C20-00130 reflector compass **Version: 3.0**

Magnetic Compass
with it's appliances

AUTONAUTIC
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《Safety Precautions and Attention point as Installing》

GENERAL

Access to the interior of the C20-00130 reflector compass should only be by a AUTONAUTIC INSTRUMENTAL technician.

The following precautions and warnings are general safety precautions that personnel should understand and apply during installation, operation and maintenance of the C20-00130 system equipment.

Wear proper safety attire and use the proper equipment while handling the C20-00130 during transport and installation.

Do install in place that ventilate well and can't raise more 40℃ ambient temperature. Avoid the place as dusty.Avoid some direct ray of light and Put(Install)distance more 10cm from other equipment or wall. Further more, Put(Install)distance more 1.5M distance form some magnetic substance.

POSITIONING

IMO Resolution A382(X) Magnetic Compasses Carriage and Performance Standards includes a section on the positioning of the magnetic compass. It is also strongly recommended that ISO 25862:2019 ANNEX E Positioning of Magnetic Compasses in Ships - is complied with. If, due to the special construction of the vessel, it is necessary to deviate from these, then the Flag State Authority should be consulted, as incorrect positioning can affect the expected performance of the magnetic compass.

[Contents]

1. Compass Bowl

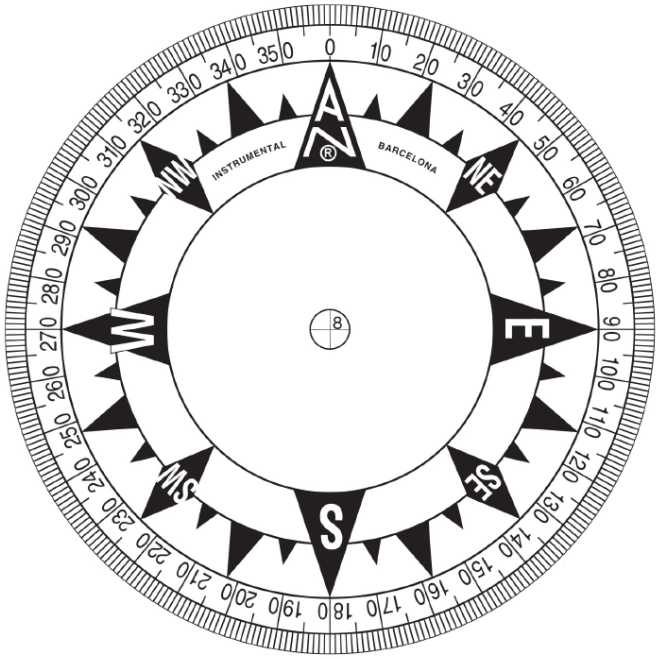
The C20-00130 is a bearing compass for class A magnetic compass and complies with IMO resolution A.382(10), ISO25862, ISO standards and IEC60945.

The C20-00130 of compass bowl was designed to be capable of combining with azimuth reading device, binnacles, transmitting system.
In addition to these appliances, it also can be available with the reflection tube to read out at a steering position

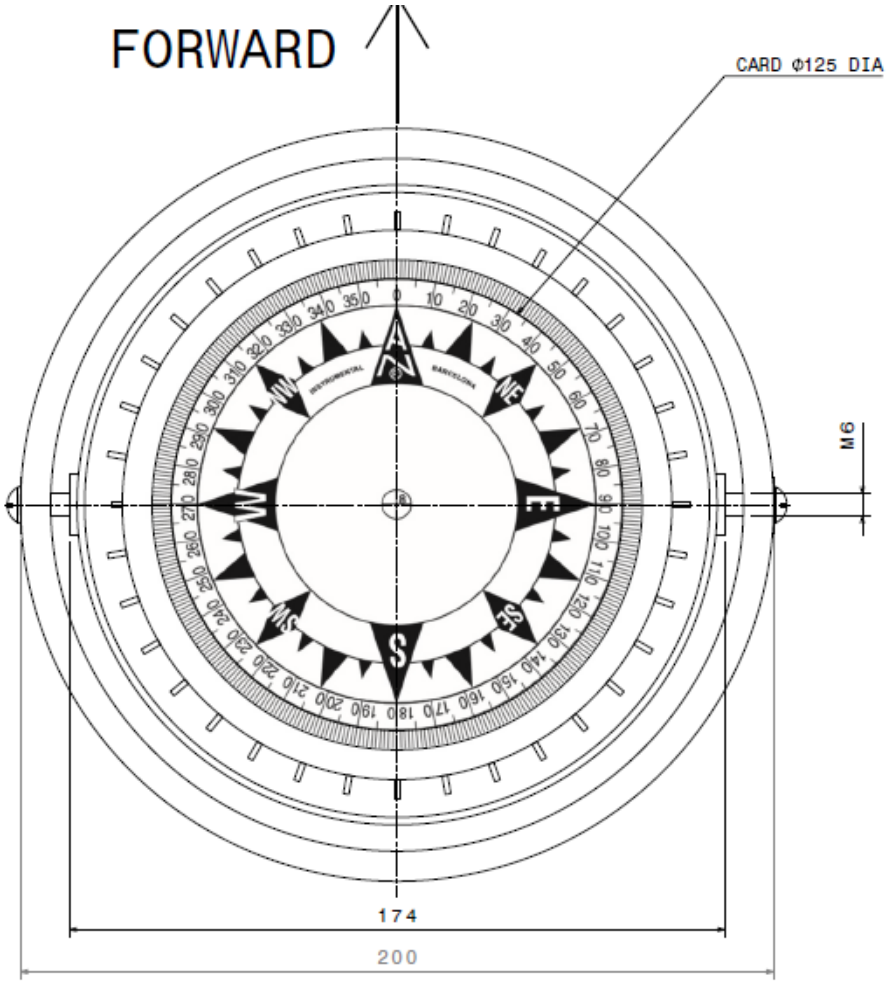
1.1 Composition

1.1.1 Compass Card

The C20-00130 is magnetic compass bowl with card 125mm diameter.
It has been graduated in 360 angle degrees starting from north clockwise. The cardinal point has been indicated by the capital letters N, S, E and W and intermediate points NE, SE, SW, NW also marked. Especially, north point is indicated by triangle symbol.



The card has been numbered every single degree.
The compass card is printed on both sides the graduation to be coincided so as to be capable of reading out not only at installation position but also from periscope tube.
This compass card can be read clearly in conjunction with lubber mark of fore gimbal axis .



These lubber mark are within 0.5° of the fore gimbal axis.

The name of manufacturer, AUTONAUTIC is marked in conspicuous place on the compass card and verge ring with type and serial number.

1.1.2 Liquid

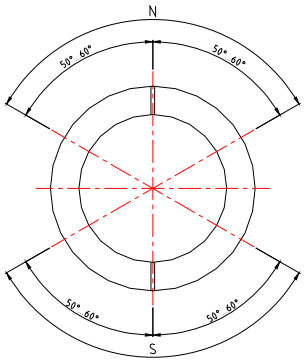
Compass fluid is OIL BASED fluid.
This is composed of the mixture of aliphatic hydrocarbons.
The type of liquid used is indicated on the bowl in near of the filling plug.
This liquid is colourless and free from turbidity and formation of flocks.

1.1.3 Glass

The top and bottom glass covers of compass have a thickness of 4.5mm and toughened glass is used.

1.1.4 Directional system magnets

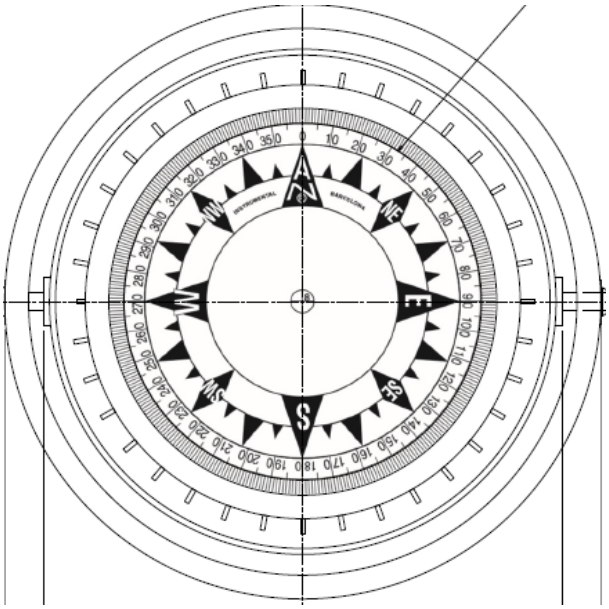
The magnet moment of the directional system has 1.1Am^2
The pole of the directional system magnets has been arranged in such a way that no excess sextantal or octantal deviations will be produced by the influence of the correcting device.



The magnet used in the directional system has 48 KA/m of coercivity and of 1.24 T of remanence.

1.1.5 Compass gimballing

The gimbal axes lie in one plane, within a tolerance of 1mm.
The angle formed by the outer and inner gimbal axes is 90°±1° and the vertical planes through the gimbal axes intersect to within 1 mm of the pivot point.
The outer gimbal axis lies in the fore and aft direction.



The directional system mounting in the compass bowl has been constructed to be rotated freely even if the compass bowl is tilted in any direction at 10°.
The gimbal ring revolves freely about the inner axis up to ±40°. That's why the compass bowl is balanced so that its verge ring or top glass cover settles in the horizontal plane to within 2° when the gimbal ring is fixed in a horizontal position.

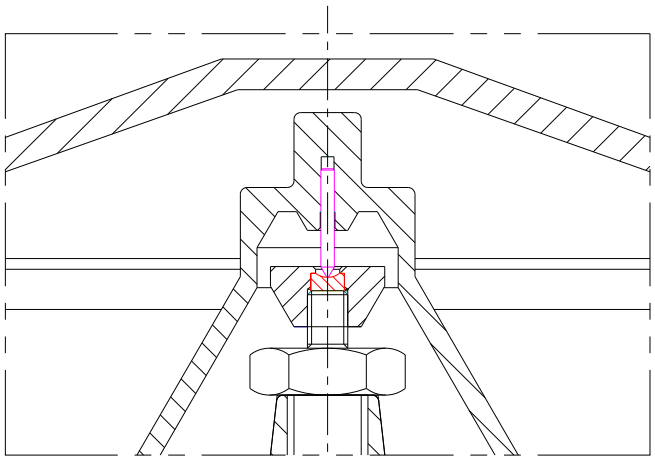
1.1.6 Centering of Azimuth Reading Device

The rotating axis of the azimuth reading device and the vertical rotating axis of the compass card are not different on a horizontal plane.

The rotation axis has a center boss on the top glass cover of the compass to fit the azimuth reading device.

1.1.7 Pivot Bearing

The pivot point is not deviate from the horizontal plane through the inner gimbals axis by more than 1mm.



1.2 Specification

1.2.1 Directional Error

Less than 0.5°

1.2.2 Error of lubber marks

Less than 0.5°

1.2.3 Error due to friction

When the card is given an initial deflection of 2° under the horizontal magnetic flux density of 6μT, first on one side of the meridian and then on the other, it returns to within 0.5° of its original position.

1.2.4 Swirl error

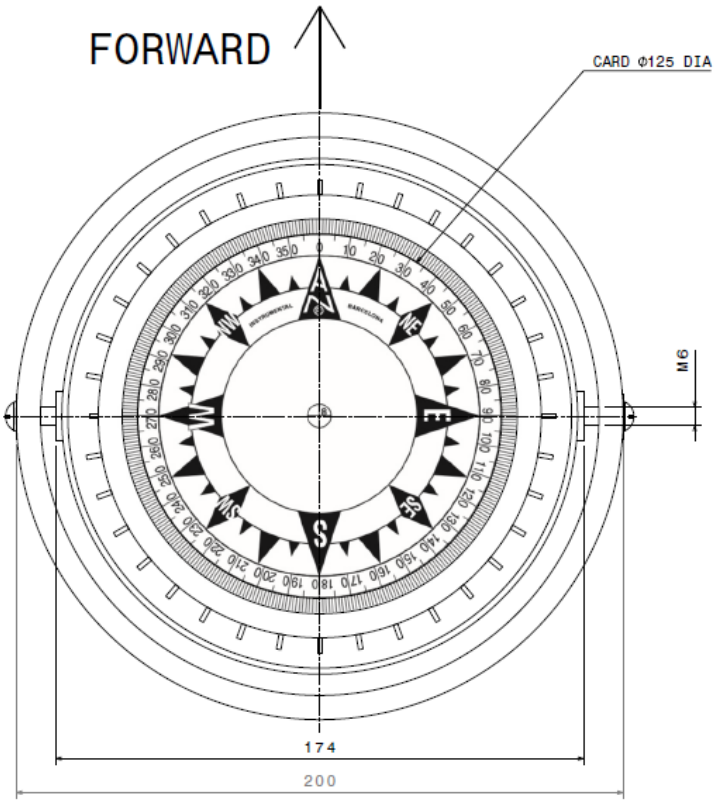
With the compass rotating at a uniform rotational frequency of 6°/s in horizontal plane the horizontal magnetic flux density of 6μT, the card deflection when the bowl has been rotated 180° don't exceed 6° from the magnetic meridian.

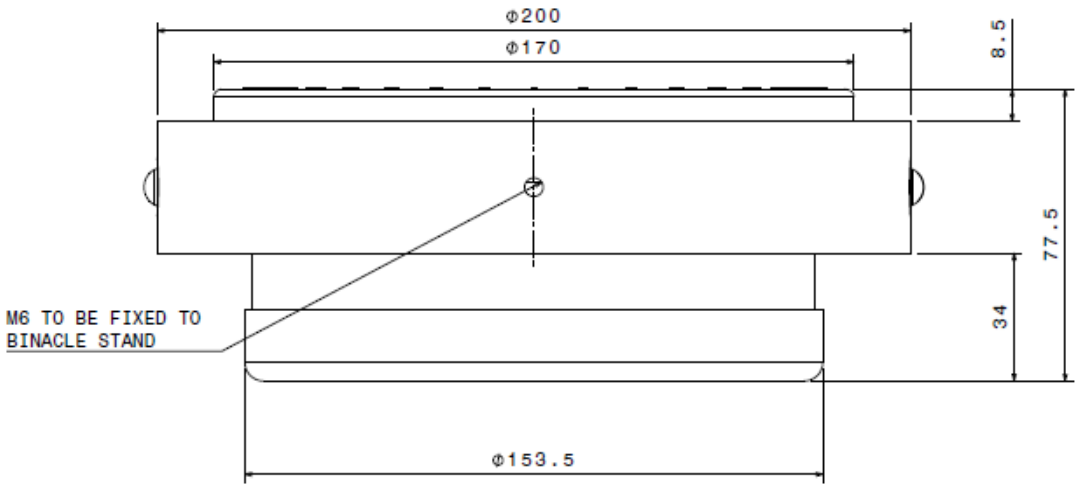
Alternatively, when rotating at a uniform rotational frequency of 1.5°/s the horizontal magnetic flux density of 6μT, the card deflection when the bowl has been rotated 360° don't exceed 2° from the magnetic meridian.

1.2.5 Period

The card is deflected 40° from the magnetic meridian and held there for at least 10s. It is then released and the time taken between the first and second passing of the original heading is not less than 12.2s

1.3 Drawings


FORWARD
CARD Φ125 DIA
M6
174
200


Φ200
Φ170
8.5
77.5
34
M6 TO BE FIXED TO
BINACLE STAND
Φ153.5

2. Binnacle

The marine grade aluminun binnacle is designed to accept the C20 type magnetic reflector compass with a 125mm diameter compass card.
A hood fitted to the binnacle will protect the compass from the elements.
The C20-00130 binnacle is a type A2 This binnacle is used in sea navigation when the design of the ship makes the provision of a full-sized binnacle impracticable.

With regard to height, there are no requirements provided that binnacles meet the following requirements.

Binnacles satisfy damp heat and corrosion tests specified in IEC 60945 (Ed.4, 2001-02).

The binnacle has a reflector tube fitted to allow the compass reading to be viewed from below decks.

*In customized binnacle solutions the C20-00130 can be supplied without periscope and TMC pick up sensor installed,

The binnacle and fittings are free from magnetic material with exception of correcting device. All materials of the binnacle can be referred from 01.1719 SECTION B+C CORRECTOR drawings.

All materials used are of sufficient strength.
The material used for correcting induced field such as D-sphere has a RILSAN coating for marine applications and a low coercivity and negligible remanence.

2.1 Composition

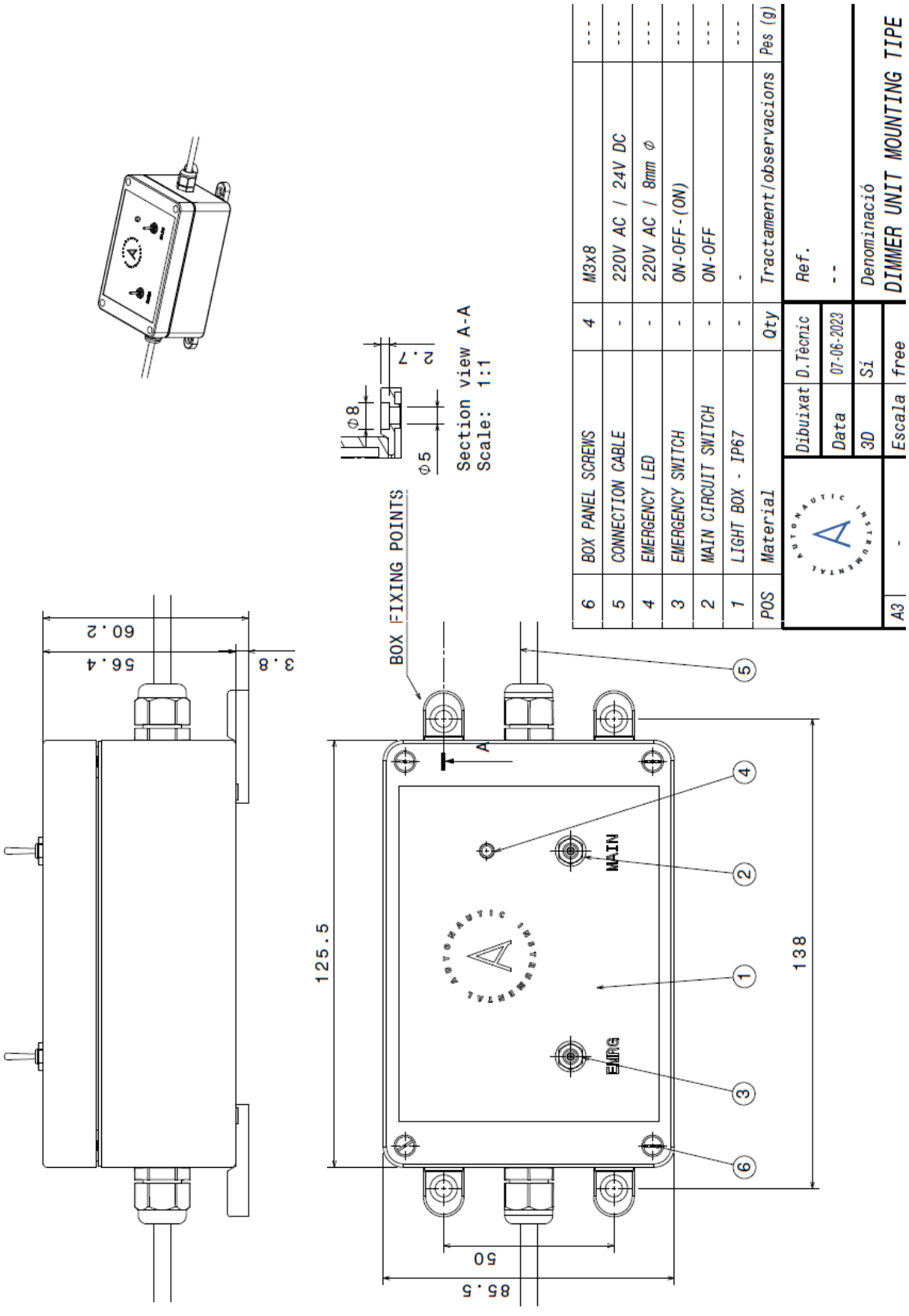
2.1.1 Binnacle Body and Hood

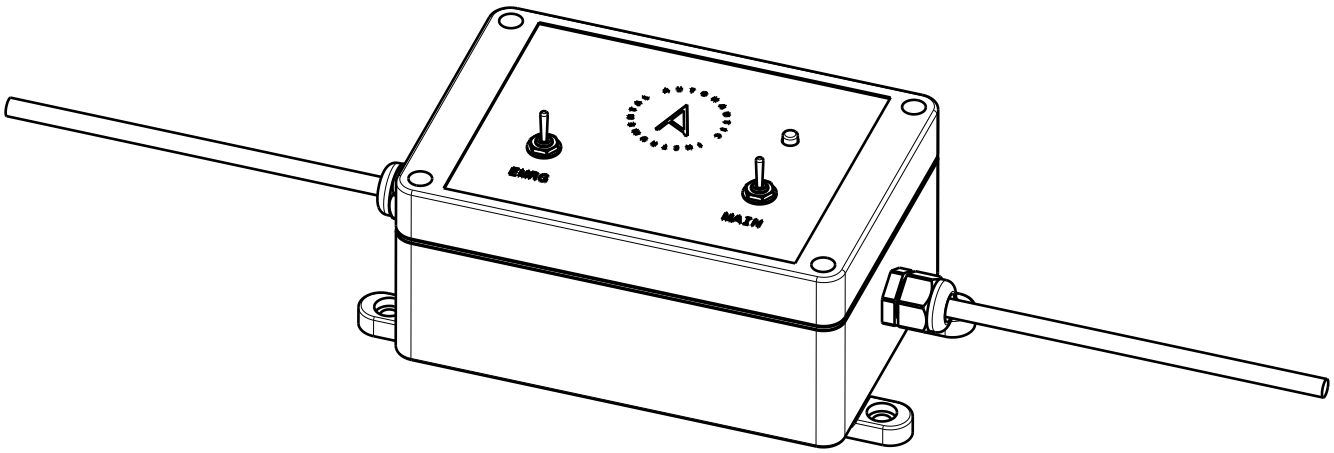
The body of the binnacle is made with marine grade aluminium.
The aluminum binnacle has been electrostaie-coated with a high-quality polimer for marine applicattions to protect against sea water corrosion.
The hood is made with the same aluminium and fitted to binnacle with two knurled screws.

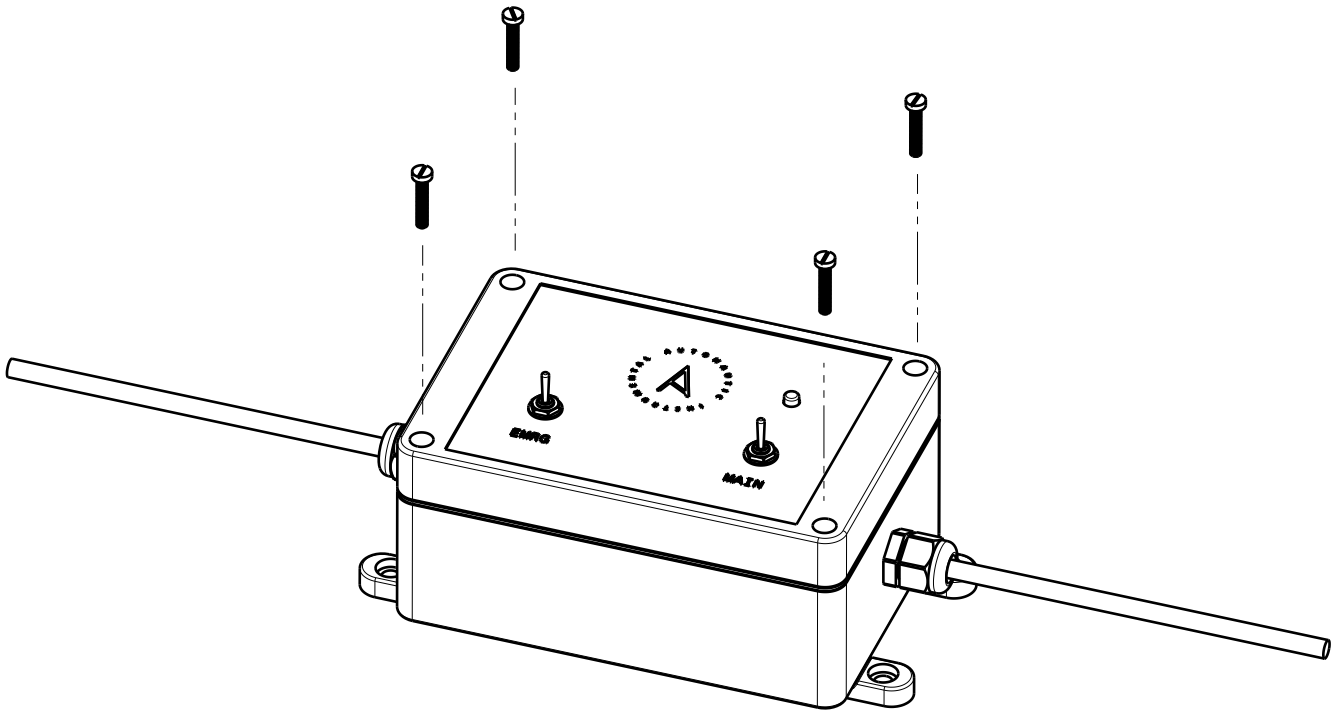
The holes of the binnacle deck fitting are made for any misalignment in respect of the fore and aft line of the ship by turning the binnacle through an angle of maximum 6°

2.1.2 Compass Illumination

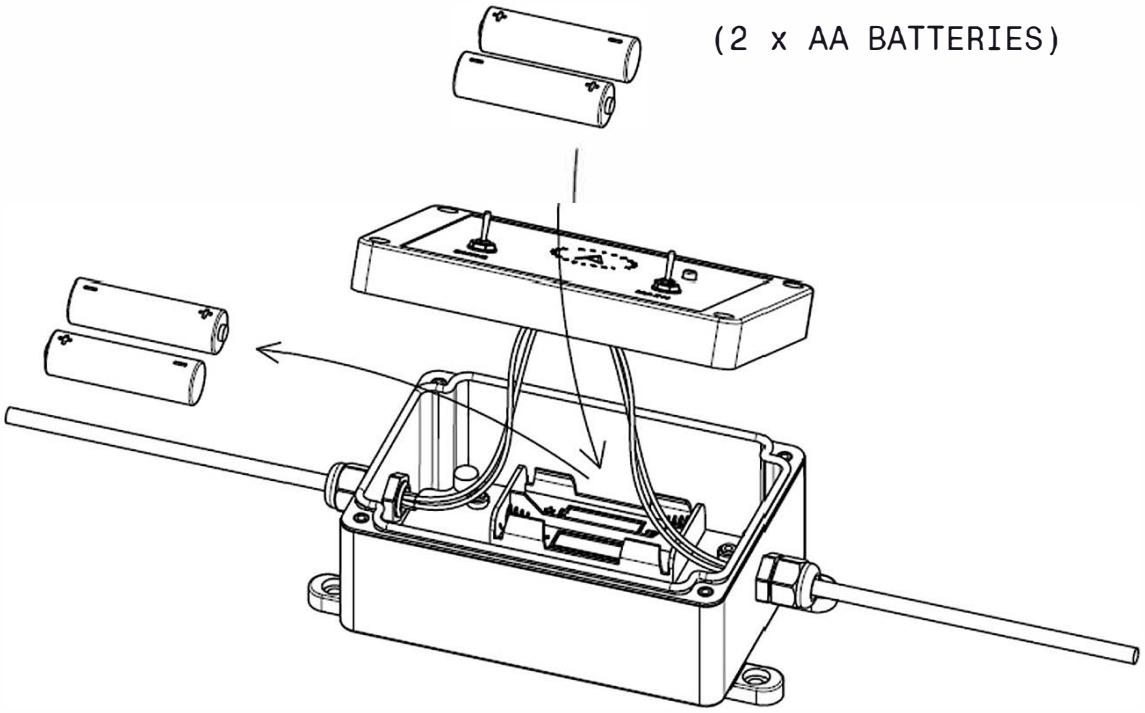
The C20-00130 is provided the main and emergency illuminations powered by AC and DC. There are two systems of compass illumination - normal and emergency. All electrical connections are made in a watertight terminal box.
To replace 2xAlkaline AA batteries LR6 1.5 V from the Light connection box. See the hereunder drawings.





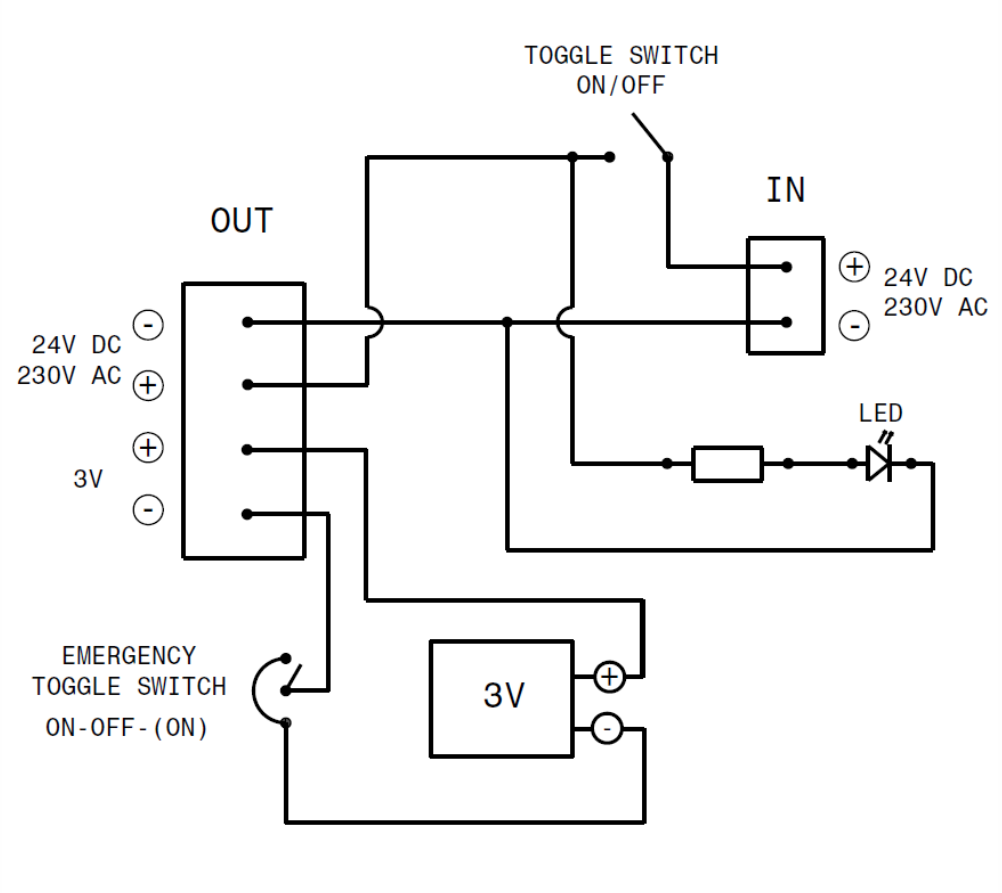


REMOVE LID SCREWS



REMOVE WORN BATTERIES AND INSERT NEW ONES

OperationVoltage dependant on ship's power supply



LIGHT BOX TERMIONAL CONNECTION DRAWING

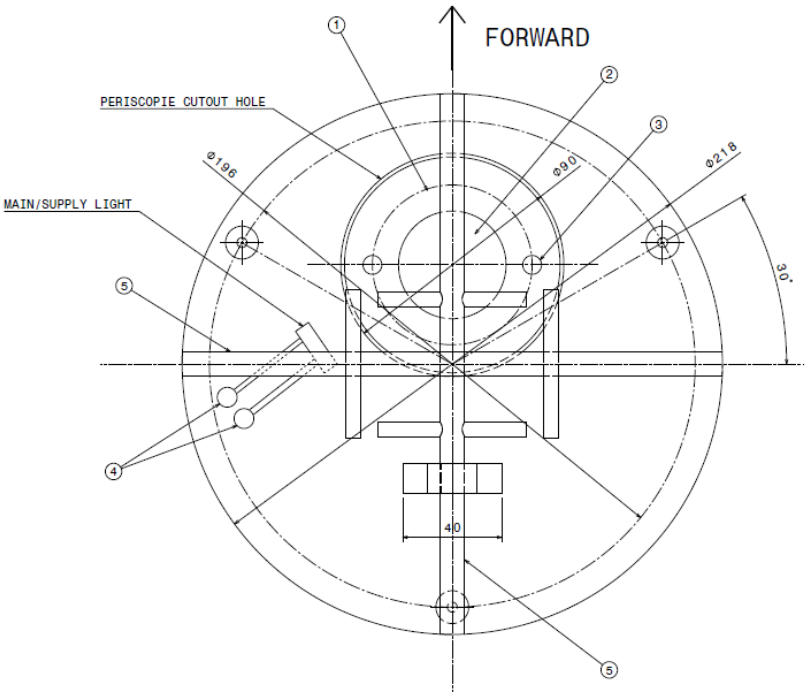
2.1.3 Compass Corrections

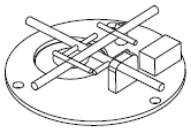
For the compass correction, the B+C correction by rod magnets and the D correction by two soft iron cylindrical correctors can be done.

These compensation rods are used to correct your compass for deviation. When testing a location, you do not want pre-set corrections in your compass, so neutralize the comp-rods by setting the slotted ends in a horizontal position. The C correction rod magnets are housed in a single vertical row of horizontal holes that are parallel to the athwart ships line of the ship.

The compensation rods has 4 magnets red (north) & blue (south)
The slots should be horizontal before starting the adjusting procedure.

A small non-magnetic screwdriver must be used for this purpose.
These are capable of correcting a coefficient B and C of at least 40º degrees.





Nº	PART	REMARK
1	LIGHT ASSEMBLY PANEL	
2	LENS	
3	KRUNLED NUTS/LIGHT ASSEMBLY PANEL	
4	LIGHT TERMINAL BLOCK	
5	B+C CORRECTORS ASEMBLY	

01.1719 SECTION B+C CORRECTOR

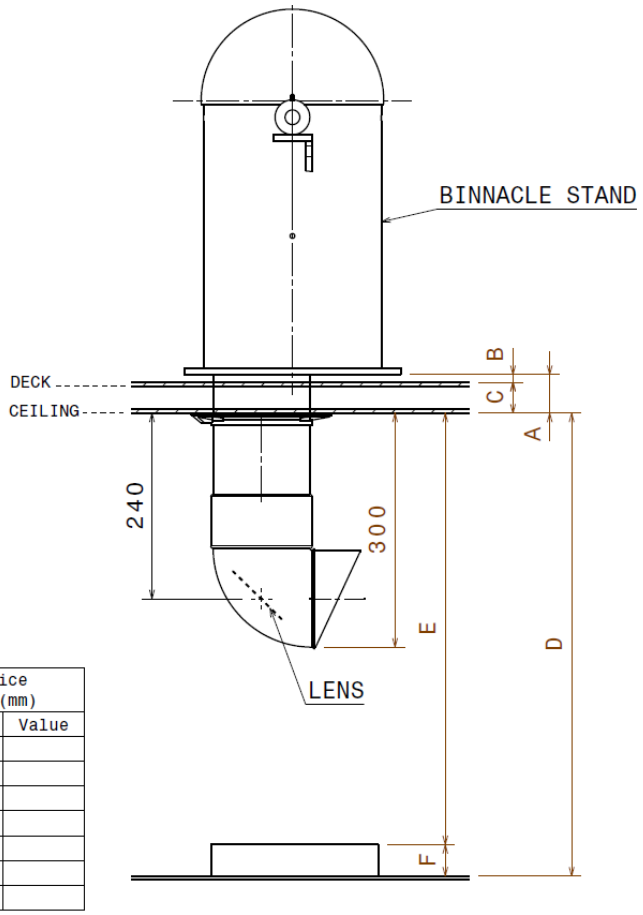
Two soft iron cilyndrical quadrantal correctors for the D correction are located on two arms at the port and starboard sides of the binnacle.
These correctors can be moved towards and away from the compass. It will be capable of correcting a deviation up to 10°
The minimum distance from the center of the corrector to the center of the compass is 140mm. The maximum distance from the center of the corrector to the center of the compass is 170mm.

The specification of the corrector is as follows:

Corrector material	SOFT IRON
Length:	65 mm
Diameter:	45 mm
Weight of one corrector	0.65kg

2.1.4 Compass Reflector

A 25° section, on both sides of the lubber line, of the compass card can be viewed through the reflector tube from below decks. The maximum length of the reflector tube is 30 cm. The viewing mirror angle can be varied.
The reflector tube is supplied to the C20-00130 binnacle. Except especific customer requiremets.
The course as read from the projected image agrees with the course read at the main lubber. Optical arrangements on reflector tuve can be made as per request. in that case please advice dimensions mentioned on below drawing.



Please advice dimensions (mm)		
Sign	Item	Value
+	B	
+	C	
+	D	
-	E	
-	F	
-	240	
	A	

2.2 Specification

2.2.1 Binnacle dimensions

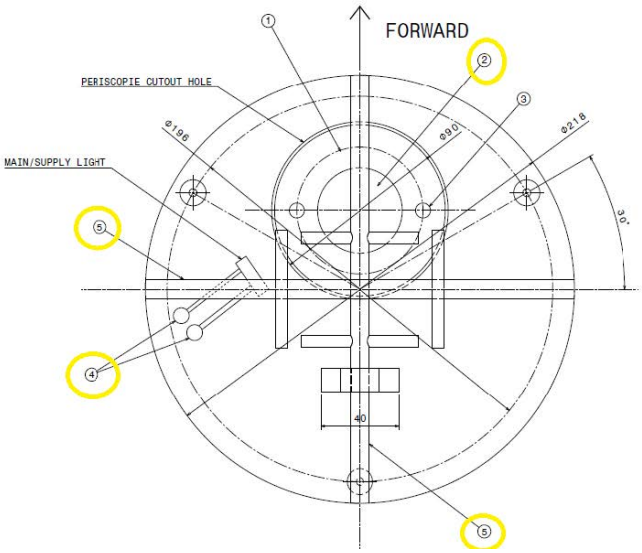
① Overall Height : 472 mm
② Compass card diameter : 125 mm
③ Base diameter : 280 mm
④ Overall width+arms : 400 mm
⑤ Reflection tube dimensions

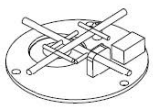
Viewing length : 240 mm
Tube diameter : 131mm
Mirror housing diameter :110mm
Lens diameter : 65mm

2.2.2 Compass illumination

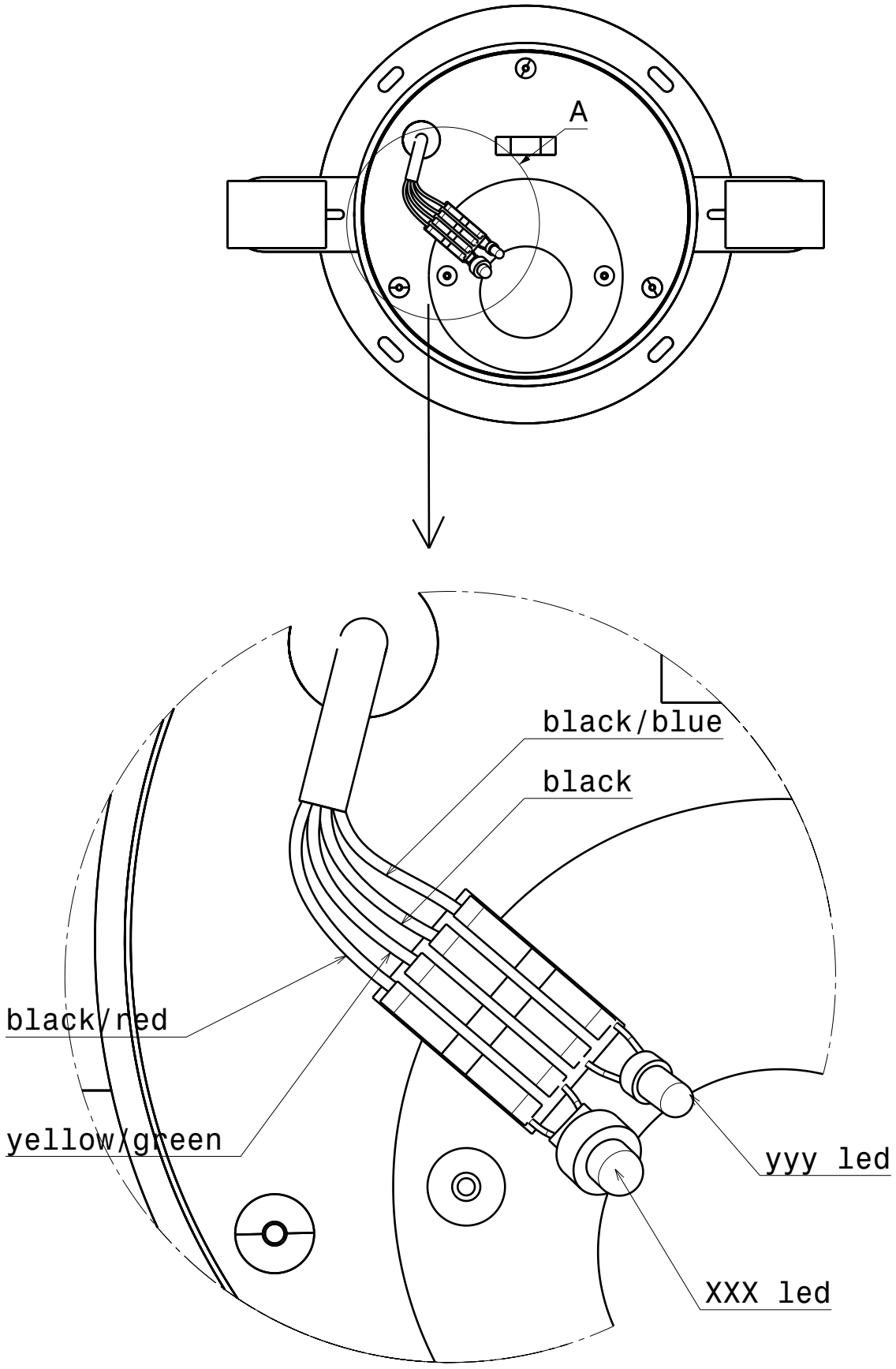
① Normal	LED 220 VAC 8mm diam. Voltage dependant on ship's power supply (24V, 220V)
② Emergency	LED 220 VAC 8mm diam. Supplpy 2xAlkaline AA batteries LR6 1.5 V

① The hood can be removed by loosing the knurled retaining screw.
② By loosing the screws of mirror housing, the viewing angle of the mirror can be adjusted.
③ Removing the hood and removing the compass to the binnacle this will permit acces to the compass light terminal block (nº 4), compass periscope lens (nº2) and compass correction system (nº5)





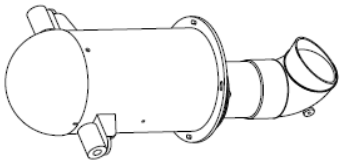
Nº	PART	REMARK
1	LIGHT ASSEMBLY PANEL	
2	LENS	
3	KRUNLED NUTS/LIGHT ASSEMBLY PANEL	
4	LIGHT TERMINAL BLOCK	
5	B+C CORRECTORS ASEMBLY	



Detail A
Scale: 1:1

2.4 Installation

2.4.1 REFLECTOR TYPE MAGNETIC COPASS SYSTEM



Nº	PART	MATERIAL	UNITS	REMARKS
1	BINNACLE STAND	ALUMINUM	1	
2	HELMET	ALUMINUM	1	
3	D-CORRECTOR	SOFT IRON	2	
4	B+C CORRECTORS	NiAlCo	2	4X40MM
5	LENS		1	V7 AD-DIAM 65 SPH+3,25
6	LAMP MAIN		1	LED 120-220VDC
7	LAMP EMERGENCY		1	LED 3,5VDC
8	TERMINAL BLOCK		1	
9	FIXED PIPE	PVC	1	
10	PERISCOPE TUBE	PVC	1	
11	TURNING ADJ. MIRROR	RUBER	2	
12	MIRROR		1	
13	COMPASS BOWL		1	

DRAWING 01.1714 | REFERENCIA DEL COMPONENTE --- | Cam. | Fecha diseño 07/2020 | Unidades mm | Plano/codigo/norma No definido

Denominacion PIEZA: REFLECTOR TYPE MAGNETIC COMPASS | Peso: --- Kg.

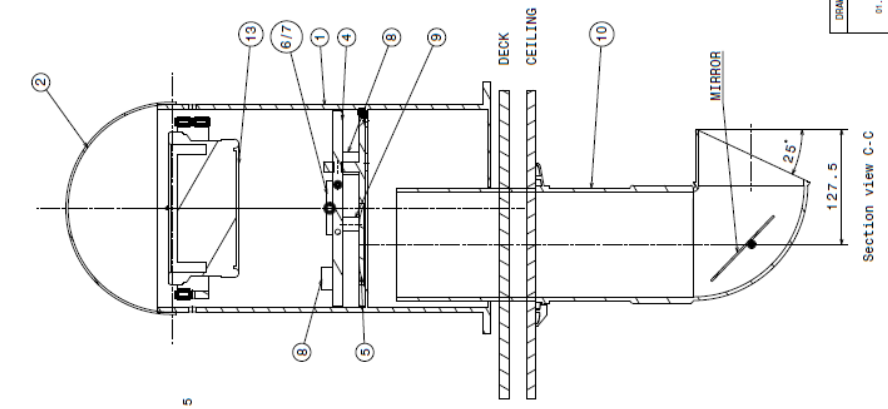
REFERENCIA CLIENTE: ----- | Sustituye a1: | Sustituido por:

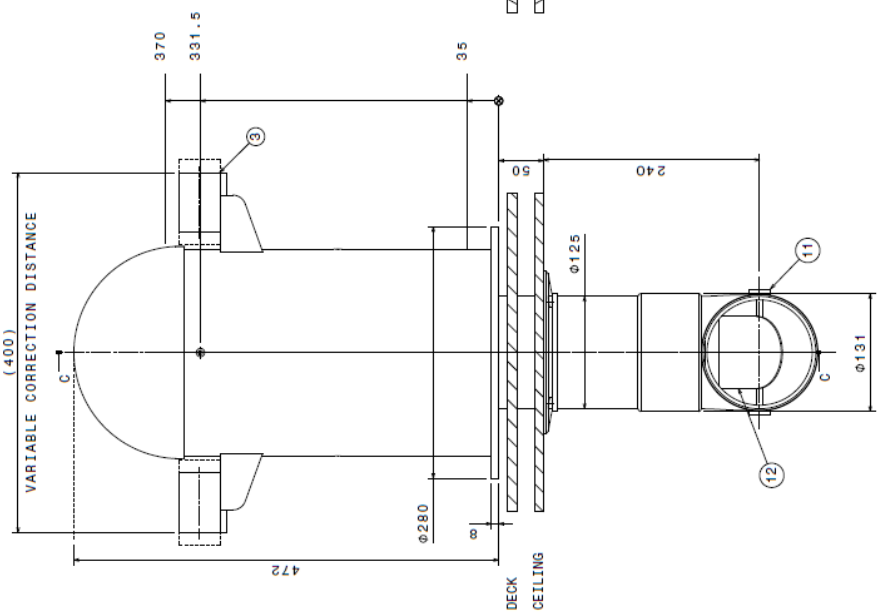
Diseño | CLIENTE: ------ | Referencia plano: ---

PROYECTO:

Tolerancia GENERAL: ±0,1

	Nombre	Fecha	Original en DIN A-2
Dibujado	---	07/2020	Escala: 1:3
Comprobado	---		Hoja Diseño 00





2.4.2 Installation Procedure

1. Drill pre-cut hole in the deck and drill and tap two x M2 holes.

2. Secure the reflector tube flange to the deck with four DIN 7982 2.9x16 screws with the rubber seal supplied throught the pre-cut holes in the deck and binnacle.

3. Drill four M40 attachment holes in the deck. See installation drawing 01.1719 BINNACLE PLATTFORM .

4. Connect the illumination power supply cables from the ligth terminal box to the ship's power supply.

5. Place the binnacle over the reflector tube and loosely secure it to the deck with the washers and M4 bolts need it.

6. Open sliding mechanism of the pivot bearing and position the compass, with its pivots, over the pivot bearings in the binnacle.

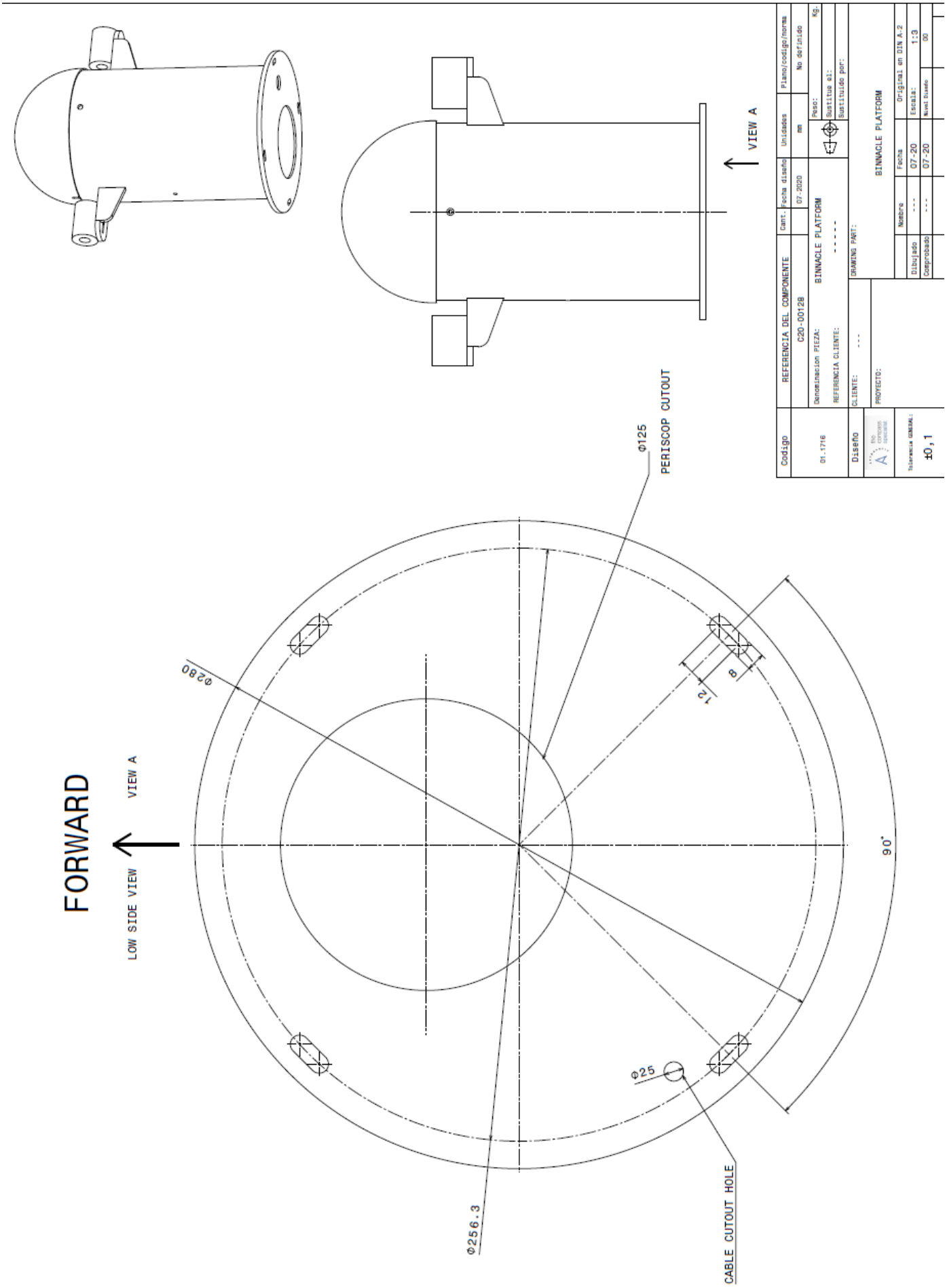
7. Secure the compass closing the sliding mechanism to engage the gimbal pivots into the pivots bearings..See picture details on Figure nº 1

8. Align the binnacle parallel to the fore/aft line of the ship by using a straight line between the 360º and 180º points on the external compass bearing ring, or between the center boss on the top verge glass and the forward lubber line.

9. Secure the binnacle to the deck with the mounting bolts already fitted.

10. Fit the hood to the binnacle and secure with the knurled retaining screw.

01.1719 BINNACLE PLATTFORM



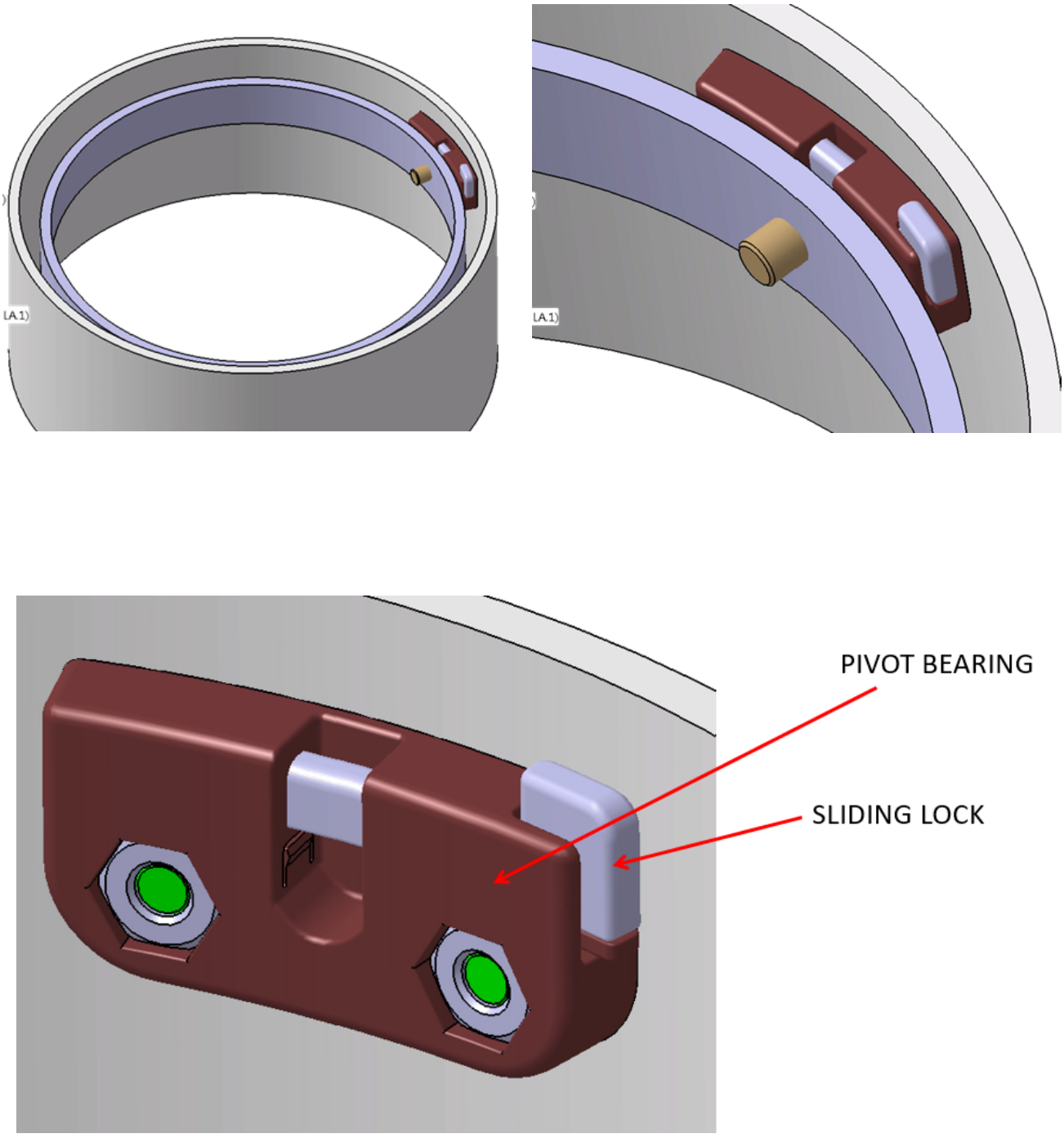


Figure nº 1

3. Azimuth Reading Device

The C20-00136 azimuth reading device is designed for group 1 of which necessary sights required to aim at distant objects exactly.
It is belongs to the C20 series compass bow which has 125mm of card diameter.
All parts of azimuth reading device are manufactured from non-magnetic material.
The field of view of the , azimuth reading device is more than 5° in the horizontal plane on each side of the line of sight.
The altitude range covered by theC20-00136 azimuth reading device is at least 5°(15°) below and 30°(more than 90°) above the horizon using observation mirror.

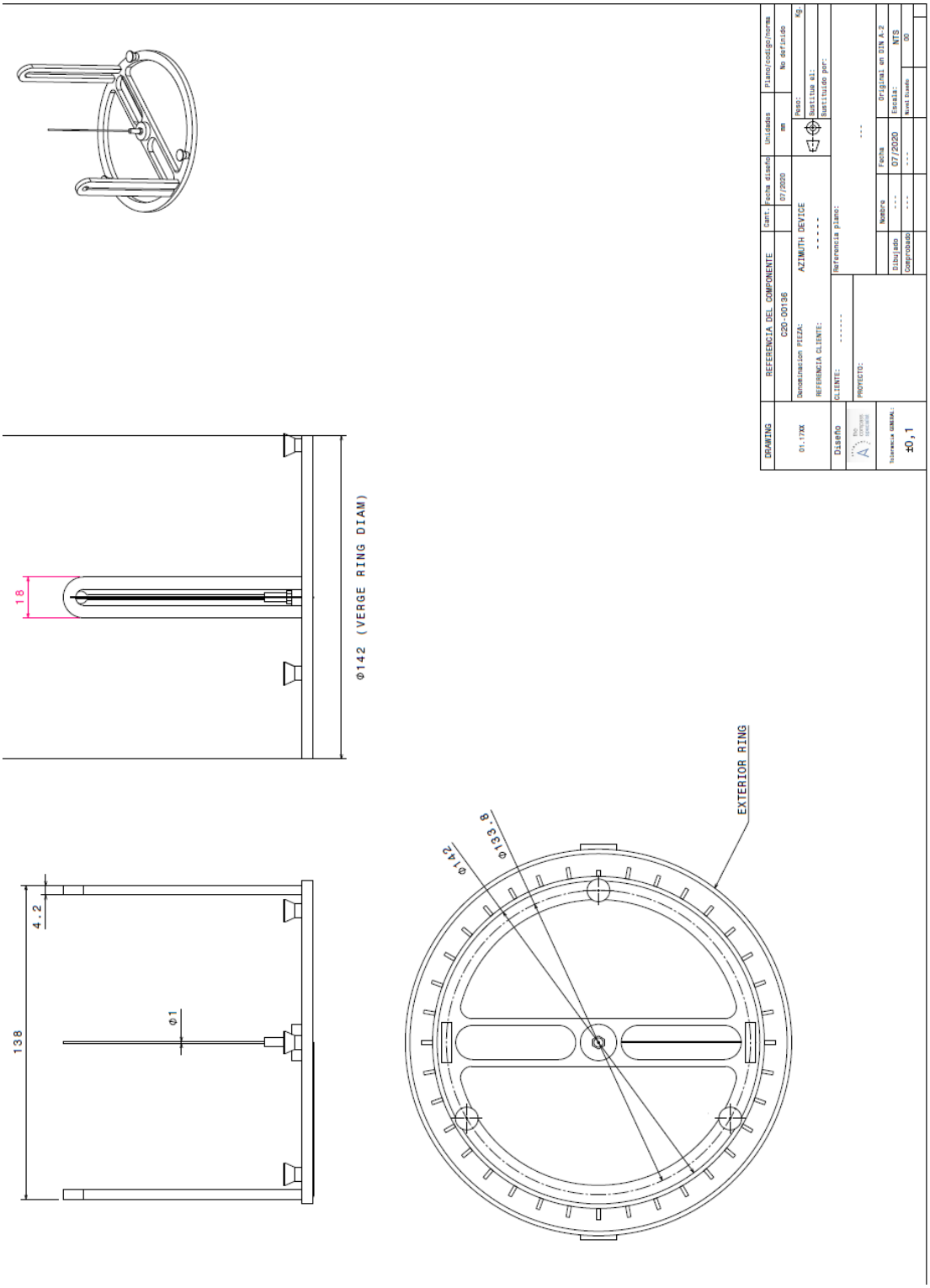
3.1 Composition

The vertical bearing thread of the object vane and the slit of the eye vane are parallel to each other.
The plane of sight defined by the object and eye vanes are perpendicular to the top glass or to the verge ring of the compass respectively and the plane of sight is pass through the rotation axis of the azimuth reading device.

In addition it contains the horizontal bearing thread for card bearing, as well as the index mark for bearing relative to the ship’s head on the verge ring graduation.

3.2 Drawing

C20-0013AZIMUTH DEVICE



Maintenance

Compass Bowl

The compass bowl should be regularly inspected to ensure that there are no leaks or bubbles. In addition, the upper and lower glass should be maintained in a clean condition, and the compass gimballing checked.

A few times per year, and more regularly on vessels with high vibration levels or following heavy weather, an operational test should be carried out on the magnetic compass to ensure that no friction has developed on the pivot and jewel. This operational test should be carried out as follows:-

Whilst the vessel is alongside, bring a magnetic object towards the compass so that the heading is deviated by 2 degrees. Hold the deviated compass card in this position for 10 seconds, and then release by removing the magnetic object. When the compass card settles it should be within 15 seconds of arc of the original heading. If the compass card does not return within this limit then there is a high level of friction between the pivot and jewel. The compass should be overhauled by a competent authority.

Binnacle

The C20 Binnacle has one of the simplest periscope arrangements, utilising only one lens and mirror. The lens is easily removed for cleaning at periodic intervals from the foreward side of the binnacle.

The only area where maintenance may be required is with the binnacle lighting. There are two LED lamps within the binnacle, and an additional spare, all accessible by removing the binnacle hood and compass bowl as described.

5 Compass Adjustment

Magnetic compass adjustment and test to be carried out during sea trial by Shipyard.

The Magnetic compass maker do not provide a compass adjustment service.

Compass Adjustment is the method of analyzing and compensating for deviating forces of a vessel's magnetic compass.

A magnetic compass should always align steadily to the earth's magnetic field, pointing to magnetic north.

However, steel, electronic instruments or equipment, and even the type of cargo carried, can cause the compass needle to point away, or deviate, from magnetic north.

Compass adjustment is necessary to compensate these deviating forces with correctors.

The adjustments should be made by a compass adjuster who holds a Certificate of Competency as Compass Adjuster.

ANNEX 1

C20-00132 NMEA0183
COMPASS PICK-UP USER MANUAL

October 2022
C20-00132 manual 13
Hardware version 3
PCB 7319-6
PCB 7322-3
Software version V040

Table of Contents

1. Description

The Autonautic C20-00132 is a complete sensing and processing sub-system for a compass indicating system which gets its heading information from a main or 'master' compass. It derives its output from the position of the powerful permanent magnet inside the main compass.

The C20-00132 contains a dual-axis fluxgate magnetometer surrounded by high-precision interface circuits which, together with the special clockwise/anticlockwise and a sequence to null offsets allow a microprocessor to acquire a binary value from the two orthogonal sensors of the direction of the field created by the main compass. The processor calculates the vector from these values and then presents the data in a manner which has been requested. Such requests alter the frequency of the data, the degree of filtering and the offset value. Calibration sequences can also be commanded.

The embedded software can be uploaded by command so that special or updated versions releases can be put into the C20-00132 to replace the previous software. These data files may be sent from Autonautic by email or downloaded from our website.

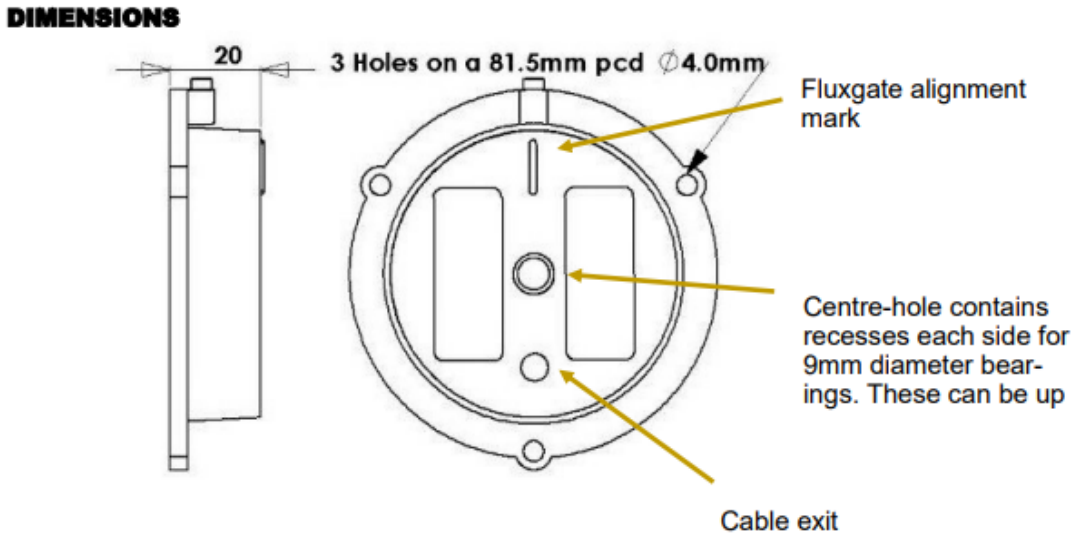
2 Installation

2.1 Mounting

The C20-00132 is fixed to the base of the ship's compass using the fixing holes shown in the data sheet. The cable hangs down directly from the labelled side of the housing with a Snap-In IP67 Male cable connector.

The C20-00132 is supplied with compass sensor adhesive mount and 3 screws and washer to fix the pick-up coil to the sensor base and 3 m multicore data cable tail with Snap-In IP67 female cable connector,

To prevent errors when mounted, the sensor must be parallel and concentric with the compass card.



It does not matter which way it faces as the azimuth can be set to North at any time. But some installers prefer to align the internal sensor to magnetic North and to facilitate this the C20-00132 is provided with an alignment mark and a rotatable housing assembly.

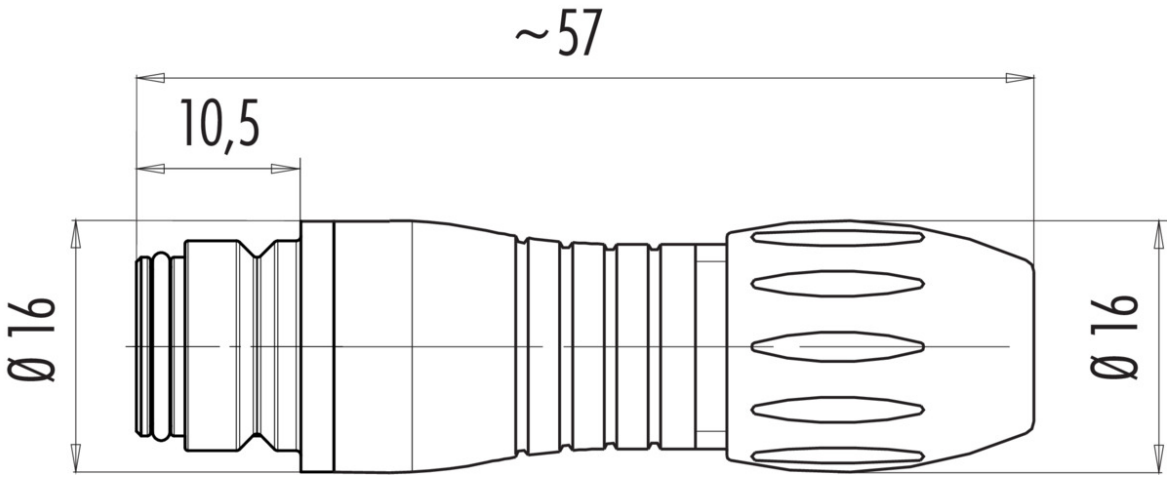
NOTE 1 The heading data is suppressed when the field is low – see the RXY command in section 4.2.14

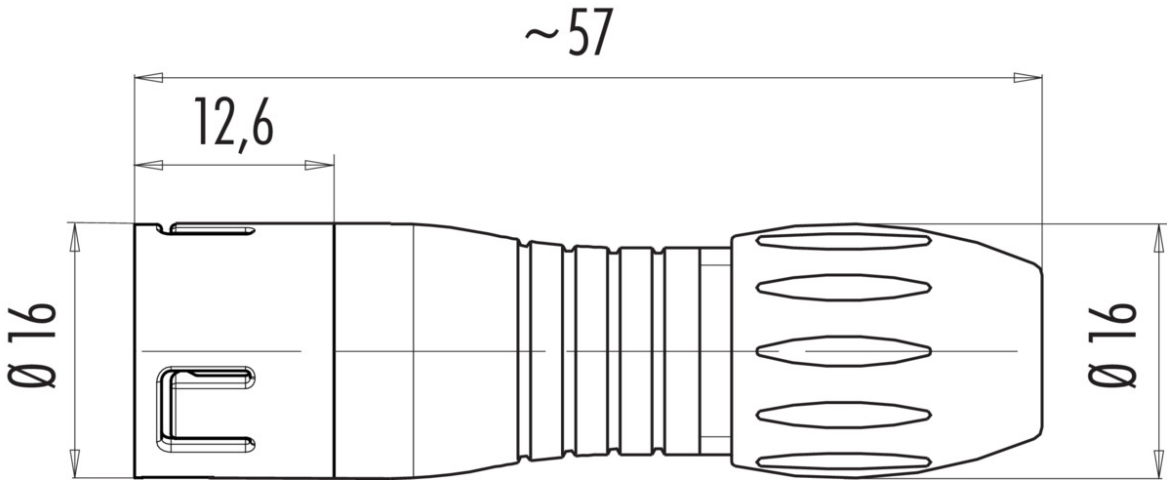
NOTE 2 The heading data is also suppressed when the field is high. See 4.2.14

2.2 Power supply

The compass is compatible with any DC power supply of between 8 and 30 V but note that for nominal 24V operation a 1W resistor of 330ohms should be inserted in the supply wire. This applies to any power supply of greater than 18V. Note that the maximum voltage must not be greater than 30V.

Typical supply current during operation is approx. 25mA. The compass is protected against reversed polarity.





Care should be taken to make sure the compass is not situated too close to the power supply, as it's accuracy may be affected by either the iron in the mains transformer, or by magnetic field 'noise' from a switching power supply. But this is unlikely as the C20-00132 will be mounted on a fixed compass which should have been sited correctly.

Note that the output from the C20-00132 takes several seconds to stabilize after power is applied; the time taken depends on the damping settings. There is a command - see section 5 – which can be used to suppress the output after power-up.

2.3 Connection

Check the datasheet that this table is valid for your version.

Wire	Colour	Type	Function
1	Red	Power	+8 to +30V note 1
2	Blue	Signal	NMEA OUT+
3	Green	Signal	NMEA IN+

4	Yellow	Signal	NMEA IN-
5	Screen	Power and Signal	GROUND 0V

Note 1 For nominal 24V operation a 1W resistor of 330ohms should be inserted in the supply wire.

2.3.1 Compass to a NMEA-0183 instrument

The hardware on which the NMEA-0183 standard is based on is a balanced serial protocol called RS422. This means that two wires are need for send and two for receive.

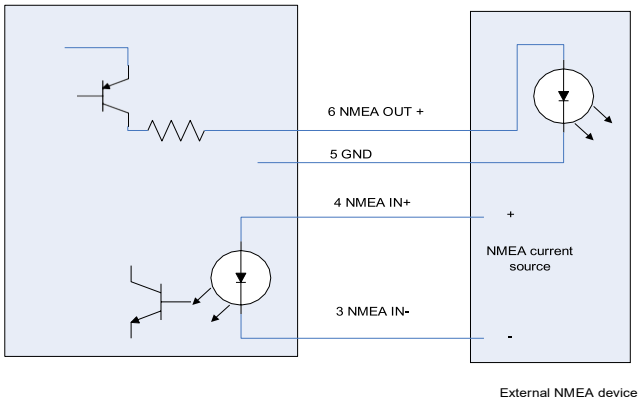


Fig 1

Note that the GND wire is used for the current return path. This might be shared with the NMEA- wire in some installations.

2.3.2 Compass to a PC serial port

In many cases the wires can be joined directly as shown in Fig 2. Alternatively use the Autonautic A3036 serial interface unit.

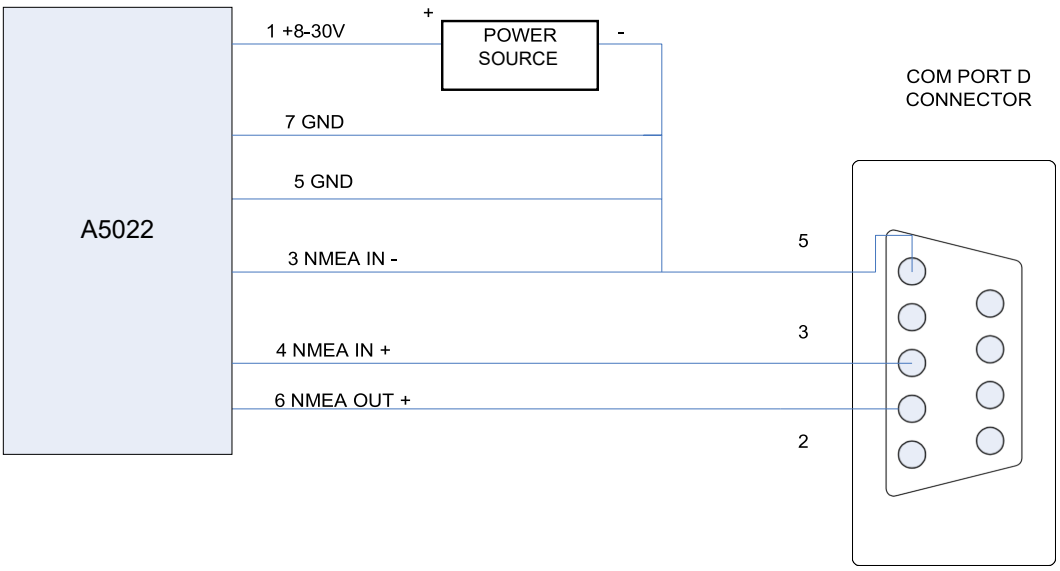


Fig 2

3 Calibration

3.1 Basic Calibration Operation

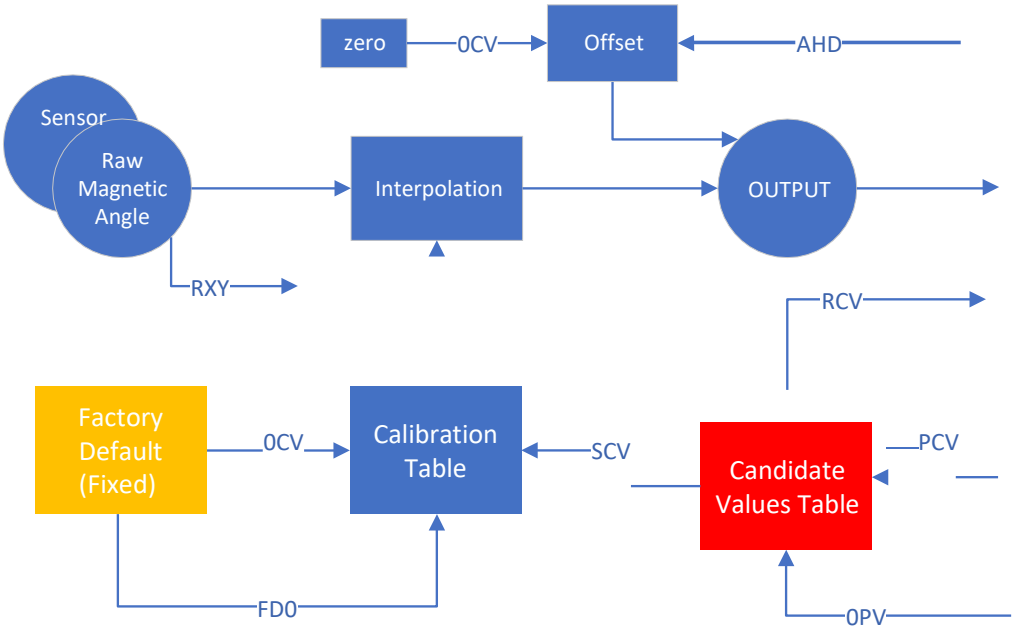


Fig 3

This diagram is intended to illustrate the operation of commands involved in the calibration process.

The Calibration Sequence is:

- Send 0CV
- Turn the compass so it points to 0 i.e. it is pointing magnetic North
- Rotate the C20-00132 until the output angle is zero
- Send a sequence of PCV commands while the compass is rotated
  - one every 10deg
- Send SCV to update the table used for correction

3.2 Use of PC Calibration Software Tools

This describes the operation of the two Autonautic C20-00132 Calibration software tools
Factory Utility 1.13 and
P6033 Calibration Tool V1.02

[Note that the Calibration Tool is only for use with C20-00132 firmware v040 and later]

This normally is delivered packed as a zip file: *C20-00132 Cal tool kit.zip*

This must first be unpacked so it can be used. Once that is done the files can be installed.

Open the Factory Utility 1.13 directory and use the file called *setup.exe*
This is likely to cause your PC to advise against it – but ignore the warnings and complete the installation

Similarly, open the P6033 Calibration Tool V1.02 directory and use the file also called *setup.exe* to install it.
This is also likely to cause your PC to advise against it – but, again, ignore the warnings and complete the installation.

Hardware notes:

1 The C20-00132 is to be attached to a magnetic compass which itself can be rotated while the C20-00132 does not move relative to the compass so that, at all times, the C20-00132 data represents the angle of the magnet of the Compass.

2 The PC will have a port assigned to the USB-RS232 cable attached to the C20-00132 and the number of this port must be found from the Device Manager Windows utility. Eg COM 6

Once this is operating the software can be used as follows:

Note that the [bracket] means the button on the screen of that name.

1 Connect the C20-00132 to the Autonautic Factory Utility V1.12 with the correct port selected (see note above) and use the [CONFIG] button to put a command string into the send panel on the screen which looks like this:

PATC,IIHDG,CFG,020

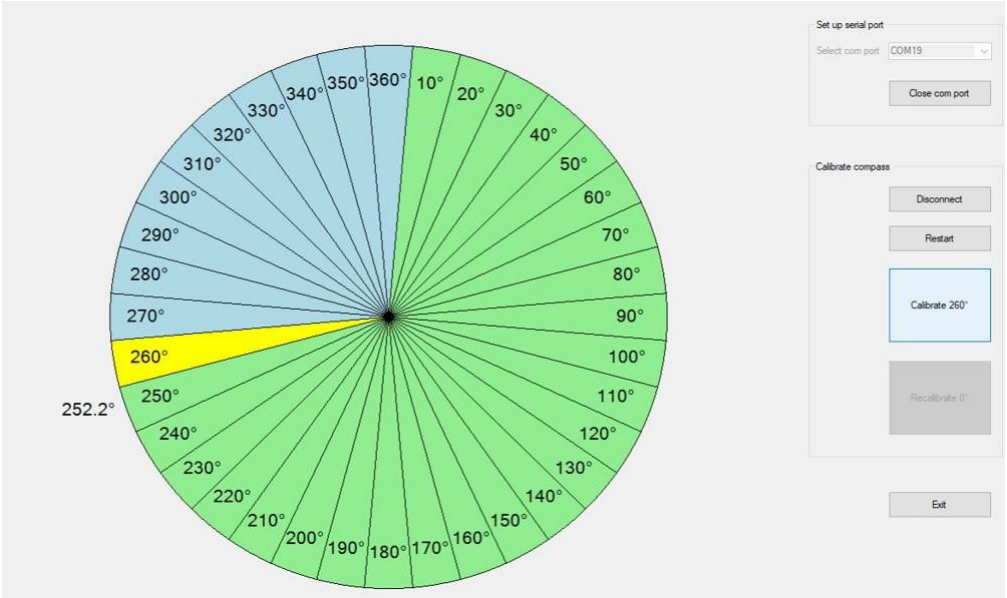
Make sure that the field is 020 as above – edit it so that it does. Then press [SEND] so that the message now uses the **HDM** format which you can see in the scrolling window.

2 The press [SCI] and adjust the field at the end of the command so it shows the calibration angle interval you wish to use - usually 10 and then press [SEND]

3 Close the port (but leave the program running) and open the Calibration Tool V1.02. Open the correct comm port to connect. Then adjust the Compass so the needle is at 0.0 and adjust the C20-00132 by rotating it so it too reads 0.0. Then press [START]

4 Click [Calibrate 0] and this button changes to 'Calibrate 10'. Turn the Compass so that it points to 10deg and press [Calibrate 10] which then changes to 'Calibrate 20' and so on. The output of the C20-00132 appears on the screen but will not exactly match the heading – that is purpose of calibration.

5 The sectors on the screen change colour as each point is set.



6 When the button says 'Calibrate 360' DO NOT press it but close the com port with [Close com port].

7 On the Autonautic Factory Utility V1.12 screen reconnect the port. Then press [SCV] to transfer the points to the internal calibration tables within the C20-00132. Which is now calibrated.

8 Note that if you don't like a point you can go back to it and reset it using the [PCV] button but any change must be transferred with [SCV]

9 If you do not want to continue with the HDM format use the [CFG] button to load the configuration string into the text window and edit it to give you the format you want according to the details in section 4.2.4

Use the buttons on the PC screen to use either the calibrated table [SCV] or the uncalibrated values [0CV].

4 NMEA-0183 Serial data

4.1 General Format

The serial output format is: 4800 Baud, 8 data bits, 1 stop bit, no parity but note that it is not NMEA-0183 at the physical level – solely in the meaning of the data.

The compass sends information using the standard NMEA-0183 sentence 'HDG': Magnetic Heading, Deviation, and Variation. But note that the information of Deviation and Variation is not sent and so blank fields are defined by consecutive commas. In the C20-00132 the sentence may have one of several forms typically of the general form:

$HCHDG,hhh.h,,,,*ssss<CR><LF>

Note that the first character is typically $ but the C20-00132 will respond correctly even if it is missing.

4.2 List of Command in V040 of the software

4.2.1	0CV	Factory default calibration values; zero heading offset;
4.2.2	0PV	Set the calibration candidate table to factory default values
4.2.3	AHD	Set heading offset
4.2.4	CFG	Configure NMEA sentence output format
4.2.5	DHD	Set heading damping value
4.2.6	DLY	Set power up delay
4.2.7	FDO	Factory default: fluxgate heading output rate; fluxgate damping factor; last calibration error code
4.2.8	INV	Set normal / inverted compass mount
4.2.9	PCV	Read current heading, calculate and program calibration value
4.2.10	RCV	Read calibration values

4.2.11	RHD	Read heading damping value
4.2.12	RHO	Read heading offset
4.2.13	RID	Read device serial number
4.2.14	RXY	One shot read of raw ADC values: X, Y, REF,Vector,Temperature
4.2.15	SCV	Copy calibration bank 2 to bank 1
4.2.16	SR	Read software version
4.2.17	TMP	Set temperature output period
4.2.18	TXP	Set NMEA output period
4.2.19	TXY	Toggle RXY
4.2.20	UPLOAD	Enter bootloader

4.2.1 0CV

$PATC,IIHDG,0CV<CR><LF>

Sets the following:
Output rate u= 100 milliseconds (10 updates/second),
output damping d= 50 percent
heading offset f= 0 degrees.
Calibration Table to Factory Settings (i.e. not calibrated)

4.2.2 0PV

$PATC,IIHDG,0PV<CR><LF>

Sets the Candidate Calibration Table values to Default (see Fig 3)

4.2.3 AHD

$PATC,IIHDG,AHD,fff.f<CR><LF>

Set heading:

Forces the heading to a certain value by supplying an offset which is stored and used thereafter.
Where f is in degrees with a valid range of 000.0 to 359.9
When f = 000.0 the result is the same as pressing switch 2 – see 1.3.
Do not use this when calibrating.

4.2.4 CFG

$PATC,IIHDG,CFG,ab<CR><LF>

Configures the output sentence structure and type.

[Replies with the standard acknowledge sentence
$PATC,HCHDG,ACK<CR><LF>]

Where 'a' specifies the heading of the output sentence as follows:

a=0 : ***$HCHDG,hhh.h,,,,<CR><LF>***
a=1 : ***$HCHDT,hhh.h,T<CR><LF>***
a=2 : ***$HCHDM,hhh.h,M<CR><LF>***
a=3 : ***$HCHCC,hhh.h<CR><LF>*** *- default*
a=4 : ***$HEHDT,hhh.h<CR><LF>***
a=5: no heading data sent

hhh.h is the compass heading in degrees
(this compass heading field will be omitted when auto-calibration is in process)

and 'b' is sentence end structure as follows:

b=0 : direction sentence will NOT include checksum nor unit ID serial number.
e.g. ***$HCHDG,hhh.h,,,,<CR><LF>***
b=1 : direction sentence will include a checksum.
e.g. ***$HCHDG,hhh.h,,,,*cc<CR><LF>*** (cc is the checksum)
b=2 : include the serial number.
e.g. ***$HCHDG,hhh.h,,,,*ssss<CR><LF>*** (ssss is the unit's serial number)

4.2.5 DHD

$PATC,IIHDG,DHD,ddd.d<CR><LF>

Set the internal filtering: ('damping')

Valid range for d is 2 to 30 with the default set at 15.

4.2.6 DLY

$PATC,IIHDG,DLYn.n<CR><LF>

Startup Delay
Sets a delay from Power-up to the transmission of the first output sentence where n.n is in seconds with a maximum of 6.5

4.2.7 FD0

$PATC,IIHDG,FD0<CR><LF>

This is very similar to 0CV except that the calibration tables are unchanged.

4.2.8 INV

$PATC,IIHDG,INV,a<CR><LF>

Set device mounting preference
where :
a=0 device mount normally (i.e. top of fluxgate pointed upward)
a=1 device mount inertly (i.e. top of fluxgate pointed downward)

The C20-00132 replies with the standard acknowledge sentence

4.2.9 PCV

$PATC,IIHDG,PCV,aa0<CR><LF>

This command should be used only after sending the 0CV command.
The PCV command has the following format:
where angle is in degrees 0 <= aa0 <= 360 and must be a multiple of 10°.

To perform full calibration:
$PATC,IIHDG,PCV,0
$PATC,IIHDG,PCV,10
$PATC,IIHDG,PCV,20
…
…
$PATC,IIHDG,PCV,340
$PATC,IIHDG,PCV,350

NOTE: $PATC,IIHDG,PCV,360 is not supported.

If the calibration is successful and within allowed limits ACK is sent back otherwise a NACK is sent back:

$PATC,IIHDG,PCV,340
$PATC,HCHDG,ACK successful

or

$PATC,IIHDG,PCV,322
$PATC,HCHDG,NACK not successful because angle not multiple of 10°.

or

$PATC,IIHDG,PCV,320
$PATC,HCHDG,NACK not successful because at 320° the P6033 thought it was at < 290° or > 350°. It must be within +/-30°

There is no checking by the P6033 to make sure all 37 points have been manually calibrated. This should be done at a higher level by the PC utility sending the PCV commands. The points can be calibrated in any order and recalibration of any point can be done at any time provided the pickup thinks it is within +/-10° of the point.
By implication an error of greater than +/-10° cannot be corrected.

4.2.10 RCV

$PATC,IIHDG,RCV<CR><LF>

This command is to read the calibration table values and the response is in the form of the example shown below:

$TCF,0,0000,071C,0E38,1554,
$TCF,1,1C70,238C,2AA8,31C4,
$TCF,2,38E0,3FFC,4718,4E34,
$TCF,3,5550,5C6C,6388,6AA4,
$TCF,4,71C0,78DC,7FF8,8714,
$TCF,5,8E30,954C,9C68,A384,
$TCF,6,AAA0,B1BC,B8D8,BFF4,
$TCF,7,C710,CE2C,D548,DC64,
$TCF,8,E380,EA9C,F1B8,F8D4,

4.2.11 RHD

$PATC,IIHDG,RHD,nn<CR><LF>

Request internal filter response
Where nn is the damping value within the range 0 to 30

4.2.12 RHO

$PATC,IIHDG,RHO<CR><LF>

$PATC,IIHDG,RHO,nnn.n<CR><LF>

Where nnn.n is the heading offset **Note** that leading zeros are suppressed eg 0.0

4.2.13 RID

$PATC,IIHDG,RID<CR><LF>

Request the serial number:
A special proprietary reply sentence follows:

$PATC,IIHDG,RID,ssss<CR><LF> where ssss is the serial number in ASCII decimal.

4.2.14 RXY

$PATC,IIHDG,RXY<CR><LF>

Returns the magnetic sensor values of X, Y, the reference voltage and the field vector and Temperature in decimal with the range 0 to 4095.

$RXY,xxxx,yyyy,vvvv,tttt,*cc<CR><LF>

A value of zero field is represented by 0. The internal analogue zero is not sent as it has already been corrected for.
The main purpose is to check that the magnetic field is not so high that it overloads the sensor (by the strong field of the compass magnet to which it is attached) nor is so low that the output will be noisy.

See also 4.2.21 for the MFE field strength warning message details.

4.2.15 SCV

$PATC,IIHDG,SCV<CR><LF>

Copy calibration data into the Calibration Table to be used for all subsequent outputs. This is why is must be cleared before calibration so that the data used for calibration is 'raw' magnetic data.

4.2.16 SR

$SR <CR><LF>

Read device firmware release
A typical response from a unit is as follows:
$SR,A5024,016,02<CR><LF>
showing the release is 016.

4.2.17 TMP

$PATC,IIHDG,TMP,rr

Set rate at which temperature data is sent.

where rr is the rate from 0 (default) to 30.

$PATC,IIHDG,TMP,0 disables the temperature display feature
$PATC,IIHDG,TMP,1 sets the temperature display rate to the fastest rate of once a minute
$PATC,IIHDG,TMP,10 sets the temperature display rate to a value in between, in this case, once every 10 minutes.
$PATC,IIHDG,TMP,30 sets the temperature display rate to the slowest of once every 30 minutes

When the set temperature display rate command is issued the temperature is displayed within 1 second and then repeats at the new rate set.
The rate setting is stored in non-volatile memory.

The ouput of temperature has the following format:

$TEMP,tt
OR
$TEMP,tt*cc if checksum is enabled in HCHDM heading output display where cs is checksum

Where tt is temperature and has the following range and format:
-20 to 70
Leading zeros suppressed. Negative temperatures displayed with '-'. E.g.: -10, -9 etc..
Zero and positive temperatures displayed purely with digits. E.g. 0, 9, 19 etc..

4.2.18 TXP

$PATC,IIHDG,TXP,uuuu<CR><LF>

Set the Output update period:

Valid range is u=100 (default) to 2500 milliseconds. This is limited by the maximum data rate of NMEA-0183 output at 4800 baud.

4.2.19 TXY

$PATC,IIHDG,TXY<CR><LF>

Toggle RXY

This command sets a flag to enable the transmission of the data of the RXY command continuously interleaved with the heading. By sending the command again the flag is cleared; it is also cleared on power-up.

4.2.20 UPLOAD

This command is used by Autonautic's updater software which runs under Microsoft Windows. It is used to send **.aeh** files to install a new version of firmware.

4.2.21 Out-of-range output

Interleaved with the normal data there is a special message sent every 500ms if the field strength is deemed to be out of range.

Typical examples are:

Low:
$PATC,HCHDG,MFE,119,LOW*65 interleaved with $HCHCC,*6F

High:
$PATC,HCHDG,MFE,1652,HIGH*06 interleaved with $HCHCC,*6F

Where the value following the MFE is a representation of the field strength.

5 References

C20-00132 data sheet
NMEA-0183 specification