Technical Practices for Revision as Mandatory Rule of the IMO Resolution A.468 for Noise

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   SOLAS, Noise limits, Noise reduction index,

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Introduction - Purpose of the Regulation

Code On Noise Levels On Board Ships

- Safe working conditions

  Speech communication

  Hearing audible alarms

  Clear-headed decisions in control stations

- Protection of the seafarer from excessive noise level

- Comport of seafarer in rest, recreation and other spaces

Introduction – Progress of Revision

MSC 83 (2007)	Development of new Code on Board Ships was proposed.
DE 53 (2010.2)	Revision of IMO res. A.468(XII) to mandatory regulation of SOLAS was proposed.
DE 54(2010.10) DE 55(2011.3)	Sub-Committee (DE) works for revisions
DE 56 (2012.2)	Finalization of DRAFT Code
MSC 90 (2012.6)	The Committee approved the draft Code with a view to adoption at MSC 91(November 2012)

Regulation - SOLAS

SOLAS refer to IMO Resolution

RESOLUTION A.468(XII)

Adopted on 19 November 1981
Agenda item 10(b)

CODE ON NOISE LEVELS ON BOARD SHIPS
(SOLAS Reg II-1/36)

Title : SOLAS 1981 Amend / Chapter II-1 / Reg. 36
Effective Date : 1-9-1984
For Ships Constructed : On or after 1-9-1984

Regulation 36

Protection against noise*

* Reference is made to the Code on Noise Levels on Board Ships, adopted by the Organization by resolution A.468(XII)

KR: IACS UI SC 82

Measures shall be taken to reduce machinery noise in machinery spaces to acceptable levels as determined by the Administration. If this noise cannot be sufficiently reduced the source of excessive noise shall be suitably insulated or isolated or a refuge from noise shall be provided if the space is required to be manned. Ear protectors shall be provided for personnel required to enter such spaces, if necessary.

SOLAS Regulation

ANNEX 15

DRAFT NEW SOLAS REGULATION II-1/3-12

CHAPTER II-1
CONSTRUCTION – STRUCTURE, SUBDIVISION AND STABILITY, MACHINERY AND ELECTRICAL INSTALLATIONS

Part A-1 – Structure of ships

1 The following new regulation 3-12 is added after the existing regulation 3-11:

"**Regulation 3-12 – Protection against noise**

1 This regulation shall apply to ships of not less than 1,600 gross tonnage the keel of which is laid or which is at a similar stage of construction on or after [*effective date*], unless the Administration deems that compliance with a particular provision is unreasonable or impractical.

2 Notwithstanding the requirements of paragraph 1, this regulation does not apply to the following types of ships:

.1 dynamically supported craft;
.2 high-speed craft;
.3 pipe-laying barges;
.4 crane barges;
.5 mobile offshore drilling units;
.6 pile driving vessels; and
.7 dredgers.

3 Ships shall be constructed to reduce onboard noise and to protect personnel from the noise in accordance with the Code on noise levels on board ships, adopted by the Maritime Safety Committee by resolution MSC...(…), as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the present Convention concerning the amendment procedures applicable to the annex other than chapter I. For the purpose of this regulation, although the Code on noise levels on board ships is treated as a mandatory instrument, recommendatory parts as specified in chapter I of the Code shall be treated as non-mandatory, provided that amendments to such recommendatory parts are adopted by the Maritime Safety Committee in accordance with its Rules of Procedure."

Regulation - Applications

Application : <u>New ships of 1,600 gross tonnage and above</u>

The Code does not applied to :

- Dynamically supported craft
- High-speed craft
- Fishing vessels
- Pipe-laying barges
- Crane barges
- Mobile offshore drilling units
- Pleasure yachts not engaged in trade
- Ships of war and troopships
- Ships not propelled by mechanical means
- Pile driving vessels
- Dredgers

Regulation - Noise Level Limit

Spaces		Noise Level Limits	
		IMO A.468(XII) (dBA)	Regulation (dBA)
Accommodation space	Navigation Bridge	65	65
	Cabin/Hospital	60	55
	Messroom, Office, Recreation room	65	60
Working space	ECR	75	75
	Workshop	85	85
	Engine room	110	110
Outdoor	Bridge wing	-	70
	Open Rec. Area	75	75
	Non-specified work space	90	90

Grace value for noise level limits shall not be applied on building specification of new ships.

Regulation - Sound Reduction Index

- Limits

Spaces	Sound reduction index (Rw, dB)	
	IMO A.468	Regulation
Cabin to Cabin	30	35
Cabin to Public spaces	45	45
Cabin to Corridor	-	30

- Considerations of test on board : Recommendatory

6.3 Erection of materials

6.3.1 Care should be taken in the erection of materials and in the construction of accommodation spaces. During sea trial testing, if the erection of materials is in doubt then measurements should be taken on board ships for a representative selection of each type of partition, floors, doors as requested in paragraph 6.2.1 and to the satisfaction of the Administration.

6.3.2 The apparent weighted sound reduction index R'_w should comply with the requirements of the paragraph 6.2.1 with tolerance of up to 3 dB.

Note: Field measurements should be performed according to ISO 140-4:1998[10]. When the area of the materials tested is <10 m^2, a minimum value of 10 m^2 should be considered for the calculation of the R'_w index.

Rw :
Laboratory test
R'w:
Onboard test

Regulation - Mandatory and Recommendatory

The Code is legally treated as a mandatory instrument under the SOLAS Convention. However the following provisions of this Code remain recommendatory, options for compliance, or informative in nature.

Parts of the Code	Contents
Paragraph 1.3.2 and 1.3.3	Application to existing ships and new ship of less than 1,600 gross tonnage
Paragraph 3.4.3	Noise from vehicles during loading and discharging for a vehicle carrier
Chapter 5	Noise Exposure Limits
Section 6.3	On board test of noise reduction index in accommodation spaces
Section 7.3	Selection and use of hearing protectors
Appendix 2	Noise issues in safety management systems
Appendix 3	Suggested methods of attenuating noise
Appendix 4	Simplified procedure for determining noise exposure

Regulation - Noise Measurement Condition and Procedures

Items	IMO A.468	Regulation
Ship speed	NCR	No less than 80% of MCR
Ships fitted with thruster	-	At 40% thruster power
Operation condition in port	Duty stations and accommodation on cargo handling operation	
Machinery space	Main turbines or engine at each level, Main gearing, Turbo-blowers, Purifiers, Electrical alternators and generators, Boiler firing platform, Fans, Compressor, Cargo pump	

Technical Practice - Development of Noise Prediction Method for Ship

Noise prediction procedure for airborne and structure-borne noise

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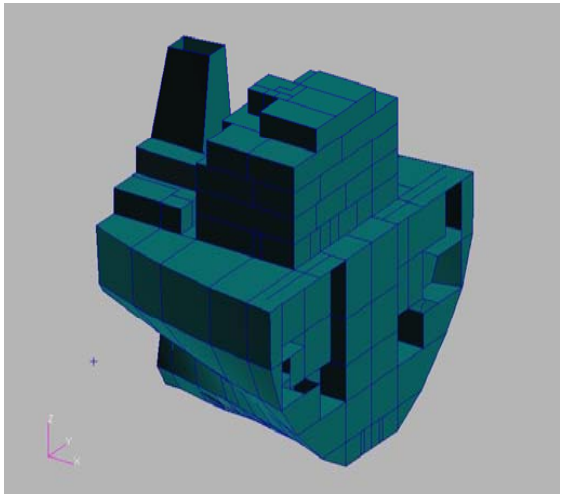
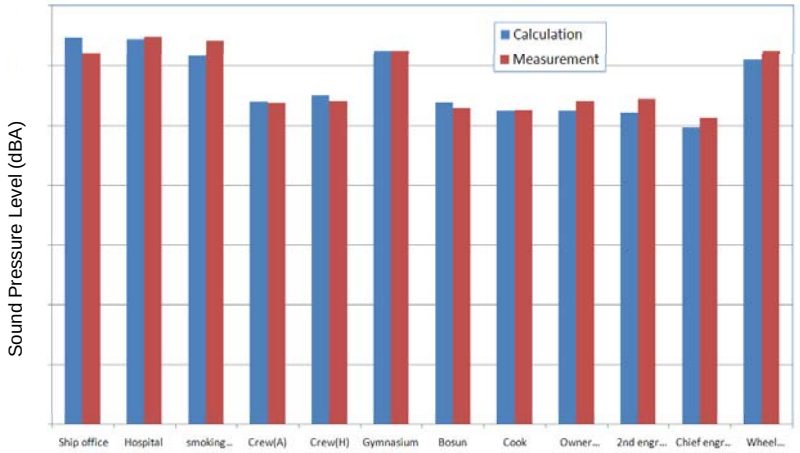
3D-model for structure-borne noise



Comparison of calculation and measurement



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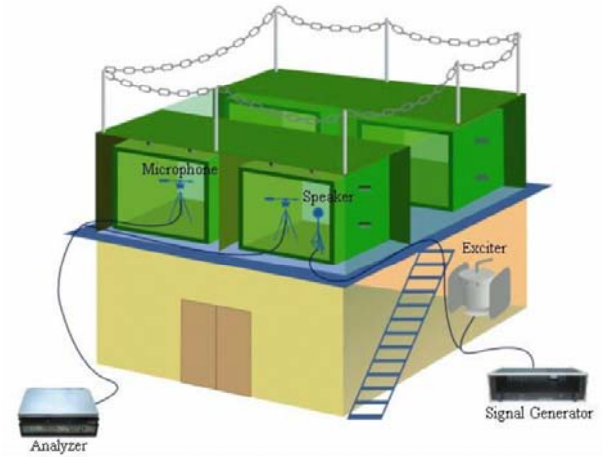
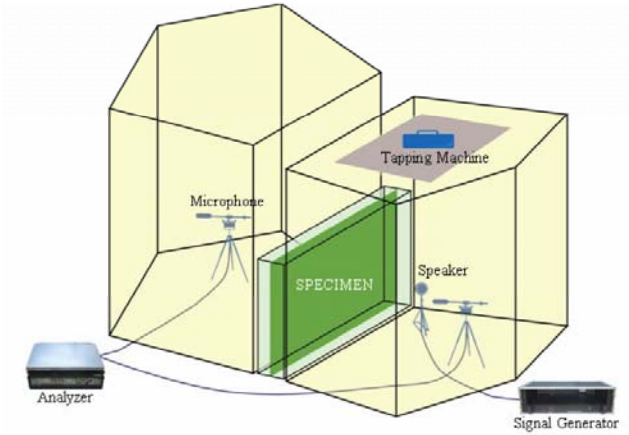
Technical Practice - Large Scale Noise Test Facilities

Deckhouse Mock-up

- Identification of airborne noise and structure-borne sound transmission of ship
- 1st Floor : Simulate the ship's engine room (10m x 6.4m x 4m)
  2nd Floor : 4 Cabins with same interior with commercial vessel





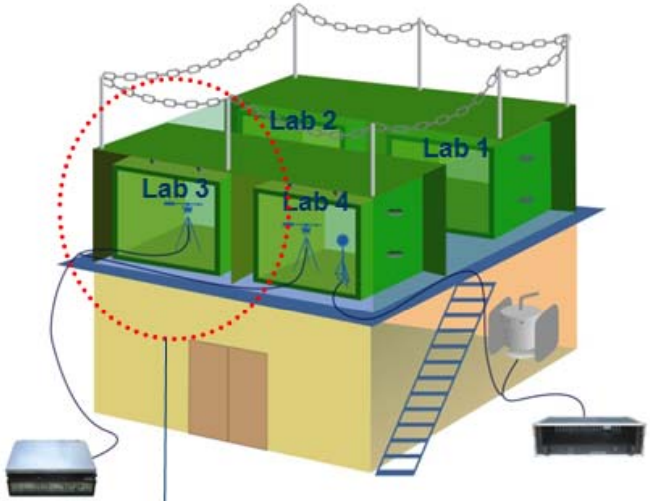
Reverberation Room

- 300mm thick concrete walls. Non-parallel pentagonal shape
- Measurement of Sound absorption, Transmission, Radiation and Impact Sound Insulation of acoustical materials
- Two openings for sound transmission test and impact insulation test

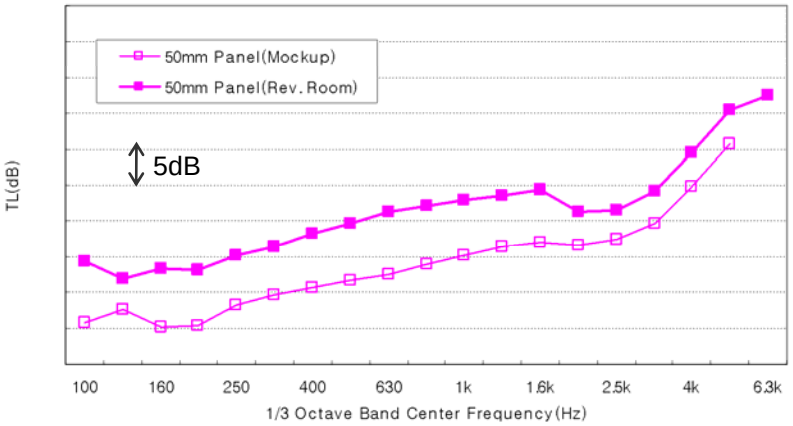
Technical Practice - Large Scale Noise Test Facilities

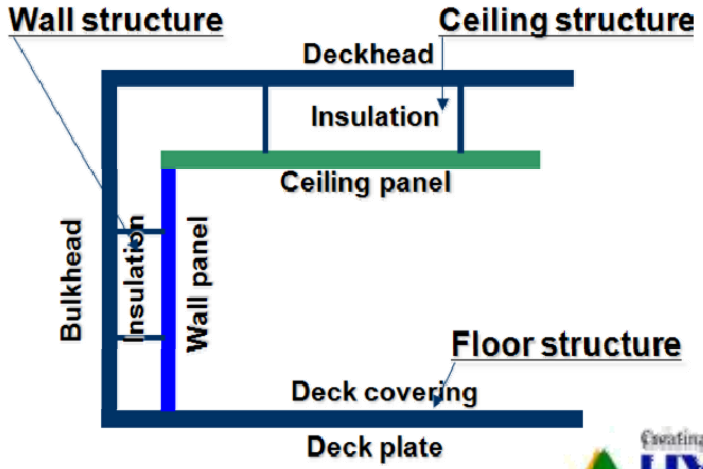
Deckhouse Mock-up

- Noise reduction index of in situ condition for partition wall, door, ceiling and floor structures
- Identification of airborne noise



Comparison of Lab. and field test results





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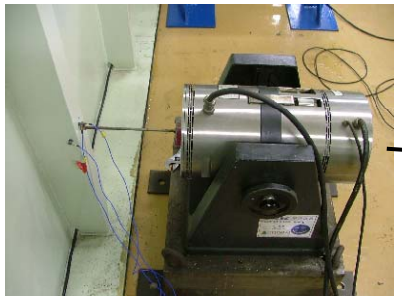
Technical Practice - Large Scale Noise Test Facilities

Deckhouse Mock-up

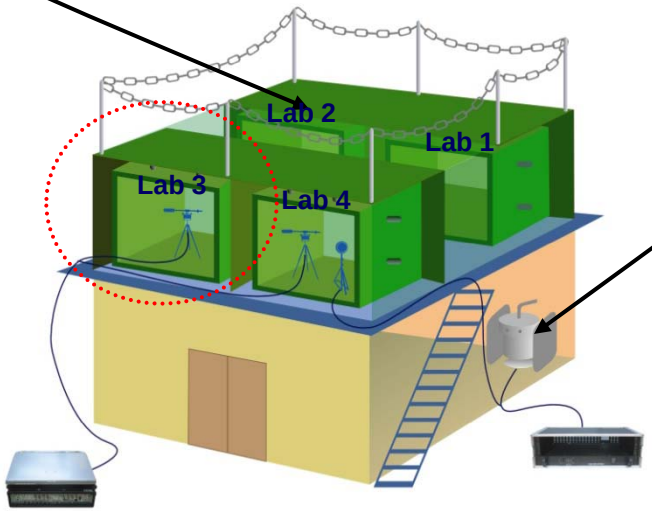
- Structure-borne sound transmission of ship
- Structure-borne noise reduction of deck structures

Tapping machine



Electro-magnetic exciter

Noise source above cabins



Noise source below cabins

Technical Practice - Large Scale Noise Test Facilities

Reverberation Room

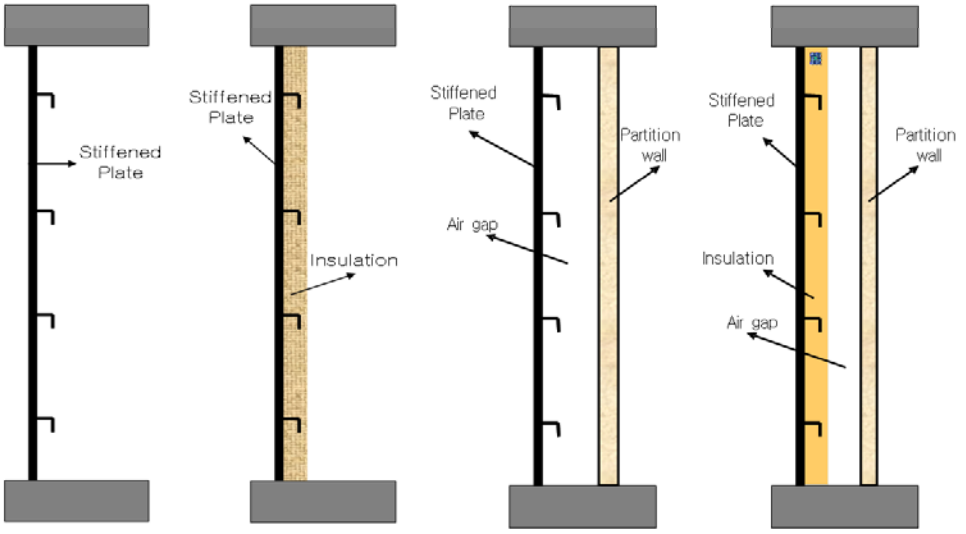
- Sound reduction index of wall and ceiling structures with steel bulkhead
- Sound absorption of insulation used in ship as thermal, fire protection and acoustic insulation
- Development of floating floor with simple structures and high performance

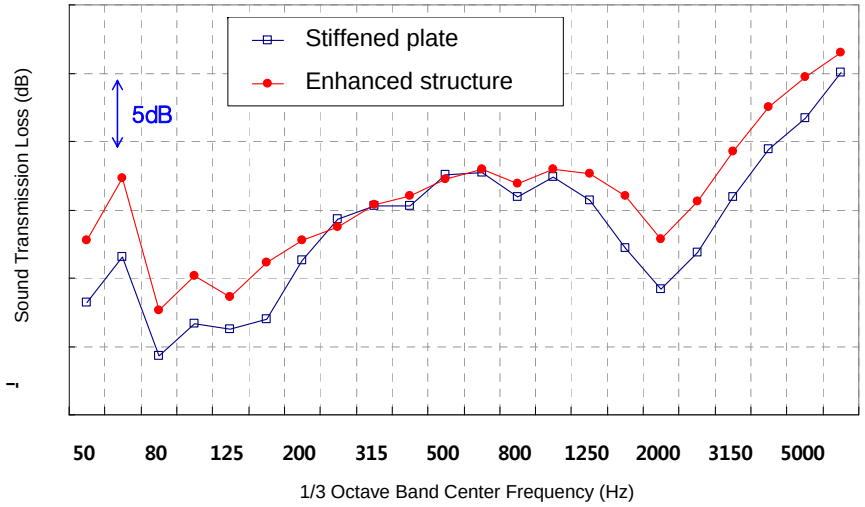
Standard	ISO
Volume	Source room : 100.8m^3 Receiver room : 160.4 m^3
Surface area	Source room : 128.7 m^3 Receiver room : 173.6 m^3
Specimen dimension	For transmission loss : 4.2m x 2.4m
	For impact insulation : 4.0m x 2.5m

Technical Practice - Advanced Noise Control Method

Sound Reduction Index

- Insulations types : Thermal, Fire (Felt/Spray type)
- Panel types : Wall panel (25mm, 50mm thickness, High noise reduction type),
  Ceiling panel(25mm and Overlay insulation)
- Air gap : 150~450mm
- Development of bulkhead structure with high noise reduction index in low frequency range





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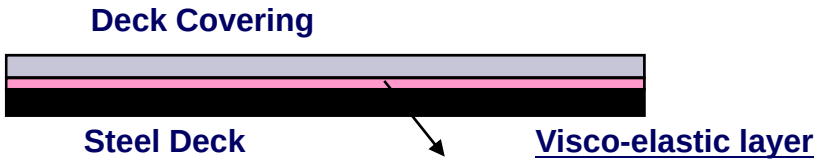
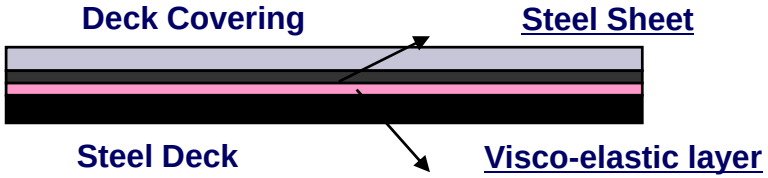
Technical Practice - Advanced Noise Control Method

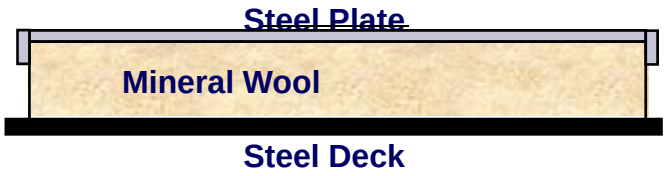
Structure-borne noise reduction

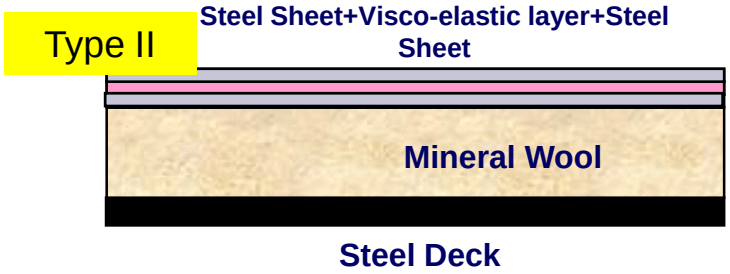
- **Constrained Damping Layer**





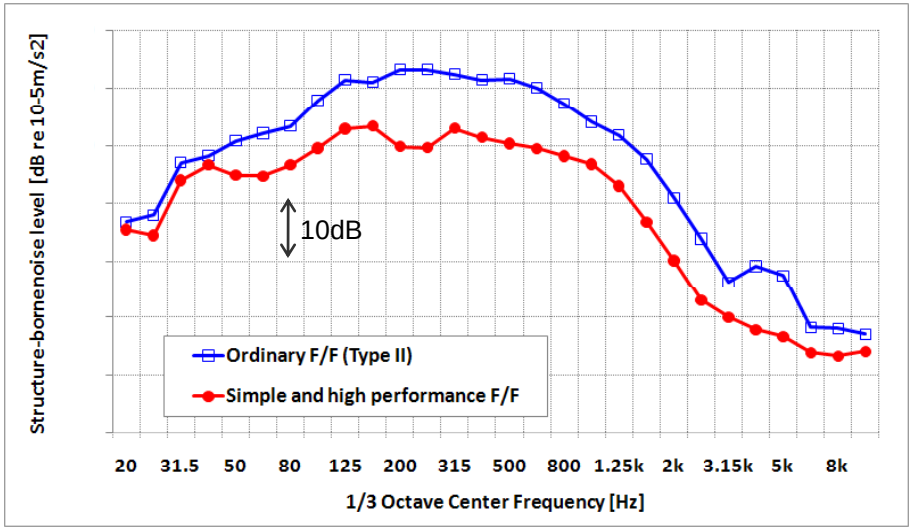
- **Floating Floor**





- **Multi-Layer Complex Structure**

- **Simple and High Performance Floating Floor**



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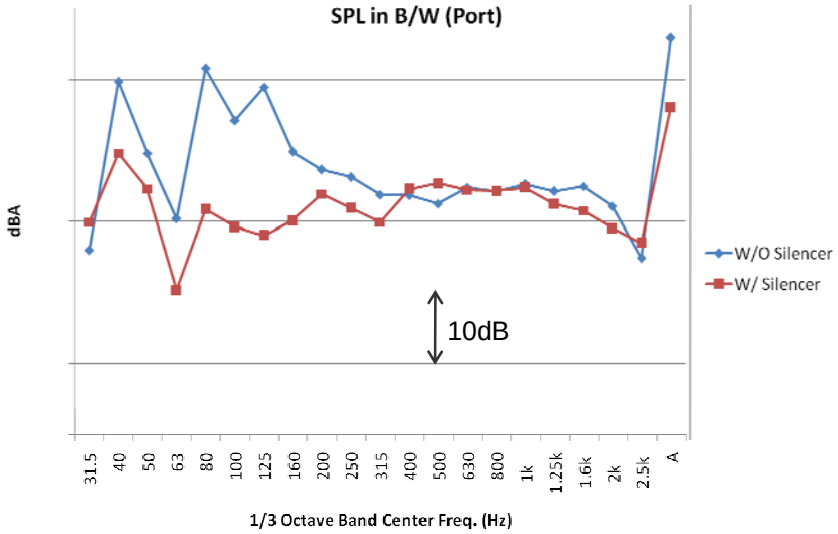
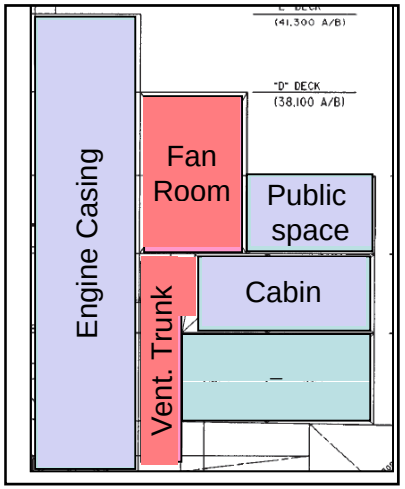
Technical Practice - Advanced Noise Control Method for Noise Sources

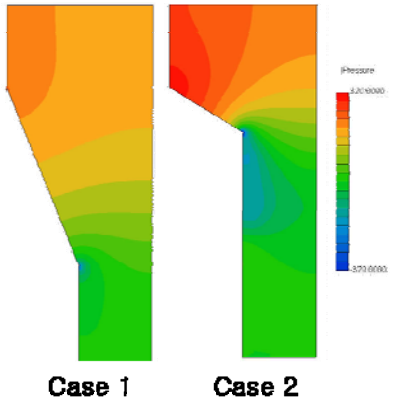
Silencer for exhaust pipe of diesel generator

Hybrid silencer (Resonator + Absorptive Silencer)



Noise reduction of ventilation fan of engine room





Pressure distributions of each arrangement of duct

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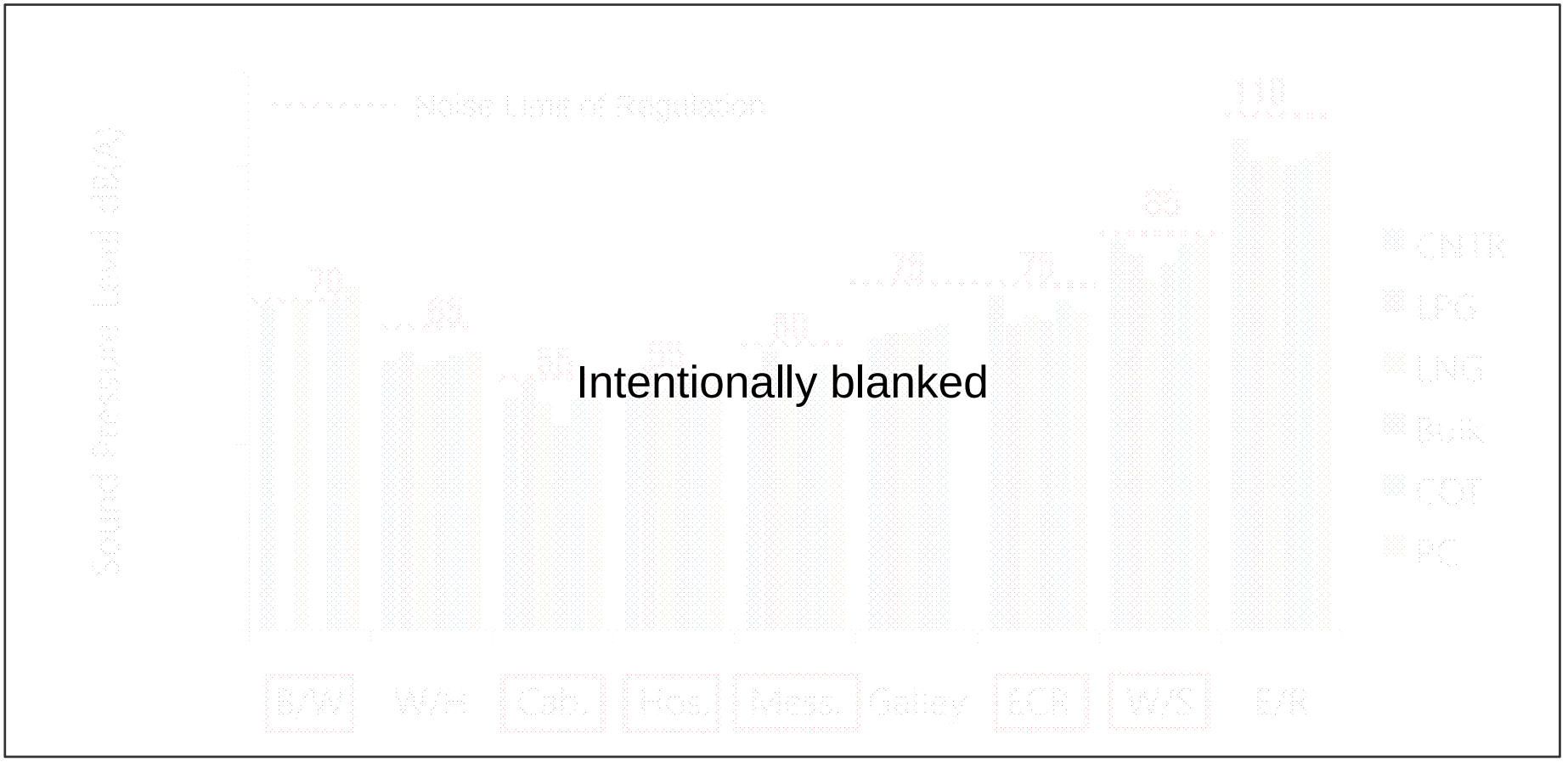
Technical Practice - Noise Level of Various Ships



Noise Reductions are needed for following areas

- Cabin/Hospital : Located in upper deck
- Working spaces : Engine control room on cargo handling conditions and Workshop
- Outdoor : Bridge wing noise due to exhaust pipes and fans

Technical Practice - Countermeasures for Noise Reduction Index

Spaces	Noise Reduction Index, Rw [dB]	Countermeasures
Cabin to Cabin	35	High noise reduction panel : Rw=43 (If not applying on board test) Rw>50 (If applying on board test)
Cabin to Public space	45	Wall panel + Steel Bulkhead + Wall panel
Cabin to Corridor	30	Door : Rw > 40

■ 318k VLCC

Cabins and hospital located on sunken deck or upper deck

→ Changes of arrangement (Noise reductions : 5dB)

Pipelines of cargo pump

→ Separated arrangement from the noise sensitive areas (Noise reductions : 3dB)

■ 5000 TEU Container Carrier

Recreation rooms on upper deck

→ Floating floor on deck structure (Noise reductions : 6dB)

Public spaces on A deck

→ Separation of exhaust pipes and countermeasures for deck structures (Noise reductions : 5dB)

Cabin on B deck

→ Noise reduction of transmission from ducts connected to engine ventilation fans (Noise reductions : 4dB)

Technical Practice - Countermeasures for Cargo Handling & Outdoor Noise

Cargo handling condition

Space	Noise limits (dBA)	Cause	Countermeasures
Accommodation	55	Structure-borne noise by pipe works	Changes of pipes installation
Duty stations	75		Anti-vibration mounts on pipe lines

Outdoor noise

Space	Noise limits (dBA)	Cause	Countermeasures
Bridge wing (Listing post)	70	Exhaust pipe noise Ventilation fan noise	Hybrid silencer Absorptive silencer for fan and insulation for fan room
Recreation area(Swimming pool)	75	Ventilation Fan noise	Absorptive silencer for fan and insulation for fan room

Conclusions

1. IMO Resolution A.468(XII) adopted on November 1981 will be revised as more severe regulation which is mandatory as SOLAS regulation.
2. The Committee in MSC 90(July, 2012) approved the draft Code with a view to adoption at MSC 91(November. 2012)
3. Technical practices by HHI (Hyundai Heavy Industry, Korea) using the noise analysis and acoustic test facilities were described to reduce the on board ship's noise focusing on the main items of new regulation.
4. The main items are noise level of accommodation, work space and sound reduction index in accommodation. And various operating conditions such as cargo handling should be considered in ship design preparations for adoption of new regulation.
5. This presentation's results are based on a large sized ships constructed by HHI such as Product Carrier (105k, 112k), Crude Oil Carrier(104k~160k), VLCC(312k), LPG Carrier(22.5k~82k), Bulk Carrier(180k) and LNG Carrier(150k~216k).