

# MANEUVERING BOARDS AND YOU

NAVIGATION CAN BE FUN

# Why we do them

- Understanding relative motion is essential for effective ship handling. An important result of skill in using maneuvering board is the ability to visualize problems and solve them mentally. Constant practice with maneuvering boards will help you to qualify and to stand watch as Officer of the Deck (OOD) and CIC Watch Officer (CICWO).
- And to pass our BM2 test

# Definitions

- Relative movement – motion relative to an arbitrarily selected object (like a ship) that may or may not have actual movement
- SRM – speed of relative movement; speed relative to the object selected
- RML – relative movement line; movement of an object relative to another object

# Dead Time

- Dead time is the time required to solve the maneuvering board before making the course adjustments
- Dead time formula:  $D = S \times T \times 100/3$
- $S = D/T \times 3/100$   
 $T = D/S \times 3/100$

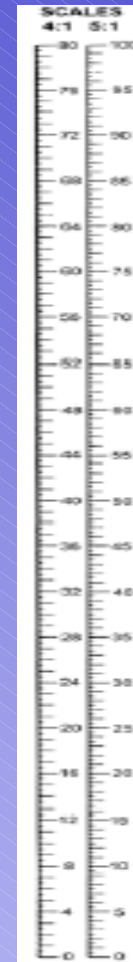
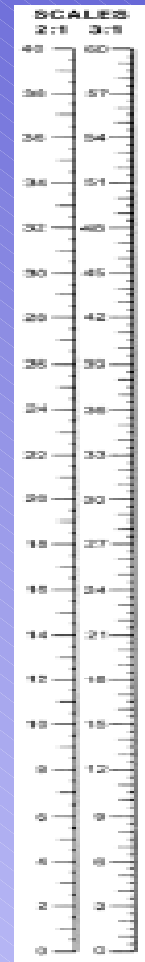
THIS FORMULA IS USEFUL FOR DOUBLE  
CHECKING NOMOGRAM FIGURING AS WELL





# Scales

- USE SCALES TO DETERMINE DISTANCE OR SPEED



# Determining Distance Scale

DISTANCE	SCALE
0 – 10,000 YARDS	1:1
11,000 – 20,000 YARDS	2:1
21,000 – 30,000 YARDS	3:1
31,000 – 40,000 YARDS	4:1
41,000 – 50,000 YARDS	5:1



- THERE IS NO TABLE TO DETERMINE SPEED SCALE
- USE BEST JUDGEMENT AND COMMON SENSE
- (i.e. DON'T USE 2:1 SCALE WHEN GOING 38KTS)

# Types Of Maneuvering Board Problems

- INTERCEPT PROBLEMS
- AVOIDANCE PROBLEMS
- CLOSEST POINT OF APPROACH
- TRUE WIND

# Labeling MOBOARDS

- e – your ship (center of board)
- e-r - own ship course and speed
- r-m – relative motion line
- e-m – maneuvering ship course & speed
- M1 – first point of contact
- M2 - second point of contact
- MX – point of interception

# Labeling MOBOARDS Cont

- SRM – speed of relative movement
- e-tw – true wind direction & speed
- e-aw – apparent wind direction & speed
- r-aw – true wind speed
- CPA – closest point of approach
- RML – new relative motion line

# Closest Point Of Approach

- SOLVING FOR CPA
  - PLOT e-r VECTOR
  - PLOT M1
  - PLOT M2
  - CONNECT M1 – M2 & EXTEND RML TO OUTER RING
  - PARALLEL RML TO CENTER OF MOBOARD
  - DETERMINE BEARING & ADD 90 DEG. THIS IS CPA BEARING
  - USING DIVIDERS MEASURE DISTANCE TO INTERSECTION OF CPA AND RML; THIS IS THE RANGE TO CPA
  - MEASURE DISTANCE FROM M1 TO CPA
  - DETERMINE SRM
  - USING SRM & DISTANCE USE NOMOGRAM TO FIND TIME; THIS IS TIMETO CPA

# Sample CPA Problem

- YOUR SHIP IS TRAVELING ON A COURSE OF 270 AT A SPEED OF 15KTS. AT 1703 YOU SPOT A VESSEL BEARING 320 AT 27,000 YDS. AT 1718 THE VESSEL IS BEARING 310 AT 24,000 YDS. DETERMINE CPA BEARING RANGE AND TIME

- Work sample problem

# Intercept Problems

- **WAYS TO SOLVE FOR INTERCEPT**
- **GIVEN COURSE – WHEN GIVEN A COURSE TO INTERCEPT YOU ARE ASKED TO SOLVE FOR SPEED TO INTERCEPT**
- **GIVEN SPEED – WHEN GIVEN A SPEED FOR INTERCEPT YOU ARE ASKED TO DETERMINE THE COURSE TO INTERCEPT**
- **GIVEN TIME – WHEN GIVEN A TIME TO INTERCEPT YOU ARE ASKED TO DETERMINE COURSE AND SPEED**



# Intercept Cont.

- STEPS FOR SOLVING GIVEN COURSE
- PLOT e-r VECTOR
- PLOT M1 AND M2
- EXTEND RML TO OUTER RING
- PARALLEL RML TO “r”
- DETERMINE SRM
- USING DIVIDERS MEASURE SRM AND EXTEND FROM “r” LABEL “m”
- CONNECT e-m (THIS IS VESSELS COURSE & SPEED)
- PLOT MX
- CONNECT “e” TO MX; THIS IS THE NEW RML
- PARALLEL NEW RML TO “m”
- EXTEND GIVEN COURSE FROM “e”
- CONNECT WITH NEW RML LABEL “r1”; MEASURE WITH DIVIDERS
- USING DIVIDERS SPREAD DETERMINE SPEED ON SCALE

# Sample Intercept Problem

OWN SHIP IS ON COURSE OF 145 AT A SPEED OF 12KTS. AT 1345 CIC REPORTS A CONTACT BEARING 020 AT 16,000YDS. AT 1348 THE CONTACT BEARS 009 AT 14,500 YDS. OOD WANTS TO BEGIN INTERCEPT AT 1351 ON A COURSE OF 310. DETERMINE THE SPEED NEEDED FOR THE INTERCEPT.

- Work sample problem

# Intercept Cont.

- SOLVING FOR GIVEN SPEED
- STEPS 1-10 ARE THE SAME
- SET DIVIDERS AT GIVEN SPEED ON SPEED SCALE
- PLACE POINT IN CENTER OF MOBOARD
- DRAW A SPEED CIRCLE AROUND “e”
- WHERE SPEED CIRCLE AND NEW RML INTERCEPT IS “r1”
- CONNECT “e” TO “r1” EXTEND TO OUTER RING FOR COURSE

# Sample Intercept Problem

- OWN SHIP IS ON COURSE OF 235T AT SPD OF 10 KTS. AT 0204 YOU SPOT A CONTACT BEARING 318T AT 12,000YDS. AT 0210 THE CONTACT BEARS 335T AT 9,000YDS. OOD WANTS TO BEGIN INTERCEPT AT 0215 USING A SPEED OF 15KTS. WHAT COURSE IS NEEDED.

- Work sample problem

# Intercept Cont.

- SOLVING FOR GIVEN TIME
- STEPS 1-10 ARE THE SAME
- WITH DIVIDERS MEASURE FROM “e” TO MX & DETERMINE DISTANCE
- USING DISTANCE AND TIME RANGE FOR INTERCEPT DETERMINE NEW SRM
- USING DIVIDERS MEASURE SRM ON SPEED SCALE AND EXTEND FROM “m”
- LABEL AS “r1”
- CONNECT “e” TO “r1”
- DETERMINE COURSE AND SPEED FOR INTERCEPT

# Sample Intercept Problem

- OWN SHIP IS ON COURSE OF 201 AT A SPEED OF 18KTS. AT 1855 A VESSEL IS SPOTTED BEARING 145T AT 17,950 YDS. AT 1858 VESSEL IS BEARING 137T AT 20,000 YDS. OOD WANTS TO BEGIN INTERCEPT AT 1901 AND COMPLETE BY 1920. DETERMINE COURSE AND SPEED NECESSARY TO COMPLETE INTERCEPT.



- Work sample problem

# Avoidance Problems

- STEPS TO SOLVE FOR AVOIDANCE COURSE
  - PLOT e-r
  - PLOT M1
  - PLOT e-m
  - PARALLEL e-m TO M1 AND EXTEND TO OUTER RING
  - PLOT POSITION/COURSE TO START AVOIDANCE
  - DRAW RANGE RING AROUND “e”
  - EXTEND TANGENT FROM MX TO OUTSIDE OF RANGE RING
  - PARALLEL TANGENT TO “m” AND EXTEND TO OUTER RING
  - USING DETERMINED SPEED FIND AVOIDANCE COURSE

# Sample Avoidance Problem

- OWN VESSEL IS ON COURSE OF 330T AT 15KTS. AT 0915 A CONTACT IS SPOTTED BEARING 320T AT 15,000 YDS. CONTACT IS ON A COURSE OF 130T AT 18KTS. OOD WANTS TO ALTER COURSE WHEN CONTACT BEARS 14,000 YDS. ALTER COURSE TO AVOID BY 4,000 YDS. DETERMINE THE DESIRED COURSE.

- Work sample problem

# Sample Avoidance Problem 2

- OWN VESSEL IS ON COURSE 235T AT A SPEED OF 16KTS. AT 1700 A VESSEL IS SPOTTED BEARING 269T AT 10 NM. AT 1710 THE VESSEL IS BEARING 266T AT 14,000YD. OOD WISHES TO ALTER COURSE WHEN CONTACT BEARS 260T BY 4,000YD ASTERN.

- Work sample problem

# True Wind

- TRUE WIND – THE TRUE DIRECTION AND VELOCITY THE WIND IS BLOWING FROM
- RELATIVE WIND – THE TRUE DIRECTION THE WIND IS BLOWING RELATIVE TO THE SHIP'S HEAD
- APPARENT WIND – THE VELOCITY AND TRUE DIRECTION FROM WHICH THE RELATIVE WIND IS BLOWING

# True Wind Cont.

- FORMULA FOR DETERMINING APPARENT WIND
- $SH + RW = AW$
- FORMULA FOR DETERMINING RELATIVE WIND
- $SH + AW = RW$
- FORMULA FOR DETERMINING SHIP'S HEADING
- $AW - RW = SH$
  
- HINT: YOU WILL SEE THIS LATER!



# True Wind Cont.

- SOLVING FOR TRUE WIND
- USING PARALLEL RULE OR WEEMS, DRAW TW VECTOR IN DIRECTION OF TW FROM ONE END OF OUTER RING TO OPPOSITE END
- AT BASE OF OPPOSITE END OF OUTER RING DRAW A SHIP WITH BOW INTO THE WIND
- LABEL PORT AND STARBOARD ON EITHER SIDE
- MOVE TO PORT OR STARBOARD NUMBER OF DEGREES OOD ORDERS
- USING DIVIDERS MEASURE SPEED DESIRED ON SPEED SCALE
- MEASURE FROM CENTER OF MOBOARD TOWARD DEG DESIRED
- LABEL POINT DOT – 1

# True Wind Cont.

- USING DIVIDERS MEASURE SPEED OF TW ON SPEED SCALE
- PLACE POINT OF DIVIDERS ON DOT – 1 AND DRAW CIRCLE AROUND DOT – 1
- LABEL POINTS WHERE CIRCLE INTERSECTS WITH TW VECTOR DOT – 2; THERE WILL BE TWO POINTS
- THE UPPER DOT – 2 WILL BE THE LOW SPEED SOLUTION AND THE LOWER DOT – 2 WILL BE THE HIGH SPEED SOLUTION
- DRAW VECTOR FROM DOT –1 TO BOTH DOT – 2 PARALLEL VECTOR FROM EACH TO CENTER OF MOBOARD TO DETERMINE COURSE REQUIRED
- USING DIVIDERS MEASURE FROM CENTER OF MOBOARD TO EACH DOT – 2 TO DETERMINE SPEED REQUIRED

# Sample True Wind Problem

- TRUE WIND IS BLOWING FROM 280T AT 20 KTS. OOD WANTS A COURSE THAT WILL PRODUCE A WIND 40 DEG OF THE PORT BOW AT A SPEED OF 25KTS. DETERMINE BOTH SPEED SOLUTIONS REQUIRED.

- WORK SAMPLE PROBLEM

# Determining True Wind

- SOLVE FOR TW WHEN GIVEN RW AND SH ONLY
- MEASURE  $e - r$  USING APPROPRIATE SCALE
- DETERMINE AW USING APPROPRIATE FORMULA (AW WILL HAVE THE SAME SPEED AS RW)
- MEASURE  $e - aw$
- USING PARALLEL RULE CONNECT “r” VECTOR TO “aw” VECTOR AND PARALLEL TO CENTER OF MOBOARD
- THIS IS THE TRUE WIND VECTOR
- USING DIVIDERS MEASURE  $r - aw$  AND DETERMINE SPEED
- SOLVE AS FOR LOW AND HIGH SPEED SOLUTIONS AS YOU WOULD A TRUE WIND FORMULA

# Sample True Wind Problem 2

- OWN SHIP IS ON COURSE OF 220T AT A SPEED OF 12 KTS. THE RELATIVE WIND IS BLOWING 060R AT A SPEED OF 22 KTS. CAPTAIN DESIRES A COURSE PRODUCING THE TW 30 DEG OFF THE PORT BOW AT A SPEED OF 25 KTS. SOLVE FOR BOTH SOLUTIONS.

- Work sample problem #2