



Operational Directorate Natural Environment  
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## *Oceanographic Research Vessel BELGICA : TECHNICAL DESCRIPTION*

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**Revision**

Revision number	Date	Description of changes	Author
1.0	December 2014	Revised version	MSO
1.1	January 2015	several small corrections	RVdB

## 1 General characteristics

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As a result of its extensive infrastructure, the oceanographic research ship RV BELGICA can perform many assignments in the field of:

- physical oceanography
- chemical oceanography
- biological oceanography
- seabed studies
- geology and geophysics
- fishing research

The preferred operating region comprises the North Sea up to 60 ° N, the Channel up to 48° N and the Irish Sea up to 10° W.

The main characteristics and dimensions of RV BELGICA are:

<i>overall length</i>	<i>50.90 m</i>	
<i>length between midship perpendiculars</i>	<i>44.95 m</i>	
<i>overall width</i>	<i>10.00 m</i>	
<i>height to the main deck</i>	<i>5.70 m</i>	
<i>depth min./max.</i>	<i>4.20 m / 4.55 m</i>	
<i>gross registered tonnage</i>	<i>765 t</i>	
<i>net registered tonnage</i>	<i>232 t</i>	
<i>water displacement</i>	<i>1132 t</i>	
<i>autonomy</i>	<i>distance</i>	<i>5000 miles at 12 knots</i>
	<i>time</i>	<i>20 days</i>
<i>freshwater stock</i>	<i>98 m<sup>3</sup></i>	
<i>engine fuel stock</i>	<i>165 m<sup>3</sup></i>	
<i>In order to obtain the best operating conditions, the rolling of the ship can be limited by an anti-roll stabiliser (passive roll tank) with a content of 10 tonnes of water.</i>		

**Table 1: main characteristics**

RV BELGICA is built according to the Germanischer Lloyd standards:

**"GL + 100 A4 = MC AUT 16/24 RESEARCH VESSEL"**

<b><i>Call sign</i></b>	<i>ORGQ</i>
<b><i>IMO number</i></b>	<i>8222563</i>
<b><i>MMSI number</i></b>	<i>205.218.000</i>
<b><i>e-mail address</i></b>	<a href="mailto:belgica@mumm.ac.be"><i>belgica@mumm.ac.be</i></a>

## 2 Residential accommodation

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RV BELGICA is built to accommodate 31 people:

- **crew : 15 people**
- **scientific staff : 16 people** (provided accommodation container suitable for 4 people is used)

Every room, laboratory, and the pilothouse, has air conditioning.

The noise in the rooms is limited to a maximum of 60 dBA.

The accommodation is arranged as follows:

### 2.1 Upper deck (level 01):

---

- commander (single cabin)
- first officer and 2 petty officers (two double cabins)
- 6 scientific staff, including the scientific coordinator (three double cabins)
- mess / meeting room for staff and scientists

The first officer's double cabin can be used as a sick bay.

### 2.2 Lower deck (level 02):

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- 11 crew members (5 double cabins and 1 double cabin shared with a scientist)
- 5 scientists (2 double cabins and 1 double cabin shared with a crew member)

### 2.3 Accommodation container:

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- 4 scientists

### 3 Propulsion

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#### 3.1 Main drive

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- Diesel engine: "ABC DZ", 6 cylinder, 1154 kW
- Gearbox: "REINTJES" (2.8636 :1)
- Axle and screw propeller: "KAMEWA", skewed back type, with adjustable speed and nominal speed of rotation of 360 rpm, (diameter 1.95 m), fitted in a nozzle.
- Rudder: "JASTRAM" with high efficiency and continuously operated hinged rudder blades, driven by a hydraulic control machine, "BRUSSELLE".

#### 3.2 Bow and stern screw propellers

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The high speed "JASTRAM" bow and stern propellers are each driven by a 150 kW hydraulic motor. These transverse propellers help the ship stay better in position when doing oceanographic activities in a measuring station.

#### 3.3 The electrical drive

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The electrical drive for the propulsion system enables the Belgica to sail slowly while keeping the underwater noise levels well below those of the main engine.

An 82 kW electric motor, driven by one of the two main generators, is then electromagnetically coupled to the propeller axle after the main engine has been disengaged.

#### 3.4 Operation of the drive systems

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The operation of the drive systems is centralised in the ship's pilothouse. The transverse propellers can be operated from both the central console in the pilothouse and from the wings of the bridge.

#### 3.5 Performance

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- max. speed : **12.5 knots**
- nominal speed : **10 knots (850 rpm)**
- speed during fishing activities : **4 knots**
- min. traction at 4 knots : **8 tonnes (fishing)**

#### 3.6 The automatic control and alarm system

---

The various control and alarm signals in the machine room are automatically sent to the bridge.

## 4 Electrical system

### 4.1 General

- Two main generators
  - Diesel engine: "CATERPILAR" 275 kW
  - Alternator: "VAN KAICK", 325 kVA, 440 V, 60Hz
- The available network voltages and the respective powers are given in table 2.
- The energy supply for the scientific measuring equipment and the IT systems comes from a static converter ("uninterruptible power supply") Aros Sentry RPS, 220 V 50 Hz, power 20 kVA.

### 4.2 Special facilities

- In order to safeguard the stabilised network voltage 220 V- 50 Hz, the geophysical equipment (Boomer, Sparker, etc.) is supplied via the 220 V- 60 Hz network.
- The various generators are mounted on dampers to reduce the vibrations transmitted to the hull (damping of frequencies between 0.1 and 5 kHz).

<b>LOCATION</b>	<b>Voltage (V)</b>	<b>Freq.(Hz)</b>	<b>Phases (No.)</b>	<b>Board/Circuit (No.)</b>	<b>Circuit Breaker (A)</b>	<b>Power (kVA)</b>
<b>BRIDGE</b>	220	60	1	L602/24	16	3.5
	220	50	1	L703/1	16	3.5
	220	50	1	L703/2	16	3.5
	24	DC		EB 25	10	0.24
<b>REAR DECK</b>	440	60	3	P120	50	38
	440	60	3	P105	6	4.5
<b>FISH LAB</b>	220	60	3	L607	32	12
	220	60	1	L615/1	16	3.5
	220	50	1	L712/1	16	3.5
	24	DC		EB 20	10	0.24
<b>WET LAB</b>	220	60	3	L615/10	16	6
	220	60	1	L615/5	16	3.5
	220	50	1	L712/5	16	3.5
	24	DC		EB 18	10	0.24
<b>LAB 1</b>	220	60	3	L615/10	16	6
	220	60	1	L615/2	16	3.5
	220	50	1	L712/2	16	3.5
	24	DC		EB 18	10	0.24



<b>LAB 2</b>	<b>220</b>	<b>60</b>	<b>3</b>	<b>L615/10</b>	<b>16</b>	<b>6</b>
	<b>220</b>	<b>60</b>	<b>1</b>	<b>L615/3</b>	<b>16</b>	<b>3.5</b>
	<b>220</b>	<b>50</b>	<b>1</b>	<b>L712/3</b>	<b>16</b>	<b>3.5</b>
	<b>24</b>	<b>DC</b>		<b>EB 19</b>	<b>10</b>	<b>0.24</b>
<b>LAB 3</b>	<b>220</b>	<b>60</b>	<b>3</b>	<b>L615/10</b>	<b>16</b>	<b>6</b>
	<b>220</b>	<b>60</b>	<b>1</b>	<b>L615/4</b>	<b>16</b>	<b>3.5</b>
	<b>220</b>	<b>50</b>	<b>1</b>	<b>L712/4</b>	<b>16</b>	<b>3.5</b>
	<b>24</b>	<b>DC</b>		<b>EB 19</b>	<b>10</b>	<b>0.24</b>
<b>SHELTER ROOM</b>	<b>440</b>	<b>60</b>	<b>3</b>	<b>P102/5</b>	<b>16</b>	<b>12</b>
	<b>220</b>	<b>60</b>	<b>3</b>	<b>L615/12</b>	<b>16</b>	<b>6</b>
	<b>220</b>	<b>50</b>	<b>1</b>	<b>L712/7</b>	<b>16</b>	<b>3.5</b>
<b>CONTAINER DECK</b>	<b>440</b>	<b>60</b>	<b>3</b>	<b>P504</b>	<b>16</b>	<b>12</b>
	<b>440</b>	<b>60</b>	<b>3</b>	<b>P102/6</b>	<b>25</b>	<b>19</b>
	<b>220</b>	<b>60</b>	<b>3</b>	<b>L608</b>	<b>32</b>	<b>12</b>
	<b>220</b>	<b>60</b>	<b>3</b>	<b>L609</b>	<b>32</b>	<b>12</b>
	<b>220</b>	<b>60</b>	<b>1</b>	<b>L615/8</b>	<b>20</b>	<b>4</b>
	<b>220</b>	<b>50</b>	<b>1</b>	<b>L704</b>	<b>32</b>	<b>7</b>
	<b>220</b>	<b>50</b>	<b>1</b>	<b>L705</b>	<b>32</b>	<b>7</b>

Table 2: Electrical power supplies available for scientific purposes.

## 5 Hydraulic unit

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RV BELGICA has a "REXROTH" hydraulic unit consisting of 2 hydraulic systems:

### 5.1 Hydraulic system I and "auxiliary" system

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This system consists of:

- two main pumps, driven by the main engine with a flow rate of 500 l/min at 230 bar nominal speed
- two auxiliary pumps driven by electric motors with a flow rate of 220 l/min at 230 bar

The hydraulic system I powers the following equipment:

- the fishing winches
- the bow and stern propellers
- the net drum winch

## 5.2 Hydraulic system II

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This system consists of 2 pumps driven by electric motors with a flow rate of 133 l/min at 230 bar.

The hydraulic system II powers the following equipment:

- rear gantry
- side gantry and davit
- oceanographic winches

## 5.3 Hydraulic system for the EFFER crane

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This system consists of 2 pumps driven by electric motors with a flow rate of 42 l/min at 60 bar.

## 6 Navigation equipment

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The following navigation equipment is installed in the pilothouse. <sup>1</sup>

### 6.1 Ship's heading

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- **gyrocompass:**           **ANSCHÜTZ STD 20**
- magnetic compass:   MARINE DATA

### 6.2 Automatic pilot

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- ANSCHÜTZ, model 102-834

### 6.3 Radar

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- 1 DECCA Bridgemaster, model E 250
- 1 FURUNO FAR-2117 RADAR

### 6.4 Track plotter

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- Navi-Sailor 3000 navigation system from Transas connected with the DECCA Bridgemaster and the Furuno FAR-2117 radars.

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<sup>1</sup> The equipment printed in bold is connected to the ODASIII oceanographic data acquisition and processing system described in section XII.

## 6.5 Positioning systems

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Two GNSS (Global Navigation Satellite System) receivers:

- **MGBTECH with SEPTENTRIO AsteRx2eH RTK heading receiver:**
  - Accurate heading calculation using 2 antennas
  - possibility to receive RTK corrections via Radio ( ARWEST AW400BT UHF) or via VSAT (Flepos RTK network)
- **Furuno GP-150 EGNOS DGPS receiver**

## 6.6 Ship's speed

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- Doppler log (dual axis) **Consilium SAL 860 T**

## 6.7 Water depth (only for navigation purposes, see also chapter 13)

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- Echo-sounder: "ATLAS Echograph" model 481 digigraph (100 kHz), range 400 metres.

## 6.8 Automatic Identification System (AIS)

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- Furuno model FA 100

## 7 Telecommunications

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The telecommunications are housed in 2 locations:

### 7.1 The radio station

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- radio telephone transmitter - receiver: "DEBEG 7313" MHF/HF - SSB , 400W
- telex - radio converter: "REDIFFUSION GK 2000"

### 7.2 The pilothouse.

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- VHF - transmitter - receiver: DEBEG model 63303 25 W
- UHF - transmitter - receiver: ELTA model AM-21 EL / K – 1000
- automatic alarm receiver: DEBEG model 2340
- GMDSS system - VHF transmitter - receiver: JRC model JHS32A with printer model NKG-52 (connected to the DGPS)
- Furuno Navtex Receiver Model NX-700
- Inmarsat satellite communications:
  - Satcom Inmarsat –fleet 77 : Furuno Model Felcom with 128 kbps high speed option for data communications (E-mail [belgica@mumm.ac.be](mailto:belgica@mumm.ac.be)).
- VSAT system with Intellian V110 stabilised antenna
- G.S.M. Siemens S4r
- Fax. OKIFAX 460

## 8 Deck infrastructure and winches

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### 8.1 Swivelling telescopic hydraulic crane

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The "EFFER MARINE KNUCKLE, type 44.000-3SL/1M, model Knuckleboom crane with 3 hydraulic extensions" crane is located at the front of the rear deck.

Characteristics and power:

- Winch : SWL 2.0 tonnes lifting (4 tonnes in double reeved execution)
- Winch drum capacity : 80 m
- Max. load moment at base : 387 kNm
- Out reach (horizontal) max : 13.6 m

### 8.2 Fishing winches

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The two "Brusselle" fishing winches are located on the rear deck for use with the rearmost gantry.

Characteristics:

- maximum load 8 tonnes: hauling in 6.4 tonnes at 60 m /min
- local operation or from the pilothouse
- meters for the tension and length of the cables: local and in the pilothouse
- capacity:
  - BB winch                      1 drum with a capacity of 4000 m of 14 mm cable  
   1 drum with a capacity of 350 m of 24 mm cable
  - SB winch                        1 drum with a capacity of 1200 m of 24 mm cable  
   1 drum with a capacity of 350 m of 24 mm cable

### 8.3 Revolving rear gantry "A-frame"

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Characteristics:

- useful height                      5.90 m
- width on deck                        5.00 m
- capacity                                2 x 6 tonnes in the central area  
    2 x 8 tonnes on the outermost arm for fishing
- fitted with a detachable roller at 2.45 m above the bridge, for the passage of nets
- inboard operating distance        4 m
- outboard operating distance       2.5 m

## 8.4 Net drum winch

---

The "BRUSSELLE" net drum winch is located at the back of the top deck and has the following characteristics:

- capacity 7 m<sup>3</sup> / 5 tonnes
- pulling power 14.8 tonnes with a diameter of 0.47 m at 25.9 m/min  
3.5 tonnes with a diameter of 1.98 m at 109 m/min

## 8.5 Revolving gantry

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The revolving gantry located on the side working deck (main deck) has the following characteristics:

- capacity **1 tonne**
- inboard / outboard operating distance **1 m / 2.5 m**
- useful width **1.3 m**
- maximum height **3 m**

## 8.6 Davit with measuring reel

---

The davit with measuring reel on the side working deck (main deck):

Characteristics:

- capacity **0.5 tonne**
- inboard / outboard operating distance **1 m / 2.5 m**
- maximum height **1.8 m**

## 8.7 Oceanographic winches

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Two oceanographic winches, the first winch with one drum and the second winch with a double drum, both of the "LEBUS" make, are located on the top deck.

The cable from the winch with one drum is taken outboard via the revolving gantry, and the cable from the winch with the double drum is taken outboard via the davit (8.7) at the side. The side winches, gantry and davit are operated from the main deck, in the vicinity of the operating platforms.

Characteristics of the winches :

- Winch with one drum
  - capacity **1000 m of 5 mm cable (RVS)**
  - pulling power **365 kg at 60 m / min**
- winch with double drum
  - pulling power **365 kg at 60 m / min**
  - capacity top drum **1000 m of 5 mm cable (RVS)**
  - capacity bottom drum **1700 m cable (6.40 mm coaxial cable, 6.7 kN working load))**

- the bottom drum also has a system with slip ring contacts.

## 8.8 Extending mast

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The extending mast is for taking air samples up to 4.5 m in front of the ship's bow.

## 8.9 The "SEATEC" oceanographic winch

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The "SEATEC" oceanographic winch (property of UG-RCMG) is used for geographic and seabed research at great depths. When used it has to be swapped with the net drum winch.

Characteristics of the SEATEC winch:

- 1100 m supply cable streamlined over the entire length (umbilical fairing) with energy cables, control and data channels.

Additional equipment:

- modular seismic source
- 100 m multichannel hydrophone array

## 9 Laboratories, activity zones and workstations

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RV BELGICA has 7 laboratories, space for 2 container laboratories, 2 activity zones located in the pilothouse, a storage room, cold-storage rooms, and mechanical and electrical workstations. The total area of these zones is 175 m<sup>2</sup>, where 115 m<sup>2</sup> are for laboratories. These rooms are spread over 4 floors. Each laboratory has a supply of pure seawater, freshwater, compressed air, and various voltage supplies. The main function of each laboratory can be adapted according to the needs of the various research assignments.

### 9.1 Intermediate deck (level 2) from back to front:

---

- a storage area of 70 m<sup>2</sup>, with a workbench and passage for cables to the rear deck
- on the port side: a mechanical workstation (7m<sup>2</sup>) with a lathe, drill press, grindstone and welding equipment (arc welders and oxyacetylene)

### 9.2 Main deck (level 1) from back to front:

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- rear working deck of 140 m<sup>2</sup>
- on the port side: fishing laboratory (20 m<sup>2</sup>), with access to the rear deck, equipped with a sorting bench and a tube for returning marked fish to the sea
- on the port side:
  - a cold store to -25°C (8 m<sup>3</sup>)
  - a cold store to 0°C (6 m<sup>3</sup>)
- centre: boatswain workshop
- room for the Alfa Laval seawater purifier (centrifuge)
- on the starboard side: the side working deck of 20 m<sup>2</sup>

- on the starboard side: the "wet" laboratory (20 m<sup>2</sup>), with access to the side working deck, equipped with fridge, freezer, benches, equipment for making Milli-RO and Milli-Q (ultrapure) water (Millipore), as well as the Sea-Bird thermosalinograph (connected to the special seawater pipe)
- on the port side: the microbiology laboratory (12 m<sup>2</sup>) with benches, a laminar flow cabinet, 2 low temperature incubators and a sterilisation oven
- on the port side: the chemical laboratory (10 m<sup>2</sup>) with benches and a laminar flow cabinet.
- on the starboard side: the biology laboratory (12 m<sup>2</sup>) with benches, a fume cupboard and an Automatic Underway Measurement System (AUMS) (See below)
- on the starboard side: the computer room (12 m<sup>2</sup>) - the data acquisition and processing system is described in section XII ,
- centre: the room in which the Kongsberg EM 1002 (not in use anymore) and EM 3002D multibeam echosounder systems are set up.

### 9.3 Upper deck (level 01)

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Two standard 20 ft containers can be installed on the upper deck, or smaller containers with non-standard dimensions (decompression chamber for divers, refrigerated containers, etc.):

- A standard 20' (13 m<sup>2</sup>) container laboratory has:
  - workbenches
  - 2 sinks
  - supply of freshwater and seawater
  - compressed air
  - electricity 220 V - 50 Hz single phase, 220 V 60 Hz three phase
  - air conditioning
- Clean Lab container (weight: circa 6 tonne):
  - divided into 2 compartments: the lock and the clean room
  - the lock contains the air conditioning with 98% filter in the input channel and automatic shutoff of supply and extraction when the airco stops, 1 sink with hot and cold water (separate boiler), a small fridge, unit for producing Milli-RO water (medium quality)
  - the clean room (class 1000) contains 2 laminar flow cabinets (class 100), fume cupboard, workbench with sink, a storage tank for Milli-RO water and a unit for producing ultrapure Milli-Q water
- The accommodation container has room for 4 people.

### 9.4 Pilothouse (level 02)

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The back of the pilothouse has 2 zones reserved for scientific activities:

- on the port side: a 7 m<sup>2</sup> zone with benches for measuring and recording equipment for echo-sounders, seismography, Side Scan Sonar, etc.
- on the starboard side: a 6 m<sup>2</sup> zone with operating station for the fishing winches with all detection equipment for fishing research
- on the starboard side: a 4 m<sup>2</sup> zone with the multibeam operating system

Note:

To help secure the equipment in the laboratories, there are securing rails on all workbenches and on the adjacent walls.

## 10 Special facilities

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These facilities are, in particular:

- A sewage plant with a processing capacity of 500 l/h of dirty water.
- The processed dirty water and the other less dirty water are discharged on the starboard side as far away as possible from the sampling point on the starboard side. There is also a sewage tank for storing the dirty water for a period of around 24 hours.
- Right at the front in the bow 3 metres below the water line is an inlet (via tubes, valves and pumps, made exclusively from high grade Cr-Ni steel and PVC) for the pure seawater distribution ("Non Toxic Seawater Conduct") to the various laboratories. The circuit has a flow rate of 7 m<sup>3</sup>/h.
  - a temperature meter connected to the ODASIII system is installed in the "Non Toxic Seawater Conduct" very close to the inlet.
  - the "Non Toxic Seawater Conduct" also supplies certain instruments that are connected to the ODASIII system whereby parameters such as salt content, turbidity, fluorescence, etc., are continuously measured.
  - A Rosemount 8700 Series Magnetic Flowmeter System is installed in the circuit and consists of a flowtube sensor and transmitter to measure volumetric flow rate by detecting the velocity of a conductive liquid that passes through a magnetic field.

## 11 Launch

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The BELGICA has a 5 m long inflatable launch (R.I.B.) with solid base, equipped with a 40 hp outboard engine.

## 12 Data acquisition and processing system

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### 12.1 General.

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The Oceanographic Data Acquisition System version III (ODASIII) was installed in January 2009.

The ODASIII system collects, processes and stores oceanographic, meteorological, navigation and other data from various measuring equipment installed on board the RV BELGICA.

The ODASIII system consists of the following subsystems:

- The data acquisition and processing system:



Around 15 different items of measuring equipment are connected by RS232 to the Hewlett Packard HP rx2660 64-port multiplexer. The raw measurement data are stored on the 72 Gbyte SCSI hard disk.

The data are processed, distributed and stored using the same Hewlett Packard HP rx2660 server with HP-UX 11i vs2 operating system.

The rx2660 contains the following components:

- Intel Itanium 2 risc processor 1.6 GHz/6 MB
- 2 Gbyte ECC RAM,
- 2 \* 15k 73 Gbyte hard disk in RAID 1 configuration,
- 19" LCD monitor,
- DVD-RW drive.
- 2 \* 10/100/1000Base-TX ethernet
- Redundant power supply

▪ The presentation units:

PC's (HP DC5750S) are used for the presentation (offline and real-time), which are connected to the UNIX-server via a 100 Mbps thin Ethernet LAN. The data can be printed out on an HP LaserJet P3005 printer or on an HP Color LaserJet 3600 color printer.

## 12.2 Acquisition, processing and presentation software.

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- The acquisition software is partly written in C and partly in Fortran90. A receiver program has been installed for each item of measuring equipment connected to the ODASIII system. A main "receiver" module manages the acquisition and sends the data to the processing module.
- The processing module on the UNIX server ensures that the retrieved data are processed and then stored in an Informix relational database. A number of tests are done on the measurement data (such as range tests, etc.). In addition to converting raw measurement data into physical quantities, the processing module is also able to calculate derived parameters. The system enables the system manager to execute management operations (export and import, back-up of the database on DAT, etc.) for the ODASIII database. The processing software is written in C, Fortran90 and Informix-4GL.
- The management software, written in MS-Access97, is installed on PC and contains the following modules:
  - control of the ODASIII system, i.e. start-up of the acquisition
  - start-up of a measurement campaign and the start-up of 1 or more PDC's within a measurement campaign
  - management of the parameter library
  - composition and management of the measurement campaign
- The presentation software is written in Visual Basic 6.0 and consists of a real-time module and an offline module.
- The application is modular and consists of the following submodules:

- retrieve information on a measurement campaign
- real-time fixed display
- real-time and offline listing
- real-time and offline graph plotting

### 12.3 List of the ODASIII continuous measurement parameters:

Instrument	OD ID	Parameter	Data acquisition rate			
			ODASIII standard		extra	
			10 sec.	10 min.	1	0.5
SEPTENTRIO AsteRx2eH RTK EGNOS receiver	573	Sept LAT.N/S	X	X		
	574	Sept LON.E/W	X	X		
	575	Sept CA_TAW	X	X		
	576	Sept UTCTIME	X	X		
	577	Sept SPEED	X	X		
	578	Sept COURSE	X	X		
	579	Sept QUALITY	X	X		
	580	Sept DSTA	X	X		
	581	Sept HDOP	X	X		
	582	Sept HFADING	X	X		
FURUNO GP-150 EGNOS DGPS receiver	560	Fur LAT.N/S	X	X		
	561	Fur LON.E/W	X	X		
	562	Fur HG_MSL	X	X		
	563	Fur UTCTIME	X	X		
	564	Fur SPEED	X	X		
	565	Fur COURSE	X	X		
	566	Fur QUALITY	X	X		
	567	Fur HDOP	X	X		
	568	Fur DRMS	X	X		
ANSHUTZ GYRO STD20 compass	36	SHIP HEADING	X	X		
CONSILIUM SAL 860T doppler log	387	PT/ST SPEED	X	X		
	388	DEPTH SAL860	X	X		
	389	FO/AF SPEED	X	X		
Kongsberg EA400 echosounder	465	EA DEPTH_38	X	X		
	466	EA DEPTH_210	X	X		
	467	EA DEPTH_33	X	X		
FRIEDRICHS meteostation	243	R. WINDDIR SB	X	X		
	244	R. WINDSPD SB	X	X		
	245	ATM PRESSURE	X	X		
	246	AIRTEMP. DRY	X	X		
	247	AIRTEMP. WET	X	X		
	266	SOL RAD	X	X		
	375	R. WINDSPPB	X	X		
	376	R. WINDDIR PB	X	X		
	487	SOL RAD	X	X		
	488	ATM PRESSURE	X	X		
SEA-BIRD SBE21 thermosalinograph	191	SBE21 TEMP.	X	X		
	192	SBE21 SALIN.	X	X		
	193	SBE21 SIGTH.	X	X		
	194	SBE21 S.VEL.	X	X		
	216	SBE21 I-TEMP	X	X		
	217	SBE21 COND	X	X		
	570	SBE21 FREQ 0	X	X		
	571	SBE21 FREQ 1	X	X		
	572	SBE21 FREQ 2	X	X		
SEA-BIRD SBF38 temperature	242	SBF38 TEMP.	X	X		
VALEPORT HM SVP	559	VALEPORT SV	X	X		
VALEPORT 106 CM currentmeter	382	CURR. I-VEL				
	383	CURR. I-DIR				
	384	CM DEPTH				
MARELEC small A-frame	206	LENGTH_W1	X	X		
	207	SPEED_W1				
	208	MEANTRAC_W	X	X		
	209	PEAKTRAC_W2				
MARELEC oceanographic winch	210	LENGTH_W2	X	X		
	211	SPEED_W2				
	212	MEANTRAC_W	X	X		

	213	PEAKTRAC W2				
pump status	377	SEAWATERPU	X	X		
	378	SEWAGE PUMP	X	X		
	489	SW PUMP	X	X		
	569	SW PUMP VOL.	X	X		
<b>AUMS OceanPack</b>						
Endress+Hauser	506	EH TURBIDITY L	X	X		
	508	EH TURBIDITY H	X	X		
Campbell Scientific OBS3+	510	OBS LOW	X	X		
	511	OBS HIGH	X	X		
SFA-BIRD SBF45	500	SBF45 SALINITY	X	X		
Trios Microflu	512	CHLOROPHYLL	X	X		
	513	BLUE ALGAE	X	X		
	514	CDOM	X	X		
Aanderaa optode	501	OPTODE O2	X	X		
Meinsberg	504	pH	X	X		
Turner Designs	515	FLUORESCENCE	X	X		
OceanPack MK2	518	pCO2	X	X		
Li-Cor LI-190SA	530	PAR	X	X		
<b>Calculated parameters</b>						
F: Absolute wind	120	IN-WIND DIR.	X	X		
	121	IN-WINDSPD.	X	X		
	122	IN-WINDSP.BF	X	X		
	379	IN-WINDIR PB	X	X		
	380	IN-WINDSP PB	X	X		
	381	IN-WINDBF PB	X	X		
F: Humidity	182	HUMIDITY DW	X	X		
F: Improved position	479	LAT AFRAME	X	X		
	480	LON AFRAME	X	X		
	481	LAT BENTHOS	X	X		
	482	LON BENTHOS	X	X		
	483	LAT VV FRAM	X	X		
	484	LON VV FRAM	X	X		
	485	LAT OCEANO	X	X		
	486	LON OCEANO	X	X		

A selection of those parameters is available in near real-time via <http://odnature.naturalsciences.be/belgica/en/odas> (coming soon) and following quality control, from the Belgian Marine Data Centre.

## 13 Scientific equipment on board.<sup>2</sup>

### 13.1 Specific equipment.

- Equipment for obtaining ultra pure water for chemical analyses:
  - Millipore Milli-RiOs 8 - "Medium Quality"
  - Millipore Milli-Q - "Ultrapure Quality"
- 2 low temperature incubators: "MEMMERT", model icp 500, capacity 108 l
  - temperature range 0°C to 60 °C
- Sterilisation oven: "Mettmert", model U40
  - capacity: 115 litres
  - maximum temperature: 300 °C
- Centrifuge: "Hereaus", model Labofuge I
  - capacity: 4 x 100 ml
  - maximum speed: 4400 rpm
- The **automatic meteorological unit "FRIEDRICHS"** measures wind direction, - speed, barometric pressure, (wet and dry bulb) air temperature and solar radiation. For backup

<sup>2</sup> The instruments printed in bold are connected directly to the **ODASIII** system, including the instruments mentioned in section VI.

purposes, an identical unit has been installed (with the sensors wind direction and – speed, barometric pressure and solar radiation).

- Continuous centrifuge: "Alfa Laval", model MMB 304 S – 11, for sampling suspended materials in seawater. The centrifuge is connected to the seawater circuit ("Non Toxic Seawater Conduct")
- The **fluorimeter: "Turner Designs", model 10-AU-005**, with continuous flow measurement cell, is configured with a lamp and filter set for the relative measurement of chlorophyll a, and is also connected to the "Non Toxic Seawater Conduct"

### 13.2 CTD equipment.

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- The **"Sea-Bird" model SBE19 (Seacat) CTD** system forms part of the equipment on the Belgica. This system is lowered in the water in the sampling stations on the starboard side using the oceanographic winch and davit. The parameters measured are: salinity, temperature, depth, turbidity and irradiance[PAR]. Two model SBE19 systems are available.
- The **"Sea-Bird" model SBE911Plus CTD** system is installed on board the Belgica on request and is also lowered in the water in the sampling stations on the starboard side. With this system, the slip-ring system mounted on the oceanographic winch is always used. The model SBE 911plus system has a depth range of up to 2000 m. The parameters measured are: salinity, temperature, depth, turbidity and dissolved oxygen.
- The **"Sea-Bird" model SBE21 thermosalinograph** connected to the "Non Toxic Seawater Conduct" enables continuous measurement of salinity and temperature of the seawater while sailing and when stationary.

### 13.3 Water sampling equipment

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- The **"Sea-Bird" model SBE32 (Carousel)** seawater sampling system has 12 "Niskin" 10 litre water sample bottles. This system is connected to the SBE911 plus CTD system. On request, 10 litre or 5 litre Go-Flo bottles can be fitted.
- Various "NISKIN" 5 litre (2 off), 10 litre (17 off) and 30 litre (3 off) water sample bottles form part of the standard equipment of the Belgica.
- Go-Flo water sample bottles (10 litre (10 off), 5 litre (1 off)) may be provided on request.

### 13.4 Equipment for sampling sediments, plankton and benthic communities, and fishing equipment.

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- 2 Boxcorers made by B.V. v/h Fa. P. Smit according to the model of the Dutch Marine Research Institute (*Nederlands Instituut voor Onderzoek van de Zee - NIOZ*)
- Van Veen grab (modified model).
- Shipec grab
- "Bowers & Connelly" multicorer
- Reineck corer made by UG - RCMG
- High Speed Encased Gulfstream Plankton Sampler"
- "Benthic sledge" made by S.K.B. according to the ARCACHON model.
- 3 m trawl with shrimp net

- For bigger fish, various trawl lengths with appropriate nets are used. This equipment is the property of the Department of Sea Fishing and is only operated by this department on board the Belgica.

### 13.5 Depth measuring equipment and auxiliary sensors.

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The following equipment is used for bathymetric recordings:

- An oceanographic single beam echo-sounder manufacture **Kongsberg EA 400** with 33 kHz and 210 kHz transducers (Atlas) and 38 kHz 7 ° transducer (Kongsberg), the latter with a range up to 3000 m.  
This echo-sounder is connected to a motion sensor Seatex MRU5 for swell compensation and to the Valeport sound velocity sensor for input of the sound velocity.  
All of these transducers are installed on a blister in the bow of the ship.
- The Kongsberg EM 3002 shallow water multibeam echosounder with extremely high resolution. This system is owned by FPS Economy, Board of Quality and Safety – Continental shelf. This multibeam uses the 300 kHz frequency and has a range from less than 1 m up to 150 à 300 m (dependant on the water temperature and salinity). The 2 Sonar Heads are installed on blisters on each side of the ship for the best acoustic conditions during sailing.
- The Kongsberg EM1002 multibeam echosounder for high resolution bathymetry and sediment classification. This system belongs to the Ministry of Economic Affairs – Board of Quality and Safety. The multibeam has frequencies of 93 kHz and 98 kHz and has a range of 2 to 1000m. The multibeam echosounder transducer is built into the ship's keel, and is lowered about 1 metre below the keel with a rod when making bathymetric recordings. The transducer is also secured to a mechanical compensation system to minimise the effect of the thudding of the ship (*not in use anymore*).

Auxiliary sensors:

- Equipment for measuring the speed of sound:  
The sound velocity profiler and sensor are used to correct depth measurements for both single and multibeam echosounders. The sensors are owned by FPS Economy, Quality & Innovation, Service Continental Shelf.
  - The Sound Velocity profiler of the manufacturer Applied Microsystems Ltd model SVPlus with a direct measured Time-of-Flight (ToF) field sensor. The measured parameters are sound velocity, temperature and depth. This sensor is used with the Kongsberg EM 3002D multibeam system.
  - Sound Velocity sensor Valeport model miniSVS with titanium housing is placed in a fixed installation just after the blister of the EM3002 sonar head on the starboard side. Herewith, the depth measurements from the Kongsberg multibeam EM3002D as well as from the Kongsberg singlebeam EA400 are corrected.
- Equipment for measuring the draught of the transducers:  
The 'vessel draught sensor' is placed in a fixed position just after the blister of the Kongsberg EM3002D sonar head on port side. This device contains a pressure sensor to measure

accurate the depth of the multibeam sonar head. A display unit is available at the bridge (not in use anymore).

### 13.6 Sea current measuring equipment

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- The “Acoustic Doppler Current Profiler” (ADCP) made by RD Instruments Ltd, model Workhorse Mariner WH300 300 kHz, with a 100 m range, measures the absolute speed and direction of the current, in many layers of seawater simultaneously while the ship is sailing. The transducers of the ADCP are also built into the ship’s keel.
- The “Acoustic Doppler Current Profiler” (ADCP) made by RD Instruments Ltd, model Workhorse Sentinel WH1200 (1200 kHz) with a 15 m range measures the absolute speed and direction of the current in many layers of seawater simultaneously. This equipment works autonomously on battery power and stores the measured data in an internal memory. This unit is anchored to the seabed using a “Trawl Resistant Bottom Mount” (TRBM”). This unit can be provided on request.

### 13.7 Sechi disks

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2 Sechi disks are available (black/white) for measuring the penetration of sunlight in seawater.

### 13.8 Minibat

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Miniaturized Towed Instrumentation Platform 8820 from Guildline. This device shall be towed from the “RIB” Tuimelaar equipped with a winch (100 m). (not in use anymore)

The equipment that can be installed on the Platform is a CTD (Sea-Bird, SBE19) and a fluorometer (Chelsea, UV Aquatracka).

These devices can be operated aboard the RV Belgica on request to OD Nature.

### 13.9 Equipment for measuring the size distribution of suspended sediment.

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The LISST-100X (Laser In-Situ Scattering and Transmissometry) made by Sequoia Scientific, Inc. is a multi-parameter system for in-situ observations of particle size distribution and volume concentration, with size-range from 2.5 – 500 microns (Type C). It also records the optical transmission, the pressure and the water temperature. The instrument is fully self-contained with internal battery and data-logger.

On request to OD Nature this device can be operated on board of the RV Belgica to execute sediment transport studies.

### 13.10 Oceanographic Measurement System with Sensors Pack (3x)

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The oceanographic measurement system with Sensors Pack (OMSP) contains the following parts:

- Sontek Acoustic Doppler Profiler ADP 3 MHz with datalogger
- Sontek Acoustic Doppler Velocimeter ADVOcean 5 Mz with Hydra datalogger
- Temperature and Conductivity sensors: Sea-Bird SBE37 CT-Microcat with datalogger

- 2 turbidity sensors: D&A Suspended Solids Monitor – model OBS-3+

For anchoring, the instruments are mounted on a so-called ‘tripode’, a construction of pipes and bars with three reinforced feet. The tripodes are made in inox.

It is also possible to fix the Liss-100X (see 13.9) on this construction.

### 13.11 Autonomous Underway Measurement System (AUMS: OceanPack with datalogger + watersampler)

The AUMS (Autonomous Underway Measurement System) measures continuously not only salinity, temperature and fluorescence but also many new parameters including important ecosystem parameters such as nitrate, ammonia, silicate, dissolved oxygen and CO<sub>2</sub>, turbidity, alkalinity and phytoplankton pigments. In addition, the new equipment allows automatic acquisition and preservation of water samples.

The AUMS is equipped with an anti-flooding system with leak detection and alarm unit, a programmable periodic cleaning cycle, auto shutdown system including full cleaning cycle (harbour approach) and position controlled seawater sampling (16 l bottles).

The AUMS is installed in the biology laboratory with a presentation screen in the wet lab.

Overview of the measured parameters and manufacturer:

Parameter	Trade	Model	Range	Time interval
Turbidity	Endress + Hauser	2 *	0 – 2000 FTU	1 s
		CUS 41	0 – 10000 FTU	1 s
Turbidity	Campbell	OBS3+	0 – 4000 FTU	1 s
Oxygen	Aanderaa	3835 optode	0 – 30 mg/l	2 s
pH	Meinsberg	AGA 140	0 – 12 pH	1 s
Chlorophyll	Trios	MicroFlu-chl	0 – 100 µg/l	1 s
Blue Algae	Trios	MicroFlu-blue	0 – 100 µg/l	1 s
CDOM	Trios	MicroFlu-CDOM	0 – 200 µg/l	1 s
Salinity	Sea-Bird	SBE45	0 – 40 PSU	1 s
pCO <sub>2</sub>	SubCtech	MK2	0 – 20000 µAtm	1 s
Fluorescence	Turner Designs	10AU	0 - 500	1 s
PAR	Li-Cor	LI-190	0 – 2000 Watt/m <sup>2</sup>	1 s
Hyperspectral irradiance	Trios	ACC-VIS	320 – 950 nm	8 s
NO <sub>3</sub> , NH <sub>3</sub> , PO <sub>4</sub> , SiO <sub>2</sub> , NO <sub>2</sub>	Systea	3 *	0 – 500 ppb	20 min. *
		MicroMac1000	0 – 8000 ppb	
			0 – 150 ppb	