by one second without modulation. The level shall be below the level required for the muting device to cut out. While increasing the level of the input signal, the output power shall be measured until it reaches at least −6 dB relative to the normal power. The input level for which this result is obtained shall be noted.

The test shall be repeated for any combination of the limits specified below:

- modulation frequency: 1,300 Hz ± 20 Hz
- modulation and carrier activation time: 1.0 s-1.2 s
- modulation and carrier interruption time: 1.0 s-1.2 s

Combinations where the ratio of activation time to interruption time is less than 1:1 shall be ignored.

6.2.2. *Limits imposed*

The muting device shall cut out after no more than 6 seconds for input levels equal to or higher than the measured sensitivity level.

6.3. **Protection against interference**

6.3.1. *Methods of measurement*

The receiver shall be arranged in accordance with paragraph 6.2.1., after which the tests described below shall be conducted with the muting device switched on.

6.3.1.1. Selective call signals on 2,170.5 kHz

A class A2A signal with a modulation factor of 70% shall be applied to the receiver input for at least 10 seconds at a level of 70 dB relative to the measured sensitivity level. The modulation shall consist of alternated tones at frequencies of 1,275 Hz and 2,110 Hz, each applied for a duration of 100 ms. The output power shall be measured. The measurements shall be repeated with modulation frequencies of 1,358 Hz and 2,110 Hz.

6.3.1.2. Voice-activated modulation

A voice-modulated signal on the 2,182 kHz frequency shall be applied to the receiver input for 5 minutes at a level 70 dB above the measured sensitivity level. The output power shall be measured.

6.3.1.3. Unspecified signals with 2,200 Hz modulation

A class A2A test signal on a carrier frequency of 2,182 kHz with a modulation factor of 70% shall be applied to the receiver input at a level of 70 dB relative to the measured sensitivity level and the output power shall be measured. With a modulation frequency of 2,200 Hz ±35 Hz, the test shall be carried out for any combination of the limits specified below:

a) Modulation activation time:
175 ms or shorter
325 ms or longer
Modulation interruption time: 250 ms.

b) Modulation interruption time:
175 ms or shorter
325 ms or longer
Modulation activation time: 250 ms.

6.3.2. *Limits imposed*

The output power resulting from modulation shall be no more than 30 dB below the normal output power.

6.4. **Operation during periods of radiotelephone silence**

When paragraph 1. d) applies, the equipment shall be set so that it is receiving the normal level over the whole of the audio-frequency passband during periods of radiotelephone silence, this operation being controlled by a clock or by any other approved means. It shall be possible to de-activate this device at any time.

6.5. **Test arrangements**

Possibilities shall exist for enabling the muting device to be tested regularly by means of a two-tone alarm signal generator. This device may be separate.

7. **OPERATING TESTS**

The authority conducting the tests shall verify that the equipment operates satisfactorily by means of tests carried out in practice under conditions equivalent to those actually encountered.

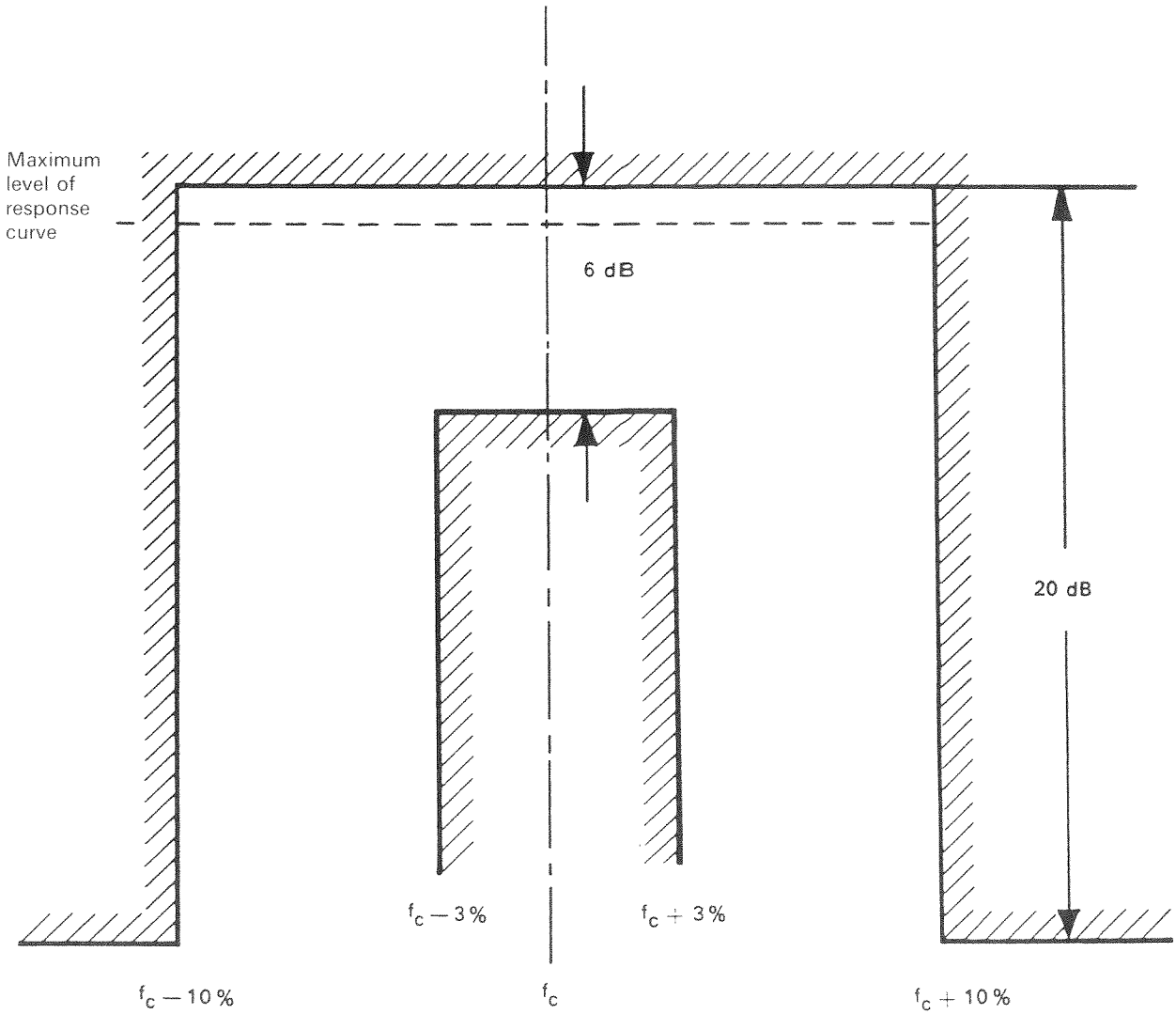


Figure III-1 (T/R 34-01). Response curve of the filter.

## Additional information to be used with Annex III to Recommendation T/R 34-01 (amended at Nice 1985)

This Appendix contains additional information concerning national derogations and options available for the implementation of Recommendation T/R 34-01.

| Paragraph | Administration | Description of variations | Reason for variations |
|---|---|---|---|
| | Greece | Annex III has been adopted for administrative purposes but is not yet a National Regulation. It is also intended to require an audible alarm if one of the signals in paragraphs 6.2.1.1., 6.2.1.2. or 6.2.1.3. is received. The alarm delay time must not exceed 15 seconds. | |
| | Fed. Rep. of Germany | Annex III is not yet in force. | |
| 1. d) and 6.1. | Denmark | A muting device is obligatory. A device should be provided so that when a received signal clears the block, the signal first applied to the loudspeaker is slightly lower than the signal corresponding to the setting of the audio-frequency gain control, after which–in 1 to 2 seconds–the signal is gradually increased to the level corresponding to the setting of the audio-frequency gain control. | |
| 1. d) and 6.1. | Spain<br>France<br>Norway<br>Sweden | The muting device is obligatory. | |
| 1. d) and 6.4. | Spain<br>Norway<br>Sweden | Automatic suppression of the muting device during periods of radiotelephone silence is obligatory. | |
| 2.3.3. | United Kingdom (MPT 1223)<br>Ireland (R 49) | Measures shall be taken to ensure that the accessible metal parts of the equipment are earthed. (For equipment such as a receiver with a plastic casing and earthed push-buttons and jack-plug sockets.) | CEPT:<br>Measures shall be taken to ensure that the casing of the equipment is earthed... |
| 3.4.2.2. | United Kingdom<br>Ireland | Power source voltage variations are 10% relative to the nominal voltage, e.g. 1.1 and 0.9 times. | CEPT:<br>The extreme voltages for batteries shall be 1.3 and 0.9 times the nominal voltage of the battery. |

| Paragraph | Administration | Description of variations | Reason for variations |
|---|---|---|---|
| 3.6. | United Kingdom Ireland | During the environmental tests: verification of performance with particular attention to sensitivity (par. 7.) and the muting device (par. 12.). | CEPT: During the environmental tests: verification of performance with particular attention to sensitivity. |
| 4.1.2. | United Kingdom Ireland | Artificial antenna for the tests: 10 ohms in series with 250 pF or an antenna comprising a non-inductive resistance of 50 ohms. | CEPT: Artificial antenna for the tests: 10 ohms in series with 250 pF. |
| 4.12. | United Kingdom Ireland | last sentence. The receiver shall have a DC resistance of not more than 100 kohms between the antenna terminals and the casing. | CEPT: No equivalent requirement. |
| 5. | Spain | Not required because the muting device is obligatory. | |
| 6.1. | United Kingdom Ireland | line 5; line 1 ... the muting device shall be phased out so as to restore the sound level *gradually* ... (The volume should not be at full power immediately.) | CEPT: ... muting shall be removed automatically and the equipment set to receive the entire passband. |
| 6.1. c) | Fed. Rep. of Germany | In addition, the muting device *must* respond to EPIRB signals. | The Federal Republic of Germany thinks the muting device should also respond to EPIRB signals in order to trigger the alert procedures. |
| | Norway | The receiver does not have to respond to an EPIRB signal. | |
| 6.2.1.1. | Norway | Modulation depth 30%, not 70%. | The signal may come from portable equipment in poor condition. |
| 6.5. | Norway | Requires an internal test generator which provides the 2-tone alarm signal or notice to mariners. It must also be possible to connect a magnetic recorder. | |

# Annex IV

# Specifications for radiotelephone alarm generators

*Note:*
Text approved by the "Telecommunications" Commission at Ostend (1979), amended at Vienna (1982).

Table of contents

## 1. INTRODUCTION

These specifications are the minimum characteristics required for an automatic radiotelephone alarm transmitter, including the power source or sources which may be necessary. It would be preferable for the device to be an integral part of the transmitter, but it may be separate.

## 2. GENERAL CONDITIONS

### 2.1. Construction

2.1.1. The mechanical and electrical construction and finish of the equipment shall conform in all respects to good engineering practice and the equipment shall be suitable for use on board ships at sea.

2.1.2. All parts of the equipment to be checked during inspection or maintenance operations shall be readily accessible.

2.1.3. Full technical documentation shall be supplied with the equipment.

2.1.4. The components shall be readily identifiable, either from markings on the equipment itself, or from the technical documentation.

### 2.2. Controls

2.2.1. The number of controls shall be the minimum necessary for a satisfactory and simple operation and these controls shall be clearly identified to show their function.

They shall be designed so that the possibility of the accidental transmission of an alarm signal is minimal.

2.2.2. The brightness of any equipment lighting which might impair navigation shall be capable of being reduced to zero.

2.2.3. Pre-set controls, if any, shall not be directly accessible to the operator.

2.2.4. The apparatus shall be capable of being switched off at any time in order to permit the immediate transmission of a distress message.

### 2.3. Safety

2.3.1. Measures shall be taken to protect the equipment against the effects of overcurrent or overvoltage.

2.3.2. Measures shall be taken to prevent damage to the equipment if the power source produces transient voltage variations and to prevent any damage that might arise from an accidental reversal of polarity at the power source.

2.3.3. Measures shall be taken to ensure that the casing of the equipment is earthed, but this shall not result in any terminal of the electrical power source being earthed.

2.3.4. All components and wiring in which the DC or AC voltage produce, singly or in combination, a peak voltage in excess of 50 V, shall be protected against any accidental access.

2.4. **Marking**

Where the apparatus is not an integral part of the equipment, it shall carry an indication of the type designation under which it has been submitted for the type approval tests. This mark shall be easily legible when the apparatus is in its normal operating position.

2.5. **Power source**

The apparatus shall be capable of operating from the power source for the associated equipment, unless otherwise stated in the appropriate technical specifications, e.g. for portable equipment.

## 3. TEST CONDITIONS

3.1. **Scope**

These test conditions are applicable only to appliances which are not associated with special equipment. For appliances which are associated with special equipment, the test conditions for that special equipment shall apply.

3.2. **Normal and extreme test conditions**

The tests shall be conducted under normal test conditions (paragraph 3.4.) and under extreme test conditions (paragraphs 3.5.1. and 3.5.2. applied simultaneously).

3.3. **Test power source**

During the tests, the equipment shall operate from a test power source capable of producing normal and extreme test voltages, as specified in paragraphs 3.4.2. and 3.5.2.

During the tests, the power source voltage shall be maintained within a tolerance of ±3% relative to the voltage level at the beginning of each test.

3.4. **Normal test conditions**

3.4.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be fixed by any convenient combination of temperature and humidity within the following limits:

— temperature +15°C to +35°C
— relative humidity 20% to 75%

*Note.* When it is impracticable to carry out the tests under the conditions specified above, a note stating the actual temperature and relative humidity during the tests shall be added to the test report.

3.4.2. *Normal test power supply*

3.4.2.1. Mains voltage and frequency

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of these specifications, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment is indicated as having been designed.

The frequency of the test power source used instead of the AC mains shall be 50 Hz ± 1 Hz.

3.4.2.2. Power source from a battery

Where the apparatus is designed to operate from an accumulator battery, the normal test voltage shall be the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.4.2.3. Other power sources

For appliances using other power sources, the normal test voltage shall be determined by agreement between the manufacturer and the authority conducting the tests.

3.5. **Extreme test conditions**

3.5.1. *Extreme test temperatures*

The extreme test temperatures shall be those applied during the environmental tests (paragraph 3.6.) for the dry-heat tests and the low-temperature tests.

3.5.2. *Extreme test power supply values*

3.5.2.1. Mains voltage and frequency

The extreme test voltages for appliances to be connected to the AC mains shall be the nominal mains voltage ±10%. The frequency of the test power source shall be 50 Hz ±1 Hz.

3.5.2.2. Power source from an accumulator battery

Where the apparatus is designed to operate from an accumulator battery, the extreme test voltages shall be 1.3 or 0.9 times the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.5.2.3. Other power sources

For appliances using other power sources, the extreme test voltages shall be determined by agreement between the manufacturer of the apparatus and the authority conducting the tests.

3.6. **Environmental tests**

The apparatus shall meet all the requirements of these specifications when it is subjected to the same environmental tests as the transmitter with which it may be associated, irrespective of the kind of transmitter.

## 4. ALARM SIGNAL SPECIFICATIONS

4.1. **Frequency and duration of tones**

4.1.1. The radiotelephone alarm signal to be transmitted shall consist of two substantially sinusoidal tones, transmitted alternately, one at a frequency of 2,200 Hz (±1.5%) and the other at a frequency of 1,300 Hz (±1.5%).

4.1.2. The duration of each tone shall be 250 milliseconds (±10 milliseconds) and the interval between two successive tones shall not exceed 4 milliseconds.

4.2. **Duration of alarm signal**

From the moment when it is activated, the apparatus shall transmit the alarm signal tones for a period of no less than 30 seconds and no more than 60 seconds, unless the transmission is interrupted manually (see also paragraph 2.2.4.).

4.3. **Repetition of alarm signal**

The apparatus shall be ready to repeat the signal within one second, either after transmitting the radiotelephone alarm signal or after manual interruption.

## 5. MODULATION

5.1. **Appliances associated with specific types of transmitters**

Appliances which are an integral part of a transmitter and appliances designed to be used with a specific type of transmitter shall be capable in either case of modulating the transmitter by at least 70%.

In addition, the ratio of the amplitude of the strongest signal modulated by one of the tones to the amplitude of the weakest signal modulated by the other tone shall remain between 1 and 1.2.

5.2. **Appliances not associated with specific types of transmitters**

In order to enable appliances not covered by paragraph 5.1. to produce a 70% modulation factor on any transmitter, the following requirements shall be met:

5.2.1. It shall be possible, using pre-set control(s), to adjust the level of the two tones relative to each other to any value from 0 to +6 dB.

5.2.2. With the power of both tones being equal, it shall be possible, using a pre-set control, to vary the output power of the apparatus within the range −20 dB to +10 dB relative to 1 mW in a load resistance capable of any value between 30 and 600 ohms.

## 6. TRANSMITTER ACTIVATION

Measures shall be taken to ensure that the transmitter is automatically activated at the beginning of the radiotelephone alarm signal and returned to standby at the end of the said signal.

## 7. MONITORING

A monitoring device incorporated in the apparatus shall permit listening surveillance of the radiotelephone alarm signal, whether or not the associated transmitter is activated.

**Additional information**
**to be used with Annex IV**
**to Recommendation T/R 34-01 (amended in Vienna 1982)**

This Appendix contains additional information concerning national derogations and options available for the implementation of Recommendation T/R 34-01.

| Paragraph | Administration | Description of variations | Reason for variations |
|---|---|---|---|
| | Denmark | The current national specifications are equivalent to Annex IV on all the essential points. | |
| | Greece | Annex IV is not yet in force.<br>The current national specifications are, however, almost equivalent to Annex IV. | |
| | Fed. Rep. of Germany | Conducted spurious emission in the 150 kHz to 30 MHz frequency band. | National specifications of the VDE Regulations of the German Electrotechnical Commission within the DIN (DEK). |

# Annex V

# Specifications for radiotelegraph alarm transmitters

*Note:*
Text approved by the "Telecommunications" Commission at its meeting at Ostend (1979), amended at Vienna (1982).

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# 1. INTRODUCTION

These specifications are the minimum characteristics required for an automatic radiotelegraph alarm transmitter, including the power source or sources which may be necessary. This device may be an integral part of the equipment, or may alternatively be separate.

# 2. GENERAL CONDITIONS

## 2.1. Construction

2.1.1. The mechanical and electrical construction and finish of the equipment shall conform in all respects to good engineering practice and the equipment shall be suitable for use on board ships at sea.

2.1.2. All parts of the equipment to be checked during inspection or maintenance operations shall be readily accessible.

2.1.3. Full technical documentation shall be supplied with the equipment.

2.1.4. The components shall be readily identifiable, either from markings on the equipment itself, or from the technical documentation.

## 2.2. Controls

2.2.1. The number of controls shall be the minimum necessary for satisfactory and simple operation and these controls shall be clearly identified to show their function and their operating condition.

They shall be designed so that the possibility of the accidental transmission of signals is minimal.

2.2.2. The brightness of any equipment lighting which might impair navigation shall be capable of being reduced to zero.

2.2.3. Pre-set controls, if any, shall not be directly accessible to the operator.

2.2.4. The apparatus shall be capable of being switched off at any time in order to permit the immediate control of the transmitter by means of a key.

## 2.3. Safety

2.3.1. Measures shall be taken to protect the equipment against the effects of overcurrent or overvoltage.

2.3.2. Measures shall be taken to prevent damage to the equipment if the power source produces transient voltage variations and to prevent any damage that might arise from an accidental reversal of polarity at the power source.

2.3.3. Measures shall be taken to ensure that the casing of the equipment is earthed, but this shall not result in any terminal of the electrical power source being earthed.

2.3.4. All components and wiring in which the DC or AC voltage produce, singly or in combination, a peak voltage in excess of 50 volts, shall be protected against any accidental access.

2.4. **Marking**

Where the apparatus is not an integral part of the equipment, it shall carry an indication of the type designation under which it has been submitted for the type approval tests. This indication shall be easily legible when the transmitter is in its normal operating position.

2.5. **Power sources**

If the apparatus is electrically powered, it shall be capable, using a converter if necessary, of operating from the reserve power source, unless otherwise stated in the appropriate technical specifications.

## 3. TEST CONDITIONS

3.1. **Scope**

These test conditions are applicable only to appliances which are not associated with special equipment. For appliances which are associated with special equipment, the test conditions for that special equipment shall apply.

3.2. **Normal and extreme test conditions**

The tests shall be conducted under normal test conditions (paragraph 3.4.) and under extreme test conditions (paragraphs 3.5.1. and 3.5.2. applied simultaneously).

3.3. **Test power source**

During the tests, the equipment shall operate from a test power source capable of producing normal and extreme test voltages, as specified in paragraphs 3.4.2. and 3.5.2.

During the tests the power source voltage shall be maintained within a tolerance of $\pm 3\%$ relative to the voltage level at the beginning of each test.

3.4. **Normal test conditions**

3.4.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be fixed by any convenient combination of temperature and humidity within the following limits:

— temperature $+15^{\circ}$C to $+35^{\circ}$C
— relative humidity 20% to 75%

*Note.* When it is impracticable to carry out the tests under the conditions specified above, a note stating the actual temperature and relative humidity during the tests shall be added to the test report.

3.4.2. *Normal test power supply*

3.4.2.1. Power source from a battery

Where the apparatus is designed to operate from an accumulator battery, the normal test voltage shall be the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.4.2.2. Other power sources

For appliances using other power sources, the normal test voltage shall be determined by agreement between the manufacturer and the authority conducting the tests.

3.5. **Extreme test conditions**

3.5.1. *Extreme test temperatures*

The extreme test temperatures shall be those applied during the environmental tests (paragraph 3.6.) for the dry-heat tests and the low-temperature tests.

3.5.2. *Extreme test power supply values*

3.5.2.1. Power source from an accumulator battery

Where the apparatus is designed to operate from an accumulator battery, the extreme test voltages shall be 1.3 or 0.9 times the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.5.2.2. Other power sources

For appliances using other power sources, the extreme test voltages shall be determined by agreement between the manufacturer of the apparatus and the authority conducting the tests.

3.6. **Environmental tests**

The apparatus shall meet all the requirements of these specifications when it is subjected to the same environmental tests as the transmitter with which it may be associated, irrespective of the kind of transmitter.

## 4. CODED SIGNALS

4.1. **Composition of coded signals**

4.1.1. Using a clearly visible control, the apparatus shall be capable of producing the sequence of coded signals specified below:

a) the radiotelegraph alarm signal, consisting of a series of 12 dashes, the duration of each dash being 4 seconds (±0.2 of a second) and the duration of the interval between two consecutive dashes being 1 second (±0.2 of a second);

a) 1. the $\overline{\text{SOS}}$ distress signal, sent 3 times,
2. the word DE,
3. the call sign of the ship station sent 3 times,
4. optionally, signals providing information on the ship's position and any other information capable of aiding rescue,
5. two dashes of 10 to 15 seconds' duration each, at an interval of 1 to 2 seconds.

In addition, it shall be possible to restrict the sequence of coded signals specified above to the sequence indicated in b) only.

After sending the sequence of encoded signals, the apparatus shall cease to encode, leaving the encoding circuit open.

4.1.2. After the period of time specified in paragraph 4.1.3. the apparatus shall automatically repeat the sequence of coded signals specified in paragraph 4.1.1. b) until encoding is interrupted or the apparatus returns to its original setting.

4.1.3. The period of time between the beginning of one sequence of coded signals and the beginning of the following sequence shall be between 10 and 14 minutes.

4.2. **Return to original setting**

The construction and design of the apparatus shall be such that whenever the sequence of signals is interrupted

a) the apparatus shall automatically return to its original setting, and
b) the time necessary to return the apparatus to its original setting and start the chosen sequence shall not exceed 10 seconds.

4.3. **Transmission rate**

The rate of transmission of the characters in the distress signal shall be no more than 13 bauds (approximately 16 words per minute), and no less than 8 bauds (10 words per minute).

## 5. LENGTH OF OPERATION

The apparatus shall be capable of meeting the requirements of these specifications

a) until the ship's reserve power source is exhausted, if the power source for the apparatus is electrical; or

b) for at least 36 hours without re-winding if the power source is not electrical.

## 6. MONITORING

A monitoring device incorporated in the apparatus shall permit surveillance of the encoded signal whether or not the associated transmitter(s) is/are modulated.

**Additional information**
**to be used with Annex V**
**to Recommendation T/R 34-01 (amended at Vienna 1982)**

This Appendix contains additional information concerning national derogations and options available for the implementation of Recommendation T/R 34-01.

| Paragraph | Administration | Description of variations | Reason for variations |
|---|---|---|---|
| | Greece | Annex V is not yet in force.<br>The current national specifications are based on the requirements specified in the Radio Regulations. | |
| | Fed. Rep. of Germany | The automatic radio-telegraph alarm transmitters used on board ships of 360 grt or more which must have a radio-telephone station on board, shall additionally be capable of transmitting Q code abbreviation "QSW 2182". | |
| | | Conducted spurious emission in the 150 kHz to 30 MHz frequency band. | National specifications of the "VDE Regulations of the German Electrotechnical Commission within the DIN (DEK)". |

# Annex VI

# Environmental tests for maritime radio equipment

*Note:*
Text approved by the "Telecommunications" Commission at Brussels (1980).

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## 1. SCOPE OF THE SPECIFICATIONS

These specifications constitute the minimum requirements for tests on maritime radio equipment designed to simulate the environment in which the equipment is intended to operate.

Some paragraphs apply only to equipment which will be exposed to the climatic conditions. The paragraphs under which tests are to be carried out on the type of equipment concerned are indicated in the appropriate specifications.

## 2. PROCEDURE FOR TESTS

### 2.1. Order of tests

The tests specified in the appropriate paragraphs shall normally be conducted in the order shown in these specifications. The Administration may, however, conduct the tests in a different order. In addition, the Administration may, if it thinks fit, decide not to conduct a test contained in the specifications, if sufficient assurance is provided that the corresponding requirements of the specifications are met.

### 2.2. Connection to the power supply

Unless otherwise stated, the equipment shall be connected to an electrical power source only during the periods for which it specified that electrical tests shall be conducted.

### 2.3. Power supply voltage

The voltage applied to the equipment during the operating test shall be the voltage specified for use in this test in the appropriate specifications. If the appropriate specifications do not indicate a particular voltage, the normal test voltage shall be applied.

## 3. VERIFICATION OF PERFORMANCE

For the purpose of these specifications, the expression "verification of performance" shall be taken to mean electrical tests and operating tests designed to verify that the equipment meets certain requirements of the appropriate operating specifications, within the permitted degradation relative to those requirements.

## 4. VIBRATION

4.1. When fitted with all the damping devices with which it may be provided, the equipment shall be fixed on the vibrating table in its normal operating position.

The equipment may be suspended in order to take up a weight which the vibrating table would be unable to support. In this case, a note stating the precise test conditions shall be included in the test report.

In addition, measures shall be taken to reduce or eliminate any harmful effect on the operation of the equipment which might be caused by the presence of an electromagnetic field produced by the vibrating unit.

4.2. The equipment shall first be vibrated vertically for 15 minutes in the 1 Hz to 12.5 Hz frequency range with an amplitude between peaks of 3.2 mm, under the conditions specified in paragraph 4.5.

4.3. The equipment shall then be vibrated vertically for 15 minutes in the 12.5 Hz to 25 Hz frequency range with an amplitude between peaks of 0.76 mm, under the conditions specified in paragraph 4.5.

4.4. Finally, the equipment shall be vibrated vertically for 15 minutes in the 25 Hz to 50 Hz frequency range with an amplitude between peaks of 0.2 mm, under the conditions specified in paragraph 4.5.

4.5. The frequency variation shall not exceed 1 octave per minute.

4.6. During all the vibration tests, the equipment shall be switched on and verification of performance tests shall be carried out.

4.7. Where warranted, for example in the case of portable equipment, equipment mounted on a mast or equipment specifically intended to be fixed to a bulkhead, the vibration test shall be repeated with vibrations in two directions on the horizontal plane, perpendicular to each other.

4.8. As far as possible, the equipment shall be inspected during the test and if a marked resonance is noticed in any part, the part shall be examined.

4.9. After concluding the vibration tests, the equipment shall be inspected for any mechanical deterioration and verification of performance tests shall be carried out.

## 5. DRY-HEAT CYCLE

### 5.1. Equipment exposed to the climatic conditions

5.1.1. The purpose of this test is to simulate the situation where the equipment is switched on after being kept in circumstances where it is exposed to the climatic conditions.

5.1.2. The equipment shall be placed in a chamber in which the temperature is increased to 70° C (± 3° C) and kept at that level for at least 10 hours.

During this time, the equipment shall not be switched on.

5.1.3. The chamber shall be cooled to +55° C (± 3° C) and the equipment shall be switched on and remain continuously operational for two hours at this ambient temperature.

If the equipment being tested is or includes a transmitter, the transmitter shall be operated at the power level and with the type of modulation specified for this test in the appropriate operating specifications.[1])

5.1.4. A verification of performance test as specified in clauses relating to the appropriate operating specifications shall be carried out at the same ambient temperature of +55° C (± 3° C).

5.1.5. At the end of the test, the equipment shall be placed under the normal room temperature for at least 3 hours before commencing any damp-heat cycle test.

### 5.2. Sheltered equipment

5.2.1. The purpose of this test is to simulate the situation where the equipment usually operates under shelter.

5.2.2. The equipment shall be placed in a chamber kept at a constant temperature of +55° C (± 3° C) where its temperature shall stabilise at that value. The equipment shall not be switched on.

5.2.3. The equipment shall then be switched on and shall operate continuously at the same temperature of +55° C (± 3° C) for two hours. If the equipment being tested is or includes a transmitter, the transmitter shall be operated at the power level and with the type of modulation specified for this test in the appropriate operating specifications.[1])

A verification of performance test as specified in clauses relating to the relevant operating specifications shall be carried out at the same ambient temperature of +55° C (± 3° C).

5.2.4. At the end of the test, the equipment shall be placed under the normal room temperature for at least 3 hours before commencing any damp-heat cycle test.

[1]) Some possible examples of these conditions are given in the Appendix.

## 6. DAMP-HEAT CYCLE

6.1. The equipment shall be placed in a chamber in which the temperature shall be increased gradually over a period of 3 ± 0.5 hours from the room temperature to a temperature of 40 °C (± 3 °C) with the relative humidity being increased during this period to 93% ± 2% so that condensation is produced on the equipment. The test chamber shall then be kept at this temperature and relative humidity for at least 10 hours. At the end of this period there shall be a verification of performance test lasting for at least 30 minutes. The ventilators or any heat source fitted in the equipment may be switched on during the last 60 minutes of the damp-heat cycle, i.e. 30 minutes before the start of the verification of performance test.

6.2. With the equipment still in the chamber, the temperature in the chamber shall then be reduced to room temperature within no less than one hour.

The equipment shall then be exposed to the normal room temperature and humidity for 3 hours or until the humidity disappears, whichever is the longer, before the low-temperature cycle.

## 7. LOW-TEMPERATURE CYCLE

### 7.1. Equipment exposed to climatic conditions

7.1.1. The purpose of this test is to simulate the situation where the equipment is switched on after being kept in circumstances where it has been exposed to the climatic conditions.

7.1.2. The equipment shall be placed in a chamber in which the temperature is reduced to −25 °C (± 3 °C) and kept at that value for at least 10 hours. The temperature shall then be increased to −15 °C (± 3 °C) and kept at that value for at least 2 hours.

7.1.3. A verification of performance test as specified in clauses relating to the appropriate operating specifications shall be carried out during the last 30 minutes of the test. Any heat source for the equipment may be switched on during the operating test.

### 7.2. Sheltered equipment

7.2.1. The purpose of this test is to simulate the situation where the equipment usually operates under shelter.

7.2.2. The equipment shall be placed in a chamber in which the temperature is reduced to −15 °C (± 3 °C) and kept at that value for at least 10 hours. The equipment shall not be switched on.

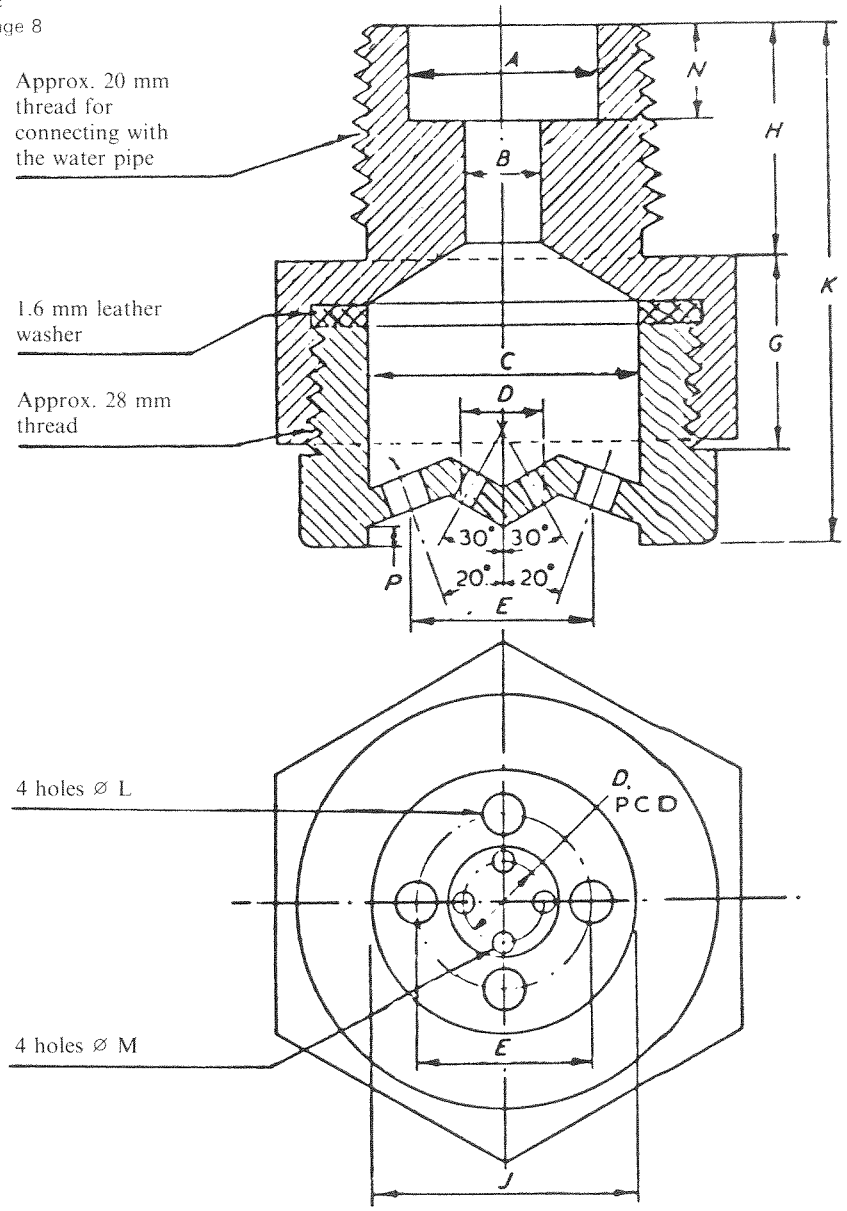
7.2.3. A verification of performance test, as specified in the clauses relating to the appropriate operating specifications, shall be carried out during the last 30 minutes of the test. The equipment shall then be exposed to the normal room temperature for at least 3 hours before other tests are conducted.

## 8. RAIN TEST

### 8.1. Test device

For this test, 8 shower heads as shown in Figure VI-1 (T/R 34-01) shall be used. The jets on 4 of the shower heads shall be directed downwards at an angle of 45° towards each of the top four corners of the equipment. The jets on the other four shower heads shall be directed horizontally at the most vulnerable parts on each side of the equipment.

The shower heads shall be positioned at a distance of 500 mm to 750 mm away from the equipment.




| Ref. | A | B | C | D | E | G | H | J | K | L | M | N | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 13·5 | 3·7 | 19·0 | 5·6 | 12·7 | 13·5 | 15·9 | 19 | 35·7 | 2·3 | 1·6 | 6·35 | 1·6 |

Spraing angle approx. 35°

Figure VI-1 (T/R 34-01). Dimensions of the spraying head.

Soft water at room temperature shall be used. The rate of flow shall be 450 ± 50 litres per hour for each shower head.

*Note.*
The rate of flow and the dimensions of the shower head produce an inlet pressure of 200 ± 30 kN/m² (2 ± 0.3 bar).

8.2. **Duration of the test and position of the equipment**

The equipment shall be subjected to the test described in paragraph 8.1. for one hour, being placed so that:
a) its control panel is in its normal position, and
b) its control panel is at the highest point if this position is not the normal position.

A verification of performance test shall be carried out immediately after the test but not during the spraying.

9. **IMMERSION TEST**

The equipment shall be immersed in water, the surface of which shall be at least 10 cm above the highest point of the equipment; it shall be kept immersed for one hour. When it is removed from the water, a verification of performance test shall be carried out. Finally, the equipment shall be inspected for water penetration.

10. **CORROSION TESTS**

10.1. **General**

The authority conducting the tests may, if it thinks fit, disregard the requirements for the corrosion tests if the manufacturer is able to certify that the equipment will not suffer any deterioration in its materials or components which might prevent the equipment from displaying satisfactory characteristics and operation.

10.2. **Salt water**

10.2.1. The equipment shall be placed in a chamber equipped with an appliance capable of spraying a fine mist, as produced by an atomiser, of a saline solution corresponding to the following formula:

| | |
|---|---|
| sodium chloride | 26.5 grammes |
| magnesium chloride | 2.5 grammes |
| magnesium sulphate | 3.3 grammes |
| calcium chloride | 1.1 gramme |
| potassium chloride | 0.73 gramme |
| sodium bicarbonate | 0.20 gramme |
| sodium bromide | 0.28 gramme |

Plus distilled water to make up the solution to 1 litre.

A tolerance of ± 10% is permitted for the quantity of each salt.

10.2.2. The atomising device shall be devised so that the corrosion products do not mix with the saline solution in the spray container. The equipment shall be sprayed with the saline solution on all its external surfaces simultaneously for one hour, after which it shall be kept in continuous operation for at least 30 minutes. The spraying operation shall be carried out four times, with a storage period of 7 days at +40° C (± 2° C) after each spraying. The relative humidity during storage shall be between 90 and 95%.

10.2.3. At the end of the complete sequence, the equipment shall be subjected to a visual inspection. There shall be no deterioration or corrosion of the metal parts, the finish, materials or components which might prevent the equipment from displaying satisfactory operation and characteristics. The equipment shall then be subjected to a verification of performance test. In the case of hermetically sealed equipment the cover(s) shall be opened and there shall be no detectable water penetration.

10.2.4. If the authority conducting the tests thinks fit, the salt water corrosion test may be carried out only on parts of the equipment or samples of the materials which are considered necessary.

10.3. **Battery leakage**

10.3.1. Equipment containing accumulator batteries shall be tested under the following conditions. The batteries shall be fully charged before being inserted into the equipment. If the installation is such as to enable the battery to be charged without removing it from the equipment, the battery shall be charged continuously at the maximum permissible rate for a period of 24 hours. The equipment shall then be stored for 4 weeks at a temperature of +40° C (± 2° C) and a relative humidity of between 90 and 95%.

10.3.2. At the end of this sequence of tests, the equipment shall be subjected to a visual inspection. There shall be no deterioration or corrosion of the metal parts, the finish, materials or components which might prevent the equipment from displaying satisfactory operation and characteristics. The equipment shall then be subjected to a verification of performance test either with the same batteries or with recently charged batteries.

## 11. MOULD CULTURE TEST

11.1. The authority conducting the tests may, if it thinks fit, disregard the requirements for the mould culture tests, if the manufacturer is able to certify that the equipment is no likely to allow harmful mould cultures to develop.

11.2. Both the external and the internal materials and finish of the equipment shall be subjected to this test. The equipment shall be contaminated by spraying it with fungal spores in an aqueous suspension containing all the following cultures:

Aspergillus niger
Aspergillus terreus
Aureobasidum pullulans
Paecilomyces varioti
Penicillium funiculosum
Penicillium ochrochloron
Scopulariopsis brevicaulis
Trichoderma viride

11.3. The equipment shall then be placed in a mould culture chamber in which the temperature shall be kept at 29° C (± 1° C) with a relative humidity of no less than 95%. The incubation period shall be 28 days, after which no harmful mould growth shall be visible to the naked eye. The equipment shall then be subjected to a verification of performance test.

11.4. If the authority conducting the tests thinks fit, the mould culture test may be carried out only on parts of the equipment or samples of the materials which are considered necessary.

## Appendix to Annex VI

## SOME EXAMPLES OF STANDARD OPERATING CONDITIONS FOR THE TRANSMITTER DURING THE DRY-HEAT TESTS

| Class of emission | Modulation |
|---|---|
| A1A-A2A-H2A | 30 bauds with an off/on ratio of 1:1 |
| F1A | 100 bauds with an off/on ratio of 1:1 |
| A3E-H3E | 50% with 1 audio-frequency |
| J3E | At 6 dB below rated $P_p$ |
| G3E | With one audio-frequency |

# Annex VII

# Technical specifications for main receivers in the maritime mobile service

*Note:*
Text approved by the "Telecommunications" Commission at Vienna (1982), amended at Nice (1985).

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# 1. INTRODUCTION

These specifications set out the minimum characteristics required for a ship's main receiver capable of receiving single-sideband (SSB) and double-sideband (DSB) radiotelegraphy and radiotelephony.

The characteristics take into account the provisions of the Radio Regulations and the International Convention for the Safety of Life at Sea (1974).

# 2. GENERAL CONDITIONS

## 2.1. Construction

2.1.1. The mechanical and electrical construction and finish of the equipment shall conform in all respects with good engineering practice and the equipment shall be suitable for use on board ships at sea.

2.1.2. All controls shall be of sufficient size to enable the usual control functions to be performed and the number of controls shall be the minimum necessary for satisfactory operation.

2.1.3. All controls, instruments, monitoring devices and input/output points shall be clearly labelled. Details concerning the kind of power source to be used for the equipment shall be clearly indicated. A label indicating the type under which the equipment is being submitted for the type approval tests shall be affixed to the equipment so as to be clearly visible in the normal operating position.

2.1.4. All parts of the equipment which are subject to inspection or maintenance operations shall be readily accessible. The components shall be readily identifiable either from markings inside the equipment or from the technical description.

2.1.5. Full technical documentation shall be supplied with the equipment.

## 2.2. Controls

2.2.1. Whatever the frequency on which the receiver is operating, it shall be capable of operating on any other frequency within no more than 15 seconds.

2.2.2. Measures shall be taken to suppress the loudspeaker in the case of reception by headset.

2.2.3. If there is a device for reducing the effects of impulsive noise, it shall be possible to turn off the device by means of a switch.

2.2.4. Where the receiver is designed to operate in association with a transmitter, the transmission and reception frequencies shall be capable of being selected independently.

2.2.5. Where an associated telegraph transmitter is operating in the same frequency band, it shall be possible to reduce the receiver sensitivity by at least 30 dB. Within less than 50 ms after an "on-keyed" condition ends, the receiver shall have regained its initial sensitivity.

2.2.6. When duplex is used, measures shall be taken to prevent harmful electrical or acoustic feedback which might produce a build-up of oscillations.

2.2.7. The receiver shall be capable of covering the following bandwidths:

- wideband
- SSB (upper sideband)
- intermediate
- narrow.

For these bandwidths, reference should be made to paragraphs 5.5.3. and 5.6.3. and to Appendix A.

## 2.3. Safety precautions

2.3.1. Measures shall be taken to protect the equipment against the effects of excess current or voltage (e.g. by means of fuses, circuit-breakers, etc.).

2.3.2. Measures shall be taken to prevent damage to the equipment if the power source produces transient voltage variations, and to prevent any damage that might arise from an accidental reversal of polarity at the power source.

2.3.3. Means shall be available of earthing the accessible parts of the equipment, but this shall not result in any terminal of the electrical power source being earthed.

2.3.4. All components and wiring in which the DC or AC voltage (other than radio-frequency voltage) produce, singly or in combination, a peak voltage in excess of 50 volts, shall be protected against any access and shall automatically be isolated from all electrical power sources if the protective covers are removed. Alternatively, the equipment shall be constructed in such a way as to prevent access to components operating at such voltages unless an appropriate tool is used such as a nut-spanner or screwdriver. Conspicuous warning labels shall be affixed both inside the equipment and on the protective covers.

2.3.5. The information in any memory system shall be preserved for at least ten seconds in the event of any power cut.

2.4. **Frequency ranges and classes of emission**

2.4.1. The receiver shall permit reception by headset or loudspeaker in the frequency ranges and classes of emission specified below:

| | | |
|---|---|---|
| 160 kHz - 535 kHz | A1A: | Double-sideband telegraphy for aural reception without the use of audio modulation; |
| | A2A: | Double-sideband telegraphy for aural reception with on-off keying of a modulated carrier; |
| | H2A: | Single-sideband, full carrier for aural reception with on-off keying of a modulated carrier; |
| | A3E: | Double-sideband telephony. |
| 535 kHz - 28 MHz | The above-mentioned classes of emission, plus: | |
| | H3E: | Single-sideband telephony, full carrier; |
| | J3E: | Single sideband telephony, suppressed carrier. |

The limits imposed by these specifications only have to be observed in the bands and sub-bands allocated by the Radio Regulations to the maritime mobile service, unless stated otherwise.

2.4.2. If there are devices for receiving frequency-modulated telegraph transmissions (F1B), they shall meet the requirements of Annex ... to this Recommendation. This Annex is under discussion.

2.4.3. The tuning frequency shall be indicated on the receiver and designated by the carrier frequency.

2.4.4. In the case of single-sideband transmissions, the receiver shall receive the upper sideband.

2.5. **Tuning methods**

The receiver shall be capable of being tuned in the specified frequency ranges by one of the methods below:

2.5.1. Step-by-step tuning using a synthesizer. Where the minimum synthesizer step is greater than 10 Hz, continuous tuning covering each step shall be possible. The means of controlling step-by-step tuning shall be such as to enable the receiver tuning to be varied over a frequency range without having to display each frequency one by one.

2.5.2. Continuous tuning in the appropriate bands covering all the specified ranges.

## 3. TEST CONDITIONS, POWER SUPPLY AND AMBIENT TEMPERATURES

### 3.1. Normal and extreme test conditions

Type approval tests shall be made under normal test conditions and also, where stated, under extreme conditions. The test conditions and procedures are described in paragraphs 3.2. to 3.5. below.

### 3.2. Test power source

During type approval tests, the equipment's power supply shall be replaced by a test power source capable of producing normal and extreme test voltages as specified in paragraphs 3.3.2. and 3.4.2.

The internal impedance of the test power source shall be low enough to have only a negligible effect on the test results. For the purpose of the tests, the supply voltage shall be measured at the input terminals of the equipment. If the equipment has a permanently connected power supply cable, the test voltage shall be measured at the point where the cable connects with the equipment. During the tests, the power source voltages shall not differ by more than ±3% from the voltage level at the beginning of each test.

### 3.3. Normal test conditions

3.3.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be fixed by any convenient combination of temperature and humidity within the following limits:

— temperature +15 C to +35 C

— relative humidity 20% to 75%.

*Note.* When it is impracticable to carry out the tests under the conditions specified above, a note stating the actual temperature and relative humidity during the tests shall be added to the test report.

3.3.2. *Normal test power supply*

3.3.2.1. Mains voltage and frequency

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of these specifications, the nominal mains voltage shall be the declared voltage or any of the declared voltages for which the equipement is indicated as having been designed.

The frequency of the test power source used instead of the AC mains shall be 50 Hz ±1 Hz.

3.3.2.2. Power source from a battery

Where the equipment is designed to operate from a battery, the normal test voltage shall be the nominal voltage of the battery (6 volts, 12 volts, etc.).

3.3.2.3. Other power sources

For operation from other power sources, the normal test voltage shall be fixed by agreement between the equipment manufacturer and the authority conducting the tests.

### 3.4. Extreme test conditions

3.4.1. *Extreme temperatures*

For tests at extreme temperatures, measurements shall be made in accordance with the methods defined in paragraph 3.5.; the lower temperature shall be 0 C and the upper temperature +40 C.

3.4.2. *Extreme test power supply values*

3.4.2.1. Mains voltage and frequency

The extreme test voltages for equipment to be connected to the AC mains shall be the nominal mains voltage ±10%.

The frequency of the test power source shall be 50 Hz ±1 Hz.

3.4.2.2. Power source from an accumulator battery

Where the equipment is designed to operate from an accumulator battery, the extreme test voltages shall be 1.3 or 0.9 times the nominal voltage of the battery (6 volts, 12 volts, etc.).

3.4.2.3. Other power sources

For operation from other power sources, the extreme test voltages shall be fixed by agreement between the equipment manufacturer and the authority conducting the tests.

3.5. **Procedure for tests at extreme temperatures**

Before measurements are made, the equipment shall have reached thermal equilibrium in the test chamber. The equipment shall be switched off during the temperature stabilizing period. The sequence of measurements shall be chosen and the humidity content in the test chamber shall be controlled so that excessive condensation does not occur.

3.6. **Environmental tests**

Before commencing the environmental tests, the equipment shall be tested under the other conditions required in these specifications, except the test for vibration-induced frequency modulation mentioned in paragraph 5.1.6., which shall be carried out during the vibration tests. Where electrical tests are required, they shall be carried out at the normal test voltage.

Where the expression "verification of characteristics" is used, this shall be taken to mean a visual inspection and simple, functional electrical tests to demonstrate that the equipment is in working order and that there is no visible damage or deterioration.

The results of verifications of characteristics shall be included in the test report.

The following tests shall be conducted under the environmental conditions specified in Annex VI to this Recommendation "Environmental tests for maritime radio equipment":

- Vibration, paragraph 4.
- Dry-heat cycle, paragraph 5.2.
- Damp-heat cycle, paragraph 6.
- Low-temperature cycle, paragraph 7.2.
- Corrosion test, paragraphs 10.1. and 10.2.

3.7. **Warm-up time**

3.7.1. The equipment shall be capable of operating in accordance with the requirements of these specifications one minute after being switched on, except in cases covered by paragraph 3.7.2.

3.7.2. If the equipment contains parts which need heating up in order to operate suitably, e.g. crystal ovens, a warm-up time of 30 minutes from the moment at which power is supplied to such parts shall be allowed, after which the requirements of these specifications shall be met.

3.7.3. Where paragraph 3.7.2. applies, the power supply for the heating circuits shall be devised to be capable of remaining connected when the other power sources connected to the equipment or the other internal power sources are switched off. If the equipment is provided with a special switch, the switch's function shall be clearly indicated and the instructions for use shall specify that these circuits should normally be left connected to the power supply. A visual indication that the power supply is connected to such circuits shall be provided on the front panel.

## 4. GENERAL MEASUREMENT CONDITIONS

### 4.1. Impedance of the test signal sources

4.1.1. For the purpose of the type approval tests, the receiver shall meet the requirements of these specifications when connected in accordance with paragraphs 4.1.2. and 4.1.3. This does not in any way imply that the receiver should only operate satisfactorily with antennas whose impedances have these characteristics.

4.1.2. The test signal shall be supplied by a source with an internal resistance of 50 ohms, except in the cases specified in paragraph 4.1.3.

4.1.3. At the request of the manufacturer and with the approval or at the instigation of the authority conducting the tests, an artificial antenna comprising a resistance of 10 ohms in series with a 250 pF capacitor may be used on frequencies lower than 4 MHz.

### 4.2. Test signals applied to the receiver input

4.2.1. Sources of test signals to be applied to the receiver input shall be connected via a network such that the impedance presented to the receiver input is equal to the impedance of the artificial antennas defined in paragraphs 4.1.2. and 4.1.3. respectively.

This requirement shall be met, irrespective of whether one or more test signals are applied to the receiver simultaneously. If there are two or more test signals, precautions shall be taken to prevent any undesirable effect resulting from an interaction between the signals in the generators or from other sources.

4.2.2. The levels of the test signals at the input shall be expressed in terms of the e.m.f. at the output terminals of the source including the associated networks mentioned in paragraph 4.2.1.

4.2.3. *Normal test signals*

Unless stated otherwise, the normal radio-frequency test signals applied to the receiver input shall be as follows:

4.2.3.1. Class of emission A1A

Unmodulated signal at the same frequency as the carrier frequency.

4.2.3.2. Classes of emission A2A/H2A and A3E/H3E

Double-sideband signal modulated at the 800 Hz frequency with a modulation factor of 30%.

4.2.3.3. Class of emission J3E

Unmodulated 1,000 Hz signal, ± 3 Hz above the carrier frequency to which the receiver is tuned.

### 4.3. Receiver output

4.3.1. The output power shall be measured in a resistance equal or very close to the modulus of impedance of the headset or loudspeaker, as the case may be.

4.3.2. The normal output power used in these specifications shall be measured at a frequency of 1,000 Hz or 800 Hz and shall be as follows:

a) for reception by headset: 1 mW;
b) for reception by loudspeaker: 50 mW.

The receiver shall be capable of providing an output power of 500 mW in the loudspeaker with a harmonic level not exceeding 10%.

### 4.4. Selection of test frequencies and receiver setting

The tests shall be made on one or more frequencies in each of the bands allocated to the maritime mobile service, including the 500 kHz, 2,182 kHz and 8,364 kHz frequencies.

## 5. ELECTRICAL CHARACTERISTICS

### 5.1. Tuning error and tuning drift

5.1.1. *Definitions*

The tuning error is the difference between the frequency indicated on the receiver and the carrier frequency of a signal applied to the receiver input which the receiver is designed to receive.

Drift is the tuning variation over a period of time without re-setting the receiver.

5.1.2. *Method of measuring the tuning error*

Measurements shall be made in the J3E mode of operation. A radio-frequency test signal representing the nominal carrier frequency plus 1,000 Hz shall be applied to the receiver input, the precision of the test signal frequency being ± 3 Hz. With the speech clarifier (if there is one) being set in the middle of the range which it covers, the receiver shall be adjusted so that the corresponding carrier frequency is read on the receiver frequency indicator. The frequency at the output shall then be measured and the difference between 1,000 Hz and the frequency measured at the output shall be determined. For receivers with step-by-step tuning using a synthesizer, this value shall be noted as being the tuning error.

For receivers with continuous tuning, the test shall be repeated after actuating the control sufficiently to re-engage the mechanism, after which the control shall be re-set to the nominal value of the carrier frequency selected, moving in the opposite direction to that used for the first measurement.

This operation shall be repeated a number of times, the tuning error of the receiver being determined by taking the mean square value of all the results thus obtained.

If a method of calibration is provided by the manufacturer, it may be applied once for each frequency band in which the receiver is to operate. Measurements shall be made at a sufficient number of frequencies to determine the tuning error in all the frequency ranges for which the receiver is designed. Measurements shall be made under normal test conditions and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

5.1.3. *Limits imposed on the tuning error*

For step-by-step tuning, the tuning error shall not exceed 50 Hz.

For continuous tuning, the tuning error shall not exceed 150 Hz.

5.1.4. *Method of measuring the tuning drift*

Measurements shall be made in the J3E mode of operation. For receivers with continuous tuning, a test signal at an appropriate frequency shall be applied and tuned so that the frequency of the signal at the output is 1,000 Hz. For receivers with step-by-step tuning, an unmodulated radio-frequency test signal representing the nominal frequency plus 1,000 Hz shall be applied to the receiver input, the precision of the test signal frequency being ± 3 Hz. The receiver speech clarifier shall be set in a position close to the middle of the range which it covers. The frequency at the input shall be kept constant and the frequency at the output shall then be measured at appropriate intervals, the results being used to determine the tuning drift.

During these measurements the ambient temperature shall be kept constant (± 3° C). Measurements shall be made under normal test conditions (paragraph 3.3.) and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

5.1.5. *Limits imposed for tuning drift*

During any 15-minute period subsequent to the warm-up time defined in paragraph 3.7., the difference between the frequency at the output at any one time and the frequency at the output at the start of the 15-minute period shall not exceed 20 Hz.

5.1.6. *Vibration-induced frequency modulation*

5.1.6.1. Definition

Vibration-induced frequency modulation is the frequency deviation which may be produced at the output when the fully-fitted receiver is subjected to vibrations in a specified range of frequencies and amplitudes.

5.1.6.2. Method of measurement

The receiver fitted complete with its protective covers and dampers (if provided) shall be placed in its normal operating position on a vibrating table. The receiver shall then be switched on, put in the reception mode for the J3E class of emission and, after the warm-up time allowed by paragraph 3.7., a radio-frequency test signal as described in paragraph 4.2.3.3. shall be applied to the receiver input at a level of +60 dB relative to 1 μV. The receiver shall be set for the normal output level at 1 kHz. The table shall be vibrated as described in the specifications for environmental tests (Annex VI to this Recommendation). Any frequency deviation of the output signal during this test shall be measured, using an appropriate discriminator. In the course of the test, care shall be taken to avoid measurement errors that might arise from tuning drift.

5.1.6.3. Limit imposed

The peak frequency deviation shall not exceed ± 20 Hz.

5.2. **Beat-frequency oscillator**

A beat-frequency oscillator is an oscillator whose function is to enable an audible tone to be produced on receiving signals in the A1A class of emission.

5.2.1. *Method of measurement*

5.2.1.1. Frequency drift

A test signal of +30 dB relative to 1 μV as described in paragraph 4.2.3.1. shall be applied to the receiver input. The frequency of the signal at the output shall be adjusted to 800 Hz by means of the beat-frequency oscillator.

The frequency at the output shall be measured at appropriate intervals.

5.2.1.2. Frequency range

An unmodulated radio-frequency signal at any level between +30 dB and +100 dB relative to 1 μV shall be applied to the receiver input. The frequency of the signal at the input shall be the frequency to which the receiver is tuned. The beat-frequency oscillator shall be varied within the range it covers and the output signal shall be measured.

5.2.2. *Limits imposed*

5.2.2.1. In any 15-minute period subsequent to the warm-up time specified in paragraph 3.7., the frequency of the beat-frequency oscillator shall not vary by more than ± 100 Hz in the case of tests carried out in accordance with paragraph 5.2.1.1.

5.2.2.2. When tests are carried out in accordance with paragraph 5.2.1.2., it shall be possible to obtain a beat note up to 1.400 Hz each side of the zero-beat setting.

5.3. **Speech clarifier for reception in the J3E class of emission**

The receiver tuning system shall enable the frequency error to be reduced to 5 Hz or less. This may be achieved by means of a fine-tuning control or speech clarifier.

The fine-tuning or clarifier control movement and the range covered shall be sufficient to permit easy adjustment.

The frequency range of the fine tuner or speech clarifier shall be no less than ± 150 Hz and no more than ± 500 Hz.

5.4. **Audio-frequency passband**

5.4.1. *Definition*

The audio-frequency passband measured at the receiver output is the frequency band within which the attenuation relative to the peak response does not exceed 6 dB.

5.4.2. *Method of measurement*

A test signal modulated at 1,000 Hz with a modulation factor of 30% shall be applied to the receiver input at a level of +60 dB relative to 1 μV and the receiver shall be set for the normal output power.

The modulation frequency shall then be varied while maintaining a constant modulation factor of 30%, and the output level corresponding to each modulation frequency shall be measured.

For this test, the wide band shall be used.

5.4.3. *Limits*

The audio-frequency passband shall be larger than 350 Hz to 2,700 Hz. The attenuation relative to the peak response shall be no less than 20 dB at 6 kHz.

5.5. **Maximum usable sensitivity**

5.5.1. *Definition*

The maximum usable sensitivity is the minimum level of a radio-frequency input signal with the modulation specified, which produces at the receiver output a chosen value of the signal-noise-distortion to noise ratio (SND/N) or the signal-noise-distortion to noise-distortion ratio (SND/ND) and, at the same time, an output power no lower than the normal power.

5.5.2. *Methods of measurement*

With the automatic gain control operative, the tests shall be carried out with the receiver being adjusted through each frequency range and in each class of emission for which it is designed. The test signals applied to the receiver shall be the normal test signals specified in paragraph 4.2.3.

For each test, the input level of the test signal shall be set to produce the SND/N or SND/ND ratio specified in paragraph 5.5.3. at the receiver output and, at the same time, at least the normal output power. The input level measured is the maximum usable sensitivity.

5.5.3. *Limits imposed*

The maximum usable sensitivity shall be better than the values shown in the Table below:

| Frequency range | Bandwidth (class of emission) | 50-ohm source of test signals (paragraph 4.1.2.) | | 10-ohm/250 pF source of test signals (paragraph 4.1.3.) | |
|---|---|---|---|---|---|
| | | SND/N or SND/ND dB | Max. level of input signal dB/1μV | SND/N or SND/ND dB/1 | Max. level of input signal dBμV |
| 160-535 kHz | Narrow (A1A) | 20 | +10 | 10 | +20 |
| | Intermediate (A2A) | 20 | +30 | 10 | +30 |
| 1,605-4,000 kHz | Wide (A3E) | 20 | +30 | 20 | +30 |
| | SSB (J3E) | 20 | +16 | 20 | +16 |
| 4-28 MHz | Narrow (A1A) | 20 | + 5 | | |
| | Wide (A3E) | 20 | +25 | | |
| | SSB (J3E) | 20 | +11 | | |

## 5.6. Adjacent channel signal selectivity

### 5.6.1. *Definition*

The adjacent channel signal selectivity is defined as being the receiver's ability to discriminate between the wanted signal (to which the receiver is tuned) and unwanted signals (on frequencies generally outside the passband), with the wanted signal and the unwanted signals acting simultaneously. For the purpose of these specifications, the adjacent channel signal selectivity is defined as the ratio at the receiver input of the level of a specified unwanted signal to the level of a specified wanted signal, which corresponds to a reduction in the SND N or SND ND ratio from 20 dB to 14 dB.

### 5.6.2. *Method of measurement*

The arrangement used for applying two test signals to the receiver input shall conform to paragraph 4.2.1. The automatic gain control shall be switched on. The test signals shall conform to the following Table:

| Filter | Class of emission | Modulation of the wanted signal | Modulation of the unwanted signal |
|---|---|---|---|
| Single sideband | J3E/R3E | Paragraph 4.2.3.3. | 30% at 400 Hz |
| Wide | A3E/H3E | 30% at 1,000 Hz | 30% at 400 Hz |
| Intermediate | A2A/H2A | 30% at 400 Hz | 30% at 1,000 Hz |
| Narrow | A1A | Paragraph 4.2.3.1.* | 30% at 400 Hz |

* The beat-frequency oscillator is set to produce a 1,000 Hz audio-frequency tone.

The receiver shall be set for normal output power on the wanted frequency, so as to produce a SND/N or SND/ND ratio of 20 dB.

The level of the unwanted signal shall be increased (from a low level) until the SND/N or SND/ND ratio falls from 20 dB to 14 dB.

### 5.6.3. *Limits imposed*

The adjacent channel signal-selectivity shall exceed the values shown in Tables VII-5.6.3.a (T/R 34-01), VII-5.6.3.b (T/R 34-01), VII-5.6.3.c (T/R 34-01) and VII-5.6.3.d (T/R 34-01).

| Separation between the carrier frequency of the unwanted signal and the carrier frequency of the wanted signal | Adjacent channel signal selectivity |
|---|---|
| −1 kHz and +4 kHz | 40 dB |
| −2 kHz and +5 kHz | 50 dB |
| −5 kHz and +8 kHz | 60 dB |

Table VII-5.6.3.a (T/R 34-01). Filter for single sideband.

| Separation between the carrier frequency of the unwanted signal and the carrier frequency of the wanted signal | Adjacent channel signal selectivity |
|---|---|
| −10 kHz and +10 kHz | 40 dB |
| −20 kHz and +20 kHz | 50 dB |

Table VII-5.6.3.b (T/R 34-01). Wide band.

| Separation between the carrier frequency of the unwanted signal and the carrier frequency of the wanted signal | Adjacent channel signal selectivity |
|---|---|
| −5.5 kHz and +5.5 kHz | 40 dB |
| −7.5 kHz and +7.5 kHz | 50 dB |

Table VII-5.6.3.c (T/R 34-01). Intermediate band

| Separation between the carrier frequency of the unwanted signal and the carrier frequency of the wanted signal | Adjacent channel signal selectivity |
|---|---|
| −1.75 kHz and +1.75 kHz<br>−2.5 kHz and +2.5 kHz | 40 dB<br>50 dB |

Table VII-5.6.3.d (T/R 34-01). Narrow band.

5.7. **Two-signal selectivity tests (blocking and cross-modulation)**

5.7.1. *Definitions*

Blocking is a change (generally a reduction) in the wanted-signal output power of a receiver or a reduction of the SND/ND ratio due to an unwanted signal on another frequency.

Cross-modulation is the carrying over to the wanted signal of the modulation of a modulated unwanted signal transmitted on another frequency.

5.7.2. *Methods of measurement*

5.7.2.1. The tests shall be conducted with the automatic gain control switched on, the RF/IF gain control at maximum and any input attenuator set to minimum attenuation. The measurements shall be made while applying two test signals simultaneously to the receiver input. One of the test signals shall be the wanted signal to which the receiver is tuned, the other being the unwanted signal.

5.7.2.2. The measurements shall be made with the level of the wanted input signal at +60 dB relative to 1 μV. The blocking measurement shall be repeated with the wanted signal at a level equal to the maximum usable sensitivity of the receiver.

5.7.2.3. The wanted signal at the receiver input shall be the normal test signal specified in paragraph 4.2.3.

5.7.2.4. The receiver shall be set so that application of the wanted signal produces normal power at the output.

5.7.2.5. For tests above 1,605 kHz, the unwanted signal shall be at a frequency ±20 kHz away from the wanted signal frequency.

5.7.2.6. For tests on reception in classes A1A, A2A, H2A, A3E and H3E on frequencies below 1,605 kHz, the unwanted signal shall be at a frequency ±10 kHz away from the wanted signal frequency.

5.7.2.7. For the blocking tests, the unwanted signal shall be unmodulated. The input level of the unwanted signal shall be adjusted to produce a 3 dB change in the output level of the wanted signal or a 6 dB reduction of the SND/N ratio, whichever occurs first. The input level of the unwanted signal when this prerequisite is met, defines the blocking level.

In making the above measurements, precautions should be taken to prevent the results from being appreciably affected by output-signal components caused by distortion.

5.7.2.8. For the cross-modulation tests, the unwanted signal shall be modulated by 400 Hz with a modulation factor of 30%. The input level of the unwanted signal shall be increased until the total power of the unwanted signal at the receiver output as a result of cross-modulation is 30 dB below the level of the wanted signal. When this prerequisite is met, the input level of the unwanted signal defines the cross-modulation level.

5.7.3. *Limits imposed*

5.7.3.1. Blocking

(a) With the level of the wanted signal at +60 dB relative to 1 μV, the level of the unwanted signal shall be no less than +100 dB relative to 1 μV.

(b) With the level of the wanted signal equal to the maximum usable sensitivity, the level of the unwanted signal shall be at least 65 dB above the level of the maximum usable sensitivity.

5.7.3.2. For cross-modulation, the level of the unwanted signal shall be no less than +90 dB relative to 1 μV.

5.8. **Intermodulation**

5.8.1. *Definition*

Intermodulation is a process whereby signals result from the simultaneous application of two or more (generally unwanted) signals to a non-linear circuit.

5.8.2. *Method of measurement*

5.8.2.1. Class of emission J3E

With the automatic gain control (AGC) switched on, the RF IF gain control at maximum and any input attenuator set to minimum attenuation, an unmodulated input signal at a frequency 1,000 Hz above the tuning frequency of the receiver shall be applied to the receiver input at a level of +30 dB relative to 1 µV, with the audio-frequency gain control set so as to produce normal output power.

The wanted signal shall then be suppressed and two equal-level unmodulated signals shall be applied simultaneously to the receiver input. Neither of the two signals shall be at a frequency less than 30 kHz away from the wanted signal frequency. (The receiver input frequencies which are likely to produce harmful intermodulation products are contained in CCIR Recommendation 332-4, paragraph 6.4.) In selecting the frequencies used for these measurements, care shall be taken to avoid those on which spurious responses are produced. The input levels of the two signals in combination shall remain equal and shall be adjusted so that the receiver output power resulting from the combined signals is equal to the normal output power. If the above input levels cannot be determined precisely from the "output level input level" characteristic, it shall simply be ascertained that the AGC operating conditions are the same as when the wanted signal was applied, using the AGC voltage, for example, as a reference.

5.8.2.2. Classes of emission A2A or H2A

The method of measurement shall be the same as for the J3E class of emission, with two exceptions:

a) The wanted test signal shall be a signal on the carrier frequency, modulated at 1,000 Hz with a modulation factor of 30%.

b) Of the two unwanted signals, the one furthest away from the wanted signal frequency shall be modulated at 1,000 Hz with a modulation factor of 30%. The other unwanted signal shall not be modulated.

5.8.3. *Limits imposed*

The level of each of the two signals which combine to produce the normal output power shall be no less than +80 dB relative to 1 µV.

5.9 **Spurious response selectivity**

5.9.1 *Definition*

The spurious response protection ratio is the ratio of the input level of the unwanted signal on the spurious response frequency to the input level of the wanted signal when the wanted and unwanted signals each separately produce the same SND/N or SND/ND ratio at the receiver output.

5.9.2. *Method of measurement*

The receiver shall be set as provided in paragraph 5.5. (sensitivity test). The position of the receiver controls shall remain unchanged throughout the course of the test. The carrier frequency of the input signal shall then be varied in order to find the spurious responses. Whenever a spurious response is obtained, the carrier frequency of the input signal shall be adjusted so as to provide maximum power at the output. The input level shall then be adjusted so as to produce a SND/N or SND/ND ratio of 20 dB at the receiver output. The ratio between the input level of each spurious signal and the input level of the wanted signal producing the same SND/N or SND/ND ratio shall then be determined.

5.9.3. *Limits imposed*

The spurious response protection ratio on the intermediate frequency, image frequency and any other frequencies of spurious responses shall be no less than 70 dB.

5.10. **Harmonic output level**

5.10.1. *Definition*

The harmonic level at a receiver output is the total r.m.s. voltage of all the harmonic components of the modulation frequency which are produced at the receiver output as a result of non-linearity effects in the receiver. For this test, the harmonic level is expressed as a percentage of the total r.m.s. voltage obtained at the output when a single sinusoidal modulation signal is applied.

5.10.2. *Methods of measurement*

This test shall be conducted for both single-sideband and double-sideband reception at both the rated output power (as stated by the manufacturer and agreed by the authority conducting the tests) and the normal output power.

For the single-sideband tests, the test signal defined in paragraph 4.2.3.3. shall be applied to the receiver input. For the double-sideband tests, the test signal shall be modulated at 1,000 Hz with a modulation factor of 30% and then of 80% (using the wide band). The level of the input signal shall be varied between +30 dB and +80 dB relative to 1 μV, with the output level being kept at the normal power value, then at the rated output power. The harmonic level shall then be measured.

5.10.3. *Limits specified*

The harmonic level shall not exceed 10% at the rated output power and 5% at the normal output power.

5.11. **Audio-frequency intermodulation**

5.11.1. *Definition*

Audio-frequency intermodulation is a process whereby signals are produced from two or more wanted signals simultaneously present in the demodulator or audio-frequency amplifier of a receiver. It is expressed as the ratio of the level of each of the intermodulation components to the level of one of the two equal-amplitude test signals.

5.11.2. *Method of measurement*

This test shall be conducted in SSB.

With the automatic gain control operative, the manual high- and intermediate-frequency gain controls, if any, at maximum and any input attenuator set to minimum attenuation, an unmodulated signal at a frequency 1,100 Hz above the tuning frequency of the receiver shall be applied to the receiver input at a level of +60 dB relative to 1 μV. A second unmodulated signal at a frequency 1,700 Hz above the tuning frequency of the receiver shall also be applied and its level adjusted so that the 1,100 Hz and 1,700 Hz audio-frequency signals at the receiver output have an equal amplitude.

The total output power of the receiver shall be adjusted to its normal value (paragraph 4.3.2.) by means of the audio-frequency gain control.

The audio-frequency intermodulation shall then be measured.

5.11.3. *Limit imposed*

No intermodulation component shall exceed −25 dB relative to the output level of one of the two wanted signals.

5.12. **Spurious emissions**

5.12.1. *Definition*

Spurious emissions are radio-frequency emissions of any kind which are produced in the receiver and radiated, whether conveyed to the antenna or other conductors linked to the receiver, or whether radiated directly by the receiver.

5.12.2. *Methods of measurement*

Spurious emissions radiated by the antenna shall be measured by connecting a 50-ohm resistance and searching for signals produced at the resistance terminals. The measurements shall extend over a range from 9 kHz to 2 GHz.

5.12.2.a. Where tests on the receiver have been made using the artificial antenna described in paragraph 4.1.3., a network comprising a 10-ohm resistance in series with a 250 pF capacitance shall be used instead of the 50-ohm resistance mentioned above.

5.12.3. *Limit imposed*

The power of any discrete component measured in the artificial antenna shall not exceed 1 nanowatt ($1 \times 10^{-9}$ watt).

5.13. **Spurious signals originating internally**

Spurious signals originating internally shall not produce, at the receiver output, an audio power more than 10 dB (with the bandwidth corresponding to the single sideband) above the intrinsic sound level of the receiver, measured with the antenna connected. No internal spurious signal shall be produced on any of the distress frequencies or in their associated guard bands.

5.14. **Gain control**

5.14.1. *Manual and automatic gain control*

The receiver shall be provided with a manual audio-frequency gain control and a manual radio-frequency and/or intermediate-frequency gain control. An automatic gain control (AGC) capable of operating satisfactorily with signals in the classes of emission and frequency ranges specified in paragraph 2.4.1. shall be fitted in the receiver. This control shall be capable of being switched off.

5.14.2. *Tests and limits imposed*

5.14.2.1. For the purpose of verifying the characteristics of the manual RF/IF control, tests shall be made with the automatic gain control switched off and the receiver adjusted within each frequency range for which it is designed.

The input signal shall be the appropriate normal test signal specified in paragraph 4.2.3.

For each test, the level of the input signal shall be equal to the maximum usable sensitivity, measured in accordance with paragraph 5.5., and the output power shall be set to the normal output power value. The input level shall be increased by 20 dB and the output power reduced to the normal output power value by means of the manual RF/IF control.

The SND/N or SND/ND ratio shall then increase by at least 15 dB.

5.14.2.2. For the purpose of verifying the characteristics of the automatic gain control, tests shall be made with the receiver being adjusted within each band of the maritime mobile service. The input signal shall be the appropriate normal test signal specified in paragraph 4.2.3.

For each test, the level of the input signal shall be equal to the maximum usable sensitivity, measured in accordance with paragraph 5.5. The input level shall then be increased by 20 dB. The SND/N or SND/ND ratio shall then increase by at least 15 dB.

When making the above measurements, precautions shall be taken so that the components from distortion in the output signal do not appreciably affect the results.

5.14.2.3. Once the test conditions specified in paragraph 5.14.2.2. have been fulfilled, the receiver shall be adjusted to provide an output level 10 dB below the normal output power. The input level shall then be increased by 70 dB. The resulting increase in output power shall not exceed 10 dB.

5.14.3. *Time constant of the AGC (forward and reverse action time)*

5.14.3.1. Definitions

AGC forward action time: the time which elapses between the moment when the level of the input signal is suddenly increased by a specified quantity and the moment when the output signal attains a new state of equilibrium and stays there to within 2 dB.

AGC reverse action time: the time which elapses between the moment when the input signal suddenly decreases by a specified quantity and the moment when the output signal attains a new state of equilibrium and stays there to within 2 dB.

5.14.3.2. Method of measurement

A test signal (see paragraph 4.2.3.3.) shall be applied to the receiver input in the J3E mode of operation via an attenuator comprising a 30 dB single-step switch. The corresponding audio-frequency output signal shall be shown on an oscilloscope.

The input level shall be adjusted to produce a SND/N or SND/ND output signal of 20 dB and the output level shall be adjusted to 10 dB below the normal output power. The attenuator shall then be switched so that the level of the input signal increases by 30 dB. The forward action time shall then be measured. The attenuator shall then be switched so that the input signal returns to its initial value. The reverse action time shall then be measured. The above method shall be repeated with the receiver in the A1A mode using the narrow bandwidth and the test signal mentioned in paragraph 4.2.3.1.

5.14.3.3. Limits imposed

For the slow AGC (J3E mode):
Forward action times: not exceeding 10 ms.
Reverse action time: 1-4 s.

For the fast AGC (A1A mode):
Forward action time: not exceeding 10 ms.
Reverse action time: 0.2-0.5 s.

5.15. **Protection of input circuits**

The receiver shall not suffer any damage when an unmodulated radio-frequency test signal representing the carrier is applied to the receiver input at a level of 30 r.m.s. volts for a period of 15 minutes under the conditions described in paragraph 4.2. on any frequency in the range for which the receiver is designed. The receiver shall operate normally without having to be re-set, after the test signal has been suppressed.

In order to provide protection against damage due to electrostatic voltage which may occur at the receiver input, the resistance to the direct current between the antenna terminal and the casing shall not exceed 100 kΩ.

## Appendix A to Annex VII

This Table is provided as a guide for choosing the selectivities required for the various bandwidths.

| Designation of bandwidth | Frequency separation relative to the carrier (kHz) | | | |
|---|---|---|---|---|
| | SSB | Wide | Intermediate | Narow |
| Minimum passband −6 dB | +0.35 to +2.7 | −2.7 to +2.7 | −1 to +1 | −0.25 to +0.25 |
| Minimum attenuation 20 dB | +3.2 | −6<br>+6 | | |
| Minimum attenuation 30 dB | | | −3.5<br>+3.5 | −1<br>+1 |
| Minimum attenuation 40 dB | −0.25<br>+3.5 | | | |
| Minimum attenuation 60 dB | −0.5<br>+3.8 | −10<br>+10 | −10<br>+10 | −2<br>+2 |

# Annex VIII

# Technical specifications for the maritime main transmitter

*Note:*
Text approved by the "Telecommunications" Commission at Cannes (1983), amended at Nice (1985).

Table of contents

# 1. INTRODUCTION

These specifications set out the minimum characteristics required for a ship's main transmitter. These characteristics incorporate the provisions of the Radio Regulations and the International Convention for the Safety of Life at Sea (1974), regulations 9 and 10.

# 2. GENERAL SPECIFICATIONS

## 2.1. Construction

2.1.1. The mechanical and electrical construction and finish of the equipment shall conform in all respects with good engineering practice and the equipment shall be suitable for use on board ships at sea.

2.1.2. All controls shall be of sufficient size to enable the usual control functions to be easily performed and the number of controls shall be the minimum necessary for simple and satisfactory operation.

2.1.3. All controls, instruments, monitoring devices and input-output points shall be clearly labelled. A label indicating the type of equipment submitted for the type approval tests shall be affixed to the equipment so as to be clearly visible in the normal operating position. Details concerning the power source to be used for the equipment shall also be clearly indicated.

2.1.4. All parts of the equipment to be checked during inspection or maintenance operations shall be readily accessible.

2.1.5 The components shall be readily identifiable either from markings on the equipment or from its technical description.

2.1.6. A full technical description shall be provided with the equipment.

## 2.2. Controls

2.2.1. Whatever the frequency on which the transmitter is operating, it shall be capable of being made ready to operate on any other frequency for which it is equipped within no more than 15 seconds.

2.2.2. All the settings and controls necessary for switching the transmitter from operation on any frequency to operation on 500 kHz shall be clearly identified and their number shall be the minimum.

2.2.3. It shall be possible to reduce the carrier output power of the transmitter to a value not exceeding 25 W, either continuously or in steps of less than 6 dB.

## 2.3. Safety precautions

2.3.1. Measures shall be taken to protect the equipment against the effects of overcurrent or overvoltage and against an excessive temperature increase in any part of the equipment (e.g. fuses, circuit-breakers, etc.).

2.3.2. Measures shall be taken to prevent damage to the equipment if the power source produces transient voltage variations, and to prevent any damage that might arise from an accidental reversal of polarity at the power source.

2.3.3. Measures shall be taken to ensure that the casing of the equipment is earthed, but this shall not result in any terminal of the electrical power source being earthed.

2.3.4. All components and wiring in which the DC or AC voltage (other than radio-frequency voltage) produce, singly or in combination, a peak voltage in excess of 50 volts, shall be protected against any accidental access and shall automatically be isolated from all electrical power sources if the protective covers are removed. Alternatively, the equipment shall be constructed in such a way as to prevent access to components operating at such voltages unless an appropriate tool is used such as a nut-spanner or screwdriver. Conspicuous warning labels shall be affixed both inside the equipment and on the protective covers.

2.3.5. When operating in the "on-keyed" condition at maximum power, the transmitter shall not be damaged as a result of the antenna terminals being placed on open circuit or closed circuit for a least 5 minutes.

2.3.6. If, after switching on, it is necessary to delay the power supply to any part of the transmitter, this shall be done automatically.

2.4. **Operating precautions**

2.4.1. The information in any device whose action affects the carrier frequency or the mode of operation shall be preserved in the event of power cuts of up to 10 seconds. If an interruption of longer than 10 seconds causes a frequency variation in excess of the limit permitted in paragraph 5.1.3. or a change in the mode of operation, the operator shall be alerted by a clear warning.

2.4.2. Transmission shall not be possible until the frequency has stabilised within the limits imposed.

2.5. **Frequency range and classes of emission**

2.5.1. The transmitter shall be capable of operating on at least seven frequencies, including 500 kHz, 410 kHz and 512 kHz, in the 405 kHz to 535 kHz band.

2.5.2. The frequencies shall be designated by the value of the carrier which shall be indicated on the transmitter.

2.5.3. The transmitter shall be capable of operating in the A1A, A2A or H2A classes of emission.

2.5.4. Instructions prescribing the A2A or H2A classes of emission for distress and safety traffic on 500 kHz shall be clearly affixed to the transmitter.

If the A2A or H2A classes of emission on 500 kHz are selected automatically, it shall be possible to override this automatic device manually.

2.5.5. For the A2A and H2A classes of emission, transmission shall be effected by on-off keying of the modulated carrier.

2.5.6. For the H2A class of emission, the upper sideband shall be used.

2.5.7. If transmission is possible in other frequency bands or other classes of emission, the appropriate CEPT Recommendation shall be complied with.

2.6. **Keying**

2.6.1. It shall be possible to key the transmitter manually and by means of an automatic keying device.

2.6.2. The transmitter shall incorporate an automatic radiotelegraph alarm transmitter operating on 500 kHz or shall enable such a device to be used.

The controls and means employed to operate such an automatic keying device shall be simple and easy to use.

2.6.3. The radiotelephone alarm transmitter shall meet the requirements of Annex V to this Recommendation.

2.7. **"Inter-sign" listening**

Means shall be provided for enabling the sensitivity of an associated receiver to be reduced when the transmitter is in the "on-keyed" condition in order to permit a distant operator to intervene if necessary.

This shall be effective at transmission rates of up to 20 bauds.

2.8. **Measurement of the antenna current**

The transmitter shall incorporate a measuring device which gives a reading of the current in the antenna with a better than 10% accuracy at 500 kHz. The current in the antenna shall not be affected by any fault in this device.

2.9. **Power supply**

The equipment shall be capable of operating from a ship's principal electrical power source.

## 3. TEST CONDITIONS–POWER SUPPLY AND AMBIENT TEMPERATURES

3.1. **Normal and extreme test conditions**

Type approval tests shall be made under normal test conditions and also, where specified, under extreme conditions. The test conditions and procedures are described in paragraphs 3.2. to 3.5. below.

3.2. **Test power source**

During type approval tests, the equipment's power supply shall be replaced by a test power source capable of producing normal and extreme voltages as specified in paragraphs 3.3.2. and 3.4.2. The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the purposes of the tests, the power source voltage shall be measured at the input terminals of the equipment. If the equipment has a permanently connected power supply cable, the test voltage shall be measured at the point where the cable connects with the equipment. During the tests, the test voltages shall be maintained within a tolerance of ±3% relative to the voltage level at the beginning of each test.

3.3. **Normal test conditions**

3.3.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be fixed by any convenient combination of temperature and humidity within the following limits:

- temperature +15 °C to +35 °C,
- relative humidity 20% to 75%.

*Note.* When it is impracticable to carry out the tests under the conditions specified above, a note stating the actual temperature and relative humidity during the tests shall be added to the test report.

3.3.2. *Normal test power supply*

The normal test voltage shall be the nominal mains voltage. For the purpose of these specifications, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment is indicated as having been designed.

The frequency of the test power source shall be 50 Hz ±1 Hz.

3.4. **Extreme test conditions**

3.4.1. *Extreme temperatures*

For tests at extreme temperatures, measurements shall be made in accordance with the procedures described in paragraph 3.5.; the lower and upper temperatures shall be 0 °C and +40 °C.

3.4.2. *Extreme test power supply values*

The extreme test voltages shall be the nominal mains voltage ±10%.

The frequency of the test power source shall be 50 Hz ±1 Hz.

3.5. **Procedure for tests at extreme temperatures**

Before starting the tests, the equipment shall have reached thermal equilibrium in the test chamber.

The equipment shall be switched off during the temperature stabilising period, except in cases covered by the provisions of paragraph 3.7.2.

For tests at the upper temperature, the equipment shall be modulated at its maximum power and keyed at a rate of 30 bauds for half an hour with an on/off ratio of 1:1; the equipment shall meet the specifications both during and after this period.

For tests at the lower temperature, the equipment shall be placed on standby for one minute, after which the equipment shall conform to the specifications.

The sequence of tests shall be chosen and the humidity in the test chamber shall be monitored so that excessive condensation does not occur.

3.6. **Environmental tests**

Before starting the environmental tests, the equipment shall be tested for the other technical requirements of these specifications.

Where electrical tests are required, they shall be carried out at the normal test voltage.

Where the expression "verification of characteristics" is used, this shall mean a visual examination and simple, electrical and functional tests to check that the equipment is in working order and that there is no visible damage or deterioration. Particular attention shall be paid to the output power (paragraph 5.2.) and the frequency error (paragraph 5.1.).

The results of verifications of characteristics shall be included in the test report.

The following tests shall be conducted under the environmental conditions described in detail in Annex VI to this Recommendation, namely:

- Vibration, paragraph 4.
- Dry-heat cycle, paragraph 5.2.
- Damp-heat cycle, paragraph 6.
- Low-temperature cycle, paragraph 7.2.
- Corrosion tests, paragraphs 10.1. and 10.2.

During tests where the transmitter is keyed, it shall operate at maximum power with a keying rate of 30 bauds and an on/off ratio of 1:1.

3.7. **Warm-up time**

3.7.1. The equipment shall be capable of operating in accordance with the requirements of these specifications within one minute after being switched on, except in cases covered by paragraph 3.7.2.

3.7.2. If the equipment contains parts which have to be heated in order to operate correctly, e.g. crystal ovens, a warm-up time of 30 minutes from the moment when the equipment is switched on shall be observed, after which the requirements of these specifications shall be met.

3.7.3. Where paragraph 3.7.2. applies, the power supply for the heating circuits shall be designed to be capable of remaining switched on when the other internal or external power sources for the equipment are switched off. If the equipment is provided with a special switch for these circuits, the function of this switch shall be clearly indicated and the instructions for use shall specify that the circuits in question should normally be left connected to the power source. A visual indication that the power supply is connected to circuits of this type shall be provided on the front.

## 4. GENERAL MEASUREMENT CONDITIONS

4.1. **Artificial antenna**

For the purpose of the tests, the transmitter shall meet the requirements of these specifications when it is connected to an artificial antenna comprising a 3-ohm non-inductive resistance in series with a capacitance of 400 pF and, where specified, with other artificial antennae comprising a 2-ohm non-inductive resistance in series with a 750 pF capacitance and a 5-ohm non-inductive resistance in series with a 300 pF capacitance.

This does not in any way imply that the transmitter should only operate correctly with antennae possessing these characteristics.

4.2. **Channels used for the tests**

The type approval tests shall, where necessary, be carried out on the channels with the highest and lowest frequencies in the frequency band covered by the equipment (405-535 kHz) and at 500 kHz.

## 5. TRANSMITTER

5.1. **Frequency error**

5.1.1. *Definition*

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

5.1.2. *Method of measurement*

The carrier frequency shall be measured in the absence of modulation (NON), with the transmitter connected to an artificial antenna (paragraph 4.1.). Measurements shall be made under normal test conditions (paragraph 3.3.) and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

5.1.3. *Limit*

The frequency error shall not exceed ± 100 Hz.

5.2. **Modulation**

5.2.1. The transmitter shall be connected to an artificial antenna (paragraph 4.1.) and keyed at a rate of 30 bauds at its maximum output power in an A2A or H2A class of emission.

5.2.2. The modulation depth shall be between 70% and 95% for all keying rates up to 30 bauds.

5.2.3. The modulation frequency shall be in the 450 Hz - 800 Hz range.

5.3. **Output power**

5.3.1. *Definition*

The output power is the mean power in continuous "on-keyed" condition, measured in the artificial antennae defined in paragraph 4.1.

5.3.2. *Method of measurement*

The transmitter shall be connected to each of the artificial antennae (paragraph 4.1.) and the power delivered to the artificial antenna shall be measured in all the classes of emission.

The measurements shall be made under normal test conditions (paragraph 3.3.) and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

5.3.3. *Limit*

With the power switch at maximum, the output power shall exceed 100 W.

5.4. **Necessary bandwidth and out-of-band spectrum**

5.4.1. *Definitions*

5.4.1.1. Necessary bandwidth: For a given class of emission, the width of the frequency band which is just sufficient to ensure transmission of the information at the rate and with the quality required by the specifications.

5.4.1.2. Out-of-band spectrum: The part of the power spectrum of a transmission which is outside the necessary bandwidth, not including spurious emissions.

5.4.2. *Method of measurement*

The necessary bandwidth and the out-of-band spectrum shall be measured when the transmitter is being keyed at a rate of 30 bauds at its maximum power. The transmitter shall be connected to the artificial antennae (paragraph 4.1.).

The measurements shall be made in all the classes of emission for which the transmitter is designed.

5.4.3. *Limits*

5.4.3.1. A1A class of emission

The necessary bandwidth shall not exceed 200 Hz.

The out-of-band spectrum shall be within the curve shown in Figure VIII-1 (T/R 34-01). The 0 dB level corresponds to the carrier level in continuous transmission.

5.4.3.2. A2A class of emission

The necessary bandwidth shall not exceed 1,750 Hz.

The out-of-band spectrum shall be within the curve shown in Figure VIII-2 (T/R 34-01).

5.4.3.3. H2A class of emission

The necessary bandwidth shall not exceed 950 Hz.

The out-of-band spectrum shall be within the curve shown in Figure VIII-3 (T/R 34-01).

The 0 dB level corresponds to the peak envelope power level.

5.5. **Spurious emissions**

5.5.1. *Definition*

Spurious emissions: emission on one or more frequencies outside the necessary bandwidth whose level can be reduced without affecting the transmission of the corresponding information.

5.5.2. *Method of measurements*

Spurious emissions shall be measured by connecting the transmitter to the artificial antennae (paragraph 4.1.) in continuous "on-keyed" condition with the output power at maximum.

Measurements shall be made in the 9 kHz to 1 GHz frequency range.

5.5.3. *Limit*

The output power of any spurious emission shall be at least 40 dB below the carrier power, without exceeding 50 milliwatts.

5.6. **Noise and hum**

5.6.1. *Definition*

The noise and hum power is the output power other than the power of the carrier or of any modulation used for the test, produced by the transmitter in the continuous "on-keyed" condition.

5.6.2. *Method of measurement*

With the transmitter adjusted to operate in the A1A, A2A or H2A classes of emission, and in the contiuous "on-keyed" condition, the amplitude of all the emissions in the bands specified below shall be measured using a spectrum analyser, a tunable wave analyser or any other appropriate means.

| Class of emission | Frequency band (Hz) relative to carrier frequency |
|---|---|
| A1A | ± 100 |
| A2A | ± 1,500 |
| H2A | − 200 to + 1,500 |

5.6.3. *Limit*

The output power of any noise and hum shall be at least 40 dB less than the carrier power.

5.7. **Continuous operation**

With the transmitter set at maximum output power, it shall be capable of operating without significant power reduction or any harmful effects under the conditions specified below:

— transmission for one hour at rates of up to 30 bauds,

— transmission for 15 minutes in the continuous "on-keyed" condition.

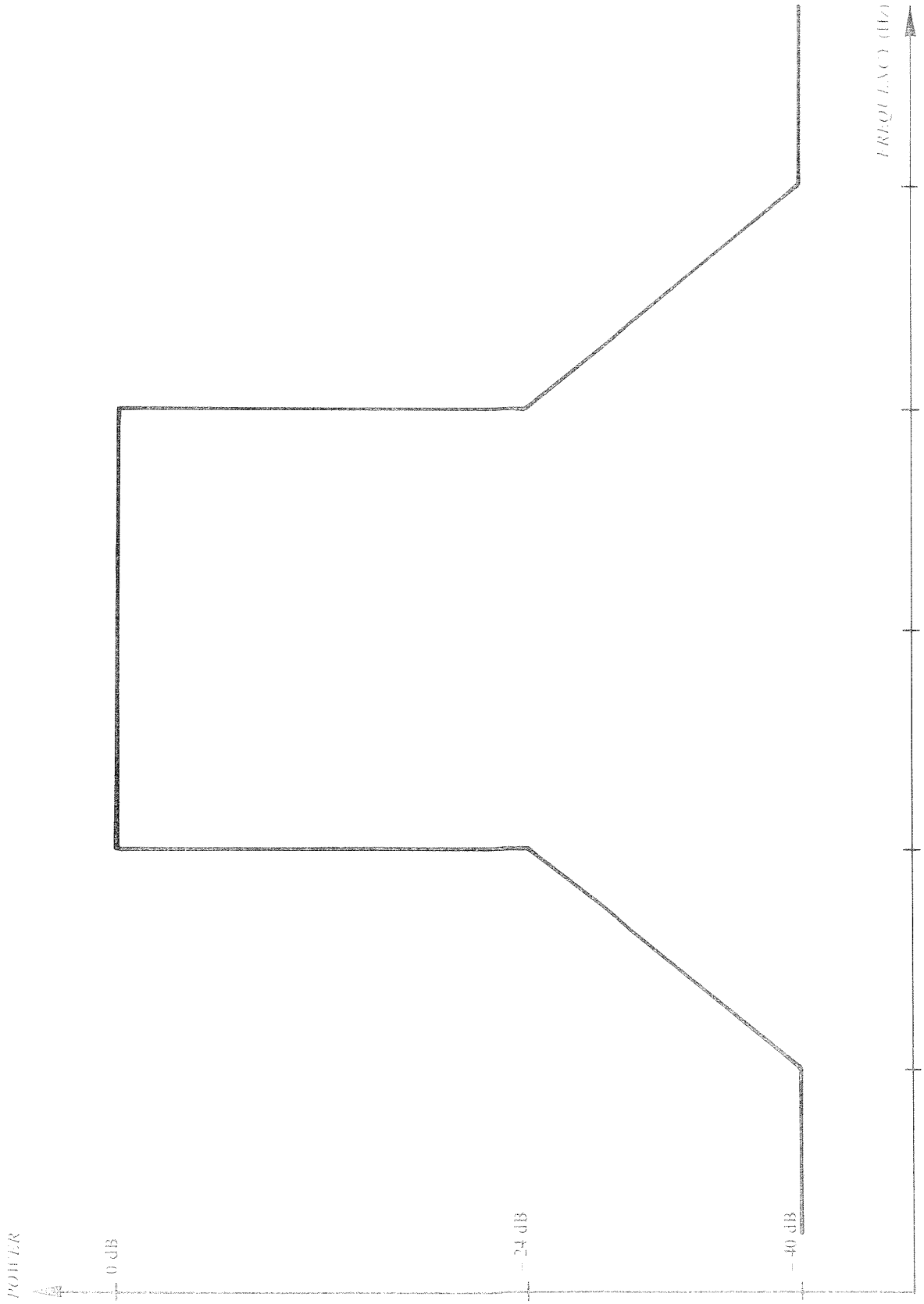


Figure VIII-1 (T/R 34-01). Bandwidth A1A.

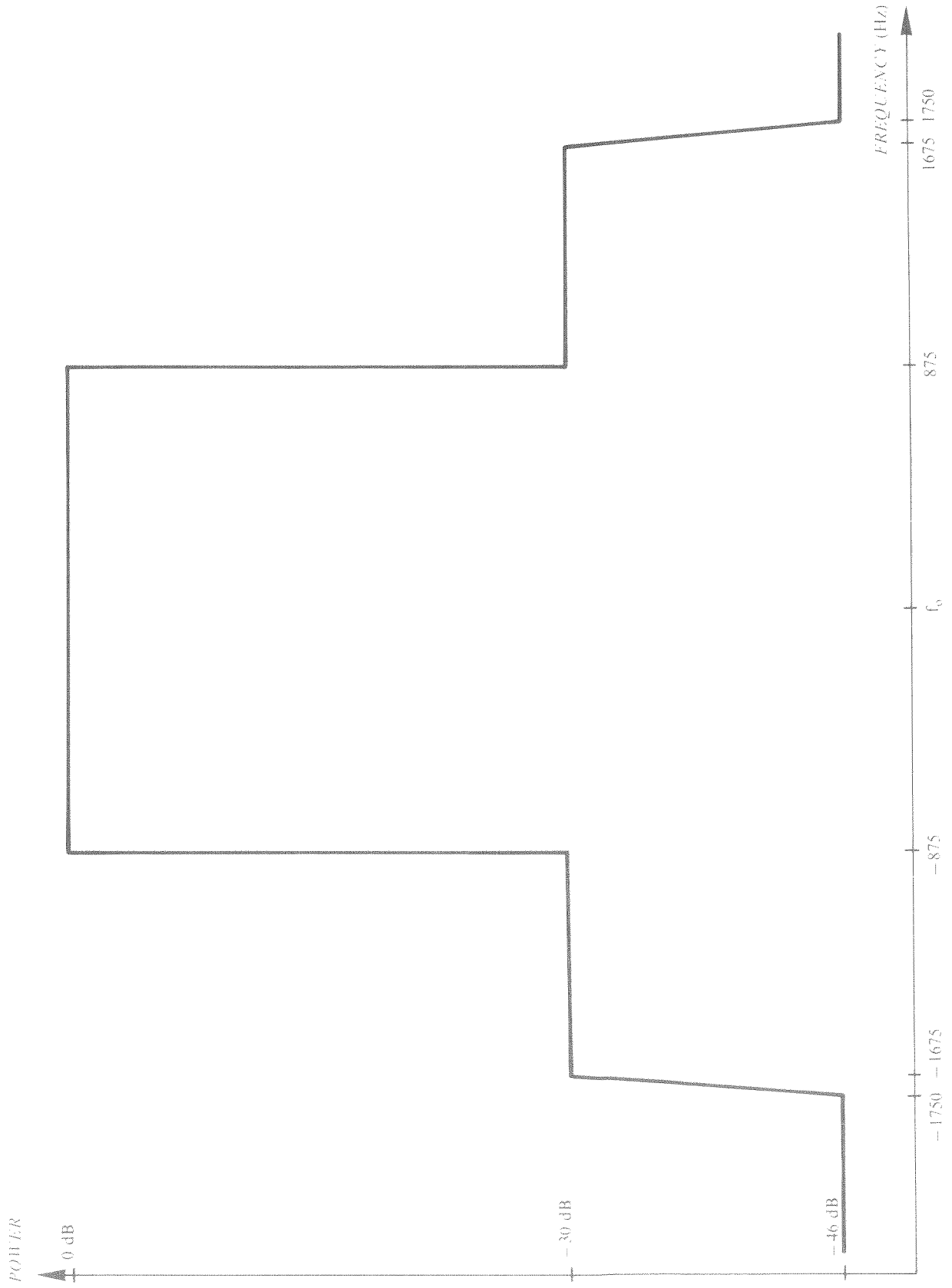


Figure VIII-2 (T/R 34-01). Bandwidth A2A.

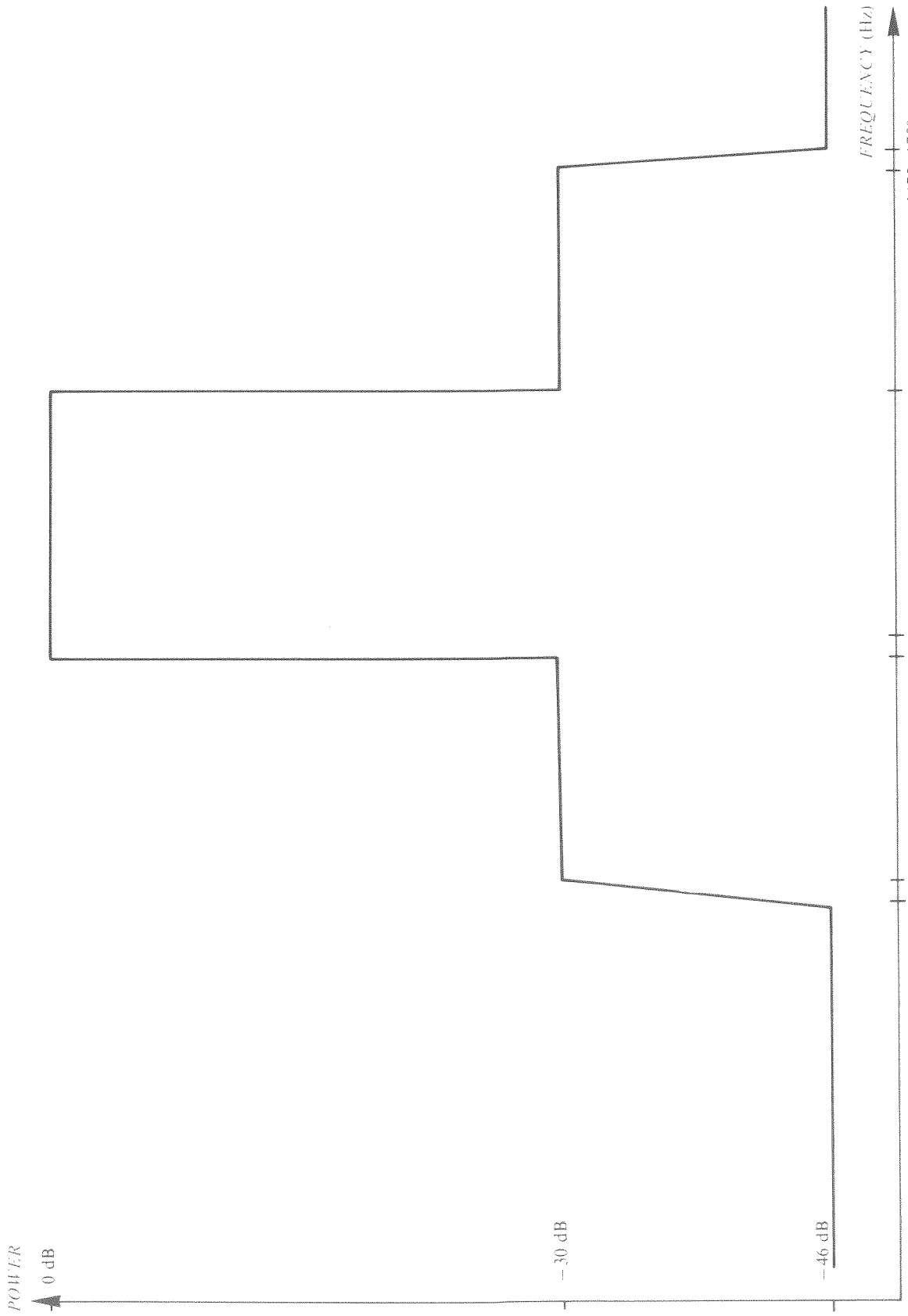


Figure VIII-3 (T/R 34-01). Bandwidth H2A.

# Annex IX

# Technical specifications for the radiotelegraph automatic alarm receiver

*Note:*
Text approved by the "Telecommunications" Commission at Cannes (1983).

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# 1. INTRODUCTION

These specifications relate to the nominal requirements for a radiotelegraph automatic alarm receiver operating on the distress frequency 500 kHz on board merchant ships, including any power source or converter necessary for its operation. The purpose of the equipment is to produce an audible alarm on reception of the radiotelegraph alarm signal. The radiotelegraph alarm signal consists of a series of 12 dashes sent in one minute, the duration of each dash being four seconds and the interval between two consecutive dashes being one second.

The equipment shall comprise:

- Receiver
- Selector
- Means for activating an audible alarm system
- Test device

# 2. GENERAL CONDITIONS

## 2.1. Construction

2.1.1. The mechanical and electrical construction and finish of the equipment shall conform in all respects with good engineering practice and the equipment shall be suitable for use on board ships at sea.

2.1.2. All controls shall be of sufficient size to enable the usual control functions to be performed easily and the number of controls should be the minimum necessary for simple and satisfactory operation.

2.1.3. All controls, instruments, monitoring devices and input output points shall be clearly labelled. A label indicating the type of equipment submitted for the type approval tests shall be affixed to the equipment so as to be clearly visible in the normal operating position. Details concerning the power source to be used with the equipment shall also be clearly indicated.

2.1.4. All parts of the equipment to be checked during inspection or maintenance operations shall be readily accessible.

2.1.5. A full technical description shall be provided with the equipment.

2.1.6. The components shall be readily identifiable either by being marked inside the equipment or from the technical description.

## 2.2. Controls

2.2.1. Means shall be provided for connecting a headset to listen to the signals received by the radiotelegraph auto-alarm.

2.2.2. The following controls shall be on the outside of the equipment:

2.2.2.1. – On/off switch with a visual indication that the equipment is switched on. This switch shall turn on the power source which operates the audible alarms and at the same time activates the equipment (see paragraph 7.).
– An additional visual indication to provide a warning if there is no power for the alarm circuit.

2.2.2.2. The volume control to regulate the audio-frequency output power. This control shall operate only during reception by headset or loudspeaker for surveillance purposes, and shall not affect the characteristics of the selector (see paragraph 6.).

2.2.2.3. Means for suppressing any loudspeaker where reception is on headset.

2.2.2.4. A single switch to stop the alarm and reactivate the selector after registering an alarm signal, with a visual indication to show whether the alarm is due to a fault in the equipment or to reception of the radiotelegraph alarm signal (see paragraph 7.).

2.2.2.5. There shall be no other switch for suppressing the audible alarms once they have been triggered.

2.2.2.6. A non-lockable switch for disconnecting two of the audible alarms for test purposes, while leaving the third alarm in operation (see paragraph 7.).

2.2.2.7. A non-lockable switch for applying a test alarm signal (see paragraph 8.).

2.2.3. The controls, if any, for adjusting the tuning, the gain (except as required in paragraph 2.2.2.2.) and the timing of the selector shall be pre-set and not accessible from outside the equipment.

2.2.4. Connecting or disconnecting the headset or loudspeaker, if any, shall not affect the characteristics of the automatic alarm.

2.3. **Safety precautions**

2.3.1. Measures shall be taken to protect the equipment against the effects of overcurrent or overvoltage and against an excessive temperature increase in any part of the equipment (e.g. fuses, circuit-breakers, etc.).

2.3.2. Measures shall be taken to prevent damage to the equipment if the power source produces transient voltage variations, and to prevent any damage that might arise from an accidental reversal of polarity at the power source.

2.3.3. Measures shall be taken to ensure that the casing of the equipment is earthed, but this shall not result in any terminal of the electrical power source being earthed.

2.3.4. All components and wiring, in which the DC or AC voltage (other than radio-frequency voltage) produce, singly or in combination, a peak voltage in excess of 50 volts, shall be protected against any accidental access and shall automatically be isolated from all electrical power sources if the protective covers are removed. Alternatively, the equipment shall be constructed in such a way as to prevent access to components operating at such voltages unless an appropriate tool is used such as a nut-spanner or screwdriver. Conspicuous warning labels shall be affixed both inside the equipment and on the protective covers.

2.4. **Connection to the power supply**

In order to enable independent electrical power sources to be used for the external bell circuit and the rest of the equipment, electrically independent access terminals shall be available to supply these parts of the equipment.

2.5. **Band of frequencies and classes of emission**

The equipment shall permit reception of at least the following classes of emission in the 496 to 504 kHz frequency range:

A2A double-sideband telegraphy with on-off keying of the modulated carrier,

H2A single-sideband (upper sideband) telegraphy with full carrier and on-off keying of a modulated carrier.

Where A2A and H2A are used, the modulation frequency shall be between 450 Hz and 1,350 Hz.

## 3. TEST CONDITIONS, POWER SUPPLY AND AMBIENT TEMPERATURES

3.1. **Normal and extreme conditions**

Type approval tests shall be made under normal test conditions and also, where stated, under extreme conditions. The test conditions and procedures shall be as specified in paragraphs 3.3. and 3.4.

3.2. **Test power source**

During type approval tests, the equipment's power supply shall be provided by a test power source capable of producing normal and extreme voltages as specified in paragraphs 3.3.2. and 3.4.2.

3.3. **Normal test conditions**

3.3.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be fixed by any convenient combination of temperature and humidity within the following limits:

- temperature +15 C to +35 C
- relative humidity 20% to 75%

*Note.* When it is impracticable to carry out the tests under the conditions specified above, a note stating the actual temperature and relative humidity during the tests shall be added to the test report.

3.3.2. *Normal test power supply*

3.3.2.1. Mains voltage and frequency

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of these specifications, the nominal mains voltage shall be the declared voltage or any of the declared voltages for which the equipment is indicated as having been designed. The frequency of the test power source used instead of the AC mains shall be 50 Hz ± 1 Hz.

3.3.2.2. Power source from a battery

Where the equipment is designed to operate from a battery, the normal test voltage shall be the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.3.2.3. Other power sources

For equipment using other power sources, the normal test voltage shall be chosen by agreement between the equipment manufacturer and the authority conducting the tests.

3.4. **Extreme test conditions**

3.4.1. *Extreme temperatures*

For tests at extreme temperatures, measurements shall be made as specified in paragraph 3.5.; the lower temperature shall be 0 °C and the upper temperature +40 °C.

3.4.2. *Extreme test power supply values*

3.4.2.1. Mains voltage and frequency

The extreme test voltages for equipment to be connected to the AC mains shall be the nominal mains voltage ± 10%.

The frequency of the test power source shall be 50 Hz ± 1 Hz.

3.4.2.2. Power source from an accumulator battery

Where the equipment is designed to operate from an accumulator battery, the extreme test voltages shall be 1.3 or 0.9 times the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.5. **Procedure for tests at extreme temperatures**

Before measurements are made, the equipment shall have reached thermal equilibrium in the test chamber.

The equipment shall be switched off during the temperature stabilising period. The sequence of tests and the humidity content in the test chamber shall be controlled so that excessive condensation does not occur.

3.6. **Environmental tests**

3.6.1. While being subject to the requirements of paragraph 3.6.2., the equipment shall be tested under the conditions described in paragraphs 4., 5.2., 6., 7.2., 10.1. and 10.2. of the specifications relating to environmental requirements (Annex VI to this Recommendation).

3.6.2. In applying the requirements of Annex VI in accordance with paragraph 3.6.1., the expression "verification of characteristics" shall mean a visual examination and simple electrical and functional tests to verify that the equipment is in working order and that there is no visible damage or deterioration. Verifications of characteristics shall be capable of being carried out in 5 to 15 minutes. The expression "in working order" shall be taken to mean that the equipment is operating but does not necessarily fully meet all the characteristics required by the specifications. Particular attention shall be given to the sensitivity, passband, attenuation, the AGC and the selector.

3.7. **Warm-up time**

The equipment shall meet the requirements of the specifications within one minute after being switched on.

## 4. CONDITIONS FOR ELECTRICAL TESTS

4.1. **Artificial antenna**

The artificial antenna for the tests shall comprise a non-inductive resistance of 10 ohms in series with a capacitance of 390 pF or, where specified, a capacitance of 250 pF or 560 pF.

4.2. **Test signals applied to the receiver input**

4.2.1. Sources of test signals to be applied to the receiver input shall be connected via a network such that the impedance presented to the receiver input is equal to the impedance of the artificial antenna described in paragraph 4.1. This requirement shall be met irrespective of whether one or more test signals are applied to the receiver simultaneously. If there are two or more test signals, measures shall be taken to prevent any undesirable effect resulting from an interaction between the signals, in the signal generators or in other sources.

4.2.2. The test signals at the input shall be expressed in terms of the e.m.f. at the output terminals of the source, including the associated network described in paragraph 4.1, where these terminals are on open circuit.

4.2.3. Unless otherwise stated, the test signals applied to the receiver input shall be as follows:

a) Unmodulated signals at the same frequency as the carrier frequency. For the purpose of these specifications, the abbreviation N0N shall be used for this type of test signal.

b) Keyed unmodulated signals at the same frequency as the carrier frequency. For the purpose of these specifications, the abbreviation A1A shall be used for this type of test signal.

c) Double sideband signal with a modulation depth of 70% and a modulation frequency of 1 kHz unless stated otherwise. For the purpose of these specifications, the abbreviation A2N shall be used for this type of signal.

d) Alarm signal consisting of an A2A or H2A signal (upper sideband) keyed in accordance with the sequence specified in paragraph 4.1.1. a) of Annex V to this Recommendation. The modulation frequency shall be 1 kHz and the modulation depth 70%.

5. **RECEIVER**

5.1. **Passband and attenuation characteristics**

5.1.1. *Definition*

The passband is the frequency band at whose limits the attenuation relative to the maximum response does not exceed 6 dB. The minimum attenuation at certain frequencies outside the passband shall be specified in dB relative to the maximum response within the passband.

5.1.2. *Method of measurement*

With the automatic gain control switched off, an unmodulated test signal (type N0N) shall be applied to the receiver input as specified in paragraph 4.2. When the frequency of the test signal is varied, the voltage at the selector input shall be measured at a sufficient number of frequencies to draw a graph of the voltage as a function of the frequency and to determine the passband and attenuations at the frequency errors specified. The test shall be carried out under the normal and extreme temperature conditions specified in paragraphs 3.3. and 3.4.

5.1.3. *Specified bandwidths and limits*

The minimum passband and attenuation shall be as follows:

| | |
|---|---|
| Minimum passband | 496 to 504 kHz |
| Minimum attenuation | 40 dB at 487 kHz and 513 kHz |

5.2. **Adjacent channel two-signal selectivity**

5.2.1. *Definition*

The adjacent channel selectivity is the receiver's ability to discriminate between the wanted signal (to whose frequency the receiver is tuned) and unwanted signals (on frequencies generally outside the passband), with the wanted signal and the unwanted signals being applied simultaneously.

5.2.2. *Method of measurement and requirements*

With the automatic gain control switched on, an alarm signal (see paragraph 4.2.3. d)) at a frequency of 500 kHz and a level of +42 dB relative to 1 μV shall be applied to the receiver input. The equipment shall respond reliably to the alarm signal when an unwanted signal with the characteristics specified below is applied simultaneously to the receiver input. The test shall be carried out under normal test conditions and under extreme test conditions as specified in paragraphs 3.3. and 3.4. with each of the artificial antennae specified in paragraph 4.1.

5.3. **Sensitivity**

5.3.1. *Definition*

For the purpose of these specifications, the maximum usable sensitivity is the minimum level of a test alarm signal at 500 kHz which reliably triggers the automatic alarm selector (see paragraph 6.).

5.3.2. *Method of measurement*

With the automatic gain control switched on, a low-level alarm signal at 500 kHz (see paragraph 4.2.3. d)) shall be applied to the receiver input. The level of this signal shall be increased until the automatic alarm selector operates and the level of the signal at the receiver input when this condition is obtained shall be taken as being the maximum usable sensitivity. The test shall be carried out under normal test conditions and under extreme test conditions as specified in paragraphs 3.3. and 3.4. with each of the artificial antennae specified in paragraph 4.1.

5.3.3. *Specified limits*

The maximum usable sensitivity at which the selector operates shall be between +35 dB and +40 dB relative to 1 μV.

5.4. **Co-channel rejection**

5.4.1. *Definition*

For the purpose of these specifications, the co-channel rejection is the equipment's ability to respond reliably to an alarm signal in the presence of an unwanted signal at or near the frequency of the test alarm signal.

5.4.2. *Method of measurement*

The measurements shall be made by simultaneously applying two signals to the receiver input in accordance with the requirements of paragraph 4.2., with the automatic gain control switched on. The wanted signal shall be the alarm signal (paragraph 4.2.3. d)) in the 497.5 to 502.5 kHz frequency range, with a level of +50 dB relative to 1 μV. The unwanted signal shall be an A2A or H2A signal (upper sideband) (keyed at a rate of no less than 15 words per minute and no more than 40 words per minute) in the 497.5 to 502.5 kHz frequency range. The modulation frequency of the unwanted signal shall be in the 450 to 1,350 Hz range. The test shall be carried out under normal test conditions and under extreme test conditions as specified in paragraphs 3.3. and 3.4.

5.4.3. *Limits imposed*

When the unwanted signal is at a level of +120 dB relative to 1 μV, the selector shall respond to the alarm signal.

5.5. **Intermodulation**

5.5.1. *Definition*

Intermodulation is a process whereby signals are produced by two or more (generally unwanted) signals simultaneously present in a non-linear circuit.

5.5.2. *Method of measurement*

With the automatic gain control switched on, two test signals shall be applied simultaneously to the receiver input under the conditions required by paragraph 4.2. One of the signals shall be of the N0N type and the other shall be the alarm signal (see paragraph 4.2.3. d)). Each signal shall be at a level of +120 dB relative to 1 μV and neither signal shall be within the 475 to 525 kHz band (the input frequencies which are likely to cause undesirable intermodulation products are specified in CCIR Recommendation 332-4, section 6.4.). The test shall be carried out under normal test conditions and under extreme test conditions specified in paragraphs 3.3. and 3.4.

5.5.3. *Specified limits*

The selector shall not operate under any of the conditions specified in paragraph 5.5.2.

5.6. **Spurious emissions**

5.6.1. *Definition*

Spurious emissions are any radio-frequency emissions originating in the receiver and radiated, whether by conduction to the antenna or from other conductors linked to the receiver, or whether radiated directly by the receiver.

5.6.2. *Method of measurement*

With the test device (paragraph 8.) inoperative, the spurious emissions radiated by the antenna shall be measured using the artificial antenna specified in paragraph 4.1. The artificial antenna shall be connected to the receiver. The search for spurious emissions in a 10 kHz to 1,000 MHz range shall be made in the resistive part of the artificial antenna, and the power of each spurious emission shall be determined.

5.6.3. *Specified limit*

The mean power of any discrete component measured in the resistive part of the artificial antenna shall not exceed one nanowatt.

5.7. **Automatic gain control**

5.7.1. *Definition*

In order to enable the equipment to recognise an alarm signal in the presence of unwanted signals, an automatic gain control shall be provided for the receiver.

The automatic gain control shall regularly reduce the sensitivity of the equipment during periods when the selector is in continuous operation and shall regularly increase the sensitivity during periods when the selector is not operating (see Appendix 1).

5.7.2. *Speed of gain reduction*

5.7.2.1. Method of measurement

With the automatic gain control switched on, a signal of the N0N type shall be applied to the receiver input in accordance with the conditions specified in paragraph 4.2. An appropriate DC voltage indicator shall be connected to the selector input. The signal at the receiver input shall be applied at a level of +40 dB μV so that the selector's threshold detector operates, the AGC and the selector system begin to increase and reduce the receiver gain in turn, i.e. the system shall be in the process of "following". During a period when the gain is decreasing and at a moment when the DC voltage at the detector output indicated by the DC voltage measuring device matches the reference point, the input signal shall be increased by +10 dB (it is important for no interruption to occur in the applied signal when this increase takes place).

The interval of time between the point when the input signal is increased and the moment when the indicated DC voltage returns to match the reference point shall be noted and the gain variation speed shall be calculated.

This procedure shall be repeated for two further 10 dB increases in the input signal, to +60 dB μV and +70 dB μV respectively.

5.7.2.2. Specified limit

In each case, the gain reduction speed shall be between 7.5 dB and 15 dB per minute.

5.7.3. *Speed of gain increase*

When the AGC and the selector system have stabilised after the increases in the input signal carried out in 5.7.2.1., and with the system again in the process of "following", the signal shall be reduced by 10 dB in a period when the gain is increasing and at a moment when the indicated DC voltage matches the reference point.

The interval of time between the point when the input signal is reduced and the moment when the indicated DC voltage returns to match the reference point shall be noted and the gain increase speed shall be calculated.

This procedure shall be repeated with two further 10 dB reductions of the input signal to +50 dB and +40 dB relative to 1 μV respectively.

5.7.3.2. Specified limit

In each case the gain increase speed shall be between 30 dB and 60 dB per minute.

5.7.4. *Morse interference suppression test*

5.7.4.1. Definition

The Morse interference suppression test is similar to the co-channel rejection test (paragraph 5.4.), but simulates conditions where there are two or more Morse signals and the off-keyed times between the unwanted signals are very short. The test demonstrates the capacity of the automatic gain control to adjust the gain as a function of the frequency at which the off-keyed times occur.

5.7.4.2. Method of measurement

Morse interference shall be simulated by continuously keying a test signal source to produce an A1A and an A2A or H2A (upper sideband) signal at 500 kHz.

The level of this signal shall be +100 dB relative to 1 μV, and the on/off ratio shall be 19 to 1. The signal source shall be applied to the receiver input in accordance with the conditions specified in paragraph 4.2.

5.7.4.3. Specified limits

a) With the test signal transmission rate adjusted so that there are 3 interruptions per second, the sensitivity of the equipment shall be between +3.5 dB and +40 dB relative to 1 μV.

b) With the test signal transmission rate reduced to 3 interruptions every 2 seconds, the sensitivity of the equipment shall be gradually reduced over a period of 15 minutes to a value such that a signal of at least +70 dB relative to 1 μV is necessary to operate the selector.

## 5.8. Protection of input circuits

The receiver shall not suffer any damage when a 30 volt (r.m.s.) N0N-type radio-frequency test signal is applied to its input in the manner specified in paragraph 4.2. for a period of 15 minutes on any frequency in the 100 kHz to 28 MHz range. The receiver shall operate normally without further intervention when the test signal is suppressed.

The receiver shall also have means of protection against damage resulting from static voltage which may occur at its input.

# 6. SELECTOR

## 6.1. Definition

The selector consists of a level detector for determining the presence or absence of a signal, followed by a timing device for measuring the duration of any signal composed of dashes identified by the level detector and the duration of the intervals between these dashes. The selector engages the alarms (paragraph 7.) when 4 dashes have been correctly identified. The detector shall be capable of identifying the dashes when they are lengthened by Morse interference.

## 6.2. Timing limits

The selector shall accept

a) dashes of 3.5 to 6.0 second duration

b) spaces between the dashes of 0.01 of a second to 1.5 seconds

The selector shall reject

a) dashes of 3.4 second duration or less

b) dashes of 6.2 second duration or more

c) spaces between the dashes of 1.6 seconds or more

*Note.* Unless the AGC system is suppressed for the test, note that an on/off ratio greater than 4:1 will reduce the receiver gain.

## 6.3. Operation

The selector shall trigger the audible alarms (see paragraph 7.) after correctly registering 4 consecutive dashes (see paragraph 6.2.). The 4th successive dash can be registered as correct if the duration of the 4th dash is greater than 3.4 seconds. The test shall be carried out under normal test conditions and under extreme test conditions specified in paragraphs 3.3. and 3.4.

# 7. ALARMS

## 7.1. General conditions

7.1.1. An audible alarm system shall be associated with the equipment.

7.1.2. Measures shall be taken to simultaneously engage 3 audible alarms, one of which may be incorporated in the equipment. The alarms shall be triggered if an alarm signal conforming to the requirements of paragraph 6. is correctly registered. Visual alarms may be installed additionally.

7.1.3. The audible alarms shall be triggered within 15 seconds after a drop in the principal DC voltage in the equipment has occurred and been maintained, but they shall not be triggered if there is a drop in this voltage for a period of less than 3 seconds. Means shall be provided for distinguishing the nature of the alarm (distress or voltage-drop alarm).

7.1.4. The equipment shall not require manual re-setting unless the audible alarms have been triggered.

7.1.5. If there is a drop of more than 10% in the power supply voltage, the equipment shall continue to respond to the correct alarm signals until the power supply voltage attains the value at which the audible alarms are triggered (see paragraph 7.1.3.).

## 8. TEST DEVICE

### 8.1. General conditions

In order to carry out regular tests, the automatic alarm receiver shall include a pre-set generator at a frequency no more than 1,500 Hz away from 500 kHz, a key, and shall be able to operate under the control of an automatic alarm transmitter (Annex V to this Recommendation). It shall then be possible, without disconnecting the antenna, to inject a test alarm signal of the A1A or A2A type at a level equivalent to an e.m.f. applied to the input via an artificial antenna (see paragraph 4.1.) at a level between +40 dB and +46 dB relative to 1 μV.

## 9. PRACTICAL TESTS

The authority conducting the tests shall appraise the satisfactory operation of the equipment by means of practical tests carried out in conditions equivalent to those actually encountered. If automatic test devices and recording devices are to be used during these tests, the manufacturer shall provide a means (e.g. relay contacts or output voltages) of indicating that an alarm has been correctly received. False alarms should be noted as far as possible.

## Appendix 1

## BRIEF EXPLANATION OF THE OPERATION OF THE AGC

Experience has shown that interference in the 500 kHz band may be so strong as to prevent the reception of an alarm signal. As all signals in this band are Morse signals, the simultaneous presence of a number of signals produces a haphazard on/off distribution in the selector's detector. If, under such conditions, an alarm signal as described in paragraph 1. is present, the duration of the dashes is lengthened and the intervals between the dashes are reduced; when the interference increases, the number of intervals will be reduced and the dashes will overlap. A normal AGC system would reduce the gain of the receiver to a level at which all signals are received without distortion or saturation.

It has been shown that by adapting an AGC system which operates not according to the strength of the signals but according to the number of signals whose level exceeds a given threshold, the probability of non-recognition of dashes may be reduced considerably.

In order to achieve this result, the AGC system is designed to reduce the receiver gain in the presence of signals at a rate chosen so that the time needed to carry out a complete scan is long relative to the transmission rate of the dashes in the alarm signal. If the signal persists, the AGC regularly reduces the gain until a "space" occurs in the signal, after which the AGC begins to re-establish the receiver gain during the space. As the nominal value of the on/off ratio in an undistorted alarm signal is 4:1, the increase in the gain needs to be four times faster than the decrease, or else the gain would continue to decrease indefinitely even on reception of an undistorted alarm signal. By this means, the receiver can significantly increase its capacity to detect whether the spaces in the unwanted Morse signal match the spaces in the alarm signal.

Morse interference simulation is used in paragraph 5.7.4. in which a signal with an on/off ratio of 19:1 is interrupted either 3 times per second or 3 times every 2 seconds. The receiver AGC has to produce certain sensitivity values in the presence of these signals. This is a simulation of the simultaneous presence of 3 to 5 typical Morse signals and constitutes a measure of the receiver's capacity to adjust its AGC level to the frequency of the space intervals received.

# Annex X

# Technical specifications for narrow-band direct-printing telegraph equipment for receiving meteorological or navigational information

# (NAVTEX receiver)

*Note:*
Text approved by the "Telecommunications" Commission at Nice (1985).

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## 1. INTRODUCTION

1.1 These specifications define the minimum performance requirements for a narrow-band, direct-printing maritime receiver operating in the NAVTEX system.

1.2 The equipment's function is to receive and print automatically and continuously meteorological and navigational messages and SAR messages transmitted by coast stations participating in the NAVTEX system.

1.3. The equipment shall consist of a radio-frequency receiver, a signal processor and a printing device.

1.4. The message format shall conform to CCIR Recommendation 476-3, collective B-mode. The system shall conform to CCIR Recommendation 540-1.

## 2. GENERAL CONDITIONS

2.1. The mechanical and electrical design and the construction and finish of the equipment shall accord with good engineering practice and the equipment shall be designed for use on board ships at sea.

2.2. All controls, instruments and terminals shall be clearly identified. Details concerning the power source with which the equipment is to be used shall be clearly indicated. A label indicating the type under which the equipment is being submitted for the type approval tests shall be affixed to the equipment in a place where it is clearly visible in the normal operating position.

2.3. It shall be possible to reduce to zero the intensity of any equipment light source other than visual alarms.

2.4. The radio-frequency receiver shall operate on the 518 kHz frequency.

2.5. The equipment shall comprise a device for performing tests to verify whether the radio-frequency receiver, signal processor or printing device are working correctly.

2.5.1. The test shall at lest provide verification of the signal's path from the antenna to the loudspeaker or to an audio-frequency output delivering sufficient power to operate a loudspeaker or earphones.

A self-return switch shall be used if a loudspeaker is used.

2.5.2. The signal processing unit and the printing device shall contain an integrated system for verifying their operation.

2.6. To limit the number of messages received, it shall be possible to select the coast stations which it is wanted to receive, by detecting the characters identifying them in the message format, as specified in any of paragraphs 2.6.1., 2.6.2. or 2.6.3.

2.6.1. *Type A NAVTEX receiver*

The user shall be able to use an external control to select the character designating the area covered by the transmitter (the $B_1$ character in CCIR Recommendation 540-1, Annex 2) which the equipment is to be capable of receiving.

Alternatively, by using an external control, the user shall be able to exclude the $B_1$ characters corresponding to what the equipment is not going to receive. It shall be possible to select or exclude any number of $B_1$ characters up to the maximum possible.

2.6.2. *Type B NAVTEX receiver*

The user shall be able to use an external control to select the geographical areas which the equipment is to be capable of receiving, entailing automatic selection of the corresponding $B_1$ characters. The selection should comprise at least four of these areas and each area should correspond to a $B_1$ group of up to at least fifteen, included in an internal programme.

2.6.3. *Type C NAVTEX receiver*

The receiver shall contain a fixed internal programme for a limited number of $B_1$ characters. For this type of receiver, the $B_1$ programming shall not be accessible to an operator.

In addition, it shall be possible to use an external control on the equipment to exclude all the $B_1$ characters one by one.

2.7. The equipment shall display information indicating that the $B_1$ characters have been selected or excluded, or this information shall be easily accessible, e.g. in printed form using the printing device.

2.8. It shall be possible to exclude the reception of message categories other than navigational warnings, gale warnings and SAR messages. It shall be possible to exclude at least four different message categories.

2.9. The equipment shall provide a clear indication of the message categories that are excluded.

2.10. Means shall exist of preventing a message being printed which has already been received correctly.
A message has been received correctly if the character error rate is less than 4%.

2.11. A message shall always be printed if $B_3B_4 = 00$.

2.12. The equipment shall be capable of storing at least 30 message identifications in its memory.
After 60 to 72 hours, a message identification shall automatically be erased from the memory.
If the number of message identifications received exceeds the memory capacity, the oldest message identification shall be erased.

2.13. An alarm indicating the reception of SAR messages shall be provided, whether incorporated in the equipment or at a distance. If an alarm also indicates the reception of navigational and gale warnings, it shall be capable of being suppressed.
These alarms shall only be able to be turned off by hand.

2.14. An alarm shall be provided to indicate that the paper has nearly run out or has run out.
If any message is incompletely printed because the paper has run out, the message identification for that message shall not be stored in the memory. Memory storage of new message identifications shall be inhibited if there is no paper available in the printing device.

2.15. The equipment shall print an asterisk if the character received is incorrect.

2.16. The equipment shall include a function which stops the printout and erases the message if the error rate exceeds 33% over a period of time. That period may be reduced for higher error rates.
This may be done, for example, by having a counter which advances 2 steps for each character received incorrectly and goes back one step for each character received correctly. The message is erased when the counter reaches 32. The counter should not go below zero.

2.17. **Safety precautions**

2.17.1 Measures shall be taken to protect the equipment against the effects of excess current or voltage and against an excessive temperature increase in any part of the equipment as a result of any defect in the cooling system.

2.17.2 Measures shall be taken to protect the equipment from damage as a result of transient changes of voltage or an accidental reversal of polarity at the power source.

2.17.3. Means shall be provided of earthing the equipment's metal parts which are accessible from the outside, but the equipment shall not cause any terminal of the electrical power source to be earthed.

2.17.4. All parts and all wiring in which the DC or AC voltage (except radio-frequency voltage) produce, singly or in combination, a peak voltage in excess of 50 volts, shall be protected against accidental access and shall automatically be isolated from all electrical power sources when the protective covers are removed.
Alternatively, the equipment shall be constructed in such a way as to prevent access to such voltages unless an appropriate tool is used such as a nut-spanner or screwdriver, and conspicuous warning labels shall be affixed both inside the equipment and on the protective covers.

2.17.5. The information in programmable memories, see paragraph 2.6., shall not be erased by power source interruptions of less than 6 hours.

## 3. TEST CONDITIONS, POWER SUPPLY AND AMBIENT TEMPERATURES

### 3.1. General

3.1.1. Type approval tests shall be made under normal test conditions and also, where stated, under extreme test conditions.

Where such conditions are applicable, the equipment shall meet the requirements of these specifications for any combination of voltages and temperatures within the extremes specified.

3.1.2. *Artificial antennas*

Where specified, the tests shall be carried out with the receiver connected, as appropriate, to the following artificial antennas.

This shall not in any way imply that the receiver only operate satisfactorily with antennas possessing these impedance characteristics.

3.1.2.1. A non-reactive resistance of 50 ohms.

3.1.2.2. A resistance of 10 ohms in series with a capacitance of 150 pF.

3.1.3. *Normal test signal*

The normal test signal shall be a F1B radio-frequency signal modulated with a frequency shift of 170 Hz centred on 518 kHz.

It shall contain signals providing the following traffic information:
1 2 3 4 5 6 7 8 9 0 A B C D E F G H I J K L M N O P Q R S T U Carriage return Line feed.

For tests with the normal test signal, the above information shall be transmitted at least 35 times continuously.

3.1.4. *Test signals applied to the receiver input*

Sources of test signals to be applied to the equipment input shall be connected via a network such that the impedance presented to the equipment is equal to the impedance of the artificial antenna (see paragraph 3.1.2.), whether one or more test signals are applied to the equipment simultaneously. If there are two or more test signals, measures shall be taken to prevent any undesirable effect resulting from interactions between the signals in the generators or other sources.

The levels of the test signals at the receiver input shall be expressed in terms of the e.m.f. at the output terminals of the source including the associated network.

### 3.2. Test power source

During type approval tests, the equipment's power supply shall be provided by a test power source capable of producing normal and extreme voltages as specified in paragraphs 3.3.2. and 3.4.2. The internal impedance of the test power source shall be low enough to have only a negligible effect on the test results. For the purpose of the tests, the power source voltage shall be measured at the input terminals of the equipment.

During the tests, the power source voltage shall be maintained within a tolerance of $\pm 3\%$ relative to its level at the beginning of each test.

### 3.3. Normal test conditions

3.3.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

- temperature: +15 °C to +35 °C
- relative humidity: 20% to 75%.

*Note.* When it is impracticable to carry out the tests under the conditions specified above, a note to that effect, stating the actual temperature and humidity during the tests, shall be added to the test report.

3.3.2. *Normal test power supply*

3.3.2.1. Mains voltage and frequency

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of these specifications, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment is indicated as having been designed.

The frequency of the test power source corresponding to the mains shall be 50 Hz ± 1 Hz.

3.3.2.2. Power source from a battery

Where the equipment is designed to operate from a battery, the normal test voltage shall be the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.3.2.3. Other power sources

For operation from other power sources, the normal test voltage shall be fixed by agreement between the equipment manufacturer and the authority conducting the tests.

3.4. **Extreme test conditions**

3.4.1. *Extreme temperatures*

For tests at extreme temperatures, measurement shall be made in accordance with the procedures specified in paragraph 3.5. at a lower and upper temperature of 0° C and 40° C.

3.4.2. *Extreme test power supply values*

3.4.2.1. Extreme mains voltage and frequency

The extreme test voltages for equipment to be connected to the mains shall be the nominal mains voltage ±10%.

The frequency of the test power source corresponding to the mains shall be 50 ± 1 Hz.

3.4.2.2. Power source from a battery

Where the equipment is designed to operate from a battery, the extreme test voltages shall be 1.3 and 0.9 times the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.4.2.3. Other power sources

For equipment using other test power sources, the extreme voltages shall be fixed by agreement between the manufacturer and the authority conducting the tests.

3.5. **Procedures for tests at extreme temperatures**

Before measurements are made, the equipment shall have reached thermal equilibrium in the test chamber. The equipment shall be switched off during the temperature stabilizing period. The sequence of measurements shall be chosen and the humidity in the test chamber shall be controlled so that excessive condensation does not occur.

3.6. **Environmental tests**

Before starting the environmental tests, the equipment shall be tested under the other clauses in these specifications. Where electrical tests have to be made, they shall be carried out at the normal test voltage.

The expression "verification of performance" used in these specifications means a sensitivity test on the receiver as described in paragraph 4.1., with the test signal at a level 6 dB higher than the normal test signal mentioned.

The following tests shall be conducted under the environmental conditions specified in Annex VI to this Recommendation, "Environmental tests for maritime radio equipment":

Vibration, paragraph 4.
Dry-heat cycle, paragraph 5.2.
Damp-heat cycle, paragraph 6.
Low-temperature cycle, paragraph 7.2.
Corrosion tests, paragraphs 10.1. and 10.2.

## 4. RECEIVER

### 4.1. Call sensitivity

4.1.1. *Definition*

The call sensitivity of the receiver is a defined level of the radio-frequency signal at which the receiver gives an error rate better than a defined value.

4.1.2. *Method of measurement*

The receiver shall be connected to the artificial antenna specified in paragraph 3.1.2.1. and a normal test signal at a level of 2 μV shall be applied.

The receiver shall then be connected to the artificial antenna specified in paragraph 3.1.2.2. and a normal test signal at a level of 5 μV shall be applied.

Measurements shall be made under normal test conditions and under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

4.1.3. *Limit*

The character error rate shall be less than $4 \cdot 10^{-2}$.

4.2. **Interference rejection and blocking immunity**

4.2.1. *Definition*

Interference rejection and blocking immunity is the receiver's ability to discriminate between the wanted signal and unwanted signals on frequencies outside the receiver's passband.

4.2.2. *Method of measurement*

Two signals shall be applied to the receiver as specified in paragraph 3.1.4.

The receiver shall be connected to the artificial antenna specified in paragraph 3.1.2.2.

The wanted signal shall be the normal test signal at a level of 20 dBµV.

The unwanted signal shall be unmodulated.

For the frequency ranges 517-517.5 kHz and 518.5-519 kHz, the level shall be 40 dBµV. For the frequency ranges 515-517 kHz and 519-521 kHz, the level shall be 60 dBµV. For the frequency ranges 100-515 kHz, 521 kHz-30 MHz, 156-174 MHz and 450-470 MHz, the level shall be 90 dBµV.

An audio-frequency output shall be used to look for responses to interference.

Measurements shall be made under normal test conditions and under extreme conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously).

4.2.3. *Limit*

The unwanted signal shall not induce a character error rate of more than $4 \cdot 10^{-2}$.

4.3. **Co-channel rejection**

4.3.1. *Definition*

The co-channel rejection is the receiver's ability to receive a wanted signal in the presence of an unwanted signal, with both signals on the frequency of the wanted receiver channel.

4.3.2. *Method of measurement*

Two signals shall be applied to the receiver as specified in paragraph 3.1.4.

The receiver shall be connected to the artificial antenna specified in paragraph 3.1.2.2.

The wanted signal shall be the normal test signal at a level of 20 dBµV.

The unwanted signal shall be modulated at a level of 14 dBµV, at the nominal receiver frequency.

4.3.3. *Limit*

The unwanted signal shall not induce a receiver error rate of more than $4 \cdot 10^{-2}$.

4.4. **Intermodulation**

4.4.1. *Definition*

Intermodulation is a process whereby signals are produced from two or more signals simultaneously present in a non-linear circuit.

4.4.2. *Method of measurement*

Three signals shall be applied to the receiver as specified in paragraph 3.1.4.

The receiver shall be connected to the artificial antenna specified in paragraph 3.1.2.2.

The wanted signal shall be the normal test signal at a level of 20 dBµV.

The two unwanted signals shall be unmodulated at equal levels of 70 dBµV, with neither signal at a frequency in the frequency band 516 kHz to 520 kHz.

4.4.3. *Limit*

Intermodulations shall not induce a character error rate of more than $4 \cdot 10^{-2}$.

4.5. Spurious emissions

4.5.1. *Definition*

Spurious emissions are any radio-frequency emissions generated in the receiver and radiated by conduction by the antenna or from other conductors connected to the receiver or radiated by the receiver.

4.5.2. *Method of measurement*

The receiver shall be connected to the artificial antenna specified in paragraph 3.1.2.1. and the spurious emissions shall be measured using a selective measuring instrument. The r.m.s. value of any component of the spurious emissions shall be measured.

The measurements shall extend over the frequency range from 9 kHz to 2,000 MHz.

4.5.3. *Limit*

The power of any discrete component shall not exceed 1 nW ($1 \times 10^{-9}$ watt).

4.6. **Protection of input circuits**

4.6.1. The receiver shall not be damaged when an unmodulated signal at a level of 30 r.m.s. volts is applied to the receiver input as specified in paragraph 3.1.4. for a period of 15 minutes on any frequency in the range from 100 kHz to 28 MHz.

The receiver shall operate normally without further intervention when the test signal is stopped.

4.6.2. In order to provide protection against damage due to electrostatic voltage which may occur at the receiver input, the resistance to the direct current between the antenna terminal and the casing shall not exceed 100 kohms.

## 5. PRINTING DEVICE

5.1. **General**

The printing device shall meet all the following requirements on the two mains frequencies 50 Hz and 60 Hz.

The printing device shall print the message received on paper. Changing the paper shall be a simple operation. The paper capacity shall be sufficient to enable at least 200,000 characters to be printed.

5.2. **Printing**

The printing device shall print easily legible signs and produce a low level of noise.

The printing device shall be capable of printing at least 32 characters per line.

# Annex XI

# Technical specifications for emergency position-indicating radio beacons (EPIRBs) operating on the frequencies 121.5 MHz and 243 MHz

*Note:*
Text approved by the "Telecommunications" Commission at its meeting in Odense (1986) and modified in Copenhagen (1987).

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## 1. INTRODUCTION

These specifications define the minimum requirements for maritime emergency position-indicating radio beacons (EPIRBs) and incorporate the provisions of the 1974 SOLAS Convention, as amended, the provisions of the Radio Regulations and the relevant standards of the International Civil Aviation Organization.

EPIRBs are defined as maritime mobile service stations whose emissions are intended to facilitate search and rescue operations.

The EPIRBs described in these specifications are only intended for transmission of signals on 121.5 MHz and 243 MHz for alerting by and locating vessels and survival craft in distress.

## 2. GENERAL CONDITIONS

### 2.1. Construction

2.1.1. The EPIRB shall primarily be designed to operate when floating in the sea, but shall also operate satisfactorily on a ship's deck or in a survival craft.

2.1.2. The mechanical and electrical design and the construction and finish of the equipment shall conform in all respects with good engineering practice.

2.1.3. The equipment shall be designed to minimise the risk of internal and external damage during use or stowage.

2.1.4. The exterior of the equipment shall have no sharp edges or projections which could easily damage inflateable rafts or injure personnel.

2.1.5. The general construction and method of operation shall provide a high degree of proof against inadvertent operation due to magnetic influences, handling, stowage and transit, whilst still providing a simple means of operating in an emergency.

2.1.6. The equipment shall be portable, lightweight and compact and be designed as one integral unit. The power source for the EPIRB shall be a battery forming part of the equipment. The EPIRB shall incorporate a permanently attached antenna which may be either of fixed length or extendable.

2.1.7. The EPIRB shall be fitted with a test facility by which the operation of the transmitter and battery can easily be verified without having to use external equipment.

2.1.8. The equipment shall be capable of being used by an unskilled person. The equipment shall only be capable of manual activation and de-activation.

2.1.9. The equipment shall withstand being dropped into the water from a height of 20 metres without damage.

2.1.10. The EPIRB shall be watertight, buoyant, self-righting and sufficiently stable to keep the antenna vertical under heavy swell conditions.

2.1.11. The equipment shall provide an indication that signals are being emitted. The indication shall be audible or visual and clearly discernible under all ambient conditions.

2.1.12. The EPIRB shall be provided with a firmly attached line so that the equipment can be tethered in use. The line shall have a length of at least 20 metres and be capable of floating in sea water.

2.1.13. A substantial part of the equipment shall be of highly visible yellow or orange colour to assist visual location.

2.1.14. The equipment shall not be unduly affected by sea water or oil and shall be resistant to deterioration by prolonged exposure to sunlight.

### 2.2. Controls

2.2.1. The equipment shall be activated by two simple, but independent mechanical actions, neither of which shall activate the equipment on its own. At least one of the means of activating the EPIRB for a purpose other than testing shall be sealed, with a label stating that the equipment is for use only in an emergency.

The equipment shall not be capable of automatic activation. The initial activation shall break a seal which shall not be replaceable by the user. The seal shall not be broken when using the test facility.

2.2.2. After activation, it shall be simple to de-activate the equipment.

2.2.3. The switch which operates the test facility (paragraph 2.1.7.) shall be designed so that it automatically returns to the off-position when released.

2.3. **Labelling**

2.3.1. The equipment shall be provided with a label or labels, permanently affixed to the exterior of the equipment and containing the following information:

2.3.1.1. a type designation of the equipment;

2.3.1.2. adequate instructions to enable the equipment to be activated and de-activated;

2.3.1.3. the type of battery specified by the manufacturer of the EPIRB;

2.3.1.4. a warning that the EPIRB should not be operated except in an emergency;

2.3.1.5. the date on which the battery will need to be replaced. Simple means shall be provided for changing this date when the battery is replaced;

2.3.1.6. space on which the name and the call sign of the ship can be recorded.

2.4. **Operating instructions**

The manufacturer shall provide all instructions and information regarding stowage, installation and operation of the EPIRB to ensure proper use and prevent false alarms.

2.5. **Power source**

2.5.1. The battery provided as a source of power shall have sufficient capacity to operated the equipment for an uninterrupted period of at least 48 hours under all temperature conditions, see paragraph 3.7.1., within the requirements of these specifications.

2.5.2. The battery shall have a shelf life of at least three years and when fitted in the equipment shall not require replacement within two years.

The type of battery specified by the manufacturer for use in the equipment shall be clearly indicated on the equipment.

2.5.3. The battery shall be clearly and durably marked with the expiry date.

2.5.4. Measures shall be taken to protect the equipment from damage due to an accidental reversal of polarity in the battery.

## 3. TEST CONDITIONS, POWER SUPPLY AND AMBIENT TEMPERATURES

3.1. **Frequencies**

For the type approval tests, the EPIRB shall be provided with the frequencies specified by the Administration carrying out the tests.

3.2. **Test fixture**

If the equipment does not have an output with an impedance of 50 Ω, the manufacturer shall supply a test fixture permitting relative measurements to be made on the submitted equipment. This test fixture shall provide a radio-frequency access terminal with an impedance of 50 Ω at the working frequencies of the equipment.

The operating characteristics of this test fixture under normal and extreme conditions shall be subject to approval by the authority conducting the tests. The following characteristics shall apply:

- the coupling loss shall be as low as possible and in no case greater than 30 dB;
- the variation of coupling loss with frequency shall not cause measurement errors exceeding 2 dB;
- the coupling device shall not include any non-linear elements;
- the power consumption of the EPIRB shall not substantially change when placed in the test fixture.

Any connections provided on the equipment in order to facilitate relative measurements shall not affect the performance of the equipment either in the test fixture or when making measurements involving the use of radiated fields.

3.3. **Artificial antenna**

Where stated, the tests shall be carried out using a 50 Ω non-reactive, non-radiating load or the test fixture described in paragraph 3.2.

3.4. **Normal and extreme conditions**

Type approval tests shall be made under normal and extreme conditions, unless stated otherwise.

3.5. **Test power source**

Where stated, the battery for the equipment shall be replaced by a test power source capable of producing normal and extreme voltages as specified in paragraphs 3.6.2. and 3.7.2.

For type approval tests, three sets of batteries shall be submitted.

3.6. **Normal test conditions**

3.6.1. *Normal temperature*

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following limits:

Temperature: +15°C to +35°C
Relative humidity: 20% to 75%

3.6.2. *Normal test voltage*

The normal test voltage shall be determined in each case and shall be the voltage corresponding to the voltage that the battery gives under normal temperature and humidity conditions at a load equal to that of the equipment.

3.7. **Extreme test conditions**

3.7.1. *Extreme temperatures*

For tests at extreme temperatures, measurements shall be made in accordance with the procedure specified in paragraph 3.8., at the lower and upper temperature of −20°C and +55°C.

3.7.2. *Extreme test voltages*

3.7.2.1. Upper extreme test voltage

The upper extreme test voltage shall be determined in each case and shall be the voltage corresponding to the voltage that the battery gives at the upper extreme temperature with a load equal to that of the equipment.

3.7.2.2. Lower extreme test voltage

The lower extreme test voltage shall be determined in each case and shall be the voltage corresponding to the voltage that the battery gives at the lower extreme temperature with a load equal to that of the equipment, after 48 hours of operation.

3.8. **Procedure for tests at extreme temperatures**

The equipment shall be switched off during the temperature stabilising period.

Before tests are carried out, the equipment shall have reached thermal equilibrium in the test chamber and shall have been switched on for at least five minutes.

3.9. **Environmental tests**

3.9.1. Before starting the environmental tests, the equipment shall be tested for the other requirements of these specifications. Where electrical tests are necessary, they shall be carried out at the normal test voltage.

The expression "verification of characteristics" used in these specifications shall be taken to means a check of the output power, frequencies and modulation of the equipment.

3.9.2. The following tests shall be conducted under the environmental conditions specified in Annex VI to Recommendation T R 34-01, "Environmental tests for maritime radio equipment":

| | |
|---|---|
| Vibration | Paragraph 4. |
| Dry-heat cycle | Paragraph 5.1. |
| Damp-heat cycle | Paragraph 6. |
| Low-temperature cycle | Paragraph 7.1., except that the lower temperature shall be −40 C |
| Corrosion tests | Paragraphs 10.1. and 10.2. |

3.9.3. The equipment shall be placed in an atmosphere of +70 C for one hour. It shall then be immersed for one hour in water at +20 C to a depth of 10 cm, measured from the highest point of the equipment to the surface of the water, excluding the antenna when extended.

3.9.4. The equipment shall be subjected to an external water pressure of 100 kPa for five minutes.

3.9.5. The equipment shall be dropped three times into water from a height of 20 metres, with the antenna extended if applicable.

3.9.6. On completion of the tests in paragraphs 3.9.2., 3.9.3., 3.9.4. and 3.9.5., the equipment shall not show any signs of significant external damage or harmful water penetration and shall meet the requirements of these specifications.

## 4. FREQUENCIES, CLASS OF EMISSION AND RADIATION CHARACTERISTICS

### 4.1. Frequencies

When activated, the EPIRB shall continuously and simultaneously transmit on the frequencies 121.5 MHz and 243 MHz.

### 4.2. Frequency error

4.2.1. *Definition*

The frequency error is the difference between the measured carrier frequency and its nominal value (paragraph 3.1.)

4.2.2. *Method of measurement*

The carrier frequency shall be measured with the equipment placed in the test fixture (paragraph 3.2.) or connected to the artificial antenna (paragraph 3.3.).

The measurement shall be made using the test power source (paragraph 3.5.).

4.2.3. *Limit*

The frequency error under both normal and extreme conditions or in any intermediate condition shall not exceed ±3.5 kHz for the radio-frequency 121.5 MHz and ±7 kHz for the frequency 243 MHz.

### 4.3. Class of emission

4.3.1. The radio emission shall be amplitude-modulated with full carrier and both sidebands (A3X).

The emission shall consist of a signal obtained by amplitude-modulation of the carrier frequency with downward frequency sweep within a range of not less than 700 Hz between 1,600 Hz and 300 Hz and with a sweep repetition rate of 2 to 4 times per second.

4.3.2. The signal may include information about the identity of the ship. If included, this information shall be transmitted automatically and shall not occupy a substantial part of the transmission time.

### 4.4. Modulation characteristics

4.4.1. *Depth of modulation*

Definition

The depth of modulation is the ratio: $\frac{A - B}{A + B}$ where A and B are respectively the maximum and minimum values of the envelope curve.

4.4.2. *Duty cycle*

Definition

The modulation duty cycle is the ratio of the positive modulation peak duration to the period of the instantaneous fundamental audio modulating frequency, observed at the half-amplitude points on the modulation envelope.

4.4.3. *Method of measurement*

The depth of modulation and the modulation duty cycle shall be measured, e.g. with an oscilloscope, with the EPIRB placed in the test fixture (paragraph 3.2.) or connected to the artificial antenna (paragraph 3.3.). (See Figure XI-1 (T/R 34-01)).

4.4.4. *Limits*

4.4.4.1. The depth of modulation shall be at least 85%.

4.4.4.2. The duty cycle shall be between 50% and 70%.

4.5. **Radiation characteristics**

4.5.1. The radiation from the antenna shall be vertically polarised.

4.5.2. The radiation shall be substantially omnidirectional in the horizontal plane.

4.5.3. The radiation from the equipment floating in the water shall predominate at small angles of elevation.

4.5.4. The conditions specified in paragraphs 4.5.1., 4.5.2. and 4.5.3. may be satisfied with a vertical whip antenna having an electrical length of between one quarter and five eighths of the wavelength at the operating frequencies.

4.6. **Radiated peak envelope power**

4.6.1. *Definitions*

The peak envelope power is the average power during one radio-frequency cycle at the crest of the modulation envelope.

The radiated peak envelope power is the peak envelope power required at the input of a quarter wave monopole antenna normal to a horizontal earth plane to produce, at the same distance, in a horizontal direction, the same field strength as produce by the equipment under specified conditions.

4.6.2. *Method of measurement*

The radiated peak envelope power shall be measured by means of a substitution method.

The measurement shall be performed with the equipment floating in salt water in its ordinary operating position, in order to simulate the radio-frequency properties on the sea.

The salt water should be contained in a water tank of at least 10 metre diameter or in a smaller tank with an additional earth plane of a least 10 metre diameter.

The radiated signal shall be measured at a distance of at least 10 metres from the antenna of the EPIRB. It shall be possible to vary the mesuring antenna's height above the ground by at least one half wavelength. The strength of the received signal shall be registered by means of a peak reading indicator.

The measuring receiver shall have a bandwidth of 10 kHz.

The height of the measuring antenna shall be varied until maximum signal strength is found.

The EPIRB shall be rotated in the horizontal plane until a minimum reading on the peak reading indicator is found.

The EPIRB shall then be replaced by a substitution antenna which shall be a quarter wave monopole antenna mounted on an earth plane and connected to an unmodulated signal source. The height of the measuring antenna shall be varied until the maximum signal strength is registered. The level of the signal source shall be adjusted to give the same reading of the peak reading indicator as from the EPIRB. The average output power of the signal source is the radiated peak envelope power of the EPIRB. Allowance shall be made for cable attenuation.

The EPIRB connected to the artificial antenna (paragraph 3.3.) or placed in the test fixture (paragraph 3.2.) shall then be placed in a climatic chamber and relative radio-frequency output power tests under extreme temperature conditions shall be performed. The battery shall be changed for each test.

4.6.3. *Limit*

The radiated peak envelope power for all temperature conditions shall be at least 200 mW on both frequencies during and at the end of 48 hours continuous operation.

4.7. **Radiation produced by operation of the test facility**

4.7.1. *Definition*

Radiation prodced by operation of the test facility is the radiation at the nominal frequencies when the equipment is being tested.

4.7.2. *Method of measurement*

The EPIRB shall be hand-held with the switch in the test position.

The method of measurement described in paragraph 4.6. shall be used, but the test shall be performed at normal test temperature only.

The transmitter shall be turned in all directions until the maximum radiation is found.

4.7.3. *Limit*

The test facility for verifying the correct operation of the EPIRB shall not produce a peak effective radiated power in excess of 25 nW on each operating frequency.

4.8. **Spurious emissions**

4.8.1. *Definition*

Spurious emissions are emissions on any 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, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

4.8.2. *Method of measurement*

Spurious emissions shall be measured on the test site described in paragraph 4.6.

The measurement shall be performed with the EPIRB immersed in salt water in its normal operating position.

The method of measurement described in paragraph 4.6. shall be used to search for spurious emissions in the frequency bands 108-137 MHz, 156-162 MHz, 406.0-406.1 MHz and 450-470 MHz.

The measuring receiver shall have a bandwidth of 10 kHz.

The measurement shall only be performed under normal test conditions.

4.8.3. *Limit*

The power of any spurious emission component shall not exceed 25 µW on any frequency.

4.9. **Protection of the transmitter**

4.9.1. *Definition*

The EPIRB transmitter, when operating, shall not be damaged due to antenna mismatching.

4.9.2. *Method of measurement*

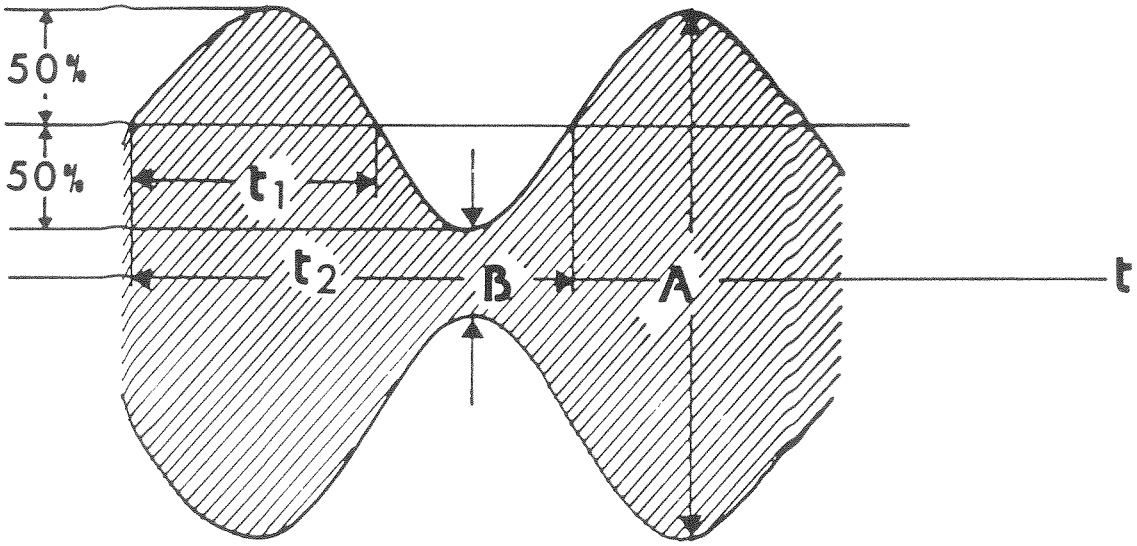
Where appropriate, the antenna shall be detached for a period of five minutes.

Where appropriate, the antenna feed point shall be short circuited for a period of five minutes.

Equipment with a non-detachable antenna shall be completely immersed in salt water for a period of five minutes with the antenna extended.

4.9.3. *Requirement*

After these operations the equipment shall function normally.




$$\text{Modulation depth} = \frac{A - B}{A + B} 100\%.$$

$$\text{Modulation duty cycle} = \frac{t_1}{t_2} 100\%.$$

Figure XI-1 (T/R 34-01).

# Annex XII

# Performance specifications for portable UHF radiotelephone equipment for on board communications for sea going ships

*Note:*
Text approved by the "Telecommunications" Commission at Copenhagen 1987.

Table of contents

# 1. INTRODUCTION

## 1.1. The scope of the specification

This specification states the minimum performance requirements for UHF radiotelephone equipment to be used for on board communications on sea going vessels and incorporates the provisions of the Radio Regulations and the requirements of SOLAS 1974 as amended (1983). Since apparatus equipped with a non-detachable antenna cannot be tested in accordance with this specification in every respect, the testing authority may decide to use alternative methods of measurement for such apparatus.

## 1.2. Definition

An on board communication station is a low power mobile station in the maritime mobile service intended for use in internal communications on board ships, or between a ship and its lifeboats and life-rafts during lifeboat drills or operations, or for communications within a group of vessels being towed or pushed, as well as for line handling and mooring instructions.

# 2. GENERAL REQUIREMENTS

## 2.1. Construction

2.1.1. In all respects the mechanical and electrical construction and the finish of the equipment and antenna shall conform with good engineering practice, and the equipment shall be suitable for use on board sea going vessels.

2.1.2. The equipment shall be operational and shall meet the requirements of this specification within 5 seconds of being switched on.

2.1.3. All controls shall be of such size to permit normal adjustments to be performed, and the number of controls should be the minimum for satisfactory and simple operation.

2.1.4. The equipment shall be so designed that it can be used in an emergency by unskilled personnel.

2.1.5. All controls, instruments, indicators, and terminals shall be clearly labelled. A label showing the type designation under which the equipment is submitted for type testing shall be fitted to the equipment.

2.1.6. Complete technical documentation shall be provided with the equipment.

2.1.7. Means shall be incorporated to prevent reversal of polarity of the battery power supply.

2.1.8. The design of the equipment should be such that any use of the controls shall not cause damage to the equipment.

2.1.9. The effect of the wind on the microphone shall be minimized.

2.1.10. The equipment, when operating, shall not be damaged by the effects of open circuited or short circuited antenna terminals.

## 2.2. Controls

2.2.1. The following controls shall be provided:

a) a non-locking push-to-talk switch to operate the transmitter;
b) a volume control to adjust the AF output power;
c) a squelch control;
d) a channel selector;
e) an on off switch with a visual indication that the equipment is switched on;
f) a switch to reduce the transmitter carrier power by 10 dB; this switch need not be provided for transmitters with a carrier power below 0.4 W (see also paragraph 5.2.).

2.2.2. *Remote control*

The equipment may be provided with facilities to enable remote control to be used.

Voice operated control of the equipment is not permitted.

2.3. **Class of emission and modulation characteristics**

2.3.1. The equipment shall use phase modulation, G3E (Frequency modulation with a pre-emphasis of 6 dB/octave).

2.3.2. The equipment shall be designed for operation with 25 kHz spacing between adjacent channels.

2.3.3. The frequency deviation corresponding to 100% modulation shall approach 5 kHz as nearly as possible. In no event shall the frequency deviation exceed ±5 kHz.

2.3.4. Transmission shall be inhibited until the frequency has stabilized within the required limits.

2.3.5. The time taken to change from the transmit condition to the receive condition shall not be longer than 0.3 seconds.

2.4. **Frequencies**

2.4.1. The equipment shall be capable of being fitted with at least channels A, B, and C from the following table and the channels shall be indicated as shown:
Channel A, corresponding to 467.525 MHz
Channel B, corresponding to 467.550 MHz
Channel C, corresponding to 467.575 MHz
Channel D, corresponding to 457.525 MHz
Channel E, corresponding to 457.550 MHz
Channel F, corresponding to 457.575 MHz

2.4.2. If a repeater arrangement is used, the following frequency pairs for the portable equipment shall be used.

| Tx | Rx |
|---|---|
| A | D |
| B | E |
| C | F |

2.4.3. To satisfy the requirements of SOLAS 1974 (as amended, chapter 4 reg. 14-3, chapter 3 reg. 6 paragraph 2.4. 1983), the equipment shall be fitted with at least one single-frequency simplex channel.

2.4.4. The channel designations and corresponding frequencies shall be labelled on the equipment.

2.5. **Battery**

2.5.1. The capacity of the battery shall be sufficient to operate the equipment continuously for at least 4 hours at any temperature condition (see paragraphs 3.3.1. and 3.4.1.) with a duty cycle of 1:9.
This duty cycle is defined as 6 seconds transmit, 6 seconds reception above squelch opening level and 48 seconds reception below squelch opening level.

2.5.2. The type of battery to be used shall be indicated on the equipment.

## 3. TEST CONDITIONS, POWER SOURCES AND AMBIENT TEMPERATURES

3.1. **Test conditions**

Type approval tests shall be made under normal and extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously), unless otherwise stated.

3.2. **Test power source**

Unless otherwise stated, the battery of the equipment shall be replaced by a test power source capable of producing normal and extreme test voltages as specified in paragraphs 3.3.2. and 3.4.2.
The voltage of the power source shall be measured at the input terminal of the equipment.

3.3. **Normal test conditions**

3.3.1. *Normal temperature and humidity*
The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:
Temperature: +15 C to +35 C
Relative humidity: 20% to 75%

3.3.2. *Normal test voltage*

The normal test voltage shall be determined in each case, and shall be the voltage corresponding to the voltage given by the battery under normal temperature and humidity at a load equal to that of the equipment.

3.4. **Extreme test conditions**

3.4.1. *Extreme temperatures*

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in paragraph 3.5. at the lower and upper temperatures of +15 °C and +55 °C.

3.4.2. *Extreme test voltage*

3.4.2.1. Upper extreme test voltage

The upper extreme test voltage shall be determined in each case and shall be the voltage corresponding to the voltage that the battery gives at the upper extreme temperature at the beginning of the battery test cycle (paragraph 2.5.1.) with a load equal to that of the equipment in the transmit condition.

3.4.2.2. Lower extreme test voltage

The lower extreme test voltage, in the case of Nickel Cadmium batteries, shall be 0.85 times the nominal voltage of the battery. For other types of battery, the extreme test voltages shall be those agreed between the equipment manufacturer and the testing authority.

3.5. **Procedure for tests at extreme temperatures**

The equipment shall be switched off during the temperature stabilization periods. Before tests at the upper temperature, the equipment shall be placed in the test chamber and left until thermal balance is attained. The equipment shall then be switched on in the transmit condition for a period of five minutes, meeting the specification both during and after this period. For tests at the lower temperature, the equipment shall be left in the test chamber until thermal balance is attained, then switched to the receive condition for a period of 1 minute after which the equipment shall meet the specified requirements.

3.6. **Environmental tests**

3.6.1. Before environmental tests are commenced, a test of the equipment to the other requirements of this specification shall be carried out. The term "performance check" shall be taken to mean functional and electrical tests to show that the equipment is functioning.

3.6.2. The following tests shall be made under environmental conditions as detailed in Annex VI to Recommendation T/R 34-01, "Environmental Testing of Maritime Radio Equipment":

| | |
|---|---|
| Vibration | Paragraph 4. |
| Damp-heat cycle | Paragraph 6. |
| Low-temperature cycle | Paragraph 7.1. |
| Corrosion tests | Paragraphs 10.1. and 10.2. |
| Dry Heat Cycle | Paragraph 5. |
| Rain Test | Paragraph 8. |

3.6.3. *Drop test*

Before any electrical tests (chapters 6. and 7.) are commenced a drop test shall be performed.

3.6.3.1. Definition

The immunity against the effects of dropping is the ability of the equipment to maintain the specified mechanical and electrical performance after being subjected to a series of drops on a hard wooden test surface.

3.6.3.2. Test conditions

During the test the equipment shall be fitted with a suitable set of batteries and antenna but it shall be switched off. The test shall be carried out under normal temperature and humidity conditions as detailed in paragraph 3.3.1.

The hard wooden test surface shall consist of a piece of solid hard wood with a thickness of minimum 15 cm and a mass of 30 kilograms or more.

The height of the lowest part of the equipment under test relative to the test surface at the moment of release shall be 1 m.

Equipment shall be subjected to this test in the configuration as it is normally used in operational circumstances.

If the equipment is to be used with, for example, a separate microphone and or loudspeaker, the test shall also be carried out for those accessories separately.

3.6.3.3. Method of measurement

The test shall consist of a series of six drops, once on each face.

3.6.3.4. Requirements

Inspection for mechanical damage, both internally and externally, shall be carried out after completion of tests in chapters 6. and 7. Any damage shall not impair the operation of the equipment. In particular parts like knobs, switches, and the antenna shall operate in the normal manner.

## 4. GENERAL CONDITIONS OF MEASUREMENTS

### 4.1. Arrangements for test signals applied to the receiver input

Sources of test signals for application to the receiver input shall be connected in such a way that the impedance presented to the receiver input is 50 ohms, irrespective of whether one or more signals are applied to the receiver simultaneously. The levels of the test input signals shall be expressed in terms of the e.m.f. which would exist at the output terminals to be connected to the receiver.

The effects of any intermodulation products and noise produced in the signal generators should be negligible. The nominal frequency of the receiver is the carrier frequency of the tuned channel.

### 4.2. Squelch

Unless otherwise specified, the squelch circuit shall be made inoperative for the duration of the type approval tests.

### 4.3. Normal test modulation

For normal test modulation, the modulation frequency shall be 1 kHz and the frequency deviation shall be ±3 kHz. The test signal shall be substantially free from amplitude modulation.

### 4.4. Artificial antenna

Where tests are carried out with an artificial antenna, this shall be a non-reactive non-radiating load of 50 ohms value.

### 4.5. Arrangement for test signal applied to the transmitter input

For the purpose of this specification, the transmitter audio frequency modulation signal shall be supplied by a generator applied at the connections of the microphone insert, unless otherwise stated.

The equipment shall be tested both with and without the remote control, if applicable.

## 5. TRANSMITTER

### 5.1. Frequency error

5.1.1. *Definition*

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

5.1.2. *Method of measurement*

The carrier frequency shall be measured in the absence of modulation with the transmitter connected to an artificial antenna (paragraph 4.4.).

5.1.3. *Limits*

The frequency error shall not exceed ±2.3 kHz.

### 5.2. Carrier power

5.2.1. *Definition*

The carrier power is the average power supplied to the artificial antenna (paragraph 4.4.) during one radio frequency cycle under the condition of no modulation.

The rated output power is the carrier power quoted by the manufacturer.

5.2.2. *Method of measurement*

The transmitter shall be connected to an artificial antenna (paragraph 4.4.) and the power delivered to this artificial antenna shall be measured.

The test shall be carried out with the carrier power reduction switch, if provided (see paragraph 2.2.1. f)) in the "full" as well as in the "reduced power" positions.

5.2.3. *Limits*

The carrier power measured under normal test conditions (paragraph 3.3.) shall not depart by more than 1.5 dB from the rated output power:

a) With the carrier power reduction switch in the "full power" position, the carrier power shall be between 0.1 W and 4 W for all conditions of test.

b) With the carrier power reduction switch in the "reduced power" position, the carrier power shall be at least 10 dB below the value determined in conformity with a) above.

5.3. **Frequency deviation**

5.3.1. *Definition*

For the purpose of this specification the frequency deviation is the difference between the instantaneous frequency of the modulated radio frequency signal and the nominal carrier frequency alone.

5.3.2. *Method of measurement*

The frequency deviation shall be measured at the output of the transmitter in an artificial antenna (paragraph 4.4.), by means of a deviation meter suitable for the measurement of the maximum deviation including that due to any harmonics and intermodulation products which may be produced in the transmitter. The modulating frequency shall be varied between the lowest frequency considered to be appropriate, and 3 kHz. The level of this test signal shall be 20 dB above the level which produces normal test modulation (paragraph 4.3.).

5.3.3. *Limits*

The maximum permissible frequency deviation is $\pm 5$ kHz.

5.4. **Reduction of frequency deviation at modulation frequencies above 3 kHz**

5.4.1. *Method of measurement*

The transmitter shall be operated under normal test conditions (paragraph 3.3.) and loaded in accordance with paragraph 4.4. The transmitter shall be modulated with normal test modulation (paragraph 4.3.). With a constant input level of the modulation signal, the frequency shall be varied from 3 kHz and the frequency deviation shall be measured.

5.4.2. *Limits*

The frequency deviation at modulation frequencies between 3 kHz and 6 kHz shall not exceed the frequency deviation at a modulation frequency of 3 kHz. At 6 kHz the deviation shall not exceed $\pm 1.5$ kHz.

The frequency deviation at modulation frequencies between 6 kHz and 25 kHz shall not exceed that given by a linear response of frequency deviation (in decibels) against modulation frequency, starting at a point where the frequency is 6 kHz and the deviation is $\pm 1.5$ kHz and having a slope of 14 dB per octave, the frequency deviation diminishing as the modulation frequency is increased.

5.5. **Limiting characteristics of the transmitter modulator**

5.5.1. *Definition*

This characteristic expresses the ability of the transmitter to be modulated near the maximum permissible deviation (paragraph 5.3.3.).

5.5.2. *Method of measurement*

A modulation signal at a frequency of 1,000 Hz adjusted in level to produce a frequency deviation of $\pm 1$ kHz shall be applied to the transmitter. The level of the signal shall then be increased by 20 dB and the deviation shall again be measured.

5.5.3. *Limits*

The frequency deviation shall be between $\pm 3.5$ kHz and $\pm 5$ kHz.

5.6. **Sensitivity of the modulator including the microphone**

5.6.1. This characteristic expresses the ability of the transmitter to produce a sufficient modulation, when a specified acoustic tone signal, corresponding to the normal average speech volume, is applied to the microphone.

5.6.2. *Method of measurement*

An acoustic tone signal of 1,000 Hz is applied to the microphone in such a way that a sound level of 94 dB relative to $2 \times 10^{-5}$ Pascal at its membrane is produced, and the resultant deviation is measured. The measurement shall only be performed at normal test conditions.

5.6.3. *Limits*

The frequency deviation shall be between ±3 kHz and ±4.5 kHz.

5.7. **Transmitter audio frequency response**

5.7.1. The transmitter audio frequency response expresses the ability of the transmitter to operate without excessive degradation of the frequency response, as a function of the modulation frequency.

5.7.2. *Method of measurement*

A modulation signal, at a frequency of 1,000 Hz adjusted in the level to produce a frequency deviation of ±1 kHz, is applied to the transmitter. The modulation frequency is then varied between 300 Hz and 3,000 Hz, the audio input level being kept constant and equal to the above value.

The measurement shall only be performed at normal test conditions.

5.7.3. *Limits*

The modulation index (ratio of the frequency deviation to the modulating frequency) shall be constant and equal to its value at 1,000 Hz within the limits of +1 dB and −3 dB.

5.8. **Audio frequency harmonic distortion of the emission**

5.8.1. *Definition*

The harmonic distortion of the emission modulated by an audio frequency signal is the percentage of the total r.m.s. voltage of all harmonics to the total r.m.s. voltage after linear demodulation.

5.8.2. *Method of measurement*

The audio frequency signal produced by the transmitter is applied through a suitable coupling device to a linear demodulator with a de-emphasis network of 6 dB/octave. (The time constant of this coupling device shall be at least 750 µs.)

5.8.2.1. Normal test conditions

Under normal test conditions (paragraph 3.3.) the radio frequency signal is modulated in turn at 300 Hz, 500 Hz and 1,000 Hz with a constant modulation index of 3.

The audio frequency harmonic distortion is measured at all the above frequencies.

5.8.2.2. Extreme test conditions

Under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously), the measurement shall be carried out at 1,000 Hz with a frequency deviation of ±3 kHz.

5.8.3. *Limits*

The audio frequency harmonic distortion shall not exceed 10%.

5.9. **Adjacent channel power**

5.9.1. *Definition*

The adjacent channel power is that part of the total power output of a transmitter under defined conditions of modulation, which falls within the bandwidth of a receiver of the type normally used in the system and operating in either of the adjacent channels. This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter.

5.9.2. *Methods of measurement*

5.9.2.1. General remarks

Two methods are proposed, the results of which are equivalent. The method applied shall be stated in the test report.

5.9.2.2. Method of measurement using a power measuring receiver

The adjacent channel power may be measured with a power measuring receiver which conforms to Appendix 1 (referred to in paragraph 5.9.2.2. and Appendix 1 as "the receiver").

The transmitter shall be operated under normal test conditions (paragraph 3.3.). The output of the transmitter shall be applied to the input of the receiver using a connecting arrangement such that the impedance presented to the transmitter is equal to that of the artificial antenna specified in paragraph 4.4. and the level at the receiver input is appropriate. The transmitter shall be modulated at 1,250 Hz and a level which is 20 dB greater than that required to produce a frequency deviation of ±3 kHz.

The receiver shall be tuned to the nominal frequency of the transmitter and the variable attenuator in the receiver shall be adjusted to a value p dB such that a meter reading of the order of 5 dB above the receiver noise level is obtained. The receiver shall then be tuned to the nominal frequency of one of the adjacent channels and the variable attenuator shall be adjusted to a value q dB such that the same meter reading is obtained.

The ratio of the carrier power to adjacent channel power is the difference between the attenuator settings p and q. The adjacent channel power is determined by applying this ratio to the carrier power as determined in paragraph 5.2. The measurements shall be repeated for the other adjacent channel.

5.9.2.3. Method of measurement using a spectrum analyser

The adjacent channel power may be measured with a spectrum analyser which conforms to paragraph 5.9.2.4.

The transmitter shall be operated under normal test conditions (paragraph 3.3.). The output of the transmitter shall be applied to the input of the spectrum analyser using a connecting arrangement such that the impedance presented to the transmitter is equal to that of the artificial antenna specified in paragraph 4.4. and the level at the analyser input is appropriate.

The transmitter shall be modulated at 1,250 Hz at a level which is 20 dB greater than that required to produce a frequency deviation of ± 3 kHz.

The spectrum analyser shall be adjusted so that the spectrum of the transmitter output, including that part which falls in the adjacent channels, is displayed.

The adjacent channel power shall be calculated by summing the power of all the frequency components, including noise, falling inside a bandwidth of 16 kHz. The measurement shall be made in each of the adjacent channels.

5.9.2.4. Spectrum analyser specification

The spectrum analyser shall meet the following requirements. It shall be possible to measure the amplitude of a signal or noise at a level of 3 dB or more above the noise level of the spectrum analyser, as displayed on the screen, to an accuracy of ± 2 dB, in the presence of a signal separated in frequency by 10 kHz, at a level of 90 dB above the level of the signal to be measured at a resolution bandwidth of 1 kHz.

The accuracy of relative amplitude measurements shall be within ± 1 dB. It shall be possible to adjust the spectrum analyser to allow the separation on its screen of two components with a frequency difference of 1 kHz.

5.9.3. *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 microwatts.

## 5.10. Spurious emissions

5.10.1. *Definition*

Spurious emissions are emissions at frequencies other than those of the carrier and sidebands associated with normal modulation.

The level of spurious emissions shall be measured as:

a) their power level in a transmission line or artificial antenna, and

b) their effective radiated power when radiated by the antenna, cabinet and structure of the equipment.

5.10.2. *Method of measuring the power level*

Spurious emissions shall be measured as the power level of any discrete signal delivered into a 50 ohms load. This may be done by connecting the transmitter output through an attenuator to a spectrum analyser or selective voltmeter, or by monitoring the relative levels of the spurious signals delivered to an artificial antenna (paragraph 4.4.).

The transmitter shall be unmodulated and the measurements made over the frequency range 9 kHz to 2 GHz, except for the channel on which the transmitter is intended to operate and its adjacent channels. The measurements shall be repeated with the transmitter modulated with normal test modulation (paragraph 4.3.).

5.10.3. *Method of measuring the effective radiated power*

On a test site, fulfilling the requirements of Appendix 2, the sample shall be placed at the specified height on a non-conducting support. The transmitter shall be operated at the carrier power as specified under paragraph 5.2, delivered to its normal antenna without modulation. Radiation of any spurious components shall be detected by the test antenna and receiver, over the frequency range 30 MHz - 2 GHz, except for the channel on which the transmitter is intended to operate and its adjacent channels.

At each frequency at which a component is detected, the sample shall be rotated to obtain maximum response and the effective radiated power of that component determined by a substitution measurement. The measurement shall be repeated with the test antenna in the orthogonal polarisation plane. The measurements shall be repeated with the transmitter modulated with standard test modulation (paragraph 4.3.). The measurement shall be performed at normal test conditions and with the normal battery power supply.

5.10.4. *Limits*

The power of any spurious emissions in the range 9 kHz to 2 GHz shall not exceed 0.25 microwatts.

5.11. **Residual modulation of the transmitter**

5.11.1. *Definition*

The residual modulation of the transmitter is the ratio in dB, after demodulation, of the audio frequency power of the radio frequency signal in the absence of wanted modulation to the audio frequency power produced when the normal test modulation is applied to the transmitter.

5.11.2. *Method of measurement*

The normal test modulation (paragraph 4.3.) is applied to the transmitter. The radio frequency signal produced by the transmitter is applied through a suitable coupling device to a linear demodulator provided with a de-emphasis network of 6 dB/octave. (The time constant of this de-emphasis network shall be at least 750 μs.)

Attention should be paid to avoiding the effects of emphasising the low frequency components of internally generated noise. The modulation is then removed and the level of the audio frequency signals is again measured.

The measurement shall only be performed at normal test conditions.

5.11.3. *Limits*

The residual modulation shall not be greater than −40 dB.

6. **RECEIVER**

6.1. **Harmonic distortion and rated audio output power**

6.1.1. *Definition*

The harmonic distortion at the output of the receiver is defined as the percentage of the total r.m.s. voltage of all harmonics to the total r.m.s. voltage delivered by the receiver. The rated audio output power is the value stated by the manufacturer to be the maximum available output power for which all requirements of this specification are met.

6.1.2. *Methods of measurement*

Test signals of levels of +60 dB and +100 dB relative to 1 microvolt at a carrier frequency equal to the nominal frequency of the receiver, and with normal test modulation are successively applied to the input of the receiver under the conditions of paragraph 5.1. For each measurement the volume control of the receiver shall be set such that the rated audio output power is obtained in a resistive load simulating the load with which the receiver is intended to operate. The value of this load shall be stated by the manufacturer. Under normal test conditions the test signal is modulated in turn at 300 Hz, 500 Hz and 1,000 Hz with a constant modulation index of 3 (ratio of frequency deviation to the modulation frequency). The harmonic distortion and audio output power are measured at each of the above frequencies.

Under extreme test conditions (paragraphs 3.4.1. and 3.4.2. applied simultaneously) the test shall be carried out at the nominal frequency of the receiver and also at frequencies of plus and minus 1.5 kHz relative to the nominal frequency. For these tests the modulation shall be 1,000 Hz and the frequency deviation shall be ±3 kHz.

6.1.3. *Limits*

The rated audio output power shall be at least:
- 200 mW for loudspeaker reception;
- 1 mW for headphone reception.

The harmonic distortion shall not exceed 10%.

6.2. **Audio frequency response**

6.2.1. *Definition*

The receiver audio frequency response is defined as the variation in the audio frequency output level of the receiver as a function of the modulation frequency of the radio frequency signal with constant deviation at the input.

6.2.2. *Method of measurement*

A test signal at a level of +60 dB relative to 1 microvolt, at a carrier frequency equal to the nominal frequency of the receiver is applied to the input of the receiver under the conditions of paragraph 4.1. The volume control of the receiver shall be adjusted to produce an audio output power of 50% of the rated audio output power (paragraph 6.1.), when normal test modulation is applied. This setting shall remain unchanged during this test.

The frequency deviation is then reduced to ±1 kHz. The deviation shall remain constant as the modulation frequency is varied between 300 Hz and 3,000 Hz and the output level is measured.

This measurement shall be repeated with the test signal at a frequency equal to the nominal frequency of the receiver plus and minus 1.5 kHz.

The measurements shall only be performed at normal test conditions.

6.2.3. *Limits*

The response of the receiver shall not depart by more than +1 dB or −3 dB from a characteristic giving the output level as a function of the audio frequency, decreasing by 6 dB per octave and passing through the measured point at 1,000 Hz.

## 6.3. Maximum usable sensitivity

6.3.1. *Definition*

The maximum usable sensitivity of the receiver is the minimum level of the signal at the receiver input, at the nominal frequency of the receiver, with normal test modulation which will produce:

- in all cases, an audio output power of 50% of the rated output power (paragraph 6.1.), and
- an SND/ND ratio of 20 dB, measured at the receiver output, through a telephone psophometric weighting network as described in CCITT Recommendation P.53.

6.3.2. *Method of measurement*

A test signal at a carrier frequency equal to the nominal frequency of the receiver and with normal test modulation shall be applied to the input of the receiver. An audio frequency output load (paragraph 6.1.2.) and a meter appropriate for measuring the SND/ND ratio through the psophometric network mentioned in paragraph 6.3.1. shall be connected to the receiver output terminals.

The test signal input level shall then be adjusted until a psophometrically weighted SND/ND ratio of 20 dB is obtained, the receiver volume control being adjusted to give 50% of the rated audio output power. The test signal input level under these conditions is the value of the sensitivity.

A variation of the output power ±3 dB relative to 50% of the rated audio output power may be allowed when making sensitivity measurements under extreme test conditions.

6.3.3. *Limits*

The maximum usable sensitivity shall not exceed +6 dB, relative to 1 microvolt under normal test conditions and +12 dB, relative to 1 microvolt under extreme test conditions.

## 6.4. Co-channel rejection

6.4.1. *Definition*

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being on the wanted channel of the receiver.

6.4.2. *Method of measurement*

The two input signals shall be connected to the receiver in the manner specified in paragraph 4.1. The wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation. The unwanted signal shall be modulated at 400 Hz with a frequency deviation of ±3 kHz. Initially it shall also be at the nominal frequency of the receiver under test. The unwanted input signal shall first be switched off and the wanted input signal shall be adjusted to the maximum usable sensitivity level (paragraph 6.3.).

The unwanted signal shall then be switched on, its carrier frequency shall be varied between −3 kHz and +3 kHz relative to the nominal frequency of the receiver in order to search for maximum degradation of the SND/ND ratio at the output of the receiver, and its input level shall be adjusted until the ratio would be reduced from 20 dB (psophometrically weighted) to 14 dB.

The co-channel rejection ratio shall be expressed as the ratio in dB of the level of the unwanted signal to the level of the wanted signal at the receiver input, for which the above mentioned reduction in SND/ND ratio occurs.

The measurement shall only be performed at normal test conditions.

6.4.3. *Limits*

The co-channel rejection ratio shall be between −8 dB and 0 dB.

6.5. **Adjacent channel selectivity**

6.5.1. *Definition*

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal which differs in frequency from the wanted signal by 25 kHz.

6.5.2. *Method of measurement*

The two input signals shall be connected to the receiver in the manner specified in paragraph 4.1. The wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation (paragraph 4.3.).

The unwanted signal shall be at the frequency of the channel immediately above that of the wanted signal, and shall be modulated at 400 Hz with a frequency deviation of ± 3 kHz. Initially, the unwanted signal shall be switched off and the wanted signal adjusted to the maximum usable sensitivity level (paragraph 6.3.). The unwanted signal shall then be switched on and the input level adjusted until either the SND/ND ratio or the SND/N ratio of 20 dB psophometrically weighted at the output of the receiver is reduced to 14 dB.

This measurement shall be repeated with the unwanted signal at the frequency of the channel below that of the wanted signal. The adjacent channel selectivity shall be expressed as the lower value of the ratios in dB for the upper and lower adjacent channels of the level of the unwanted signal to the level of the wanted signal.

6.5.3. *Limits*

The adjacent channel selectivity shall not be less than 70 dB under normal test conditions and not less than 60 dB under extreme test conditions.

6.6. **Spurious response rejection**

6.6.1. *Definition*

The spurious response rejection is a measure of the capability of the receiver to discriminate between the wanted modulated signal at the nominal frequency and an unwanted signal at any other frequency at which a response is obtained.

6.6.2 *Method of measurement*

The input signals shall be connected to the receiver in the manner specified in paragraph 4.1. The wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation.

Initially the unwanted signal shall be switched off and the wanted input signal shall be adjusted to the sensitivity level (paragraph 6.3.).

The unwanted signal shall be switched on and shall be modulated with a frequency of 400 Hz at a frequency deviation of ± 3 kHz and the input level shall be +90 dB relative to 1 microvolt. The frequency shall then be varied over the frequency range from 9 kHz to 2 GHz. At any frequency at which a response is obtained, the input level shall be adjusted until the SND/ND ratio of 20 dB at the output of the receiver, psophometrically weighted, is reduced to 14 dB. The spurious response rejection ratio shall be expressed in dB as the ratio between the unwanted signal at the receiver input, when the above mentioned reduction in the SND/ND ratio is obtained. The measurement shall only be performed at normal test conditions.

6.6.3. *Limits*

The spurious response rejection ratio shall not be less than 70 dB at any frequency separated from the nominal frequency of the receiver by more than 25 kHz.

6.7. **Intermodulation response**

6.7.1. *Definition*

The intermodulation response is a measure of the capability of a receiver to inhibit the generation of in-band signals caused by the presence of two or more signals at unwanted frequencies.

6.7.2. *Method of measurement*

Two signal generators A and B shall be connected to the receiver in the manner specified in paragraph 4.1.

Initially signal generator B shall be switched off. The signal from signal generator A shall be at the nominal frequency of the receiver and shall have normal test modulation. The input to the receiver from signal generator A shall be adjusted to the maximum usable sensitivity level (paragraph 6.3.).

This level shall be noted. Signal generator A shall then be adjusted to a frequency separated by 50 kHz above (or below) the nominal frequency. Signal generator B shall then be switched on. It shall be unmodulated and shall be adjusted to the frequency separated by 25 kHz above (or below) the nominal frequency. The output levels of the two signal generators shall be kept equal and increased in level until a SND/ND ratio of 20 dB (psophometrically weighted) is again produced at the output of the receiver.

The frequency of signal generator A shall be adjusted slightly if necessary to produce the maximum SND/ND ratio. The levels of the two test signals shall be readjusted to restore the ratio of 20 dB. The ratio, in dB, of the output levels of the two signal generators to that noted for generator A alone at the nominal frequency of the receiver is the intermodulation response ratio.

The measurement shall be performed only at normal test conditions.

6.7.3. *Limits*

The intermodulation response ratio shall not be less than 70 dB.

6.8. **Blocking**

6.8.1. *Definition*

Blocking is a change (generally a reduction) in the wanted output power of the receiver, or a reduction of the SND/ND ratio, due to an unwanted signal on another frequency.

6.8.2. *Method of measurement*

Two input signals shall be connected to the receiver in the manner specified in paragraph 4.1. The modulated wanted signal shall be at the nominal frequency of the receiver and shall have normal test modulation. Initially the unwanted signal shall be switched off and the input level of the wanted signal shall be adjusted to be +6 dB relative to 1 microvolt. The audio output power of the wanted signal shall be adjusted to 50% of the rated audio output power. The unwanted signal shall be unmodulated, and the frequency shall be varied between +1 MHz and +10 MHz, and also between −1 MHz and −10 MHz, relative to the nominal frequency of the receiver. The input level of the unwanted signal, at all frequencies in the specified ranges, shall be adjusted so that the unwanted signal causes:

a) a reduction of 3 dB in the output level of the wanted signal, or

b) a reduction of the SND/ND ratio (psophometrically weighted) to 14 dB,

whichever occurs first, a) or b). This input level is the blocking level for the frequency concerned.

The measurement shall be performed only at normal test conditions.

6.8.3. *Limits*

The blocking level for any frequency within the specified ranges shall not be less than +90 dB relative of 1 microvolt, except at frequencies on which spurious responses are found (paragraph 6.6.).

6.9. **Spurious emissions**

6.9.1. *Definition*

Spurious emissions are any radio frequency emissions from the equipment in the receive condition.

The level of spurious emissions shall be measured as:

a) their power level in a transmission line or artificial antenna, and

b) their effective radiated power when radiated by the cabinet and structure of the equipment.

6.9.2. *Method of measuring the power level*

Spurious emissions shall be measured as the power level of any discrete signal at the input terminals of the receiver. The receiver input terminals are connected to a spectrum analyser or selective voltmeter having an input impedance of 50 ohms and the receiver is switched on. If the detecting device is not calibrated in terms of power input, the level of any detected components shall be determined by a substitution method using a signal generator.

The measurements shall extend over a frequency range of 9 kHz to 2 GHz.

6.9.3. *Method of measuring the effective radiated power*

On a test site fulfilling the requirements in Appendix 2, the sample shall be placed at specified height on a non-conducting support. The receiver should be powered by its normal battery supply.

Radiation of any spurious components shall be detected by the test antenna and the receiver over the frequency range 30 MHz to 2 GHz.

At each frequency at which a component is detected, the sample shall be rotated to obtain maximum response and the effective radiated power of that component determined by a substitution measurement.

The measurement shall only be performed at normal test conditions.

The measurement shall be repeated with the antenna in the orthogonal polarisation plane.

6.9.4. *Limits*

The power of any spurious emission shall not exceed 2 nanowatts.

6.10. **Amplitude characteristics of the receiver limiter**

6.10.1. *Definition*

The amplitude characteristic of the receiver limiter is the relationship between the radio frequency input level of a specified modulated signal, and the audio frequency level at the receiver output.

6.10.2. *Method of measurement*

A test signal at the nominal frequency of the receiver, with normal test modulation, at a level of +6 dB relative to 1 microvolt, shall be applied to the input of the receiver, and the audio output power (paragraph 6.1.) shall be measured. The input signal shall be increased to +100 dB relative to 1 microvolt and the level of the audio output power shall again be measured.

The measurement shall be performed only at normal test conditions.

6.10.3. *Limits*

For the specified change in radio frequency input level, the change of audio output level shall not exceed 3 dB between the maximum and minimum output levels.

6.11. **Noise and hum of the receiver**

6.11.1. *Definition*

The noise and hum level of the receiver is defined as the ratio, in dB, of the audio frequency noise and hum resulting from the parasitic effects of the power supply or other causes, to the audio output power produced when a moderately high level radio frequency signal, with normal test modulation, is applied at its input.

6.11.2. *Method of measurement*

A test signal at a level of +30 dB relative to 1 microvolt at a carrier frequency equal to the nominal frequency of the receiver, with normal test modulation, shall be applied to the receiver input terminals. Audio frequency output load and psophometric filter network (paragraph 6.3.1.) shall be connected to the receiver output terminals. The receiver volume control shall be adjusted to produce the rated audio output power as defined in paragraph 6.1.

The output signal is measured by means of an r.m.s. voltmeter. The modulation is then removed and the level of the audio frequency output is again measured.

The measurement shall only be performed at normal test conditions.

6.11.3. *Limits*

The noise and hum level shall not be greater than −40 dB.

6.12. **Squelch operation**

6.12.1. The purpose of the squelch circuit is to silence the receiver when the signal at the receiver input is below a given level.

6.12.2. *Methods of measurement*

a) With the squelch circuit rendered inoperative, a test signal at a level of +30 dB relative to 1 microvolt, at a carrier frequency equal to the nominal frequency of the receiver, with normal test modulation, shall be applied to the receiver input terminals. An audio frequency output load and a psophometric filter network (paragraph 6.3.1.) shall be connected to the receiver output terminals. The receiver volume control shall be adjusted to produce the rated audio power as defined in paragraph 6.1. The output signal is measured by means of an r.m.s. voltmeter. The input signal shall then be removed, the squelch circuit put into operation, and the level of the audio frequency output again measured.

b) With the squelch circuit rendered inoperative, a test signal with normal test modulation shall be applied to the receiver input at a level of +6 dB relative to 1 microvolt, and the receiver shall be adjusted to give 50% of the rated audio output power.
The squelch circuit shall then be put into operation, and the SND/ND ratio shall be measured.

c) Applicable only to equipment with continuously adjustable squelch control. With the squelch circuit rendered inoperative, a test signal with normal test modulation shall be applied to the receiver input at a level of +6 dB relative to 1 microvolt, and the receiver shall be adjusted to give 50% of the rated audio output power. The squelch circuit shall then be put into operation at its maximum position, and the level of the input signal shall be increased until the output power again is 50% of the rated audio output power.

The measurements shall only be performed at normal test conditions.

6.12.3. *Limits*

Under the conditions of paragraph 6.12.2. a), the audio frequency level shall not exceed −40 dB relative to rated audio output power.

Under the conditions of paragraph 6.12.2. b), the SND/ND ratio shall be at least 20 dB and the output power shall be at least 50% of the rated audio output power.

Under the conditions of paragraph 6.12.2. c), the input level shall not exceed +40 dBμV.

## Appendix 1

## POWER MEASURING RECEIVER SPECIFICATION

The power measuring receiver shall consist of a mixer, a crystal filter, a variable attenuator, an amplifier and a r.m.s. voltmeter all connected in cascade, and a local oscillator. The local oscillator may be a signal generator.

The bandwidth of the filter shall be as follows:

1. between 6 dB attenuation points: 16 ± 1.6 kHz;
2. between 70 dB attenuation points: 35 ± 3.5 kHz;
3. between 90 dB attenuation points: 50 ± 5 kHz.

The attenuator shall cover a minimum range of 80 dB in 1 dB steps. However, in order to cater for future requirements a range of 90 dB or more is recommended.

The noise factor of the amplifier shall not be worse than 4 dB. The amplitude frequency characteristic of the amplifier shall not vary more than 1 dB over the bandwidth of 16 kHz.

If the attenuation of the crystal filter is less than 90 dB outside the bandwidth of 50 kHz as specified above, the amplitude/frequency characteristic of the amplifier shall be such that the combined attenuation of the crystal filter and amplifier is not less than 90 dB.

The r.m.s. voltmeter shall indicate, at full scale, the r.m.s. value of non-sinusoidal signals having a ratio of peak amplitude to r.m.s. amplitude of up to at least 10.

The measuring equipment shall be such that the power measurements will remain accurate to within 1.5 dB when the input level of the receiver is increased by 100 dB above the minimum level measurable.

The level of the noise of the local oscillator shall not be greater than — 90 dB relative to the level of the carrier of the local oscillator in a band 16 kHz wide, centred on a frequency separated from the carrier by 25 kHz.

Appendix 2

# TEST SITE AND GENERAL ARRANGEMENTS FOR MEASUREMENTS INVOLVING THE USE OF RADIATED FIELDS

## 1. Test site

The test site shall be on a reasonably level surface or ground.

At one point on the site, a ground plane of at least 5 metres 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 metres 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 metres whichever is the greater. The distance actually used shall be recorded with the results of the tests carried out on the site.

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

## 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 measurements of receiver characteristics.

This antenna is mounted on a support such as to allow the antenna to be used in either horizontal or vertical polarisation and for the height of its centre above ground to be varied over the range 1-4 metres. 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 radiation measurements, the test antenna is connected to a test receiver, capable of being tuned to any frequency under investigation and of measuring accurately the relative levels of signals at its input. When necessary (for receiver measurements) the test receiver is replaced by a signal source.

## 3. Substitution antenna

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. The centre 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 30 cm.

The substitution antenna shall be connected to a calibrated signal generator when the site is used for radiation measurements and to a calibrated measuring receiver when the site is used for measurement of receiver characteritics. 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.

## 4. 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 metres by 7 metres and at least 2.7 metres in height.

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 site arrangement is in principle shown in Figure XII-1 (T/R 34-01).

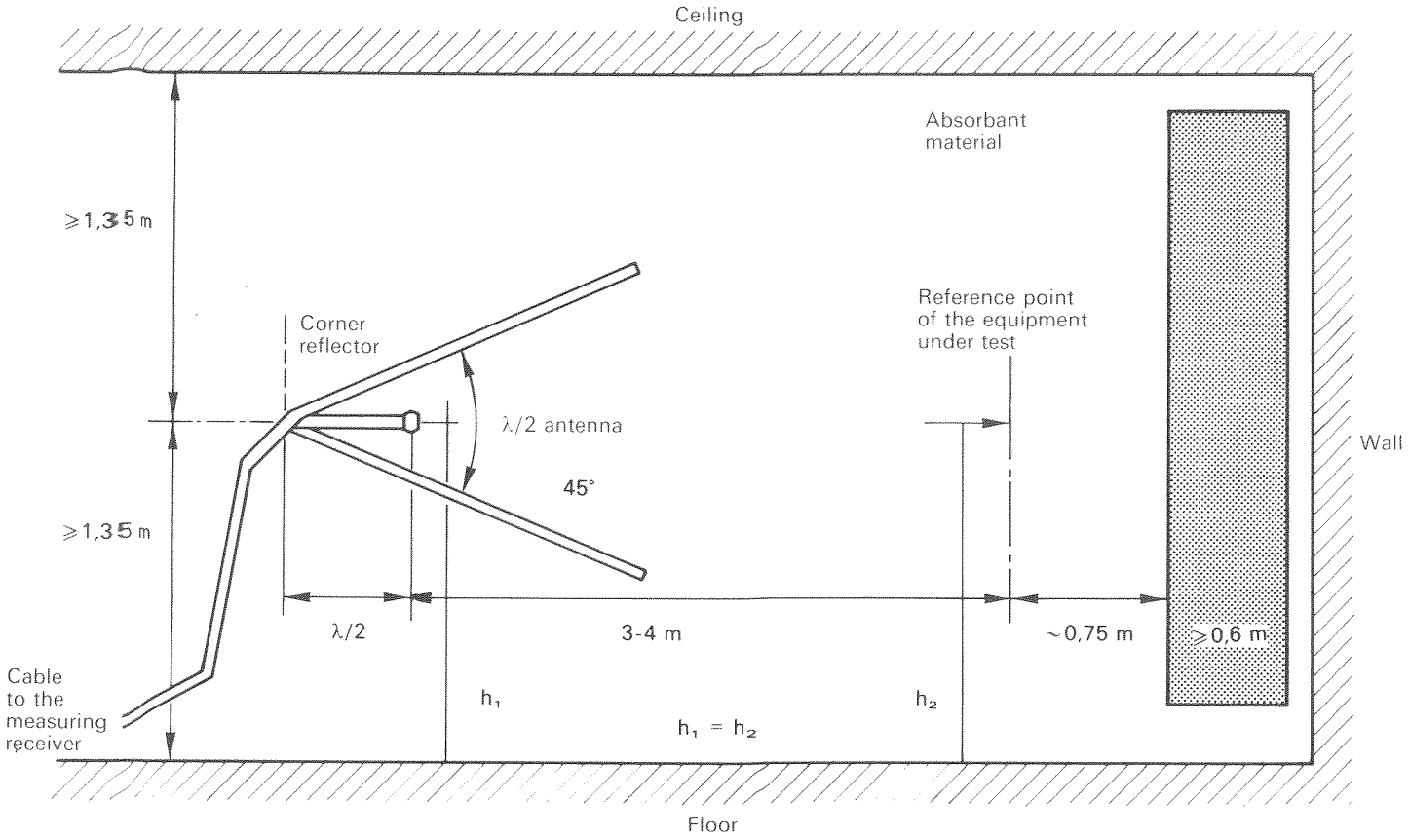



Figure XII-1 (T/R 34-01).

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 polarised measurements.

Similarly, the corner reflector reduces the effects of reflections from the side walls for vertically polarised measurement.

For the lower part of the frequency range (below approximately 175 MHz) no corner reflector or absorbent barrier is needed. For practical reasons, the λ/2 antenna in Figure XII-1 (T/R 34-01) may be replaced by an antenna of constant length, provided that this length is between λ/4 and λ at the frequency of measurement and the sensitivity of the measuring system is sufficient. In the same way, the distance to the apex max be varied from λ/2.

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

To ensure that errors are not caused by the propagation path approaching the point at which phase cancellation between direct and the remaining reflected signals occurs, the substitution antenna shall be moved through a distance of ± 10 cm in the direction of the test antenna as well as in the two directions perpendicular to this first direction.

If these changes of distance cause a signal change of greater than 2 dB, the test sample should be resited until a change of less than 2 dB is obtained.

# Annex XIII

# Performance specifications for equipment for the generation, transmission and reception of digital selective calls in the maritime MF/HF and VHF mobile service

*Note:*
Text approved by the "Telecommunications" Commission at Copenhagen 1987.

Table of contents

FIGURES

# 1. INTRODUCTION

This specification states the minimum performance requirements for equipment to be used for generation, transmission and reception of digital selective calls for use on board ships.

Digital Selective Calling is used in the MF, HF and VHF maritime mobile service, both in connection with distress and safety communication and in connection with public correspondence.

This specification covers the requirements to be fulfilled by

- digital selective calling equipment integrated with a transmitter and/or a receiver
- digital selective calling equipment not integrated with a transmitter or a receiver

If the equipment, or parts of it, is designed in such manner that it can also be used for other categories of maritime radio communication (e.g. radiotelephony, narrow-band direct printing), the relevant parts of the equipment shall furthermore fulfil the requirements of the relevant annexes of CEPT Recommendation T/R 34-01 applicable to equipment for the service(s) in question.

These requirements include the provisions of the ITU Radio Regulations, CCIR Recommendations 493-3, 541-2, and relevant resolutions of the International Maritime Organization.

Equipment for generation, transmission and reception of digital selective calls is recommended to be designed according to following equipment classes:

Class A. Including all facilities of Annex I of CCIR Recommendation 493-3.

Class B. Providing minimum facilities for equipment on ships not required to use Class A equipment. This equipment should provide for:

- alerting, acknowledgement and relay facilities for distress purposes,
- calling and acknowledgement for general communication purposes,
- calling in connection with semi-automatic/automatic VHF services,

as defined in CCIR Recommendation 493-3, Annex II, paragraph 3.

Class C. Simple add-on for existing VHF transceivers as defined in CCIR Recommendation 493-3, Annex II, paragraph 4.

# 2. GENERAL REQUIREMENTS FOR THE EQUIPMENT

## 2.1. Construction

2.1.1. The equipment shall comprise the necessary facilities for coding and transmission of digital selective calls and for decoding and conversion of the information content of received digital selective calls to visual form in plain language.

2.1.2. The design and function of Digital Selective Calling equipment shall comply with the provisions of CCIR Recommendation 493-3.

2.1.3. *The equipment can be either*

a) an independent unit for connection to an external radio installation designed for maritime radio communication within one or more of the frequency bands 415-526.5 kHz, 1,606.5-4,000 kHz, 4-28 MHz and 156.025-162.025 MHz;

b) mechanically and electrically integrated in such radio equipment.

2.1.4. If the equipment is designed as an independent DSC unit for connection to the AF terminals of external radio equipment, the input and output impedances shall be 600 ohms free of earth and the closed circuit level shall be adjustable to a voltage of 0.775 V ± 10 dB.

2.1.5. Where inputs and outputs are used at DC levels, the logic level shall comply with CCITT standard V.10 and the appropriate functions shall comply with CCITT standard V.24.

2.1.6. The equipment shall be constructed in conformity with good engineering practice, both mechanically and electrically, and shall be suitable for use on board ships.

2.1.7. The equipment shall be so designed that in the decoding process the greatest possible use is made of parity bits for error detection, time multiplex repetitions and error check characters in the received call, cf. CCIR Recommendation 493-3, Annex I, paragraph 1.6 and (if appropriate) paragraph 1.7.2.

2.1.8. All parts of the equipment which are subject to inspection or adjustment shall be readily accessible. It shall be easy to identify the individual parts of the equipment.

2.1.9. The equipment shall be so constructed that its main modules can easily be replaced and put into operation without elaborate calibration or re-adjustment.

2.1.10. In the construction of the equipment steps should be taken to the extent reasonable and practicable to ensure electromagnetic compatibility between the equipment and other electronic communication and navigational equipment on board the ship.

2.1.11. Equipment constructed for digital selective calling on frequencies both in the MF HF range and in the maritime VHF band shall automatically select the signal characteristics relevant to the frequency range concerned (CCIR Recommendation 493-3, Annex I, paragraphs 1.2 and 1.3).

2.1.12. The receiver part of the equipment shall be designed for continuous operation.

2.1.13. The equipment shall be designed for continuous watch on the frequencies to which it is set (taking into account any scanning loss where a scanning receiver is employed – see CCIR Report 908-1, Annex I).

2.2. **Operational facilities, general**

2.2.1. The number of operational controls, their location, size, design and manner of functioning shall provide for simple, quick and efficient operation of the equipment, and such that the risk of inadvertent activation is minimized.

2.2.2. All operational controls shall be easy to be identified from the position at which the operator operates the equipment.

2.2.3. Where an input panel on the equipment for entering the digits 0 to 9 is provided, this shall be in conformity with CCITT Recommendation E.161.

2.2.4. Controls which are not necessary for normal operation of the equipment shall not be readily accessible to the operator.

2.2.5. If the equipment is provided with light sources for indication, illumination, etc., the equipment shall be provided with a control by which the light from such sources can be reduced either continuously or in steps to the point of extinction. For warning and alarm indicators which are illuminated in the warning alarm condition, it shall be possible to reduce but not totally extinguish the illumination.

2.2.6. The equipment shall be so designed that misuse of the controls cannot cause damage to the equipment or injury to personnel.

2.2.7. Means shall be provided to interrupt the transmissions and to reset the equipment manually.

2.2.8. The equipment shall be capable of transmitting DSC calls within 60 seconds after switching on.

2.2.9. Equipment for transmission of digital selective calls in the maritime VHF band shall be provided with facilities which, except for distress and safety calls, automatically prevents the transmission of a digital selective call until the channel is free.

2.2.10. It shall be possible to reduce the carrier power of a transmitter transmitting digital selective calls in the maritime VHF band to 1 watt or less.

2.3. **Facilities for coding and decoding of digital selective calls**

2.3.1. The equipment shall be provided with the necessary facilities for coding and composition of calls in accordance with CCIR Recommendation 493-3.

2.3.2. The facilities mentioned in paragraph 2.3.1. shall be so arranged that it is possible for the operator quickly and precisely to enter a call (without using external aids, e.g. manuals, for converting the information contained in the call to the figure codes used in the signal format).

2.3.3. The ship's 9-digit Maritime Mobile Service Identity number shall be capable of being stored permanently in the equipment and shall be inserted automatically in the call. It shall not be possible for the operator to change the identity number.

2.3.4. Means shall be provided for manual entry of the geographical position information and of the time when this position information was valid. In addition, facilities for automatic entry and encoding of the geographical position and time information may be provided.

2.3.5. The equipment shall be provided with facilities for visual indication, inspection and possible manual correction of the information content of the call before the call is sent.

2.3.6. When encoding of the information content of the call is finished (indicated by the end of sequence codes 117(RQ), 122(BQ) or 127), the final error check character shall be inserted automatically.

2.3.7. The facilities for initiating distress calls shall be easy to operate and shall be protected against inadvertent activation.

2.3.8. If the equipment can be operated from more than one position, the control unit provided at the position from where the ship is normally navigated shall have priority and the individual control units shall be provided with an indicator showing whether the equipment is in operation.

2.3.9. Initiation of a distress call shall automatically have priority over any other operation of the equipment.

2.3.10. When the equipment is activated for transmitting a distress call attempt on a single frequency, the call shall automatically be transmitted five times in succession with no intervals between the individual calls so that bit synchronization between the transmitter and receiver of the call can be maintained.

2.3.11. Equipment constructed for digital selective calling on frequencies in the MF and/or the HF range may be provided with facilities for automatic transmission of a multi-frequency distress call attempt as up to 6 consecutive calls dispersed over a maximum of 6 distress frequencies (1 at MF and 5 at HF). Where such facilities are provided the equipment should be capable of receiving DSC calls on all distress frequencies (except for the transmit frequency in use) whilst the distress call is being transmitted or be able to complete the distress call attempt within one minute.

2.3.12. Where no distress acknowledgement (containing telecommand "distress acknowledgement" and end of sequence code 127) is received, the equipment shall automatically retransmit the distress call attempt after a random delay of between 3½ and 4½ minutes from the beginning of the previous call.

This sequence shall be continued until a distress acknowledgement has been received, or until the automatic transmission of the distress call is discontinued manually.

Means shall be provided for transmitting the distress call attempt again by manual intervention at any point of time.

2.3.13. The equipment shall be provided with suitable facilities for converting incoming calls with relevant address content to visual form in plain language (see also paragraphs 2.1.1. and 2.3.2.).

2.3.14. Equipment not provided with a printer unit for immediate paper printout of the information content of the call received shall contain an internal store with sufficient capacity for storing of at least 20 different received DSC distress calls.

2.3.15. The contents of such received DSC calls shall remain stored until readout is initiated manually.

2.3.16. Received messages shall be stored or printed out even if the received error check character (ECC) does not match. An ECC error should be clearly indicated when the information in the received symbols is displayed.

2.3.17. The equipment may be provided with facilities for automatic transmission of acknowledgements except for distress acknowledgements and acknowledgements to calls having the distress category.

Automatic acknowledgement transmission shall not take place unless the error check character is received and decoded correctly.

2.3.18. Any visual display of the information content shall be clearly legible under all ambient light conditions.

2.3.19. Means shall be provided to enable routine testing of the DSC unit without activating the associated radio transmitter.

2.4. **Alarm circuits**

2.4.1. The equipment shall be provided with a specific acoustic alarm and a visual alarm, activated automatically when a call with format specifier distress or category distress or urgency has been received. The alarms shall remain in activated conditions until reset manually. It shall not be possible to disable these alarm circuits.

2.4.2. The equipment shall be provided with an acoustic and a visual alarm, activated automatically on receipt of calls of categories other than those mentioned under paragraph 2.4.1. Capability of disabling the acoustic alarm circuit may be provided.

2.5. **Interfaces between DSC equipment and external circuits**

2.5.1. It is recommended that the equipment be provided with facilities for connecting remote alarms as mentioned in paragraph 2.4.

2.5.2. The equipment may furthermore be provided with a suitable interface for connecting navigation and position-determining equipment.

Information on the Physical Link Layer and Data Link Layer specification of this interface may be found in the CCIR Report 1043, "Characteristics of a data exchange system for use with maritime navigation and radiocommunications equipment".

The electrical levels should conform to CCITT Recommendation V.10.

2.5.3. The equipment may be provided with a suitable interface for entering time information.

2.5.4. The equipment may furthermore be provided with facilities for automatic control (transmitter frequency, class of emission, etc.) of a transmitter in accordance with information contained in a received digital selective call or when a multi-frequency distress call attempt transmission is required (see paragraphs 2.3.11. and 2.3.12.).

2.5.5. As far as practicable, failures in external circuits shall not disable the DSC equipment.

2.5.6. MF HF DSC equipment not provided with an integral receiver shall be provided with a suitable interface to stop and restart the scan of a scanning receiver in accordance with paragraphs 10.1.2. and 10.1.3.

2.6. **Safety precautions**

2.6.1. Provision shall be made for protecting the equipment from the effects of excessive current or voltage and from excessive rise of temperature in any part of the equipment due to failure of the cooling system, if any.

2.6.2. Provision shall be made for protecting the equipment from damage if the power supply is subject to transient voltage changes and from damage due to the accidental reversal of the polarity of the power supply.

2.6.3. Means shall be provided for earthing exposed metallic parts of the equipment, but the equipment shall not cause any terminal of the source of electrical energy to be earthed.

2.6.4. All parts and wiring in which the direct or alternating voltages or both (other than radio frequency voltages) combine to give a peak voltage greater than 50 volts shall be protected against accidental access and shall be isolated automatically from all sources of electrical energy when the protective covers are removed.

Alternatively, the equipment shall be so constructed that access to such voltages may only be gained after having used a tool for this purpose, such as a spanner or screwdriver, and warning labels shall be prominently displayed both within the equipment and on protective covers.

2.6.5. The information in programmable memory devices shall be protected from interruptions in the power supply up to at least 10 hours duration. The ship's identity and information inherent to the DSC process shall be stored in non-volatile memory devices.

2.7. **Marking, etc.**

2.7.1. All controls, instruments, indicators and terminals shall be clearly marked. Details of the power supply from which the equipment is intended to operate shall be clearly indicated. The type designation under which the equipment is submitted for type testing shall be marked on the equipment so as to be clearly visible in the normal operating position.

2.7.2. All parts of the equipment which are subject to inspection and maintenance adjustments shall be easily accessible. Components shall be easily identifiable either by markings within the equipment, or with the aid of technical description.

2.7.3. The marking shall be mechanically solid and durable and may be made for example by means of engraving, embossing or application of a metal plate.

2.7.4. Where applicable, the frequencies allocated for the transmission of a DSC distress call 2,187.5-4,188-6,282-8,375-12,563 and 16,750 kHz, and the frequencies allocated for the transmission of distress related telephony traffic 2,182-4,125-6,215.5-8,257-12,392 and 16,522 kHz as well as distress related telex traffic 2,174.5-4,177.5-6,268-8,357.5-12,520 and 16,695 kHz shall be clearly indicated, either on the front panel of the equipment or an instruction label attached to the equipment.

In addition, the controls necessary for the tuning of the equipment to the frequencies above and their setting shall be clearly indicated.

The adjustment of the equipment to those frequencies shall be performed easily.

2.7.5. If the equipment includes radio apparatus for transmission and/or reception in the maritime VHF band, channel 70 shall be clearly indicated unless channel 70 is selected automatically when the DSC mode is selected.

2.8. **Operation and maintenance instructions**

2.8.1. Reasonably detailed operation and maintenance instructions shall be provided along with the equipment.

2.8.2. Where the equipment is so constructed that fault diagnosis and repair is practicable down to component level, the instructions shall include full circuit diagrams, component layouts and component parts lists.

2.8.3. If the equipment contains complex modules in which fault diagnosis and repair down to component level is not practicable, the instructions shall contain sufficient information for these modules to enable localization and replacement of the defective module. In regard to other modules and components in the equipment, the instructions shall contain the information mentioned under paragraph 2.8.2.

2.9. **Channels for digital selective calling**

The number of transmitting and receiving channels required for digital selective calling and the frequencies for these channels shall be specified by the national authorities.

The frequencies for distress and safety calling using digital selective calling techniques are given in the Radio Regulations, article 38.

2.10. **Warming-up period**

2.10.1. The equipment shall be operational and shall meet the requirements of this specification within one minute after switching on, except as provided in paragraph 2.10.2.

2.10.2. If the equipment includes parts which require to be heated in order to operate correctly, for example crystal ovens, then a warming-up period of 30 minutes from the instant of application of power to those parts shall be allowed, after which the requirements of this specification shall be met.

2.10.3. Where paragraph 2.10.2. is applicable the power supplies to the heating circuits shall be arranged so that they can remain operative when other supplies to the equipment or within the equipment are switched off. If a special switch for these circuits is provided on the equipment, the function of the switch shall be clearly indicated and the operating instructions shall state that the circuit should normally be left connected to the supply voltage. A visual indication that power is connected to such circuits shall be provided on the front panel.

2.11. **Facilities for printing out the decoded call sequences**

The decoding part of the equipment may be provided with a printer or an output terminal for connecting an external printer.

For decoders not provided with such facilities, the specimen delivered for the purposes of testing shall be provided with a printer or an output terminal for connecting a printer or computer for registration of the decoded call sequences. Details concerning such output signals to an external printer or computer shall be agreed between the manufacturer and the testing authority.

## 3. TEST CONDITIONS

### 3.1. General

The type approval tests shall be made under normal test conditions and also, where stated, under extreme test conditions.

The test conditions and the procedure for the test are described in more detail in the following (paragraphs 3.2. to 3.10.).

### 3.2. Generation and examination of the digital selective call signal

3.2.1. During the approval tests the digital selective call signals generated by the equipment shall be examined by means of calibrated apparatus for decoding and printing out the information content of the signals.

3.2.2. The facilities of the equipment for reception and or decoding of digital selective calling shall be examined by feeding digital selective call signals from calibrated apparatus for generating various forms of digital selective call signals.

### 3.3. Standard test signal

3.3.1. The test signal consists of a series of identical call sequences, each of which containing a known number of information symbols (format specifier, address, category, identification, etc., of CCIR Recommendation 493-3, paragraph 1.5). See also paragraph 3.4.

The test signal should be of sufficient length for the measurements to be performed or it should be possible to repeat it without interruption as long as necessary to make the measurements.

3.3.2. The test signal for DSC decoders not integrated with receivers and operating with 100 baud transmission speed shall be a signal with a nominal frequency of 1,700 Hz with a frequency shift of 170 Hz.

3.3.3. The test signal for DSC decoders not integrated with receivers and operating with 1,200 baud transmission speed shall be a signal with a nominal frequency of 1,700 Hz with a frequency shift of 800 Hz.

3.3.4. The test signal for DSC decoders integrated with MF/HF receivers and operating with 100 baud transmission speed shall be an RF signal with a nominal frequency equal to an assigned radio frequency for DSC operations with a frequency shift of 170 Hz.

3.3.5. The test signal for DSC decoders integrated with VHF receivers and operating with 1,200 baud transmission speed shall be an RF signal with a carrier frequency equal to an assigned VHF radio frequency for DSC operations, modulated with a frequency of 1,700 Hz, a frequency shift of 800 Hz, and a modulation index of 2.0 ± 10%.

### 3.4. Determination of the symbol error rate in the output of the receiving part

The information content of the decoded call sequence displayed at the readout device of the receiving part shall be divided into blocks, each of which corresponding to one information symbol in the applied test signal (paragraph 3.3.1.). The total number of incorrect information symbols relative to the total number of information symbols shall be registered.

### 3.5. Artificial antennas and impedance of test signal sources

3.5.1. *Artificial antennas for transmitter testing*

For the purpose of type testing, the transmitter shall meet the requirements of the specification when connected to the artificial antennas listed below. This shall in no way imply that the transmitter shall only work with antennas having these characteristics.

- 415-526.5 kHz: The artificial antenna shall consist of a non-reactive resistor of 3 ohms and a capacitance of 400 pF connected in series.
- 1,605-4 MHz: The artificial antenna shall consist of a non-reactive resistor of 10 ohms and a capacitance of 250 pF connected in series.
- 4-28 MHz and 156.025-162.025 MHz: The artificial antenna shall consist of a non-reactive resistor of 50 ohms.

3.5.2. *Impedance of test signal sources*

For the purpose of type testing, the receiver shall meet the requirements of this specification when connected as described below. This shall in no way imply that the receiver should operate satisfactorily only with antennas having these impedance characteristics.

The test signal shall be derived from a resistive source of 50 ohms except as permitted below.

At the request of the manufacturer and with approval of the testing authority, or at the initiative of the testing authority, an artificial antenna consisting of a 10 ohms resistor in series with a 250 pF capacitor may be used for frequencies below 4 MHz.

3.5.3. The source impedance for signals used for testing the decoder shall be 600 ohms.

3.6. **Connection of test signals**

Sources of test signals for application to the equipment input shall be connected through a network such that, irrespective of whether one or more test signals are applied to the equipment simultaneously, the impedance presented to the equipment input is equal to

a) that of the artificial antenna (paragraph 3.5.2.) for equipment including an RF receiver;
b) 600 ohms for equipment designed for connection to an external RF receiver.

In the case of multiple test signals, steps shall be taken to prevent any undesirable effects due to interactions between signals in the generators or other sources.

The level of the test signal shall be expressed by the e.m.f. existing at the point where the signal is fed to the receiving or decoding part of the equipment.

3.7. **Test power supply source**

During type approval tests the equipment shall be supplied from a test power source, capable of producing normal and extreme test voltages as specified in paragraphs 3.8.2. and 3.9.2. The test power source voltages shall be maintained within a tolerance of ±3% relative to the voltage at the beginning of each test.

3.8. **Normal test conditions**

3.8.1. *Normal temperature and humidity*

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

Temperature: +15°C to +35°C
Relative humidity: 20% to 75%

*Note.* When it is impractical to carry out the test under the conditions stated above, a note to this effect, stating the actual temperature and relative humidity during the tests, shall be added to the test report.

3.8.2. *Normal test power source*

3.8.2.1. Mains voltage and mains frequency

The normal test voltage for equipment to be connected to the AC mains shall be the nominal mains voltage. For the purpose of this specification the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of the test power supply corresponding to the AC mains shall be 50 Hz ±1 Hz.

3.8.2.2. Secondary battery power source

When the equipment is intended for operation from a secondary battery power supply, the normal test voltage shall be the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.8.2.3. Other power sources

For operation from other power sources, the normal test voltage shall be that agreed between the equipment manufacturer and the testing authority.

3.9. **Extreme test conditions**

3.9.1. *Extreme temperatures*

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in paragraph 3.10., at the lower and upper temperatures of 0°C and 40°C.

3.9.2. *Extreme value of test power sources*

3.9.2.1. Mains voltage and mains frequency

The extreme test voltages for equipment to be connected to an AC mains supply shall be the nominal mains voltage ±10%.

The frequency of the test power supply corresponding to the AC mains shall be 50 Hz ±1 Hz.

3.9.2.2. Secondary battery sources

When the equipment is intended for operation from a secondary battery power supply, the extreme test voltages shall be 1.3 and 0.9 times the nominal voltage of the battery (12 volts, 24 volts, etc.).

3.9.2.3. Other power sources

For equipment using other power sources, the extreme test voltages shall be those agreed between the equipment manufacturer and the testing authority.

3.10. **Procedures of tests at extreme temperatures**

Before making measurements, the equipment shall have reached thermal balance in the test chamber. The equipment shall be switched off during the temperature stabilizing period. A warming-up period according to paragraph 2.10. shall then be allowed. The sequence of measurements shall be chosen, and the humidity content in the test chamber shall be controlled so that excessive condensation does not occur.

3.11. **Environmental tests**

Before environmental tests are commenced, a test of the equipment to the other requirements of this specification shall be carried out, except for the requirement on symbol error rate due to vibration, paragraph 3.4., which shall be performed during the vibration test. Where electrical tests are required, these shall be done with the normal test voltage.

The following tests shall be made under environmental conditions as detailed in Annex VI to Recommendation T R 34-01, "Environmental Testing of Maritime Radio Equipment":

| | |
|---|---|
| Vibration | paragraph 4. |
| Dry Heat Cycle | paragraph 5.2. |
| Damp Heat Cycle | paragraph 6. |
| Low Temperature Cycle | paragraph 7.2. |
| Corrosion Tests | paragraphs 10.1. and 10.2. |

The term "performance" check, as used in Annex VI, shall be taken to mean a check of the symbol error rate sensitivity of the receiving/decoding part, cf. paragraph 3.4., with a test signal +6 dB relative to the mentioned normal test signal level.

Performance check for transmitting/coding part shall be taken to mean a check of the transmitting power/output voltage (paragraph 4.2. or 5.2./6.2. or 7.2.), frequency error and check of the undesignated distress call as defined in CCIR Recommendation 493-3. The limits specified in paragraphs 4.2.3., 5.2.3./6.2.3., 7.2.3., 4.1.3., 5.1.3./6.1.3., 7.1.3. have to be fulfilled.

## 4. MF/HF TRANSMITTER WITH DSC ENCODER

### 4.1. Frequency error

4.1.1. *Definition*

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

4.1.2. *Method of measurement*

The frequencies corresponding to B-state and Y-state (CCIR Recommendation 493-3, Annex I, paragraph 1.4.) shall be measured on the output terminal, for a period of at least 8 hours for each test condition. The measurements shall be carried out under normal test conditions (paragraph 3.8.) and under extreme test conditions (paragraphs 3.9.1. and 3.9.2. applied simultaneously).

4.1.3. *Limits*

The frequency error, following the warming-up period (paragraph 2.10.) shall at any time be within ± 10 Hz.

### 4.2. Output power

4.2.1. *Definition*

The radio frequency output power is defined as the mean power delivered to the artificial antenna.

4.2.2. *Method of measurement*

The transmitter output shall be connected to an artificial antenna as indicated under paragraph 3.5.

The equipment shall be set to transmit a call sequence, and the delivered mean output power shall be measured.

The measurement shall be carried out under normal test conditions (paragraph 3.7.) and under extreme test conditions (paragraphs 3.8.1. and 3.8.2. applied simultaneously).

4.2.3. *Limits*

For transmitters designed for frequencies within the band 415-526.5 kHz, the mean power shall be at least 60 watts.

For transmitters designed for maritime frequencies within the frequency range 1.6-4 MHz, the mean power shall be at least 60 watts and shall not exceed 400 watts.

For transmitters designed for maritime frequencies within the frequency range 4-28 MHz, the mean power shall be at least 60 watts and shall not exceed 1,500 watts.

4.3. **Modulation rate**

4.3.1. *Definition*

The modulation rate is the bit stream speed measured in bits per second.

4.3.2. *Method of measurement*

The equipment shall be set to transmit digital selective call of a known nominal duration.

The duration of the call sequence shall be determined as the time elapsing between 90% of the maximum value of the amplitude of the modulating envelope reached at the beginning of the first character, and at the end of the last character of the sequence.

4.3.3. *Limits*

Within a tolerance corresponding to 30 parts in $10^6$ the duration of the call sequence shall correspond to the nominal modulation rate multiplied by the total number of bits in the sequence.

The nominal modulation rate is 100 baud for digital selective calling in the MF/HF bands.

4.4. **Residual modulation of the transmitter**

4.4.1. *Definition*

The residual frequency modulation of the transmitter is defined as the ratio in dB of the demodulated RF signal in the absence of wanted modulation to the demodulated RF signal when modulated with a call sequence.

4.4.2. *Method of measurement*

The RF output terminal of the equipment shall be connected to a linear FM demodulator with a de-emphasis of 6 dB/octave.

The r.m.s. output level shall be measured during the absence of modulation and during the transmission of a call sequence.

4.4.3. *Limits*

The ratio of the residual frequency modulation shall not be greater than −26 dB.

4.5. **Unwanted emission**

4.5.1. *Definition*

Unwanted emissions consist of spurious emissions and out-of-band emissions.

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.

Out-of-band emissions are emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but excluding spurious emissions.

4.5.2. *Method of measurement*

The equipment shall be set to transmit digital selective call sequences.

The measurement shall be carried out with a frequency selective measuring instrument, capable of indicating the individual emission components within the frequency range 9 kHz-2 GHz.

4.5.3. *Limits*

The unwanted emission shall fulfil the requirement in Figure XIII-1 (T/R 34-01). 0 dB refers to the registered mean power output level.

4.6. **Testing of generated call sequences**

The output of the equipment shall be connected to calibrated apparatus for decoding and printing out the information content of the call sequences generated by the equipment (cf. paragraph 3.2.1.).

The equipment shall be set to transmit various forms of digital selective calls appropriate for the equipment concerned. The generated calls shall be analysed with the control apparatus for correct configuration of the signal format, including time diversity.

4.7. **Tuning time**

Transmitters for digital selective calling on MF and or HF frequencies shall be able to be changed from operation at any frequency to operation on any other frequency as quickly as possible, but in any event within a period not exceeding 15 seconds. The transmitter shall not be able to transmit during channel switching operations.

4.8. **Settling time of the transmitter**

When transmitting a DSC call, the transmitter shall reach at least 90% of the nominal RF output power within a period of time not exceeding 10 bits of the dot pattern.

Transmission shall be inhibited until the frequency has stabilized within the required limits.

## 5. VHF TRANSMITTER WITH DSC ENCODER

5.1. **Frequency error**

5.1.1. *Definition*

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

5.1.2. *Method of measurement*

The frequencies corresponding to B-state and Y-state (CCIR Recommendation 493-3, Annex I, paragraph 1.4) shall be measured on the output terminal, for a period of at least 8 hours for each test condition. The measurements shall be carried out under normal test conditions (paragraph 3.8.) and under extreme test conditions (paragraphs 3.9.1. and 3.9.2. applied simultaneously).

5.1.3. *Limits*

The frequency error, following the warming-up period (paragraph 2.10.) shall at any time be within ± 10 Hz relative to the nominal audio B and Y frequency. The carrier frequency shall be within ± 1.5 kHz relative to its nominal value.

5.2. **Output power**

5.2.1. *Definition*

The output power is the power supplied by the unmodulated transmitter to the artificial antenna.

5.2.2. *Method of measurement*

The transmitter output shall be loaded with an artificial antenna of 50 ohms (cf. paragraph 3.5.) connected to an r.m.s.-reading voltmeter.

The measurement shall be made under normal test conditions (paragraph 3.8.) and under extreme test conditions (paragraphs 3.9.1. and 3.9.2. applied simultaneously).

5.2.3. *Limits*

With the output power set to its maximum, the transmitter carrier power shall be between 6 and 25 watts.

With the output power being set to its minimum, the transmitter carrier power shall be between 0.1 and 1 watt.

5.3. **Modulation index**

5.3.1. *Definition*

The modulation index is the ratio between the frequency deviation and the frequency of the modulation signal.

The frequency deviation is the difference between the instantaneous frequency of the modulated RF signal and the carrier frequency.

5.3.2. *Method of measurement*

The equipment shall be set to transmit a call sequence. The frequency deviation during the call sequence shall be measured.

5.3.3. *Limits*

The call sequence shall produce a frequency deviation corresponding to a modulation index of 2.0 ± 10%.

5.4. **Modulation rate**

5.4.1. *Definition*

The modulation rate is the bit stream speed measured in bits per second.

5.4.2. *Method of measurement*

The equipment shall be set to transmit digital selective call of a known nominal duration.

The duration of the call sequence shall be determined as the time elapsing between 90% of the maximum value of the amplitude of the modulating envelope reached at the beginning of the first character and at the end of the last character of the sequence.

5.4.3. *Limits*

Within a tolerance corresponding to 30 parts in $10^6$ the duration of the call sequence shall correspond to the nominal modulation rate multiplied by the total number of bits in the sequence.

The nominal modulation rate is 1,200 baud for digital selective calling in the VHF bands.

5.5. **Residual modulation of the transmitter**

5.5.1. *Definition*

The residual frequency modulation of the transmitter is defined as the ratio in dB of the demodulated RF signal in the absence of wanted modulation to the demodulated RF signal when modulated with a call sequence.

5.5.2. *Method of measurement*

The RF output terminal of the equipment shall be connected to a linear FM demodulator with a de-emphasis of 6 dB/octave.

The r.m.s. output level shall be measured during the absence of modulation and during the transmission of a call sequence.

5.5.3. *Limits*

The ratio of the residual frequency modulation shall not be greater than −40 dB.

5.6. **Adjacent channel power**

5.6.1. *Definition*

The adjacent channel power is that part of the total output of a transmitter during transmission of call sequences, which falls within the bandwidth of a receiver of the type normally used in the system and operating in either of the adjacent channels. This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter.

5.6.2. *Methods of measurement*

5.6.2.1. General remarks

Two methods are proposed, the results of which are equivalent. The method applied shall be stated in the test report.

5.6.2.2. Method of measurement using a power measuring receiver

The adjacent channel power may be measured with a power measuring receiver which conforms to paragraph 5.6.2.3. (referred to in paragraphs 5.6.2.2. and 5.6.2.3. as "the receiver").

The transmitter shall be operated under normal test conditions, paragraph 3.8. The output of the transmitter shall be applied to the input of the receiver using a connecting arrangement such that the impedance presented to the transmitter is equal to that of the artificial antenna specified in paragraph 3.5. and the level at the receiver input is appropriate.

The transmitter shall be set to transmit call sequences.

The receiver shall be tuned to the nominal frequency of the transmitter and the variable attenuator in the receiver shall be adjusted to a value p dB such that a meter reading of the order of 5 dB above the receiver noise level is obtained.

The receiver shall then be tuned to the nominal frequency of one of the adjacent channels and the variable attenuator shall be adjusted to a value q dB such that the same meter reading is obtained.

The ratio of carrier power to adjacent channel power is the difference between the attenuator settings p and q.

The adjacent channel power is determined by applying this ratio to the carrier power as determined in paragraph 5.2.2.

The measurement shall be repeated for the other adjacent channel.

5.6.2.3. Power measuring receiver specification

The power measuring receiver shall consist of a mixer, a crystal filter, a variable attenuator, an amplifier and an r.m.s. voltmeter, all connected in cascade, and a local oscillator. The local oscillator may be a signal generator.

The bandwidth of the filter shall be as follows:
Bbetween −6 dB attenuation points: 16 ± 1.6 kHz
Bbetween 70 dB attenuation points: 35 ± 3.5 kHz
Bbetween 90 dB attenuation points: 50 ± 5 kHz

The attenuator shall cover a minimum range of 80 dB to 1 dB steps. However, in order to cater for future requirements a range of 90 dB or more is recommended.

The noise factor of the amplifier shall not be worse than 4 dB. The amplitude frequency characteristic of the amplifier shall not vary more than 1 dB over the bandwidth of 16 kHz.

If the attenuation of the crystal filter is less than 90 dB outside a bandwidth of 50 kHz as specified above, the amplitude frequency characteristic of the amplifier shall be such that the combined attenuation of the crystal filter and amplifier is not less than 90 dB.

The r.m.s. voltmeter shall indicate, at full scale, the r.m.s. value of non-sinusoidal signals having a ratio of peak amplitude to r.m.s. amplitude of up to at least 10.

The measuring equipment shall be such that the power measurements will remain accurate to within 1.5 dB when the input level of the receiver is increased by 100 dB above the minimum level measurable.

The level of the noise of the local oscillator shall not be greater than −90 dB relative to the level of the carrier of the local oscillator in a band 16 kHz wide, centred on a frequency separated from the carrier by 25 kHz.

5.6.2.4. Method of measurement using a spectrum analyser

The adjacent channel power may be measured with a spectrum analyser which conforms to paragraph 5.6.2.5.

The transmitter shall be operated under normal test conditions, paragraph 3.8. The output of the transmitter shall be applied to the input of the spectrum analyser using a connecting arrangement such that the impedance presented to the transmitter is equal to that of the artificial antenna specified in paragraph 3.5, and the level at the analyser input is appropriate.

The transmitter shall be set to transmit digital selective call sequences.

The spectrum analyser shall be adjusted so that the spectrum of the transmitter output, including that part which falls in the adjacent channels, is displayed.

The adjacent channel power shall be calculated by summing the power of all the frequency components, including noise, falling inside a bandwidth of 16 kHz. The measurement shall be made in each of the adjacent channels.

5.6.2.5. Spectrum analyser specification

The spectrum analyser shall meet the following requirements:

It shall be possible to measure the amplitude of a signal or noise at a level 3 dB or more above the noise level of the spectrum analyser, as displayed on the screen, to an accuracy of ± 2 dB, in the presence of a signal separated in frequency by 10 kHz, at a level 90 dB above the level of the signal to be measured at a resolution bandwidth of 1 kHz.

The accuracy of relative amplitude measurements shall be within ± 1 dB. It shall be possible to adjust the spectrum analyser to allow the separation on its screen of two components with a frequency difference of 1 kHz.

5.6.3. *Limits*

The adjacent channel power shall not exceed a value of 70 dB below the carrier power of the transmitter.

5.7. **Conducted spurious emissions into the antenna**

5.7.1. *Definition*

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.

5.7.2. *Method of measurement*

Conducted spurious emissions shall be measured with the transmitter connected to an artificial antenna as specified in paragraph 3.5. The measurement shall be made during transmission of a "B" or "Y" state and during the transmission of a call sequence.

The measurement shall be made over the frequency range 9 kHz to 2 GHz, except on the channel on which the transmitter is operating, and its adjacent channels.

Measurements of individual spurious emissions shall be made using a tuned radio-frequency measuring instrument or a spectrum analyser.

5.7.3. *Limits*

The power of any conducted spurious emission, on any discrete frequency, shall not exceed 2.5 microwatts.

5.8. **Testing of generated call sequences**

The output of the equipment shall be connected to calibrated apparatus for decoding and printing out the information content of the call sequences generated by the equipment (cf. paragraph 3.2.1.).

The equipment shall be set to transmit various forms of digital selective calls appropriate for the equipment concerned. The generated calls shall be analysed with the control apparatus for correct configuration of the signal format, including time diversity.

5.9. **Tuning time**

5.9.1. Transmitters for digital selective calling in the maritime VHF band and designed for manual tuning shall be able to be changed from operation on any channel to channel 70 as rapidly as possible, but in any event within 5 seconds.

5.9.2. Transmitters for digital selective calling in the maritime VHF band and designed for use in an automatic/semiautomatic VHF radiotelephone system using DSC shall, after an acknowledgement indicating "able to comply" has been received by the ship station, within 5 seconds automatically be tuned to the channel indicated in the acknowledgement and transmit an unmodulated carrier for a minimum period of 2 seconds.

5.10. **Settling time of the transmitter**

When transmitting a DSC call, the transmitter shall reach at least 90% of the nominal RF output power within a period of time not exceeding 10 bits of the dot pattern.

Transmission shall be inhibited until the frequency has stabilized within the required limits.

## 6. MF/HF DSC ENCODER

6.1. **Frequency error**

6.1.1. *Definition*

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

6.1.2. *Method of measurement*

The frequencies corresponding to B-state and Y-state (CCIR Recommendation 493-3, Annex I, paragraph 1.4) shall be measured on the output terminal. The measurements shall be carried out under normal test conditions (paragraph 3.8.) and under extreme test conditions (paragraphs 3.9.1. and 3.9.2. applied simultaneously).

6.1.3. *Limits*

The frequency error, following after the warming-up period (paragraph 2.10.) shall at any time be within 0.5 Hz.

6.2. **Output voltage**

6.2.1. *Definition*

The output voltage is the audio voltage measured across a non-reactive load of 600 ohms.

6.2.2. *Method of measurement*

A non-reactive load of 600 ohms shall be connected to the output terminal of the equipment.

The equipment shall be set to transmit a call sequence and the r.m.s. output voltage during the call sequence shall be measured.

6.2.3. *Limits*

The output voltage shall at least be adjustable over the range from 0.24 volts to 2.44 volts.

6.3. **Bit stream speed**

6.3.1. *Definition*

The bit stream speed is the number of bits per second.

6.3.2. *Method of measurement*

The equipment shall be set to transmit digital selective call of a known nominal duration.

The duration of the call sequence shall be determined as the time elapsing between 90% of the maximum value of the amplitude of the modulating envelope reached at the beginning of the first character, and at the end of the last character of the sequence.

6.3.3. *Limits*

Within a tolerance corresponding to 30 parts in $10^6$ the duration of the call sequence shall correspond to the nominal modulation rate multiplied by the total number of bits in the sequence.

The nominal modulation rate is 100 baud.

6.4. **Unwanted spectral components of the output signal**

6.4.1. *Definition*

Unwanted spectral components 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. Unwanted spectral components include harmonic spectral components and intermodulation products.

6.4.2. *Method of measurement*

The output terminals of the equipment shall be connected to a non-reactive load of 600 ohms.

The equipment shall be set to transmit call sequences. The unwanted spectral components in the output signal shall be determined.

6.4.3. *Limits*

The unwanted spectral components shall fulfil the requirement in Figure XIII-2 (T/R 34-01). 0 dB refers to the registered mean power output level.

6.5. **Testing of generated call sequences**

The output of the equipment shall be connected to calibrated apparatus for decoding and printing out the information content of the call sequences generated by the equipment (cf. paragraph 3.2.1.).

The equipment shall be set to transmit various forms of digital selective calls appropriate for the equipment concerned. The generated calls shall be analysed with the control apparatus for correct configuration of the signal format, including time diversity.

## 7. VHF DSC ENCODER

7.1. **Frequency error**

7.1.1. *Definition*

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

7.1.2. *Method of measurement*

The frequencies corresponding to B-state and Y-state (CCIR Recommendation 493-3, Annex I, paragraph 1.4) shall be measured on the output terminal. The measurements shall be carried out under normal test conditions (paragraph 3.8.) and under extreme test conditions (paragraphs 3.9.1. and 3.9.2. applied simultaneously).

7.1.3. *Limits*

The frequency error, following after the warming-up period (paragraph 2.10.) shall at any time be within ±10 Hz.

7.2. **Output voltage**

7.2.1. *Definition*

The output voltage is the audio voltage measured across a non-reactive load of 600 ohms.

7.2.2. *Method of measurement*

A non-reactive load of 600 ohms shall be connected to the output terminal of the equipment.

The equipment shall be set to transmit a call sequence and the r.m.s. output voltage during the call sequence shall be measured.

7.2.3. *Limits*

The output voltage shall at least be adjustable over the range from 0.24 volts to 2.44 volts.

7.3. **Bit stream speed**

7.3.1. *Definition*

The bit stream speed is the number of bits per second.

7.3.2. *Method of measurement*

The equipment shall be set to transmit digital selective call of a known nominal duration.

The duration of the call sequence shall be determined as the time elapsing between 90% of the maximum value of the amplitude of the modulating envelope reached at the beginning of the first character, and at the end of the last character of the sequence.

7.3.3. *Limits*

Within a tolerance corresponding to 30 parts in $10^{-6}$ the duration of the call sequence shall correspond to the nominal modulation rate multiplied by the total number of bits in the sequence.

The nominal modulation rate is 1,200 baud.

7.4. **Unwanted spectral components of the output signal**

7.4.1. *Definition*

Unwanted spectral components 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. Unwanted spectral components include harmonic spectral components and intermodulation products.

7.4.2. *Method of measurement*

The output terminals of the equipment shall be connected to a non-reactive load of 600 ohms.

The equipment shall be set to transmit a call sequence. The unwanted spectral components in the output signal shall be determined.

7.4.3. *Limits*

The unwanted spectral components shall fulfil the requirement in Figure XIII-3 (T/R 34-01). 0 dB refers to the registered mean power output level.

7.5. **Testing of generated call sequences**

The output of the equipment shall be connected to calibrated apparatus for decoding and printing out the information content of the call sequences generated by the equipment (cf. paragraph 3.2.1.).

The equipment shall be set to transmit various forms of digital selective calls appropriate for the equipment concerned. The generated calls shall be analysed with the control apparatus for correct configuration of the signal format, including time diversity.

## 8. MF/HF RECEIVER WITH DSC DECODER

8.1. **General**

8.1.1. *Tuning*

MF/HF receivers to be used for reception of digital selective calls shall be capable of being easily tuned to the assigned (centre) frequency of the wanted DSC channel.

When frequency synthesizers are used, the maximum increment shall be 100 Hz.

8.1.2. *Frequency stability*

Following the warming-up period (paragraph 2.10.), the frequency error of RF receivers to be used for reception of digital selective calls shall at all times remain within ± 10 Hz relative to the nominal frequency of the wanted channel.

8.1.3. *Receiver bandwidth*

The bandwidth of the receiver shall be designed to cater for a channel spacing of 500 Hz.
(See Appendix 1.)

8.1.4. *Scanning facilities*

MF/HF receivers intended to be used for reception of digital selective calls may be provided with scanning facilities.

Six digital selective calling channels may be scanned in the same scanning sequence.

It shall be possible for the operator to select which channels and the number of channels to be scanned.

At any time it shall be possible for the operator to select any of these scanned channels.

All selected channels shall be scanned within 2 seconds, and the dwell time on each channel shall be adequate to allow detection of the dot patern which preceeds each digital selective call.

The scanning facilities shall operate in such a manner that the scanning process stops automatically only on detection of a 100 baud dot pattern and restarts in accordance with paragraph 10.1.3.

8.2. **Calling sensitivity**

8.2.1. *Definition*

The calling sensitivity of the receiver is a defined RF-signal level at which the receiver gives a symbol error rate better than or equal to a defined value.

8.2.2. *Method of measurement*

The receiver input terminal shall be connected to the artificial antenna specified in paragraph 3.5. and a test signal as described in paragraph 3.3. shall be applied. The level of the test signal shall be 0 dB 1 μV for receiving frequencies in the bands 415-526.5 kHz and 1.6 MHz to 28 MHz.

The frequency of the test signal shall during the test periodically be changed ± 10 Hz relative to its nominal value.

The test shall be performed for a period of at least 8 hours and in such a manner that call sequences are applied, decoded and the output of the decoder registered at sufficiently short intervals.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

The measurements shall be carried out under normal test conditions (paragraph 3.8.) and under extreme test conditions (paragraphs 3.9.1. and 3.9.2. applied simultaneously).

8.2.3. *Limits*

The symbol error rate in the decoded call sequences shall be $1 \times 10^{-2}$ or less.

8.3. **Adjacent channel selectivity**

8.3.1. *Definition*

Adjacent channel selectivity is defined as the suppression of an unwanted signal, expressed as the symbol error rate caused by the unwanted signal in the output from the decoder.

8.3.2. *Method of measurement*

The arrangements for applying the test signals shall be in accordance with paragraph 3.6.

The wanted signal shall be in accordance with paragraphs 3.3.1. and 3.3.4. The level of the wanted signal shall be 20 dB/1 μV.

The unwanted signal shall be an unmodulated signal at the frequency + 500 Hz and then − 500 Hz relative to the nominal frequency of the receiver (centre frequency). The level of the unwanted signal shall be 60 dB/1 μV.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

8.3.3. *Limits*

The symbol error rate in the decoded call sequences shall be $1 \times 10^{-2}$ or less.

8.4. **Co-channel rejection**

8.4.1. *Definition*

The co-channel rejection is the ability of the receiver to receive a wanted signal in the presence of an unwanted signal, both signals being on the wanted channel of the receiver.

8.4.2. *Method of measurement*

The arrangements for applying the test signals shall be in accordance with paragraph 3.6.

The wanted signal shall be in accordance with paragraphs 3.3.1. and 3.3.4. The level of the wanted signal shall be 20 dB 1 μV. The unwanted signal shall be unmodulated with a level of 14 dB 1 μV at the nominal frequency of the receiver.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

8.4.3. *Limits*

The symbol error rate in the decoded call sequences shall be $1 \times 10^{-2}$ or less.

8.5. **RF intermodulation response**

8.5.1. *Definition*

The RF intermodulation response is defined as the rejection of intermodulation products originating from two unwanted signals with given levels and frequencies, expressed as the symbol error rate which is produced by such conditions in the decoded call sequence from a wanted signal.

8.5.2. *Method of measurement*

The signals applied to the receiver input shall be connected in accordance with paragraph 3.6.

The wanted signal shall be in accordance with paragraphs 3.3.1. and 3.3.4. The level of the wanted signal shall be 20 dB/1 μV.

The two unwanted signals are both unmodulated and at the same level of 70 dB/1 μV. Neither of the two signals shall be at a frequency nearer to the wanted signal than 30 kHz (frequency combinations capable of resulting in unwanted intermodulation products are given in CCIR Recommendation 332-3, section 6.4).

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

8.5.3. *Limits*

The symbol error rate in the decoded call sequences shall be $1 \times 10^{-2}$ or less.

8.6. **Interference rejection and blocking immunity**

8.6.1. *Definition*

The interference rejection and blocking immunity is the ability of the receiver to discriminate between a wanted signal and unwanted signals with frequencies outside the passband of the receiver.

8.6.2. *Method of measurement*

The wanted signal and an unmodulated unwanted signal shall be applied to the receiver input in accordance with paragraph 3.6.

The wanted signal shall be in accordance with paragraphs 3.3.1. and 3.3.4. The level of the wanted signal shall be 20 dB/1 μV.

For the frequencies in the range from 9 kHz to 2 GHz with the exception of the wanted channel and its adjacent channels of the receiver ($f_{nom.} \pm 750$ Hz) the level of the unmodulated unwanted signal shall be 90 dB/1 μV.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

8.6.3. *Limits*

The symbol error rate in the decoded call sequences shall be $1 \times 10^{-2}$ or less.

8.7. **Dynamic range**

8.7.1. *Definition*

The dynamic range of the equipment is the range from the minimum to the maximum level of a radio frequency input signal at which the symbol error rate in the output of the decoder does not exceed a specified value.

8.7.2. *Method of measurement*

A test signal in accordance with paragraphs 3.3.1. and 3.3.4. shall be applied to the receiver input. The level of the test signal shall be 80 dB/1 μV.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

8.7.3. *Limits*

The symbol error rate in the decoded call sequences shall be $1 \times 10^{-2}$ or less.

8.8. **Conducted spurious emissions**

8.8.1. *Definition*

Conducted spurious emissions are all internally generated signals conducted to the antenna terminal, irrespective of the frequency.

8.8.2. *Method of measurement*

The receiver input is connected to the artificial antenna specified in paragraph 3.5., and the spurious emission is measured, using a selective measuring instrument. The r.m.s. value of any component of the spurious emission is then evaluated.

The measurement is made over the frequency range from 9 kHz to 2 GHz.

8.8.3. *Limits*

The power of any discrete frequency component shall not exceed 1 nW.

8.9. **Verification of correct decoding of various types of digital selective calls**

The input terminal of the equipment shall be connected to a calibrated apparatus for generation of digital selective call signals (cf. paragraph 3.2.2.).

Various types of digital selective calls in accordance with CCIR Recommendation 493-3 and relevant for the equipment under test shall be applied to the equipment.

The decoded call sequences at the output of the equipment shall be examined.

When receiver measurements are made by use of a printer or a computer, a check shall be made to ensure accordance between printer output and display unit.

8.10. **Protection of receiver antenna input circuits**

The receiver shall not suffer damage when an unmodulated radio frequency test signal at a level of 30 volts r.m.s. at any frequency in the range 100 kHz to 28 MHz is applied to its input terminals for a period of 15 minutes in accordance with paragraph 3.6. The receiver shall operate normally without further attention when the test signal is removed.

In order to provide protection agains damage due to static voltages which may appear at the input at the receiver, there shall be a DC path from the antenna terminal to chassis not exceeding 100 kohms.

## 9. VHF RECEIVER WITH DSC DECODER

### 9.1. Sensitivity

9.1.1. *Definition*

The calling sensitivity of the receiver is a defined RF-signal level at which the receiver gives a symbol error rate better than or equal to a defined value.

9.1.2. *Method of measurement*

The receiver input terminal shall be connected to the artificial antenna specified in paragraph 3.5. and a test signal as described in paragraph 3.3. shall be applied. The level of the test signal shall be 0 dB 1 µV for receiving frequencies in the bands 156.025-162.025 MHz.

The frequency of the test signal shall during the test periodically be changed ± 1.5 kHz relative to its nominal value.

The test shall be performed for a period of at least 8 hours and in such a manner that call sequences are applied, decoded and the output of the decoder registered at sufficiently short intervals.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

The measurements shall be carried out under normal test conditions (paragraph 3.8.) and under extreme test conditions (paragraphs 3.9.1. and 3.9.2. applied simultaneously).

9.1.3. *Limits*

The symbol error rate in the decoded call sequences shall be $1 \times 10^{-2}$ or less.

### 9.2. Adjacent channel selectivity

9.2.1. *Definition*

Adjacent channel selectivity is defined as the suppression of an unwanted signal, expressed as the symbol error rate caused by the unwanted signal in the output from the decoder.

9.2.2. *Method of measurement*

The arrangements for applying the test signals shall be in accordance with paragraph 3.6.

The wanted signal shall be in accordance with paragraphs 3.3.1. and 3.3.5. The level of the wanted signal shall be +3 dB 1 µV.

The unwanted signal shall be tuned to the centre frequency of the upper adjacent channel and be modulated with a 400 Hz tone to a frequency deviation of 3 kHz. The level of the unwanted signal shall be +73 dB 1 µV.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

The measurement shall be repeated with the unwanted signal tuned to the centre frequency of the lower adjacent channel.

9.2.3. *Limits*

The symbol error rate in the decoded call sequences shall be $1 \times 10^{-2}$ or less.

### 9.3. Co-channel rejection

9.3.1. *Definition*

Co-channel rejection is a measure of the capability of the equipment to produce a decoded call sequence with a limited symbol error rate from a wanted signal, when an unwanted signal is present at the same nominal frequency as the wanted signal.

9.3.2. *Method of measurement*

The two input signals shall be connected to the receiver in accordance with paragraph 3.6.

The wanted signal shall be in accordance with paragraphs 3.3.1. and 3.3.5. The level of the wanted signal shall be +3 dB/1 μV.

The unwanted signal shall be tuned to the same nominal frequency as for the wanted signal and modulated at 400 Hz to a frequency deviation of 3 kHz. The level of the unwanted signal shall be −5 dB/1 μV.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

The measurement shall be repeated for displacements of the unwanted signal of up to ±3 kHz relative to the nominal frequency of the wanted signal.

9.3.3. *Limits*

The symbol error rate in the decoded call sequences shall be $1 \times 10^{-2}$ or less.

9.4. **Intermodulation response**

9.4.1. *Definition*

The intermodulation response is defined as the rejection of intermodulation products originating from two unwanted signals with given levels and frequencies, expressed as the symbol error rate which is produced by such conditions in the decoded call sequence from a wanted signal.

9.4.2. *Method of measurement*

The signals applied to the receiver input shall be connected in accordance with paragraph 3.6.

The wanted signal shall be in accordance with paragraphs 3.3.1. and 3.3.5. The level of the wanted signal shall be +3 dB/1 μV.

Two unwanted signals shall be applied, each of a level of + 68 dB/1 μV.

One of the unwanted signals shall be unmodulated, the other shall be modulated at 400 Hz to a frequency deviation of 3 kHz. The frequencies of the unwanted signals shall be 25 kHz and 50 kHz, respectively, above the nominal frequency of the wanted signal.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

The measurement shall be repeated with the two unwanted signals adjusted to 25 kHz and 50 kHz, respectively, below the nominal frequency of the wanted signal.

9.4.3. *Limits*

The symbol error rate in the decoded call sequence shall be $1 \times 10^{-2}$ or less.

9.5. **Spurious response and blocking immunity**

9.5.1. *Definition*

The spurious response and blocking immunity is the ability of the receiver to discriminate between a wanted signal and an unwanted signal with frequencies outside the passband of the receiver.

9.5.2. *Method of measurement*

The signals applied to the receiver input shall be connected in accordance with paragraph 3.6.

The wanted signal shall be in accordance with paragraphs 3.3.1. and 3.3.5. The level of the wanted signal shall be +3 dB/1 μV.

The unwanted signal shall be unmodulated at a level of +93 dB/1 μV.

For blocking test the frequency of the unwanted signal shall be varied between −10 MHz and −1 MHz and also between +1 MHz and +10 MHz relative to the nominal frequency of the wanted signal.

For search of spurious responses the frequency of the unwanted signal shall be varied over the range 9 kHz to 2 GHz with the exception of the channel of the wanted signal and its adjacent channels. Where spurious responses occur, the level of the unwanted signal shall be reduced to 73 dB/1 μV.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

9.5.3. *Limits*

The symbol error rate in the decoded call sequence shall be $1 \times 10^{-2}$ or less.

9.6. **Amplitude characteristic of receiver limiter**

9.6.1. *Definition*

The amplitude characteristic of the receiver limiter is the ability of decoding received signals correct at different levels of the radio-frequency input signal.

9.6.2. *Method of measurement*

A test signal in accordance with paragraphs 3.3.1. and 3.3.5. shall be applied to the receiver input. The level of the test signal shall be varied over the range from 0 dB/μV to 100 db/μV.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

9.6.3. *Limits*

The symbol error rate in the decoded call sequence shall be $1 \times 10^{-3}$ or less.

9.7. **Conducted spurious emissions**

9.7.1. *Definition*

Conducted spurious emissions are all internally generated signals conducted to the antenna terminal, irrespective of the frequency.

9.7.2. *Method of measurement*

The receiver input is connected to the artificial antenna specified in paragraph 3.5., and the spurious emission is measured, using a selective measuring instrument. The r.m.s. value of any component of the spurious emission is then evaluated.

The measurement is made over the frequency range from 9 kHz to 2 GHz.

9.7.3. *Limits*

The power of any discrete frequency component shall not exceed 2 nW.

9.8. **Verification of correct decoding of various types of digital selective calls**

The input terminal of the equipment shall be connected to a calibrated apparatus for generation of digital selective call signals (cf. paragraph 3.2.2.).

Various types of digital selective calls in accordance with CCIR Recommendation 493-3 and relevant for the equipment under test shall be applied to the equipment.

The decoded call sequences at the output of the equipment shall be examined.

When receiver measurements are made by use of a printer or a computer, a check shall be made to ensure accordance between printer output and display unit.

## 10. MF/HF DSC DECODER

10.1. **Interface for scanning**

10.1.1. If the MF/HF DSC decoder is intended to be used with an MF/HF receiver for reception of digital selective calls with facilities for scanning 6 digital selective calling channels (see paragraph 8.1.4.), the decoder shall fulfil the following requirements:

10.1.2. The decoder shall provide a suitable signal to stop the scanning process automatically only on detection of a 100 baud dot pattern.

10.1.3. The decoder shall provide a suitable signal to restart the scanning process after receipt of a DSC call or, during the reception of a DSC call which is not addressed to the ship, as soon as it is recognized as not being addressed to the ship.

10.2. **Dynamic range**

10.2.1. *Definition*

The dynamic range of the equipment is the range from the minimum to the maximum level of an audio frequency input signal at which a message is correctly decoded.

10.2.2. *Method of measurement*

A test signal as described in paragraphs 3.3.1. and 3.3.2. shall be applied to the input terminal of the equipment. The level of the test signal shall be varied over the range 0.775 volts ± 10 dB.

If the equipment is provided with a preset control for adjustment to different input levels, this shall be set to correspond to the input level for which the equipment is designed (see paragraph 2.1.4.).

The centre frequency of the test signal shall during the test periodically be changed to a value ± 20 Hz relative to its nominal value.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

The measurement shall be carried out under normal test conditions (paragraph 3.8.) and under extreme test conditions (paragraphs 3.9.1. and 3.9.2. applied simultaneously).

10.2.3. *Limits*

Within the stated voltage range the message shall be correctly decoded.

10.3. **Verification of correct decoding of various types of digital selective calls**

The input terminal of the equipment shall be connected to a calibrated apparatus for generation of digital selective call signals (cf. paragraph 3.2.2.).

Various types of digital selective calls in accordance with CCIR Recommendation 493-3 and relevant for the equipment under test shall be applied to the equipment.

The decoded call sequences at the output of the equipment shall be examined.

When receiver measurements are made by use of a printer or a computer, a check shall be made to ensure accordance between printer output and display unit.

## 11. MF/HF DSC DECODER

### 11.1. Dynamic range

11.1.1. *Definition*

The dynamic range of the equipment is the range from the minimum to the maximum level of an audio frequency input signal at which a message is correctly decoded.

11.1.2. *Method of measurement*

A test signal as described in paragraphs 3.3.1. and 3.3.3. shall be applied to the input terminal of the equipment. The level of the test signal shall be varied over the range 0.775 volts ± 10 dB.

If the equipment is provided with a preset control for adjustment to different input levels, this shall be set to correspond to the input level for which the equipment is designed (see paragraph 2.1.4.).

The centre frequency of the test signal shall during the test periodically be changed to a value ± 10 Hz relative to its nominal value.

The symbol error rate in the decoder output shall be determined as described in paragraph 3.4.

The measurement shall be carried out under normal test conditions (paragraph 3.8.) and under extreme test conditions (paragraphs 3.9.1. and 3.9.2. applied simultaneously).

11.1.3. *Limits*

Within the stated voltage range the message shall be correctly decoded.

### 11.2. Verification of correct decoding of various types of digital selective calls

The input terminal of the equipment shall be connected to a calibrated apparatus for generation of digital selective call signals (cf. paragraph 3.2.2.).

Various types of digital selective calls in accordance with CCIR Recommendation 493-3 and relevant for the equipment under test shall be applied to the equipment.

The decoded call sequences at the output of the equipment shall be examined.

When receiver measurements are made by use of a printer or a computer, a check shall be made to ensure accordance between printer output and display unit.

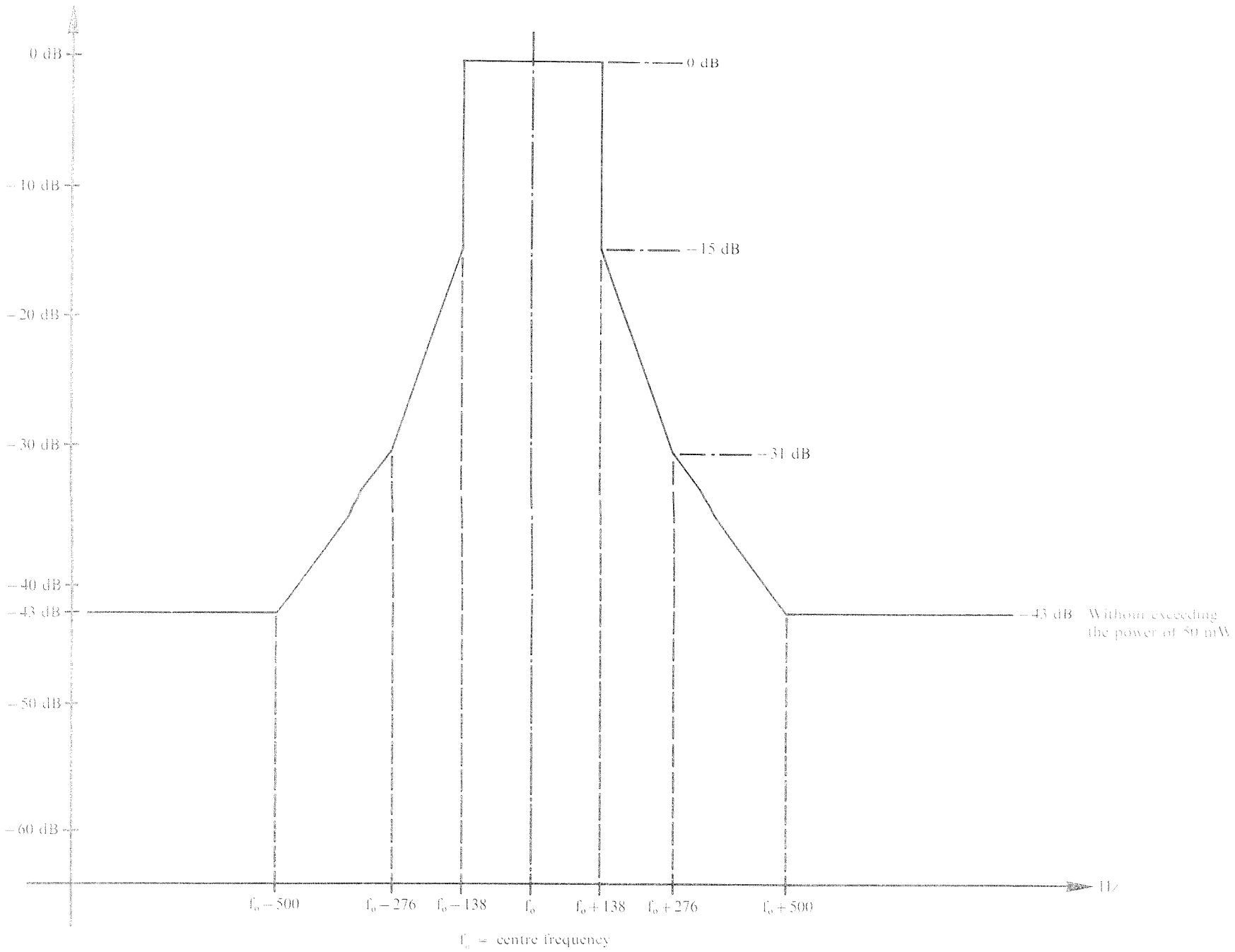



Figure XIII-1 (T.R 34-01). Limits for unwanted emission (MF, HF transmitter with DSC encoder).

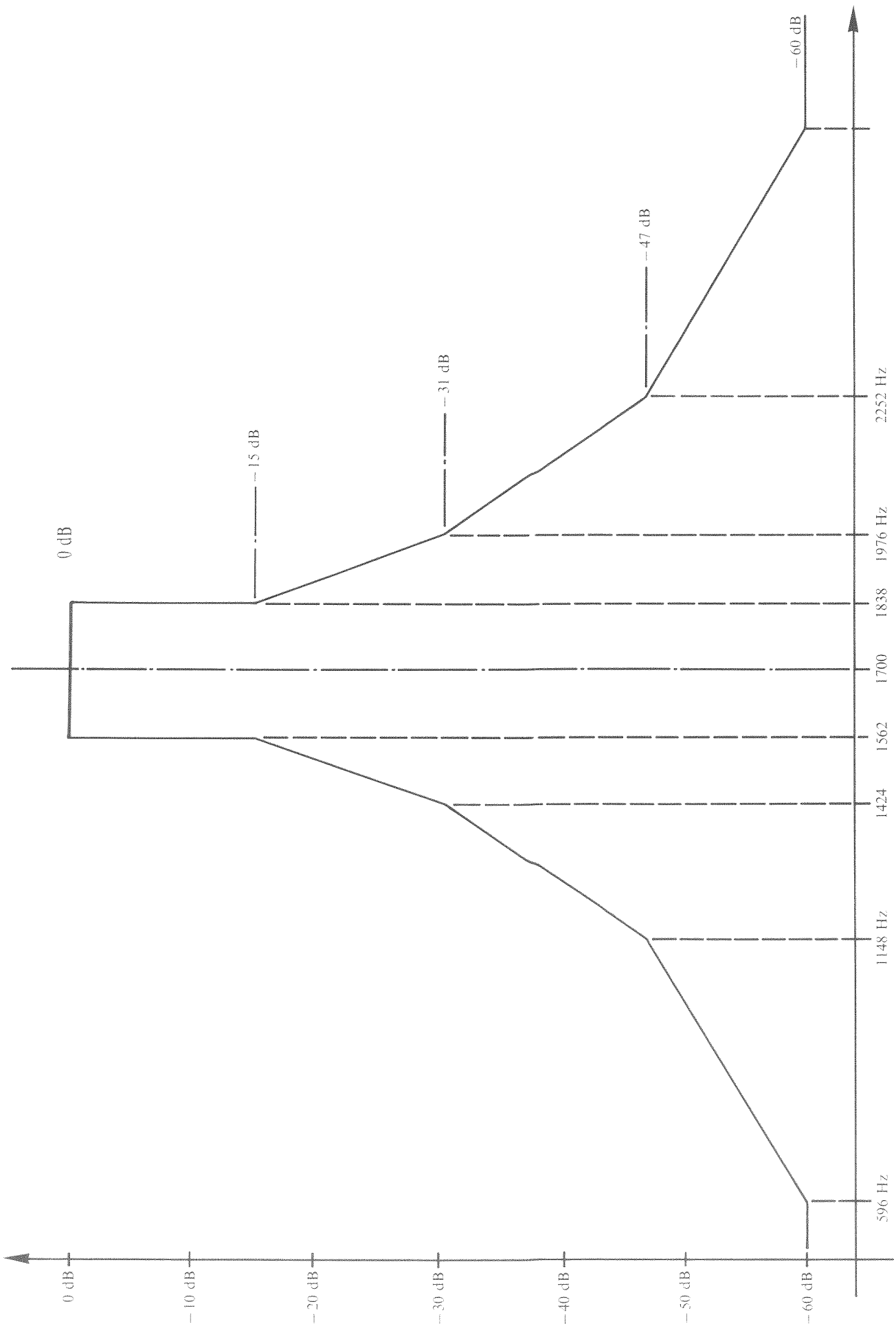



Figure XIII-2 (T/R 34-01). Unwanted spectral components (MF/HF DSC encoder).

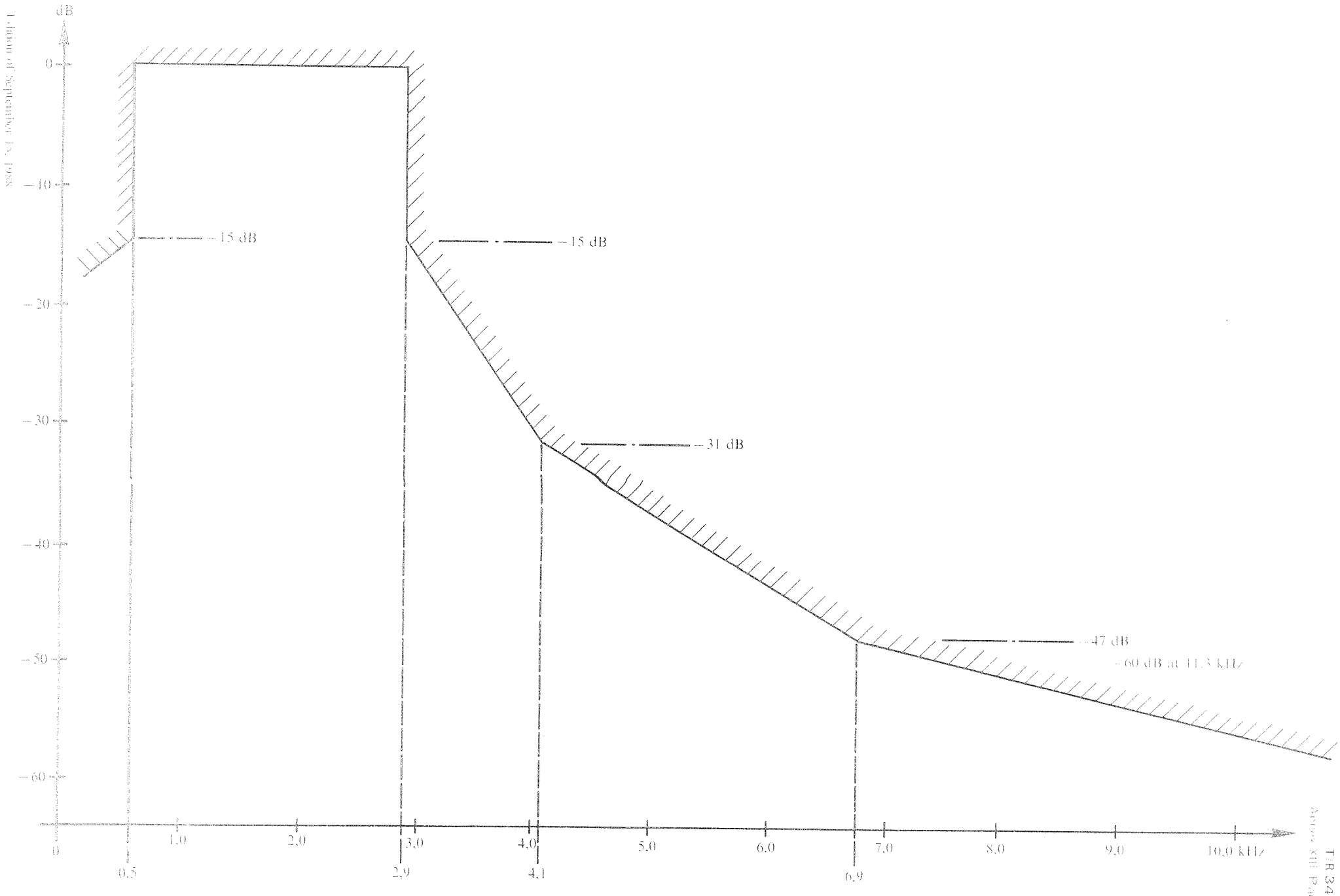



Figure XIII-3 (T R 34-01). Unwanted spectral components (VHF DSC encoder).

## Appendix 1

## RECEIVER SELECTIVITY PERFORMANCE

It is suggested that the attenuation and the passband of the receiver as a function of a frequency deviation relative to the nominal frequency $F_o$, measured after the final frequency conversion stage, should be as specified below:

Passband between −6 dB points shall be min. 250 Hz (the minimum necessary bandwidth of an F1B signal with a shift of 170 Hz and a modulating rate of 100 baud is 270 Hz).

Attenuation min. 30 dB at $F_o \pm 380$ Hz.

Attenuation min. 60 dB at $F_o \pm 550$ Hz.