Chesapeake Marine Training Institute

Bringing professional maritime training to you!

RADAR OBSERVER RECERTIFICATION

3566 George Washington Memorial Highway
PO Box 1153
Hayes, VA 23072-1153

(804)642-0123 or (800)642-CMTI

www.chesapeakemarineinst.com

TRANSFER PLOTTING,
USING THE RAPID RADAR PLOTTING TECHNIQUE

PART 1
DETERMINING RELATIVE
MOTION LINE (RML) AND
CLOSEST POINT OF APPROACH (CPA)

6-2. Draw own ship's true course from the center of the plotting sheet to the periphery of the plotting sheet and label own ship's course (OC).

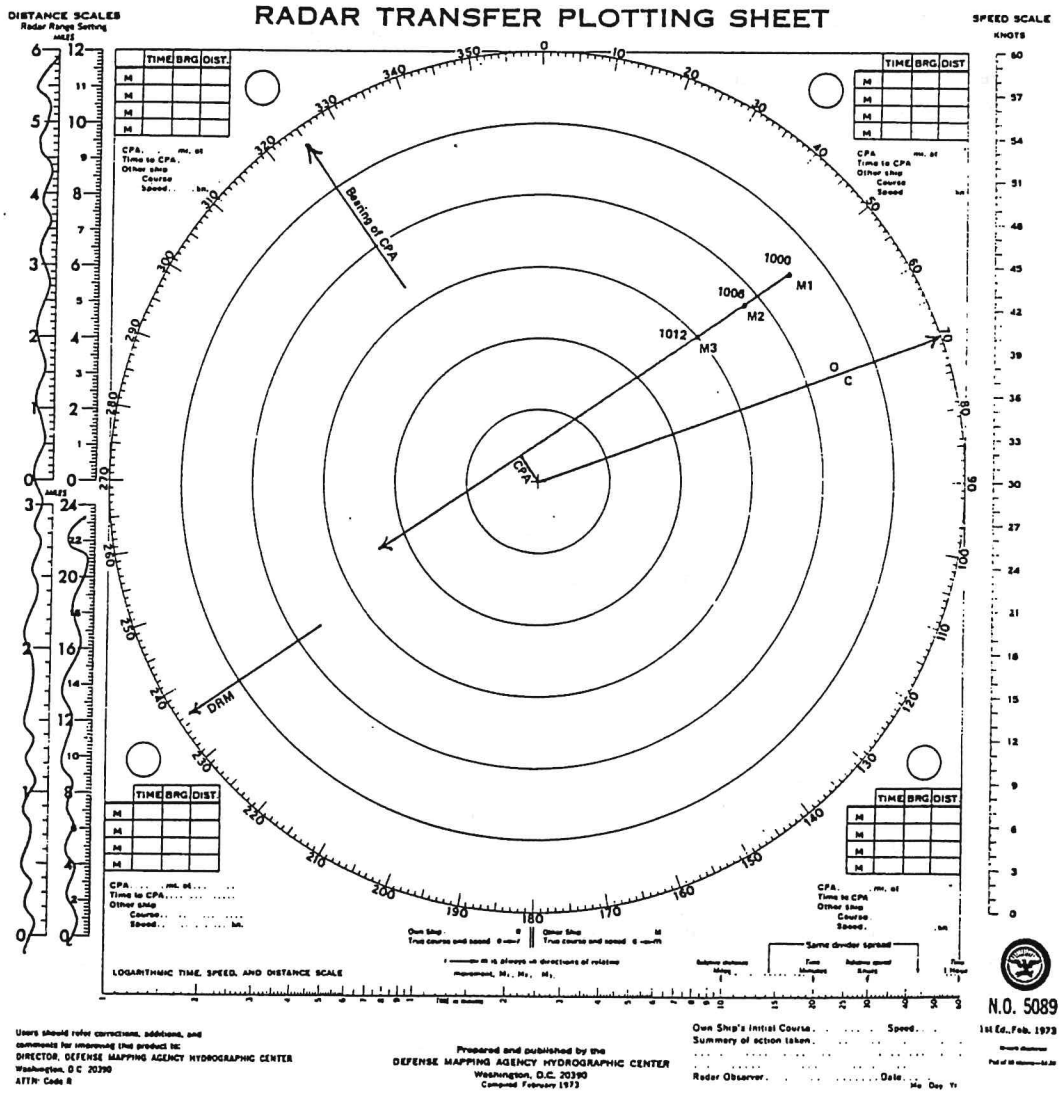

Figure 61 – Graphic Illustration of EXAMPLE 1

6-3. Plot the ranges and true bearings of the contact (M1, M2, M3, etc.) as observed on the radarscope and record the times that each was noted. (Three and six minute intervals between plots simplify calculations on the plotting sheet.) (Note: In time, students drop the symbols M1, M2, M3, etc. and show the times of the ranges and bearings instead.)

Note: There should be sufficient plots of the contact to insure accurate construction of the RML faired through the plots. Should only two plots be made, there would be no means of detecting course or speed changes by the other ship. The solution is valid only if the other ship maintains course and speed constantly. Equal spacing of the plots timed at regular intervals and the successive plotting of the relative positions in a straight line indicate that the other ship is maintaining constant course and speed.

6-4. Construct the relative motion line by passing a line through the plot marks (M1→M3). Extend this line well past the center of the plotting sheet; never be stingy on the length of this line. Label this line RML and terminate it with an arrowhead that points in the direction of relative motion (DRM).

6-5. From the center of the plotting sheet construct a line perpendicular to the RML and label the intersection CPA. This indicates the closest point of approach. CPA bearing can be readily obtained, using the azimuth ring of the plotting sheet in the same fashion as though it was a compass rose.

6-6. EXAMPLE 1

6-7. With own ship on course 070° and the radar set on the 12-mile scale, a contact is observed as follows:

TIME	BEARING	RANGE
1000	050°	9.0 miles
1006	049°	7.5 miles
1012	047°	6.0 miles

Required:

(1) Direction of relative movement (DRM).
(2) Closest Point of Approach (CPA).
(3) Bearing of CPA.

Answers:

(1) DRM — 236°
(2) CPA — 0.9 mile
(3) ϕ of CPA — 326°

See figure 61 for graphic illustration of EXAMPLE 1.

PART 2

DETERMINING RELATIVE SPEED

6-8. Measure the distance from the first plotted position of contact (M1) to the last plotted position of contact (M3) with a pair of dividers.

6-9. Without changing the spread of the dividers (without changing the angle between the legs of the dividers), bring them to the distance scale in use on the plotting sheet and measure this distance.

6-10. Note the time intervals between the plots.

6-11. These two measurements (distance and time) are then introduced into the logarithmic time, speed, and distance scale, as described in chapter five, to obtain speed of relative movement (SRM).

6-12. EXAMPLE 2

6-13. In this example, courses, speeds, times, bearings and ranges are exactly as shown in EXAMPLE 1.

Required:

Speed of Relative Motion.

Answer:

SRM — 15 knots

See Figure 62 for graphic illustration of EXAMPLE 2.

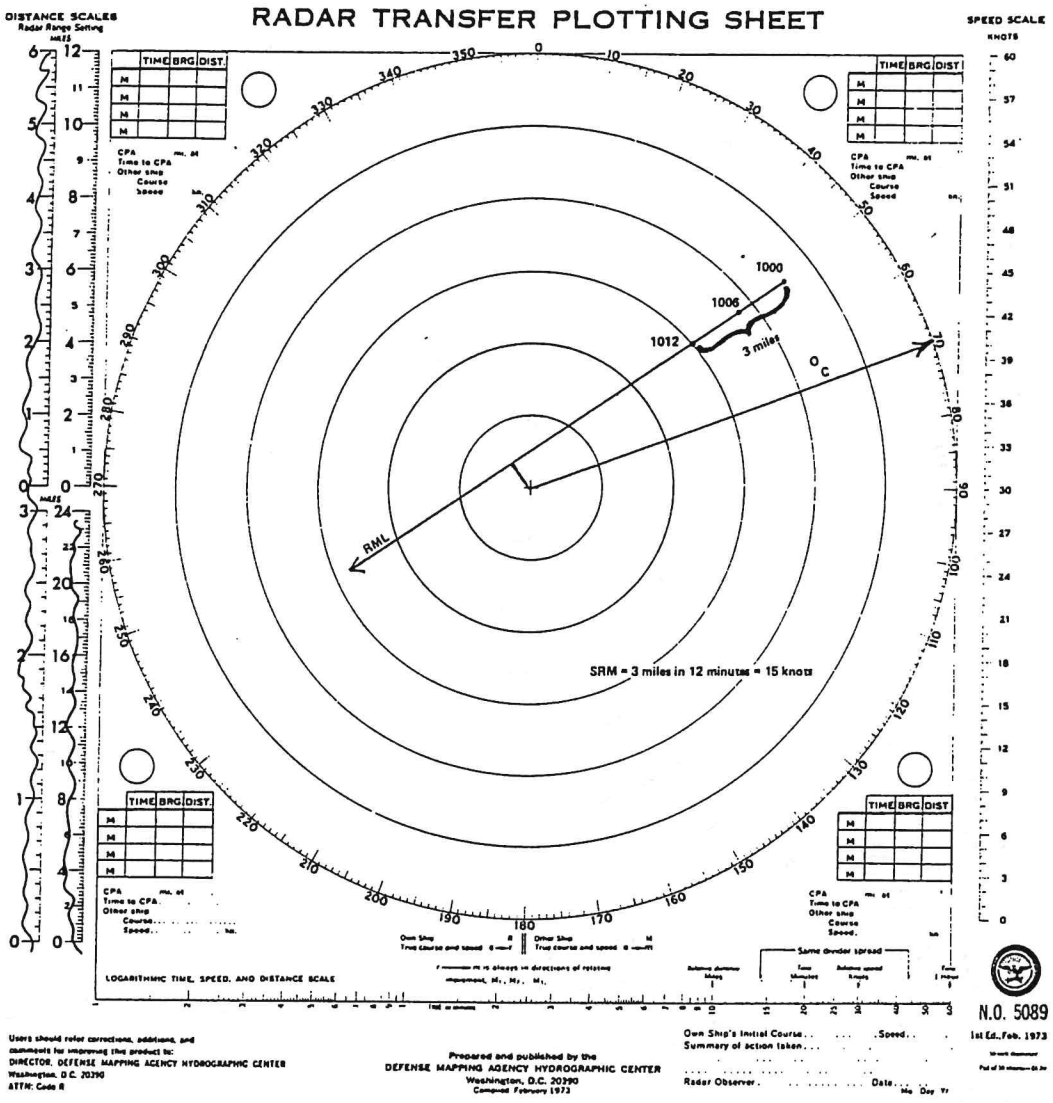

Figure 62 – Graphic Illustration of EXAMPLE 2.

PART 3

DETERMINING TIME OF CLOSEST

POINT OF APPROACH

6-14. Measure the distance along the RML, from the last contact plot (M3) to CPA.

6-15. With the relative speed already determined (see EXAMPLE 2), calculate the time interval necessary for contact to arrive at CPA.

6-16. Add the time interval thus found (step 2) to the time of last contact plot (M3). This will be the time of CPA.

Notes: (A.) a rapid estimate can be made by stepping off 6-minute intervals along the RML from the M3 to the CPA. (B.) Own ship is always at the center of the sheet and may be illustrated by drawing the outline of a ship, headed on own course line. Clearance, if any, whether ahead, astern, or abeam, depends on how the RML runs in relation to own ship. If RML crosses own course line, this is the crossing distance and indicates how far the contact will clear dead ahead.

6-17. EXAMPLE 3

6-18. In this example, courses, speeds, times, bearings and ranges are exactly as shown in EXAMPLE 1.

Required:

(1) Time of CPA.

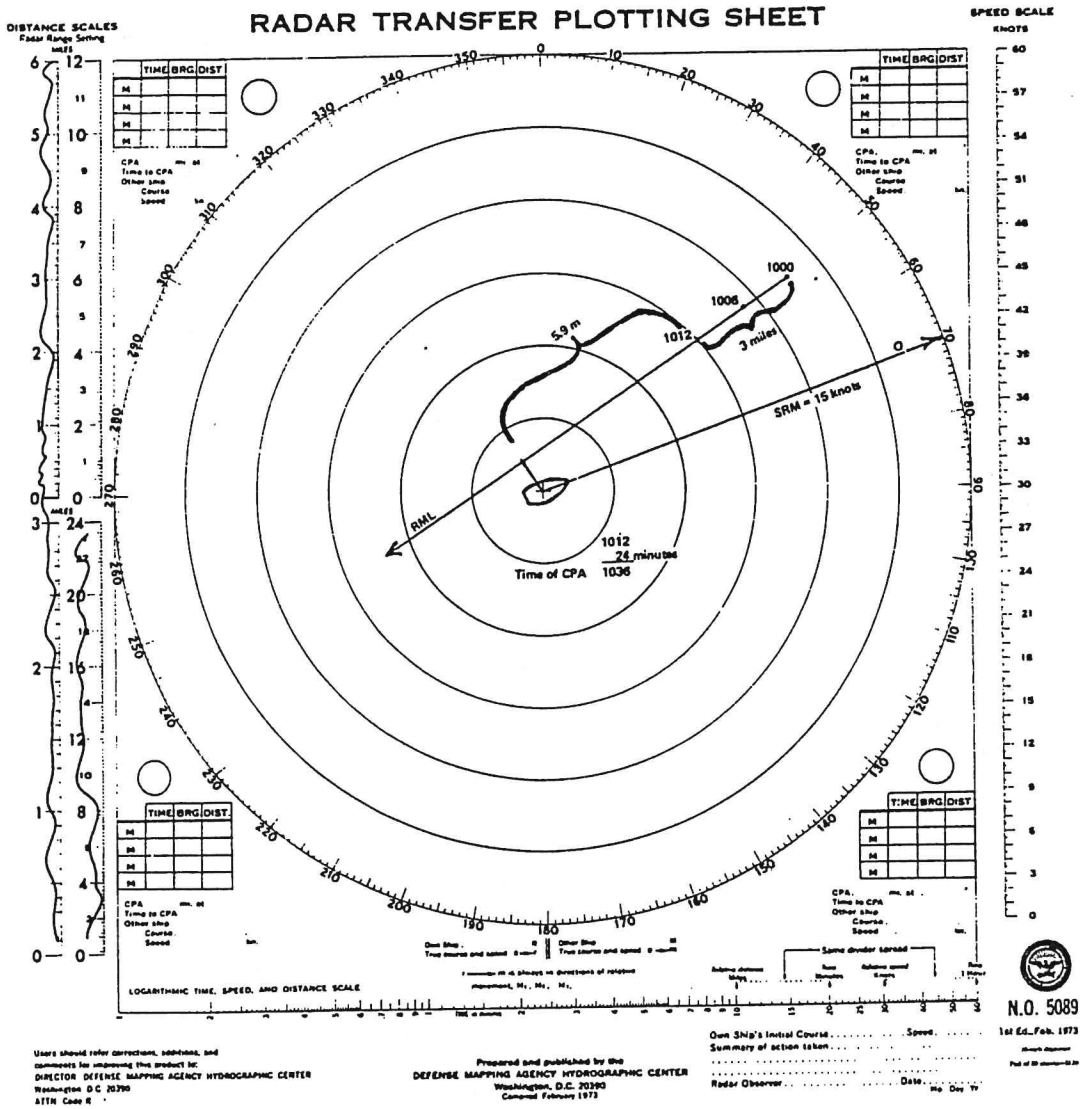

Figure 63 — Graphic Illustration of EXAMPLE 3.

(2) In this problem, will the contact pass ahead or astern of own ship?

Answer:

(1) Time of CPA — 1036.

(2) Neither. The contact will pass on own ship's port side.

PART 4

THE FIRST VECTOR TRIANGLE

(DETERMINING CONTACT'S TRUE COURSE AND SPEED)

6-19. Draw own ship's initial true vector (e-r). This line (e-r) parallels own course line (OC), extending itself to the first contact plot (M1). The head of this vector extends itself in the same direction as OC. Place arrowhead at M1 on this vector and label the point "r".

6-20. Using own ship's speed and the elapsed time between M1→M3, compute actual distance own ship runs in that time interval. The logarithmic time, speed, and distance scale can be used for this purpose.

6-21. Using the same distance scale as that used when making the M1, M2, M3 plots, pick off the distance our ship actually ran (step 2). With dividers, transfer this measurement, starting at the point "r" and extending it along the PARALLEL LINE, marking it and label the point "e". (Note: Two sides of the vector triangle have been formed up to this point. Side 1 is the RML from M1 to M3 and beyond. Side 2 is own ship's course and actual distance run; i.e., the vector e-r.)

6-22. The remaining side of the vector triangle (side 3) is then formed by connecting the point "e" to the point M3 and label this "m". Terminate the vector e-m with an arrowhead that points toward "m". This is the contact's true course and actual distance run in the time interval between M1→M3. The contact always travels in a direction from point "e" to point "m".

6-23. Walk the contact's true course to the center of the plotting sheet and read same on the azimuth ring of the plotting sheet in the same fashion as though it was a compass rose.

6-24. The contact's speed may be calculated by first measuring the distance between points "e" and "m". This is the distance run by the contact in the time interval M1→M3. Compute this actual speed using the logarithmic time, speed, and distance scale.

Note: Regardless of how the triangle is drawn, point "e" is always our principal objective in the First Vector solution.

Remember:
e→r is our course and distance run.
e→m is contact's course and distance run.
r→m is relative motion (direction and distance run).

6-25. EXAMPLE 4

6-26. Our own ship is on a course of 000 true°, speed 11 knots. Our radar set is on the 12 mile scale. A contact is observed as follows:

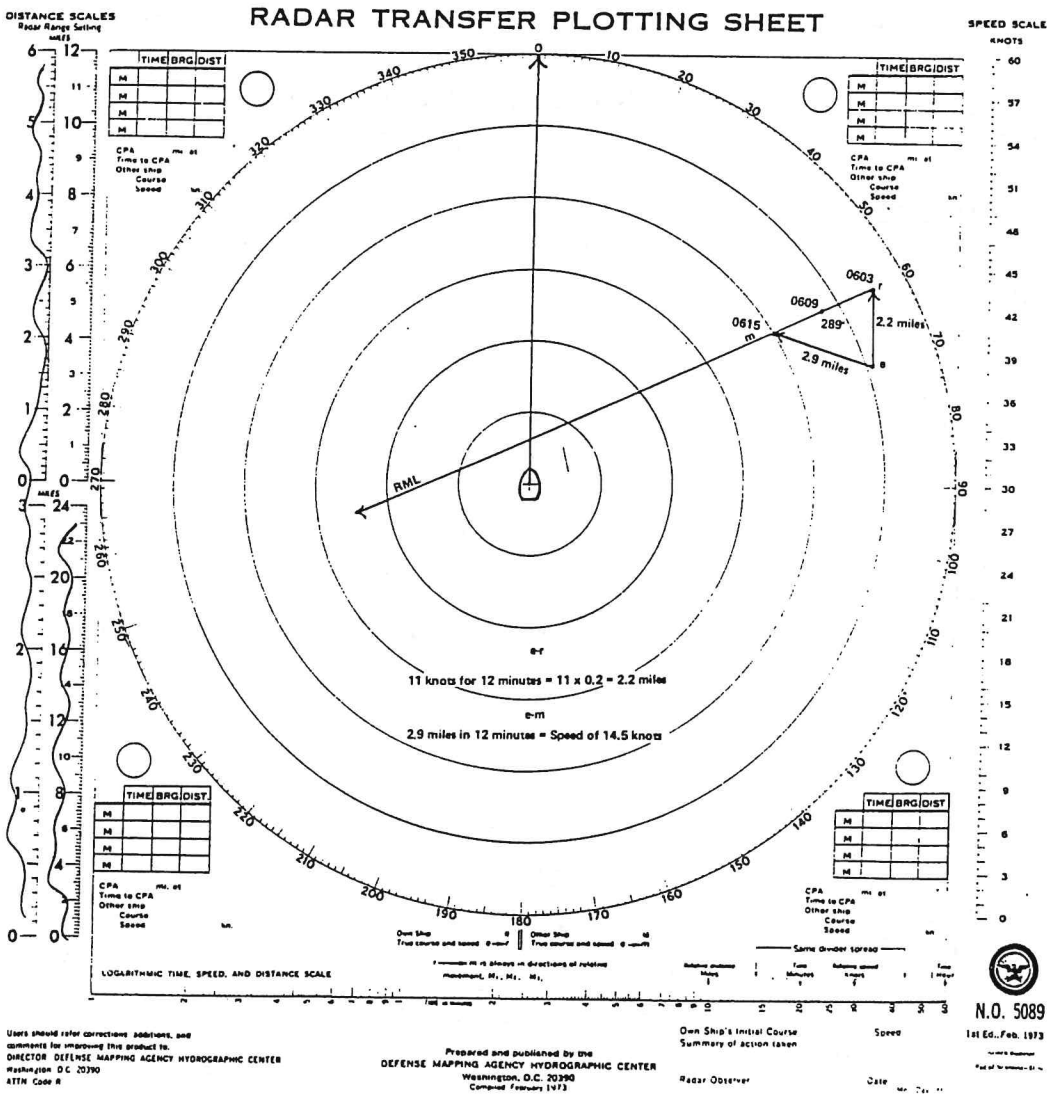

Figure 64 — Graphic Illustration of EXAMPLE 4.

TIME	BEARING	RANGE
0603	060°	11.0 miles
0609	059°	9.5 miles
0615	058°	8.0 miles

Required:

(1) Contact's true course

(2) Contact's actual speed

Answer:

(1) Contact's true course — 289°.

(2) Contact's actual speed — 14.5 knots.

See figure 64 for graphic illustration of EXAMPLE 4.

PART 5

SPECIAL SITUATIONS WITH FIRST VECTOR TRIANGLES

6-27. In cases where contacts are on opposite courses to our own ship's course (meeting situations) or on the same courses as our own ship but at slower speeds (overtaking situations), the relative motion lines will be parallel to own course line. In order to solve these problems, we still must proceed in the same manner as with the conventional Vector Triangle; that is, parallel own course line to M1, etc. Own course line will, in these cases, fall on top of the RML. We then proceed to calculate distance own ship runs in the time interval M1→M3, and lay this distance off from M1 along own course line; which, in situations like these, is also the

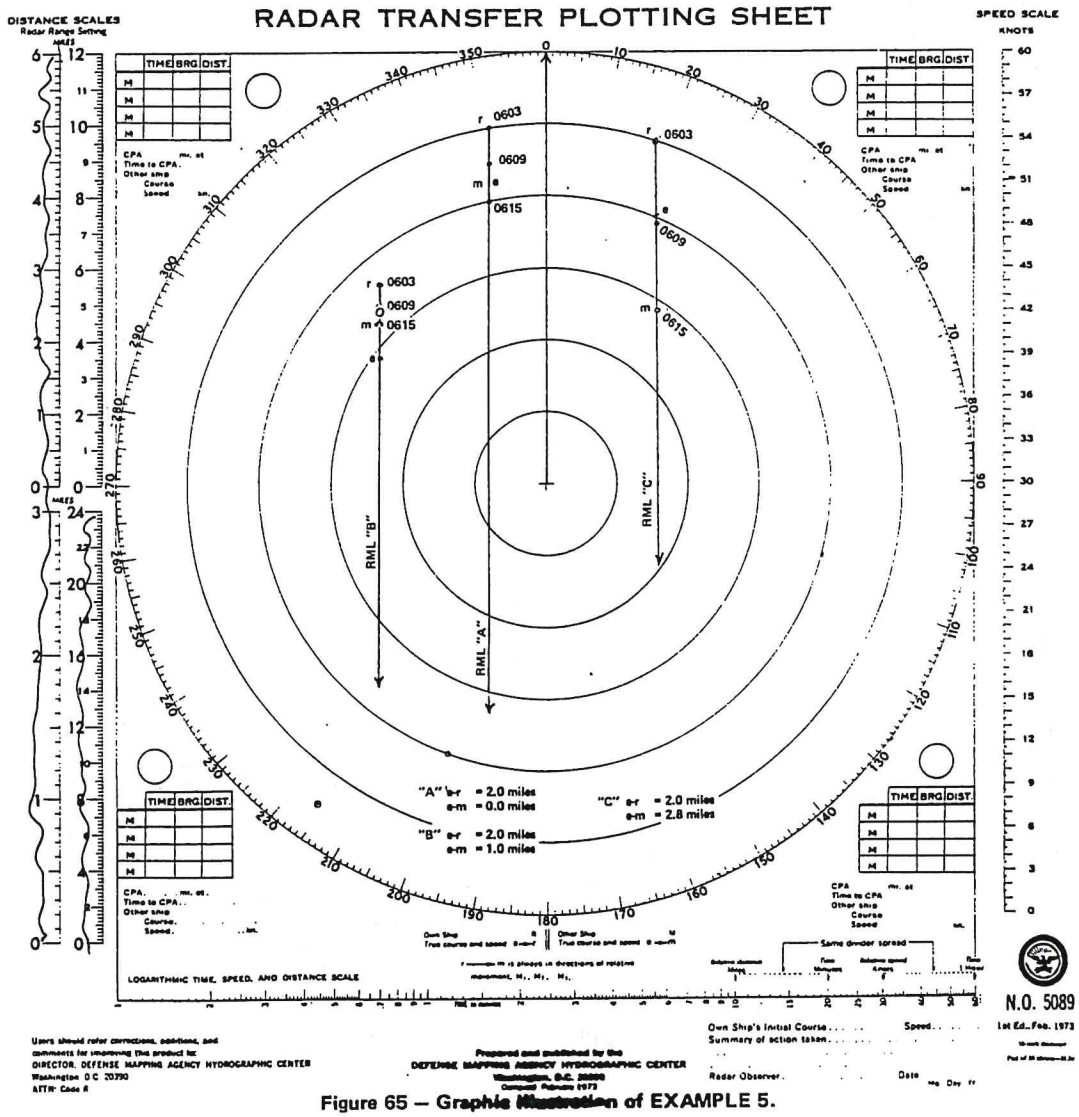

Figure 65 — Graphic illustration of EXAMPLE 5.

relative motion line. The point thus determined is the point "e". If the point "e" falls between the first and last bearing, the contact is on an opposite course to our own. In case point "e" falls between the last bearing and our own ship, the contact is on the same course as own ship but proceeding along at a slower speed than our own ship. If point "e" falls on top of the last bearing, then the contact is stationary or, if a vessel, dead in the water or nearly so. In these latter cases, there are no speeds and, of course, no courses.

Note: Always keep in mind, no matter what shape the triangle takes, or if there is no triangle at all (flattened triangle), that own ship travels from "e" to the first bearing and the contact moves from "e" to the last bearing.

6-28. EXAMPLE 5

6-29. Our own ship is on a course of 000° true, speed 10 knots. Contacts are observed as follows:

Time	Contact A:	Contact B:	Contact C:
0603	351°-10.0 mi.	320°-7.2 mi.	018°-10.0 mi.
0609	350°- 9.0 mi.	317°-6.8 mi.	023°- 7.8 mi.
0615	349°- 8.0 mi.	314°-6.5 mi.	033°- 5.7 mi.

Required:

What are the courses and actual speeds of the three contacts?

Answers:

(1) Contact "A" is dead in the water or nearly so (that is, if the contact is a vessel), or a stationary object. If it is a vessel dead in the water, it will not be able to steer a course. With radar alone, we would not be able to tell, of course, the heading of such a vessel.

(2) Contact "B" is on a course of 000° and has an actual speed of 5 knots.

(3) Contact "C" is on a course of 180° and has an actual speed of 13 knots.

See figure 65 for graphic illustration of EXAMPLE 5.

FACTORS TO CONSIDER IN ESTABLISHING A SAFE CPA

1. Rules of the Road.
This covers traffic in the area — which vessel is burdened or privileged — whether the target should pass in front or astern of own ship — determining which vessel is most dangerous.

2. Own vessel's characteristics
Size, speed, tonnage, stopping distance, turning circle, maneuverability, type vessel, GM, automated, bridge control of engine, draft, cargo.

3. Geography
Shoals in area, obstructions of any kind, oil rigs about, depth of water, limitations because of adjacent land, wrecks.

4. Weather – air
Visibility, fog mist, rain, falling snow, rainstorms.

5. Weather – sea
Rough or smooth, currents, set.

6. Miscellaneous
Other vessel's characteristics; type; towing or not; pusher; relative speed and relative course, type of cargo; when is M_X execution point.

Personal Experience.
Time (i.e. experience at sea) is one of the requirements for obtaining a license. Personal experience causes learning; learning should bring about wisdom.

PART 6

THE SECOND VECTOR TRIANGLE

(DETERMINING OWN SHIP'S COURSE AND/OR SPEED CHANGE(S))

6-30. CHANGE OF COURSE PROBLEMS

6-31. Note that, in all cases, the FIRST VECTOR TRIANGLE must be completed before starting the SECOND VECTOR TRIANGLE.

6-32. The following step by step explanation will provide the reader with a process for determining the course change for own ship to make while holding original speed so as to reduce risk of collision. The steps, as explained below, can be followed on figure 66. (Changes of speed and changes of both speed and course will be explained further on:)

6-33. Locate and mark the Point of Execution (MX). This is the assumed position of the contact at the time the course change is to be made. So long as all vessels maintain original courses and speeds, the contact con-

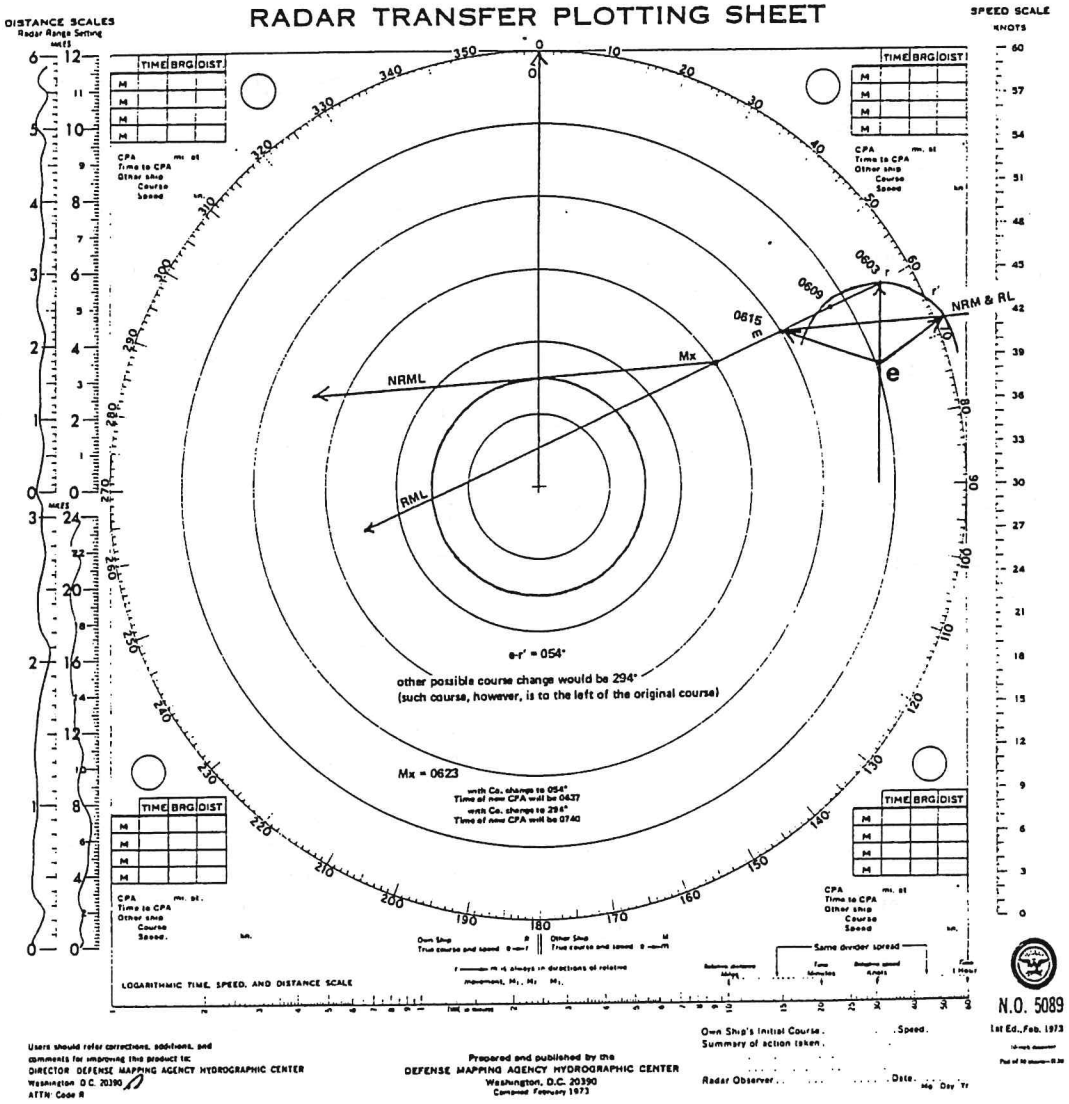

Figure 66 — Graphic Illustration of EXAMPLE 6.

Note: Another possible course change in this instance, without changing speed, would have been 294°. To have made this maneuver, however, it would have been necessary for us to come left and, in this problem, we looked for course change to be made to the right. Too, if we had changed course to 294° instead of 054°, it would have taken the contact over an hour more of time to come abeam of own ship.

tinues along the original RML and will arrive at the MX as predicted.

Note: There are two methods of choosing the point of execution (MX). One is by arbitrarily selecting some distance off own ship at which the maneuver will take place. The other is by picking a time for the event to happen. In the case of the latter, work up the time interval between the last plot and the time of MX; then with the Speed of Relative Movement and that time interval found, compute the distance ahead, along the RML, from the last plot (M3).

6-34. With a drawing compass, scribe a circle around the center of the plotting sheet such that its radius is equal to the selected safety or buffer zone.

Note: If the chosen safety or buffer zone is with a radius corresponding to one of the plotting sheet rings, it obviously is not necessary to draw the circle with a drawing compass; this, since the ring is already scribed.

6-35. Draw in a New Relative Motion Line, starting at MX and extending outward, tangent to the buffer zone circle on the side you want the contact to pass. Make the line long enough for the purpose intended.

Note: Label this line NRML. Two such tangent lines (NRML'S) are possible. These would allow contact to pass either ahead or astern, as the case may be, or passage on the port or starboard side. Logic, Rules of the Road, and prevailing conditions would dictate which one should be used.

6-36. With parallel rulers or a pair of right triangles, walk the NRML up to the last plot (the point "m") and lay down a new line that is parallel to the NRML, extending outward (away from the center of the plotting sheet), terminating at the last plot (point m) and of sufficient length that it will serve the purpose. This is called the New Relative Motion and Reference Line. As such, it is the reference line for all course changes.

Note: Label this line NRM and RL.

6-37. Since, in these problems, we assume that the contact maintains course and speed, the contact's original true vector (that is, the e-m vector of the FIRST VECTOR TRIANGLE) remains the e-m vector for the SECOND VECTOR TRIANGLE. We can say, then, that one side of the FIRST VECTOR TRIANGLE (e-m) is employed as one side of the SECOND VECTOR TRIANGLE (e-m).

6-38. Place the metal point of the drawing compass at point "e" of the FIRST VECTOR TRIANGLE and the pencil point of the same drawing compass at point r of FIRST VECTOR TRIANGLE; then, with the drawing compass spread to this angle, draw an arc (equal to e-r) that intersects the NRM and RL. Where the two intersect, label the point r'. The vector e-r' becomes the second side of the SECOND VECTOR TRIANGLE.

Note: In many instances, the arc's radius can intersect the NRM and RL line at two places. When this happens, two (2) course changes are possible. Either course change will, of course, yield the same safety or buffer zone. The course generally selected in these instances is the one which gives the greater new relative speed.

6-39. Although previously solved in the first vector triangle, the third side of the SECOND VECTOR TRIANGLE is formed by drawing a line (vector) from the point "e" to the point "m" (the vector e-m). Place an arrow-head on this vector, pointing toward "m"; in this way, confusion will not occur insofar as the correct direction of this vector is concerned. The direction of the vector e-m represents the true course of the contact. To determine this course, walk the vector e-m to the center of the plotting sheet (similar to walking a bearing line to the compass rose of a chart) and note same.

6-40. Measure the length of the vector e-m and, with the time between the first and last plots of the contacts (M1→M3), enter the logarithmic time, speed, and distance scale and pick out the contact's actual speed.

6-41. EXAMPLE 6 (AN EXTENSION OF EXAMPLE 4)

6-42. Our own ship is on a course of 000° true, speed 11 knots. A contact is observed as follows:

TIME	BEARING	RANGE
0603	060°	11.0 miles
0609	059°	9.5 miles
0615	058°	8.0 miles

6-43. Since the bearings of the contact are not changing rapidly, it is evident that some action will have to be taken if collision or near-collision is to be avoided.

6-44. We learned, from Example 4, that the true course of contact is 289° and its actual speed is 14.5 knots. Extending this same problem a step further, let us say that the mariner conning own ship plans: (a) a safety zone of 3 miles, (b) a course change when contact's range decreases to 6 miles, and (c) a course change to the right so that the contact clears ahead.

Required:
What will be own ship's new course?
Answer:
(Own Ship's new course will be 054°.)
(See figure 66).

6-45. CHANGE OF SPEED PROBLEMS

6-46. Once we have set up the SECOND VECTOR TRIANGLE as explained earlier and found the course change required to reduce risk of collision, we might find that the course change cannot be made after all. This may be due to navigational hazards in the area or impeding vessels arriving on the scene. In these instances, the only alternative may be a change in speed. In such cases, we measure the new own ship vector (e-r') from the point "e" to where the original own ship vector intersects the NRM and Ref line, labeling the latter point "r'". Convert this distance into the new speed.

Note: In those cases where, during construction of the SECOND VECTOR TRIANGLE, the e-r vector is too short to intersect the NRM and RL, the e-r vector should be extended (lengthened) to where it does intersect that line. Convert the length of this new e-r vector to the new speed required.)

6-47. EXAMPLE 7 (AN EXTENSION OF EXAMPLE 6)

6-48. We learned, in Example 6, that own ship's course could be changed to either 054° or 294°. However, there is a reef to starboard and three additional ships to port that prevent either course changes.

Required:
What other course of action could be taken?
Answer:
Reduce speed to 5.2 knots. (Eye-balling Figure 67, the reader should see that the e-r' (new) vector is about one-half the length of the e-r (original) vector.)

6-49. CHANGE OF SPEED AND COURSE PROBLEMS

6-50. To change both the speed and course of own ship, the problem should be resolved as follows:

(a) Determine what the new speed of own ship should be.
(b) Determine the distance own ship will travel at the new speed for the same time interval.
(c) Open the drawing compass to the distance determined in (b).
(d) With the point of the drawing compass on the point "e", scribe an arc which will become the vector e-r'.
(e) Where the arc intersects the NRM and RL, mark the point "r'".
(f) The direction of the vector e-r' is the new course.

6-51. EXAMPLE 8 (A FURTHER EXTENSION OF EXAMPLE 6)

6-52. Instead of continuing own ship at a speed of 11 knots and instead of changing course to either 054° or 294°, we decide to increase speed to 15 knots.

Required:

What course change will have to be made so that, at 15 knots, the CPA will continue to be 3 miles?.

Answer:

065° true.

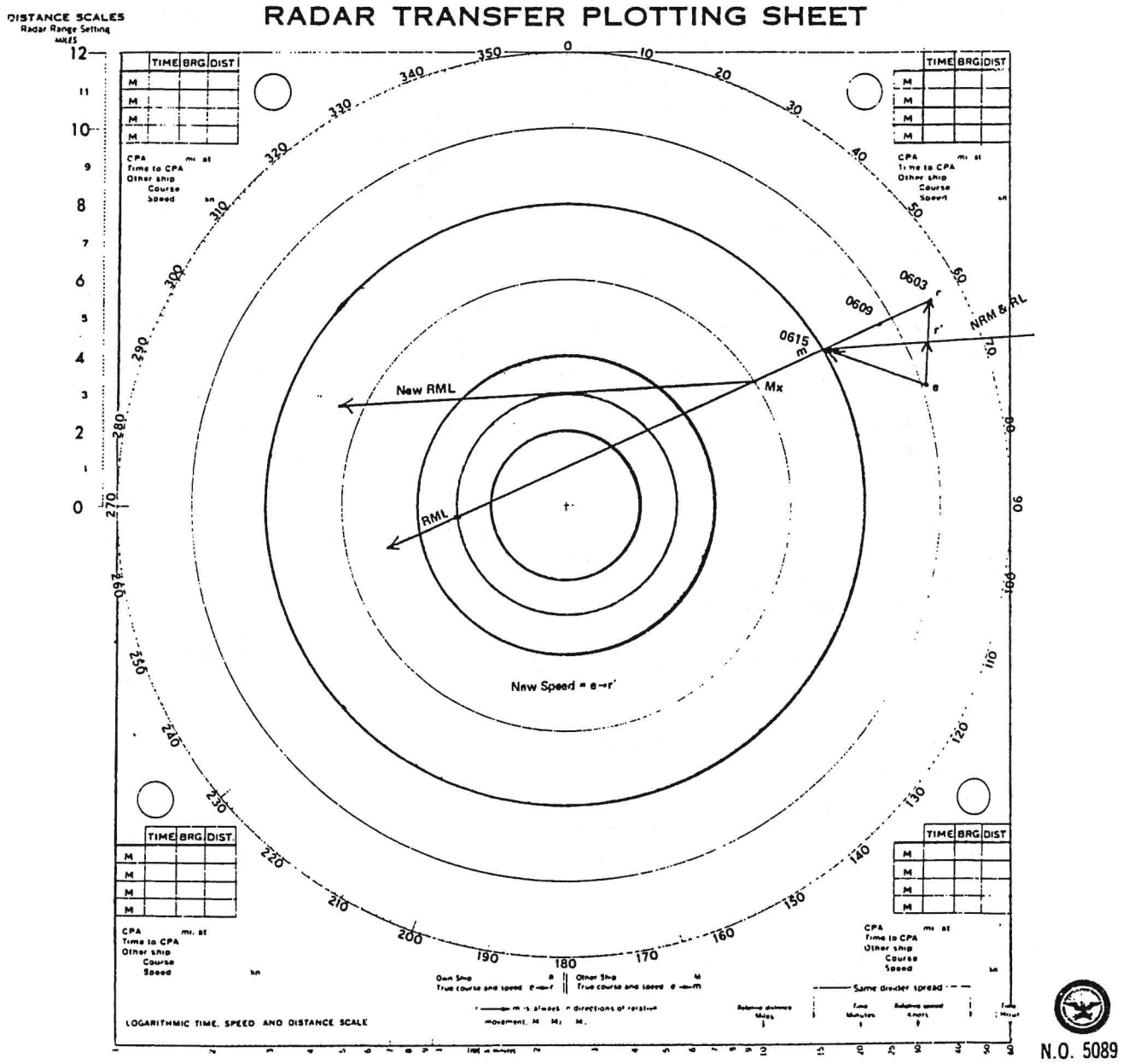

Figure 67 — Graphic illustration of Example 7

6-53. Determining New Closest Point of Approach (CPA), when own ship changes course or speed.

A. To determine new CPA, when "own ship" changes course:
   1. Parallel new course line to point (e) and draw a line from point (e) in the same direction as the new course.
   2. Transfer our original distance run (er) to this line and label the head of the new course line r'.
   3. Draw NRM & RL from point (r') to point (m).
   4. Parallel NRM & RL to M_x. Draw NRML from M_x in the same direction.
   5. Drop perpendicular line from the center to NRML for the new CPA.

B. To determine new CPA, when "own ship" maintains course but changes speed:
   1. Calculate new distance run, using new speed and the time interval between thefirst and last bearings (in the original triangle).
   2. Lay off this new distance run from point (e) along our course line (er) and label the head of this new distance run (r').
   3. Follow the same procedures in steps 3, 4 and 5 above, to find new CPA

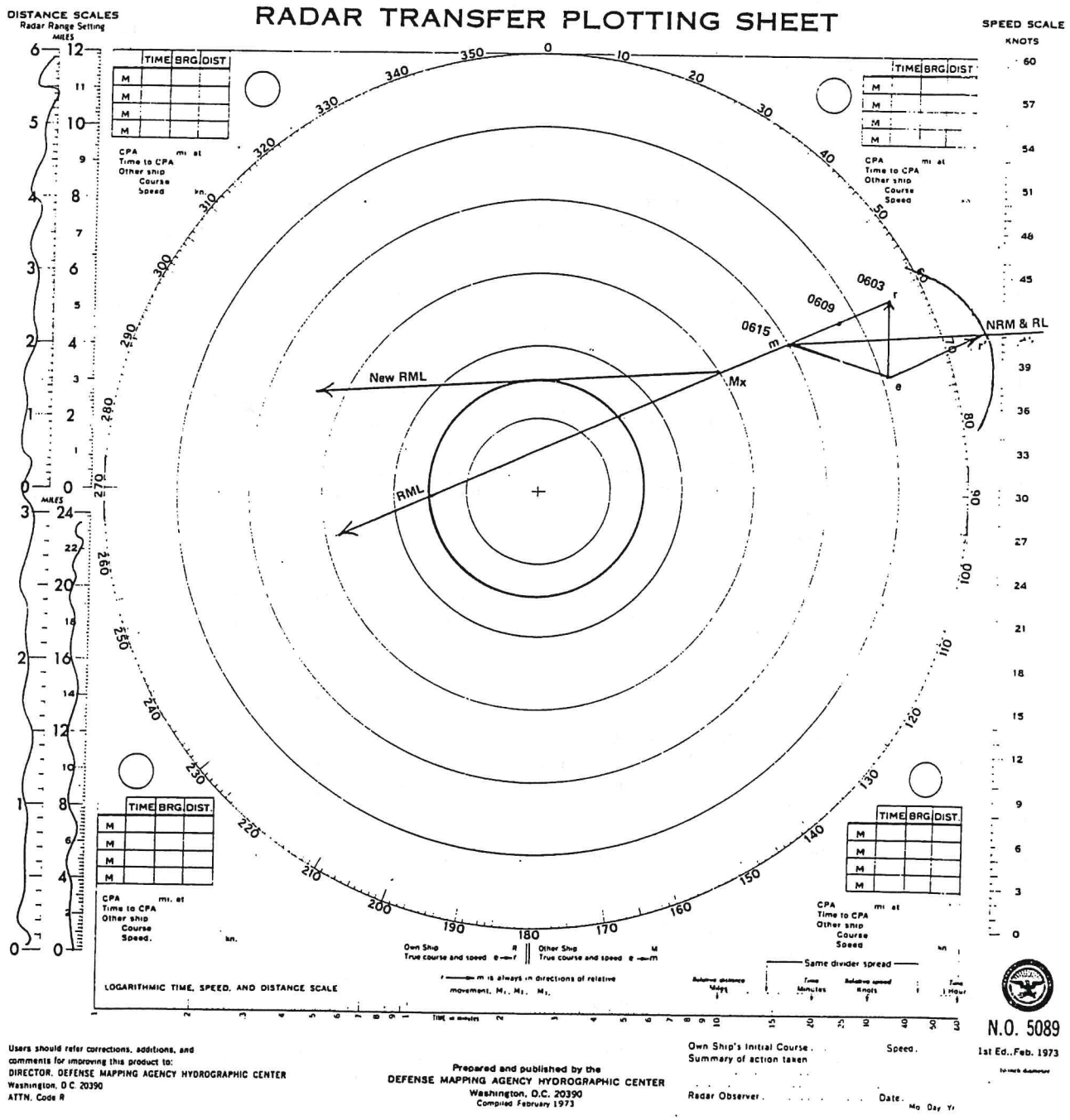

Figure 68 — Graphic Illustration of EXAMPLE 8.

6-55. RAPID RADAR PLOTTING SUMMARY. In the preceding pages you have been given information on how to apply Rapid Radar Plotting techniques. In the "Abbreviated Memory Sheet" below, the technique is presented using somewhat different symbols. The system, however, is unchanged. This presentation is used only for "six-minute triangles", i.e. six minutes between "r" and "m".

ABBREVIATED MEMORY SHEET
(for radar plotting a six-minute triangle)
FIRST TRIANGLE

TC ↑

1. Plot your own True Course(TC) by a dotted line with arrow.

r

2. Plot "r". "r" is a point that represents the range, bearing and time of target when it is first picked up.

TTC ↓

3. Transfer your own TC to point "r". From "r", draw a line in opposite direction of the arrow. On this line will be point "e".

e

4. Determine point "e". "e" comes from our " own ship" speed! Whatever own ship's speed is, take .1 (one-tenth) of that speed. The resulting figure is the distance, the length of "er", or how far the point "e" is from point "r" in six (6) minutes time, or as shown graphically in the six (6) minute triangle. D= S × .1

m

5. Plot point "m". "m" is the point representing range, bearing and time six (6) minutes after point "r" if you are working a six (6) minute triangle of the same target.

RML

CD CPA

6. Connect points "r" and "m" and continue the line past the center. Label this line RML, which stands for "Relative Motion Line".

   The Crossing Distance (CD) point is where the RML line intersects OTC, Own True Course. The Closest Point of Approach, (CPA) is where the RML is at a right angle distance from "own ship" at center.

7. Close the triangle. Each side of the triangle is a friend that wants to give you information you need! Each side contains information such as course (direction-as related to the center), speed, time, distance (length).
   Side: "er"=OTC and OTS, Our True Course and Our True Speed
   "em"=TTC and TTS, Them's True Course and Them's True Speed
   "rm"=rC and rS, relative Course and relative Speed

8. To find "speed" on any side of triangle, measure the length of the side. This gives " distance". Multiply this distance by 10 (in a 6-minute triangle). The resulting figure is the nautical miles per hour (knots)figure .
   S=D × 10

SECOND TRIANGLE

M_X

9. On RML, locate the point of execution," M_x". This point can be located in terms of time, or in terms of range. If time, measure from "r" towards center; if range, measure from the center towards the target on RML

NCPA

10. Describe (draw) an arc for the desired new CPA (Closest Point of Approach).

RML_1

11. Draw a line from M_x tangent to the CPA arc. Label it RML_1. RML_1 is drawn as crossing own true course if the Rules of the Road require the target to pass ahead of" own ship". Own ship is always at the center. Or, RML_1 is drawn astern of own ship if the Rules of the Road require the target to pass astern. Visualize the situation in a practical problem. Usually paper problems state whether the crossing is ahead or astern.

$ARML_1$

12. Advance the RML_1 line to point "m". From point "m" draw a line parallel - and away from the center. Label it $ARML_1$.

er
r_1
er_1

13. Describe an arc using "er" as its radius with point "e" as center. This arc will cross $ARML_1$ in two (2) places.
   The point of intersection farthest (usually) from "m" gives point "r_1". Draw line "er_1". "er_1" is the new course with no change of speed.

14. If a change of speed is desired with no change of course, then note that our "r_1" becomes the point of intersection of line "er" and line "$ARML_1$". Thus, the new speed will be the length of line "er_1" multiplied by 10-in a 6-minute triangle.

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Radar Observer
Practice Plot

EXERCISE #1

Own Ship: Course - 270°T Speed - 16 Kts

	TARGET #1		TARGET #2	
TIME	BEARING	RANGE	BEARING	RANGE
0700	060°T	10.0 NM	000°T	11.0 NM
0706	060°T	8.0 NM	001°T	10.0 NM

1. What is the CPA of target #1?

A. 2.0 NM
B. 2.5 NM
C. 1.0 NM
D. Collision

2. What is the CPA of target #2?

A. 2.0 NM
B. 0.5 NM
C. 4.0 NM
D. Collision

3. What is the true course of target #1?

A. 000°T
B. 210°T
C. 253°T
D. 187°T

4. What is the true course of target #2?

A. 233°T
B. 190°T
C. 283°T
D. 045°T

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Practice Plot

5. What is the TCPA of target #1?

A. 0730
B. 0715
C. 0720
D. 0706

6. What is the TCPA of target #2?

A. 0740
B. 0810
C. 0758
D. 0748

7. The Rules of the Road situation with target #1 is _____.

A. Meeting
B. Overtaking
C. Crossing
D. None of the above

ANSWERS

1.D 2.A 3.C 4.A
5.A 6.C 7.B

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Practice Plot

EXERCISE #2

Own Ship: Course - 030°T Speed - 12 Kts

	TARGET #1		TARGET #2	
TIME	**BEARING**	**RANGE**	**BEARING**	**RANGE**
2006	152°T	5.5 NM		
2012	151°T	4.0 NM		

1. What is the DRM?

A. 150°T
B. 065°T
C. 335°T
D. 260°T

2. What is the SRM?

A. 15 K
B. 10 K
C. 21 K
D. 28 K

3. What is the CPA?

A. 1.5 NM
B. 0.3 NM
C. 1.0 NM
D. 1.3 NM

4. What is the TCPA?

A. 2020
B. 2011
C. 2037
D. 2028

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5. What is the BCPA?

A. 245°T
B. Collision
C. 065°T
D. 359°T

6. What is the target's course?

A. 359°T
B. 040°T
C. 180°T
D. 330°T

7. What is the true speed of the target?

A. 24 K
B. 15 K
C. 18 K
D. 10 K

8. What type of Rules of the Road situation is this?

A. Crossing
B. Meeting
C. Overtaking
D. None of the above

9. Your vessel is the _____vessel.

A. Give-way
B. Stand-on
C. Neither give-way nor stand-on

10. At night, what navigational light(s) would you see on the other vessel?

A. Both side lights and masthead light(s)
B. Port side light and masthead light(s)
C. Stern light only
D. Starboard side light and masthead light(s)

ANSWERS
1.C 2.A 3.B 4.D
5.C 6.A 7.A 8.C
9.B 10.B

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EXERCISE #3 **1ST TRIANGLE**

Own Ship: **Course - 000°T** **Speed - 12 Kts**

	TARGET #1		TARGET #2		TARGET #3	
TIME	BEARING	RANGE	BEARING	RANGE	BEARING	RANGE
0410	035°T	11.1 NM				
0416	031°T	9.2 NM				

1. What is the DRM of target #1?

   A. 310°
   B. 296°
   C. 139°
   D. 234°

2. What is the SRM of target #1?

   A. 6K
   B. 10K
   C. 20K
   D. DIW

3. What is the CPA of target #1?

   A. 7.0 NM
   B. 3.5 NM
   C. Collision
   D. 10 NM

4. What is the time of CPA of target #1?

   A. 0406
   B. 0418
   C. 0441
   D. 0400

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5. What is the true course of target #1?

   A. 180°T
   B. 264°T
   C. 088°T
   D. 000°T

6. What is the true speed of target #1?

   A. 9K
   B. 27K
   C. DIW
   D. 16K

7. What is the bearing at CPA?

   A. 192°
   B. 268°
   C. 088°
   D. 324°

8. What Rules of the Road situation exists between own ship and target #1?

   A. Crossing
   B. Meeting
   C. Overtaking
   D. None of the above

ANSWERS

1.D 2.C 3.B
4.C 5.B 6.D
7.D 8.A

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EXERCISE #4 **1ST TRIANGLE**

Own Ship: **Course - 030°T** **Speed - 23 Kts**

	TARGET #1		TARGET #2		TARGET #3	
TIME	BEARING	RANGE	BEARING	RANGE	BEARING	RANGE
1020	081°T	10.8 NM				
1026	083°T	7.7 NM				

1. What is the DRM of target #1?

   A. 077°
   B. 257°
   C. 303°
   D. 166°

2. What is the SRM of target #1?

   A. 6K
   B. 10K
   C. 20K
   D. 32K

3. What is the CPA of target #1?

   A. 1.0 NM
   B. 3.5 NM
   C. Collision
   D. Past CPA

4. What is the time of CPA of target #1?

   A. 1006
   B. 1018
   C. 1041
   D. 1000

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5. What is the true course of target #1?

   A. 304°
   B. 270°
   C. 088°
   D. 000°

6. What is the true speed of target #1?

   A. 9k
   B. 35k
   C. 22k
   D. 16k

7. What is the bearing at CPA?

   A. 167°
   B. 268°
   C. 088°
   D. 324°

8. What Rules of the Road situation exists between own ship and target #1?

   A. Crossing
   B. Meeting
   C. Overtaking
   D. None of the above

9. Assuming that the contact has turned on its running lights during daylight due to inclement weather, what side light(s) might be seen at CPA?

   A. Green
   B. Red
   C. Both
   D. None

10. The vector EM represents_____.

   A. Own ship course and speed
   B. Relative Motion
   C. Target's true course and speed
   D. All of the above

ANSWERS

1.B 2.D 3.A
4.C 5.A 6.C
7.A 8.A 9 .A
10. C

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EXERCISE #5 1ST TRIANGLE

Own Ship: Course - 310°T Speed - 20 Kts

	TARGET #1		TARGET #2		TARGET #3	
TIME	BEARING	RANGE	BEARING	RANGE	BEARING	RANGE
0000	330°T	9.0 NM	010°T	9.0 NM	240°T	9.0 NM
0006	335°T	7.0 NM	011°T	8.0 NM	245°T	7.0 NM

1. What is the CPA of target #3?

A. 2.5 NM
B. 0.5 NM
C. 1.0 NM
D. Collision

2. What is the CPA of target #1?

A. 0.5 NM
B. 3.0 NM
C. 1.0 NM
D. Collision

3. What is the time of CPA of target #2?

A. 0036
B. 0044
C. 0048
D. 0052

4. What is the time of CPA of target #1?

A. 0025
B. 0012
C. 0034
D. 0048

5. What is the true course of target #1?

A. 130°
B. DIW
C. 310°
D. 085°

6. What is the true speed of target # 2?

A. 16K
B. 8K
C. 21K
D. 32K

7. What is the true course of target #3?

A. 353°
B. 170°
C. 045°
D. 090°

8. With regard to target #3, you are:

A. The give way vessel in a overtaking situation
B. The give way vessel in a crossing situation
C. The stand on vessel in a overtaking situation
D. The stand on vessel in a crossing situation

9. What lights would you expect to see on target #3 at 0020?

A. Both port and starboard side lights
B. Port side light and masthead lights
C. Starboard side light and masthead lights
D. No lights

10. What is the SRM of target #1?

A. 16K
B. 8K
C. 21K
D. 32K

ANSWERS

1.A 2.B 3.D
4.A 5.B 6.A
7.A 8.D 9 .C
10. C

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EXERCISE #6 1ST TRIANGLE

Own Ship: Course - 090°T Speed - 20 Kts

	TARGET #1		TARGET #2		TARGET #3	
TIME	BEARING	RANGE	BEARING	RANGE	BEARING	RANGE
0000	120°T	9.0 NM	140°T	6.0 NM	001°T	6.0 NM
0006	116°T	7.0 NM	136°T	5.0 NM	005°T	4.0 NM

1. What is the CPA of target #1?

A. 3.5 NM
B. 0.5 NM
C. 2.3 NM
D. Collision

2. What is the BCPA of target #2?

A. 353°
B. 170°
C. 045°
D. 075°

3. What is the time of CPA of target #1?

A. 0015
B. 0026
C. 0034
D. 0052

4. What is the time of CPA of target #2?

A. 0028
B. 0042
C. 0020
D. 0048

5. What is the true course of target #3?

A. 135°
B. DIW
C. 310°
D. 085°

6. What is the true speed of target # 3?

A. 16K
B. 8K
C. 21K
D. 30K

7. What is the true course of target #2?

A. 353°
B. 170°
C. 055°
D. 090°

8. With regard to target #1 you are:

A. The give way vessel in a overtaking situation
B. The give way vessel in a crossing situation
C. The stand on vessel in a overtaking situation
D. The stand on vessel in a crossing situation

9. What lights would you expect to see on target #3 at CPA?

A. Both port and starboard side lights
B. Port side light and masthead lights
C. Starboard side light and masthead lights
D. Stern light

10. What is the SRM of target #2

A. 11K
B. 8K
C. 21K
D. 32K

ANSWERS

1.C 2.D 3.B
4.A 5.A 6.D
7.C 8.B 9 .D
10. A

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EXERCISE #8

Own Ship: Course - 235°T Speed - 15 Kts

	TARGET #1		TARGET #2	
TIME	BEARING	RANGE	BEARING	RANGE
1940	270°T	11.0 NM		
1946	271°T	10.0 NM		

1. What is the DRM?

   A. 008°T
   B. 180°T
   C. 270°T
   D. 080°T

2. What is the SRM?

   A. 10 K
   B. 20 K
   C. 16 K
   D. 28 K

3. What is the CPA?

   A. 1.9 NM
   B. 5.5 NM
   C. 3.0 NM
   D. 0.1 NM

4. What is the TCPA?

   A. 2037
   B. 1944
   C. 2040
   D. 2045

5. What is the BCPA?

   A. 300°T
   B. 165°T
   C. 350°T
   D. 271°T

When the target is 6 NM away, change course to allow the contact to pass 3.0 NM astern.

6. What time is your course change?

   A. 2051
   B. 1946
   C. 2029
   D. 2010

7. What is your new course?

   A. 225°T
   B. 210°T
   C. 180°T
   D. 246°T

8. What is the New TCPA?

   A. 2036
   B. 2059
   C. 2044
   D. 1940

9. What is the target's true course?

   A. 160°T
   B. 202°T
   C. 180°T
   D. 252°T

10. What is the target's true speed?

    A. 12.0 K
    B. 4.0 K
    C. 8.0 K
    D. 16.0 K

ANSWERS

1. D 2. A 3. A 4. D
5. C 6. D 7. A 8. C
9. B 10. C

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EXERCISE #9 2ND TRIANGLE

Own Ship: Course - 290°T Speed - 20 Kts

	TARGET #1		TARGET #2		TARGET #3	
TIME	BEARING	RANGE	BEARING	RANGE	BEARING	RANGE
0000	320°T	9.0 NM	010°T	8.0 NM	040°T	6.0 NM
0006	310°T	8.0 NM	010°T	6.0 NM	050°T	5.0 NM

1. What is the BCPA of target #1?

A. 350°
B. 170°
C. 045°
D. 282°

2. What is the CPA of target #1?

A. 6.9NM
B. 2.3NM
C. 0.5NM
D. 8.2NM

3. What is the time of CPA of target #1?

A. 0015
B. 0032
C. 0020
D. 0052

4. What is the time of CPA of target #2

A. 0015
B. 0024
C. 0034
D. 0052

5. What is the true course of target #2?

A. 135°
B. 244°
C. 310°
D. 085°

6. What is the true speed of target # 3?

A. 16K
B. 8K
C. 22K
D. 30K

7. What is the true course of target #3?

A. 353°
B. 170°
C. 055°
D. 247°

8. With regard to target #2 you are:

A. The give way vessel in a overtaking situation
B. The give way vessel in a crossing situation
C. The stand on vessel in a overtaking situation
D. The stand on vessel in a crossing situation

9. When the range of target #2 is 3 miles, maneuver in accordance with the rules of the road for target #2 to have a CPA of 1 NM, what would be your new course?

A. 354°
B. 190°
C. 035°
D. 249°

10. What is the NDRM of target #2?

A. 212°
B. 160°
C. 025°
D. 147°

ANSWERS

1.D 2.A 3.C
4.B 5.B 6.C
7.D 8.B 9 .A
10. A

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EXERCISE #10 2ND TRIANGLE

Own Ship: Course - 340°T Speed - 20 Kts

	TARGET #1		TARGET #2		TARGET #3	
TIME	BEARING	RANGE	BEARING	RANGE	BEARING	RANGE
0000	000°T	12.0 NM	020°T	10.0 NM	090°T	4.0 NM
0006	358°T	10.0 NM	020°T	8.0 NM	090°T	4.0 NM

1. What is the BCPA of target #1?

A. 350°
B. 170°
C. 045°
D. 282°

2. What is the CPA of target #1?

A. Collision
B. 2.2NM
C. 1.5NM
D. 8.2NM

3. What is the CPA of target #2?

A. Collision
B. 2.3NM
C. 1.5NM
D. 4.0NM

4. What is the true course of target #2?

A. 135°
B. 270°
C. 310°
D. 085°

5. What is the true course of target #3?

A. 340°
B. 256°
C. 001°
D. 060°

6. What is the true speed of target # 3?

A. 16K
B. 8K
C. 20K
D. 30K

7. What is the SRM of target #1?

A. 21K
B. 8K
C. 28K
D. 30K

8. When the range of target #2 is 4NM, maneuver in accordance with the Rules of the Road for target #2 to have a 1NM CPA, your new course would be:

A. 340°
B. 256°
C. 000°
D. 060°

9. What is your new DRM?

A. 301°
B. 214°
C. 000°
D. 040°

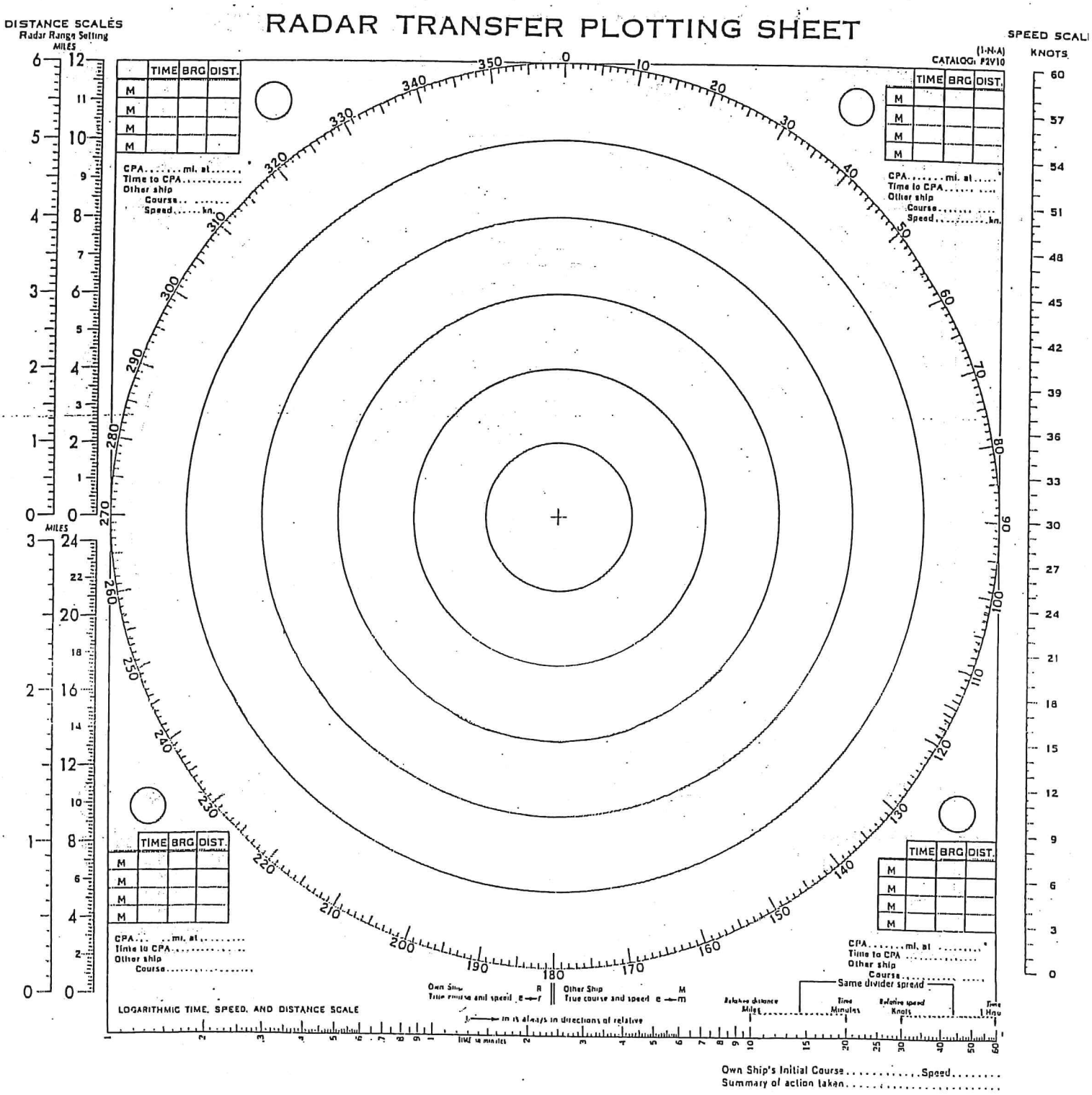
10. What time is Mx?

A. 0018
B. 0012
C. 0026
D. 0030

ANSWERS

1.D 2.B 3.A
4.B 5.A 6.C
7.A 8.C 9 .B
10. A

RADAR TRANSFER PLOTTING SHEET



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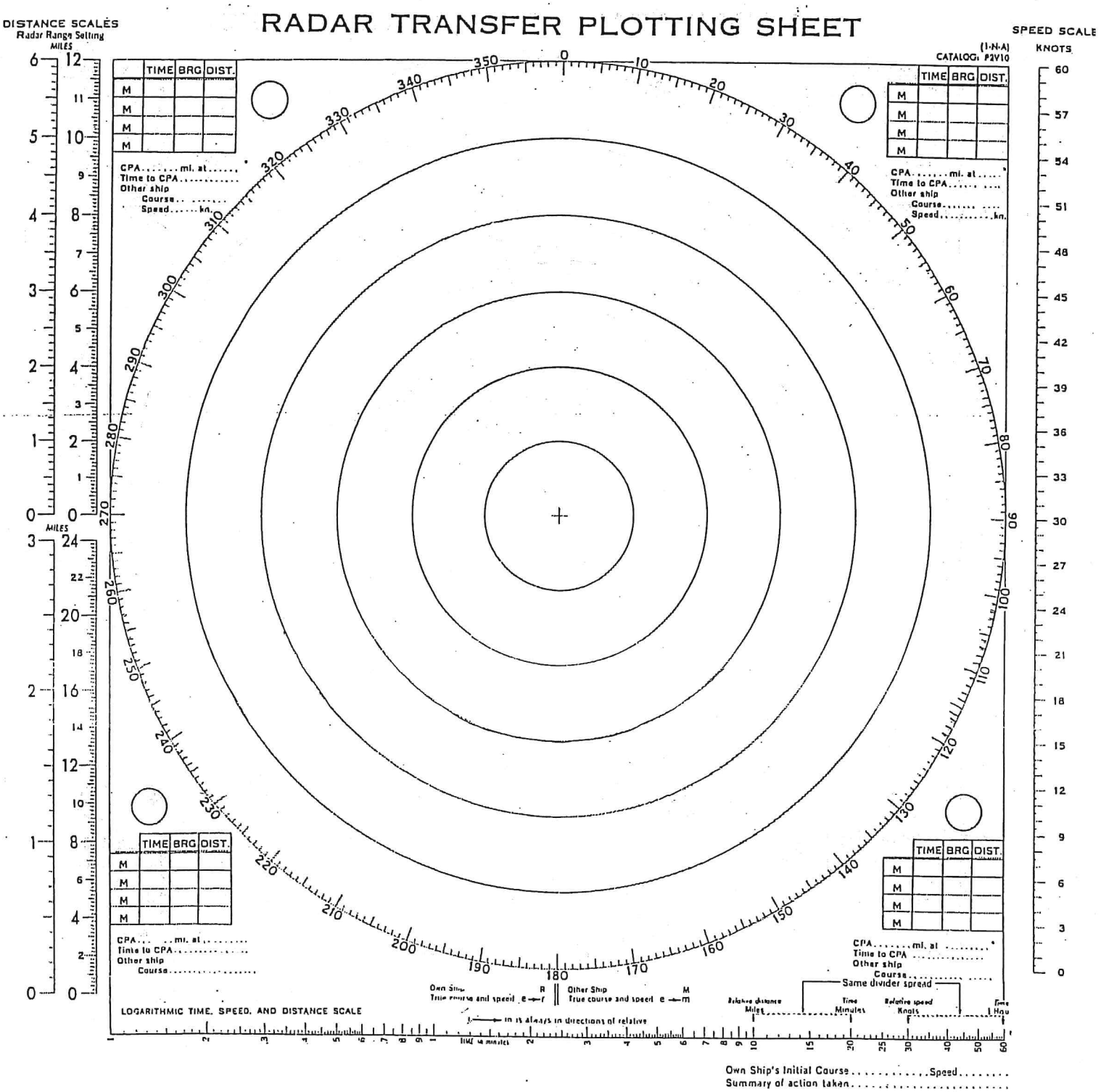

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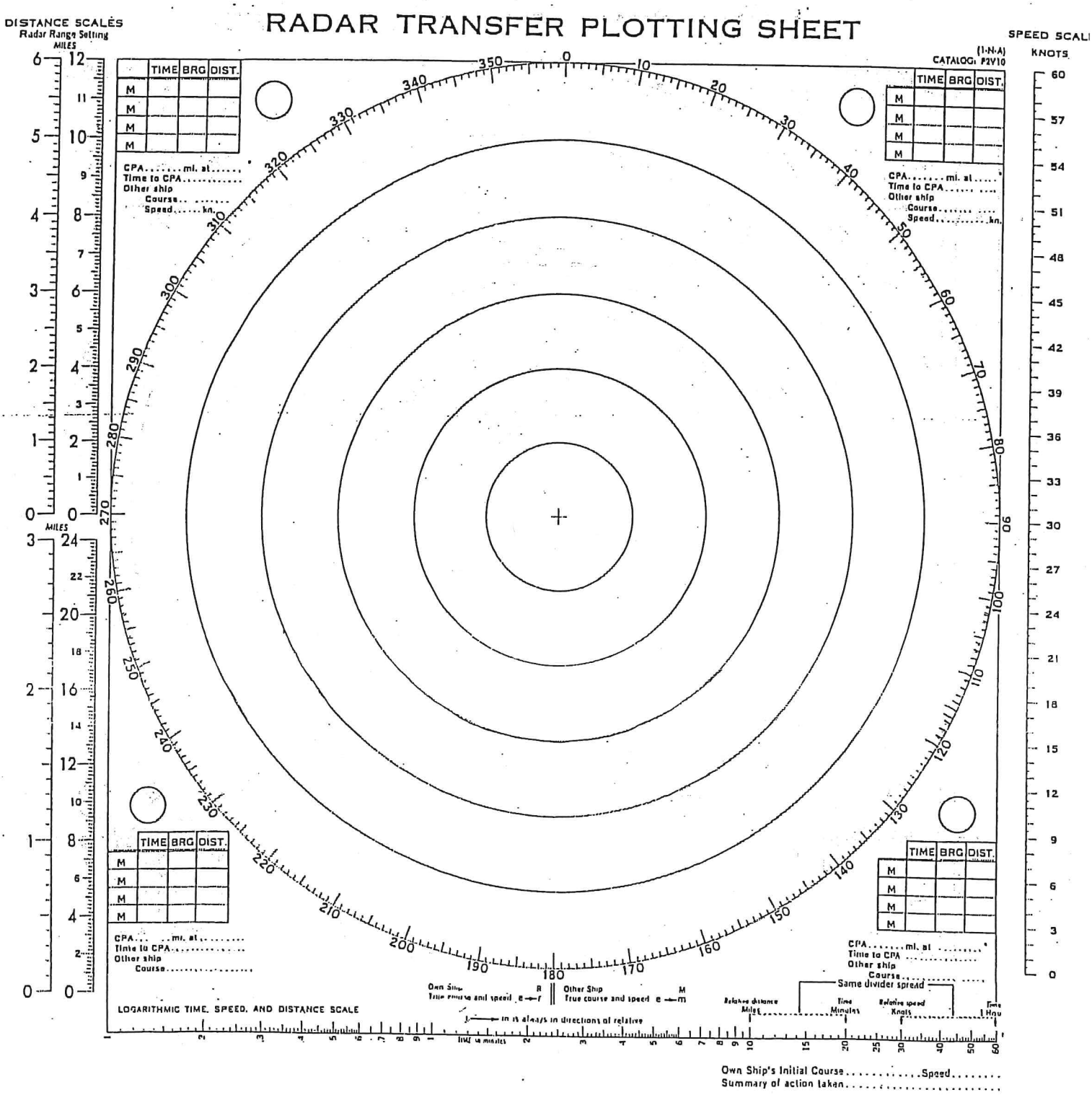

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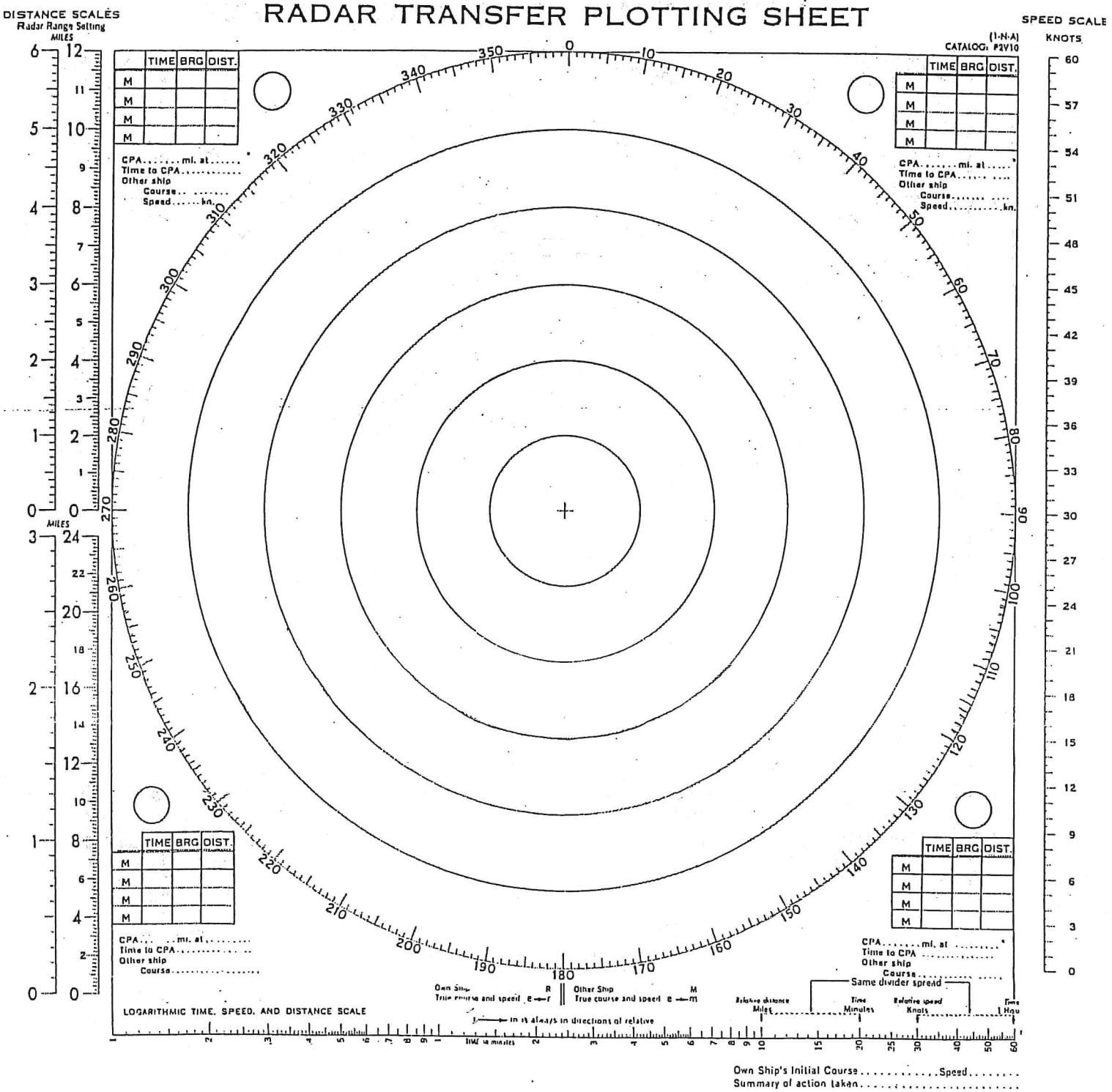
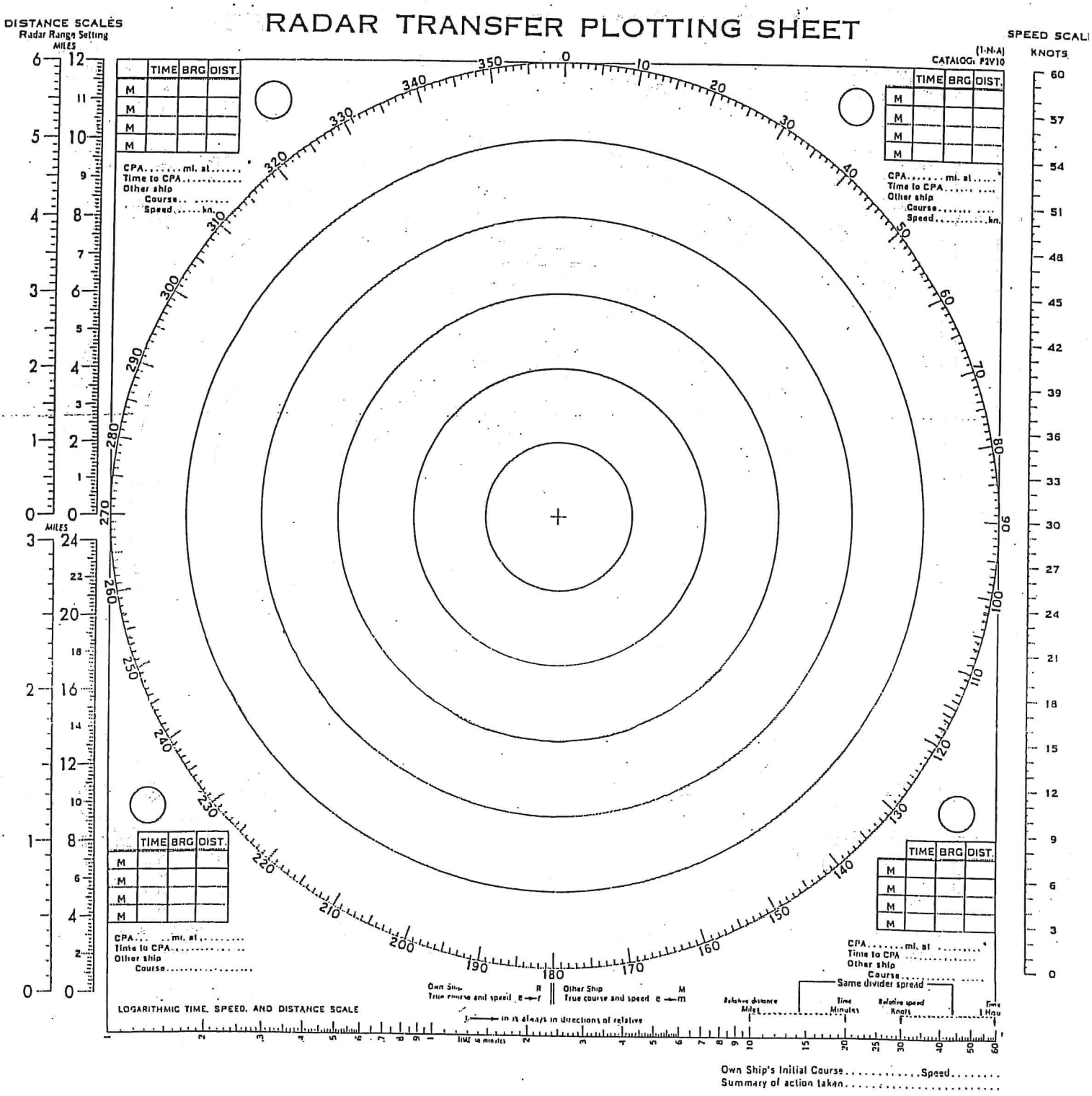
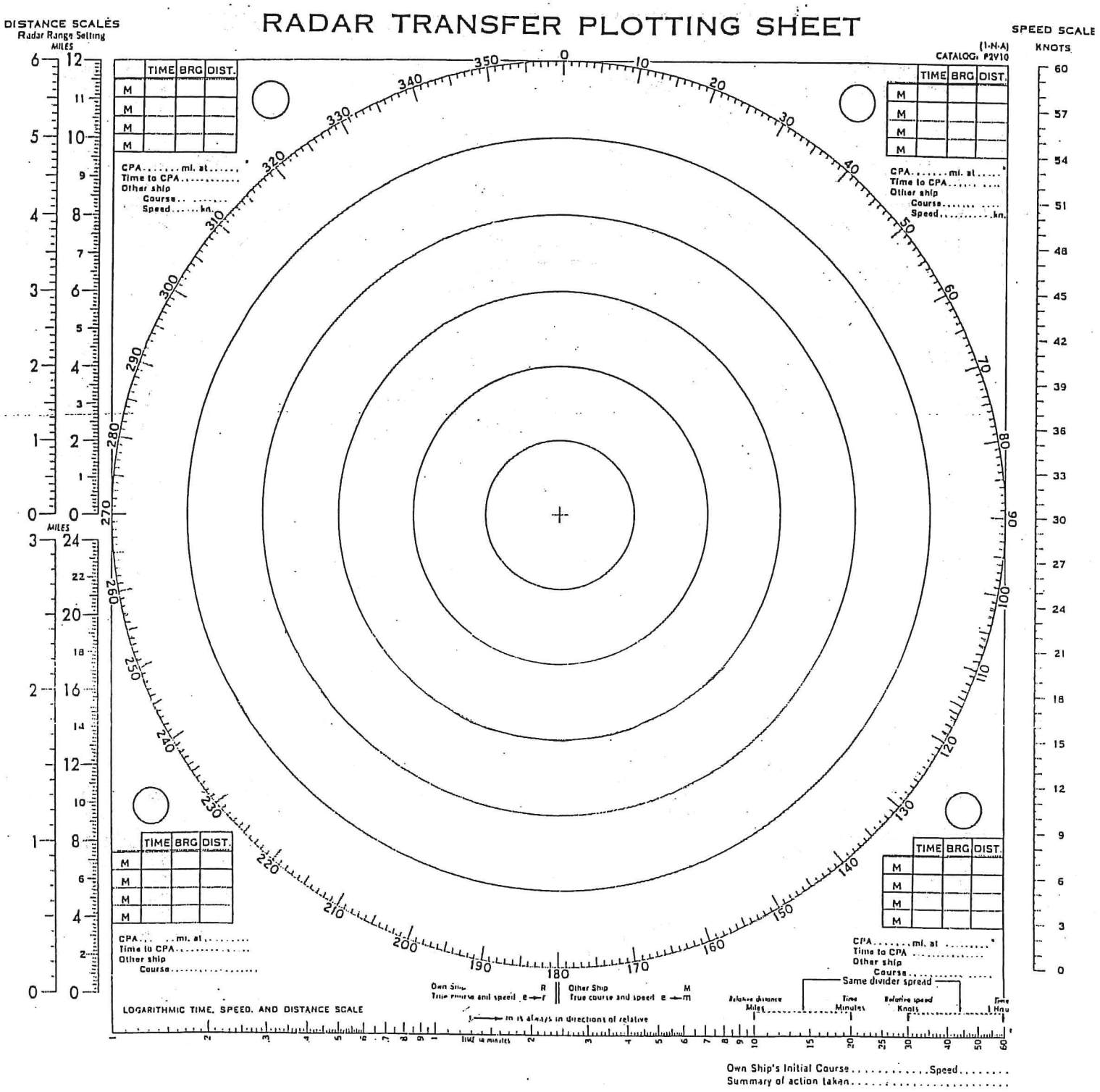
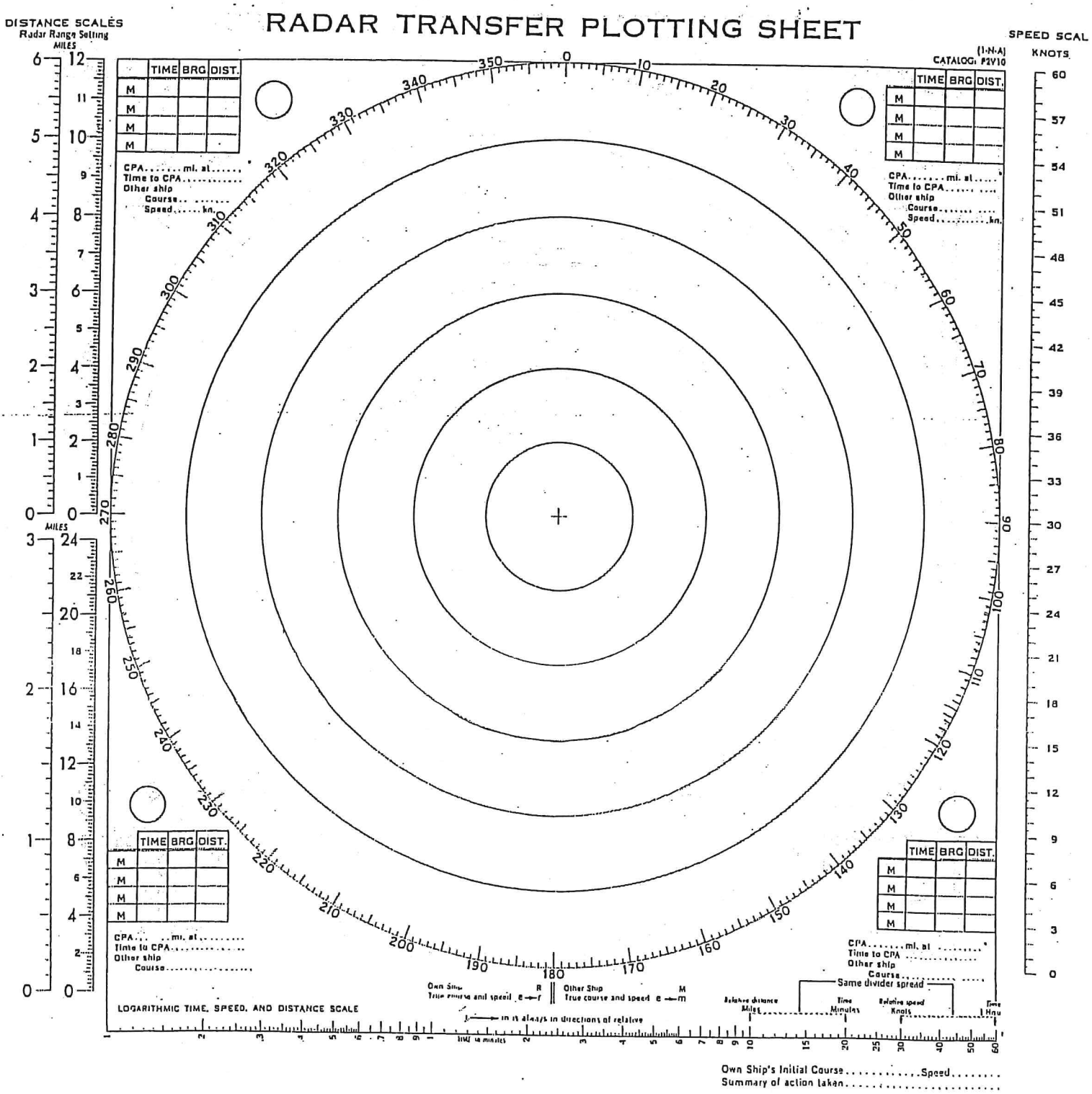


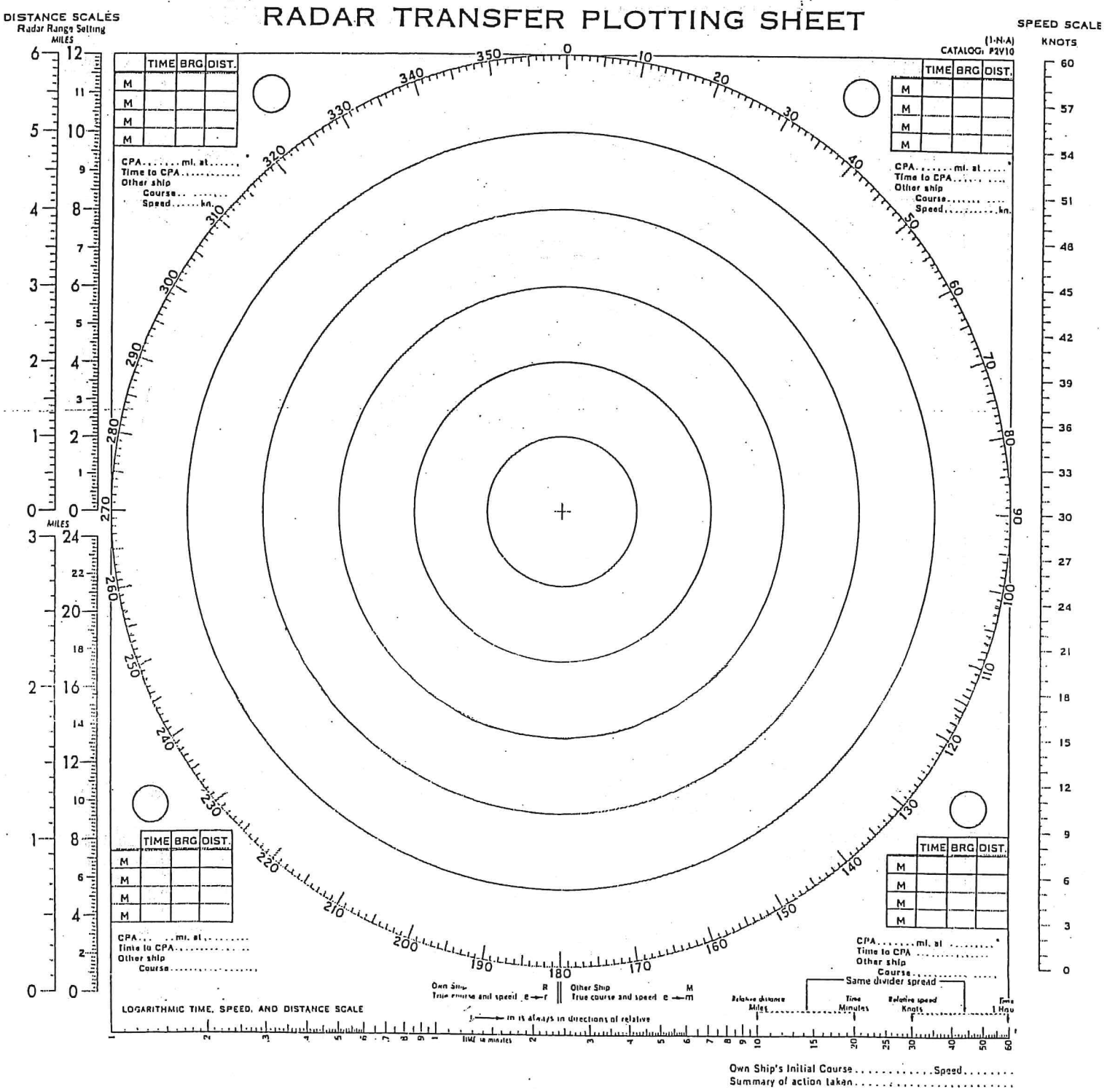

RADAR TRANSFER PLOTTING SHEET
DISTANCE SCALES
Radar Range Setting
MILES
MILES
SPEED SCALE
KNOTS
(U.S.N.A.)
CATALOG P2V10
TIME BRG DIST.
M
CPA..... mi. at.....
Time to CPA.....
Other ship
Course.....
Speed.....kn.
LOGARITHMIC TIME, SPEED, AND DISTANCE SCALE
Own Ship
True course and speed
Other Ship
True course and speed
Same divider spread
Relative distance
Miles
Time
Minutes
Relative speed
Knots
Time
Hours
Own Ship's Initial Course.....Speed.....
Summary of action taken.....

RADAR TRANSFER PLOTTING SHEET




RADAR TRANSFER PLOTTING SHEET
DISTANCE SCALES
Radar Range Setting
MILES
SPEED SCAL
KNOTS
(1-N-A)
CATALOG: P2V10
TIME BRG DIST.
CPA..... mi. at.....
Time to CPA.....
Other ship
Course.....
Speed.....kn.
LOGARITHMIC TIME, SPEED, AND DISTANCE SCALE
Own Ship
True course and speed
Other Ship
True course and speed
Same divider spread
Relative distance
Miles
Time
Minutes
Relative speed
Knots
Time
Hou
Own Ship's Initial Course.....Speed.....
Summary of action taken.....

RADAR TRANSFER PLOTTING SHEET



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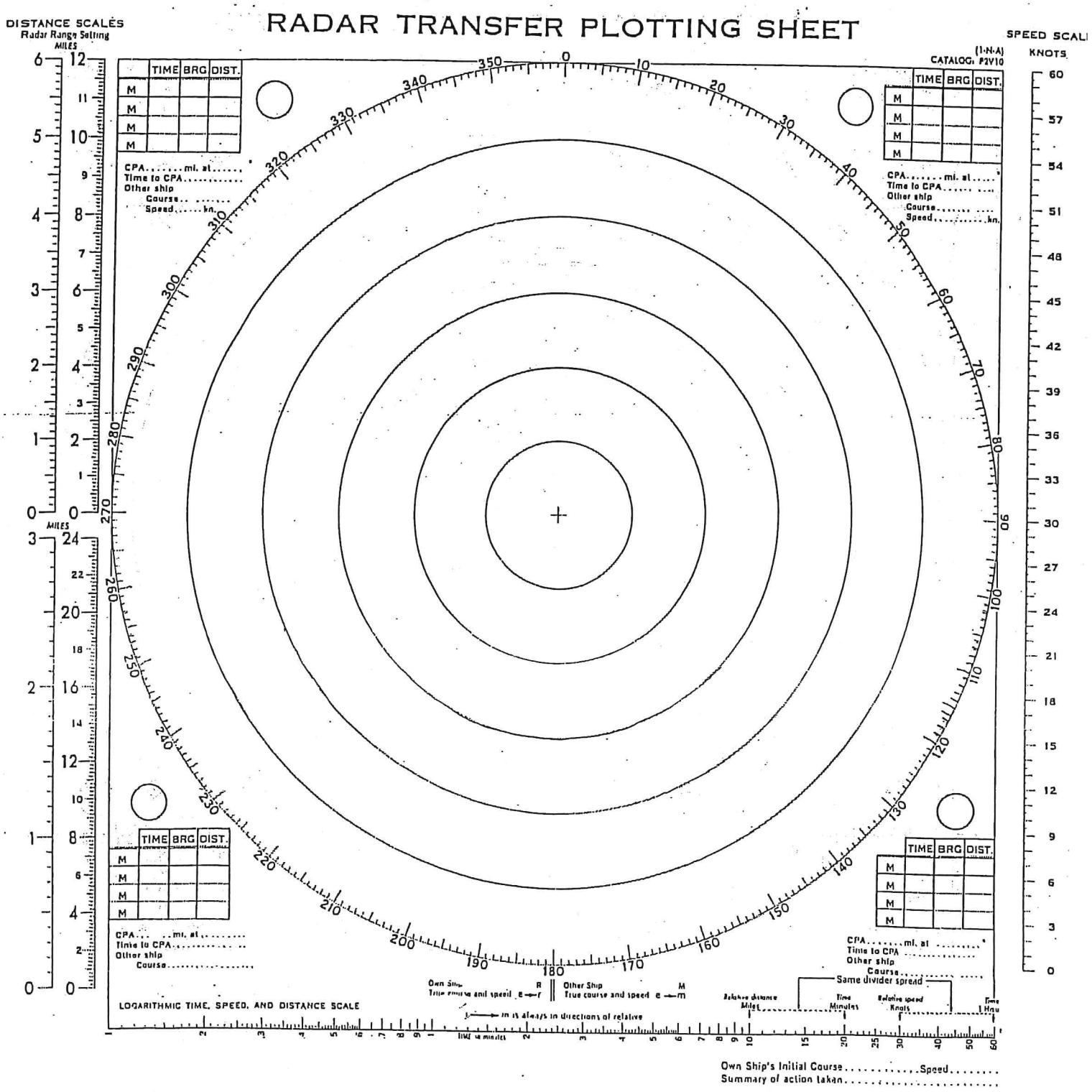

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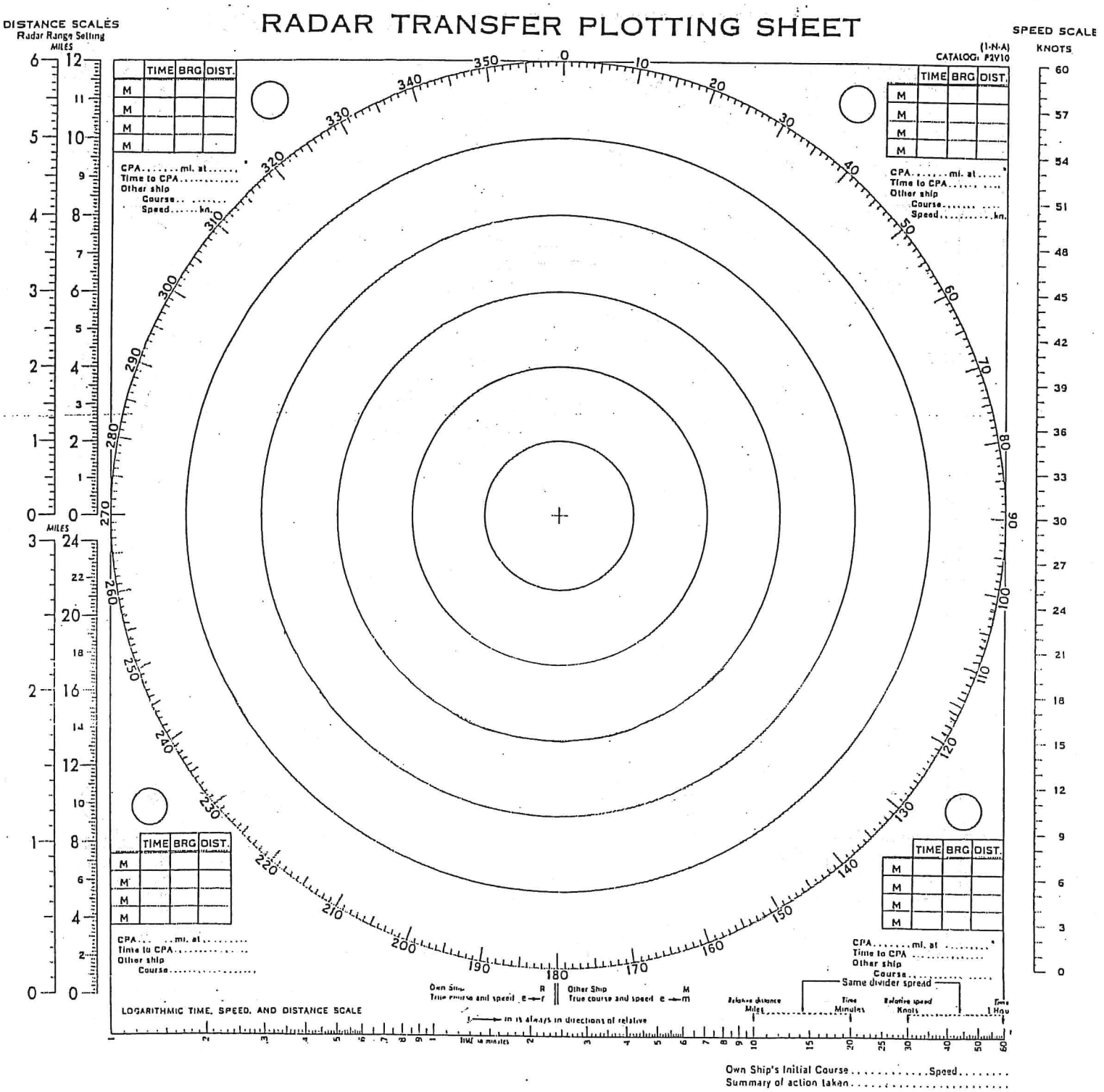

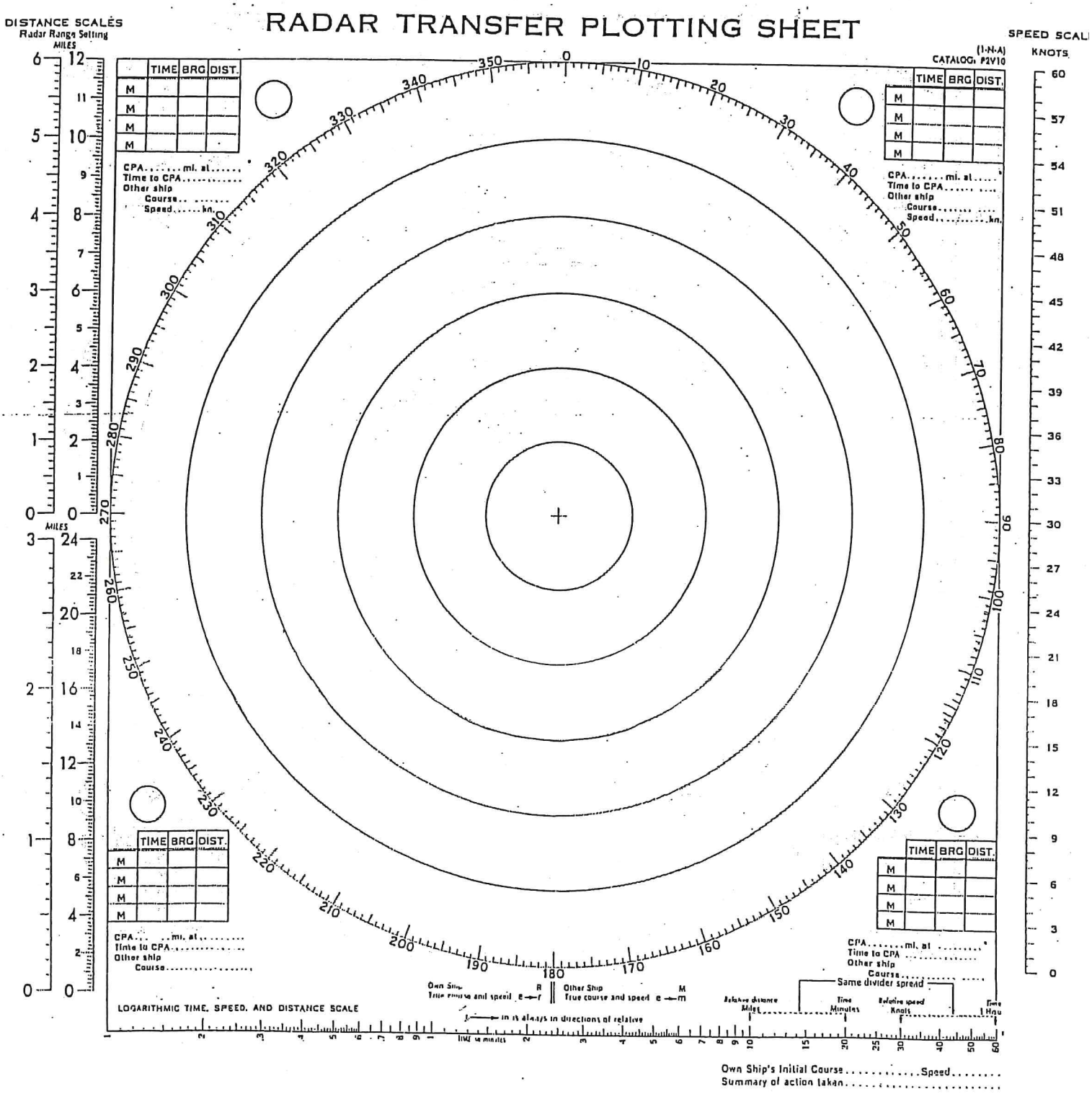
RADAR TRANSFER PLOTTING SHEET
DISTANCE SCALES
Radar Range Setting
MILES
MILES
SPEED SCALE
KNOTS
(U.S.N.A.)
CATALOG, P2V10
TIME BRG DIST.
M
CPA..... mi. at.....
Time to CPA.....
Other ship
Course.....
Speed..... kn.
LOGARITHMIC TIME, SPEED, AND DISTANCE SCALE
Own Ship
True course and speed
Other Ship
True course and speed
Same divider spread
Relative distance
Miles
Time
Minutes
Relative speed
Knots
Time
Hou
Own Ship's Initial Course.....Speed.....
Summary of action taken.....

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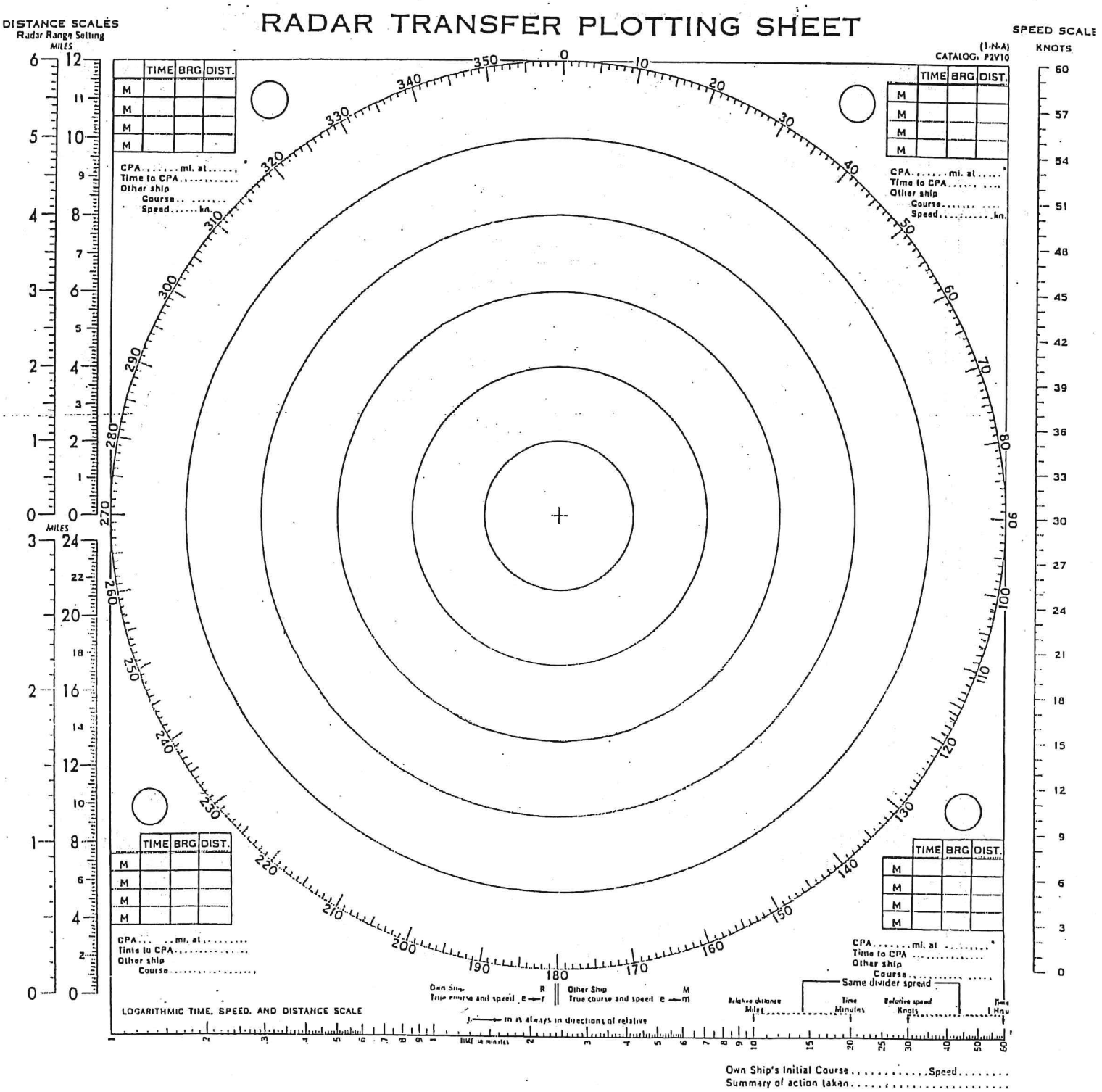

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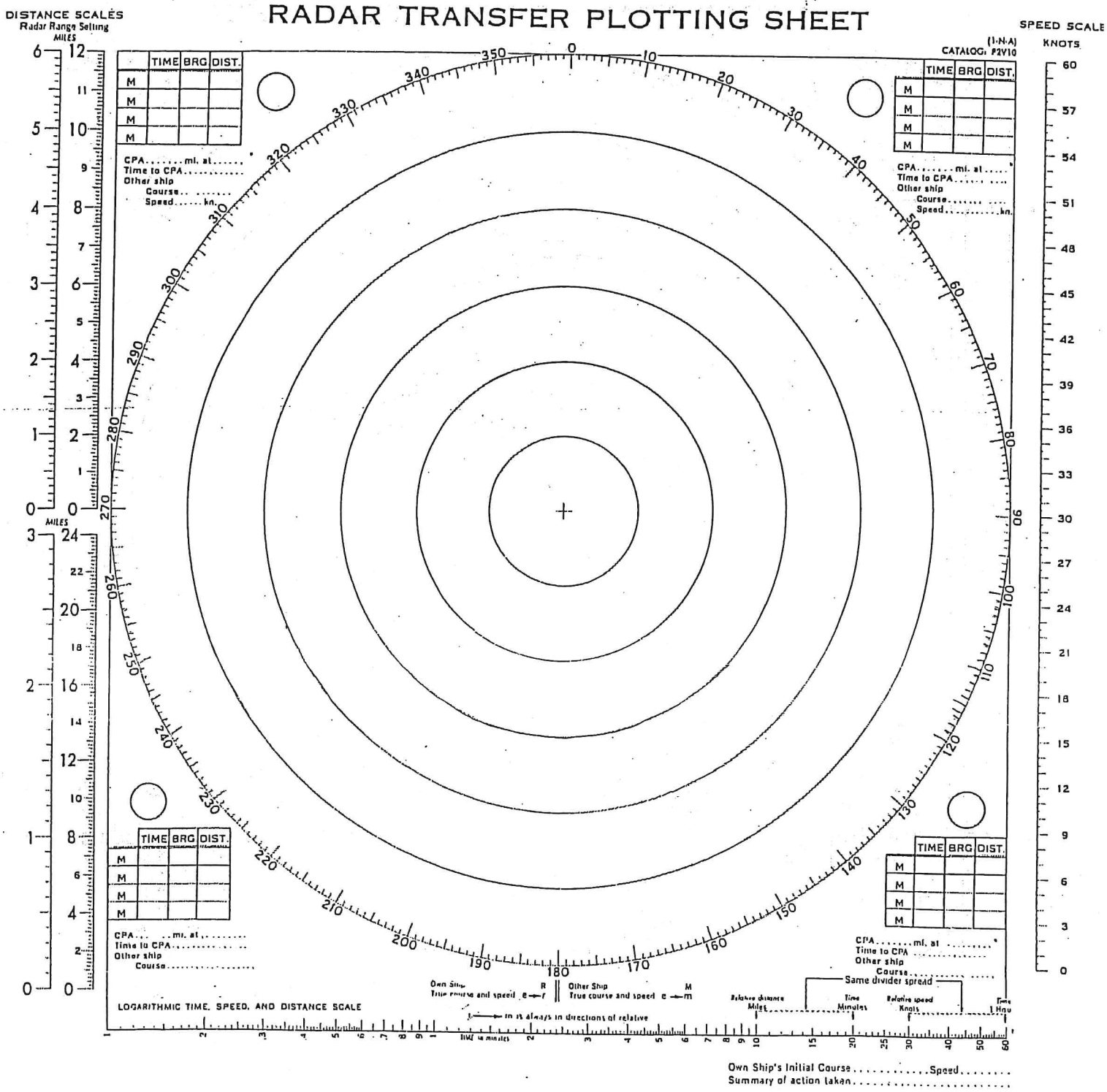

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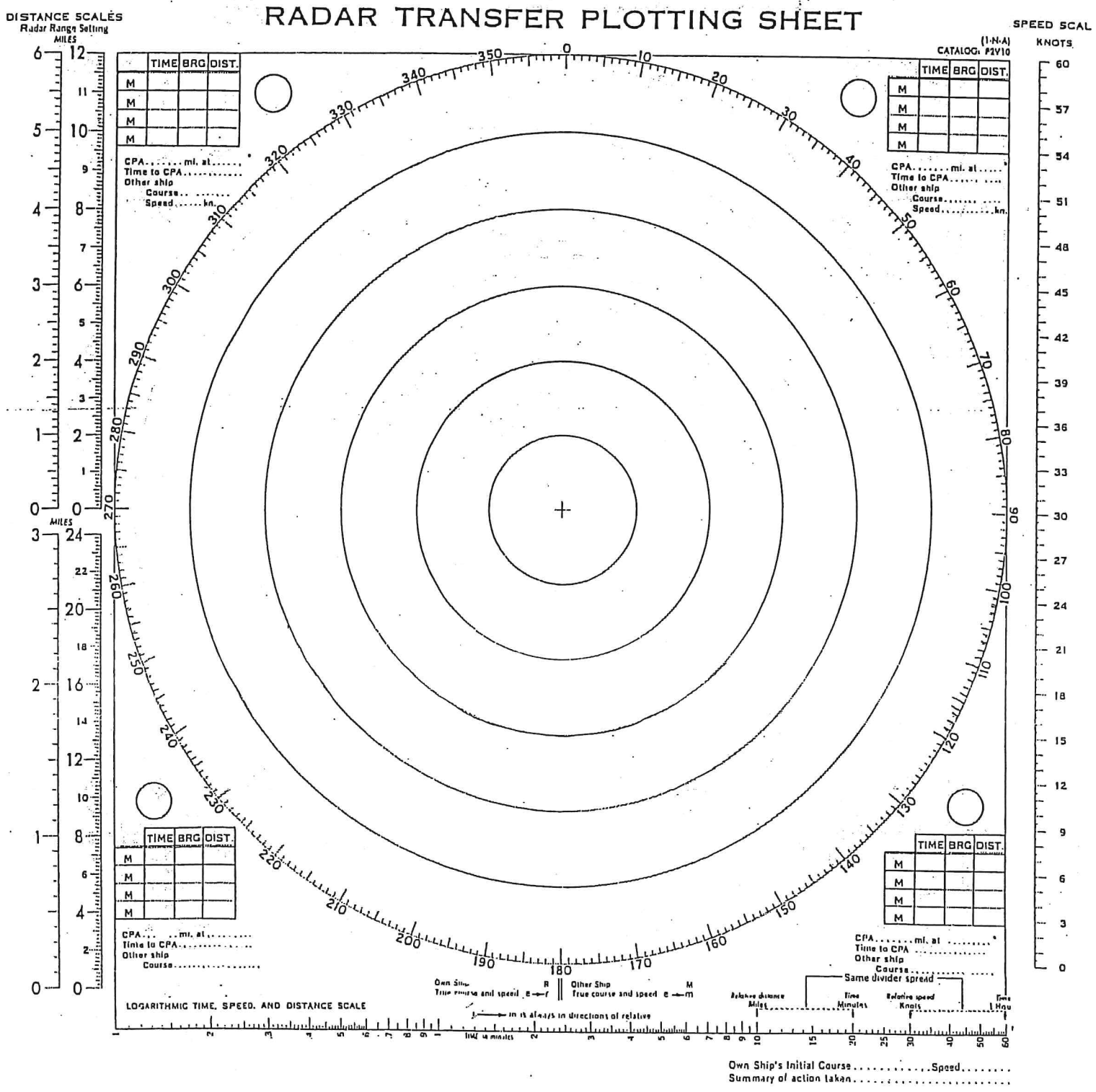

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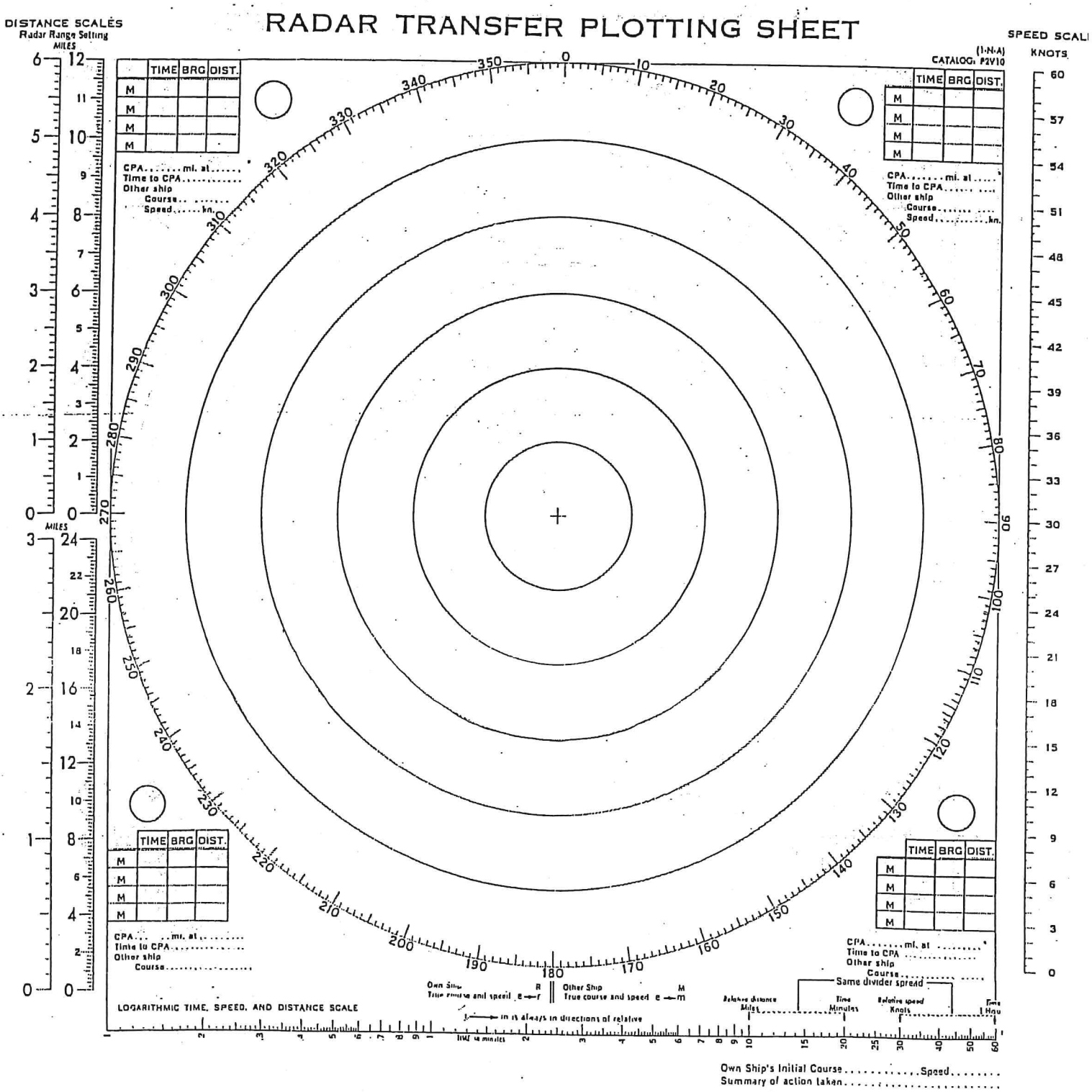

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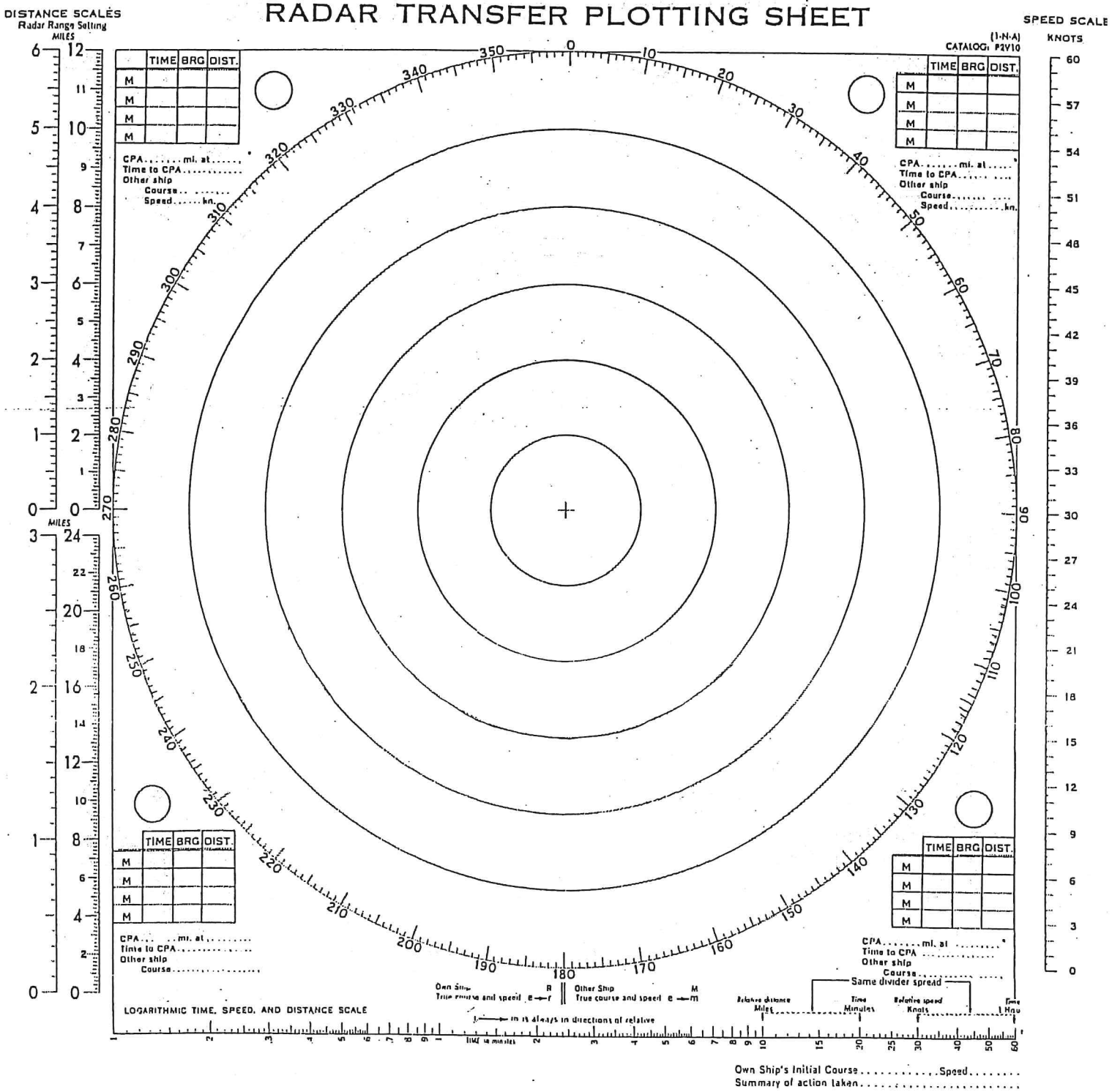

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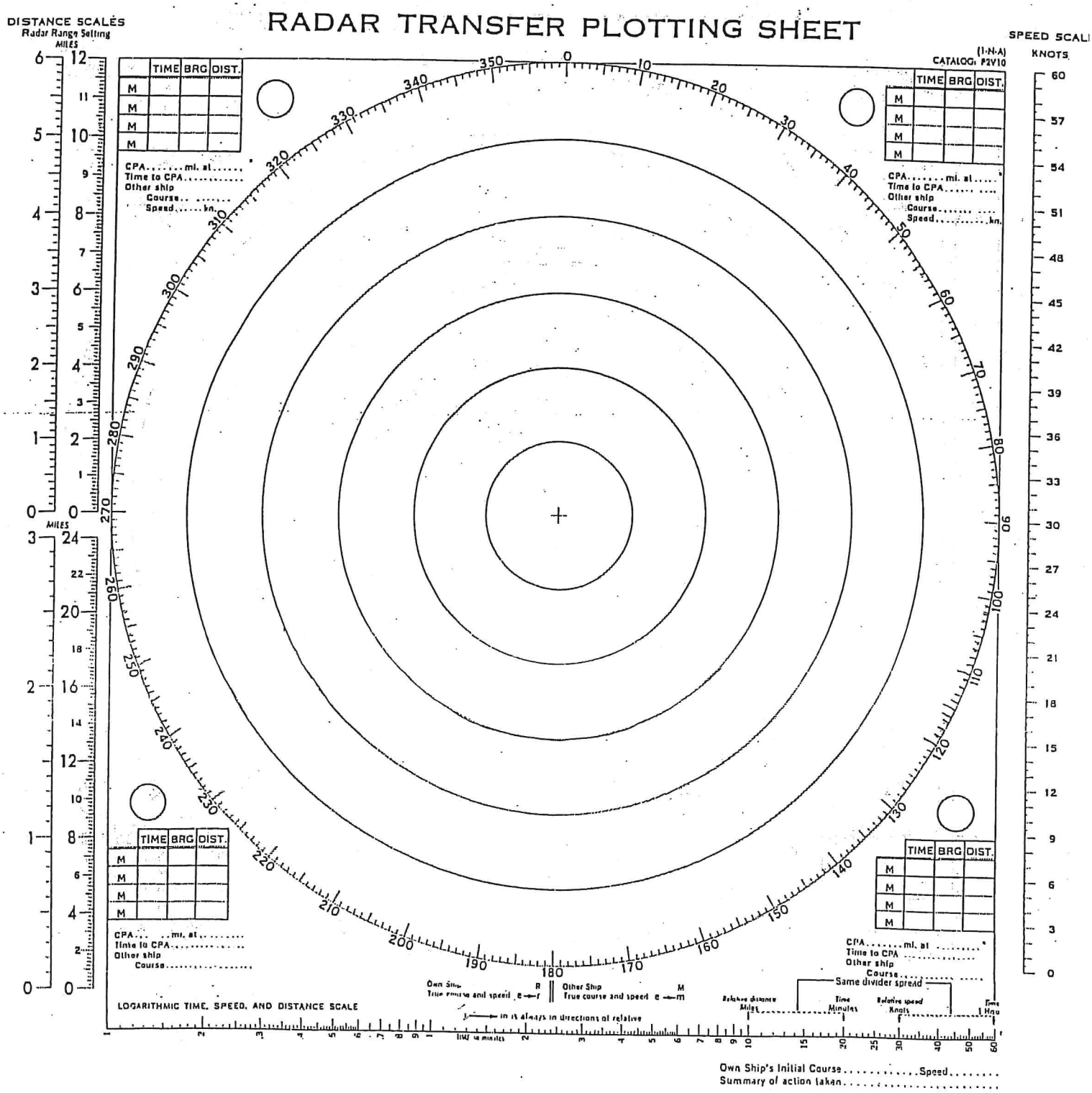

RADAR TRANSFER PLOTTING SHEET