Korean Register of Shipping

# **Noise Control of 2.8K DWT Oil/Chemical**

Tanker



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- 1. Introduction of Noise Code
- 2. Noise Control of Ships
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### **1. Introduction of Noise Code**

Applied to the new ships of 1,600 GT and above



# Definitions





# Definitions

#### **Weighted Sound Pressure Level**



- A-weighted sound pressure level or noise level, dB(A): The quantity measured by <u>a sound level meter</u> in which the frequency response is weighted according to the A-weighted curve (IEC 61672-1)
- Integrated sound level meter: A sound level meter adapted to measure the level of the mean squared time averaged Aweighted and C-weighted sound pressure
- dB(A): a single value of dB based on <u>equal-loudness curve</u> for the human ear
- <u>dB(C)</u>: linear over several octaves for measurements at <u>very high</u> sound pressure levels (>85dB)



#### Maximum Acceptable Sound Pressure Levels

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

	Noise lev	vel limit	
	1.6K-10K	>10KGT	
	Machinery spaces	110	110
Work	Machinery control rooms	75	75
spaces	Workshops other than those forming part of machinery spaces	85	85
	Non-specific work spaces	85	85
	Navigation bridge and chartrooms	65	65
Naviga-	Look-out posts incl. navigating bridge wings and windows	70	70
Spaces	Radio rooms	60	60
	Non-specific work space	65	65
	Cabin and hospitals	60	55
Accommo-	Messrooms	65	60
dation	Recreation rooms	65	60
Spaces	Open recreation areas (external)	75	75
	Offices	65	60

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### Maximum Acceptable Sound Pressure Levels



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

	Noise level limit			
	1.6K-10K	>10KGT		
Service Spaces	Galleys without for processing equipment operating	75	75	
	Serveries and pantries	75	75	
Normally unoccupied spaces	Spaces referred in section 3.14	90	90	

<MSC.1/Circ.1509 Unified interpretations of the CODE>







- ✤ Stage 1: Initial Design Review
  - G/A & M/A review for the target ship
  - Checking the noise criteria & building specification
  - Noise levels Estimation by using the records from any similar vessel's
  - Establishment of noise counter measure if necessary
- Stage 2: Noise Prediction using numerical model (SEA)
  - After receiving the detailed drawings and information for the target ship
  - Considering SBN(Structure-Borne Noise) & ABN(Air-Borne Noise)
  - Confirmation of noise control results conducted in the initial design review
  - Noise control by using numerical analysis result
  - Suggestion of additional or alternative noise control method if necessary

### **Procedures of Noise Prediction by SEA**



- Estimation of source level: measurement data, SNAME empirical formula
- Space element modeling: noise source room, close receiving room, receiving room
- Evaluation of hull transmission loss by statistical energy analysis
- Estimation of room constant
- Air-borne and structure-borne noise prediction for cabins and workspaces
- Evaluation of HVAC system noise (using experienced data)



<Ship model for cabin noise analysis>



<Model for HVAC noise analysis>



# 3. Noise Prediction, Analysis and Measures for a Chemical Tanker

### **Transmission of Noise**





- Chemical Tanker: GT 2,200 tons
- Main Noise Sources
  - Main engine (4-stroke, 1 set) @ E/R
  - Reversing gear (1 set) @ E/R
  - Diesel generator (2 sets) @ E/R
  - Propeller (1 set) @ Aft-body
  - E/R vent. Fan (2 set) @ Nav. Bri. Deck





- Structural considerations
  - E/R is smaller size, so noise level in E/R is expected to be high considering reflecting waves
  - Accommodation structure is closer to E/R
  - Aft-body is closer to accommodation, so structure-borne noise generated from propeller is directly transmitted to accommodation structure
- Noise source consideration
  - 4-stroke diesel engine and reversing gear have high air-borne noise level : air-borne noise from diesel engine is directly transmitted to lower part of accommodation structure (needed to supply the noise data of M/E & Gear)
- Suggested noise control measures
  - High class heat & sound insulation and floating floor should be installed between E/R and lower part of accommodation structure for reducing the transmitted noise (floating floor below ECR & Mess Rm, noise insulation wall besides ECR)

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#### Noise control area & predicted levels by experienced data



: High Noise Area

: Noise Control Target Area

: Noise Absorbing Area

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#### Noise control area & predicted levels by experienced data





#### Noise control area & predicted levels by experienced data

NAV. BRI. DECK



: High Noise Area : Noise Control Target Area : Noise Absorbing Area

# **Stage 2: SEA Model for Cabin Noise Analysis**

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SEA(Statistical Energy Analysis) model for decks



<Tank plan>

<Below tank plan>

## **Stage 2: Noise Analysis Result**

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✤ Analysis result: predicted overall noise levels





#### ✤ Analysis result: Poop Deck

				1/1 Oct. Band Center Frequency (Hz)										Total	Cuiteuria	Initial
DK	Name	Name	31.5	63	125	250	500	1000	2000	4000	8000	AO	HVAC	(dBA)	(dB(A))	Prediction (dB(A))
		SBN	25.9	43.6	51.0	55.3	59.0	57.7	54.6	46.1	38.9	63.4				72
	MESS ROOM	ABN	22.5	61.8	66.9	55.8	53.2	52.5	55.9	51.0	45.7	68.9	52	70.1	65	
		TOTAL	27.5	61.9	67.0	58.6	60.0	58.8	58.3	52.2	46.5	70.0				
		SBN	25.0	42.8	50.0	54.1	57.6	55.8		41.8	35.5	61.5				
	GALLEY	ABN	25.1	63.4		54.8	50.3	50.3	54.0	52.2	47.6	69.7		71.4	75	74
		TOTAL	28.1	63.4	68.1	57.5	58.3	56.9	55.2	52.6	47.9	70.3				
		SBN	22.6	41.8	47.4	50.3	54.5	49.4	43.8	36.1	33.2	57.6				
	SHIP'S OFFICE & C.C.R	ABN	4.7	47.4	53.6	40.6	38.8		44.1	41.9	35.9	55.6		60.4	65	63
		TOTAL	22.7	48.5	54.5	50.7	54.6		47.0	42.9	37.8	59.7				
	соок	SBN	23.9	43.0	48.5	51.2	54.9	49.4	42.2	38.2	34.9	58.1			60	62
		ABN	1.4	46.6	49.7	38.2	34.9	35.0		37.1		52.2		59.9		
Роор		TOTAL 2	23.9	48.2	52.2	51.4	54.9	49.6	44.0	40.7	36.4	59.1				
Deck		SBN	23.5	42.6	48.1	50.9	54.8	49.5	43.2		35.5	58.0			60	59
	BOSUN	ABN	-	45.1	51.1	35.3	33.1	34.7		35.6	26.0	52.6		52 <b>59.9</b>		
		TOTAL	23.5	47.0	52.9	51.0	54.8	49.6	44.6	40.4		59.1				
		SBN	28.0	45.6	53.3	58.0	62.2	61.9	60.5	50.1	42.3	67.3				
	EMG.D/G RM	ABN	-	35.0	39.4	23.9	20.1	19.2	23.0	20.5	13.1	41.0		67.3		-
		TOTAL	28.0		53.5	58.0	62.2		60.5	50.1	42.3	67.3				
		SBN	31.1	48.4	55.6	59.4	62.5		52.8	45.7						
	PROV. STORE	ABN	9.9	48.8	60.4	51.5	49.4	49.1	52.6	50.4	45.1	62.6		68.1		-
		TOTAL	31.1	51.6	61.6	60.1	62.7	61.3	55.7	51.7		68.1				
		SBN	29.4	46.7	54.6	58.8	61.9	61.4	58.9		39.5	66.9				
	DECK STORE	ABN	11.5	50.2	58.4		44.5	43.5	46.7	44.9	40.3	59.9		67.7		
		TOTAL	29.5	51.8	59.9	59.1	62.0	61.5	59.2	49.7	42.9	67.7				

- Conclusion of noise analysis
  - From noise analysis, some areas exceeding noise level are classified as excess area
  - Especially, engine room space is small and close to cabins. So noise levels at cabins close to E/R & E/Casing would be high
  - Noise treatments such as high noise reduction panel, heat & sound insulation and floating floor are required for reduction of ABN & SBN
  - Noise treatments should be carried out considering frequency characteristic of cabin noise

<	Noise	analysis	result:	excess	area	&	main	noise	sources	>
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NO.	Classification	Name of cabin	Deck	Remarks
1	Excess	MESS ROOM	Poop Deck	<ul> <li>SBN and ABN generated from E/R &amp; E/Casing are transmitted</li> </ul>
2	Area	ENG. CONT. ROOM	Upper Deck	to excess area

# Stage 2: Final Recommendation for Noise Control



#### **Recommendation of noise control measure**

< UPPER Deck >



Noise insulation ceiling above pump room (to keep noise level of Cook room within allowable limit)





#### **Recommendation of noise control measure**





# **Stage 2: Noise Analysis Result**

Comparison noise levels before and after nose control treatments

- Poop deck & Below Upper deck

#### 1) Before noise control

DK	Nama					Total	Criteria								
	Name		31.5	63	125	250	500	1000	2000	4000	8000	AO	HVAC	(dBA)	(dB(A))
Poop Deck MESS ROOM		SBN	25.9	43.6	51.0	55.3	59.0	57.7	54.6	46.1	38.9	63.4			
	MESS ROOM	ABN	22.5	61.8	66.9	55.8	53.2	52.5	55.9	51.0	45.7	68.9	52	70.1	65
		TOTAL	27.5	61.9	67.0	58.6	60.0	58.8	58.3	52.2	46.5	70.0			
Below	ENG. CONT. ROOM	SBN	28.8	47.7	54.3	58.0	62.1	61.4	55.3	46.8	40.8	66.4			
Upper		ABN	28.7	66.6	74.8	68.1	67.3	66.4	68.3	67.1	62.9	78.1	60 78	78.5	75
Deck	k		31.8	66.7	74.8	68.5	68.4	67.6	68.5	67.1	62.9	78.4	1		

#### 2) After noise control : Floating floor & High noise reduction panel

DK	Nama					Total	Criteria								
	Name		31.5	63	125	250	500	1000	2000	4000	8000	AO	пуас	(dBA)	(dB(A))
Poop Deck MES		SBN	26.6	45.3	46.8	39.8	37.8	32.8	23.2	13.3	6.0	50.0			
	MESS ROOM	ABN	19.7	56.0	60.4	43.7	37.4	38.0	40.7	39.0	35.9	61.9	52	62.6	65
		TOTAL	27.4	56.4	60.6	45.2	40.6	39.1	40.8	39.0	35.9	62.2			
Below		SBN	30.9	50.9	53.4	49.0	50.5	47.1	41.0	32.0	27.9	57.8			
Upper	ENG. CONT. ROOM	ABN	25.7	63.5	70.3	55.4	48.9	48.9	50.1	48.8	44.2	71.4	60	71.9	75
Deck		TOTAL	32.0	63.7	70.4	56.3	52.8	51.1	50.6	48.9	44.3	71.6			





#### 4. Discussions

### Discussions



- ✤ Most of rooms and spaces in Noise Code are under the noise level limits.
- ✤ Calculated noise levels of Mess room and Engine control room are exceeding the noise level limits. Recommendations are suggested.
- Base on the recommendation, noise control measures, such as high noise reduction insulation/panel, heat & insulation ceiling and floating floor, are considered. Re-analysis for verification treatments has been carried out.
- Construction quality control should be required for effective application of noise control measures, such as floating floor and high noise reduction panel.
- **\*** HVAC noise is assumed to be and should be controlled under;
  - 52 dB(A) for cabins, mess room and offices
  - 60 dB(A) for wheel house
  - 65 dB(a) for galley, exhaust fan off



# Thank you for your attention!

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