IMO NOISE CODE SOLUTION

AIR SUSPENSION FOR ACCOMMODATIONS

LOGGERS
SHOCK | VIBRATION | NOISE

PLEASED TO MEET YOU

LOGGERS

イング・ピーター・バーティング

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COMPANY PROFILE

Loggers is **thought leader** and international recognized solution provider in the field of shock, vibration and noise control. With **excellent technical know-how** in combination with proven market knowledge and experience Loggers designs, develops and engineers **innovative solutions** for the most complex and challenging situations for leading clients worldwide for over 95 years.

REGULATORY REQUIREMENTS

REGULATORY REQUIREMENTS

From a compliance perspective, the following strict regulations for accommodations require attention:

- **Rules for the Classification of Steel Ships**

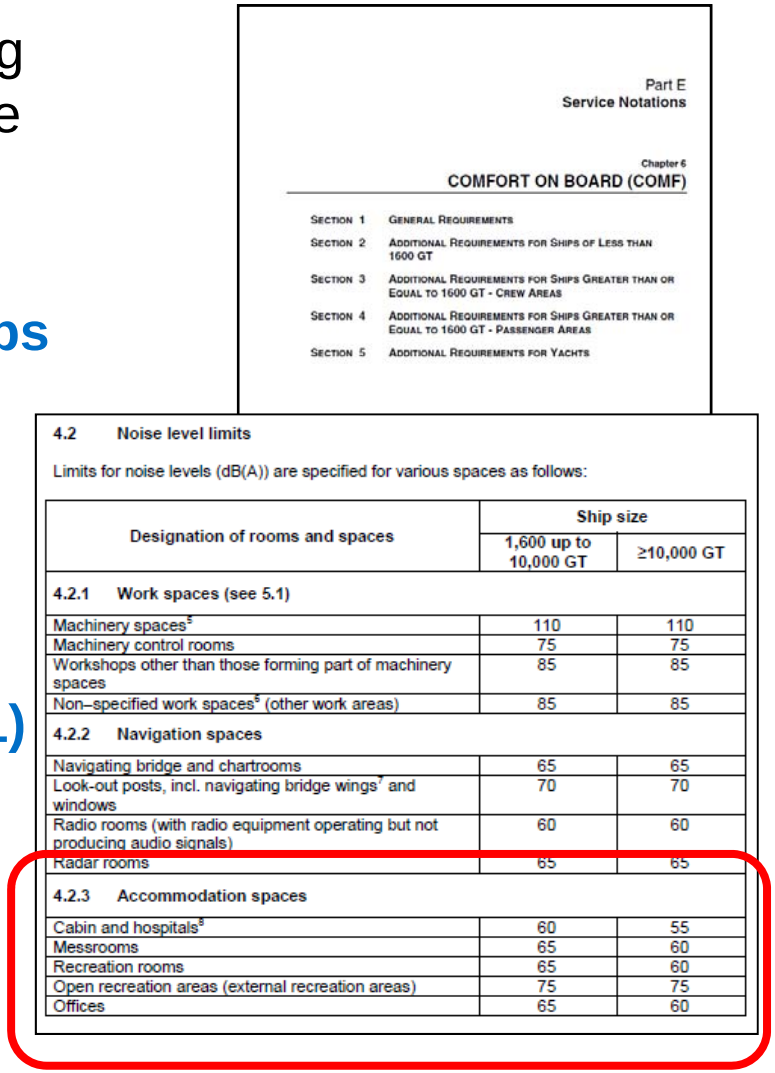
  COMF-NOISE / COMF-VIB requirements

  Bureau Veritas, NR 467.E2 DT R07 part E

  COMF-Class requirements

  DNV Rules for Ships, Pt.5 Ch.12 Sec.1

- **SOLAS regulation II-1/3-12 / MSC.337(91)**
  the “IMO Noise Code”



Part E
Service Notations

Chapter 6
COMFORT ON BOARD (COMF)

SECTION 1 GENERAL REQUIREMENTS
SECTION 2 ADDITIONAL REQUIREMENTS FOR SHIPS OF LESS THAN 1600 GT
SECTION 3 ADDITIONAL REQUIREMENTS FOR SHIPS GREATER THAN OR EQUAL TO 1600 GT - CREW AREAS
SECTION 4 ADDITIONAL REQUIREMENTS FOR SHIPS GREATER THAN OR EQUAL TO 1600 GT - PASSENGER AREAS
SECTION 5 ADDITIONAL REQUIREMENTS FOR YACHTS

4.2 Noise level limits

Limits for noise levels (dB(A)) are specified for various spaces as follows:

Designation of rooms and spaces	Ship size	
	1,600 up to 10,000 GT	≥10,000 GT
4.2.1 Work spaces (see 5.1)		
Machinery spaces[6]	110	110
Machinery control rooms	75	75
Workshops other than those forming part of machinery spaces	85	85
Non–specified work spaces[5] (other work areas)	85	85
4.2.2 Navigation spaces		
Navigating bridge and chartrooms	65	65
Look-out posts, incl. navigating bridge wings[7] and windows	70	70
Radio rooms (with radio equipment operating but not producing audio signals)	60	60
Radar rooms	65	65
4.2.3 Accommodation spaces		
Cabin and hospitals[8]	60	55
Messrooms	65	60
Recreation rooms	65	60
Open recreation areas (external recreation areas)	75	75
Offices	65	60

CHALLENGE

- Traditional situation: **fixed connection** between accommodations and hull
- Main engine, propeller impact and other **rotating equipment** cause **vibration**
- Vibrations **propagate** through the construction and cause **noise nuisance** in the accommodations
- Noise levels **exceed** the **maximum dB(A)-values** of regulatory requirements

IMO Noise Code

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Limits for noise levels (dB(A)) are specified for various spaces as follows:

Designation of rooms and spaces	Ship size	
	1,600 up to 10,000 GT	≥10,000 GT
4.2.1 Work spaces (see 5.1)		
Machinery spaces[5]	[illegible]	110
Machinery control rooms	75	75
Workshops other than those forming part of machinery spaces	85	85
Non–specified work spaces[5] (other [illegible] areas)	85	85
4.2.2 Navigation spaces		
Navigating bridge and chartrooms	65	65
Look-out [illegible] navigating bridge wings[7] and windows	70	70
Radio rooms (with radio equipment operating but not producing audio signals)	60	60
[illegible]	[illegible]	[illegible]
4.2.3 Accommodation spaces		
Cabin and hospitals[8]	60	55
Messrooms	65	60
Recreation rooms	65	60
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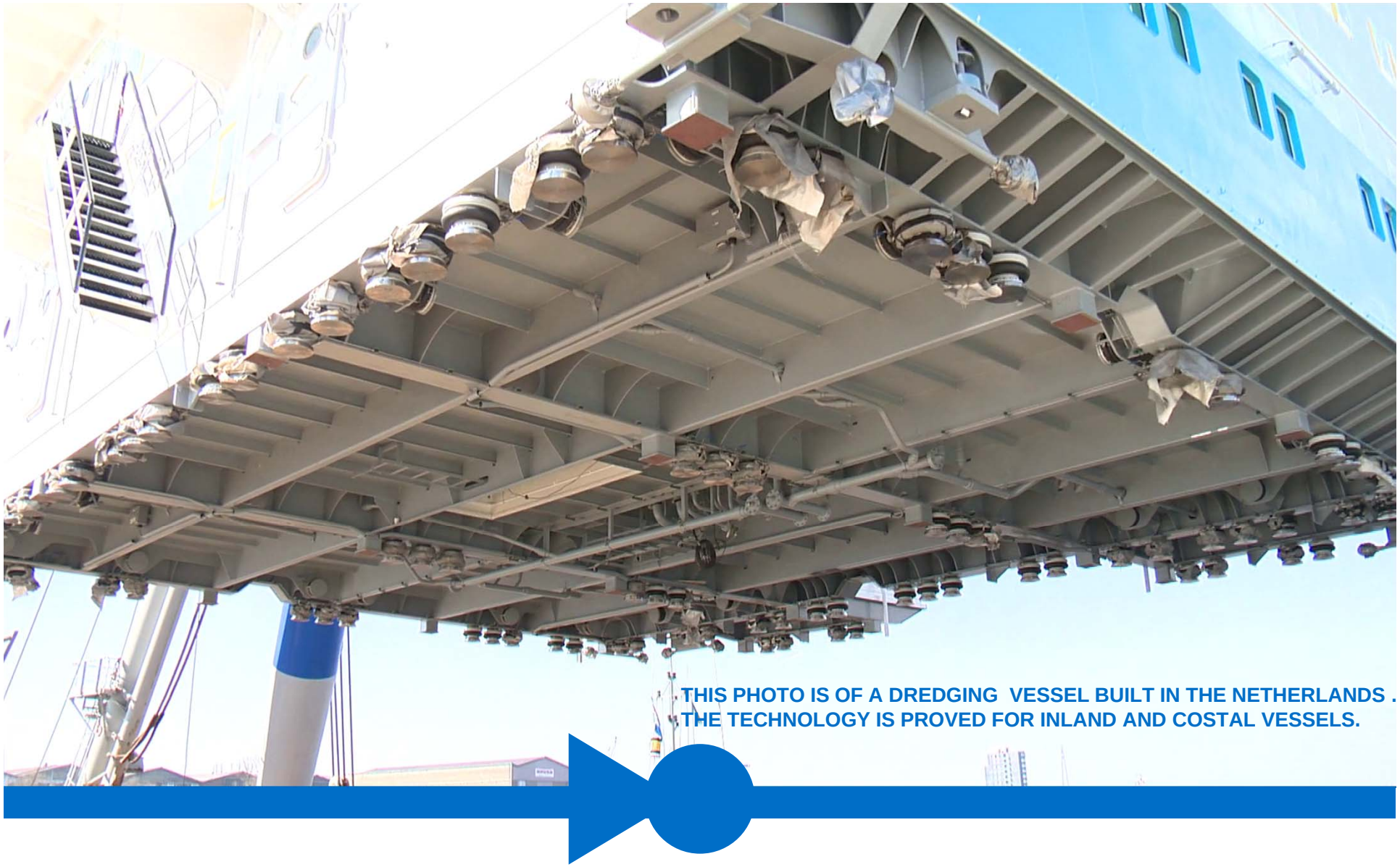
INCOMPLIANCE



THIS PHOTO IS OF A DREDGING VESSEL BUILT IN THE NETHERLANDS .
THE TECHNOLOGY IS PROVED FOR INLAND AND COSTAL VESSELS.

AIR SUSPENSION SOLUTION FOR ACCOMMODATIONS

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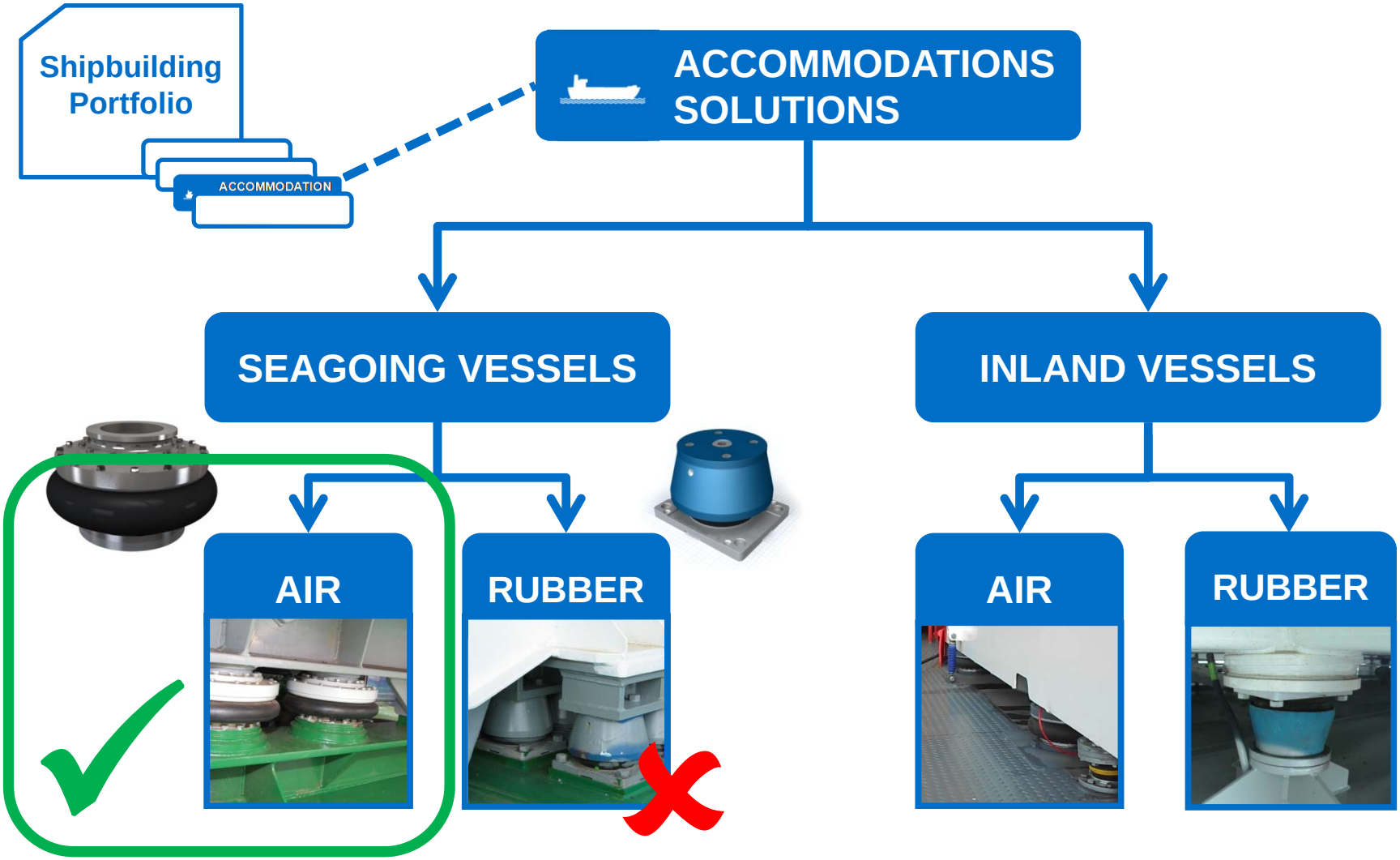
SOLUTIONS FOR ACCOMMODATIONS



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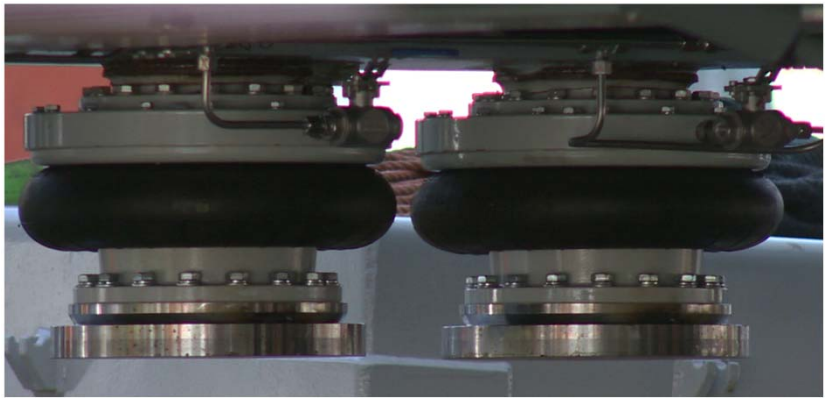
AIR SUSPENSION FOR SEAGOING VESSELS



SOLUTION CHARACTERISTICS

- Accommodations decoupled from the hull by air suspension system
- Highest possible isolation grade, extremely quiet
- Noise levels < 50 dB(A) achieved in the accommodations
- Isolation of low frequencies, starting from 1.5 Hz
- Support and stabilization air springs divided into multiple sections
- Monitoring and control system copes with ship motion (roll & pitch)

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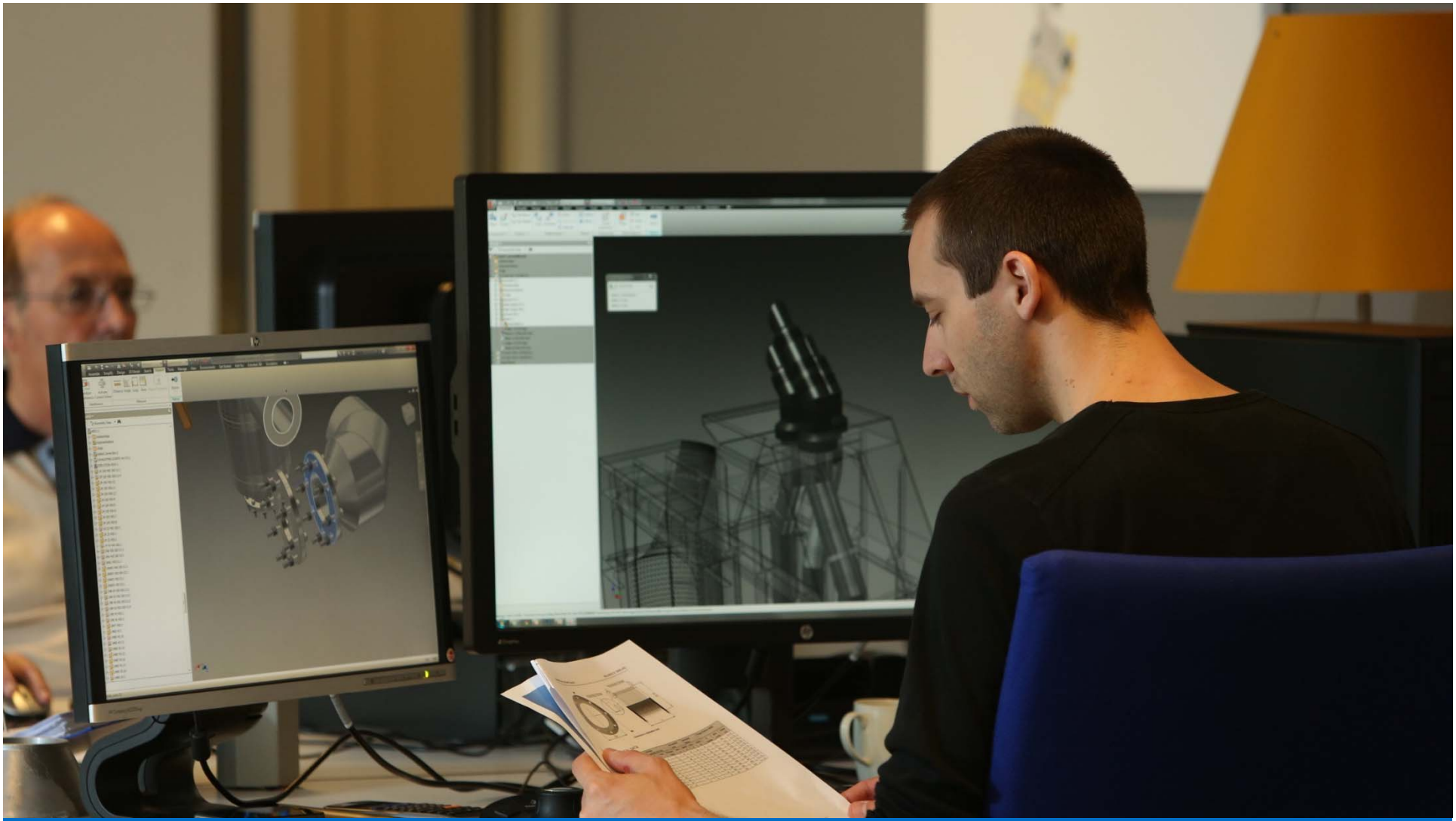
BUSINESS ADVANTAGES

The main advantages of Loggers' vibration isolation solutions for accommodations are:

- Major reduction of noise & vibration levels
- Compliance with laws and regulations (with air suspension):
  - *IMO Noise Code*
  - *COMF-NOISE, COMF-VIB, COMF-Class*
- Continuous and safe operation
- Proven, safe and reliable technology



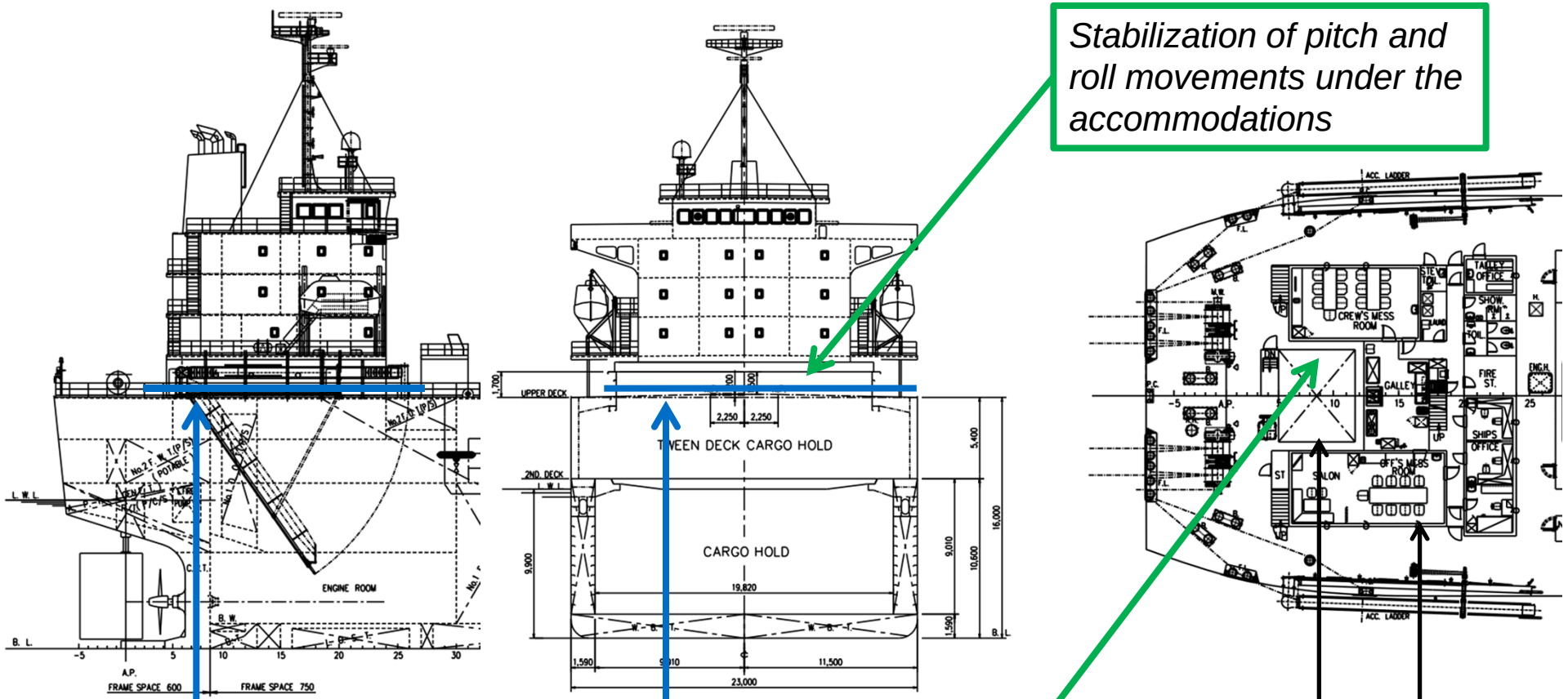
ENGINEERING PRINCIPLES

ENGINEERING PRINCIPLES

During the engineering phase of the vessel, the following topics require attention:

- Decoupling of the accommodations
- Monitoring & Control system sections
- Tripod setup
- Interfacing with the hull: cables, ducts and pipes
- Safety countermeasures
- Vibration isolation calculations

DECOUPLING OF THE ACCOMMODATIONS



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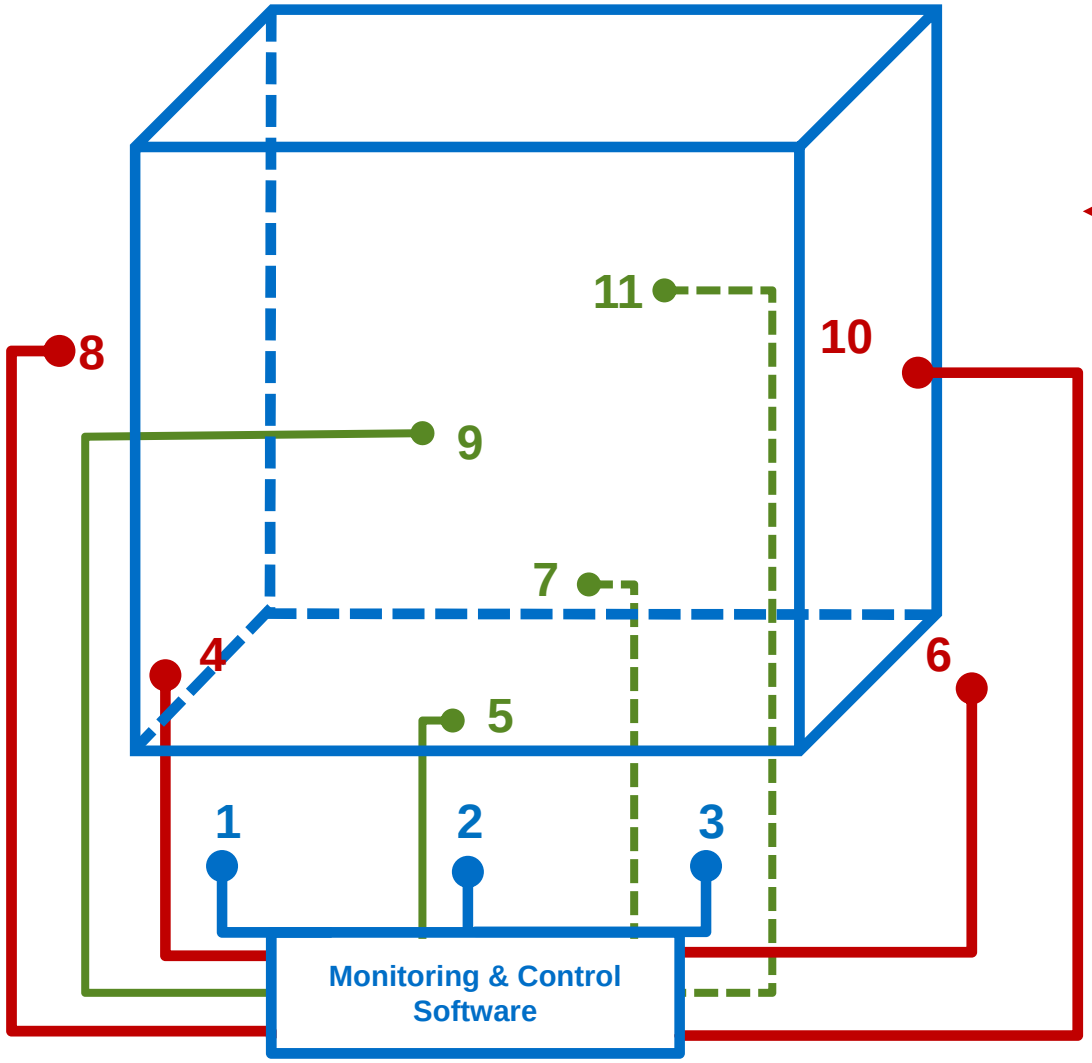
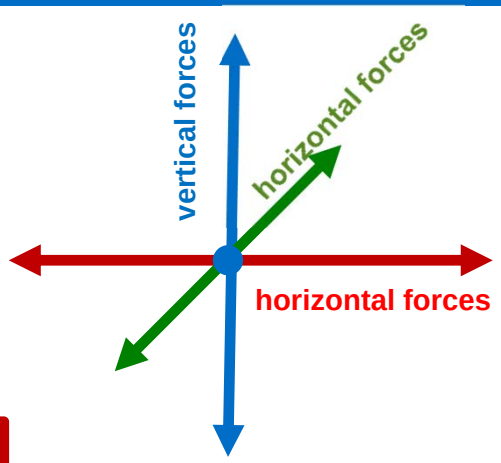
MONITORING & CONTROL SYSTEM SECTIONS





AIR SPRING SECTIONS

STABILIZATION

AT THE FUNNEL
Section 8, 10
Section 9, 11

UNDER ACCOMMODATIONS
Section 4, 6
Section 5, 7

SUPPORT

UNDER ACCOMMODATIONS
Section 1, 2, 3
(in tripod setup)

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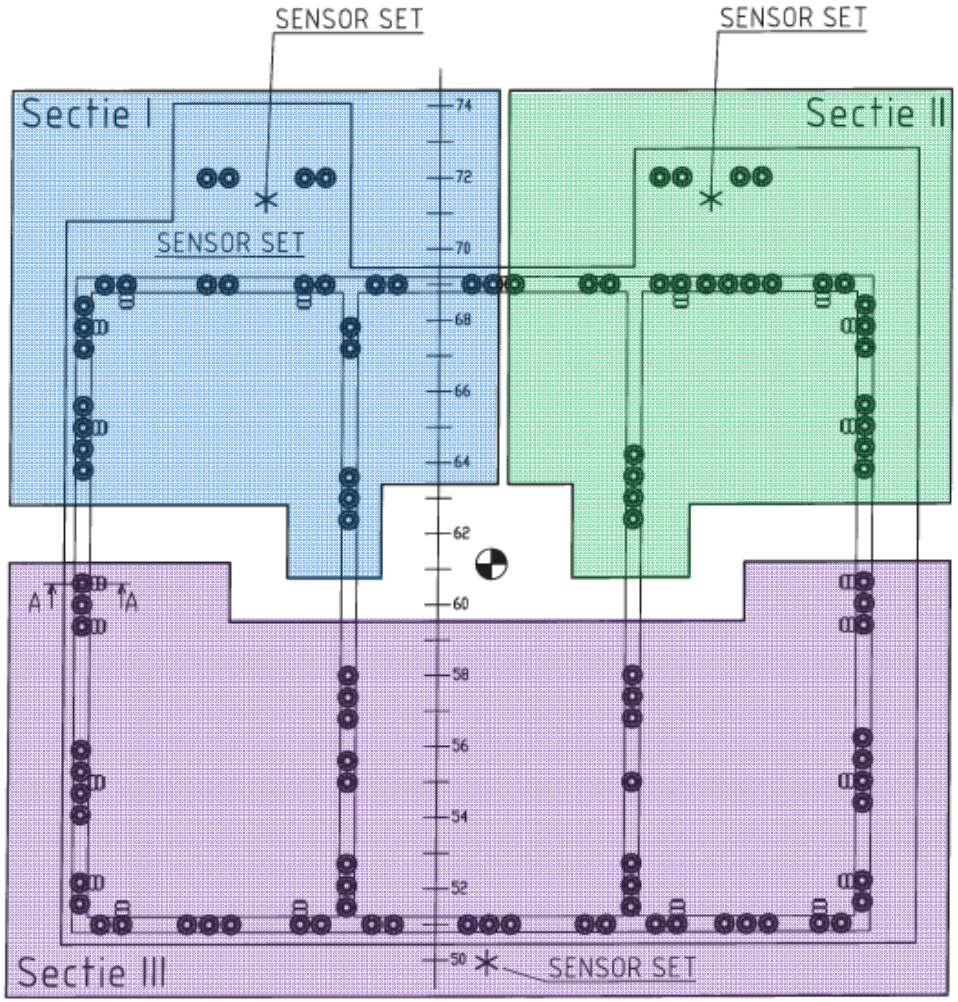
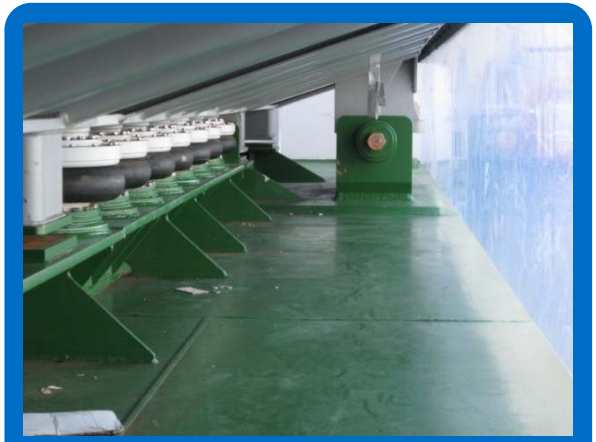
TRIPOD SETUP





SUPPORT AIR SPRINGS

STABILIZATION AIR SPRINGS

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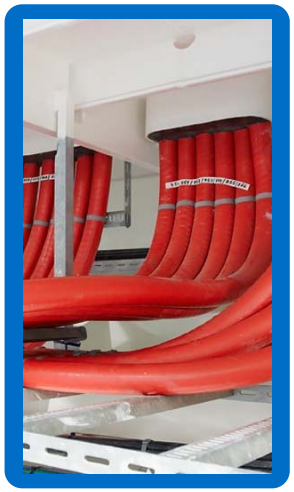
INTERFACING WITH THE HULL

The displacement of the accommodations requires all connections to the hull to be flexible, such as

- Cables
- Ducts
- Pipes

Pay attention to the cable's length, mount in a "S"-shaped curve

Use expansion joints or hoses to create flexible connections



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SAFETY COUNTERMEASURES

SEA FASTENERS

- Safety countermeasure when system is switched off during incidents at sea
- Sea-fastening mode establishes a rigid, fixed connection to the hull
- Disables vibration isolation

INTENDED USE

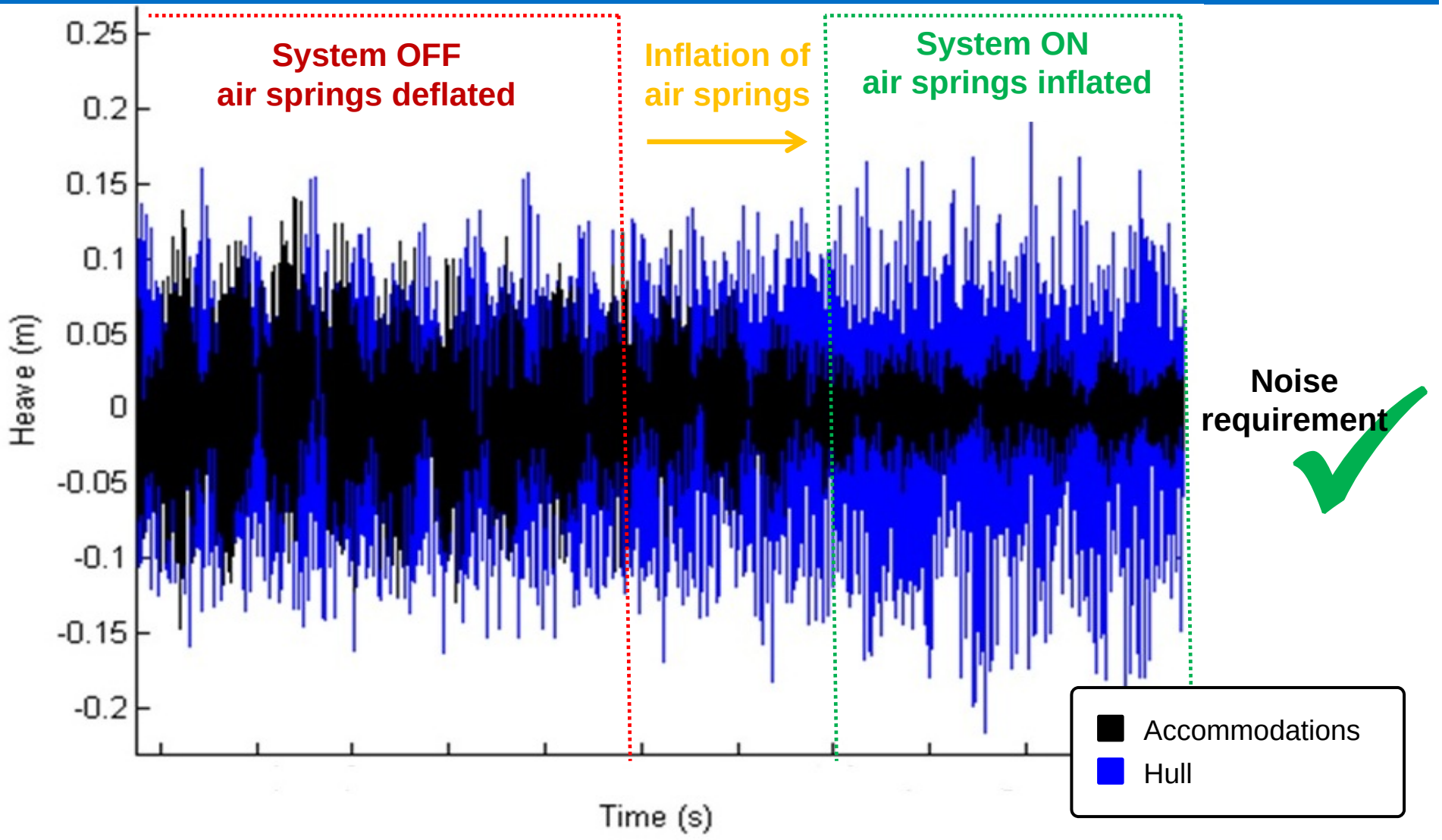
- During building process & vessel launch
- In the event of serious incidents or extreme situations at sea
- When air supply fails

6 DOF & NATURAL FREQUENCIES

Natural frequencies of accommodations on Loggers' air suspension solution

Degree of freedom	Natural frequency
$F_n T_x$	1.8 Hz
$F_n T_y$	1.0 Hz
$F_n T_z$	1.7 Hz
$F_n R_x$	1.8 Hz
$F_n R_y$	0.9 Hz
$F_n R_z$	1.2 Hz

SOLUTION IN PRACTICE



Source: results measured by IHC Shipyards

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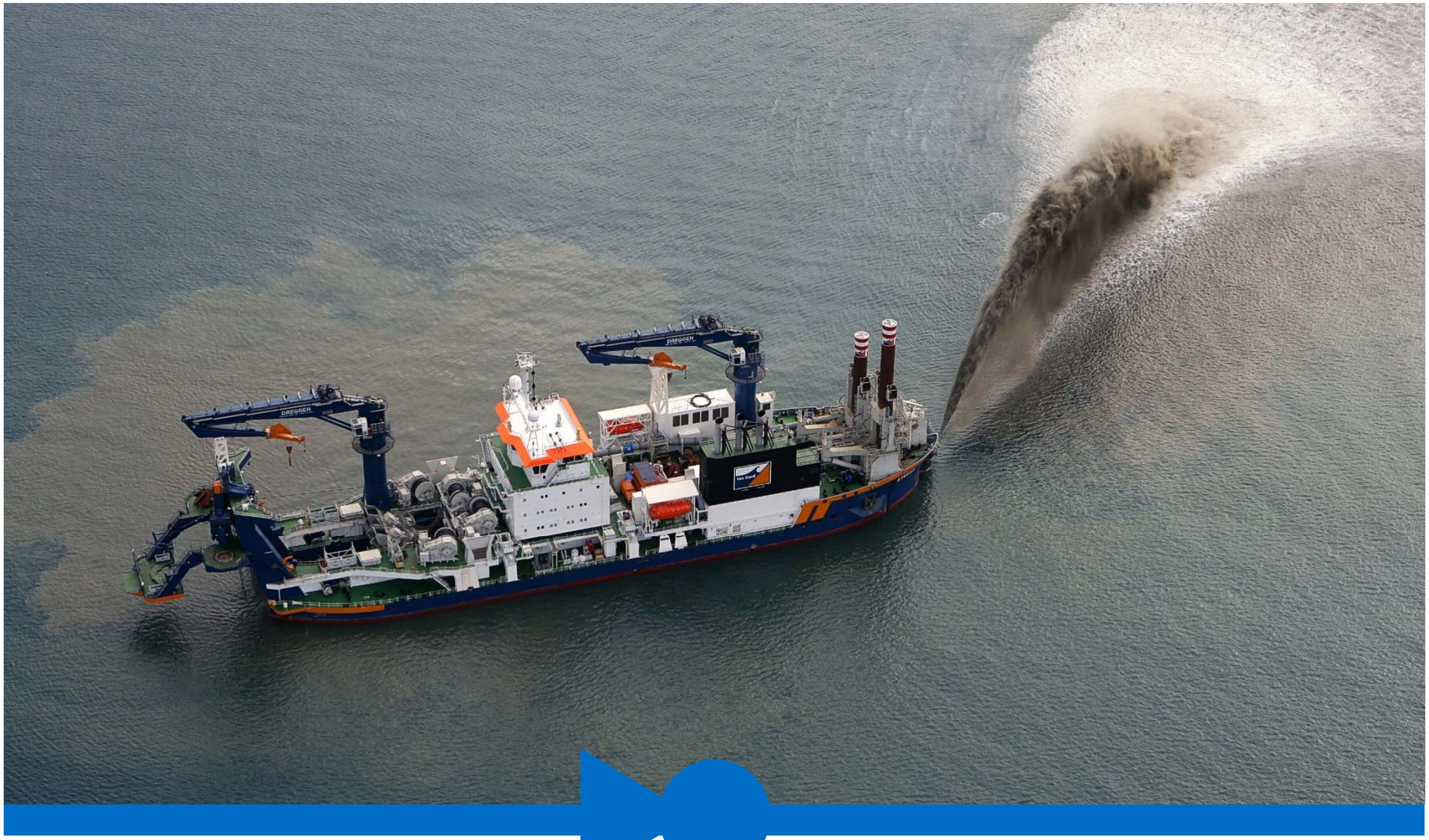

VISUAL IMPRESSION

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VIDEO: INSTALLATION OF ACCOMMODATIONS

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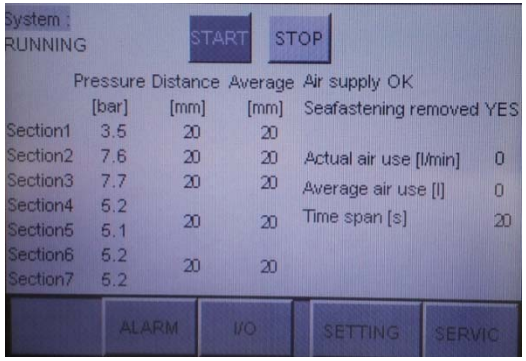
CONTROL CABINET (MONITORING & CONTROL)



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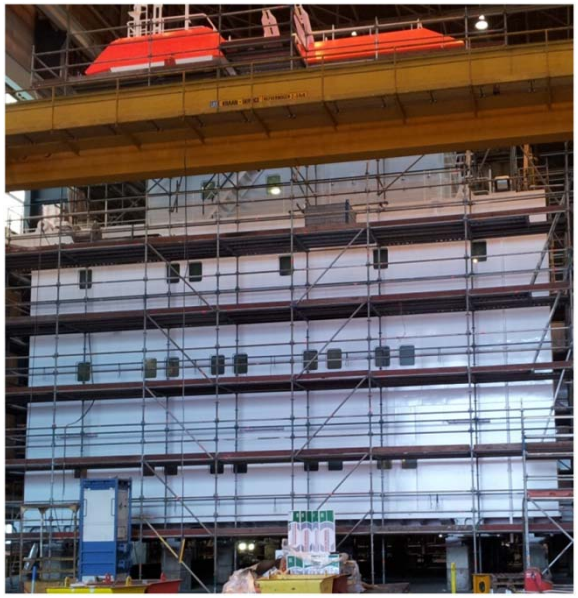
INSTALLATION OF THE AIR SPRINGS



CSD ATHENA & CSD ARTEMIS

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NEXT STEPS

REQUIRED INPUT

Relevant information for solution development:

CURRENT DESIGNS

- (Sea trial) measurements, preferably simultaneous
  - dB(A) levels
  - vibration levels
- Exhaust dB(A) measurements outside the accommodations
- Separation possibilities of the funnel
- Reinforcement possibilities of deck and accommodations

NEW DESIGNS

- Vibration Application Sheet for accommodations
- Drawing of the accommodations including sizes and weight
- Main engine and propeller data
- Ship movements pitch, roll and yaw

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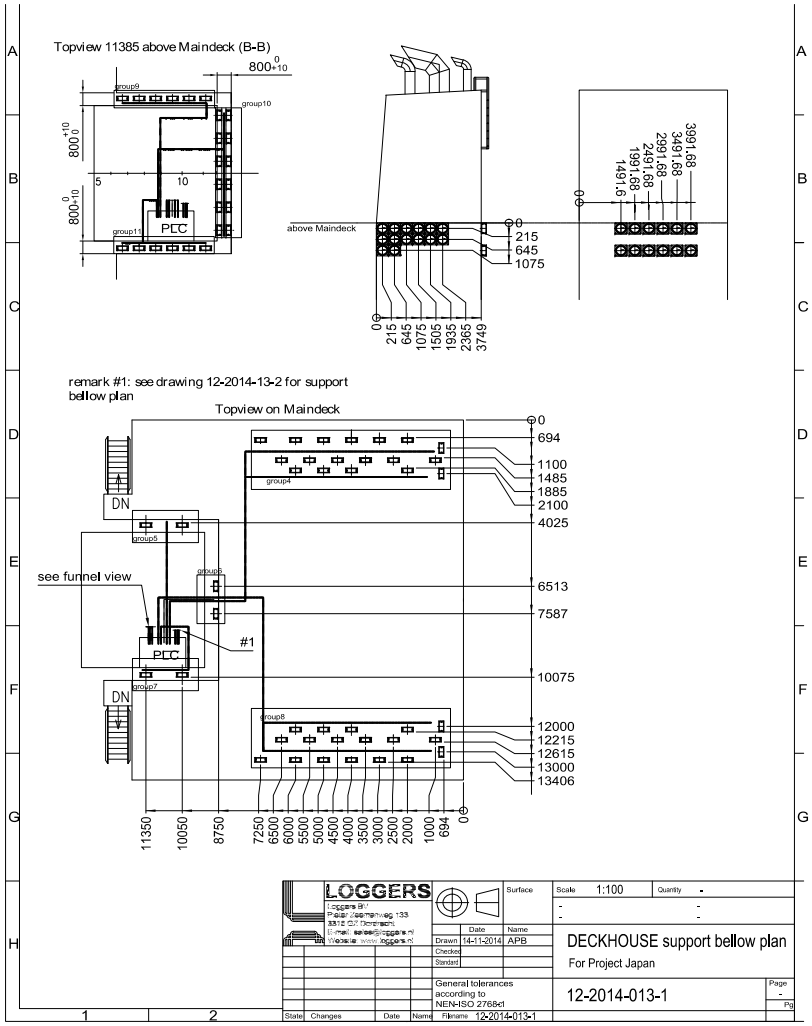
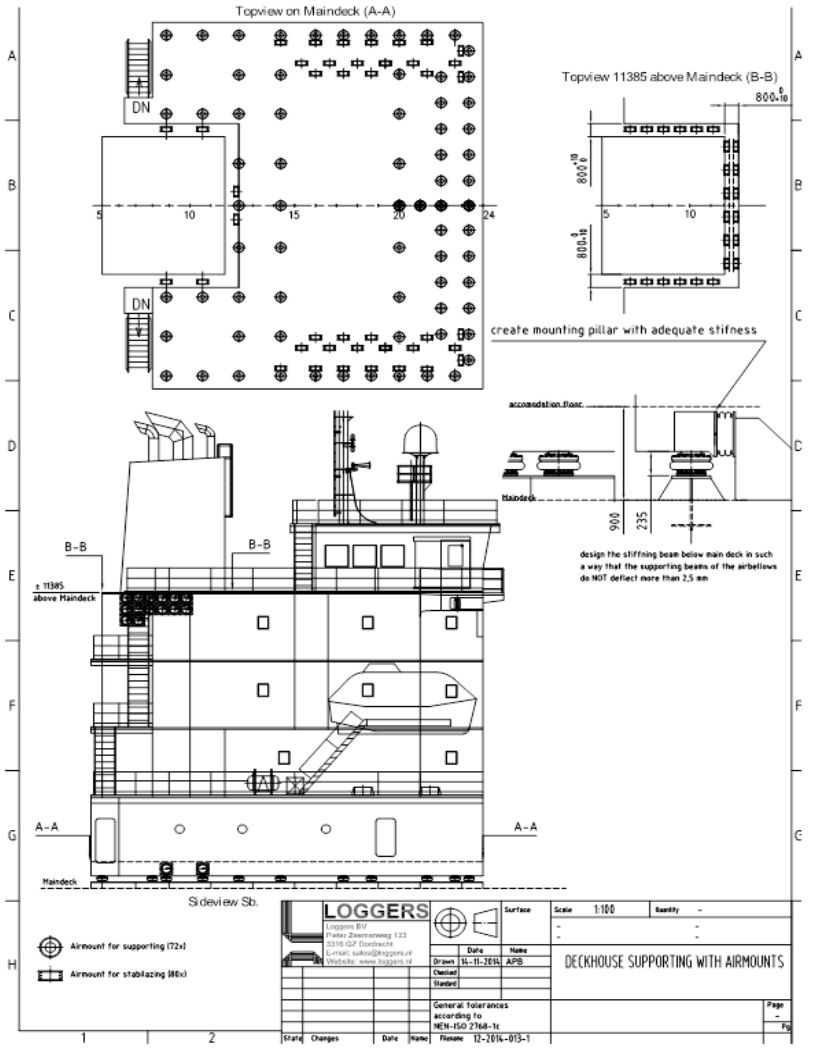
OUTPUT EXAMPLE: DESIGN DRAWINGS





REFERENCES

DAMEN
COFELY GDF SUEZ
Keppel
ASML
BOEING
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STORK
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Ministry of Defence
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LÜRSSEN FR. LURSSEN WERFT
Blohm+Voss
ENSCO
Bundeswehr
PHILIPS
Van Oord
Dredging International Marine & Waterway Contractor
Royal Boskalis Westminster nv
Singapore Technologies
TATA STEEL
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HDW
DSM BRIGHT SCIENCE. BRIGHTER LIVING.

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LEXSYS-MODULAR

THE EXHAUST LINE FOR LOW VIBRATION AND DB(A) LEVELS

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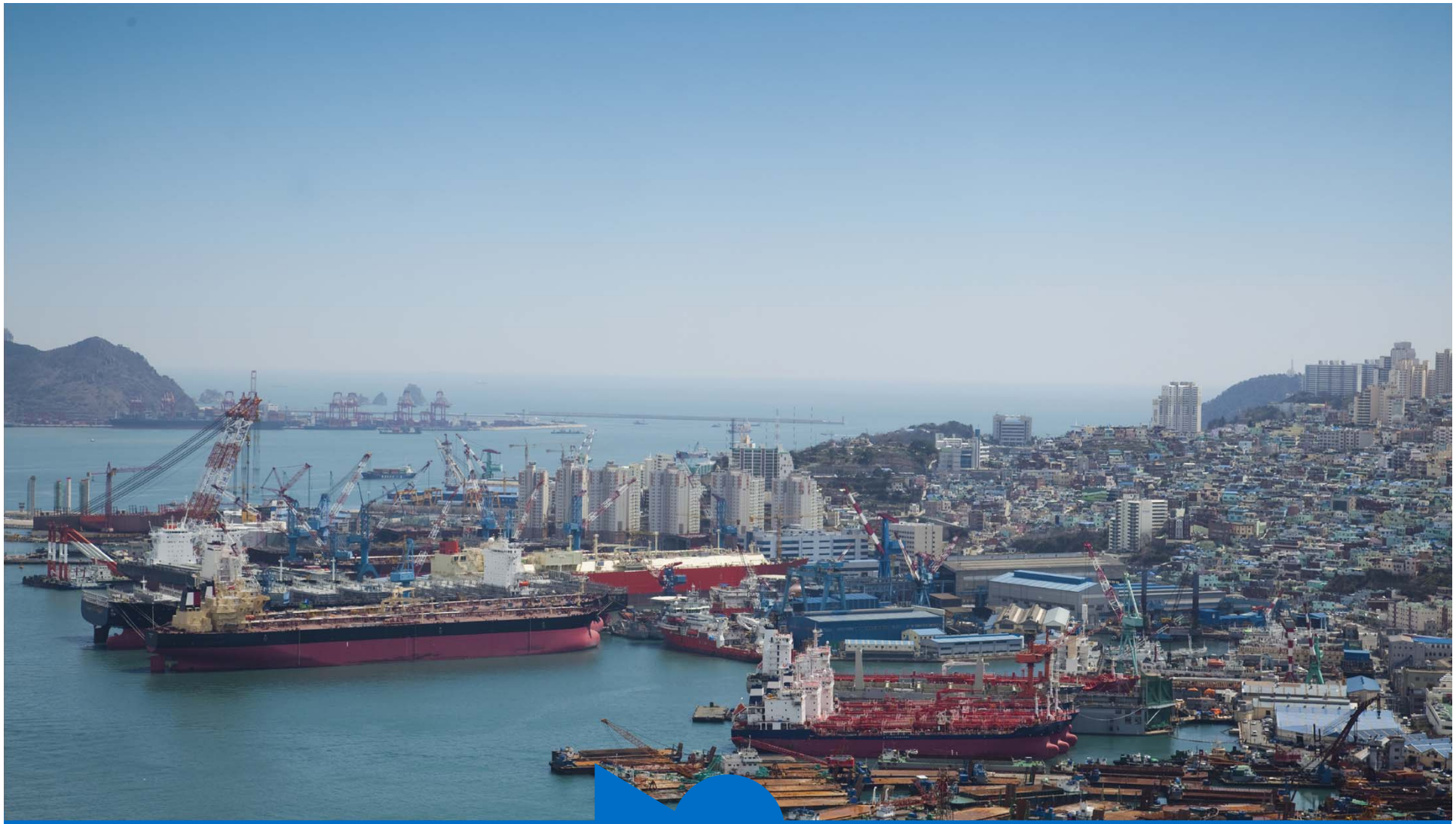
CERTIFIED QUALITY MANAGEMENT SYSTEM ISO 9001:2008 DNV

CONTENTS

- LEXSYS® Solution Family
- LEXSYS®-modular



THE LEXSYS SOLUTION FAMILY

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LEXSYS SOLUTIONS

The **LEXSYS®** family consists of three different solutions, each with their specific characteristics to offer the most optimal solution in various market segments.

- **LEXSYS®** *flexible exhaust lines*
- **LEXSYS® -shock** *shock-proof flexible exhaust lines*
- **LEXSYS® -modular** *lightweight flexible exhaust lines*

LEXSYS

- ✓ No transmission of annoying and dangerous vibrations to the environment
- ✓ Decrease of noise levels on the ship
- ✓ Full compensation of thermal expansion and contraction
- ✓ Significant longer lifetime and lower maintenance cost
- ✓ Continuous operation
- ✓ Improved working conditions (compliance with working conditions & safety act)
- ✓ Increased safety

LEXSYS®

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LEXSYS-MODULAR

- ✓ Innovative LEXSYS® solution based on durable, light-weight building blocks for both suspension and piping.
- ✓ LEXSYS®-modular shares the benefits of regular LEXSYS®, but also offers substantial lower weight and a more easy installation.
- ✓ The lightweight modular concept with prefabricated building blocks results in additional business advantages.

LEXSYS® modular

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IN MORE DETAIL: LEXSYS-MODULAR

SHORT MOVIE OF LEXSYS®-MODULAR

SOLUTION CHARACTERISTICS

The main characteristics of LEXSYS®-modular are:

- Innovative modular design
- Thermal expansion is compensated in the system itself
- Prefabricated stainless steel building blocks in various sizes with diameters up to 1000 mm
- Insulation, bellows and/or compensators are no longer required
- Minimum distance of only 50 mm to combustibles
- Suitable for external use
- Acoustics solutions available
- Type approvals by certification authorities

Like all other LEXSYS® solutions, Loggers provides relief by taking care of the **complete engineering process** with **excellent craftsmanship**.

BUILDING BLOCKS

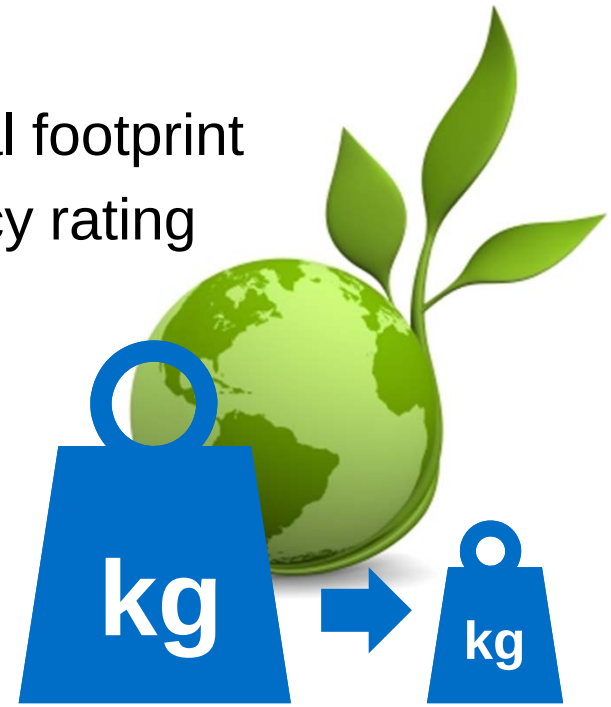
LEXSYS®-modular offers **all building blocks** needed to engineer the most **optimal course** of the exhaust line:

- LEXSYS® exhaust elements in various lengths (20, 30, 40, 50 and 100 cm)
- Adjustable length exhaust elements
- Flanged adaptors
- Elbows (15/30/45°)
- T-pieces (45/90°)
- Various supports
- Adjustable brackets
- Terminals
- Drain sections

LIGHTWEIGHT SOLUTION

All building blocks, including the supports and brackets are lightweight. In comparison to conventional exhaust lines a **weight reduction of 50% (minimum) up to 75%** is achieved.

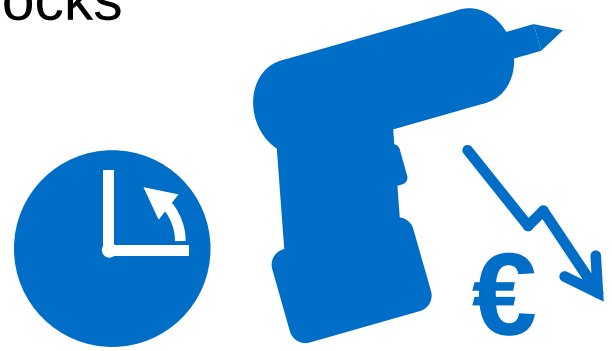
- Contributes to sustainability goals
- Improves ship performance
- Long term fuel savings and lower ecological footprint
- Improves Environmental & Energy Efficiency rating
- Low mass and modular design makes the exhaust line less vulnerable to vibrations
- Easy handling and installation



EASY INSTALLATION

In comparison to traditional exhaust line systems, the installation of a LEXSYS®-modular exhaust line is **easy** and significantly **less labour intensive**.

- Low installation cost (less labour involved)
- Installation with only battery operated hand tools, no welding and grinding equipment required
- “Click & Fix”-principle → faster installation
- No post-installation insulation due to pre-insulated elements
- Easy handling due to lightweight building blocks
- Easy exchange of exhaust elements



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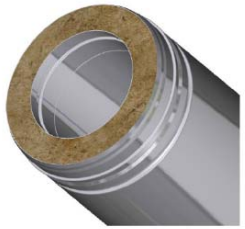
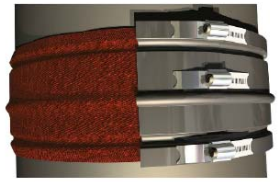
TECHNICAL CHARACTERISTICS

The **main technical characteristics** of the LEXSYS®-modular exhaust line system are:

Operating mode	Dry / High temperature / Pressurized	
Max. approved temperature	600° C	
Max. admissible temperature	± 1000° C	
Inner wall	AISI 316L / EN1.4404	0,5 – 0,6 mm
Outer wall	AISI 304 / EN1.4301	0,5 – 0,6 mm
Outer wall	AISI 254SMO / EN1.4547	0,6 mm
Insulation thickness	37,5 mm	
Insulation	mineral wool	



LEXSYS® modular

APPROVALS

Many **type approvals by independent certification bodies** apply for LEXSYS®-modular, including:

- Germanischer Lloyd
- Lloyd's Register
- Bureau Veritas
- Det Norske Veritas (DNV, written approval)
- Class NK (since July 2015)

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MEMBER OF NETHERLANDS MARITIME TECHNOLOGY

Maritime by Holland.

NIDV

DPRA DUTCH PLASTIC AND RUBBER ASSOCIATION

CERTIFIED QUALITY MANAGEMENT SYSTEM ISO 9001:2008 DNV