UNITED NATIONS

E

Economic and Social Council

Distr.
RESTRICTED

TRANS/SC.3/WP.3/R.68
9 January 1995

ENGLISH
Original: FRENCH AND RUSSIAN

ECONOMIC COMMISSION FOR EUROPE

Principal Working Party on
Inland Water Transport

Working Party on the Standardization
of Technical and Safety Requirements
in Inland Navigation
(Tenth session, 14-16 June 1995,
agenda item 6)

RECOMMENDATIONS ON TECHNICAL REQUIREMENTS FOR ELECTRONIC NAVIGATIONAL SHIPBORNE EQUIPMENT AND ITS INSTALLATION ON BOARD SHIPS, INCLUDING IN PARTICULAR RADAR INSTALLATIONS AND RATE-OF-TURN INDICATORS

Transmitted by the Danube Commission

Note: During the thirty-eighth session of the Principal Working Party on Inland Water Transport, the representative of the Danube Commission offered to submit the draft recommendations concerning the main technical and operational parameters of radar installations used in navigation on the Danube to the secretariat (TRANS/SC.3/135, para. 29).

The secretariat reproduces below the draft recommendations received from the Danube Commission. This draft was prepared by the secretariat of the Danube Commission taking into account the relevant requirements of the Central Commission for the Navigation of the Rhine (CCNR), in force since 1 January 1990.

The distribution of documents of the Inland Transport Committee and its subsidiary bodies is limited. They are distributed only to Governments, to specialized agencies and to governmental and non-governmental organizations which take part in the work of the Committee and of its subsidiary bodies, and should not be given to newspapers or periodicals.

GE.95-20105 (E)

Draft

RECOMMENDATIONS CONCERNING THE MAIN TECHNICAL AND OPERATIONAL PARAMETERS FOR RADAR INSTALLATIONS USED IN NAVIGATION ON THE DANUBE

CHAPTER I

GENERAL PROVISIONS

Article 1

Basic principles: procedure for bringing shipborne radar installations (RI) into operation

1.1. Basic principles

1.1.1. These Recommendations define the minimum requirements concerning the technical and operational parameters for all types of shipborne radar installation intended for use in navigation on the Danube, and conditions for testing their conformity with these Recommendations.

1.1.2. Radar equipment shall not be installed on board vessels until a detailed check has been carried out to ensure that it conforms with the technical and operational parameters laid down in these Recommendations.

1.1.3. The requirements concerning radar reflectors can be found in the Recommendations concerning optimum types of radar reflectors and the methods of installing them on buoys on the Danube, approved by Decision of the twenty-ninth session (document CD/SES 29/34) and amended by Decision of the forty-seventh session (document CD/SES 47/22).

1.1.4. The technical and operational parameters of all types of RI shall conform at least to the parameters indicated in these Recommendations.

1.1.5. The screen image of all types of RI tested shall:

correspond exactly to the position of the vessel in relation to shorelines, buoys and other objects protruding above the surface of the surrounding river;

permit the timely recognition of hydraulic structures of importance to navigation on the river and other waterborne or stationary equipment;

be easy to use and enable the vessel to be steered reliably in poor visibility.

1.2. Approval of the RI for operation

1.2.1. Applications for approval testing of any type of RI, shall be submitted in writing to the national authority competent to carry out the test and to issue the required certificate concerning the suitability of the relevant type of RI for use on the Danube.

1.2.2. The Danube Commission shall be notified of the national authorities competent to carry out the above-mentioned tests and to install and replace RI on board vessels, and shall prepare and update periodically a list of these authorities containing all necessary information concerning them.

1.2.3. The form of the written application, the procedure for completing and submitting it and the number and type of documents to be attached to it shall be established by the appropriate competent authority.

1.2.4. Any legal or natural person concerned with the use of the RI in question for the steering of a vessel in poor visibility in accordance with the Basic Regulations of Navigation on the Danube (DFND) may submit an application for approval.

1.3. Period of validity of the approval

1.3.1. The approval for operation drawn up in conformity with these Recommendations shall be issued once only and be valid for a period of 10 years. It may be extended once for a further period of 10 years only by the competent authority which issued it in conformity with paragraph 1.4.1.

1.3.2. When any defects have been eliminated in conformity with paragraph 1.4.2., a new certificate shall be issued for the RI for a period established by the competent authorities, but not exceeding 10 years, in accordance with paragraph 1.3.1.

1.4. Withdrawal of approval

1.4.1. If the results of the tests of the specific RI are satisfactory, the competent authority which has performed the test (in accordance with paragraph 1.2.1.) shall issue the appropriate approval certificate, entering on it the approval number specially assigned to the RI tested.

If the results of the test are unsatisfactory, the applicant shall be notified in writing of the reasons for the refusal to issue the certificate (in accordance with paragraph 1.2.4.).

1.4.2. Every authority competent to carry out the tests and to approve shipborne RI shall have the right to make an additional unannounced check of any RI it has already approved. If this check reveals defects, the approval certificate of the RI shall be withdrawn until they are rectified.

1.4.3. The right to withdraw the certificate of approval of the RI in question shall be granted only to the authority which issued it.

1.5. Assignment of the approval number

1.5.1. All the main components of the RI approved for use on the Danube shall be marked indelibly with the name of the manufacturer, the trade designation of the equipment, the type of equipment, the serial number of the RI and the approval number.

1.5.2. The approval number assigned to the specific RI by the competent authority shall also be affixed indelibly to the display unit in such a way that it remains clearly visible after this unit has been installed.

1.5.3. The approval number may be used only for the RI to which it has been assigned.

Under paragraph 1.2.4. above, it shall devolve on the applicant to take the necessary steps to obtain and affix the approval number of any RI.

1.5.4. The structure of the approval number for any type of RI intended for navigation on the Danube shall comprise the following elements:

DN-abc, where

(a) D = Danube

(b) N = Letter or group of letters of the country of the competent authority issuing the certificate of approval for the RI in accordance with Annex 1 to the DFND.

(c) a, b and c = three-digit number representing the serial number of the RI or the numerical symbol established by the competent authority which issued the approval.

1.5.5. Each shipborne RI must be accompanied by a document from the manufacturer certifying that it meets the minimum requirements of the Recommendations of the Danube Commission in force on the Danube and that it is identical in every respect to the RI model which has been tested and approved for operation on the Danube in accordance with paragraph 1.2.

1.5.6. In accordance with paragraph 1.2.1., the competent authorities shall inform the secretariat of the Danube Commission in writing of the types of shipborne RI approved by them for operation in navigation on the Danube and their approval numbers, as well as the organizations authorized to install shipborne RI.

On the basis of the information received, the secretariat of the Danube Commission shall prepare and keep up to date, if necessary, lists containing these data (including the types of shipborne RI approved for operation on the Danube and their approval numbers, the manufacturer's name, and the date on which and the place where the approval number was assigned).

1.5.7. The secretariat of the Commission shall send the lists mentioned in paragraphs 1.2.2. and 1.5.6. to the competent authorities of the member countries of the Commission and other Danube countries, at their request.

1.5.8. The names and data contained in these lists shall be mutually recognized by the pertinent competent national authorities of the member countries of the Danube Commission and the other Danube countries.

1.6. Modifications and changes to the RI

1.6.1. Any modification to any type of RI already approved and to which an approval number has been assigned shall automatically cause the certificate to become invalid and the approval number to be withdrawn.

1.6.2. If it is necessary to modify the construction of the RI in question in any way, the modification shall be announced in advance in writing to the competent authority which issued the approval for that type of RI.

1.6.3. The authority competent to carry out the tests and issue the certificates of approval shall decide how next to proceed and whether or not to make further tests. In any case, the RI shall be assigned a new approval number, which shall be communicated to the Danube Commission.

CHAPTER II

MAIN TECHNICAL AND OPERATIONAL PARAMETERS OF RADAR INSTALLATIONS USED IN NAVIGATION ON THE DANUBE

Article 1

Main technical parameters of RI

1.1. Construction, design

1.1.1. Every RI intended to be used in navigation on the Danube shall, in its construction and the technical parameters of its operation meet the requirements and conditions for navigation on the Danube.

1.1.2. The RI shall also be suitable for installation and operation on board vessels accepted for navigation on the Danube.

1.1.3. The construction and design by the manufacturer of the shipborne RI for navigation on the Danube shall meet the minimum technical requirements laid down by these Recommendations with regard to the mechanical and electrical parameters of RI approved for operation on the Danube.

1.1.4. In the absence of specific parameters in the Recommendations or requirements in force on the Danube the competent authorities shall (when carrying out checks) apply the requirements and test methods relating to power supply, safe operation, mutual interference with other shipborne and electrical equipment, compass safe distance, resistance to mechanical and climatic conditions, mechanical strength, influence on the environment, noise emitted during operation and RI markings, established in the Marine Navigational Equipment General Requirements of the International Maritime Organization (IMO).*

The provisions of the International Telecommunication Union Radio Regulations shall also apply.

1.1.5. All requirements concerning the main technical parameters of shipborne RI contained in these Recommendations shall be satisfied as a minimum for RI display ambient temperatures between O°C and 40°C

1.1.6. Every RI intended for use in navigation on the Danube shall be designed to operate 24 hours a day.

1.2. Spurious emissions and electromagnetic compatibility

1.2.1. Emission frequency and band width shall be selected so as not to cause harmful interference in other frequency bands.

The shipborne RI shall be installed in such a way as not to interfere with the operation of other shipborne electrical equipment.

1.2.2. In the frequency range of 30 MHz to 2000 MHz, the field strength of spurious emissions by the RI shall not exceed 500 µV/m at a distance of 3 metres from the RI under test.

In the frequency ranges of 156-165 MHz, 450-470 MHz and 1.53-1.544 GHz, the field strength shall not exceed a value of 15 µV/M at a distance of 3 metres from the RI under test.

1.2.3. The installations shall be so designed that the maximum power of spurious emissions (power of the transmitter harmonics) shall not exceed 1×10^{-2} watts.

The power of non-essential transmitter radiation and receiver spurious radiation shall not exceed 2×10^{-9} watts.

---

* Publication "IEC 945 Marine Navigational Equipment General Requirements".

1.2.4. The radar installation shall satisfy the minimum requirements at electromagnetic field strengths of up to 15V/m in the immediate vicinity of the equipment under test in the frequency range of 30 MHz to 2000 MHz.

1.2.5. The structural parts of the RI shall carry indications of the minimum distances to be observed between them and the standard compass and the steering compass. These distances shall be measured from the centre of the magnetic compass to the nearest point of the RI part in question.

The distances shall be such that the RI part in question - whether current-carrying or not - cannot affect the reading of the standard compass or the steering compass be more than 1 degree.

1.3. Range of detection

1.3.1. It is recommended that the detection distance of a reflector with an effective reflecting surface of 1 m^2 should be established by moving the RI closer or further away, or with the RI stationary, for each sweep (revolution of the antenna) according to the "yes-no" principle. With a series of at least 10 revolutions of the antenna (in a full 360° circle) the value of the detection distance of a standard reflector shall be established with a detection probability of at least 0.8 (8 times).

The echo of the reflector shall therefore be clearly and distinctly perceptible on the screen without being superimposed on the pulse probe circle.

1.3.2. The distance readings shall be made using a variable range circle or fixed range circles.

The optimum adjustment of the controls of the RI shall be permitted as well as regulators to reduce sea and rain clutter in the normal basic position.

1.3.3. The minimum range of the RI shall be 15 m. The RI shall comply with this condition over a distance of up to 1,200 m, with the image centred.

1.3.4. The maximum range measured in the same way shall be at least 1,200 m; this means that the standard reflector shall be visible on the screen at a distance of 1,200 m on all the range circles.

1.4. Resolution

1.4.1. Angular resolution is related to range scale and distance. Minimum angular resolution is understood to be the minimum azimuthal distance between two standard reflectors at which they are shown clearly and distinctly separated on the RI screen.

1.4.2. In measuring the minimum angular resolution, two standard reflectors placed at a distance of 1,200 m from the antenna and 30 m apart shall be shown clearly and distinctly separated on the monitored RI screen (annex 1).

A standard reflector and a reflector of 300m^2 of equivalent reflecting surface, placed at a distance of 300 m from the antenna and 18 m apart shall also appear clearly and distinctly separated on the RI screen, without any adjustment of the setting (annex 2).

1.4.3. The RI shall meet these conditions for all range circles permitting representation up to 1,200 m.

1.4.4. Distance resolution means that two standard reflectors located 15 m apart on the same bearing shall be shown clearly separated on the RI indicator screen on each range circle of 15 to 1,200 m, where the distance represented is 1,200 m or less.

1.4.5. Functions of the RI that can cause a deterioration of resolution in range scales up to 2,000 m shall not be permitted.

1.5. Range scales and fixed range circles

1.5.1. The RI shall be provided with the following sequentially-switchable range scales and circles:

Range scale 1 - 500 m, one circle every 100 m
Range scale 2 - 800 m, one circle every 200 m
Range scale 3 - 1,200 m, one circle every 200 m
Range scale 4 - 1,600 m, one circle every 400 m
Range scale 5 - 2,000 m, one circle every 400 m

1.5.2. Further sequentially-switchable range scales shall be permitted.

1.5.3. The selected range scale, distance between range circles and the distance of the variable range marker (VRM) shall be indicated in metres or kilometres.

1.5.4. The width of the range circles, at the normal brightness setting of the RI screen, shall not exceed 2 mm.

1.5.5. Within a range circle, not fewer than two, or more than six fixed range markers shall appear. The fixed range markers shall be equidistant to within 3%.

1.5.6. Sub-sector display and enlargements on the RI screen shall not be permitted during navigation on the Danube.

1.6. Variable range marker

1.6.1. The variable range marker for measuring distances shall be able to measure the distance continuously in all the ranges represented.

1.6.2. Within eight seconds, it shall be possible to set the range marker to any distance.

1.6.3. It shall be possible to make measurements from the minimum range (15 m) up to a measurement range of 1,200 m. Up to 1,200 m, distances shall be expressed in metres in a clear and standard form, with 10 m graduations. For distances of more than 1,200 m, the graduations shall be 25 m.

1.6.4. The distance at which the variable range marker is set shall not change even after switchover to other range scales.

1.6.5. The width of the range marker shall not exceed 10 m or 1.5% of the distance represented, whichever of these values is the greater.

1.6.6. The range shall be displayed as a three or four-digit number. The accuracy for ranges up to 2,000 m shall be within 10 m. The radius of the range marker shall correspond to the digital display.

1.6.7. The RI should enable the fixed and variable range markers mentioned above to be disconnected if necessary.

1.7. Lubber line

1.7.1. A lubber line shall be superimposed on the radar image from the point corresponding to the antenna position up to the edge of the radar screen.

The lubber line shall be on 0° of the azimuth dial placed on the screen.

1.7.2. The width of the lubber line at the edge of the screen shall not be more than 0.5 degrees.

1.7.3. The RI shall have an adjusting device for correcting any azimuthal angular error in the antenna mounting.

1.7.4. Following correction of the angular error in accordance with paragraph 1.7.3. and activation of the radar unit, the deviation of the lubber line from the keel line shall not exceed 0.5 degrees.

1.7.5. The RI shall be provided with devices for adjusting the brightness of the screen and temporarily turning off the lubber line.

1.8. Off-centring

1.8.1. To permit an extended view of the area represented off-centring towards the rear of the radar image shall be possible within the given scale. This off-centring shall be adjustable to at least 0.25 of the effective diameter of the radar image on the indicator screen.

1.8.2. The off-centring of the radar image shall be possible at all the range scales mentioned in paragraph 1.5.1. above. This will permit an extended forward view.

1.8.3. Off-centring shall be adjustable to at least 0.25, and at most 0.33, of the effective screen diameter.

1.8.4. If the image of the region observed moves forward, the range circles shall move simultaneously.

1.8.5. In off-centring the image of the area observed as indicated above, the range circles shall be extended and the variable range marker shall be adjustable and readable up to the maximum of the displayed range.

1.8.6. A fixed extension of the radar image of the area observed in accordance with this paragraph is permitted provided that the effective diameter is not less than that specified in paragraph 1.9., and that the bearing scale is designed in such a way that a reading (measurement of the direction and the distance to a defined object - part of the radar image) can be taken in accordance with paragraph 1.10.

1.8.7. In the case referred to above, the off-centring facility shall not be required.

1.9. Working diameter of the radar screen

1.9.1. The working diameter of the RI screen, within the limits of which the radar image of the area observed around the vessel is displayed, shall not be less than 270 mm (12 inches).

1.10. Bearing scale

1.10.1. The RI shall have a bearing scale arranged at the edge of the screen.

1.10.2. The bearing scale shall be divided into at least 72 parts each representing 5 degrees. The graduation marks representing 10 degrees must be clearly longer than those representing 5 degrees.

1.10.3. The bearing scale shall be marked in three-figure numbers from 000 to 360 degrees in a clockwise direction. Numbering shall be in Arabic numerals every 10 or every 30 degrees.

1.10.4 The 000 mark on the bearing scale shall be positioned in the middle of the upper edge of the screen. The figure 000 may be replaced by a clearly visible arrow.

1.11. Bearing facilities

1.11.1. Special facilities for taking bearings of targets shall be allowed.

1.11.2 If such facilities are provided, they shall be capable of taking a bearing of any target within approximately 5 seconds, with a maximum error of ± 1 degree.

1.11.3. If an electronic bearing line is used, it shall:

(a) be clearly distinguishable from the lubber line;

(b) be displayed quasi-continuously;

(c) be freely rotatable through 360 degrees left and right;

(d) be at most 0.5 degrees wide at the edge of the screen or 1/720 of the external circle of the image;

(e) extend from origin up to the bearing scale;

(f) comprise a three- or four-figure decimal degree reading.

1.11.4. If a mechanical bearing line is used, it shall:

(a) be freely rotatable through 360 degrees left and right;

(b) extend from the marked origin to the bearing scale;

(c) be designed without any further markings;

(d) be designed in such a way that target echo readings are not obscured unnecessarily.

1.12. Vertical radiation pattern

1.12.1. The width of the vertical radiation pattern shall not extend more than 15° above the horizontal surface of the intensity point of the emission field corresponding to 3dB.

1.12.2. Requirements concerning the range of detection and the resolution set out in paragraph 1.3 above shall be met even if the vessel gives a range of up to 15°.

1.13. Emission frequency

1.13.1. The emission frequency of all types of RI shall be selected from the 9 GHz frequency band in accordance with the requirements of the ITU Radio Regulations in force. The use of other frequencies which the Radio Regulations provide for navigation shall be permitted exceptionally.

1.13.2. The RI shall be provided with a tuning indicator. The tuning scale shall have a length of at least 30 mm.

1.13.3. The indicator shall function in all ranges, even without radar echoes. The indicator shall also function when the gain or suppression of close proximity echoes is activated.

1.13.4. A manual control to correct the tuning of the RI shall be available.

1.14. Facilities for reducing sea and rain clutter

1.14.1. The radar equipment shall have facilities with manual controls for reducing clutter from meteorological causes (sea and rain).

1.14.2. The sea-clutter control (STC) shall, at its maximum setting, be effective up to a distance of approximately 1,200 m.

1.14.3. The RI shall not be provided with automatic facilities for reducing sea and rain clutter.

1.15. Facilities for reducing interference from other radar equipment

1.15.1. There shall be a switchable facility for the reduction of interference caused by other RI in operation.

1.15.2. The operation of this facility shall not adversely affect the display of useful targets.

1.16. Compatibility with radar beacons

1.16.1. Signals from radar beacons in accordance with IMO resolution A 423 (XI) shall be displayed clearly on the RI display even when the rain clutter suppression (FTC) is switched off.

1.17. Gain control

1.17.1 The range of the gain control shall be such that, at maximum sea-clutter suppression setting, surface movement of the water is clearly visible and that powerful radar echoes with an echo area equivalent to 10,000 m^2 may be cut out at any distance from the RI.

Article 2

Main parameters for operation

2.1. Operating instructions

2.1.1. A detailed operator’s manual shall be supplied by the manufacturer with each unit. It shall be available in English, French, German and Russian and shall contain at least the following information:

(a) activation and operation;

(b) maintenance and servicing;

(c) general safety instructions;

(d) health hazards, e.g., influence on pacemakers and similar appliances (electromagnetic radiation);

(e) instructions for correct technical installation.

2.1.2. A summarized operator's manual in a durable and water-resistant form shall be supplied with each unit.

It shall be available in English, French, German and Russian.

2.2. Installation and operating tests

2.2.1. Installation, replacement and operating tests for all shipborne RI shall be in accordance with article 1 of these Recommendations.

2.3. Access to shipborne RI and use

2.3.1. All persons meeting the requirements of the Recommendations of the Danube Commission, in particular, the "Recommendations concerning the issue of the certificate in radar navigation on the Danube" (document CD/SES .../...) shall be entitled to work with shipborne RI.

2.3.2. It shall be possible to operate the RI and watch the display simultaneously.

If the control panel is a separate unit, it shall contain all the controls for the RI.

The use of cordless remote controls shall not be permitted.

2.3.3. It shall be possible to read the display also when there is considerable ambient brightness. Where necessary, appropriate vision aids shall be available and shall be attachable and removable simply and easily. Vision aids shall be usable by wearers of spectacles.

2.3.4. Variations in the mains voltage shall not prevent the correct operation of the apparatus if they do not exceed 10% of the nominal value.

2.3.5. Each RI shall be supplied from a separate feeder (power source).

2.4. Operation and handling of the RI

2.4.1. The operation and handling of all types of RI shall be as simple as possible.

The RI shall be fully operational in not more than 4 minutes.

2.4.2. The devices for starting up, stopping and adjusting each RI shall be installed on the indicator and shall be provided with markings which are legible in the dark.

2.4.3. The number of controls shall be kept to the strict minimum necessary for safe operation. All controls shall be easily accessible, easy to use and easily identifiable.

2.4.4. The design, markings and manipulation of the controls shall be such as to permit the simple, unambiguous and fast operation of each RI.

2.4.5. Image quality controls shall be graduated. Their arrangement shall be such as to prevent operating mistakes as far as possible.

2.4.6. Controls not necessary for normal operation shall not be immediately accessible.

2.4.7. Each RI shall have appropriate controls and signalling equipment for monitoring image quality and for precise adjustment of the RI.

2.4.8. All controls and indicators shall be provided with symbols and/or markings in English. Symbols shall meet the requirements of IMO Recommendation No. A.278 (VIII) "Symbols for controls on marine navigational radar equipment" or the requirements contained in IEC publication No. 417. The height of all numerals and letters shall be at least 4 mm. If it can be demonstrated that, for technical reasons, numerals and letters of 4 mm high are not possible and if for the purposes of operation smaller numerals and letters are acceptable, a reduction to 3 mm shall be allowed.

2.4.9. All controls shall be arranged in such a way that, when a control is used, the associated indication remains visible and that radar navigation can continue without any restriction.

2.4.10. Controls to switch off the RI or the operation of which may result in an error function shall be protected against unintentional operation.

2.4.11. All controls and indicators shall be equipped with a dazzle-free source of lighting suitable for use under all conditions of light and adjustable down to zero by means of an independent control.

2.4.12. The following functions shall have their own directly-accessible controls:

(a) Stand-by/on

(b) Range

(c) Tuning

(d) Gain

(e) Sea-clutter (STC)

(f) Rain-clutter (FTC)

(g) Variable range market (VRM)

(h) Cursor or Electronic Bearing Line (EBL) (if provided)

(i) Ship’s heading marker suppression (SHM)

2.4.13. If rotary-knobs are used for these functions, they shall not be arranged concentrically. At least the controls for gain, sea-clutter suppression and rain-clutter suppression must be adjustable by means of rotary knobs, the effect of which shall be roughly proportional to the angle of rotation.

2.4.14. The effect of the operation of controls shall be such that movements to the right or upwards shall have a positive effect on the manipulated variable, while movements to the left or downwards shall have a negative effect.

2.4.15. If push-buttons are used, they shall be designed in such a way that they can be found and operated by touch. They shall also have a clearly perceptible contact release.

2.4.16. The respective brightnesses of the following display values shall be independently adjustable from zero to the level necessary for operation:

(a) Radar picture;

(b) Fixed range circles;

(c) Variable range circles;

(d) Bearing scale;

(e) Bearing line;

(f) Nautical information as specified in paragraph 2.62 of article 2.6.

2.5. Display

2.5.1. "Radar picture" means the scaled representation of radar echoes of the surroundings and their motion relative to the vessel on the display unit’s screen from one antenna revolution with the vessel’s keel line and the lubber line coinciding at all times.

2.5.2. "Display unit" means that part of the equipment (main component of the RI) that contains the screen.

2.5.3. "Screen" means the main, low-reflection part of the display unit on which either the radar picture only, or the radar picture together with additional nautical information, is shown in accordance with article 2.6, paragraph 2.6.2. of these Recommendations.

2.5.4. "Effective diameter of the radar picture" means the diameter of the (externally) largest completely circular radar picture which can be shown within the bearing scale.

2.5.5. "Raster scan representation" means the quasi-static representation of the radar picture from a complete revolution of the antenna, in the form of a television picture.

2.6. Nautical orientation lines and information on the screen

2.6.1. Only the lubber line, bearing lines and range circles may be superimposed on the radar screen.

2.6.2. Apart from the radar picture and in addition to information on the operation of the RI, only nautical information such as that listed below may be displayed:

(a) speed of the vessel;

(b) rate of turn;

(c) rudder position;

(d) water depth;

(e) compass course.

2.6.3. All screen information besides the radar picture shall be displayed quasi-statistically and the refreshment rate shall satisfy the operational requirements.

2.6.4. The requirements regarding the display and accuracy of nautical information shall be the same as those applicable to the respective main RI.

2.7. Radar picture characteristics

2.7.1. The effective diameter of the radar picture shall be not less than 270 mm.

2.7.2. The diameter of the outer range circle in the range scales specified in paragraph 1.5.1. above shall be at least 90% of the effective radar picture diameter.

2.8. Picture refreshment rate and persistence

2.8.1. The frequency of refreshment of the radar image on the screen shall be $\geq$ 0.4 Hz, depending on the speed of the vessel during the operation of the RI.

For a speed of less than 30 km/h, the radar image on the screen shall be replaced at least every 2.5 seconds. For a speed of 30 km/h or more it shall be replaced at least every second.

2.8.2. The persistence may be achieved in two ways: either by a continuous display or by periodical picture refreshment. Periodical picture refreshment shall be effected at not less than 50 Hz.

2.8.3. Each echo on the screen shall persist for at least the duration of one antenna revolution, but not longer than two antenna revolutions.

2.8.4. The difference in brightness between the writing of an echo and its afterglow during one antenna revolution shall be as small as possible.

2.9. Colour of the display

2.9.1. The display colour shall be chosen on the basis of physiological factors. If various colours can be reproduced on the screen, the actual radar picture of each object shall be monochrome. The reproduction of different colours shall not result in mixed colours by superimposition, on any part of the screen.

2.10. Display linearity

2.10.1. The linearity error of the radar picture shall not exceed 5%.

2.10.2. In all ranges up to 2,000 m, a fixed straight shore line at a distance of 30 m from the radar antenna shall be displayed as a straight continuous echo structure without observable distortions.

2.11. Accuracy of range and azimuthal measurements

2.11.1. The determination of the distance to a target by means of variable or fixed range circles shall be accurate to $\pm$ 10 m or $\pm$ 1.5%, whichever is the larger.

2.11.2. The angular value of the bearing of an object shall not differ by more than $\pm$ 1 degree from the real value.

2.12. Auxiliary indicators

2.12.1. Auxiliary indicators shall fully satisfy all requirements applicable to navigational radar equipment.

2.12.2. Provided that the difference in brightness of some of the displayed values is only slight and the fixed range circle, the variable range circle and the bearing line can be switched off independently of each other, there may be one brightness control for each of the following groups of values:

(a) radar picture and lubber line; fixed range circles;

(b) variable range circles;

(c) bearing line and bearing scale and nautical information as specified in article 2.6, paragraph 2.6.2.

2.12.3. The brightness of the lubber line shall be adjustable but shall not be reducible to zero.

2.12.4. To switch off the lubber line, there shall be a control with automatic reset.

2.12.5. The anti-clutter devices shall be continuously adjustable to zero.

Article 3

Antenna characteristics

3.1. Radar antenna and its radiation range

3.1.1. The antenna drive system and the antenna shall be such as to allow correct operation at wind speeds of up to 100 km per hour.

3.1.2. The antenna drive system shall have a safety switch by means of which the transmitter and the rotator drive can be switched off.

3.1.3. The horizontal radiation pattern of the antenna, measured in one direction, shall meet the following requirements:

(a) at intensity point -3 dB of the radiation field the width of the main lobe shall be not more than 1.2 degrees;

(b) at intensity point -20 dB of the radiation field the width of the main lobe shall be not more than 3.0 degrees;

(c) side-lobe attenuation with $\pm$ 10 degrees around the main lobe: $\geq$ 25 dB;

(d) side-lobe attenuation outside $\pm$ 10 degrees around the main lobe: $\geq$ 32 dB.

3.1.4. The vertical radiation pattern of the antenna measured in one direction shall meet the following requirements:

(a) at intensity point -3 dB of the radiation field the width of the main lobe shall be not more than 30 degrees;

(b) the maximum of the main lobe shall be in the horizontal axis;

(c) side-lobe attenuation shall be greater than 25 dB.

3.1.5. The radiated high-frequency energy shall be horizontally polarized.

3.1.6. The operating frequency of the RI shall be in a range above 9 GHz which is allocated to navigational radar installations under the prevailing Radio Regulations of the International Telecommunication Union (Geneva).

3.1.7. The frequency spectrum of the high-frequency energy radiated by the antenna shall be in conformity with ITU Radio Regulations.

CHAPTER III

TEST CONDITIONS AND TEST METHODS FOR RADAR INSTALLATIONS

Article 1

Test conditions

1.1. Safety, load capacity and interference diffusion

1.1.1. The testing of power supply, safety, mutual interference with other shipborne equipment, compass safe distance, resistance to climatic influences, mechanical strength, environmental impact and audible noise emission shall take place in accordance with IEC publication 945 "Marine Navigational Equipment General Requirements" (IMO).

1.2. Spurious emissions and electromagnetic compatibility

1.2.1. The measurement of spurious emissions shall be performed in accordance with IEC publication 945 "Marine Navigational Equipment Interference" (IMO) in the frequency range of 30 to 2,000 MHz.

The requirements of article 1.2, paragraph 1.2.2. above shall be met.

1.2.2. The electromagnetic compatibility requirements of article 1.2, paragraph 1.2.4. shall be met.

1.3. Test methods

1.3.1. The test field shown in annex 2 for the testing of radar equipment shall be arranged on a calm water surface at least 1.5 km long and 0.3 km wide, or on terrain with equivalent reflection properties.

1.3.2. A standard reflector shall be a radar reflector which, at a wavelength of 3.2 cm, has an equivalent radar cross section of 10 m^2.

The equivalent radar cross section (Sigma) of a three-axis radar reflector with triangular surfaces for a frequency of 9 GHz (3.2 cm) shall be calculated according to the following formula:

$$\delta = \frac{4.\pi \cdot a^4}{3.\ 0.032^2}$$

a = edge length in m

For a standard reflector with triangular surfaces, the edge length a = 0.222 m.

The dimensions of the reflectors used for the testing of range and discrimination at a wavelength of 3.2 cm shall also be used when the radar equipment under test has a wavelength other than 3.2 cm.

1.3.3. Standard reflectors shall be set up at distances of 15 m, 30 m, 45 m, 60 m, 85 m, 300 m, 800 m, 1,170 m, 1,185 m and 1,200 m from the antenna position (see annex 2).

(a) Beside the standard reflector at 85 m, standard reflectors shall be set up at a distance of 5 m on both sides, at right angles to the bearing line.

(b) Beside the standard reflector at 300 m, a reflector with an equivalent radar cross section of 300 m^2 shall be set up at a distance of 18 m, at right angles to the bearing line.

(c) Further reflectors with an equivalent radar cross section of 1 m^2 and 1,000 m^2 shall be set up at an azimuthal angle to each other of 15 degrees, at the same distance of 300 m from the antenna.

(d) Beside the standard reflector at 1,200 m, standard reflectors and a reflector with a radar cross section of 1 m^2 shall be set up at a distance of 30 m on both sides, at right angles to the bearing line.

1.3.4. The RI shall be adjusted to the best quality of picture. The gain must be adjusted in such a way that, in the area immediately beyond the range of operation of the anti-clutter control, noise can no longer be seen.

The sea-clutter suppression control (STC) shall be set at minimum, while the rain-clutter suppression control (FTC) shall be switched off.

All controls that influence picture quality shall be left unchanged for the duration of the test at a specific antenna height and be fixed in an appropriate way.

1.3.5. The antenna shall be set up at any desired height between 5 and 10 m above the surface of the water or the ground. The reflectors shall be set up at such a height above the surface of the water or of the ground that their effective radar return corresponds to the value specified in article 1.3.2 above.

1.3.6. All reflectors set up within the selected range shall, at all distances up to and including 1,200 m, be shown on the screen simultaneously as clearly-separated targets, regardless of the azimuthal position of the test field in relation to the lubber line.

Signals from radar beacons as described in article 1.16, paragraph 1.16.1. shall be displayed clearly.

All requirements specified in these provisions shall be met at any antenna height between 5 and 10 m, with only essential adjustments of the controls being authorized.

1.4. Antenna parameter measurements

The measurement of the antenna characteristics shall be executed according to IEC publication 936 "shipborne Radar", issued by IMO.

CHAPTER IV

Article 1

Minimum requirements and test conditions for rate-of-turn indicators

1.1. Minimum requirements for rate-of-turn indicators

1.1.1. The rate-of-turn indicator is intended to facilitate radar navigation and to measure and indicate the rate-of-turn of the vessel to port or starboard.

1.1.2. No rate-of-turn indicators of any type may be installed on board vessels intended for navigation on the Danube until it has been established by means of a test that they satisfy the minimum requirements set out in these Recommendations.

1.2. Test conditions for obtaining an approval to operate rate-of-turn indicators

1.2.1 An application for testing a rate-of-turn indicator shall be submitted to the appropriate competent authority of a member country of the Danube Commission, entitled to carry out this type of test.

The Danube Commission shall be notified of the competent authorities responsible for testing, installing and replacing rate-of-turn indicators and shall prepare and keep up to date a list of competent authorities in the Danube basin containing all necessary information about them.

1.2.2. Each application shall be accompanied by the following documents:

(a) two copies of a detailed technical description of the rate-of-turn indicator;

(b) two complete sets of documents concerning installation and use;

(c) two copies of a user’s manual.

1.2.3. The applicant shall determine or cause to be determined that the minimum requirements of these Recommendations are met.

The results of the test and the measurement reports of the horizontal and vertical radiation pattern of the antenna shall accompany the application.

These documents and the information obtained during testing shall be kept by the competent testing authority.

1.2.4. For approval testing purposes, an "applicant" is understood to be any legal or natural person interested in the use of the rate-of-turn indicator.

1.3. Approval

1.3.1. If the rate-of-turn indicator passes the test, the competent testing authority shall issue a certificate of conformity.

If the equipment fails the test, the applicant shall be notified in writing of the reasons for its rejection.

1.3.2. The competent authority which has carried out the tests and issued the certificate of approval shall inform the Danube Commission in writing of the rate-of-turn indicators it has approved for operation.

1.3.3. The Secretariat of the Danube Commission shall prepare and, when necessary, update a list of approved rate-of-turn indicators and shall transmit it to all interested parties on request.

1.3.4. The testing authority shall be entitled to select equipment from the production series at any time for inspection.

If this inspection reveals defects, the approval may be withdrawn by the competent authority until the defects prompting the withdrawal have been eliminated.

The certificate of approval may be withdrawn only by the authority which initially issued it.

1.3.5. The certificate of approval shall be issued for an initial period of 10 years and its validity may be extended by the competent authority if a request to that effect is submitted in writing.

1.4. Rate-of-turn indicator markings and approval number

1.4.1. Each component of the equipment shall be marked indelibly with the name of the manufacturer, the trade designation of the equipment, the type of equipment and the serial number.

1.4.2. The equipment approval number assigned by the competent authority shall be affixed to the indicator of the equipment in such a way that it remains clearly visible after the equipment has been installed.

1.4.3. The approval number shall be composed as follows:

D - N - def where

D = "Danube"

N = letter or group of letters of the country of the competent authority which issued the approval in accordance with Annex 1 to the DFND

d, e and f = 3-digit number or numerical symbol to be established by the competent authority.

1.4.4. The approval number may be used only for the indicator to which it has been assigned.

It shall be the responsibility of the applicant to produce and affix the approval number.

1.4.5. The competent authority which carries out the test on the basis of which an approval number is assigned to the rate-of-turn indicator in question shall be required to inform the Danube Commission in writing in due course, of the approval number assigned.

1.5. Manufacturer's declaration

1.5.1. Each rate-of-turn indicator shall be accompanied by a written manufacturer's declaration to the effect that it meets the requirements contained in these Recommendations and that its construction corresponds exactly to the indicator type which has undergone approval tests in accordance with paragraphs 1.1. and 1.2. of this article.

1.6. Modifications to approved indicators

1.6.1. Any modification to a rate-of-turn indicator already approved shall cause the type approval to be withdrawn. Whenever modifications are planned, details shall be sent in writing to the competent testing authority.

1.6.2. The competent authority which carried out the tests and issued the approval shall decide whether the approval still applies or whether a further test of the indicator is necessary. If a new test is carried out and a new approval issued, a new approval number shall be assigned to the rate-of-turn indicator in question.

Article 2

Minimum technical parameters for rate-of-turn indicators

2.1 Construction, design

2.1.1. Every type of rate-of-turn indicator intended for use on board vessels navigating on the Danube shall meet the minimum technical and operational requirements set out in these Recommendations.

2.1.2. The construction and design of the indicator shall be in accordance with modern technical requirements for the main mechanical and electrical parameters of such equipment.

2.1.3. In the absence of any specific provision in these Recommendations or in other provisions of the Danube Commission the requirements and measurement methods contained in IEC publication 945 "Marine Navigational Equipment General Requirements" shall apply in practice to power supply, safety, mutual interference of shipborne equipment, compass safe distance, resistance to climatic influences, mechanical strength, environmental influences, audible noise emission and equipment markings.

The equipment shall satisfy all requirements of these Recommendations at ambient temperatures between 0° C and + 40° C.

2.2. Spurious emissions and electromagnetic compatibility

2.2.1. In the frequency range 30-2000 MHz, the field strength of spurious emissions shall not exceed 500 µV/m.

In the frequency ranges 156-165 MHz, 450-470 MHz and 1.53-1.544 GHz, the field strength shall not exceed a value of 15 µV/m.

These field strengths shall apply at a test distance of 3 metres from the equipment under test.

2.2.2. Rate-of-turn indicators shall satisfy the minimum requirements at electromagnetic field strengths of up to 15 V/m in the immediate vicinity of the equipment under test in the frequency range 30-2000 MHz.

2.3. Operation

2.3.1. The equipment shall not have more controls than are necessary for its operation in accordance with the requirements.

The design, markings and adjustment of the controls shall be such as to permit their simple, unambiguous and fast operation. Their arrangement shall be such as to prevent operating mistakes as far as possible.

Controls not necessary for normal operation shall not be immediately accessible.

2.3.2. All controls and indicators shall be provided with symbols and/or markings in English. The height of all numerals and letters shall be at least 4 mm.

If it can be demonstrated that, for technical reasons, numerals and letters of 4 mm high are not possible and if, for the purposes of operation, smaller numerals and letters are acceptable, a reduction to 3 mm shall be allowed.

2.3.3. The indicator shall be designed in such a way that operating mistakes cannot cause its failure.

2.3.4. Any functions of the indicator not covered by these Recommendations, such as facilities for connection to other equipment, shall be provided in such a way that the equipment meets the minimum requirements under all operating conditions.

2.4. Operating instructions

2.4.1. A detailed operator's manual shall be supplied with each unit. It shall be available in English, French, German and Russian and shall contain at least the following information:

(a) activation and operation;

(b) maintenance and servicing;

(c) general safety requirements.

2.5. Installation and operating tests

2.5.1. Installation, replacement and operating tests of the rate-of-turn indicator shall be in accordance with these Recommendations.

2.5.2. The direction of installation in relation to the fore-and-aft line and installation instructions to ensure maximum insensitivity to other normal movements of the vessel shall be indicated on the rate-of-turn indicator's sensor unit.

Article 3

Minimum operational parameters for rate-of-turn-indicators

3.1. Operational readiness of the rate-of-turn indicator

3.1.1. From a cold start, the rate-of-turn indicator shall be fully operational within four minutes and shall operate to within the required accuracy tolerances.

3.1.2. A warning signal shall indicate that the indicator is switched on. Observation and operation of the rate-of-turn indicator shall be possible simultaneously.

3.1.3. The use of cordless remote controls shall not be permitted.

3.2. Indication of the rate of turn

3.2.1. The rate of turn shall be indicated on a linear graduated scale having the zero point situated in the middle. It shall be possible to read the direction and extent of the rate of turn with the necessary accuracy.

Needle indicators and bar-graphs shall be permitted.

3.2.2. The indicator scale shall be at least 20 cm long and may be circular or rectilinear.

Rectilinear scales may be arranged horizontally only.

3.2.3. Indicators which are digital only shall not be permitted.

3.3. Measuring ranges

3.3.1. Rate-of-turn indicators may be provided with one or more measuring ranges. The following measuring ranges are recommended:

(a) 30°/minute

(b) 60°/minute

(c) 90°/minute

(d) 180°/minute

(e) 300°/minute.

3.4. Accuracy of the indicated rate of turn

3.4.1. The indicated rate-of-turn shall not differ by more than 2% from the measurable maximum value or by more than 10% from the actual value, whichever is the greater (see annex 3).

3.5. Sensitivity

3.5.1. The operating threshold shall be less than or equal to a change in angular speed equivalent to 1% of the indicated value.

3.6. Monitoring of operation

3.6.1. If the rate-of-turn indicator does not operate within the required accuracy range, this shall be indicated.

3.6.2. If a gyroscope is used, any critical fall in the rate of rotation of the gyroscope shall be signalled by an indicator. A critical fall in the rate of rotation of the gyroscope is one which lowers accuracy by 10%.

3.7. Insensitivity to other normal movements of the vessel

3.7.1. Rolling of the vessel of up to 10° at a rate of turn of up to 4° per second shall not cause measurement errors in excess of the stipulated tolerances.

3.7.2. Impacts such as those that may occur during berthing shall not give rise to measurement errors in excess of the stipulated tolerances.

3.8. Insensitivity to magnetic fields

3.8.1. The rate-of-turn indicator shall be insensitive to magnetic fields which may typically occur on board the vessel and in their vicinity.

3.9. Slave indicators

3.9.1. Slave indicators shall satisfy all requirements which apply to rate-of-turn indicators.

Article 4

Minimum technical parameters for rate-of-turn indicators

4.1. Operation

4.1.1. All the indicator's controls shall be so arranged that during their operation, no information coming from the equipment is concealed from view and radar navigation remains unaffected.

4.1.2. All controls and indicators shall be provided with a dazzle-free source of lighting appropriate for all ambient lighting conditions and adjustable down to zero by means of an independent control.

4.1.3. Adjustment of controls shall be such that movements to the right or upwards have a positive effect on the variable and movements to the left or downwards a negative effect.

4.1.4. If push-buttons are used, it shall be possible to locate and operate them by touch. They shall also have clearly perceptible contact release.

4.2. Damping devices

4.2.1. The sensor system shall be damped for critical values. The damping constant (63% of the limit value) shall not exceed 0.4 seconds.

4.2.2. The indicator shall be damped for critical values.

Controls for increasing damping shall be permitted.

Under no circumstances may the damping constant exceed 5 seconds.

4.3. Connection of additional equipment

4.3.1. If the rate-of-turn indicator can be connected to slave indicators or similar equipment, the rate-of-turn indication shall remain usable as an electric signal.

The rate of turn shall continue to be indicated for a galvanic earth insulation equivalent to a similar voltage of 20 mV/degree $\pm$ 5% and a maximum internal resistance of 100 ohm.

4.3.2. Polarity shall be positive when the vessel is turning to starboard and negative when it is turning to port.

4.3.3. The operating threshold shall not exceed 0.3°/minute.

Zero error shall not exceed 1°/minute at temperatures from 0° C to 40° C.

4.3.4. With the indicator switched on and the sensor not exposed to the effects of movement, the spurious voltage at the output signal measured with a 10 Hz pass-band low-pass filter shall not exceed 10 mV.

4.3.5. The rate-of-turn signal shall be received without additional damping of the sensor system within the limits referred to in article 4.2, paragraph 4.2.1.

4.3.6. There shall be an external alarm switch. The switch shall be installed as a galvanic insulation break-switch for the indicator.

4.3.7. The external alarm shall be triggered by contact closure:

(a) if the rate-of-turn indicator is disconnected; or

(b) if the rate-of-turn indicator is not in operation, or

(c) if the operating control has reacted following an excessive error (art. 3.6).

CHAPTER V

TEST CONDITIONS AND PROCEDURE FOR RATE-OF-TURN INDICATORS

Article 1

Text conditions for rate-of-turn indicators

1.1. Safety, load capacity and interference diffusion

1.1.1. The testing of power supply, safety, mutual interference of shipborne equipment, compass safe distance, resistance to climatic influences, mechanical strength, environmental influences and audible noise emission shall take place in accordance with IEC publication 945 "Marine Navigational Equipment General Requirements" (IMO).

1.2. Spurious emissions and electromagnetic compatibility

1.2.1. The measurement of spurious emissions shall be performed in accordance with IEC publication 945 "Marine Navigational Equipment Interference" in the frequency range 30 to 2000 MHz.

The requirements of chapter IV, paragraph 2.2.1. shall be met.

1.2.2. The electromagnetic compatibility requirements of chapter IV, paragraph 2.2.2, shall be met.

1.3. Test procedure

1.3.1. Rate-of-turn indicators shall be brought into operation and tested under nominal and boundary conditions. In this regard, the influence of the operating voltage and of the ambient temperature shall be tested as far as the prescribed limit value.

In addition, radio transmitters shall be used to set up the maximum magnetic fields in the vicinity of the indicators.

1.3.2. Under the conditions described in paragraph 1.3.1 of this chapter, indicator errors shall remain within the tolerances indicated in annex 3.

All other requirements shall be met.

CHAPTER VI

REQUIREMENTS FOR INSTALLATION AND PERFORMANCE TESTS OF RADAR EQUIPMENT AND RATE-OF-TURN INDICATORS INSTALLED ON BOARD VESSELS NAVIGATING ON THE DANUBE

Article 1

Requirements for installation of RI and rate-of-turn indicators on vessels navigating on the Danube

1.1. Purpose of the requirements

1.1.1. The purpose of these requirements is to ensure that, in the interest of safety and so as to create normal conditions for radar navigation on the Danube, the high-quality installation of radar equipment and rate-of-turn indicators takes place in optimum technical and ergonomic conditions and is followed by an appropriate performance test.

1.2. Approval for operation

1.2.1. So as to ensure safe navigation by radar under conditions of poor visibility on the Danube, only the installation of equipment approved for operation under the requirements in force adopted by the Danube Commission and bearing an approval number shall be permitted.

1.3. Approved specialized firms

1.3.1. The installation or replacement of radar equipment and rate-of-turn indicators and their repair or maintenance shall be carried out only by specialized firms in countries members of the Danube Commission, approved by the competent authority.

1.3.2. Approval may be granted by the competent authority for a fixed limited period. It may be withdrawn (by the same competent authority) if the conditions of article 1.1. are not met.

1.3.3. The competent authority shall notify the Danube Commission in due course and in writing of the specialized firms it has approved, and provide information concerning them (address, fax, telephone, telex).

1.4. Requirements for on-board power supply

1.4.1. All power supply leads for RI and rate-of-turn indicators shall have their own separate safety devices and if possible be fail-safe.

1.5. Installation of the radar antenna

1.5.1. The radar antenna shall be installed as close as possible to the fore-and-aft-line. There shall be no obstruction in the vicinity of the antenna causing false echoes or unwanted shadows. If necessary, the antenna shall be mounted on the forecastle. The mounting and attachment of the radar antenna in its operational position shall be sufficiently stable to enable the radar equipment to perform within the required accuracy limits.

1.5.2. After the angular error in the mounting has been corrected and the equipment has been switched on, the difference between lubber line and fore-and-aft-line shall not be greater than 1 degree.

1.6. Installation of the indicator screen and the control unit

1.6.1. The indicator screen and control unit shall be installed in the wheelhouse in such a way that the evaluation of the radar picture and the operation of the equipment present no difficulty. The azimuthal orientation of the radar picture shall be in accordance with the normal situation of the surroundings. Clamps and adjustable consoles are to be constructed in such a way that they can be locked in any position free of vibration.

1.6.2. During radar navigation, artificial lighting shall not be reflected in the direction of the steersman operating the RI.

1.6.3. When the control unit is not part of the display unit, it shall be located in a housing within 1 metre of the display unit. Cordless remote controls shall not be permitted.

1.6.4. If slave indicators are installed, they shall satisfy the requirements which apply to shipborne RI.

1.7. Installation of the rate-of-turn indicator

1.7.1. The sensor system shall be installed as far as possible amidships, horizontal and aligned with the ship’s fore-and-aft-line.

The installation site shall as far as possible be free of vibration and be liable to modest temperature variations. The rate-of-turn indicator shall if possible be installed above the RI.

1.7.2. If slave indicators are installed, they shall satisfy the requirements which apply to rate-of-turn indicators.

1.8. Installation and performance test

1.8.1. Before the equipment is switched on for the first time after installation or after renewals or extensions of the ship's survey certificate as well as after each modification of the vessel likely to affect the operating conditions of the equipment, an installation and performance test shall be carried out by the competent authority or by an approved specialized firm as mentioned in article 1.3. above.

1.8.2. The following conditions shall be fulfilled:

(a) The power supply shall have a safety device;

(b) The operating voltage shall be within the tolerance (see chap. II, art.2.3. and chap. IV, art.2);

(c) The cabling and its installation shall satisfy the technical requirements in force on the Danube;

(d) The number of antenna revolutions shall reach at least 24 per minute;

(e) There shall be no obstruction in the vicinity of the antenna which may impair navigation;

(f) The safety switch of the antenna shall be in good working order. This shall not apply to radar equipment approved before 1 January 1990;

(g) The arrangement of display units, rate-of-turn indicators and control units shall be ergonomic and user-friendly;

(h) The lubber line on the screen of the radar equipment shall not deviate from the ship's fore-and-aft-line by more than 1 degree;

(i) The accuracy of the range and azimuthal displays shall satisfy requirements (measurements using known targets);

(j) Linearity in short ranges shall be correct (pushing and pulling);

(k) The minimum displayable range shall be 15 metres or less;

(l) The centre of the picture shall be visible and its diameter shall not exceed 1 mm;

(m) False echoes caused by reflections and unwanted shadows on the lubber line shall not occur or shall not impair the safety of navigation;

(n) Sea-clutter and rain-clutter suppressors (STC and FTC preset) and the associated controls shall perform correctly;

(o) The gain adjustment shall be in proper working order;

(p) Focus and picture definition shall be correct;

(q) The ship's turning direction shall be as indicated on the rate-of-turn indicator and the zero position at dead ahead shall be correct;

(r) The RI shall not be sensitive to transmissions by the ship's radio equipment or to interference from other on-board sources;

(s) The radar equipment and/or rate-of-turn indicator shall not interfere with other on-board equipment.

1.9. Installation and performance certificate

1.9.1 After a successful test in accordance with article 1.8, the competent authority (or the approved specialized firm) shall issue a certificate in accordance with the attached model (see annex 4). This certificate shall be kept permanently on board.

1.9.2. If the test conditions have not been met, a list of defects shall be drawn up. Any existing certificate shall be withdrawn or sent to the competent authority by the approved firm.
