INTERNATIONAL STANDARD

IEC 60872-2

First edition
1999-01

**Maritime navigation and radiocommunication equipment and systems –
Radar plotting aids –**

**Part 2:
Automatic tracking aids (ATA) –
Methods of testing and required test results**

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For general terminology, readers are referred to IEC 60050: *International Electrotechnical Vocabulary* (IEV).

For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to publications IEC 60027: *Letter symbols to be used in electrical technology*, IEC 60417: *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets* and IEC 60617: *Graphical symbols for diagrams*.

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – RADAR PLOTTING AIDS –

Part 2: Automatic tracking aids (ATA) – Methods of testing and required test results

FOREWORD

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International Standard IEC 60872-2 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems. The IEC 60872 series, of which this is part 2, replaces IEC 60872 published in 1987 and amendment 1 (1991) and reflects the new requirements of the International Maritime Organization (IMO).

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

FDIS	Report on voting
80/195/FDIS	80/220/RVD

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

Annexes A, B, C, D and E form an integral part of this standard.

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

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – RADAR PLOTTING AIDS –

Part 2: Automatic tracking aids (ATA) – Methods of testing and required test results

1 Scope

This International Standard specifies the minimum performance requirements, technical characteristics, methods of testing and test results for equipment that complies with performance standards not inferior to those adopted by the International Maritime Organisation (IMO) – resolution MSC.64(67) Annex 4.

This standard takes account of IMO resolution A.694 and is associated with IEC 60945.

When a requirement in this standard is different from IEC 60945, the requirement in this standard shall take precedence.

Equipment intended for use on high speed craft (HSC) shall additionally satisfy the requirements of the HSC scenarios as defined in IEC 60936-2, annex D.

All texts of this standard, the wording of which is identical to that in IMO Resolution MSC.64(67) Annex 4, are printed in *italics* and the resolution and paragraph numbers are indicated in brackets.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60872. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 60872 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60872-1:1998, *Maritime navigation and radiocommunication equipment and systems – Radar plotting aids – Part 1: Automatic radar plotting aids (ARPA) – Methods of testing and required test results*

IEC 60872-3, *Maritime navigation and radiocommunication equipment and systems – Radar plotting aids – Part 3: Electronic plotting aid (EPA) – Methods of testing and required test results* [1)]

IEC 60936-1, *Maritime navigation and radiocommunication equipment and systems – Radar – Part 1: Shipborne radar – Methods of testing and required test results* [1)]

IEC 60936-2:1998, *Maritime navigation and radiocommunication equipment and systems – Radar – Part 2: Shipborne radar for high speed craft (HSC) – Methods of testing and required test results*

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1) To be published.

IEC 60945:1996, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

IEC 61162, — *Maritime navigation and radiocommunication equipment and systems – Digital interfaces*

ISO 9000, — *Quality management and quality assurance standards*

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

IMO Resolution A.820:1995, *Performance standards for navigational radar equipment for high-speed craft*

IMO Resolution A.823:1995, *Performance standards for automatic radar plotting aids (ARPAs)*

IMO Resolution A.824:1995, *Performance standards for devices to indicate speed and distance*

IMO MSC.64(67):1996, *Annex 4 – Performance standards for radar equipment*

IHO S-52:1996, *Specifications for chart content and display aspects of ECDIS*

3 Performance requirements

NOTE – The following requirements are from IMO MSC.64(67) Appendix 1 of Annex 4.

3.1 (MSC.64(67)/1) **Introduction**

3.1.1 (MSC.64(67)/1.1) *"Auto tracking aid"* (ATA) shall, *in order to improve the standard of collision avoidance at sea:*

.1 reduce the workload of observers by enabling them to obtain information about automatically plotted targets so that they can perform as well with several separate targets as they can by manually plotting a single target;

.2 provide continuous, accurate and rapid situation evaluation.

3.1.2 The radar facilities provided by an ATA display shall comply with those clauses of IMO Resolution MSC.64(67) annex 4 or A.820 appropriate to its mode of use.

3.1.3 (MSC.64(67)/Annex 4/1) *In addition to the general requirements contained in resolution A.694(17),* ATA shall *comply with the following minimum requirements.*

3.1.4 Where an ATA display is intended for use as the master display of a complete radar system, the system shall comply with IEC 60936-1. For high speed craft (HSC) ATA, the relevant clauses of IEC 60936-2 shall apply.

3.1.5 Where an ATA display is intended for use as a slave display of a complete radar system it shall comply with the relevant clauses of IEC 60936-1, where applicable to such a display. For HSC ATA the relevant clauses of IEC 60936-2 apply. In addition, the ATA display shall be capable of presenting readily, without significant degradation, the signals shown on the master display.

3.1.6 Additional ARPA facilities, not mandated in this ATA standard, shall comply with IEC 60872-1.

3.1.7 Quality assurance

The ATA shall be designed, produced and documented by companies complying with ISO 9000, as applicable.

3.2 (MSC.64(67)/2) Definitions

Definitions of terms used in these performance standards are given in annex A.

3.3 (MSC.64(67)/3) Performance standards

3.3.1 (MSC.64(67)/3.1) Detection

Where a separate facility is provided for detection of targets, other than by the radar observer, it shall *have a performance not inferior to that which could be obtained by the use of the radar display.*

3.3.2 (MSC.64(67)/3.2) Acquisition

3.3.2.1 (MSC.64(67)/3.2.1) *There* shall *be a facility to provide for manual acquisition* with the relevant symbol (see symbol 1 of annex E) *and cancellation for relative speeds up to 100 knots.*

3.3.2.2 (MSC.64(67)/3.2.2) Manual acquisition shall have a performance not inferior to that which could be obtained by the user of the radar display.

3.3.3 (MSC.64(67)/3.3) Tracking

3.3.3.1 (MSC.64(67)/3.3.1) *The "auto tracking* aid" shall *be able to automatically track, process, simultaneously display and continuously update the information on at least 10 targets*. A target being acquired and tracked during the initial stage shall be shown by a symbol (see symbol 3 of annex E) within 3 s. Targets being tracked when tracking is in steady state shall be shown by symbols 4A or 4B and 5 of annex E within 20 scans.

3.3.3.2 (MSC.64(67)/3.3.2) *The "auto tracking* aid" shall *continue to track an acquired target which is clearly distinguishable on the display for* any *5 out of 10 consecutive scans, provided the target is not subject to target swop.*

3.3.3.3 (MSC.64(67)/3.3.3) *The possibility of tracking errors, including target swop,* shall *be minimised by "auto tracking* aid" *design. A qualitative description of the effects of error sources on the automatic tracking and corresponding errors* shall *be provided to the user, including the effects of low signal-to-noise and low signal-to-clutter ratios caused by sea returns, rain, snow, low clouds and non-synchronous emissions*. Such descriptions shall be in the operating manual.

3.3.3.4 Automatically applied "target identities" shall not be re-used until, as a minimum, the number assigned equals the maximum number of tracked targets.

3.3.3.5 The ATA shall continuously track a manoeuvring target.

3.3.4 (MSC.64(67)/3.4) Display

3.3.4.1 (MSC.64(67)/3.4.1) *The display may be a separate or integral part of the ship's radar. However the "auto tracking* aid" *display* shall *include all the data required to be provided by a radar display in accordance with the performance standards for navigational radar equipment.*

3.3.4.2 (MSC.64(67)/3.4.2) *The design* shall *be such that any malfunction of "auto tracking* aid" *parts producing data additional to information to be produced by the radar as required by the performance standards for navigational equipment* shall *not affect the integrity of the basic radar presentation.*

The equipment shall be regarded as complying with the above if the design is such that, where practicable, normal performance of the radar system in accordance with IEC 60936-1 or IEC 60936-2 will not be affected by malfunction of any ATA subsystem that is not an essential part of the radar.

3.3.4.3 (MSC.64(67)/3.4.3) *The "auto tracking* aid" *facilities* shall *be available on at least 3, 6 and 12 nautical mile range scales, and there* shall *be a positive indication of the range scale in use.*

3.3.4.4 (MSC.64(67)/3.4.4) "*Auto tracking* aid" *facilities may also be provided on other range scales.* The methods of operation which are provided shall be clearly described in the manufacturer's manual.

3.3.4.5 (MSC.64(67)/3.4.5) *The "auto tracking* aid" shall *be capable of operating with a relative motion display with "north-up" and "course-up" azimuth stabilization. In addition, the "auto tracking* aid*" may also provide for a true motion display. If true motion is provided, the operator* shall *be able to select for his display either true or relative motion. There* shall *be a positive indication of the display mode and orientation in use.*

3.3.4.6 (MSC.64(67)/3.4.6) *The course and speed information generated by the "auto tracking* aid" *for acquired targets* shall *be displayed in a vector or graphic form which clearly indicates the target's predicted motion with the relevant symbols* (see symbols 4A or 4B or 5 of annex E). *In this regard:*

.1 *"auto tracking* aid" *presenting predicted information in vector form only* shall *have the option of both true and relative vectors. There* shall *be an indication of the vector mode selected and if "true" is selected, there* shall *be a display of whether it is stabilized with reference to sea or ground;*

.2 *an "auto tracking* aid*" which is capable of presenting target course and speed information in graphic form* shall *also, on request, provide the target's true and/or relative vector;*

.3 *vectors displayed* shall *be time-adjustable;*

.4 *a positive indication of the time-scale of the vector in use* shall *be given; and*

.5 *if stationary targets are being used for ground referencing then this shall be indicated with the relevant symbols* (see symbol 13 of annex E). *In this mode, relative vectors including those of the targets used for ground referencing* shall *be displayed when requested.*

3.3.4.7 (MSC.64(67)/3.4.7) *The "auto tracking* aid" *information* shall *not obscure the visibility of radar targets. The display of "auto tracking* aid" *data* (vector, graphic and associated symbol) shall *be under the control of the radar observer. It* shall *be possible to cancel the display of unwanted "auto tracking* aid" *data within 3 s* of command.

3.3.4.8 (MSC.64(67)/3.4.8) *Means* shall *be provided to adjust independently the brilliance of the "auto tracking* aid" *data and radar data, including complete extinction of the "auto tracking* aid" *data.*

3.3.4.9 (MSC.64(67)/3.4.9) *The method of presentation* shall *ensure that the "auto tracking* aid*" data is clearly visible in general to more than one observer in the conditions of light normally experienced on the bridge of a ship by day and by night. Screening may be provided to shade the display from sunlight but not to the extent that it will impair the observer's ability to maintain a proper look-out. Facilities to adjust the brightness* shall *be provided.*

3.3.4.10 (MSC.64(67)/3.4.10) *Provisions* shall *be made to obtain quickly the range and bearing of any object which appears on the "auto tracking* aid*" display.* The accuracy for this data shall be as stated in IMO MSC.64(67) annex 4.

3.3.4.11 (MSC.64(67)/3.4.11) *The "auto tracking* aid*"* shall *present in a period of not more than 1 min an indication of the target's motion trend and display within 3 min the targets predicted motion in accordance with* 3.3.4.6, 3.3.6, 3.3.7.2 and 3.3.7.3.

3.3.4.12 (MSC.64(67)/3.4.12) *After changing range scales on which the "auto tracking* aid*" facilities are available or* on *resetting the display, full plotting information* shall *be displayed within a period of time not exceeding one scan* of 360°.

3.3.5 (MSC.64(67)/3.5) **Operational warnings**

3.3.5.1 (MSC.64(67)/3.5.1) *The "auto tracking* aid*"* shall *have the capability to warn the observer with a visual and audible signal of any distinguishable target which closes to a range or transits a zone chosen by the observer. The target causing the warning* shall *be clearly indicated with the relevant symbols* (see annex E) *on the display.*

A simple guard zone (3.3.5.2) is required.

3.3.5.2 Guard zone

A target entering the zone shall initiate an audible and visual alarm. The visual alarm being symbol 7 of annex E. After acknowledgement the symbol may cease to flash and shall remain until outside the zone.

3.3.5.3 The methods of operation which are provided shall be clearly described in the manufacturer's operation manual.

3.3.5.4 (MSC.64(67)/3.5.2) *The "auto tracking* aid*"* shall *have the capability to warn the observer with a visual and audible signal of any tracked target which is predicted to close within a minimum range and time chosen by the observer. The target causing the warning* shall *be clearly indicated with the relevant symbols* (see symbol 8 of annex E) *on the display.*

3.3.5.5 (MSC.64(67)/3.5.3) *The "auto tracking* aid*"* shall *clearly indicate if a tracked target is lost, other than out of range, and the target's last tracked position shall be clearly indicated on the display* (see symbol 9 of annex E).

3.3.5.6 (MSC.64(67)/3.5.4) *It* shall *be possible for the observer to activate or de-activate the audible warning capability.*

3.3.6 (MSC.64(67)/3.6) **Alphanumeric *data requirements***

3.3.6.1 (MSC.64(67)/3.6.1) *The observer* shall *be able to select any tracked target to obtain data. Targets selected* shall *be marked with the relevant symbol* (see symbol 12 of annex E) *on the radar display. If data is required for more than one target at the same time each symbol* shall *be separately identified, for example with a number adjacent to the symbol.*

3.3.6.2 (MSC.64(67)/3.6.2) *The following data for each selected target* shall *be clearly and unambiguously identified and displayed immediately and simultaneously in alphanumeric form outside the radar area:*

.1 present range of the target;

.2 present bearing of the target;

.3 predicted target range at the closest point of approach (CPA);

.4 predicted time to CPA (TCPA);

If the CPA has passed, it shall be indicated by a TCPA with a negative (–) sign.

.5 calculated true course of the target;

.6 calculated true speed of the target.

3.3.6.3 (MSC.64(67)/3.6.3) *The display of* 3.3.6.2.5 and 3.3.6.2.6 shall *include an identification of whether the data uses sea or ground reference.*

3.3.6.4 (MSC.64(67)/3.6.4) *When data for several targets is displayed, not less than two items* shall *be displayed simultaneously for each target selected. If the items of data are displayed in pairs for each target the groupings* shall *be* 3.3.6.2.1 with 3.3.6.2.2; 3.3.6.2.3 with 3.3.6.2.4; and, 3.3.6.2.5 with 3.3.6.2.6.

3.3.7 (MSC.64(67)/3.7) **Accuracy**

3.3.7.1 (MSC.64(67)/3.7.1) *The "auto tracking* aid*"* shall *provide accuracies not less than those given in* 3.3.7.2 and 3.3.7.3 *for the four scenarios defined in annex 2* (see annex B). *With the sensor errors specified in annex 3* (see annex C), *the values given relate to the best possible manual plotting performance under environmental conditions of ± 10 degrees of roll.*

3.3.7.2 (MSC.64(67)/3.7.2) *An "auto tracking* aid*"* shall *present within 1 min of steady state tracking the relative motion trend of a target with the following accuracy values (95 % probability values).*

Data / ***Scenario***	***Relative course*** *(degrees)*	***Relative speed*** *(knots)*	***CPA*** *(nautical miles)*
1	*11*	*2,8*	*1,6*
2	*7*	*0,6*	---
3	*14*	*2,2*	*1,8*
4	*15*	*1,5*	*2,0*

Note 1 – In steady state tracking both own and target ship follow straight line course at constant speed.

Note 2 – Probability values are the same as confidence levels.

NOTE – In the above table, the values are plus (+) and minus (–).

3.3.7.3 (MSC.64(67)/3.7.3) *An "auto tracking* aid*"* shall *present within 3 min of steady state tracking the motion of a target with the following accuracy values (95 % probability values).*

Data / ***Scenario***	***Relative course*** *(degrees)*	***Relative speed*** *(knots)*	***CPA*** *(nautical miles)*	***TCPA*** *(min)*	***True course*** *(degrees)*	***True speed*** *(knots)*
1	*3,0*	*0,8*	*0,5*	*1,0*	*7,4*	*1,2*
2	*2,3*	*0,3*	---	---	*2,8*	*0,8*
3	*4,4*	*0,9*	*0,7*	*1,0*	*3,3*	*1,0*
4	*4,6*	*0,8*	*0,7*	*1,0*	*2,6*	*1,2*

NOTE – In the above table, the values are plus (+) and minus (–).

3.3.7.4 (MSC.64(67)/3.7.4) *When a tracked target, or own ship, has completed a manoeuvre, the system* shall *present in a period of not more than 1 min an indication of the target's motion trend and display within 3 min the target's predicted motion, in accordance with* 3.3.4.6, 3.3.6, 3.3.7.2 and 3.3.7.3. *In this context, a "manoeuvre of own ship"* shall *be deemed to consist of an alteration of course of ± 45° in 1 min.*

3.3.7.5 (MSC.64(67)/3.7.5) *The "auto tracking* aid*"* shall *be designed in such a manner that under the most favourable conditions of own ship motion the error contribution from the "auto tracking* aid*"* shall *remain insignificant compared to the errors associated with the input sensors, for the scenarios of annex 2* (see annex B).

3.3.8 (MSC.64(67)/3.8) **Connections with other equipment**

3.3.8.1 (MSC.64(67)/3.8.1) *The "auto tracking* aid*"* shall *not degrade the performance of any equipment providing sensor inputs. The connection of the "auto tracking* aid*" to any other equipment* shall *not degrade the performance of that equipment. This requirement* shall *be met whether the "auto tracking* aid*" is operating or not. Additionally the "auto tracking* aid*"* shall *be designed to comply with this requirement under fault conditions as far as is practicable.*

3.3.8.2 The ATA shall provide an indication when any input from an external sensor is absent. The ATA shall also repeat any alarm or status messages concerning the quality or source of the input data from its external sensors which may influence its operation.

3.3.8.3 Information exchange between the ATA and other equipment, shall be in accordance with IEC 61162. As far as possible, such an interface shall not degrade the ATA performance by normal or abnormal behaviour of the interface nor of the signals on it.

3.3.8.4 If no suitable IEC 61162 interface is available, another appropriate interface may be used.

3.3.9 (MSC.64(67)/3.9) **Performance tests and warnings**

3.3.9.1 (MSC.64(67)/3.9.1) *The "auto tracking* aid*"* shall *provide suitable warnings of "auto tracking* aid*" malfunction to enable the observer to monitor the proper operation of the system. Additionally, test programmes* shall *be available so that the overall performance of "auto tracking* aid*" can be assessed periodically against a known solution. When a test programme is being executed the relevant test symbols* (see symbol 11A or B of annex E) shall *be displayed.*

3.3.9.2 The test scenario may be shown on a synthetic or live picture. For a synthetic picture symbol 11A of annex E shall be used, and for a live picture symbol 11B of annex E shall be used.

3.3.10 (MSC.64(67)/3.10) **Sea and ground stabilization**

3.3.10.1 (MSC.64(67)/3.10.1) *Log and speed indicators providing inputs to "auto tracking* aid*" equipment* shall *be capable of providing the ship's speed through the water in the fore and aft direction.*

3.3.10.2 (MSC.64(67)/3.10.2) *If a ground stabilized input is also available from the log* (dual axis)*, or from an electronic position-fixing system* (if the speed measurement accuracy is in accordance with the requirements of IMO resolution A.824) *or from tracked stationary targets, then the type of input in use* shall *be displayed.*

3.3.11 (MSC.64(67)/3.11) **Equipment connected to "auto tracking aid"**

3.3.11.1 (MSC.64(67)/3.11.1) *Speed and course measuring equipment* shall *be connected to the "auto tracking* aid"

3.3.11.2 (MSC.64(67)/3.11.2) *The speed input* shall *provide speed through the water and may, in addition, provide speed over ground.*

3.3.11.3 (MSC.64(67)/3.11.3) *The type of measuring equipment in use* shall *be indicated on the display.*

4 Methods of testing and required test results

4.1 General

Tests shall be conducted normally by operating the ATA under test covering the adjacent sea area and using simulated target echoes from a synthetic target generator (see annex D) whose characteristics are similar to target echoes produced by the radar. Means shall be provided for setting the effective amplitude of one or more simulated targets to 10 dB above peak noise level, such a target being referred to in the test data as a "test reference" target.

Unless otherwise stated, simulated targets shall follow constant courses at constant speeds and tests shall be carried out on each range scale on which ATA facilities are provided, up to a maximum of 48 nautical miles.

Annex D shall be consulted for more details on using simulated targets.

Before these tests, the equipment under test (EUT) shall be subjected to, and shall satisfy, the relevant parts of IEC 60945.

4.2 (3.3.1, 3.3.2, 3.3.3) Detection, acquisition, tracking and general facilities

4.2.1 Confidence

Before implementing these tests, the test operator shall carry out a confidence check, by non-quantitative means, to ensure that the basic functions of 3.3.1, 3.3.2 and 3.3.3 are available.

4.2.2 (3.3.1) Detection

There is no additional test for this function which is covered by other tests.

4.2.3 (3.3.2.1) Manual acquisition

4.2.3.1 Method of measurement

Ten simulated radar targets superimposed on radar receiver generated noise, or equivalent, shall be fed into the ATA. One or more of these targets shall be a reference target. The targets shall be positioned with an approximately uniform distribution at ranges between 1 nautical mile and the maximum of the range scale in use or the maximum acquisition range provided, and over an arc of not less than 120°.

Two or more of the simulated targets shall have a speed relative to the test radar of not less than 5 knots and one of these shall start at a range of approximately 5 nautical miles with a relative speed of 100 knots. The operation of the manual acquisition and tracking cancellation controls shall be tested on all range scales on which acquisition facilities are provided, and the target symbols of those acquired, shall be observed on the display.

Acquisition shall be tested in the following cases:

a) each of a pair of targets on the same bearing, at a mean range of approximately 10 nautical miles, and separated by 0,5 nautical miles;

b) as a) but at a mean range of approximately 2,5 nautical miles;

c) each of a pair of targets at a common range of approximately 10 nautical miles and on bearings such that the adjacent edges of their targets are separated by 4°;

d) as c) but at a common range of approximately 2,5 nautical miles.

4.2.4 (3.3.3) **Tracking**

4.2.4.1 Method of measurement

Following the acquisition phases of 4.2.3 the system shall be required to continue to track the acquired targets for a period of not less than 12 min or until they exceed the maximum tracking range or fall below the reference target level.

At the end of the 12 min period the range scale shall be changed and the presentation of full plotting information shall be checked for those acquired targets which shall be displayed on the new range scale.

4.2.5 Results required (4.2.3/4.2.4)

.1 It shall be possible in all cases specified in 4.2.3 to acquire each target within not more than five scans after the initiation of acquisition, i.e. from the time of the completion of the manual acquisition procedure.

Proportionately longer time up to a maximum of 1 min shall be allowed where the target to be acquired is within 6° of other targets which are being, or have been, acquired.

.2 In all cases, it shall be possible to acquire not less than 10 targets by manual means.

.3 In all cases, a clearly identifiable relevant symbol (see annex E) shall appear on the display at each acquired target.

.4 It shall be possible, by suitable means provided, including manual means, to cancel any chosen acquired target.

.5 Within 20 scans of the initiation of acquisition of each target the appropriate symbol in annex E shall indicate the general trend of the target motion.

.6 Within 60 scans of the initiation of acquisition, data as required by 3.3.4.6 and 3.3.6.2 shall be available on all tracked targets.

.7 All symbols shall correlate with the relevant targets unambiguously.

.8 The provision of suitable means of complying with 3.3.4.7 and 3.3.4.8 shall be verified.

.9 Compliance with 3.3.4.12 shall be verified.

4.3 (3.3.3) **Tracking reliability**

4.3.1 (3.3.3.3) **Fading target**

4.3.1.1 Method of measurement

The echo due to a test reference target with a relative speed of 20 knots and on a constant course shall be fed into the ATA and shall be acquired. To avoid the possibility of target swop, no other target shall come within 1 nautical mile of the test target.

Starting not less than 60 scans after the initiation of acquisition, the echo shall be caused to miss 50 % of any 10 consecutive paints in various patterns which shall include missing alternate paints and missing five consecutive paints. The test shall be repeated with test target relative speeds of 5 knots and 100 knots.

4.3.2 (3.3.5.5) **Lost target warning**

4.3.2.1 Method of measurement

At the conclusion of each test of 4.3.1 the test target echo shall be suppressed at its source.

4.3.3 (3.3.3.5) **Target manoeuvre**

4.3.3.1 Method of measurement

The echo due to a test reference target with a relative speed of 20 knots and on a collision course with own ship shall be fed into the ATA and be acquired at a range of not less than 5 nautical miles. When the target reaches a range of 3 nautical miles, it shall be caused to turn to starboard at a rate 5°/s through an angle of 90° and shall then follow a constant course at constant speed for not less than 3 min.

4.3.4 (3.3.3.4) **Target swop**

4.3.4.1 Method of measurement

The echo due to a test reference target with a relative speed of 20 knots and on a collision course with own ship shall be fed into the ATA and shall be acquired at a range of not less than 10 nautical miles.

When the target reaches a range of 5 nautical miles it shall be caused to pass an unacquired, stationary, reference target displaced in bearing such that the adjacent edges of their echoes are separated by 4° and shall continue on the same course for not less than 1 min.

4.3.5 Results required (4.3.1/4.3.2/4.3.3/4.3.4)

.1 The ATA shall continue to track the test target throughout the test of 4.3.1 and shall not initiate the lost target warning.

.2 The lost target warning shall be initiated automatically not more than 20 scans after the start of test of 4.3.2. Observe that the indication appears initially at the track position at which the alarm was initiated.

.3 The ATA shall continue to track the target throughout the test of 4.3.3.

.4 The ATA shall continue to track the acquired target throughout the test of 4.3.4.

4.4 (3.3.7) Tracking accuracy

4.4.1 Method of measurement

.1 The ATA shall be set to the 12 nautical mile range scale and shall be fed with compass and log inputs corresponding to scenario 1 of annex B. A test reference target, whose course, speed and initial position are such that 3 min after acquisition they shall correspond to those given in scenario 1 of annex B shall be fed into the ATA. The target echo signal and own ship inputs shall be generated by means which take account of the sensor errors listed in annex C including those due to own ship roll of ±10°.

The target shall be acquired and the time of acquisition, t_0, as defined in 4.2.5.1 shall be noted.

At t_0 + 1 min the motion trend of the target as indicated on the ATA display in vector or graphic form shall be observed.

At t_0 + 3 min the true course and speed and the CPA and TCPA of the tracked test target shall be obtained from the ATA alphanumeric readout facility and recorded, and the motion of the target as indicated on the ATA display in vector or graphic form shall be observed. The target echo generator shall be reset and the test repeated until a total of 20 tests have been recorded. If the target echo generator utilizes pseudo-random number generators then it shall be arranged that a different sequence is used for each test.

.2 The observed indications in vector or graphic form shall be compared with the requirements of 3.3.7.2 or 3.3.7.3 as appropriate.

.3 The error in each recorded value shall be determined by subtracting from it the correct value for that parameter as derived from this scenario.

.4 The above test procedure shall be repeated successively for scenarios 2, 3 and 4 of annex B.

.5 The operating manual shall be checked for the inclusion of information relating to the requirements of 3.3.3.3.

4.4.2 Results required

If the results of all 20 tests are within the limits given in the tables of 3.3.7.2 or 3.3.7.3 as appropriate, the equipment shall be considered as complying with the requirements for the particular scenario under test.

If the result of any test is outside the limits, a statistical analysis shall be applied to all the results and, if necessary, additional tests shall be carried out.

4.5 (3.3.5.1-3) Closing target warning

4.5.1 Method of measurement

.1 The echo due to a test reference target with a relative speed of 20 knots and on a collision course with own ship shall be fed into the ATA. The guard zones shall be previously adjusted to be at a range of 10 nautical miles encompassing the bearing of the target and shall not include a clutter area. The target shall be initially at a range of not less than 11 nautical miles. The target shall follow a constant course until it reaches a range of 8 nautical miles. The test shall be repeated with the zone adjusted to a range of 2,5 nautical miles with initial and final ranges of the target of approximately 3 nautical miles and 1,5 nautical miles respectively.

.2 The operation of the zone shall be observed for an extended period.

.3 The operating manual shall be checked for the inclusion of information relating to the requirements of 3.3.5.

4.5.2 Results required

.1 The guard zone shall be clearly indicated on the display with the relevant symbol. In each test of 4.5.1, the closing target warning shall be initiated automatically not more than 1 min after the target crosses the outer boundary of the guard zone as indicated on the display, and the position of the target shall be clearly indicated on the display with the relevant symbol.

.2 The false alarm rate shall not be excessive.

.3 The operating manual shall be satisfactory.

4.6 (3.3.5.4) Collision risk (CPA/TCPA) warning

4.6.1 Method of measurement

.1 Using the 12 nautical mile range scale, the CPA warning limit shall be set to a range of approximately 1,5 nautical miles and the TCPA warning limit shall be set to a convenient time between 10 min and 20 min, inclusive. The echoes due to two reference targets, each with a relative speed of 20 knots and on a collision course with own ship shall be fed into the ATA at ranges such that their TCPAs differ by 3 min. Each target shall be acquired at a range such that its TCPA is at least 4 min greater than the limit set for the TCPA warning.

The alphanumeric readout of TCPA for the nearer target shall be monitored and its value when the warning is initiated shall be recorded. The minimum value observed before the warning is initiated shall be recorded.

Any audible warning initiated by this target shall be cancelled within 30 s of its initiation. The farther target shall then be similarly monitored and recorded.

.2 The test shall be repeated using the same warning limit settings, but with a single test target on a succession of courses giving CPA ranges just less than and just greater than the limit set for the CPA warning, the target being tracked until it reaches its CPA.

The alphanumeric readouts of CPA and TCPA shall be monitored and shall be recorded when the warning is initiated. Additionally, prior to the initiation of the warning, the indicated CPA and TCPA shall be recorded if at any time both of them are less than 0,9 times their respective set limit values.

4.6.2 Results required

.1 For each target in the test of 4.6.1.1, the recorded TCPA at which the warning is initiated shall be not greater than 1,1 times the limit set for the TCPA warning and the minimum TCPA recorded before the warning is initiated shall be not less than 0,9 times the limit set for the TCPA warning.

.2 For each test of 4.6.1.2, the recorded CPA and TCPA at which the warning was initialized shall be not greater than 1,1 times their respective set limit values.

There shall be no recorded instance of the CPA and TCPA indications both being less than 0,9 times their set limit values before the warning is initiated.

4.7 (3.3.4) Display

Check by inspection of the equipment that the requirements of 3.3.4 are complied with, except that in 3.3.4.11, 1 min and 3 min shall be replaced by 20 scans and 60 scans respectively.

4.8 (3.3.5.6) Audible warnings

Check by inspection of the EUT.

4.9 (3.3.6) Data requirements

Check by inspection of the EUT.

4.10 (3.3.8) **Interfaces**

By practical demonstration and inspection of the documentation.

4.11 (3.3.9) **Performance test and warnings**

By practical demonstration and inspection of the documentation.

4.12 (3.3.10) **Sea and ground stabilization**

Methods provided shall be tested by practical demonstration and inspection of the documentation.

4.13 (3.3.11) **Equipment connected to "auto tracking aid"**

By practical demonstration and inspection of the documentation.

4.14 (3.1.4-7) **System configuration and quality assurance**

By practical demonstration and inspection of the relevant documentation.

Annex A
(normative)

Definitions of terms to be used in connection with “auto tracking aids” and radar performance standards
(Annex 1 to appendix 1 of IMO Resolution MSC.64(67) Annex 4)

Acquisition:	*The process of selecting a target or targets and initiating their tracking*
Acquisition area:	*An area set up by the observer which should automatically acquire a target when it enters such an area*
Azimuth stabilized display:	*A display in which the azimuth orientation relative to a nominated true bearing is fixed*
Bad echo:	*The name associated with a tracked target which appears to have been temporarily lost or which has a poorly defined radar aspect, in so much that, the target does not have tracking ability*
Bow passing prediction:	*Situation associated with a target which is crossing or predicted to cross ahead of own ship*
Course-up display:	*An azimuth stabilized display in which a line connecting the centre of own ship with the top of the display is own ship's intended course*
CPA/TCPA:	*Closest point of approach and time to closest point of approach limit as defined by the observer to give warning when a tracked target or targets will close to within these limits from own ship*
Detection:	Identification of a target in the presence of noise and clutter
Echo reference:	*A facility for indicating that a particular fixed navigational mark which is being tracked is to be used as a ground stabilized reference*
ERBL:	*An electronic range and bearing line used to measure bearings and/or ranges*
Ground stabilization:	*A mode of display whereby own ship and all targets are referenced to the ground using ground track or set and drift inputs*
Guard zone:	A zone in which an alarm is given when a target is detected
Heading:	*The direction in which the bows of a ship are pointing expressed as an angular displacement from north*
History:	*Equally time-spaced past position of a target which is being tracked. The history may be relative or true*
Lost target:	*The name associated with a target that is no longer being tracked having become lost or obscured*
Map lines:	*Navigational facility whereby the observer can define lines to indicate channels or traffic separation schemes. Sometimes called nav lines. These lines require ground stabilization to stop them drifting*
North-up display:	*An azimuth stabilized display in which a line connecting the centre of own ship with the top of the display is north true bearing*

PAD:	*Predicted area of danger defined around a predicted close quarter situation area. The size is determined by speed ratios between own ship and the target in question and CPA distance limits as defined by the observer*
Predicted points of collision:	*A graphical representation of where predicted collision intercept points lie with respect to own ship and other targets*
Relative bearing:	*The direction of a target from own ship expressed as an angular displacement from own ship's heading*
Relative course:	*The direction of motion of a target relative to own ship's position expressed as an angular displacement from north. It is deduced from a number of measurements of target range and bearing on own ship's radar*
Relative motion:	*The combination of relative course and relative speed*
Relative motion display:	*A display on which the position of own ship remains fixed and all targets move relative to own ship*
Relative speed:	*The speed of a target relative to own ship's position. It is deduced from a number of measurements of target range and bearing on own ship's radar*
Relative vector:	*The predicted movement of a target relative to own ship*
Scan:	The interrogation of an area covering 360° in bearing. A sector, or sectors, may be suppressed within the 360° bearing
Sea stabilization:	*A mode of display whereby own ship and all targets are referenced to the sea, using gyro heading and single axis log water speed inputs*
Suppressed area:	*An area set up by the observer within which targets are not acquired*
Target swop:	*A situation in which the incoming radar data for a tracked target becomes incorrectly associated with another tracked target or a non-tracked radar echo*
Target:	*Any object fixed or moving whose position and motion is determined by measurements of range and bearing on radar*
Target's predicted motion:	*A prediction of future target motion based on linear extrapolation from its present motion as determined by past measurements of its range and bearing on the radar*
Tracking:	*The computer process of observing the sequential changes in the position of a target in order to establish its motion*
Trails:	*Tracks displayed by the radar echoes of targets in the form of a synthetic afterglow. The trails may be either relative or true. The true trails may be sea or ground stabilized*
Trial manoeuvre:	*A facility to assist the observer in making the correct manoeuvre for navigation and collision avoidance purposes*
True bearing:	*The direction of a target from own ship or from another target expressed as an angular displacement from north*
True course:	*The true direction of motion of a target expressed as an angular displacement from north. It is obtained by a vector combination of target relative motion and own ship's true motion*

True motion:	*The combination of true course and true speed*
True motion display:	*A display across which own ship and each target moves with its own true motion*
True speed:	*The speed of a target obtained by a vector combination of target relative motion and own ship's true motion**
True vector:	*The predicted true motion of a target as a result of own ship's direction and speed input. The true vector may be either displayed with reference to the water or to the ground*

NOTE – Where reference is made to target range, bearing, relative course or relative speed, closest point of approach (CPA) or time to closest point of approach (TCPA), these measurements are made with respect to the radar antenna.

* *For the purposes of these definitions there is no need to distinguish between sea and ground stabilization.*

Annex B
(normative)

Operational scenarios
(Annex 2 of appendix 1 of IMO Resolution MSC.64(67) Annex 4)

For each of the following scenarios predictions are made at the target position defined after previously tracking for the appropriate time of one or three minutes:

Scenario 1	*Own ship course*	*000°*
	Own ship speed	*10 knots*
	Target range	*8 nautical miles*
	Bearing of target	*000°*
	Relative course of target	*180°*
	Relative speed of target	*20 knots*
Scenario 2	*Own ship course*	*000°*
	Own ship speed	*10 knots*
	Target range	*1 nautical mile*
	Bearing of target	*000°*
	Relative course of target	*090°*
	Relative speed of target	*10 knots*
Scenario 3	*Own ship course*	*000°*
	Own ship speed	*5 knots*
	Target range	*8 nautical miles*
	Bearing of target	*045°*
	Relative course of target	*225°*
	Relative speed of target	*20 knots*
Scenario 4	*Own ship course*	*000°*
	Own ship speed	*25 knots*
	Target range	*8 nautical miles*
	Bearing of target	*045°*
	Relative course of target	*225°*
	Relative speed of target	*20 knots*

Annex C
(normative)

Sensor errors
(Annex 3 of appendix 1 of IMO Resolution MSC.64(67) Annex 4)

The accuracy figures quoted in 3.3.7 are based upon the following sensor errors and are appropriate to equipment complying with the performance standards for shipborne navigational equipment.

NOTE – σ means "standard deviation".

C.1 Radar

C.1.1 Target glint (scintillation) (for 200 m length target)

Along length of target σ = 30 m (normal distribution)

Across beam of target σ = 1 m (normal distribution)

C.1.2 Roll-pitch bearing

The bearing error will peak in each of the four quadrants around own ship for targets on relative bearings of 045°, 135°, 225° and 315° and will be zero at relative bearings of 0°, 90°, 180°, and 270°. This error has a sinusoidal variation at twice the roll frequency.

For a 10° roll the mean error is 0,22° with a 0,22° peak sine wave superimposed.

C.1.3 Beam shape

– *assumed normal distribution giving bearing error with σ = 0,05°*

C.1.4 Pulse shape

– *assumed normal distribution giving range error with σ = 20 m*

C.1.5 Antenna backlash

– *assumed rectangular distribution giving bearing error ±0,05° maximum*

C.1.6 Quantization

Bearing – rectangular distribution ±0,1° maximum

Range – rectangular distribution ±0,01 nautical miles maximum

Bearing encoder assumed to be running from a remote synchro giving bearing errors with a normal distribution σ = 0,03°

C.2 Gyro-compass

Calibration error 0,5°

Normal distribution about this with σ = 0,12°

C.3 Log

Calibration error 0,5 knots

Normal distribution about this, 3σ = 0,2 knots.

The above values were used in generating the accuracy figures quoted in 3.8 of IMO Resolution A.823 and shall be used for the testing of an ATA in this standard.

The bearing error resulting from the combination of all sensor errors including target glint shall be limited to ±0,6°.

Annex D
(normative)

ATA testing using simulated targets

IMO Resolution MSC.64(67) specifies the accuracy requirements and various other aspects of performance with which an ATA shall comply. These requirements are contained in clause 3 of this standard.

One method of determining whether an ATA satisfies the accuracy requirements is to simulate the radar return from a target by injecting signals into the ATA at video frequency and causing the simulated target to move in accordance with each of the scenarios of annex B. This can be achieved by passing antenna bearing, trigger and video signals from the radar to a synthetic echo generator (SEG) which then feeds the trigger and video signals to the ATA having mixed a synthetic echo, representing a target, with the radar video. This synthetic echo can, if required, be controlled in size and intensity.

In normal operation at sea, the data fed to the ATA by the radar suffers from errors due to several factors. The principal ones are identified and quantified in annex C. When simulated targets are used to determine the accuracy of an ATA, it is necessary to superimpose the effects of these errors onto the simulated target signal. This can be done by random sampling of the distributions of the various errors, using different (randomly selected) values for each successive revolution of the radar antenna.

Most errors can be expressed as simple relative range and bearing deviations of the track of a target. However, one error source identified in annex C, which has to be simplified for purposes of the simulation, is the target glint, because real target glint is a very complex physical phenomenon, being a characteristic of the target's structure and instantaneous aspect relative to the radar. A simple and reasonably realistic method of simulating the effect of target glint is to generate a synthetic echo of fixed size and intensity and cause the position of this echo to move in accordance with the distributions identified for target glint in annex C.

It is necessary to simulate each scenario at least 20 times using different random samples of the errors in order to assess whether or not an ATA satisfies the accuracy requirements. All the random numbers required can be computer generated.

Many of the performance tests specified in this standard are preferably carried out by using a SEG which, for some of the tests, shall have the capability of generating up to 20 targets.

This method of testing an ATA has certain advantages over the use of real targets. For example, each test is carried out under controlled conditions which can be set up accurately and can be repeated exactly.

Annex E
(normative)

Electronic plotting video symbols (EPVS)

E.1 General

E.1.1 IMO Resolutions A.823 for ARPA and MSC.64(67), annex 4 for marine radar and A.820 for high speed craft radar require that certain indications and warnings be given on electronic plotting aids for anti-collision purposes.

Video symbols 1 to 14, illustrated in this annex, shall be used on ARPA to conform with the IMO mandatory requirements.

Video symbols 1, 3, 4, 5, 7, 8, 9, 11, 12 and 13 shall be used on ATA.

Video symbols 1, 4, 6, 8 and 12 shall be used on EPA. Symbol 7 may be used optionally where this facility is provided.

E.1.2 The size of the video symbols in the text assumes a 340 mm effective diameter display. Where the sizes of alphanumerics are not specified, they shall be 6 mm high. For smaller diameter displays the size shall be proportionally smaller.

E.1.3 Other symbols may be used for other anti-collision functions provided they do not conflict with symbols 1 to 14 and navigational symbols for radar (annex E of the IEC 60936 series) and IHO chart symbols (IHO S-52). The use of these other anti-collision symbols shall be limited to ensure that they do not obscure the anti-collision requirements of the electronic plotting aids.

E.1.4 If two or more symbols simultaneously apply to a target, then the symbols may be displayed together provided that they are clearly distinguishable.

E.1.5 For the three warning alarm symbols (symbols 7, 8 and 9) the following priorities shall be used:

E.1.5.1 An unacknowledged alarm (symbol 7 flashing) is always a higher priority than an acknowledged alarm (symbol 7 steady);

E.1.5.2 CPA/TCPA warning (symbol 8) has a higher priority than a target entering a guard zone (symbol 7);

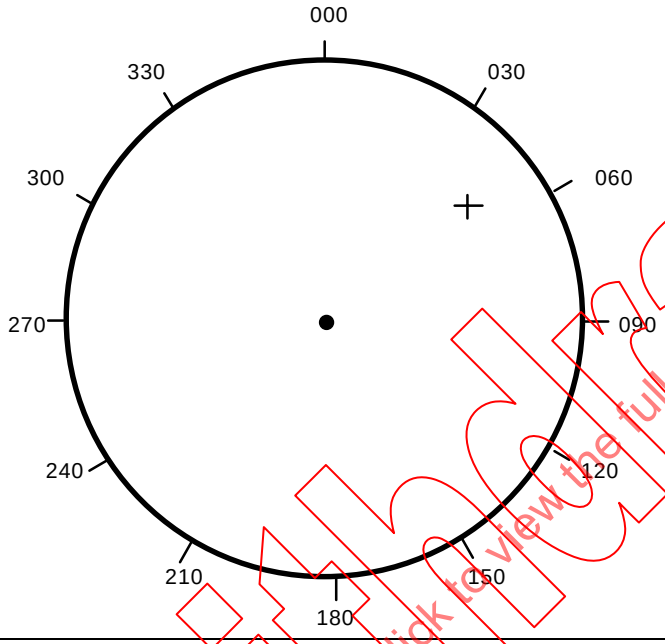
E.1.5.3 Guard zone warning (symbol 7) has a higher priority than a lost target warning (symbol 9).

E.2 Symbols

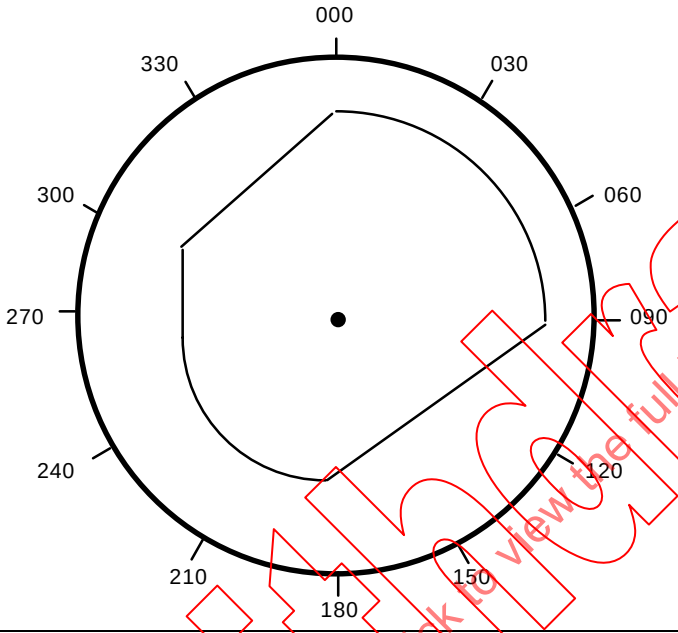
The following symbols are graphically presented within a representation of a radar plotting display, which includes a bearing scale graduated at nominal 30° intervals. In practice, the bearing scale is divided into marks at least every 5° (see IEC 60936-1).

These diagrams that follow are intended to illustrate only the form of the symbols.

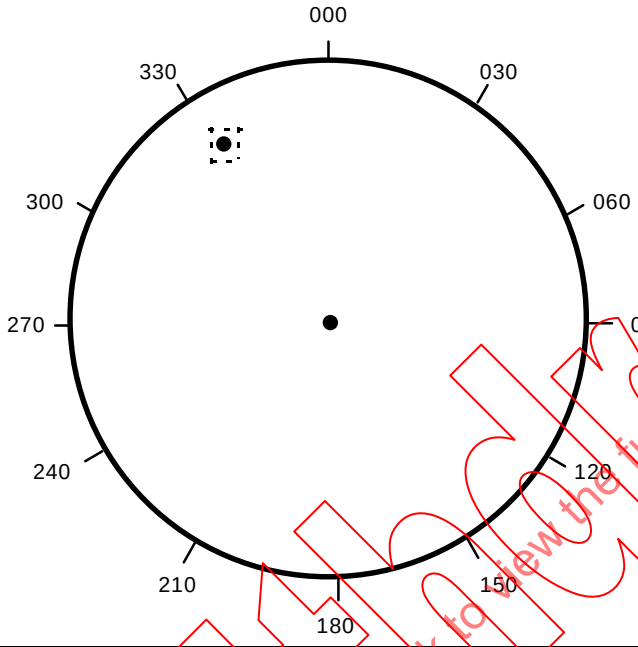
E.2.1 Symbol 1

IMO/IEC references	EPVS symbol number	Detail	Description of symbol
3.2.1 of IMO A.823 3.3.2.1 of IEC 60872-1 3.3.2.1 of IEC 60872-2 3.3.5.1 of IEC 60872-3	**1** ARPA ATA EPA	Manual acquisition and plotting	A cross shall be used as the cursor for manual acquisition on an ARPA and ATA and for plotting on an EPA
			NOTE 1 – The cross shall be at least 10 mm in height and 10 mm in width, to avoid confusion with other navigational and chart symbols, as well as for electronic chart display and information system (ECDIS) harmonization. NOTE 2 – The cursor is also used for other radar purposes.

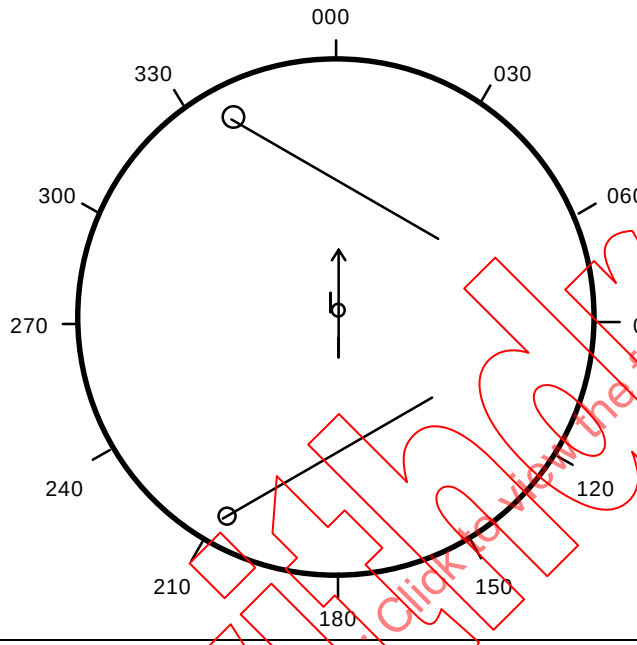
E.2.2 Symbol 2

IMO/IEC references	EPVS symbol number	Detail	Description of symbol
3.2.1 of IMO A.823 3.3.2.1 of IEC 60872-1	**2** ARPA	Area of auto acquisition. *On any range scale where acquisition is suppressed over a certain area, the area of acquisition* shall *be indicated on the display.*	If facilities are provided for suppression of acquisition, continuous lines shall be used to define the limits outside of which auto acquisition is suppressed.
			NOTE 1 – In 3.2.1 of IMO A.823, no restriction is placed on the number and shapes of auto acquisition zones. NOTE 2 – The acquisition zone can also serve as a guard zone (see symbol 7).

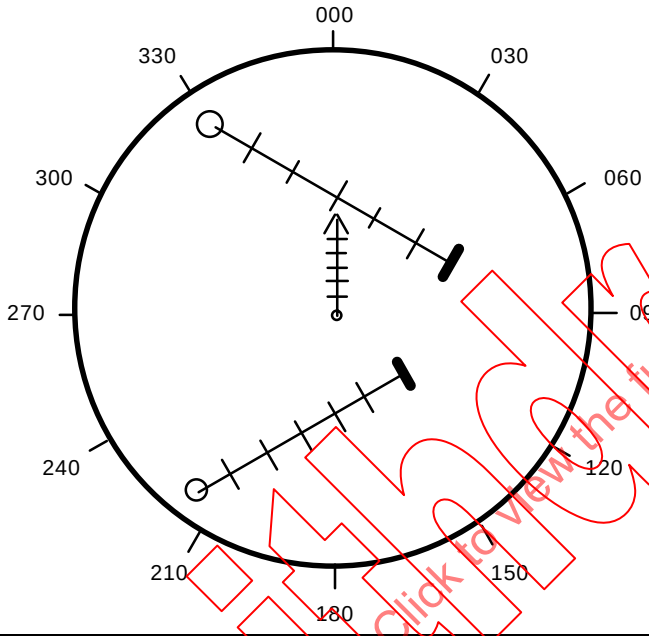
E.2.3 Symbol 3

IMO/IEC references	EPVS symbol number	Detail	Description of symbol
3.3.2 of IMO A.823 3.3.3.1 of IEC 60872-1 3.3.3.1 of IEC 60872-2	**3** ARPA ATA	Target being tracked during the initial stage.	A broken square around the echo indicates the targets under acquisition and initial stage of tracking before steady-state tracking.
			

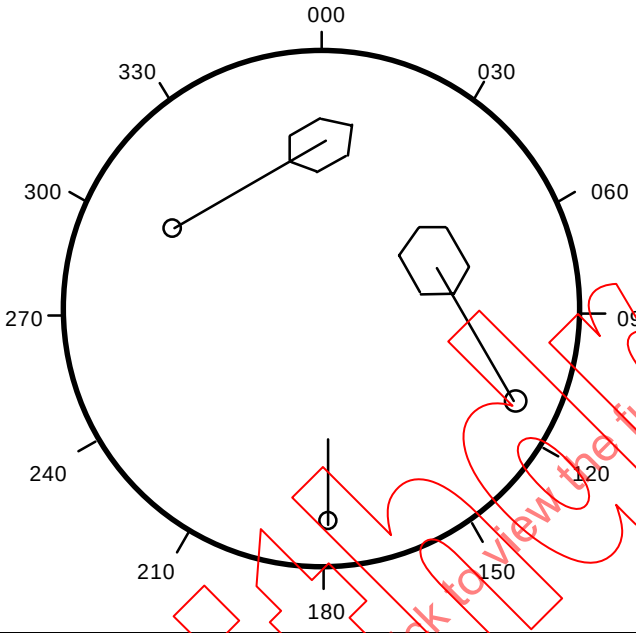
E.2.4 Symbol 4A

IMO/IEC references	EPVS symbol number	Detail	Description of symbol
3.4.6 of IMO A.823 3.3.4.6 of IEC 60872-1 3.3.4.6 of IEC 60872-2 3.3.5.1 of IEC 60872-3	**4A** ARPA ATA EPA	Course and speed vector. Target being tracked when tracking is in steady state. *The course and speed information generated by the ARPA*/ATA/EPA *for acquired targets* shall *be displayed in a vector or graphic form.*	A vector indicating the target's predicted true or relative motion, which may have a fixed time scale or time-adjusted scale. The vector origin is to be defined by a small dot or the centre of a circle. The circle shall be at least 2 mm in diameter. The position of own ship shall always be indicated by a dot.
			NOTE – Optionally an open arrow or a double arrow may be added, if chosen by the user, to the end of own ship true vector. This is to indicate that all the vectors are sea stabilized to show course and speed through water (single arrow) or ground stabilized to show course and speed over the ground (double arrow) respectively.

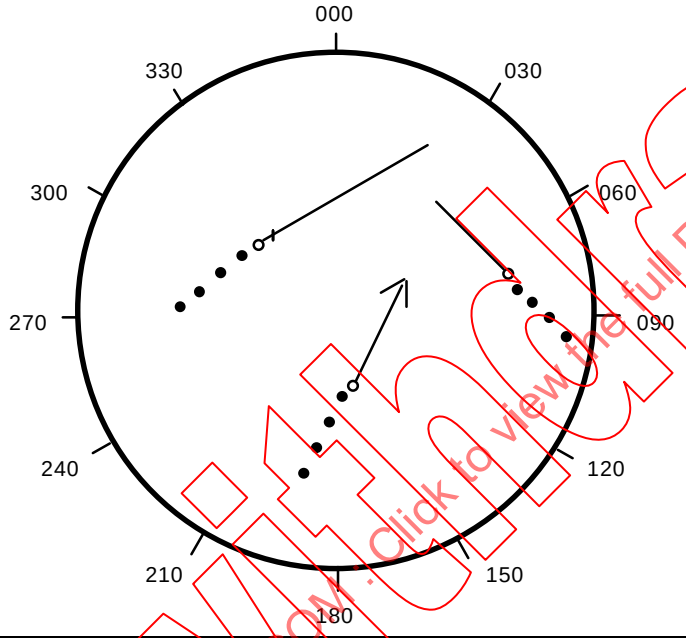
E.2.5 Symbol 4B

IMO/IEC references	EPVS symbol number	Detail	Description of symbol
3.4.6 of IMO A.823 3.3.4.6 of IEC 60872-1 3.3.4.6 of IEC 60872-2 3.3.5.1 of IEC 60872-3	**4B** ARPA ATA EPA	Course and speed vector. Target being tracked when tracking is in steady state. *The course and speed information generated by the ARPA*/ATA/ETA *for acquired targets* shall *be displayed in a vector or graphic form.*	A vector indicating the target's predicted true or relative motion, which may have a fixed time scale or time-adjusted scale. The vector origin is to be defined by a small dot or the centre of a circle. The circle shall be at least 2 mm in diameter.
			NOTE 1 – Optionally an open arrow or a double arrow may be added, if chosen by the user, to the end of own ship true vector. This is to indicate that all vectors are sea stabilized to show course and speed through the water (single arrow) or ground stabilized to show course and speed over the ground (double arrow) respectively. NOTE 2 – Marks at 1 min intervals. Bold mark at 6 min intervals. Length represents user-selectable period applied to ALL vectors.

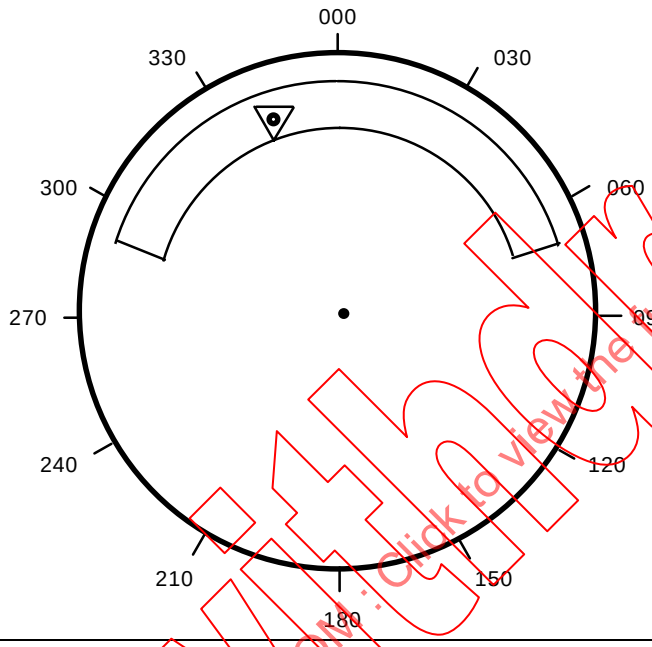
E.2.6 Symbol 5

IMO/IEC references	EPVS symbol number	Detail	Description of symbol
3.4.6 of IMO A.823 3.3.4.6 of IEC 60872-1 3.3.4.6 of IEC 60872-2	**5** ARPA ATA	Course and speed graphics. Target being tracked when tracking is in steady state. *The course and speed information generated by the ARPA*/ATA *for acquired targets* shall *be displayed in a vector or graphic form.*	The graphics can take the form of a shape such as a hexagon (see example) or ellipse. The vector origin is to be defined by a small dot or the centre of a circle. The circle shall be at least 2 mm in diameter.
			NOTE 1 – The form of the graphics shall avoid shapes that are being used for other ARPA symbols. NOTE 2 – The meaning of the graphics shall be fully explained in the manufacturer's handbook, and shall specifically include how the graphics represent target speed.

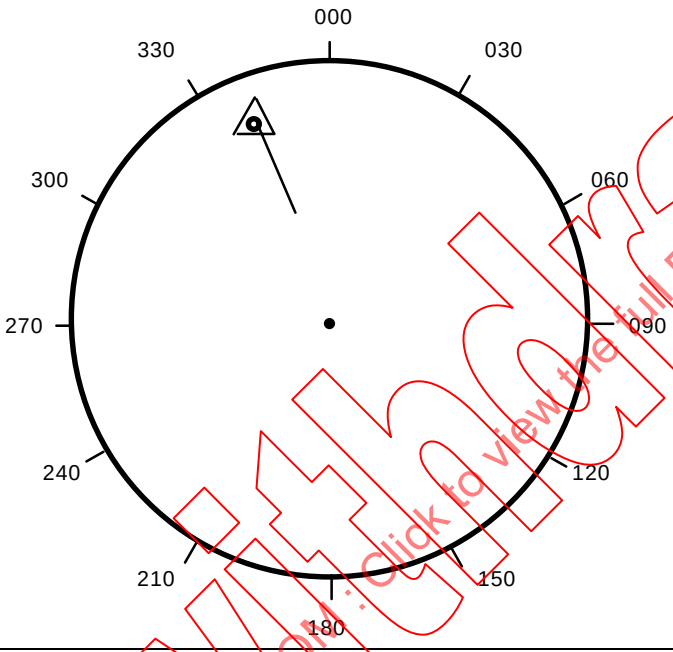
E.2.7 Symbol 6

IMO/IEC references	EPVS symbol number	Detail	Description of symbol
3.3.5 of IMO A.823	**6**	Past position of target on ARPA.	At least four equally time-spaced past positions to be shown on request as dots on an ARPA. This diagram applies to ARPA only. For EPA see IEC 60872-3 C.2.7.
3.3.3.8 of IEC 60872-1	ARPA	*The ARPA* shall *be able to display on request at least four equally time-spaced past positions of any targets being tracked over a period appropriate to the range scale in use.*	Plot positions shall be identified by an associated plot number adjacent to the initial plot and subsequently adjacent to the vector origin.
3.2.5 of IEC 60872-3	EPA	Plot position of targets on EPA.	On EPA, the past plot positions may not be equally time-spaced, and are not shown astern of own ship.
			This diagram applies to ARPA only. For EPA see IEC 60872-3 C.2.7

E.2.8 Symbol 7

IMO/IEC references	EPVS symbol number	Detail	Description of symbol
3.5.1 of IMO A.823 3.3.5.1 of IEC 60872-1 3.3.5.1 of IEC 60872-2	**7** ARPA ATA	Target entering guard zone. *The ARPA*/ATA shall, and the EPA may, *have the capability to warn the observer with a visual and audible signal of any distinguishable target which closes to a range or transits a zone chosen by the observer. The target causing the warning* shall *be clearly indicated on the display.*	A flashing equilateral triangle, apex down, shall be used to mark the target. A guard zone shall consist of continuous lines bounding the area chosen by the operator.
			NOTE 1 – Flashing is at a frequency of about 0,5 Hz to 1 Hz. NOTE 2 – After acknowledgement it is permissible to cease flashing. NOTE 3 – The area chosen by the operator shall be limited in range depth. NOTE 4 – It is permissible to show symbols 4A or 4B together with this symbol.

E.2.9 Symbol 8

IMO/IEC references	EPVS symbol number	Detail	Description of symbol
3.5.2 of IMO A.823 3.3.5.6 of IEC 60872-1 3.3.5.4 of IEC 60872-2 3.3.13.1 of IEC 60872-3	**8** ARPA ATA EPA	CPA /TCPA warning *The ARPA*/ATA shall, and the EPA may, *have the capability to warn the observer with a visual and audible signal of any tracked target which is predicted to close within a minimum range and time chosen by the observer. The target causing the warning* shall *be clearly indicated on the display.*	A flashing equilateral triangle, apex top, shall be used to mark the target. In addition, the target vector may be flashed.
			NOTE 1 – Flashing is at a frequency of about 0,5 Hz to 4 Hz. NOTE 2 – After acknowledgement it is permissible to cease flashing.