## Instructions for Installation of the Armored Vehicle Compass on Fleet Submarines

1. Install one compass in the Conning Tower on the centerline of forward bulkhead as indicated in Plate (A). The top of the mounting bracket should be approximately 13¼" from the overhead. Distance from centerline of compass to bulkhead should not be less than 10 inches. The navigator's shelf locker, usually placed above it, should be of brass, and so placed as to give the clearance indicated on Plate (C). The mounting bracket and any necessary supporting straps must be of brass. To hold the mounting bracket SMALL iron spuds may be spot welded to the forward bulkhead and tapped for the appropriate size brass screws.

2. Install one compass in the Control Room in the position indicated in Plate (B). Locate the compass approximately 5½ feet above the deck, and about thirty inches to left of the steering shaft. The mounting bracket and supporting straps should be of brass or non-magnetic corrosion-resisting steel.

3. Attach the instruments to the mounting brackets so the plane of the lubber's line and compass card pivot post is vertical and parallel to the keel of the vessel in its normal cruising position. Vibration mounts, with which each instrument is equipped, must fit the mounting brackets, in accordance with the dimensions shown in Plate (C). When the instrument is in place, with stop nuts completely tightened, the vibration cushions will then be under proper deflection.

4. Since the card is luminous, the light fixture need not be connected. Should the connection be made, a 12-volt D.C. input is required.

ENCLOSURE (A)



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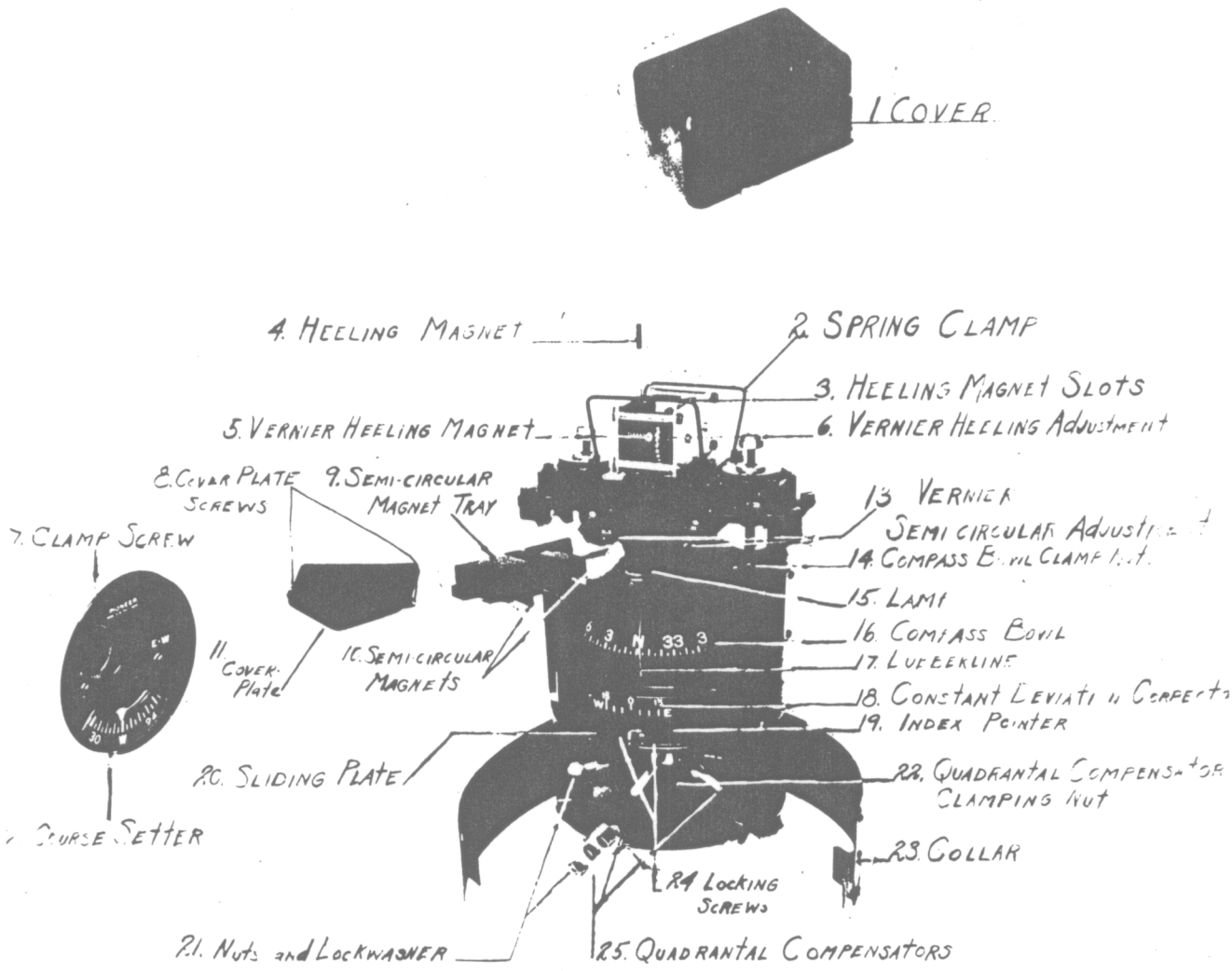


# PLATE A

# ARMORED VEHICLE COMPASS

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# AUXILIARIES
## Magnetic Compass

S65-11 12

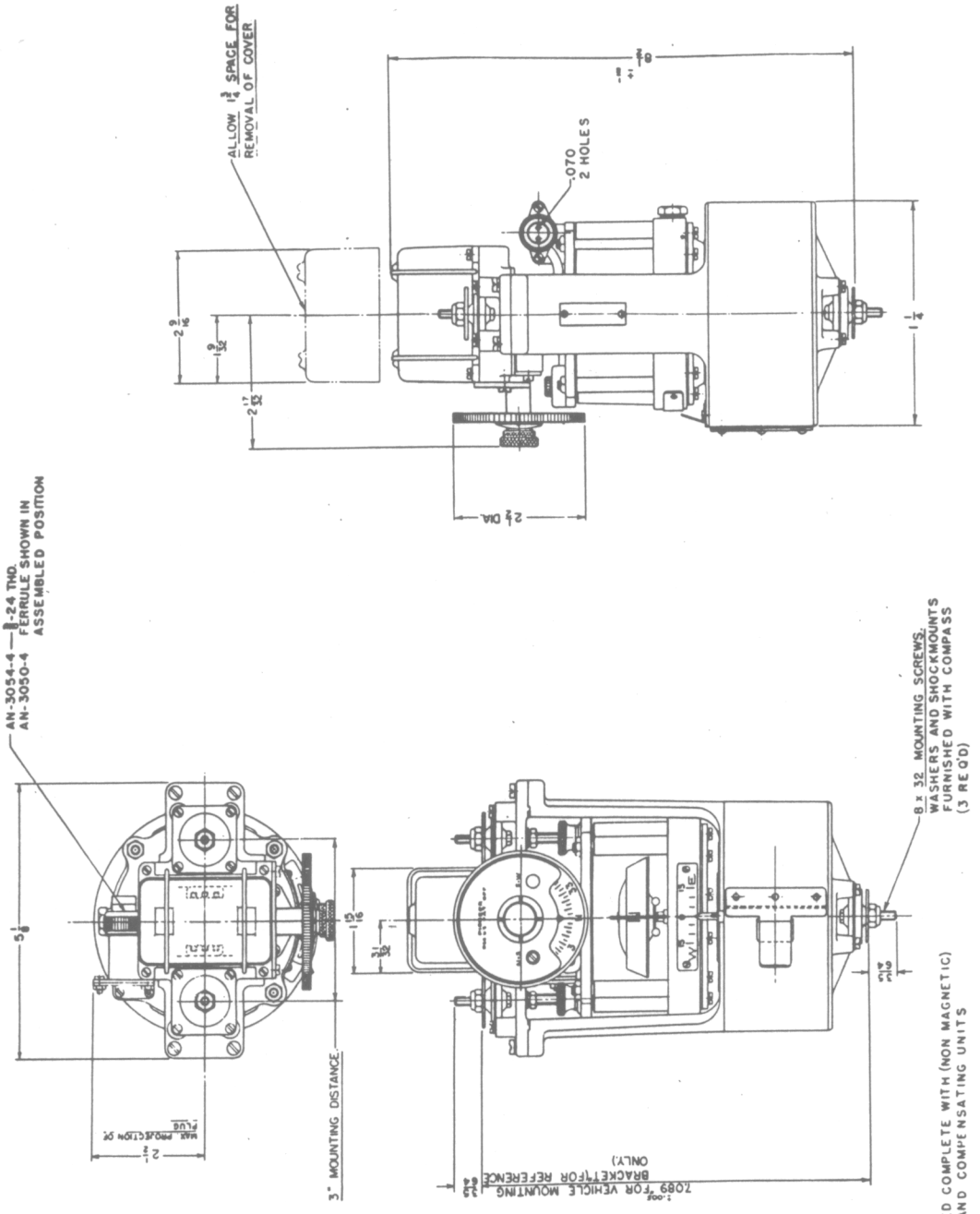


PLATE - C

THIS DRAWING IS APPLICABLE TO

# PIONEER VEHICLE COMPASS - TYPE 1829

NOTE - FURNISHED COMPLETE WITH (NON MAGNETIC) SCREW DRIVER AND COMPENSATING UNITS

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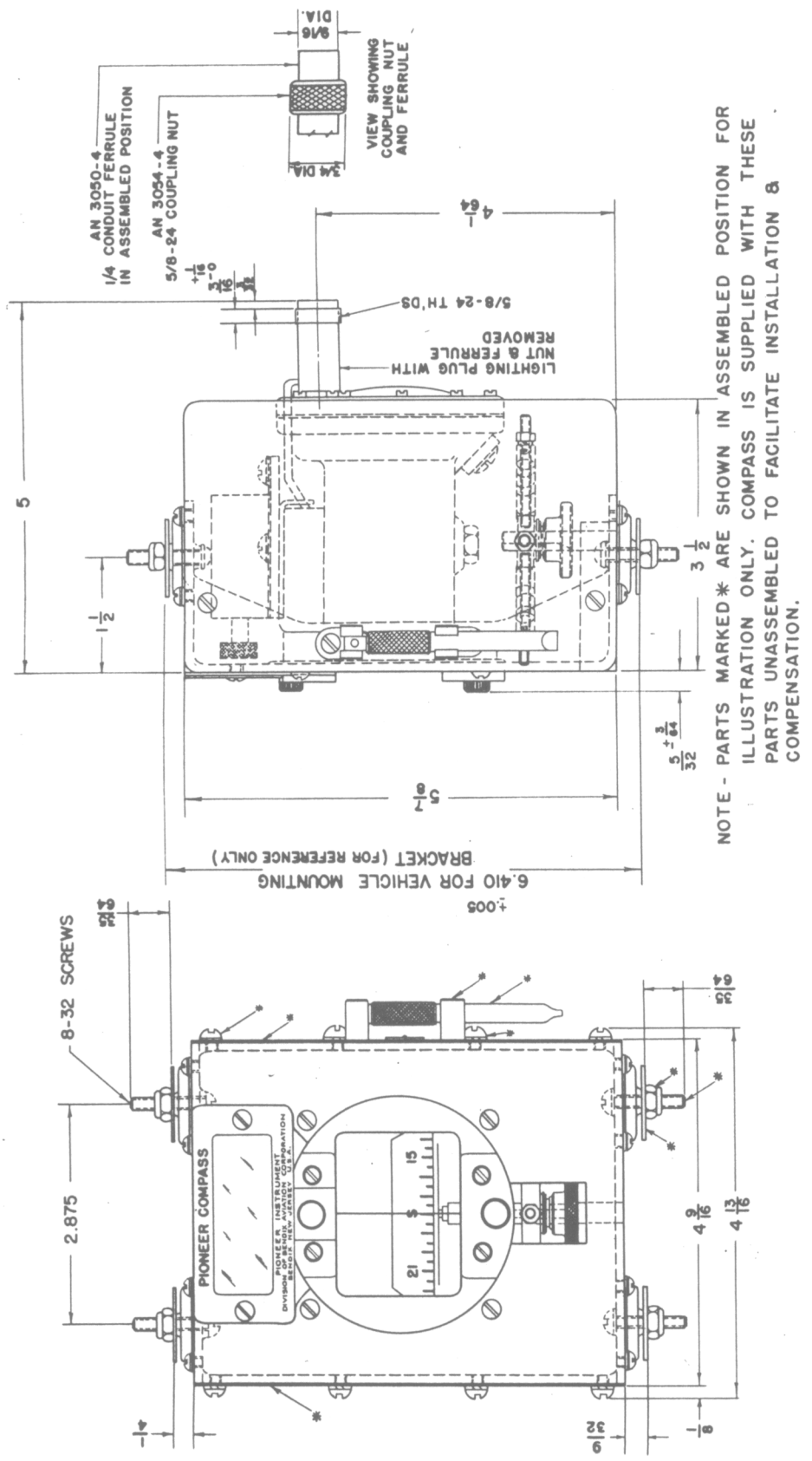


NOTE - PARTS MARKED * ARE SHOWN IN ASSEMBLED POSITION FOR ILLUSTRATION ONLY. COMPASS IS SUPPLIED WITH THESE PARTS UNASSEMBLED TO FACILITATE INSTALLATION & COMPENSATION.

PLATE - D
THIS DRAWING IS APPLICABLE TO

# PIONEER VEHICLE COMPASS-TYPE 1830

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Preliminary Copy

# Instructions For Compensation of The Armored Vehicle Compass in Submarines

## ORIGINAL COMPENSATION

I. Preparation for Compensation.

Step 1. Break out tools: (a) needlenose pliers (b) small steel screwdriver (c) brass screwdriver.

Step 2. With compass properly located, place gear in Normal Condition under which compass is most likely to be used.

(a) 20 mm gun stowed in usual stowage location.

(b) Operate (as in Cruising Condition above) diesel engines or battery at 1/3 speed or less, and auxiliary mechanical, electrical and radio equipment operated as for evasive conditions.

(c) Keep all control levers and mechanisms as nearly as possible in normal evasive position.

(d) Place Gyro-repeater (if mounted on a swivel) in a position which cannot be easily changed. (The nuts and screws are magnetic, the selsyn is not.)

Step 3. IMPORTANT ! ! ! (a) If equipped with degaussing gear, make sure it is secured in the proper manner. The proper way to secure is to reverse the current and again reverse, and so on, halving the amperage at each reversal. See Buord Manual.

(b) If vessel has been flashed: Allow a period of 10 days to two weeks to elapse (if possible) before compensating.

Step 4. Remove and neutralize compensators. (Refer to Plate (a))

(a) Take out the clamp screw (7) by turning it counter-clockwise Remove the course-setter (12).

(b) Take off the coverplate (11) by withdrawing the coverplate screws (8) with the steel screwdriver.

(c) Remove the semi-circular magnets (10) from the semi-circular magnet tray (9).

(d) Align the white dots on the semi-circular verniers (13) so that they are adjacent to and aligned with the corresponding white dots on the compass frame.

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(e) After removing the cover (1) by pressing the spring clamps (2) free of their slots, remove the heeling magnets (4) from their slots (3).

(f) Using brass screwdriver, rotate the gears of the vernier heeling magnets (6) until the two magnets are in the same straight horizontal line.

(g) Remove the collar (23) by unsnapping spring clip. With needle nose pliers remove nuts and lockwashers (21). Strip beads from spiders of quadrantal compensators (25).

(h) Loosen the two locking screws (24) with steel screwdriver. Move sliding plate (20) as necessary to align the white mark on the index pointer (19) with that on the compass frame, then tighten. Next loosen two compass bowl clamp nuts (14) and rotate compass bowl (16) so that index pointer (19) is precisely opposite 0 on the scale of the constant deviation corrector (18). Retighten clamp nuts to secure in this position.

Step 5. Tools, loose magnets and permalloy beads should be removed a distance of six feet. For easy access, place magnets and beads in a box. Each magnet should be stowed with red pole parallel to opposite pole of adjacent magnet. For compensation only the brass screwdriver should be used.

II. Compensation.

Step 6. Preliminary Heeling Adjustment.

(a) From experience, it has been found that four magnets inserted symetrically in the heeling magnet slots (Red up in North latitudes) will give an approximate heeling adjustment in the conning tower compass at New London, Connecticut and Newport, R.I. The final heeling adjustment may be made in the normal manner by using the vernier heeling adjustment only. Always use an even number of loose heeling magnets in correcting heeling errors.

(b) Placing heeling magnets in at the start will save one and a half swings of the vessel.

(c) If the heeling magnets are not placed in the beginning, the vessel should be headed North after Step 8 (c). Sufficient heeling magnets may then be added to steady the card. It will be necessary then to repeat Step 8.

(d) Heeling magnets are used to compensate for the strong vertical magnetic fields in the vessel. These may vary somewhat from vessel to vessel. A poor heeling compensation will result in an oscillating card when the ship rolls. The vernier may be used for trimming (on a North or a South heading) at periodic intervals.



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Step 7. Freeing the Card:

(a) Easterly deviations are plus, Westerly, minus. Obtain and record the deviation on each magnetic cardinal heading. It is probable the compass is magnetically locked; i.e. reads nearly the same on each heading.

(b) On the magnetic heading on which the next-to-the-smallest deviation appeared, place semi-circular magnets in the appropriate slots corresponding to the magnetic heading (either E-W or N-S, but not both) of the semi-circular magnet tray to reduce the deviation as much as possible. Adjust the proper semi-circular vernier (E-W if on East or West, N-S if on North or South) to make the deviation zero.

(c) Head the ship on magnetic heading which had the smallest deviation and repeat as in (b) but this time using semi-circular magnets and vernier for the other pair of cardinal headings.

(d) When the deviation is less than 20° the vernier adjustment alone can be used. The FEWER magnets than can be used in (b) and (c), the better will be the expected performance of the compass. The compass card will now be free.

Step 8. Semi-circular compensation.

(a) Record the deviations remaining after completing Step 7, (b) and (c).

(b) Swing (clockwise) to the next magnetic cardinal heading not corrected in Step 7. Using the vernier halve the deviation. Record the deviation remaining.

(c) Head vessel on next adjacent magnetic cardinal heading in clockwise direction and repeat 8 (b).

Step 9. Compensation for Induced Magnetic Effects on Intercardinal Headings. (Quadrantal "D" error)

(a) Obtain and record the deviation on magnetic NE, SE, SW and NW.

(b) Average the deviations obtained (reversing the sign of NE, SW).

(c) With vessel steadied on magnetic NW, remove the average deviation obtained in (b) above, by placing beads in a symmetrical pattern on the pair of spider legs running fore and aft or the pair running athwartships (but not on both pairs). If the average deviation obtained in (b) above was Westerly (minus) adding beads on the athwartship pair of legs will remove the error.

(d) If enough compensation is not obtainable with spider in this position, additional compensation may be obtained by raising it.

Step 10. Compensation for induced magnetic effects on cardinal heading. (Quadrantal "E" Error).

(a) Average the deviations remaining on the cardinal headings. (Be sure to reverse the sign of deviations remaining on East and West).

(b) With the vessel on the North magnetic course and the quadrantal compensator in the midpoint of its vertical travel, remove the average obtained in (a) above by placing permalloy beads on a pair of diagonal spider legs in the same straight line. Place the beads symmetrically on one of the diagonal pairs but not both pairs. If the average deviation obtained in 9 (a) was Easterly (plus) adding beads on the pair of legs running from left front to right rear will correct it.

(c) Step 10 should be OMMITTED if the average obtained in 10 (a) is less than 1°.

Step 11. Trimming of Compensation for Permanent Horizontal Magnetism.

(a) Obtain and record deviation on North and on East.

(b) Obtain deviation on South.

(c) Compute average of North-South deviations (reversing sign of North deviation).

(d) Remove the average obtained in (c) on South - using N-S vernier semi-circular adjustment.

(e) Obtain deviation on West.

(f) Compute average East-West deviation (reversing sign of deviation on East).

(g) On the West heading, remove the average deviation obtained in (f), using the E-W semi-circular vernier.

Step 12. Obtaining Residual Deviations.
FINAL ADJUSTMENT (for Constant Deviation).

(a) Swing ship to obtain and record the deviations remaining on each magnetic cardinal and intercardinal heading.

(b) Average the deviations obtained on the eight headings (do NOT reverse any signs).

(c) The average deviation obtained in 12 (b) may be removed by loosening the compass bowl clamp nuts and turning the compass bowl. Turn the compass bowl clockwise if average deviation

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was Easterly (plus), counter-clockwise if Westerly (minus). When the bowl has been turned the proper number of degrees, secure it by clamping knurled compass bowl nuts. Read number of degrees turned by using scale on constant deviation corrector and index pointer.

(d) The number of degrees removed in this manner will be removed alike on all headings.

(e) Align the index pointer opposite the new position of the zero on the constant deviation correction by loosening the locking screws and moving the sliding plate. Secure by tightening locking screws.

(f) If desired, variation may be set in when compensation is complete. This may be done by loosening the compass bowl clamp nuts and turning the compass bowl in the appropriate direction the proper number of degrees.

WARNING ! ! !
It must be remembered that this compass is intended as a standby in case of silent running, gyro-failure due to depth charge shock, or shipping of water, etc. The magnetic condition of the vessel is EXPECTED to change somewhat. Consequently the price of a fairly satisfactory compass in case of emergency is a continual check. It is recommended that the compass deviation be obtained on the cardinal headings and the compensation trimmed by using the semi-circular verniers at least twice a week. This should take not longer than 20 minutes. It may be done at night or submerged during the day if the original compensation conditions are reproduced.

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I. Preparation

Step 1. Break out tools.
(a) Brass screwdriver.

Step 2. Place gear in same position as for original compensation.

Step 3. If equipped with Degaussing equipment secure it in proper manner as for original compensation.

II. Semi-Weekly Compensation.

(a) Obtain and record the deviation on magnetic North and on magnetic East.

(b) Obtain the deviation on South. Compute the average North-South deviation (reversing the sign of the deviation obtained on North).

(c) With vessel on the magnetic South heading, remove the average obtained in (b), by using the N-S semi-circular vernier. Record the remaining deviation.

(d) Obtain deviation on West. Compute the average deviation (reversing the sign of the deviation obtained on East).

(e) With the vessel on magnetic West course, remove the average obtained in (d) by using the E-W semi-circular vernier. Record the remaining deviation.

(f) Obtain and record the deviations now appearing on the other two cardinal headings.

III. Compensation for Change in Induced Magnetism due to Large Change in Latitude.

(a) This compensation is only made when changing latitude considerably.

(b) On a magnetic inter-cardinal heading, raise or lower the quadrantal compensator until the deviation obtained in the original compensation appears.

(c) Repeat steps (a), (b), (c), (d), (e) and (f) of Semi-weekly compensation.

(d) Swing vessel for residual deviations and repeat (b) and (c) above if necessary.

IV. Change in Heeling Compensation.

(a) This compensation should be heeded only if vessel cruises from Northern to Southern latitudes or vice versa.

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(b) On a North or a South magnetic heading, turn vernier heeling adjustment until card is steadied. If this does not steady card, put vernier heeling magnets in same straight horizontal line and remove loose heeling magnets from heeling magnet slots. Again try vernier adjustment. If this is still insufficient, replace heeling magnets in heeling magnet slot with poles placed opposite to their former position. Then use vernier to add or subtract polarity, as needed.

(c) Changing the heeling compensation may be expected to change the semi-circular deviations slightly. Hence the semi-weekly compensation II above should be undertaken.

## OBTAINING MAGNETIC HEADING
by check against the gyro-repeater

Step 1. From the navigator, obtain and record:

(a) The gyro error. (plus if Easterly, minus if Westerly).

(b) The variation. (This will change with change of cruising position).

Step 2. Reverse the sign of the gyro error and add it (algebraically) to the variation.

Step 3. If the sum obtained in (2) above was Westerly (minus) adding it to the reading of the gyro-repeater will give the magnetic heading. If the sum obtained was Easterly (plus), subtracting it from the reading of the gyro-repeater gives the magnetic heading.

REMEMBER:

TRUE (gyro) Heading minus MAGNETIC Heading equals VARIATION (neglecting gyro error).

Example: (1) Gyro Error: 2 E; Variation: 14 W; Gyro Reading: 020
SOLUTION:

Gyro Error (reversed sign) plus Variation = Sum
2 W Plus 14 W Equals 16 W

| Gyro Reading | | | | Magnetic Heading |
|---|---|---|---|---|
| 020 | PLUS + | Sum 16 | Equals = | 036 |

Example: (2) Gyro Error: 2 W Variation: 6 E

Gyro Reading: 020



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SOLUTION:

Gyro Error 2 E (sign reversed) PLUS Variation 6 E = Sum 8 E

Gyro Reading 020 MINUS - Sum 8 = Magnetic Heading 012

Example: (3) Gyro Error: 1 W Variation: 6 W

Gyro Reading: 355

SOLUTION:

Gyro Error 1 E (sign reversed) plus + Variation 6 W = Sum 5 W

Gyro Reading 355 Plus + Variation 6 W = Magnetic Heading 361 or 001

## DETERMINING DEVIATION

Step 1. Obtain the magnetic heading (by check against gyro repeater).

Step 2. Obtain the compass reading.

Step 3. MAGNETIC HEADING minus COMPASS READING equals DEVIATION, provided:

(a) The value used for Magnetic North is 000° when the compass reads between 000° and 180°.

(b) The value used for Magnetic North is 360° when the compass reads between 180° and 360°.

(c) When the Magnitude of observed deviation (with sign ignored) exceeds 180°: True deviation and its sign are determined by subtracting from 360° the magnitude of the observed deviation (sign ignored). The resulting difference is then given the sign opposite to that possessed by the original deviation.

Example: (1)

Magnetic Heading, NORTH. Compass reads 10°.

SOLUTION: Magnetic Heading 000 minus - Compass Reading 010 = Deviation - 10 or 10 W

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Example: (2)

Magnetic Heading, NORTH. Compass Reads 315.

SOLUTION: Magnetic Heading 360° minus Compass Reading 315 = Deviation + 45 or 45 E

Example: (3)

Magnetic Heading SOUTH. Compass reads 175.

SOLUTION: Magnetic Heading 180° minus Compass Reading 175° = Deviation + 5 or 5 E

Example: (4)

Magnetic Heading WEST. Compass reads 295°.

SOLUTION: Magnetic Heading 270 minus Compass Reading 295 = Deviation - 25 or 25 W

Example: (5)

Magnetic Heading WEST. Compass Reading 082.

SOLUTION: Magnetic Heading 270 minus Compass Reading 082 = Observed NOT true deviation + 188 or 188 E

360 minus 188 (disregard sign of observed deviation) equal 172. Sign of 188° was plus, so sign of 172° is the opposite, namely, MINUS. TRUE deviation equals - 172 (or 172 W).

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