



# Classification of inland navigation vessels operated in restricted maritime areas

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# 1. Classification process

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# Bureau Veritas – Origin of classification



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- ▶ Today's global leader in **Testing, Inspection** and **Certification**, Bureau Veritas was founded in Antwerp in 1828 following the 1821's violent storms leading to 2,000 shipwrecks and 20,000 deaths.
- ▶ A **note of risk** was ascribed to each vessel by considering a vessel's structural design, quality of materials, strength of scantlings, state of maintenance of hull and rigging and history.
- ▶ Classification societies have developed a **close association with leading national and international institutions dedicated to maritime safety**.
- ▶ Today, the **classification certificate** is one of the main ship documents needed to provide **evidence of seaworthiness** and to show that neither an overdue survey or expired recommendation has been recorded.



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# Classification

<u>Purpose of classification</u>	<u>Means</u>	<u>Implication for shipowner</u>
<ul style="list-style-type: none"> <li>• Safety</li> <li>• Reliability</li> <li>• Risk mitigation</li> <li>• Protection of crew and passengers</li> <li>• Protection of the environment</li> <li>➤ <b><u>Provide information to:</u></b></li> <li>• Shipowners / operators</li> <li>• Flag State Administrations</li> <li>• Insurance companies</li> <li>• Stakeholders in the shipping business</li> <li>➔ <b><u>Obtaining license to operate</u></b></li> </ul>	<ul style="list-style-type: none"> <li>• Independent expertise</li> <li>• International network</li> <li>• Technical references</li> <li>• Rules and guidelines</li> <li>• Software</li> <li>• Design approval</li> <li>• Survey during construction</li> <li>• Type approval &amp; inspection at work</li> <li>• Periodical survey</li> <li>• Non-periodical survey</li> <li>• Reports &amp; attestations</li> </ul>	<ul style="list-style-type: none"> <li>• Technical team</li> <li>• Maintenance plan</li> <li>• Qualified shipyards</li> <li>• Qualified suppliers</li> <li>• Periodical tests</li> <li>• Follow up of survey schedule</li> <li>• Follow up of recommendations</li> </ul>

# Classification process – New construction

**Class notations** are defined with regard to the service and the conditions of operations. The Range of Navigation IN(x) indicates the admissible roughness conditions of waters.

I ✕ HULL ● MC

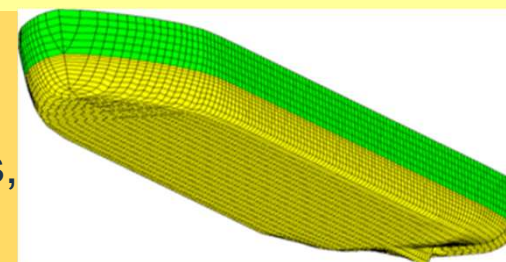
5 IN(0,6) Z

Tanker / DG-N closed/ double-hull/2R

DP=11,5 kPa / TP=13 kPa

Cleanvessel

**Design review** with regard to the applicable Rules and class notations: general arrangement, hull, equipment, stability, fire safety... Influence on wave bending moment, dynamic effects, hull integrity, intact stability, freeboard, etc.



**Certification** of materials and equipment

✕ or ●

**Survey during construction**: complete technical process, the Rules embrace numerous parameters related to the strength and reliability of the hull structure, superstructures, appendages, equipment, intact stability etc. *such as materials, welding processes, welder's qualifications, construction assembly, non-destructive testing, scheduled inspections and patrol inspections.*



**Quay and river trials**

**Classification certificate** possibly with attestation of compliance to statutory regulations



# Classification process – Vessels in service



## Class renewal survey:

The interval between 2 class renewal surveys is normally 5 years

Survey is due in dry-dock condition (bottom survey). Scope of survey depends on the age of the vessel and class notations.

Thickness measurement every 5 years depending on age and condition of the vessel

Survey of propeller shaft (drawing of the shaft every p or 2p years)

Possible extension: survey may be postponed by 1 year (or less) provided that an extension survey is performed before the expiry date

## Intermediate survey:

General survey afloat, to be completed between 2 and 3 years.

As a rule, dry-dock survey is requested when a vessel is 20 years old or more, or when the range of navigation is greater than IN(1.2), or when the vessel is operated in brackish or salt waters.

Under-water survey: under-water survey may be carried out so as to postpone the dry-dock survey (on a case by case basis, by approved diving firm, with presence of BV surveyor)

## Annual survey:

Survey afloat. Optional additional class notation.

May be required when a vessel is operated mainly at sea or in brackish waters and/or the waves height is greater than 1,20 m.



## 2. Connecting waterways to maritime areas

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## Connecting waterways to maritime areas

- ▶ Each State must classify its waters according to the international law.
  - **Internal waters** are defined landward of the baseline (the low-water line along the coast) and the State has complete sovereignty (waterways, lakes and even small bays).
  - **State's territorial sea** extends seaward up to 12 NM from the baseline. The coastal nation is free to set laws and to regulate any use, like on its own territory and its internal waters. Foreign vessels have right of innocent passage.
- ▶ Most of the IMO regulations applicable to ocean vessels are not quite appropriate to **domestic trade** alongside the coastline in restricted maritime areas.
- ▶ Like waterways, the territorial waters might be classified for the purpose of suitable requirements consistent with the risk level depending notably on the severity of the wave/weather conditions when the areas are not open to the high seas or benefit of protection of island, archipelago, reef, delta or any other natural conditions of the coastline.
- ▶ Inland vessels must be **designed to withstand more severe weather conditions** than pure fluvial vessels.
- ▶ Some countries such as **Belgium, France, India, Russia and China** laid down **national regulations** applicable to inland navigation vessels intended for operation alongside the coastline in **domestic** maritime areas.



# Connecting waterways to maritime areas

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- ▶ **Inland navigation**: smooth stretches of water with very limited waves.
  
- ▶ **In estuaries or maritime areas**:
  - **Higher waves and swell**: more stresses to the hull and its appendages.
  - **Risk of shipping water**: overload on deck and superstructures, risk of water ingress or flooding, exposure of the crew.
  - **Exposition to strong wind**: impact on intact stability and weathertightness
  - **More distant from shore and refuge**: needs for more self-sufficiency (e.g. bilge system, fire protection, navigational equipment, qualification of crew, etc.).
  
- ▶ **Weather forecast** is reliable for a short period of time therefore the vessels would not be exposed to severe conditions.
  
- ▶ Access to maritime areas would be given to inland navigation vessels considering **restricted routes** associated with **limitations on wave height**.

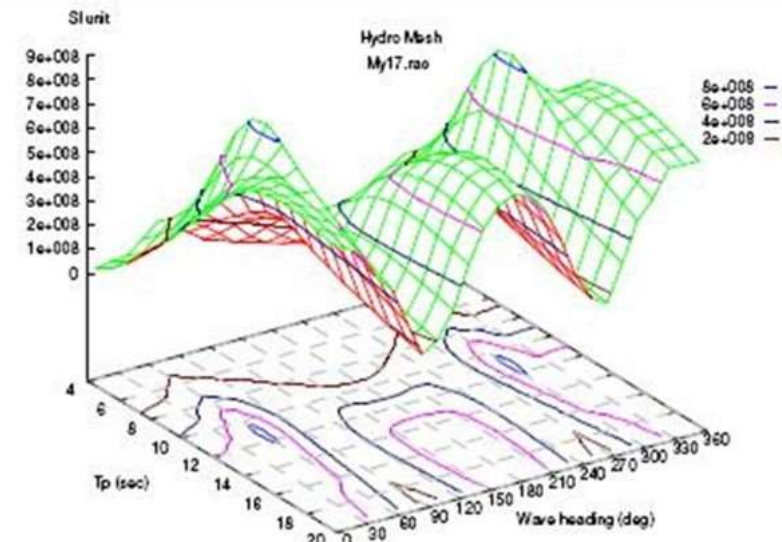
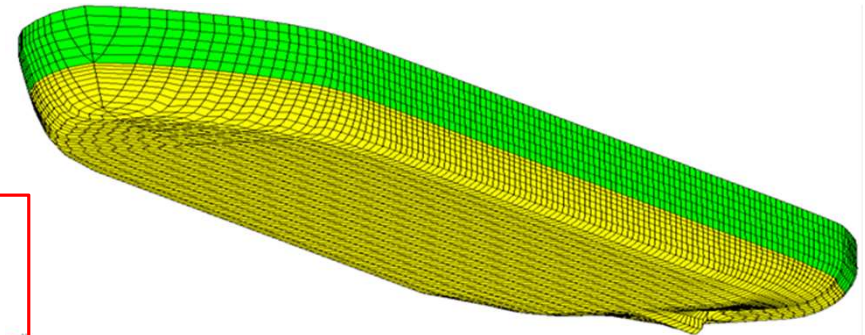
# National regulations – Belgium & France

- ▶ A hydrodynamic study must be carried out.  
**Seakeeping**: forces induced by the waves and motions of the vessel in response to waves.

Assessment of risks of slamming, waves crashing on deck and shipping of water, excessive bending moment or excessive values of lateral acceleration when sailing in that given maritime area.

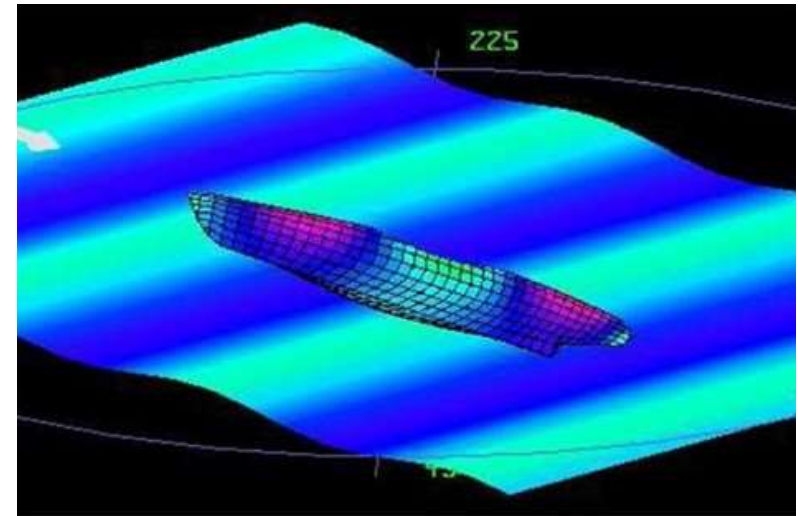
- ▶ The allowable significant wave height must be higher than 1.20 m up to 2.00 m
- ▶ 300 return voyages per year (Belgium).  
Lifetime: 20 years
- ▶ Occurrences:
  - Once a year: slamming
  - Once in the lifetime: shipping of water, roll angle (67%  $\theta_f$  or  $G_{zmax}$ ), bending moment and lateral acceleration

*France: number of voyages per year (100) and occurrences are different*



# National regulations – Belgium & France

- ▶ Computation for several different loading conditions.
- ▶ Location of the non-weathertight openings plays a very important role in determining the limits of exploitation for the ship.
- ▶ Roll angle proves to be a crucial factor which can threaten the stability of the ship during its coastal navigation.
- ▶ Structural strength is checked considering the excessive vertical wave bending moment coming from the risk analysis.



## 👉 BV Rules for inland navigation vessels (2019 edition):

The notation “**Estuary Plus**” may be assigned to inland navigation vessels operated in areas where the maximum significant wave height is up to 2 m ( $H_s: 0,6 < X \leq 2$ ). The **operating area** completes the notation, it expresses the area where the vessel is intended to operate.



### 3. Class notation “Estuary Plus”

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# Class notation “Estuary Plus”

Influence of notation “Estuary Plus” on ship design:

- ▶ Hull structure (depending on wave height)
- ▶ Minimum forward draught
- ▶ Minimum freeboard
- ▶ Minimum “safety clearance” (position of the lowest non-weathertight openings)
- ▶ Minimum bow height
- ▶ Bulwark and guardrails
- ▶ Intact stability (weather criterion)
- ▶ Two independent propulsion systems
- ▶ Bilge systems (open cargo holds)
- ▶ Power source (two generators)

The notation “Annual survey” is assigned to “Estuary Plus” vessels (afloat survey)





## Class notation “Estuary Plus”

The **range of navigation** would be completed by the navigation notation Estuary Plus, if:

- the significant wave height exceeds 1,2 m, or
- the vessel is operated on restricted maritime stretches of water, or
- the vessel is operated on large lakes.

### Operating area

It expresses the specified area where the vessel is intended to operate.

The operating area will be completed with:

- mention of the wind force on Beaufort scale considered for classification
- possible limitations or restrictions (e.g. current speed, etc.)



## Class notation “Estuary Plus”

For instance:

I { HULL { MC

5 Z IN(1,7) / Estuary Plus / Belgian coast / operating between the Western Scheldt and the Zeebrugge harbour / within 5NM from shore / Beaufort 7

Tanker / Type C / ADN / 2R / Annual survey

DP = 57,5kPa / TP = 65kPa





# Class notation “Estuary Plus”



## Design

Sea-keeping characteristics will be specially considered by the Society in the case of vessels of unusual design e.g.:

- vessel without bilge keel
- vessel with unusual hull shape.

**Fore part:** the minimum draught at the most forward point of the keel,  $T_{\min}$ , is not to be less than:  $T_{\min} = 1,3 h_2$

$h_2$  : Reference value, in m, of the relative motion in the inclined vessel condition

**Table 4 : Reference value of the relative motion  $h_2$  in the inclined vessel condition**

Location	Reference value of the relative motion $h_2$ in the inclined vessel condition, in m
$0 \leq x \leq 0,75L$	$\frac{n}{1,7} \left[ \left( 0,63 - \frac{2,5L}{1000} \right) + (BT_1)^{0,14} \right]$
$0,75L < x < L$	$h_{2,FC} + \frac{h_{2,FE} - h_{2,FC}}{0,25} \left( \frac{x}{L} - 0,75 \right)$
$x = L$	$\frac{n}{1,7} \frac{12}{\sqrt[3]{L}}$
$h_{2,FC}$	: Reference value $h_2$ calculated for $x = 0,75 L$
$h_{2,FE}$	: Reference value $h_2$ calculated for $x = L$

# Class notation “Estuary Plus”

## Hull integrity

The **safety clearance** of the lowest non-weathertight opening must be greater than  $1,5 h_2$ .

The **freeboard** must not to be less than:  $F_B = 1,5h_2 - 0,95$

The **bow height** defined as the vertical distance at the forward perpendicular between the waterline and the top of the exposed deck shall not be less than  $1,5 h_2$ .

*The bow height may be obtained through sheer extending for at least  $0,15L$  or raised forecastle deck at least  $0,07L$  measured from the forward perpendicular. A forecastle bulwark extending at least  $0,07L$  may be taken into account in the assessment.*

The **angle of roll**  $\theta_R$  is to be limited as follows:

$$\theta_R \leq 2\theta_f/3$$

$\theta_R$ : Angle of roll

$\theta_f$ : Angle of heel

In all cases, the angle of roll  $\theta_R$  shall not exceed  $15^\circ$ .

# Class notation “Estuary Plus”



## Bulwarks and guard rails

The height of the bulwarks or guardrails is to be at least 1 m from the deck.

*However, where their height would interfere with the normal operation of the vessel, a lesser height may be accepted, if adequate protection is provided and subject to any applicable statutory requirement.*

Where bulwarks on the weather deck form a well, provisions are to be made for rapidly freeing the deck from water.

The minimum required **freeing ports** area, on each side, is:

$$A_{fp} = 0,029nl_Bh_B$$

$A_{fp}$  : Area of freeing ports, in m<sup>2</sup>

$l_B$  : Length, in m, of well at one side

$h_B$  : Mean height, in m, of well

$n$  : Navigation coefficient ;  $n = 0,85 H$  where  $H$  is the wave height

# Class notation “Estuary Plus”

## Intact stability

### GZ curve area:

The area under the righting lever curve (GZ curve) shall not be less than 0,055 m.rad up to  $\theta = 30^\circ$  and not less than 0,09 m.rad up to  $\theta = 40^\circ$  or the down-flooding angle  $\theta_f$ .

Additionally, the area under the GZ curve between  $30^\circ$  and  $40^\circ$  or between  $30^\circ$  and  $\theta_f$  (if  $\theta_f$  is less) shall not be less than 0,03 m.rad.

In case where the down-flooding angle  $\theta_f$  is less than  $30^\circ$ , the area under the GZ curve shall not be less than 0,09 m.rad up to  $\theta_f$ .

Anyway, the angle of down-flooding  $\theta_f$  shall be not less than  $17^\circ$

### Minimum righting lever

The righting lever GZ shall be at least 0,2 m at an angle of heel equal to or greater than  $\min(30^\circ, \theta_f)$ .

### Angle of maximum righting lever

The maximum righting lever shall occur at an angle of heel not less than  $\min(25^\circ, \theta_f)$

### Initial metacentric height

The initial metacentric height  $GM_0$  must not be less than 0,15 m.

# Class notation “Estuary Plus”



## Intact stability

### Severe wind and rolling criterion (weather criterion)

The ability of the vessel to withstand the combined effects of beam wind and rolling shall be demonstrated, considering:

- a) The vessel is subjected to a steady wind pressure acting perpendicular to the vessel's centerline which results in a steady wind heeling lever ( $lw1$ );
- b) From the resultant angle of equilibrium ( $\theta_0$ ), the vessel is assumed to roll owing to wave action to an angle of roll ( $\theta_1$ ) to windward. The angle of heel under action of steady wind ( $\theta_0$ ) should not exceed  $16^\circ$  or 80% of the angle of deck edge immersion, whichever is less;
- c) The vessel is then subjected to a gust wind pressure which results in a gust wind heeling lever ( $lw2$ ); and
- d) Under these circumstances, area “b” shall be equal to or greater than area “a”

# Class notation “Estuary Plus”

## Intact stability

The wind heeling levers  $l_{w1}$  and  $l_{w2}$  are constant values at all angles of inclination and shall be calculated as follows:

$$l_{w1} = \frac{PAZ}{1000g\Delta}$$

$$l_{w2} = 2l_{w1}$$

Where:

$P$  : *Wind pressure*, in  $N/m^2$ , according to the wind force provided by the relevant administration

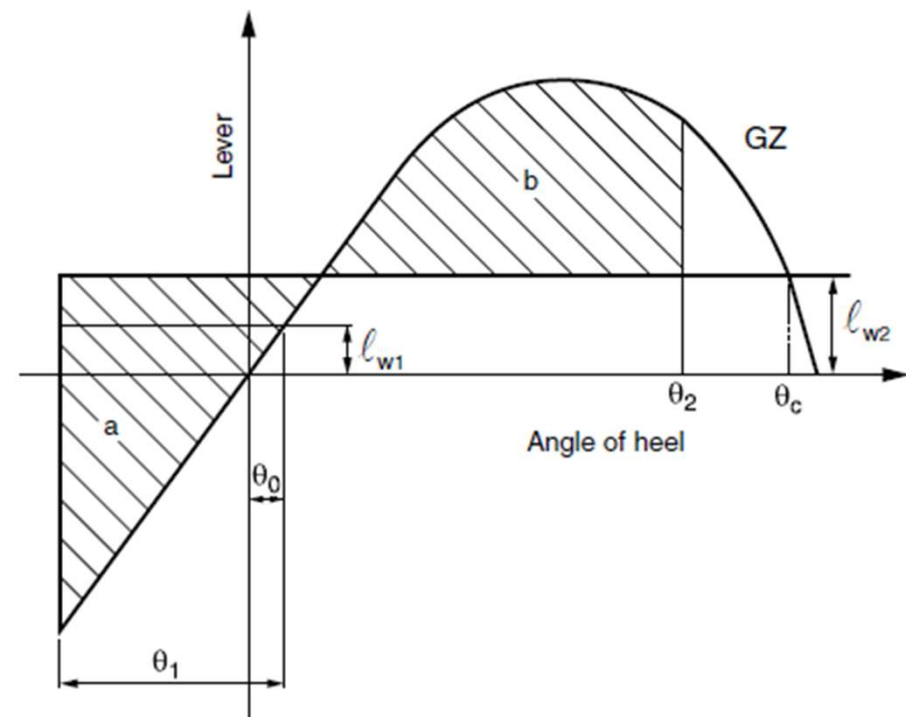
$A$  : *Projected lateral area above the waterline.*

$Z$  : *Vertical distance from the center of  $A$  to the center of the underwater lateral area*

$\Delta$  : *Displacement in t*

$g$  :  $9.81 m/s^2$

Figure 1 : Severe wind and rolling



# Class notation “Estuary Plus”

## Machinery and systems

### Propulsion

The vessel shall be equipped with two independent propulsion systems.

The main propulsion system shall enable the vessel to reach a speed of at least 15 km/h. The auxiliary propulsion system shall enable the vessel to reach a speed of 7 km/h.

### Main propulsion shafting

Shaft – Scantling: higher factor F than usual inland navigation vessel

### Bilge system

A fixed bilge system with two independent pumps shall be provided.

For each open cargo hold, a supplementary bilge pump shall be provided whose capacity shall be equal to the one of the two other pumps.

Each open cargo hold shall be fitted with a bilge level alarm.

## Electrical installations

### Power source

The power supply system shall comprise two generator sets. Each generator set shall be capable of supplying all essential consumers in case the other generator set is defect. The two generator sets shall not be located in the same room.





## 4. Statutory regulations

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# Statutory regulations

The statutory regulations are applicable in addition to the classification rules. They are laid down by each State Administration and they may provide **complementary requirements** or they may cover topics not included within the scope of classification, notably with regard to:

- ✓ The **national law**,
- ✓ What is specific to **operational conditions** on the domestic waterways,
- ✓ **Radio** communication,
- ✓ **Navigation lights**,
- ✓ **Habitability**,
- ✓ Qualification of **crew**,
- ✓ Possible agreement or harmonization with the **neighbouring countries**,
- ✓ Administrative topics (e.g. **tonnage**),
- ✓ **Validity of the sailing permit** and survey schedule



# Inland navigation vessels vs seagoing ships

## Advantage

- Light ship weight (hull scantling)
- Flexibility, adjustment to the actual operational conditions
- Simplified statutory regulations
- Simplified safety equipment (operation near sheltered areas)
- Simplified survey schedule
- Lower construction cost
- Lower maintenance cost
- Qualification / number of crew
- Reduced freeboard (waterways and estuary)
- Seagoing ship can be easily transferred to the inland navigation register (possible recalculation to decrease the minimum acceptable thickness values)

## Inconvenient

- Limited to significant wave height 2 m
- Operation at sea subject to agreement from the national authorities
- Only domestic trade (maritime) in territorial waters
- Vessel restricted to fixed operational conditions
- Difficult to transfer inland navigation vessel to the register of seagoing ships

*Thanks for your attention*



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