INTERNATIONAL STANDARD

IEC 60872-1

First edition
1998-09

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

Part 1:
Automatic radar plotting aids (ARPA) – Methods of testing and required test results

Matériels et systèmes de navigation et de radiocommunication maritimes – Aides de pointage radar –

Partie 1:
Aides de pointage radar automatiques (APRA) – Méthodes d'essai et résultats d'essai exigés

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

Part 1: Automatic radar plotting aids (ARPA) – Methods of testing and required test results

FOREWORD

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International Standard IEC 60872-1 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems. The IEC 60872 series, of which this is part 1, 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
80/192/FDIS	80/207/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 1: Automatic radar plotting aids (ARPA) – Methods of testing and required test results

1 Scope

This International Standard specifies the minimum operational and performance requirements, methods of testing and test results for equipment that complies with performance standards not inferior to those adopted by the International Maritime Organization (IMO) in Resolution A.823. In addition, 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.

All texts of this standard, in which the wording is identical to that in IMO Resolution A.823, 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 60872-2,— *Maritime navigation and radiocommunication equipment and systems – Radar plotting aids – Part 2: Automatic tracking aids (ATA) – Methods of testing and required test results* [1)]

IEC 60872-3, — *Maritime navigation and radiocommunication equipment and systems – Radar plotting aids – Part 3: Electronic plotting aids (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, — *Maritime navigation and radiocommunication equipment and systems – Radar – Part 2: Shipborne radar for high speed craft (HSC) – Methods of testing and required test results* [1)]

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

[1)] To be published.

IEC 61162: (all parts), *Maritime navigation and radiocommunication equipment and systems – Digital interfaces*

ISO 9000:1987, *Quality management and quality assurance standards*

IMO Resolution A.477:1981, *Performance standards for radar equipment*

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

3.1 (A.823/A.1) **Introduction**

3.1.1 (A.823/A.1.1) *Automatic radar plotting aids (ARPA)* 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 (A.823/A.1.2) *The radar facilities provided by an ARPA display* shall *comply with the performance standards for radar equipment (Resolution A.477) appropriate to its mode of use*.

3.1.3 (A.823/A.1.3) *In addition to the general requirements contained in resolution A.694, ARPA* shall *comply with the following minimum performance standards.*

3.1.4 Where an ARPA 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) ARPA, the relevant clauses of IEC 60936-2 apply.

3.1.5 Where an ARPA 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 high speed craft (HSC) ARPA, the relevant clauses of IEC 60936-2 apply.

3.1.6 Quality assurance

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

3.2 (A.823/A.2) **Definitions**

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

3.3 (A.823/A.3) **Performance standards**

3.3.1 (A.823/A.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 (A.823/A.3.2) **Acquisition**

3.3.2.1 (A.823/A.3.2.1) *Target acquisition may be manual or automatic for relative speeds up to 100 knots. However there* shall *always be a facility to provide for manual acquisition* with the relevant symbol (see symbol 1 of annex E) *and cancellation: ARPAs with automatic acquisition* shall *have a facility to suppress acquisition in certain areas. On any range scale where acquisition is suppressed over a certain area, the area of acquisition* shall *be defined and indicated on the display* with the relevant symbol (see symbol 2 of annex E).

3.3.2.2 (A.823/A.3.2.2) *Automatic or manual acquisition* shall *have a performance not inferior to that which could be obtained by the user of the radar display.*

3.3.3 (A.823/A.3.3) **Tracking**

3.3.3.1 (A.823/A.3.3.1) *The ARPA* shall *be able to automatically track, process, simultaneously display and continuously update the information on at least 20 targets, whether automatically or manually acquired.* 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 (A.823/A.3.3.2) *If automatic acquisition is provided, description of the criteria of selection of targets for tracking* shall *be provided to the user. If the ARPA does not track all targets visible on the display, targets which are being tracked* shall *be clearly indicated with the relevant symbol* (see symbols 4A, 4B, or 14 of annex E) *on the display. The reliability of tracking* shall *not be less than that obtainable using manual recordings of successive target positions obtained from the radar display.*

3.3.3.3 In order to reduce the complexity of vectors and graphics, a facility for the input of operator interest limits may be provided. If targets are being tracked, which do not require vectors or graphics, because they are outside the operator interest limits (e.g. range, CPA, TCPA), they shall be clearly indicated with the relevant symbol (see symbol 14 of annex E). The operating manual shall contain an explanation of the operator interest limits.

3.3.3.4 (A.823/A.3.3.3) *The ARPA* 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.*

3.3.3.5 (A.823/A.3.3.4) *The possibility of tracking errors, including target swop,* shall *be minimised by ARPA 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.

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

3.3.3.7 The ARPA shall continuously track a manoeuvring target.

3.3.3.8 (A.823/A.3.3.5) *The ARPA* shall *be able to display on request with* the *relevant symbol* (see symbol 6 of annex E) *at least four equally time-spaced past positions of any targets being tracked over a period appropriate to the range scale in use.* At least on 3, 6 and 12 nautical mile range scales, user-selectable time intervals of 0,5 min, 1,0 min and 2,0 min shall be provided. Facility to switch to other time intervals is permitted. *The time scale of the past position plot* shall *be* continuously *indicated,* together with an indication of whether they are true or relative "past positions"*. The operating manual* shall *contain an explanation of what the past position plots represent.*

3.3.4 (A.823/A.3.4) **Display**

3.3.4.1 (A.823/A.3.4.1) *The display may be a separate or integral part of the ship's radar. However, the ARPA 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 (A.823/A.3.4.2) *The design* shall *be such that any malfunction of ARPA 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, will not be affected by malfunction of any ARPA subsystem that is not an essential part of the radar.

3.3.4.3 (A.823/A.3.4.3) *The ARPA facilities* shall *be available on at least 3, 6 and 12 mile range scales, and there* shall *be a positive indication of the range scale in use.*

3.3.4.4 (A.823/A.3.4.4) *ARPA facilities may also be provided on other range scales permitted by resolution* A.820 *and MSC.64(67), annex 4 and, if provided,* shall *comply with this standard.*

3.3.4.5 (A.823/A.3.4.5) *The ARPA* shall *be capable of operating with a relative motion display with "north-up" and "course-up" azimuth stabilisation. In addition, the ARPA 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 (A.823/A.3.4.6) *The course and speed information generated by the ARPA 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 *ARPA 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 vector mode is selected, the display* shall *show whether it is sea or ground stabilized;*

.2 *an ARPA 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 (A.823/A.3.4.7) *The ARPA information* shall *not obscure the visibility of radar targets. The display of ARPA data* shall *be under the control of the radar observer. It* shall *be possible to cancel the display of unwanted ARPA data within 3 s* of command.

3.3.4.8 (A.823/A.3.4.8) *Means* shall *be provided to adjust independently the brilliance of the ARPA data and radar data, including complete extinction of the ARPA data.*

3.3.4.9 (A.823/A.3.4.9) *The method of presentation* shall *ensure that the ARPA 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 (A.823/A.3.4.10) *Provisions* shall *be made to obtain quickly the range and bearing of any object which appears on the ARPA display.* The accuracy for this data shall be as stated in IMO MSC.64(67), annex 4.

3.3.4.11 (A.823/A.3.4.11) *When a target appears on the radar display and, in the case of automatic acquisition, enters within the acquisition area chosen by the observer or, in the case of manual acquisition, has been acquired by the observer, the ARPA* shall *present in a period of not more than one minute 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, 3.3.8.2 and 3.3.8.3.

3.3.4.12 (A.823/A.3.4.12) *After changing range scales on which the ARPA 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 (A.823/A.3.5) **Operational warnings**

3.3.5.1 (A.823/A.3.5.1) *The ARPA* 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) or a combined acquisition and guard zone (3.3.5.4) is required.

3.3.5.2 Guard zone

Where the zone selected is a simple guard zone, a target entering that 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. The area chosen by the operator shall be narrow (that is of limited range depth) to avoid confusion with symbol 2 of annex E.

3.3.5.3 Acquisition zone

Where the zone selected is an acquisition zone only (3.3.4.11), without the guard zone function, a target transiting this zone will be indicated by symbol 3 of annex E, with no audible alarm. When the tracking criteria has been satisfied, the symbol will change to symbols 4A/B or 5 of annex E.

3.3.5.4 Combined acquisition and guard zone

Where the zone selected is a combined acquisition and guard zone, a target entering that zone shall initiate an audible and visual alarm, the visual alarm being symbol 7 of annex E. When the target is acknowledged, and when the acquisition criteria have been met, this symbol will change to symbols 3 or 4 of annex E, and the audible alarm shall be suppressed. Any warning message will be removed. Symbol 5 of annex E may be used instead of symbol 4 of annex E. If the target was acquired prior to entering a zone, symbols 4 or 5 of annex E shall be shown in addition to the warning symbol 7 of annex E.

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

3.3.5.6 (A.823/A.3.5.2) *The ARPA* 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.*

3.3.5.7 (A.823/A.3.5.3) *The ARPA* 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).

3.3.5.8 (A.823/A.3.5.4) *It* shall *be possible for the observer to activate or de-activate the audible warning signal.*

3.3.6 (A.823/A.3.6) Alpha-numeric data requirements

3.3.6.1 (A.823/A.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 (A.823/A.3.6.2) *The following data for each selected target* shall *be clearly and unambiguously identified and displayed immediately and simultaneously in alpha-numeric 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 (A.823/A.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 provided is referenced to sea or ground stabilization.*

3.3.6.4 (A.823/A.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 (A.823/A.3.7) **Trial manoeuvre**

3.3.7.1 (A.823/A.3.7.1) *The ARPA* shall *be capable of* graphically *simulating the effect on all tracked targets of an own ship manoeuvre with, or without, time delay before manoeuvre, without interrupting the updating of target tracking and display of actual target alpha-numeric data. The simulation* mode shall *be indicated with the relevant symbol* (see symbol 10 of annex E) *on the display.*

3.3.7.2 (A.823/A.3.7.2) *The operating manual* shall *contain an explanation of the principles underlying the trial manoeuvre technique adopted including, if provided, the simulation of own ship's manoeuvring characteristics.*

3.3.7.3 (A.823/A.3.7.3) *It* shall *be possible to cancel a trial manoeuvre at anytime.*

3.3.8 (A.823/A.3.8) **Accuracy**

3.3.8.1 (A.823/A.3.8.1) *The ARPA* shall *provide accuracies not less than those given in* 3.3.8.2 and 3.3.8.3 *for the four scenarios defined in appendix 2* (annex B)*. With the sensor errors specified in appendix 3* (annex C)*, the values given relate to the best possible manual plotting performance under environmental conditions of ±10 degrees of roll.*

3.3.8.2 (A.823/A.3.8.2) *An ARPA* shall *present within one minute 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 (–).

3.3.8.3 (A.823/A.3.8.3) *An ARPA* 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 (–).