

RECOMMENDATION 428-3*

DIRECTION-FINDING AND/OR HOMING
IN THE 2 MHz BAND ON BOARD SHIPS**

(1963-1966-1970-1990)

The CCIR,

CONSIDERING

- (a) that Regulation IV/7.3 of the 1988 Amendments to the International Convention for the Safety of Life at Sea, 1974, requires that until 1 February 1999 every passenger ship and cargo ship of 300 tons gross tonnage and upwards shall, unless the ship is engaged in sea area A1 only, be fitted with a device for generating the radiotelephone alarm signal on the frequency 2182 kHz;
- (b) that Regulation V/12(p) of the International Convention for the Safety of Life at Sea, 1974, requires that when engaged on international voyages, ships of 1600 tons gross tonnage and upwards shall be fitted with a radio direction-finding apparatus, and IMO Resolution A.223(VII) prescribes that such equipment should be capable of receiving signals in the frequency range 2167 kHz to 2197 kHz;
- (c) that Regulation V/10 of the International Convention for the Safety of Life at Sea, 1974, requires the master of a ship at sea on receiving a distress signal to proceed with all speed to the assistance of the persons in distress;
- (d) that a large number of ships of more than 1600 tons gross tonnage (which are compulsorily fitted with medium frequency radiotelegraph equipment) are voluntarily fitted with medium frequency radiotelephone equipment and that the number of such ships is increasing;
- (e) that the majority of deep-sea fishing vessels are fitted voluntarily with medium frequency radiotelephone equipment;
- (f) that an increasing number of ships are being fitted with direction-finding equipment capable of taking bearings in the 2 MHz band;
- (g) that direction-finding and especially homing by ships is important in cases of distress;
- (h) that technical studies in several countries have shown:
- h.a* that direction-finding, or at least homing, is usually possible in the 2 MHz band on many ships;
- h.b* that compared with the problems of direction-finding by ships in the lower parts of the medium frequency band, the main cause of error in direction-finding in the 2 MHz band is re-radiation from various parts of the ship's superstructures, masts, downleads, halyards, stays, derricks, etc., and from other antennas;
- h.c* that errors caused by re-radiation effects, however, should be constant if the disposition and electrical conditions of the re-radiators are constant and that such errors can be taken into account by calibrating the direction-finder;
- h.d* that direction-finding and homing is easier on board small ships than on larger ones, because an increase in the size of ships and their superstructures, masts, etc., as given in § *h.b* leads to an increase of disturbing resonance effects;
- h.e* that a reliable direction-finder calibration can be more readily obtained if it is restricted to a specific frequency such as 2182 kHz, instead of a wide frequency band;
- h.f* that even where omnidirectional direction-finding, even on a specific frequency, is difficult or impossible (such as on board large vessels with strong re-radiation effects), homing will nearly always be possible,

* The Director CCIR is invited to bring this Recommendation to the attention of IMO.

** For the purpose of this Recommendation "homing" means the taking of direction-finding bearings without ambiguity of sense within an arc of 30° on either side of the bow.

UNANIMOUSLY RECOMMENDS

1. that the following technical measures and precautions should be observed when installing direction-finders for taking bearings in the 2 MHz band, and in particular for homing on the frequency 2182 kHz:
 - 1.1 the antenna system, including the sense antenna, of the direction-finder should be erected as far as possible away from any re-radiators;
 - 1.2 the direction-finder antenna system should, preferably, be installed on the fore-and-aft line of the ship;
 - 1.3 if the direction-finding antenna system is to be fitted on a mast it should preferably be installed symmetrically on top of the mast and not to one side of it; where a mast-head installation may require the use of longer cables, their possible influence on the bearing should be taken into consideration;
 - 1.4 the mounting of the direction-finding antenna system may be considered satisfactory for homing purposes if the calibration in the sector ahead as in § 2.5 has proved to be possible;
 - 1.5 if the resonance frequency of a mast and its rigging is within approximately $\pm 20\%$ of the frequency used for direction-finding, then the antenna system of the direction-finder should not in general be mounted on or near the top of the mast, unless the antenna system is one which is not influenced by the mast resonance. The calculation or assessment of the resonance frequency should take into account the effect of the antenna system of the direction-finder;
 - 1.6 that the sense antenna should be mounted on or as near as is practicable to the central axis of the antenna system of the direction-finder;
 - 1.7 the effects caused by re-radiating antenna wires can be minimized by providing properly located isolating switches for the antennas;
 - 1.8 re-radiation from the rigging (e.g. stays, wire ropes, etc.) should be reduced by the insertion of insulators such that the resonance frequency of the longest portion is considerably above the highest frequency used for direction-finding or considerably above 2182 kHz where the installation is used for homing only;
 - 1.9 the formation of "closed loops", e.g. by the rigging, should be avoided by inserting insulators at appropriate points;
 - 1.10 to avoid electrically doubtful connections, the connecting points of movable parts of the rigging and connections between masts and derricks, wire ropes, etc., should be short-circuited as far as possible;
2. that the following measures and precautions should be observed in the calibration of direction-finders for the 2 MHz band and in particular for homing on the frequency 2182 kHz;
 - 2.1 the rigging, downleads, derricks, halyards, etc. should be in their sea-going positions;
 - 2.2 any antennas that affect the direction-finder should preferably be isolated and other antennas which cannot be isolated (for example, because of operational requirements), should be in the same condition as they will be when bearings are being taken or when homing is being done at sea; the condition and electrical arrangement of all antennas should be noted on the direction-finder calibration charts;
 - 2.3 calibration in the forward direction for the purpose of homing (or a more complete calibration if so desired) should be carried out in an area well clear of the shore and of other ships. If a shore-based transmitter is used, calibration should be carried out on a line passing through that station and crossing the coast-line approximately at right angles. The transmitting antenna should radiate vertically polarized waves from a single element, and care should be taken to avoid re-radiation from any object in the vicinity. The distance between the transmitting antenna and the direction-finder should be great enough to avoid the calibration being affected by the induction field of the transmitting antenna;
 - 2.4 care should be taken to ensure that the direction-finder gives the correct sense on all bearings and frequencies concerned and in particular for homing purposes on the frequency 2182 kHz, within a sector of 30° on both sides of the bow;
 - 2.5 the calibration, if not complete, should at least cover a sector of 30° on both sides of the bow, and as far as possible should be made at sufficiently small bearing intervals (say, in steps of a few degrees) to detect any sudden changes (for example, re-entrant portions where two or more different corrections exist for the same indicated bearing);
 - 2.6 calibration at 2182 kHz should be carried out at a frequency as near as possible to 2182 kHz, special attention being paid to No. 3023 of the Radio Regulations, and to the avoidance of interference to established operations in adjacent channels;

3. that the calibration should be checked periodically, especially if the condition of the rigging, etc. has been altered since the last calibration;
4. that on board ships equipped with a direction-finder, the frequency range of which includes the 2 MHz band, a calibration should be made to determine if the direction-finder could be used without modification for omnidirectional direction-finding, or at least for homing on the frequency 2182 kHz;
5. that when administrations encourage the use of direction-finders on board ship, capable of operating in the 2 MHz band, or at least on the international radiotelephony distress and calling frequency 2182 kHz, they should also encourage the provision of suitable facilities for the calibration of such direction-finder equipment;
6. that administrations should bring the above Recommendation to the attention of those responsible for the provision, installation and maintenance of direction-finders on ships.

ANNEX I

Under good conditions, when the above precautions and technical measures have been taken, an accuracy of about $\pm 2^\circ$ can be attained in taking bearings in the 2 MHz band by reception of "ground" waves on board ships of less than about 800 tons gross tonnage. In unfavourable conditions, for example, when the ship is pitching and rolling, an accuracy of about $\pm 5^\circ$ can be obtained. On larger ships, the accuracy may be worse, but in most cases it should usually be possible to use the direction-finder for homing purposes on 2182 kHz. Bearings taken by reception of sky-waves, although variable in azimuth and sharpness, are useful for homing into the ground-wave range by utilizing their average value.
