



Magnetic Reflector Compass Binnacle

REFLECTA/3

Operation - Installation

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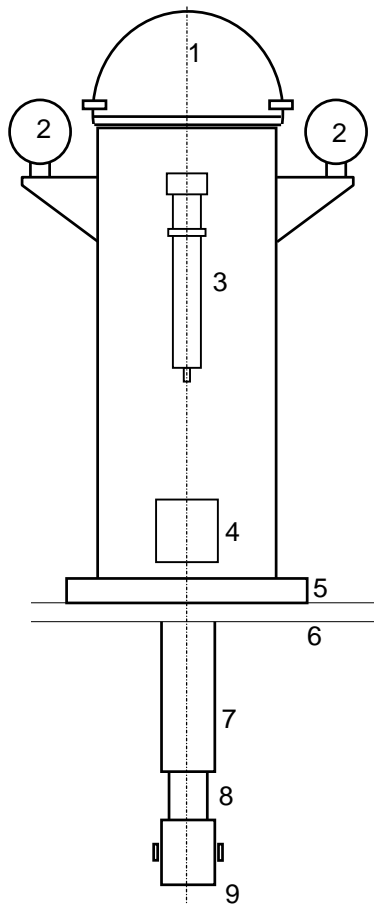
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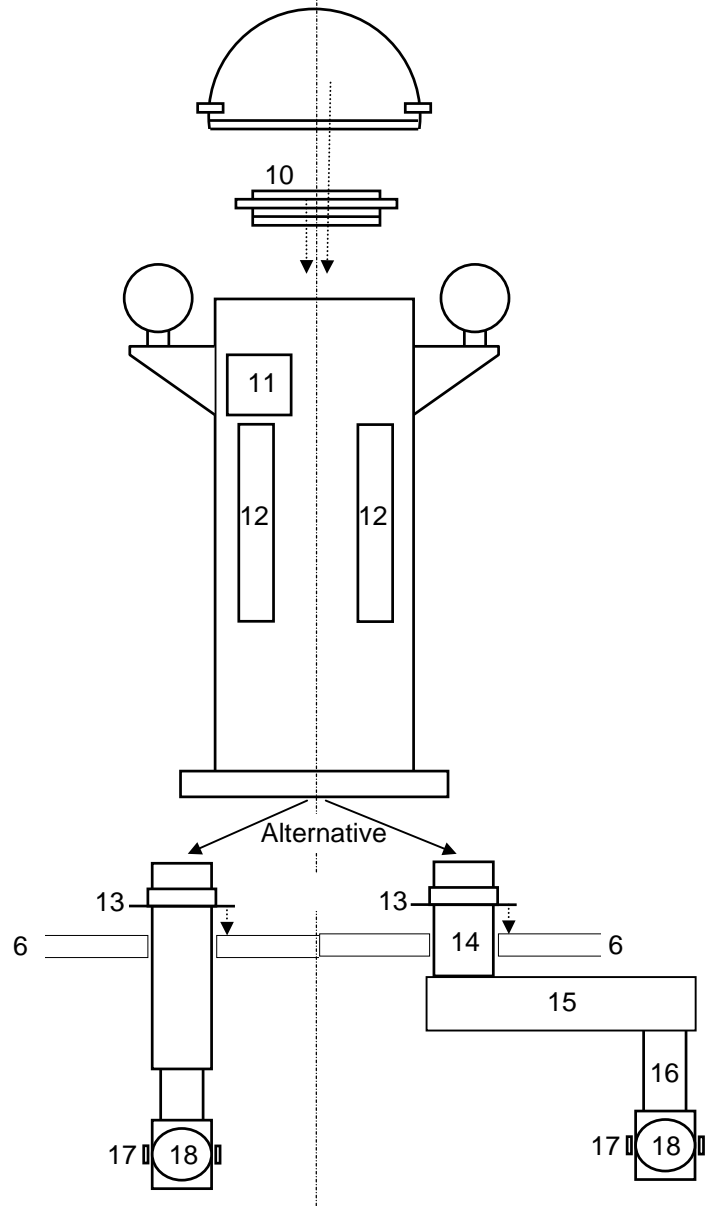
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Compass Binnacle, Outline

As to be seen from ahead



as to be seen from astern



- 1 Hood (turn and remove)
- 2 D-Sphere and brackets
- 3 Flinder's bar (Option)
- 4 Cover of optical lens (if required) and junction box of detector cable (Option)
- 5 Binnacle base
- 6 Compass bridge
- 7 Reflection tube
- 8 Extension tube
- 9 Mirror head with aperture

- 10 Compass
- 11 Cover of heeling magnets & illumination
- 12 Cover of B+C-correctors
- 13 Fixing flange of reflection tube resp. lead-in tube
- 14 Lead-in tube
- 15 Horizontal optical by-pass (Option), see extra manual
- 16 Mirror tube
- 17 Knurled knob for reflection mirror
- 18 Reflection mirror

Intended Purpose

Apart from the gyro compass seagoing ships have to be equipped with a second heading source, the magnetic compass. Furthermore the magnetic compass works more and more as back-up to drive the autopilot. Magnetic compasses have to be installed in a sufficient distance to any magnetic iron as well as to the different navigational instruments. Therefore the preferred location is the compass bridge. To read the heading at the helmsman's position inside the wheelhouse one makes use of a reflection arrangement. This is an optical arrangement consisting of magnification lenses and mirrors. According to SOLAS regulations the remote reading has to be independent of electrical means.

The magnetic compass is found within the compass binnacle. It is easy to remove and to replace with another one. Spare magnetic compasses are obligatory according to SOLAS.

A divided verge ring on top of the compass allows taking bearings of coastal or heavenly objects. A vane type azimuth device with a swivel black mirror is included in the range of delivery to allow compass and relative bearings.

In spite of the distance to any magnetic source a deflecting influence -the deviation- cannot be totally excluded. For correction of these residual errors the compass binnacle possesses an adjusting arrangement.

Installation of magnetic compasses and the requirements for their location are laid down in basic national and international regulations. These are IMO A.382(X) and SOLAS consolidated Edition, 1992, Chapter V, regulation 12. The technical and design requirements for magnetic compasses are laid down in ISO 25862:2009(E) as well as in the relevant national documents. REFLECTA fulfills all these regulations.

Technical Data

Compass Binnacle

Card height	standard column 1100 mm, as option 920 mm up to 1700 mm
Total height.....	1280 mm in case of standard column
Maximum width measured over D-spheres.....	880 mm
Weight of binnacle and compass complete.....	net 75 kg in case of standard column
Material of binnacle column.....	seawater resistant light alloy
Built-in correctors.....	B+C, K, D
Correctors as option	E
Correctors as option	Flinder's bar

Reflector/bearing compass type 21

Diameter of directional system	160 mm
Orientations of card printing from below for reflection reading	N below N
Card division	1/1°
Magnet.....	Ring
Magnetic moment.....	typically 2 Am ²
Damping factor	typically 3.3
Working temperature range.....	-30°C +65°C
Swirl error according to ISO 25862:2009(E), 2010/68/EC,2011/75/EC	< 2,0°(at 18µT)
Friction error according ISO 25862:2009(E), 2010/68/EC,2011/75/EC	< 0.5°(at 6µT)
Directional error according ISO 25862:2009(E), 2010/68/EC,2011/75/EC.....	< 0.5°(at 18µT)
Half period	13 sec
Tilt freedom of card in compass bowl.....	+/- 10°
Rolling/pitching tolerance of compass in gimbal suspension.....	+/- 180°
Weight.....	10 kg

Reflection arrangement

Type CUTUBE	length 1200 mm to be cut by yard
Type FIXTUBE.....	ready adjusted in length at delivery
Diameter of tube	140 mm
Material.....	PVC
Extension length of mirror head.....	150 mm
Turning range of mirror head.....	360°
Swivel range of reflection mirror, black and white	360°

Range of delivery

Compass Binnacle

- Reflector compass binnacle with mounting pieces, hood without window (as option also window with/without oil lamp), magnetic bearing/reflector compass Type 21, azimuth device in wooden box with one shadow pin.

Correctors

- B+C-correctors, consisting of six bar magnets 100 mm long x 10 mm \varnothing (at delivery inserted in magnet magazine behind B+C-corrector).
- Heeling-corrector, consisting of one each heeling magnet of 50 mm and 125 mm length, 25 mm \varnothing , within magnet tube with numbered chain (at delivery inserted in heeling magnet guiding tube inside binnacle column).
- D-correctors (as standard) consisting of two weak iron spheres of 180 mm \varnothing (at delivery separately packed). One each bracket moved intercardinal of port and starboard to fix the D-spheres upon
- Flinder's bar (as option), consisting of Flinder's bar tube with upper and lower bracket (already fixed to the binnacle) as well as cover, one set of wooden spacer pieces (inserted in Flinder's bar tube), one set of weak iron cylinders (one piece of 305, 152, 76 and 38 mm long), packed separately.
- E-corrector (as option), consisting two weak iron spheres of 180 mm \varnothing (at delivery separate packed). One each bracket port and starboard to fix the E-spheres.

Reflection tube

- Reflection tube with mirror head (extendable mirror head only if no horizontal by-pass) and mounting flange, rubber gasket and facing ring.

Accessories as option

Instruction are included separately as required.

Approvals

REFLECTA/3 is type approved by all leading maritime authorities as A-class compass for worldwide use.

The most important approvals are:

MED - European Community, GL – Germanischer Lloyd, USCG – US Coast Gard.

Certificates of Lloyds Register of Shipping LRS, Amercian Bureau of Shipping ABS can be supplied on request.

REFLECTA/3 fullfills the international specifications: ISO 25862:2009(E) und IMO A.382(X), amendment: 2010/68/EC,2011/75/EC SOLAS (1992, Chapter V, Regulation 12) as well as IMO High Speed Craft-Code.

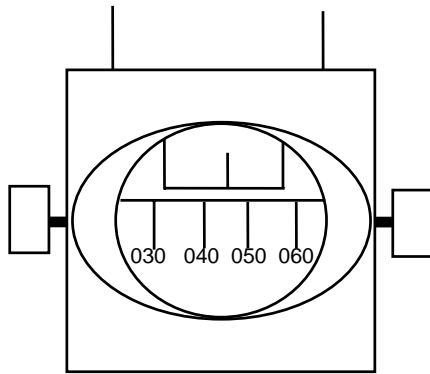
The required approval has to be stated with order because there are technical differences.

Operation

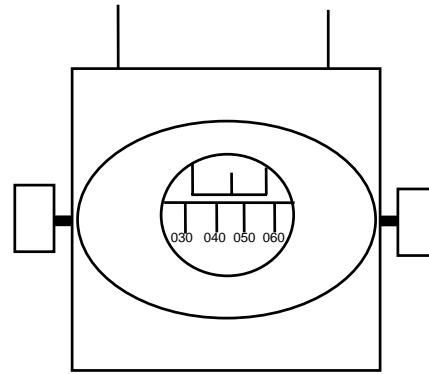
How to Read the Heading

It should be possible to read the heading clearly from a distance of 1,4 m from the mirror head in the wheelhouse at the helmsman's position. The image has to be centric to the field of view. The figures are upright and on both sides of the lubber mark an area of minimum 15° should be visible.

Use an illumination dimmer (as option) for brightness control to be operated from the helmsman's position. In case of long optical ways (long by-passes) the picture may be much smaller than the reflection mirror.



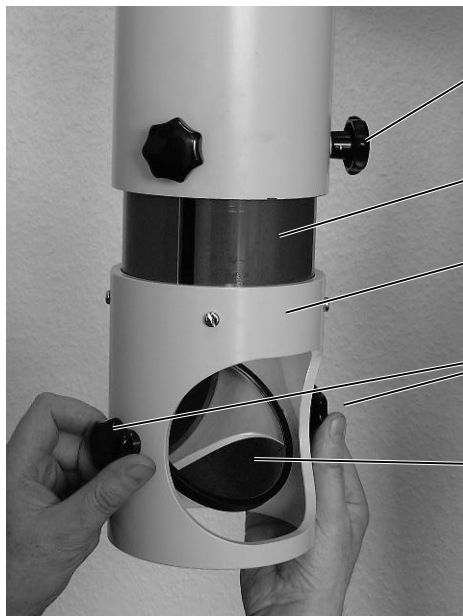
Short optical way: large picture



Long optical way: small picture

Adjustment of Mirror Head

Best position of the mirror head is 10 cm above eye level of the helmsman. For adjustment the reflection tube can be extended or shortened. To do this loosen the arrest knobs left/right of the reflection tube. Now take the rotary knobs as illustrated below with both hands and lift or lower the mirror head.



Arrest Knob to fix the extension tube

Extension tube

Mirror head

Take the rotary knobs here by hand to turn and swivel reflection mirror

Reflection mirror.
White mirror for daylight use,
black mirror for night use.

Maintenance: Clean reflection mirrors with a weak, not scratching cloth. The axles of the rotary knob have to be oiled from time to time.

Direct Reading of Heading on the Compass Bridge

Remove the hood. Read the heading at the ahead lubber mark of the compass.

The second, aft orientated, lubber mark is for officer's inspection. Add 180° correction to get the ship's heading.

Removing/Attaching of Binnacle Hood



Take hood with both hands

Loosen two knurled knobs

Turn hood and lift

When closing the binnacle secure carefully the hood by fixing the knurled knob!

Maintenance: Guiding surface of hood should be lubricated from time to time.

Taking Bearings

A vane type azimuth device is included in the standard range of delivery and will be found in a wooden box.

Also included is a shadow pin.

Remove the binnacle hood to set up the azimuth device onto the centre pivot of the upper compass cover glass.

Open object (wire) sight vane and ocular (slit) sight vane. Use the circular peep in the ocular (slit) sight vane for a rough pick-up of the bearing mark. For accurate bearing use the slit of the ocular sight-vane.

Compass bearing (azimuth) of land marks up to 30° of elevation:

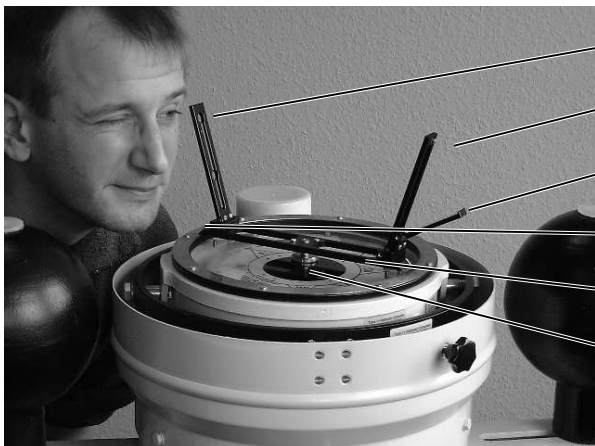
Read the compass card as illustrated below.

Relative bearing of land marks up to 30° of elevation:

Read the divided verge ring at the index of the ocular sight-vane. The scale ring is marked all-round. If semi-circular bearings are required subtract 360° from the all-round value for objects port side of the vessel. The starboard bearings remain unchanged.

Sun or star azimuth by azimuth mirror:

The black mirror at the object sight-vane can be hinged up and down according to the star height. The darkness is suitable to allow sun observations (before make sure that sun will not dazzle!). Read the bearing as required at the divided verge ring of the compass or at the compass card. Make sure that the compass is horizontal balanced. It is not recommended to take bearings of astronomical objects higher than 45° because each accidental inclination of the compass will distort the measurement.



Slit sight (ocular side)

Wire sight (object side)

Foldable black mirror
for sun azimuth

Reading of relative bearings

Reading of compass bearings

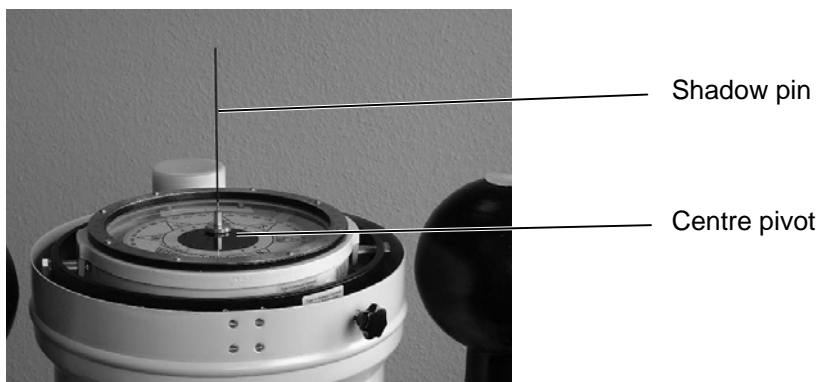
Centre pivot for guiding the azimuth device

While taking bearings make sure that the compass is horizontally levelled!

Maintenance: The turning joints of both sight-vanes and of the black mirror as well as the centre hole should be oiled from time to time. Clean and tighten the wire of the wire sight-vane. The azimuth device should be easy to rotate on the centre pivot and should not clatter when turned.

Shadow Pin

A shadow pin is stowed in the wooden box of the azimuth device. This can be inserted into the drilling of the centre pivot. Now the sun's shade can easily be recognized on the white compass card. The shadow direction makes it possible to calculate the compass deviation and to adjust the compass.

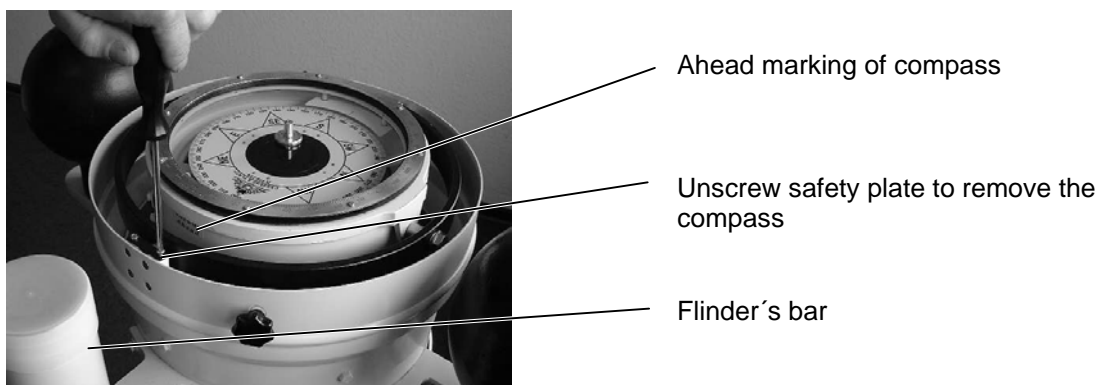


Removing the Compass out of the Binnacle

After removing the hood the compass and its suspensions fore and aft will be visible. These are covered by safety plates to fix the compass in its position. Loosen the screws of the safety plates and remove the compass. If a detector is fitted watch the cables! Unfit the detector cables either by removing the connector or by unscrewing the wires in a junction box. The junction box is found in the upper part of the binnacle column, behind the lower cover of the binnacle (see drawing: Compass Binnacle, Outline) or inside the wheelhouse at the place where the detector cable comes in.

When reinstalling the compass make sure that the detector cable does not obscure the reflection channel. Furthermore the cable should not be in direct neighbourhood to the illumination bulbs because the heat may destroy the insulation.

The compass is marked by an ahead label. The zero marking of the divided verge ring shows to aft.



Spare Compass

Store spare compass upside down to reduce friction of the pivot.

Maintenance of Compass and Compass Binnacle

Refer to chapter "Maintenance, Errors, Repair"

Adjustment of Compass

General

Compass adjustment is necessary to neutralize the deflecting magnetic fields caused by the ship's steel hull or superstructure.

The first adjustment has to be made on maiden voyage. Later, it should be repeated periodically according to the requirements of the maritime authority (for ships flying the German flag: two years). Furthermore it should be carried out additionally on particular circumstances like reconstruction works, lightning stroke, grounding It is necessary to call a qualified compass adjuster for adjustment works.

Before adjustment the vessel must be ready for sea: cargo derricks, hatchway covers, davits.....are to be positioned as on voyage.

Further details will be found in "Handbook of Compass Adjustment", Pub. 226 of U.S. Department of Defense, Defense Mapping Agency.

A-Correction

This is to correct the alignment error of the compass binnacle: Compass ahead and ships ahead have to be corresponding. For correction loosen the binnacle fixing bolts in the base. Oblong holes in the base allow to turn the binnacle column by $\pm 5^\circ$ around its vertical axis. Attach the azimuth device and take a bearing of a midship object like masts (provided the compass binnacle itself is located midships) and turn the binnacle so that the index mark of the azimuth device shows "000" at the divided verge ring on top of the compass.

B+C-Correction

At delivery 6 B+C magnets (10 mm \varnothing x 200 mm) are to be found in their magazines behind the relevant covers. See chapter "Compass Binnacle, Outline".

These are to correct the errors caused by the ship's permanent longitudinal and cross magnetism. The B-corrector compensates the longitudinal and the C-corrector the athwardship field. The following picture is to identify the magnets. B-magnets are longitudinal and C-magnets are transversal orientated. Correction of $\pm 40^\circ$ deviation is possible to meet the regulations. Choose quantity, orientation and position of magnets as required. There are 2x10 holes to put in the B-magnets (10 each on port and starboard) and 1x10 holes to put in the C-magnets. This enables sufficient fine adjustment. Start inserting magnets from the lowest position. The holes are numbered to note the magnet positions required in the compass diary.



Closed B+C cover, port

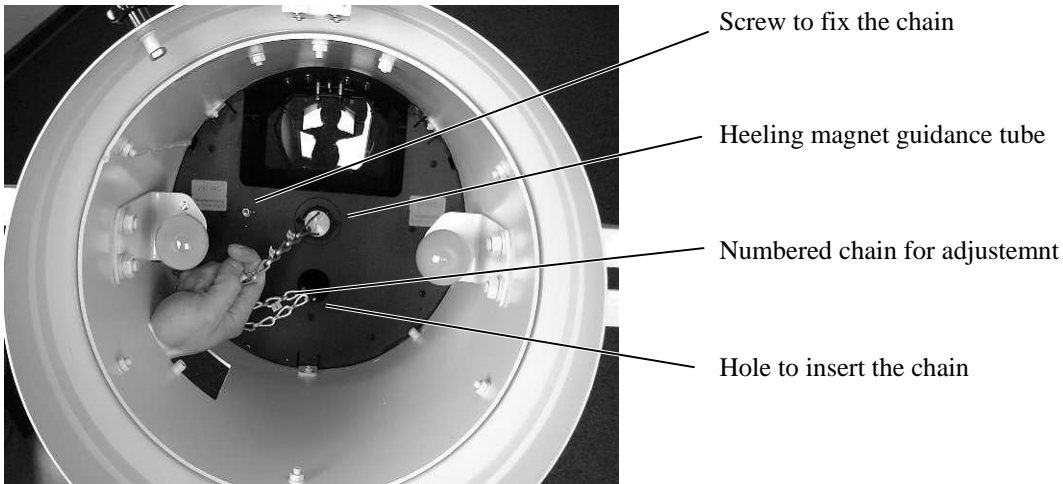
uncovered B+C magazines, starboard

B-Magnets, longitudinal orientated

C-Magnets, cross ship orientated

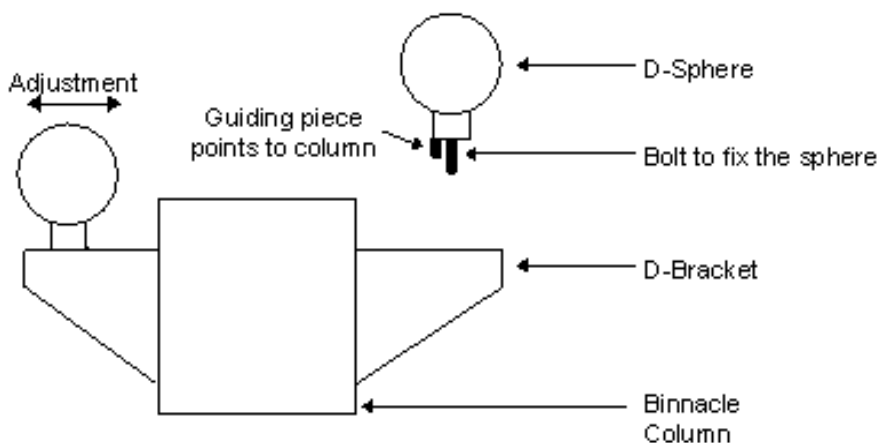
Heeling Correction

At delivery the heeling magnet is to be found within the heeling guidance tube. The heeling corrector is to neutralize the ship's permanent vertical field. Remove the compass from the binnacle and inside the chain to lift up and lower the heeling magnet will be visible (See the following picture). Pull out the chain to get the brass tube containing the magnets. To open the tube unscrew the cover. There are two magnets (25 mm and 125 mm length, both 25 mm Ø). For adjustment you may use one or both magnets and combine as required. After adjustment the chain should be fixed by screw at its final position. If the compass is at its position within the binnacle one can reach the heeling corrector chain by removing the relevant cover. See chapter "Compass Binnacle, Outline".



D-Correction

At delivery the D-brackets are mounted at the binnacle column and the D-spheres are packed separately. D-adjustment is necessary for correction of the ship's symmetrical weak iron influence. For attaching there are bolts and washers. The guiding piece of the sphere runs in the slit of the bracket and secures the sphere against rotating. The guiding piece is orientated towards the binnacle column. There are index marks at the spheres and scales at the D-bracket to note the position in the deviation diary. For D-correction the sphere has to be approached or drawn away from the binnacle column.



E-Correctors (Extra)

If ordered there are a two intercardinal brackets for E-spheres visible at the binnacle column, same as the D-spheres/.brackets but moved by 45°, so in total 4. The E-spheres are same as D-spheres and separate packed.

E-correctors are recommended in case the binnacle column is not located in the centre line of the vessel but moved to port or starboard, so causing unsymmetrical magnetic environment to the compass. The relevant errors only can be removed by these E-correctors.

A discription how to carry out E-correction will be attached to the delivery of the material.

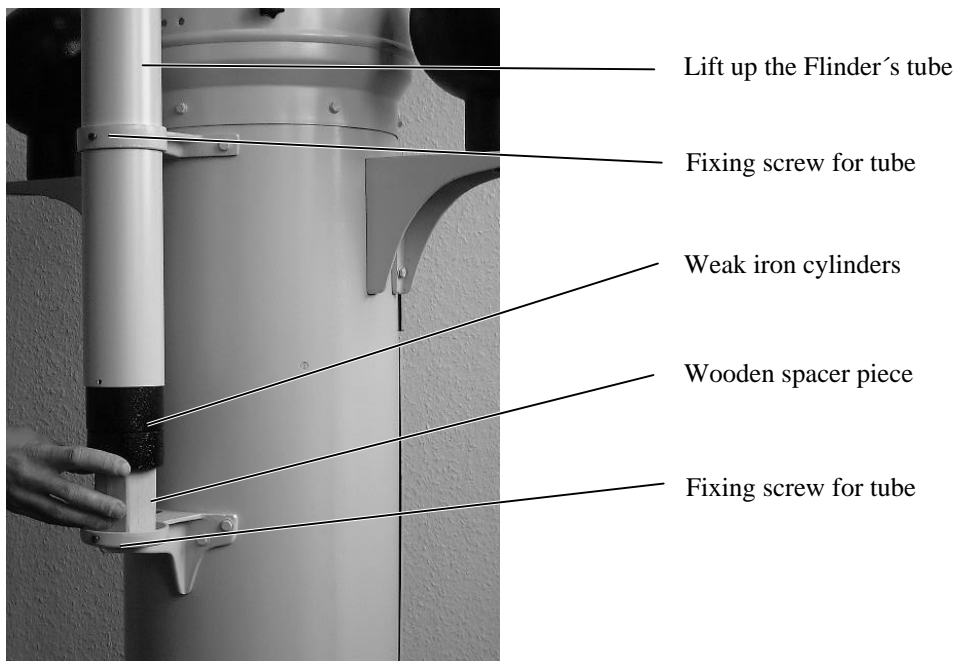


Flinder's bar (Extra)

If ordered four cylinders (305 mm, 152 mm, 76 mm, 38 mm length, all 78 mm \varnothing) are separate included to delivery. The Flinder's tube is fixed to the binnacle column and in it there are four wooden spacers (280 mm, 140 mm, 70 mm, 35 mm).

The Flinder's bar is used to correct the longitudinal field (B_2) caused by the ship's weak iron. The first adjustment of Flinder's bar on maiden voyage remains preliminary because the latitude influence cannot be established at that time. When passing the equator at first sufficient deviation data has to be collected to allow the final adjustment. On locally operating vessels like harbour tugs or in coastal fishery a Flinder's bar is not necessary.

Open the Flinder's tube by removing the upper plastic cover. For adjustment lift up tube to allow access to the weak iron cores and the wooden spacer pieces. Loosen the tube by unscrewing the fixing screws at the upper and lower Flinder's bracket. Refer to the illustration below.



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Maintenance

Ensure proper operation of the magnetic compass whenever possible to guarantee safe navigation!

Lubrication of Compass Suspensions

This has to be done from time to time to grant free movement of compass bowl.

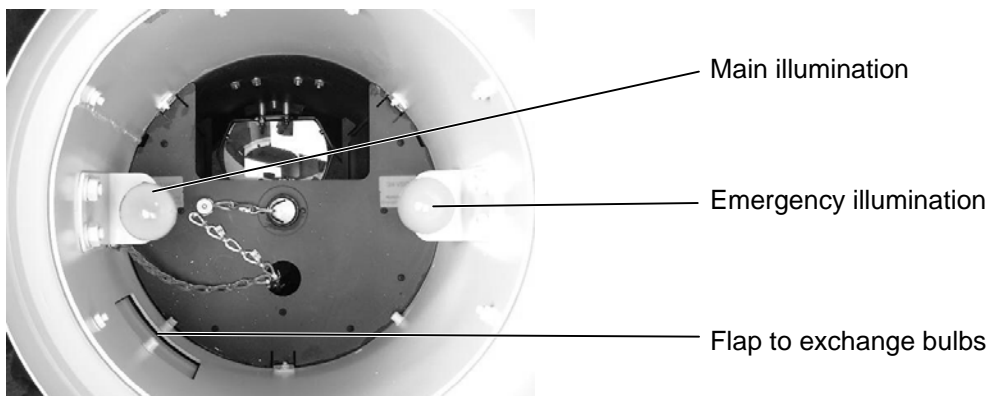
Compass Routine Service

A faulty compass function is difficult to detect by onboard means. Therefore a routine service is recommended. Often certain service intervals are laid down in the national regulations. According to German BSH regulations an inspection of the compass is necessary every two years. The correct function will be certified by the BSH authorized compass work shop by the official BSH test label stuck on the compass bowl. A certificate will be issued alternately. If the compass service was carried out by a foreign and not BSH authorized work shop (because the vessel has not called a German port) the certificate issued can be sent to the BSH for acceptance. A preliminary functional test with onboard means is described below in chapter "Friction Error and Swirl Error Test". This should be carried out from time to time. A positive result is not to be understood as guarantee for a reliable operation but in case of a negative result the compass should be immediately replaced with the spare compass and sent to a qualified compass workshop.

Replacing Bulbs

Use glow lamps of type E14, 40VA (60 VA) with 14 mm screw socket only.

The illumination arrangement is to be found in the upper part of the binnacle column and will be accessible after removing of hood and compass.



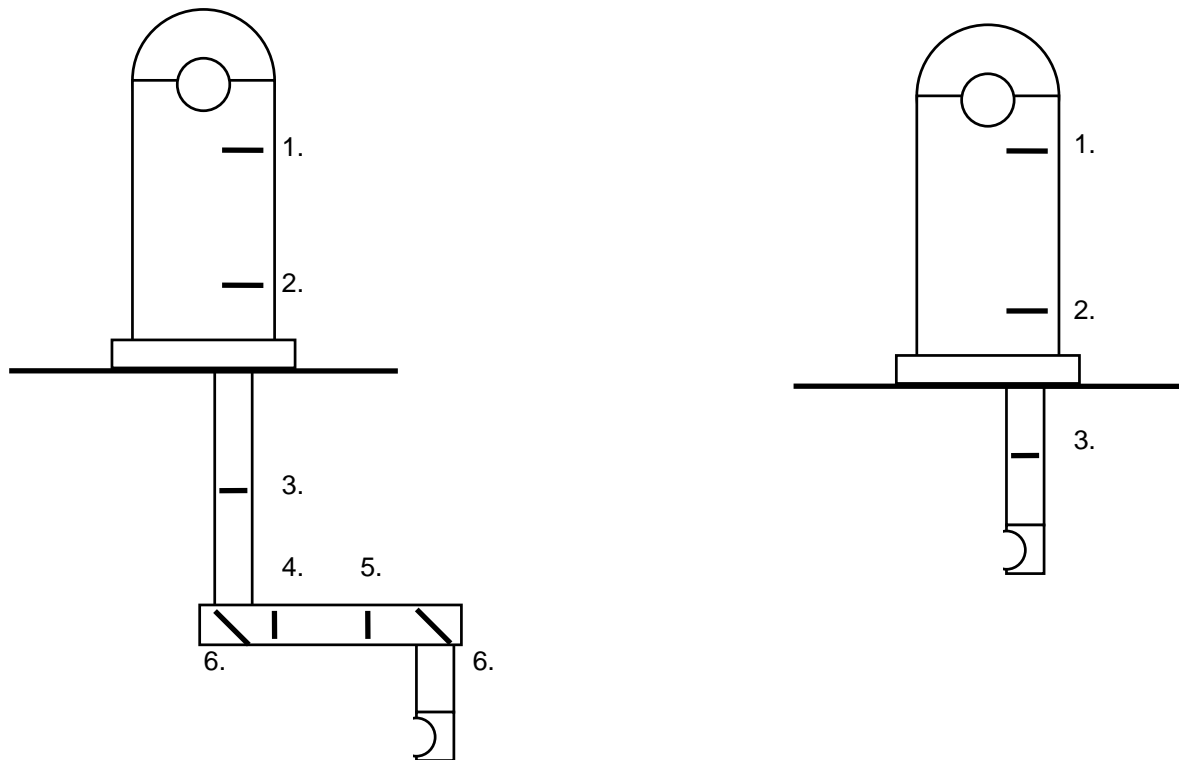
Cleaning of Reflection Optics

Use only a soft and non scatching cloth.

Not in every case all below mentioned positions are equipped with lenses.

Details for cleaning of lenses and mirrors inside the horizontal by-pass channel can be found in the relevant instructions attached separately.

Possible Lens Positions



1. Upper part of the binnacle colum. Accessible by removing of compass.
2. Bottom side of the binnacle colum. Accessible by removing the relevant cover, ref. to chapter „Compass Binnacle, Outline“.
3. Inside Lead-in tube (right) or mirror tube (left). If lead-in tube or reflection tube are outside the wheelhouse they have to be protected by an additional channel. This channel should have a removable flap at the position of the lens to allow access to the lens.
4. Inside horizontal by-pass channel. If the by-pass channnel is above the ceiling there must be a removable flap in the ceiling to allow access to the lens.
5. Same as 4.
6. By-pass mirrors. Refer to special instructions of by-pass.

Errors, Diagnosis and Help

Visible Compass Errors

- Bubbles in the fluid, broken cover glass, buckled compass bowl, tilted compass bowl, loose in suspension, dirty or cloudy fluid or similar.
⇒ Take compass out of operation immediately (replace with spare compass) and hand over to a qualified service workshop as soon as possible.
- Directional system tilted
Possible reason:
A slight sinking of the north mark on north latitudes and of the south mark on south latitudes is normal and results from the variation of the vertical earth field on different magnetic latitudes.
Remove the compass from its position within the binnacle and take it to a magnetically undisturbed location for example ashore. If the tilt remains the reason is the earth's vertical field and not the ship's vertical field.
This tilt does not exceed about 5°.
⇒ No further action is necessary.

Possible other reason:
The ship's vertical field or the heeling corrector is unadjusted.
Remove the compass from its position within the binnacle and take it to a magnetically undisturbed location for example ashore. If the tilt disappears the reason is the ship's vertical field and not the earth's vertical field.
⇒ Carry out heeling adjustment.

Possible other reason:
A strong card tilt often in combination with bubbles in the fluid, with the upper or lower points not near to the north or south mark may be caused by a leaking float. Sometimes the upper or lower points are moving with time.
⇒ Take compass out of operation immediately (replace with spare compass) and hand over to a qualified service workshop as soon as possible.

Indication Errors

- Static Indication Errors:
Indication errors can be discovered by comparison of magnetic compass and gyro compass indication. These indication errors may be caused by a faulty compass (non visible errors) or by a faulty adjustment.
⇒ If friction and swirl error test (below) are not successful, the reason might be a defective compass. Take compass out of operation immediately (replace with spare compass) and hand over to a qualified service workshop as soon as possible.
If friction and swirl error tests are successful the compass seems to be in order. Carry out compass adjustment.
- Dynamic Indication Errors
Indication oscillates correlated with rolling of the vessel. If the oscillation is strongest on north or south headings and smallest on east or west headings this is most probably caused by unadjusted ship's vertical field.
⇒ Arrange heeling adjustment.
- Unstable indication, seemingly arbitrary oscillation of the indication
Possible reason:
Strong vibration of the compass which results in a rise and spin of the directional system.
⇒ Fix compass binnacle more strongly. Install lashings for the compass binnacle (supply Cassens & Plath).

Possible other reason:
Pivot/jewel suspension of the directional system is defective.
⇒ If friction and swirl error tests (below) are not successful take compass out of operation immediately (replace with spare compass) and hand over to a qualified service workshop as soon as possible.

Possible other reason:

The orientating earth's horizontal field at the place of the magnetic compass is too weak. This may be caused by wrong adjustment or an insufficient compass safe distance to magnetic iron or instruments. Furthermore the position of the adjusting magnets perhaps has been changed accidentally or the ship's own magnetic field has been altered by grounding, lightning stroke or welding works.

⇒ Make sure that the correction magnets are at the position as mentioned in the deviation diary.

Repeat compass adjustment and check the safe distances of the compass.

Friction Error and Swirl Error Test

The following simple examinations for onboard use will only give a provisional result for reliable compass operation. A definite proof of faultless function can only be granted by a qualified service workshop.

1. Place the compass on a horizontal baseplate as free as possible of deflecting magnetic fields and free of vibrations. This may be a place on board of the ship, e.g. the chart desk. Better is a place on shore where only the earth's magnetic field is effective. If the compass test should be carried out on board the ship should not be moving. Mark the place of the compass to make sure the same magnetic and other conditions in any direction for the following tests. Note the heading indication.
2. Let the directional system stabilize on a certain direction. Knock slightly with your fingertip onto the cover glass. Now use a piece of light magnetic material (e.g. a key) to deflect the compass card by 2° only. Wait until the card has stabilized in this new orientation.
3. Now quickly pull away the deflecting magnet. Watch how the card returns to the undeflected direction. A tolerance of less 0.5° is acceptable after stabilizing.
4. Deflect the compass card as mentioned above to the opposite direction by 2° and repeat the settling process. Again, the compass card must return to the original direction within a tolerance of 0.5°.
5. Repeat these tests each 45° of compass orientation.
6. If the compass card returns to the respective original orientation within the tolerance of +/-0.5° on each of these 8 directions, pivot and jewel suspension of the card assembly are, so far, in order.
7. Take the compass with both hands and hold it horizontally in front of you. Turn yourself (ideally one turn of 360° within 4') and watch the movement of the directional system. The card should show to north the whole turn and its movement should be steady without jerking. If the directional system is abruptly dragged with the movement of the compass it is defective.

If friction and swirl error test are not successful take compass out of operation immediately (replace with spare compass) and hand over to a qualified service workshop as soon as possible.

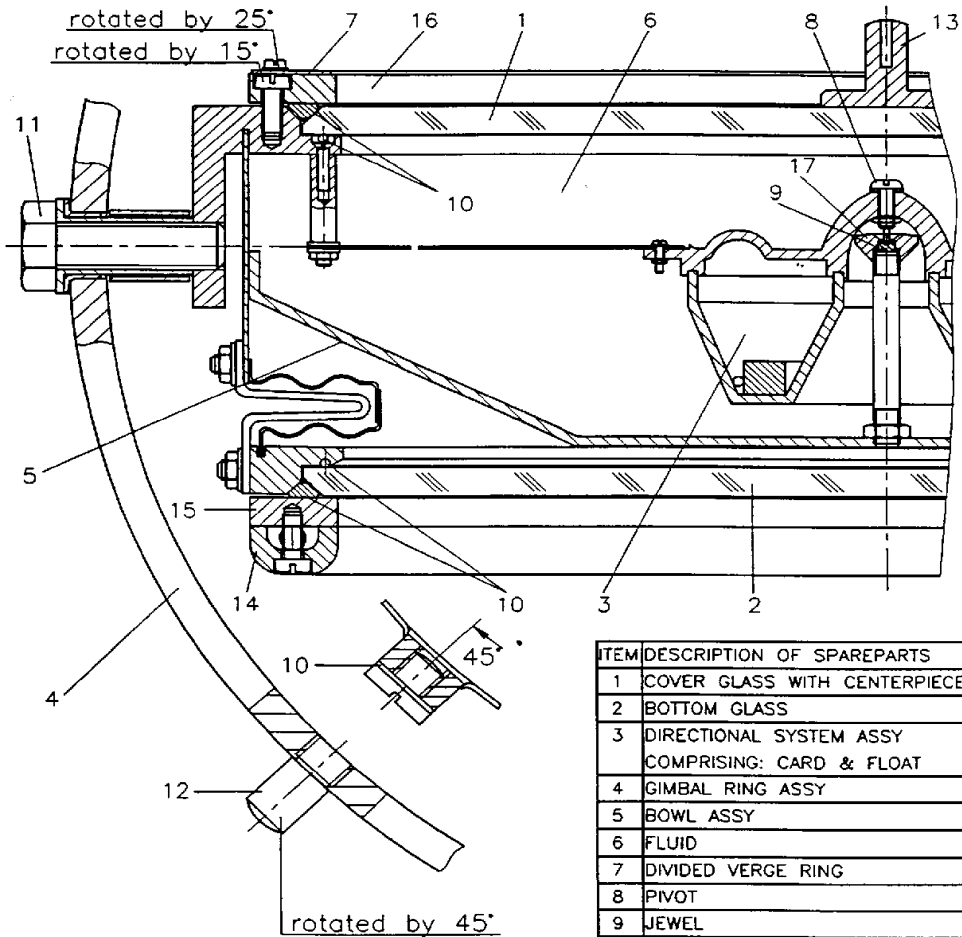
Even if these tests are successful routine compass checks still have to be carried out.

Workshop Repair of Compass

Compass repair should be carried out by qualified compass workshops only to grant safe navigation!

Spare Parts

(In case of order please quote part description and also type of compass -here reflector compass Type 21-)



ITEM	DESCRIPTION OF SPAREPARTS
1	COVER GLASS WITH CENTERPIECE
2	BOTTOM GLASS
3	DIRECTIONAL SYSTEM ASSY COMPRISING: CARD & FLOAT
4	GIMBAL RING ASSY
5	BOWL ASSY
6	FLUID
7	DIVIDED VERGE RING
8	PIVOT
9	JEWEL
10	SET OF GASKETS
11	INTERNAL GIMBAL AXLE
12	EXTERNAL GIMBAL AXLE
13	CENTRE PIVOT
14	WEIGHT RING
15	LOWER COVER RING
16	UPPER COVER RING
17	JEWEL RETAINER

Compass Fluid

If less than 5 cm³ fluid has to be completed use pure Ethanol or distilled water. If it is more, only use original Cassens & Plath compass fluid #39012.

Don't use any different fluid because this may destroy the compass and impair the function!

5-Years-Spare-Parts-Outfit (Extra)

A box containing the most essential spare parts is available as an extra (Order No. 10651).

Included are:

1. One cover glass/bottom glass
2. Two rubber gaskets
3. Two filling screw gaskets
4. Two pivots for the directional system assembly
5. Two jewels
6. Three each bulbs for main and emergency illumination
7. One centre pivot for azimuth device (only bearing compass)
8. One reflection mirror (only reflector compass binnacle)

Required Tools

Special tools are not required.

- Slot screw driver, 3 mm, to unscrew the pivot from the float,
- Box wrench, 5.5 mm, or pointed pliers for counter nut of the pivot
- Slot screw driver, 7 mm, for the cover rings of the compass
- Slot screw driver, 12 mm, for the filling screw of the compass
- Pipe wrench for removal of external gimbals
- Screw spanner, 17 mm, for the internal gimbals

Replacement of Directional System (Card Assembly) or Pivot and Jewel

1. Place the compass on a horizontal plane and solid surface.
2. Remove the divided verge ring by unscrewing the relevant screws (only bearing/reflector compass). The "180" mark is in ahead direction.
3. Remove the upper cover ring by unscrewing the relevant screws. Mark the orientation before.
4. Remove rubber gasket and cover glass. Mark the orientation of the cover glass before. Take the cover glass with the centre pivot or use a small screw driver and lift up the glass at its edge.
5. Remove the directional system by hand and replace by a new one if necessary.
6. Remove pivot. Loosen the pivot counter nut from below of the float by use of the box wrench 5.5 mm or pointed pliers. Now the pivot can be unscrewed from above with the screw driver of 3 mm. Replace with a new pivot (recommended each time the compass is opened or latest after two years of operation).
7. Replace the jewel: Unscrew the jewel retainer by hand or with pliers. Now take the jewel and replace with a new one.
8. Close the compass with the cover glass. Watch its orientation. The cover glass should be centric to the compass bowl. Check this visually. Insert the rubber gasket and fasten the upper cover ring. Tighten the screws with as equal as possible force around the whole circle.
9. Fit the divided verge ring. Place the azimuth device on the compass for adjustment. Adjust the divided verge ring to match the lubber marks. Turn the azimuth device to all four major directions and adjust the divided ring to be centric to the centre pivot.
10. Fill up the compass fluid. Refer to paragraph: "Filling the compass".

Replacement of Upper Cover Glass

1. Place the compass on a horizontal, plane and solid surface.
2. Remove the divided verge ring by unscrewing the relevant screws (only bearing/reflector compass). The "180" mark is in ahead direction.
3. Remove the upper cover ring by unscrewing the relevant screws. Mark the orientation before.
4. Remove rubber gasket. Take the cover glass at the centre pivot or use a small screw driver and lift up the glass at its edge.
5. Replace the old cover glass with a new one.
6. The cover glass should be centric to the compass bowl. Check this visually. Insert the rubber gasket and fasten the upper cover ring. Tighten the screws with as equal as possible force around the whole circle.
7. Fit the divided verge ring. Place the azimuth device on the compass for adjustment. Adjust the divided verge ring to match the lubber marks. Turn the azimuth device to all four major directions and adjust the divided ring to be centric to the centre pivot.
8. Complete the compass fluid. Refer to paragraph: "Filling the compass".

Replacement of the Bottom Glass

1. Place the compass upside down on a horizontal, plane and solid surface. Caution: do not lay down the compass on its protruding centre pivot! Use a plate (e.g. cardboard) of approximate 10 mm thickness as supporting surface with hole for the centre pivot.
2. First unscrew weight ring and then lower cover ring. Mark the orientation of both.
3. Remove the rubber gasket.
4. Take the defective bottom glass with a small screw driver and lift up the glass at its edge. Insert the new glass which must be centric to the bowl.
5. Complete the compass and fill in fluid. Refer to paragraph: "Filling the compass".

Replacement of Gaskets.

1. For replacement of upper gasket proceed as described in the paragraph "Replacement of cover glass".
2. For replacement of lower gasket proceed as described in the paragraph "Replacement of bottom glass".

Filling the Compass

1. Place the compass so that the filling screw is upside. Unscrew the filling screw with screw driver of 12 mm and complete fluid. In case larger quantities are needed use only original compass fluid #39012. Smaller quantities up to 5 cm³ can be completed with Ethanol or distilled water. Medical syringes are suitable to complete the fluid.
2. Close the compass with the filling screw. Use a new gasket.
3. To ensure the tightness of the compass cool it to -30°C and keep it approximately 8 hours at this temperature. If there is no bubble in the fluid after this time the compass should be in order.

Replacement or Dressing of Gimbal Ring

1. Use a pipe wrench for removal of the external gimbal trunnions. For that cover the trunnion with emery paper to keep its surface smooth and to prevent slipping of the pipe wrench.
2. Remove the internal gimbal trunnions by use of a screw spanner of 17 mm.
3. Now dress the gimbal ring with a light rubber hammer after having it separated from the compass bowl. The slack must be less 0.2 mm.

Installation - Content

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Procedure, Outline

1. Checking range of delivery
2. Choosing location of compass binnacle with respect to magnetic interferences, constructional conditions and applicable regulations
3. Positioning of reflection tube
4. Cutting-out deck holes
5. Installing reflection tube
6. Installing compass binnacle
7. Connecting illumination
8. Carrying out functional tests and preparing compass adjustment

Range of Delivery

Compass Binnacle

- Reflector Compass Binnacle with mounting pieces, hood, magnetic bearing/reflector compass, azimuth device in wooden box with one shadow pin.

Correctors

- B+C-correctors, consisting of six bar magnets 100 mm long x 10 mm \varnothing (at delivery inserted in magnet magazine behind right B+C-corrector cover. Refer to chapter „Compass Binnacle, Outline“).
- Heeling-corrector, consisting of one each heeling magnet of 50 mm and 125 mm length, 25 mm \varnothing , inside magnet tube with numbered chain (at delivery inserted in heeling magnet guiding tube within binnacle column).
- D-correctors (as standard) consisting of two weak iron spheres of 180 mm \varnothing (at delivery separately packed). One each bracket moved intercardinal of port and starboard to fix the D-spheres upon
- Flinder´s bar (as option), consisting of Flinder´s bar tube with upper and lower bracket (already fixed to the binnacle) and cover, one set of wooden spacer pieces (4 pcs, inserted in Flinder´s bar), one set of weak iron cylinders (4 pcs, separately packed).
- E-Correction (as option), consisting of two weak iron spheres of 180 mm \varnothing (at delivery separately packed). One each bracket port and starboard to fix the E-spheres upon.

Reflection tube

- Reflection tube with mirror head (extendable mirror head) and mounting flange, rubber gasket and facing ring.
- Horizontal optical by-pass, if ordered (Instructions attached separately).

Accessories as options

For example spare magnetic compass. Instructions included separately as required.

Location of Binnacle, Magnetic Requirements

The location of a magnetic compass binnacle is subject to the approval of the maritime authority of the vessel's flag nation. This is for German flagged vessels the Federal Maritime and Hydrographic Agency (BSH). Address: Bundesamt für Seeschifffahrt und Hydrographie (BSH), Bernhard-Nocht-Str. 78, P.O. Box 301 220, D-20359 Hamburg, Germany, Tel. +49 (0)40 31900, Fax +49 (0)40 3190 5150.

The heading indication of magnetic compasses is generally deflected by all magnetic fields in the neighbourhood. This makes it necessary to keep a suitable safe distance to all sources of interfering magnetic fields.

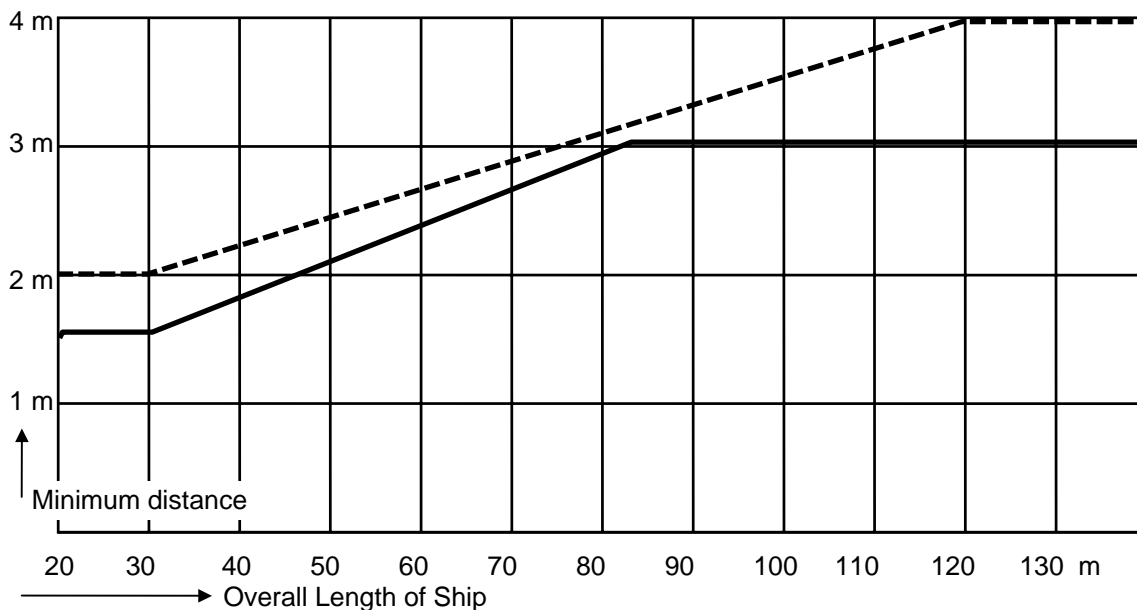
Interfering fields are caused by:

1. magnetic iron
2. navigational instruments which produce magnetic fields
3. D.C. live cables

A static deflecting influence of magnetic iron from the ship's hull or superstructure can be adjusted if indication errors are less 35° ... 40°. Variable fields coming from devices like window wipers, loudspeakers ... cannot be adjusted, the only way is to increase the distance. It is not possible to shield the compass against interfering fields.

1. The distance to magnetic iron, measured as spherical radius around the compass, depends on the overall length of the vessel. The following diagram will give an impression of the necessary distances according to IMO A.382(X) regulations. This is relevant also for: wheelhouse front wall boards including their mounting systems, pipes installed below the compass bridge plating, cable wireways and lights (housings) installed below the wheelhouse ceiling.

Minimum desirable distances of magnetic material from the standard compass according to IMO Res. A.382(X)



- Uninterrupted fixed magnetic material
- - - End parts of fixed magnetic material such as top edges of walls, partitions and bulkheads, extremities of frames, girders, stanchions, beams, pillars, and similar steel parts. magnetic material subject to movement at sea such as davids, ventilators, steel doors, etc. Large masses of magnetic material with variable field such as funnels.

2. The necessary safe distance to the different navigational instruments were individually determined by the maritime authorities. This is marked on the instrument. If the instrument was not tested individually then general distances have to be followed which are higher. In Germany the BSH will inform about these distances.
3. Direct current live cables near to the compass should be led bipolar and drilled.

For German vessels these requirements will be found in detail in the publication "Requirements for the Installation of Standard Magnetic Compasses and Steering Magnetic Compasses" issued by the BSH.

Even if all these regulations are followed a heading indication free of errors cannot be granted. In addition, the compass has to be adjusted. Compass adjustment must be carried out on maiden voyage by a professional compass adjuster. Contact your authorities for addresses.

Location of Compass Binnacle, Constructional Requirements

1. The magnetic compass should be installed on the ship's centreline, otherwise asymmetric iron around will cause non adjustable errors. If a place on the centre line is not possible then the iron free zone has to be moved with the compass to port or starboard. Authority has to be contacted for approval.
2. The compass foundation should be designed to reduce vibrations and to give the binnacle a raise of minimum 80 mm. If freedom of vibration cannot be guaranteed by construction optional lashings for the binnacle column are necessary (available as an extra).
3. The binnacle shall be installed in a way that in a range from right ahead to 115° to both sides of the vessel, visibility may be impaired only by obstructions in the form of masts, cargo booms, derrick posts, cranes and the like. If this is not possible peloruses may be used to take bearings with one each fixture on star or port bridge wing.
4. The compass light should be dimmable. Dimmers are available as an extra.
5. If a higher binnacle column or a foundation has to be used and a direct reading of the compass from above is no longer possible an additional walk around with railing is necessary. The minimum diameter of the walk around should be of 1000 mm.
6. A voice pipe has to be installed between the compass on the compass bridge and the helmsman's position in the wheelhouse. This must be made of non-magnetic material.
7. If a compass foundation is used the reflection tube has to be covered by a protective channel.
8. The protective channel should be equipped with removable covers to allow free access (for cleaning and service) to the lenses installed in the reflection tube or lead-in tube.

Optical Arrangement (Reflection Tube), Requirements for Installation

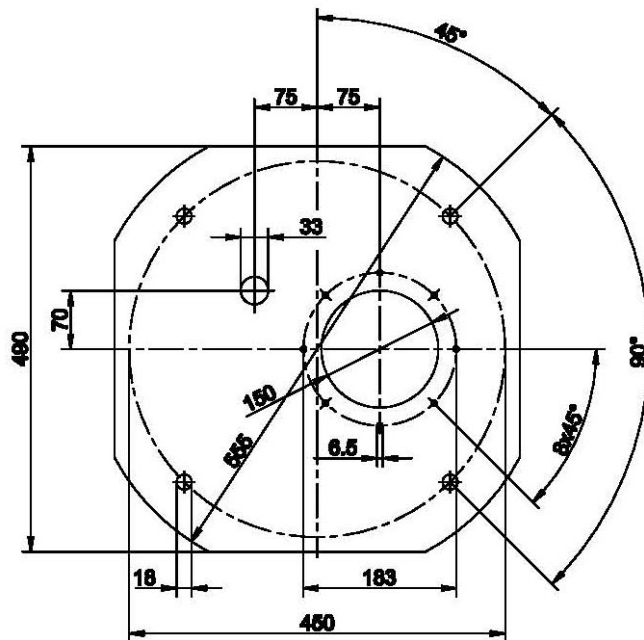
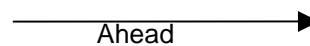
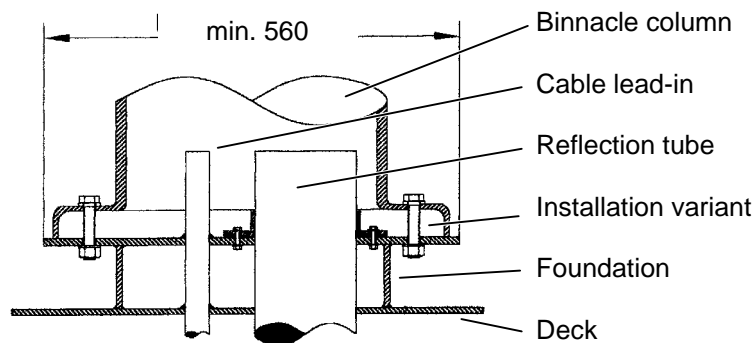
1. The distance between helmsmen's eyes and mirror head should not exceed 1 m ... 1.2 m.
2. To get a picture with upright figures as required by the maritime authorities the location of the mirror head should be in ship's ahead direction of the helmsman's position.
3. The recommended height above eye level of the reflection mirror is about 10 cm.
4. There are no insulating glass panes in all reflection tubes to avoid condensation caused by the temperature difference between wheelhouse inside and compass deck.
To prevent water from coming into the wheelhouse the reflection tube was extended so that it exceeds the compass deck level by about 70mm. If water should get into the binnacle column in which ever way clearances in the binnacle base allow the water to flow out again. Therefore please do not seal the binnacle base against the compass deck!
5. The vertical axes of reflection tube and binnacle column have to be parallel to ensure line up of optical components and to grant a symmetric reflection image.
6. If a higher foundation is necessary to reach a suitable iron safe distance of the magnetic compass, then the reflection tube has to be weather protected by an protective tube. Use only amagnetic material for this.
7. In case of long reflection tubes (or lead-in tubes), especially if the compass binnacle stands on a higher foundation, it may be necessary that a lens is installed inside this tube. This is visible by a flap marked "Revision Flap for Lens" which allows access to the lens. This flap should be free for service. Therefore if a protective cover is installed outside the reflection tube this has to have a flap, too, at the same position of the revision flap for lens. Its size should be not less 700 mm in height. The position of the lens and of the flaps cannot be stated generally, this depends on the length of the reflection tube. If it is necessary to know the location before delivery of the binnacle the yard should return the relevant data to Cassens & Plath to calculate the reflection tube (C&P issues a Questionnaire with the required data). The revision cover for lens is orientated to ship's aft. Additionally the ahead direction of the reflection tube is marked.
8. The flange of the reflection tube should be installed on the upper surface of the foundation when installed and not on the compass deck below of it.
9. Horizontal optical by-passes are horizontal optical channels. These should be installed between wheelhouse roof resp. deck beams and ceiling. Special instructions are attached to the delivery.

Compass Foundation, Cut-outs and Drillings

Install compass foundation as shown below if required. The following openings should be cut before starting to install the reflection tube and compass binnacle:

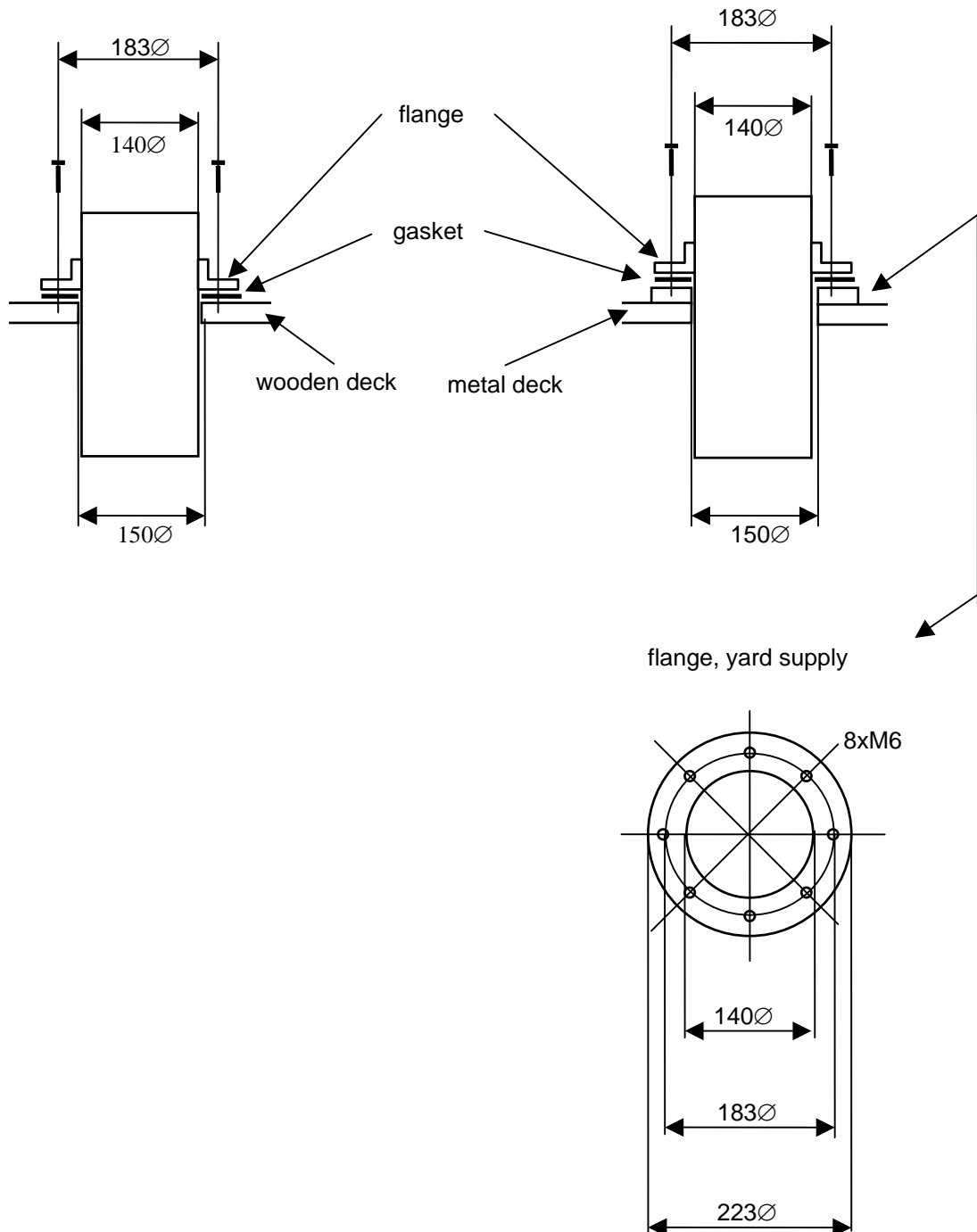
1. for the reflection tube
2. for the binnacle fixing pieces
3. for the illumination cables and detector cable

The following drawing shows the location of the cutouts and drillings as well as the mounting elements. The hole of the illumination cables and detector cable should be furnished with a sleeve (app. 30 mm internal Ø) for bending protection.

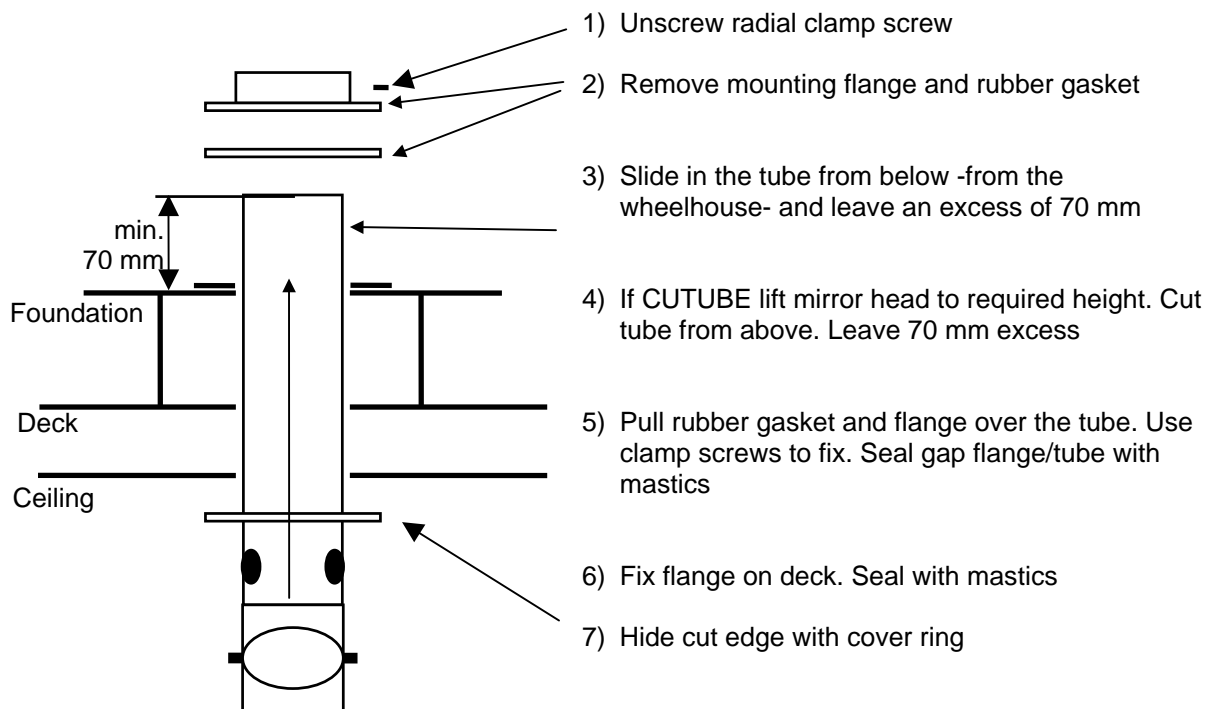


Installation of Optical Arrangement (Reflection Tube)

The reflection tube must be installed before installation of compass binnacle.



Installation of Optical Arrangement (Reflection Tube)



Installation of Compass Binnacle

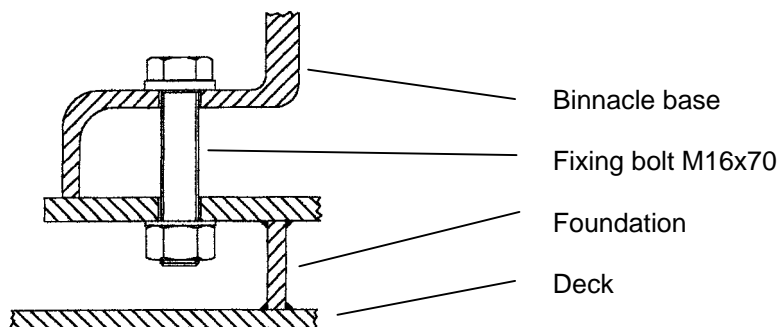
The reflection tube should be installed already. Holes to fix the binnacle column should be drilled to the platform and cables for illumination and detectors should be visible in a length of about 60 cm above platform level.

1. Move the binnacle to its final position. The ahead direction is marked The Flinder's bar points to a head.
2. Remove the cover near to the base and connect light cables to the relevant junction box (refer to page wiring below), same with detector cables.
3. Make sure that cable do not obscure the sight channel!
4. Fix the binnacle temporarily at its position. Final fixing will be done by the compass adjuster when adjusting the compass.

Note:

1. Do not seal the the binnacle base on the platform! Water inside the binnacle column should flow off this way.
2. A voice pipe has to be installed between the compass on the compass deck and the helmsman's position in the wheelhouse. Use non magnetic material. The upper part with mouth piece must be rotatory.

Fixing the binnacle on a metal deck



Illumination

Optional supply voltages are 220-240 VAC, 115 VAC or 24 VDC, all 40 VA. Choice is made with order. If the wrong voltage was delivered just replace the illumination bulb by the right one. In case of longer reflection tubes or by-passes one may use 60 VA bulbs.

As standard the illumination cables will end approximately 150 cm below the binnacle base. Main and emergency cables are marked. A junction box (yard supply) should be installed near the cable inlet which allows easy disconnection in case of compass service.

Use glow lamps of type E14 with 14 mm screw socket.

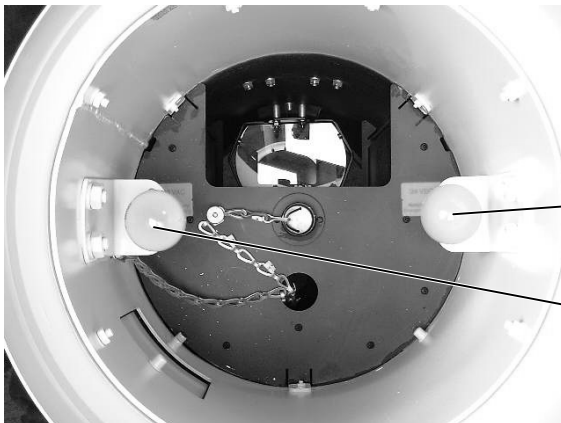
Illumination Dimmer (Extra)

Optionally available are dimmers with or without enclosure for 220-240 VAC, 115 VAC or 24 VDC. According to international regulations the compass illumination should be of adjustable birightness. Install the dimmer near to the helmsman's position.

The dimmers are of rheostat type. Instructions are attached to the dimmers if ordered.

Caution: Wires inside enclosure are not insulated, danger of electric shock! The dimmers generate heat! Make sure there is sufficient air circulation!

Replacing of the Bulbs



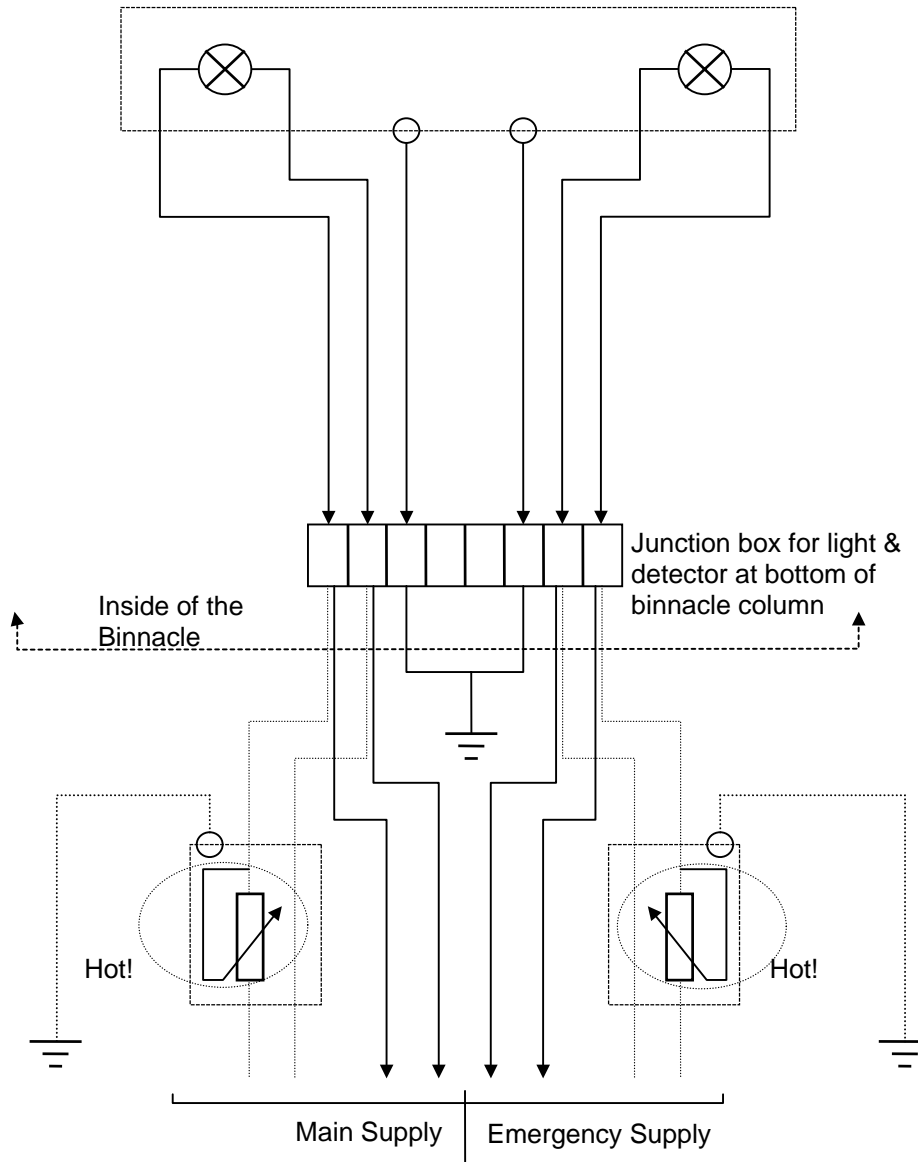
Remove compass from binnacle

Emergency illumination

Main illumination

(Bulb type E14, screw socket)

Wiring



Dimmers:
1,5 kOhm for 230 VAC
680 Ohm for 115 VAC
47 Ohm for 24 VDC

Setting into Operation, Functional Tests & Preparing of Adjustment

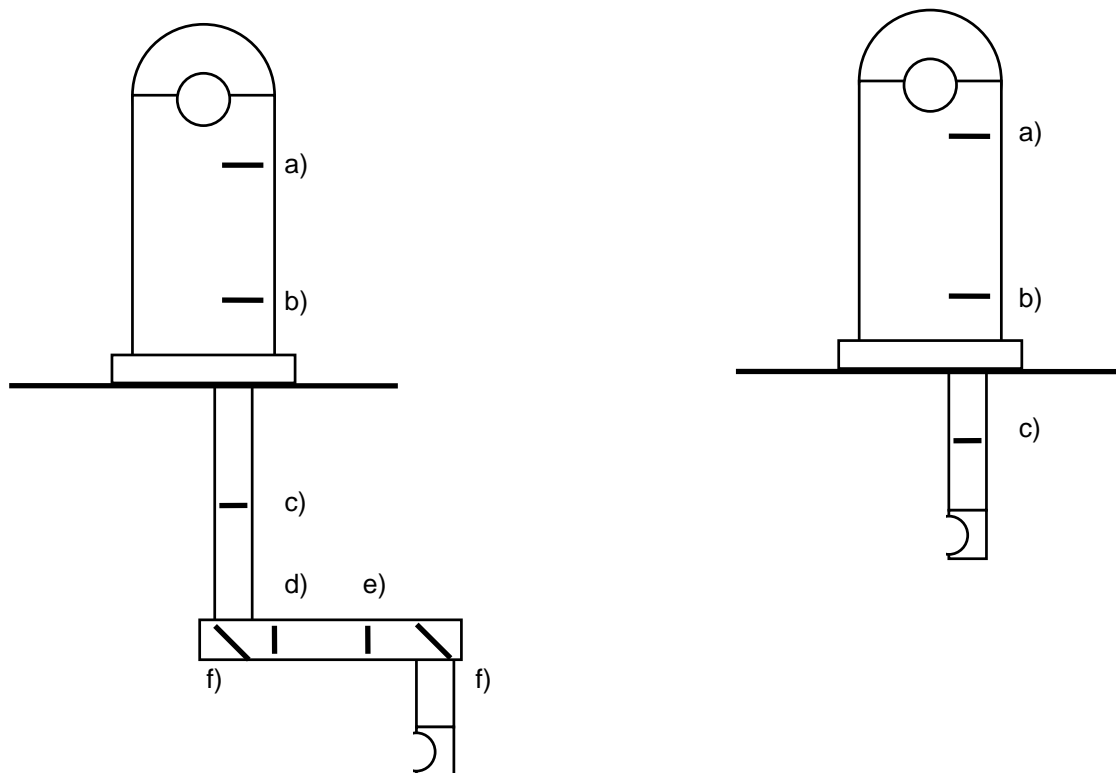
1. Cleaning of Reflection Optics

Use only a soft and non scatching cloth.

Not in every case all below mentioned positions are equipped with lenses.

Details for cleaning of lenses and mirrors inside the horizontal by-pass channel can be found in the relevant instructions attached separately.

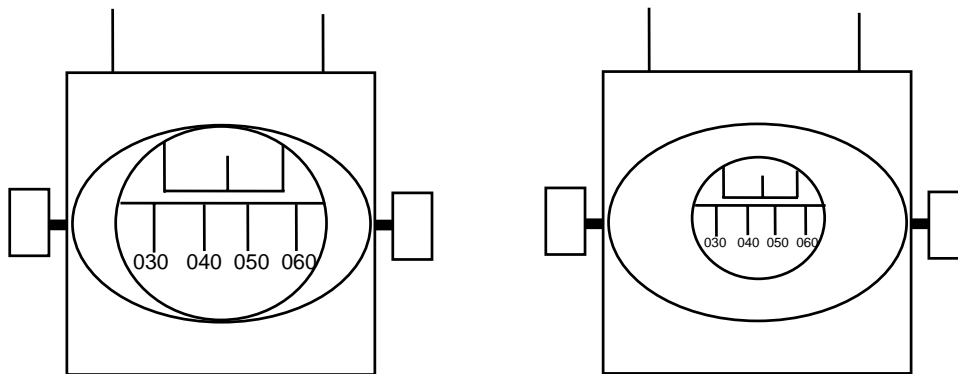
Possible Lens Positions



- a) Upper part of the binnacle colum. Accessible by removing of compass
- b) Bottom side of the binnacle colum. Accessible by removing the relevant cover, ref. to chapter „Compass Binnacle, Outline“
- c) Inside Lead-in tube (right) or mirror tube (left). If lead-in tube or reflection tube are outside the wheelhouse they have to be protected by an additional channel. This channel should have a removable flap at the position of the lens to allow access to the lens
- d) Horizontal by-pass channel. If the by-pass channel is above the ceiling so there should be a removable flap in the ceiling to allow access to the lens
- e) Same as d)
- f) By-pass mirrors. Refer to special instructions of by-pass

- Put the Compass into its suspension. Before remove the suspension cover plates. Compass ahead is marked by "Ahead" or the "180" marking of the divided verge ring. Carefully fix the suspension covers again after inserting the compass. Make sure the compass is swinging freely. The detector cables must not obscure the reflection field of view. Keep the detector cables loose so that free movement of the compass is not affected. Cables must be kept away from hot illumination bulbs. Make sure that the compass does not show obvious defects (bubbles, inclined directional system, misbalanced compass ...).
- Switch on the illumination. Check main and emergency illumination. Check dimmer function.
- Check the reflection reading at the helmsman's position. It should be comfortably readable from a distance of appr. 1 m to the mirror head, symmetric in composition, the figures should be upright and an area of at least 15° to both sides of the lubber mark should be clearly visible. Make sure that the reflection reading is not obscured by any obstacle like illumination or detector cables.

In case of long optical ways (long by-passes) the picture may be much smaller than the reflection mirror.



Short optical way: large picture

Long optical way: small picture

- Can the mirror head and reflection mirror be turned? Are white and black mirror of the reflection mirror undamaged? Can the mirror head be slipped downwards or upwards after loosening of the clamping knobs? (not applicable for horizontal by-passes)
- Make available the azimuth device. It is located in a wooden box separate added to the delivery.
- Make sure that the B+C correctors are available for compass adjustment. At delivery B+C-magnets are located in their magazines behind the B+C-covers. refer to chapter "Compass Binnacle, Outline".
- Check that the heeling magnets are available. At delivery there are two magnets located inside a brass tube with screwed on cover and adjusting chain. This adjusting chain is visible when looking from above into the binnacle column (after removing of compass). Refer to chapter "Adjustment".
- Put the D-spheres on their consoles port and starboard of the binnacle column and fix it preliminarily. The guiding piece is orientated towards the binnacle.
- If a Flinder's bar is mounted to the compass binnacle make available the four weak iron cylinders for adjustment. These are separately packed and added to the delivery. Four wooden spacer pieces are to be found within the Flinder's bar.