Guidance Relating to Rules for the Classification of Steel Ships(Draft)

(Rules and Guidance for the Classification of Underwater Vehicles)

- For exnternal opinion inquiry -



Hull Rule Development Team

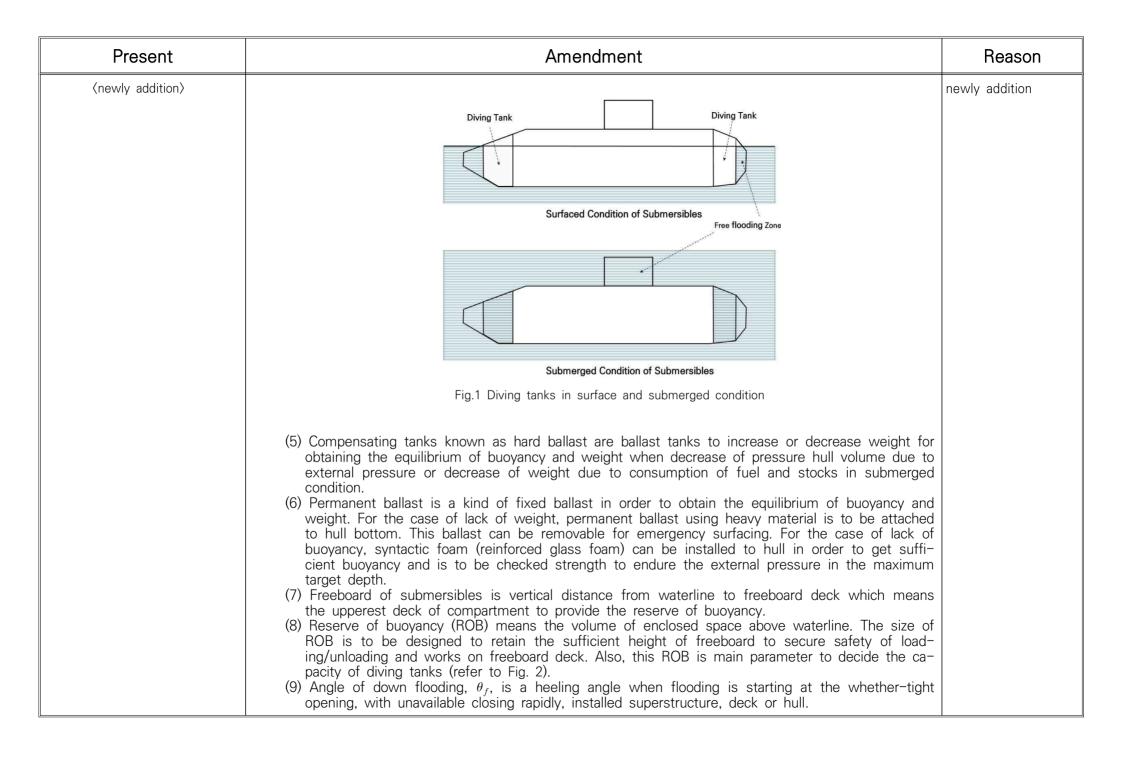
- Main Amendments -

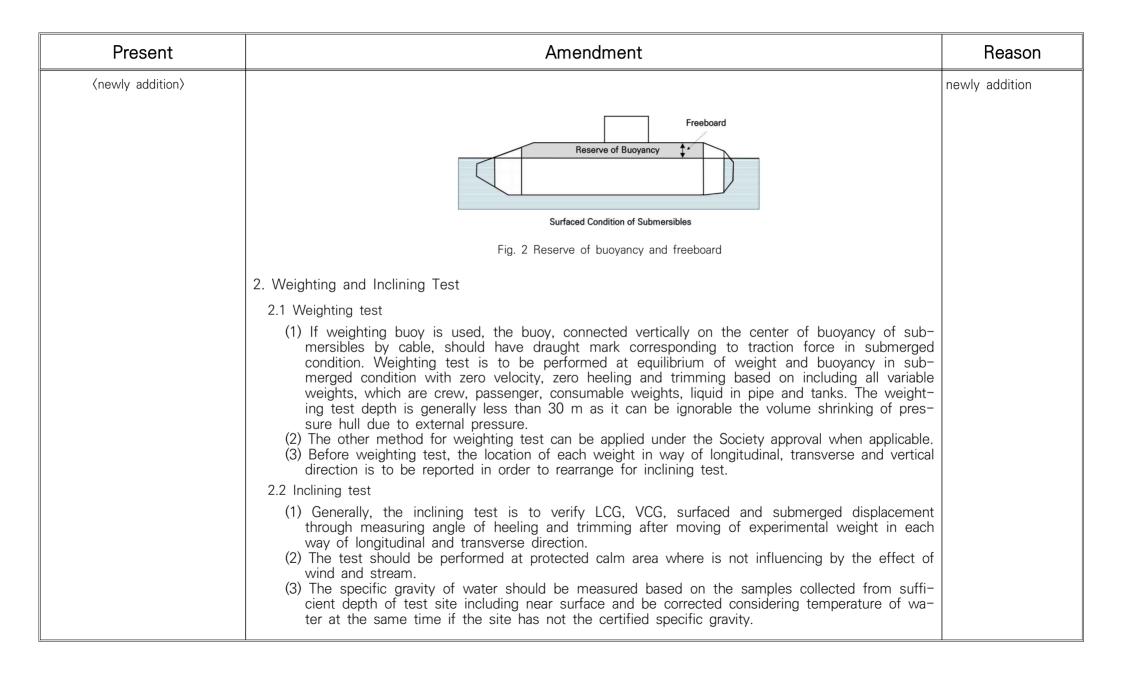
(1) Effective date : 1 July 2021

• Annex 3 Guidance for Stability of submersibles

Present	Amendment	Reason
Guidance Relating to the Rules for the Classification of Underwater Vehicles	Guidance Relating to the Rules for the Classification of Underwater Vehicles	
CHAPTER 1 GENERAL	CHAPTER 1 GENERAL	
Section 1 General	Section 1 General	
101. Application1. In application to 101. 5 of the Rules, the design and the construction for submersible with GRP shall be complied with Annex 2 of this guidance.	101. Application1. In application to 101. 5 of the Rules, the design and the construction for submersible with GRP shall be complied with Annex 2 of this guidance.	
<newly add=""></newly>	Section 2 Drawings and Documents 205. Diving and buoyancy tanks, trimming devices The mathematical proof described in 205. of the Rules is to be complied with the requirements in Annex 3.	⟨newly Add⟩
Section 3 Test and trials	Section 3 Test and trials 〈same as current〉	

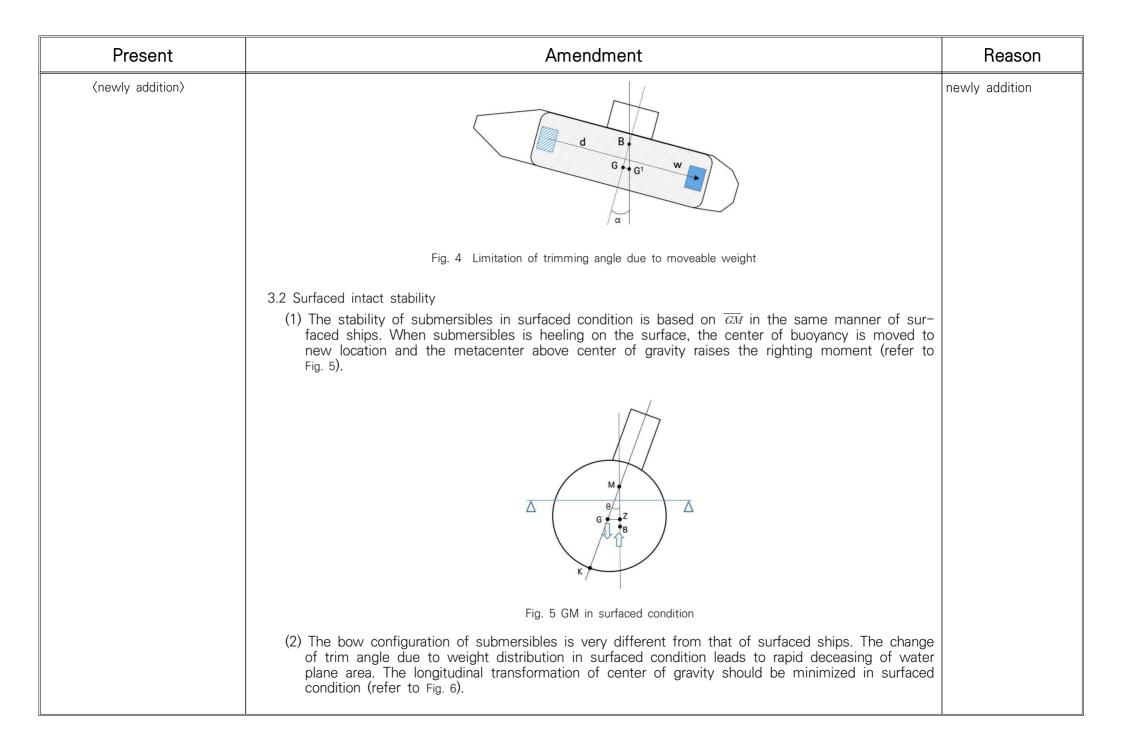
Present	Amendment	Reasor
<pre>(newly addition)</pre>	Annex 3 Stability of Submersibles (2020)	newly addition
	1. General	
	1.1 Drawing and documents	
	 This Annex shows the minimum requirements for drawings and documents described in 205. Sec.2, Ch.1, Part 1 of the Rules. After weight and inclination test, the Trim & stability report and Damage stability report should be submitted to the Society and located onboard always. The drawing and documents for the verification of stability should be included as following; general arrangement center of gravity and volume/capacity arrangement for all compartment and tanks lines plan hydrostatic curves. report of weight and inclining test trim and stability report damage stability report 	
	 Definition Surfaced displacement, Δ_f, is the same as the displacement of common surfaced ships. For submersibles, the surface displacement is based on fully boarded crews and passengers or cargo, 50% of filling in trim tanks which controls longitudinal trim, full consumable items, empty compensating tanks and empty diving tanks. Submerged displacement, Δ_b, is resulted from adding a volume of diving tanks to surfaced displacement. Sea water in free flooded zones is not included to this displacement. Free flooded zone as a part of hull compartments is admitted free inflow and ventilating of sea water. Diving tanks known as soft ballast are ballast tanks to increase weight for diving. The capacity of diving tanks is to be designed to acquire the equilibrium of buoyancy and weight, known as neutral buoyancy, in submerged condition (refer to Fig. 1). 	

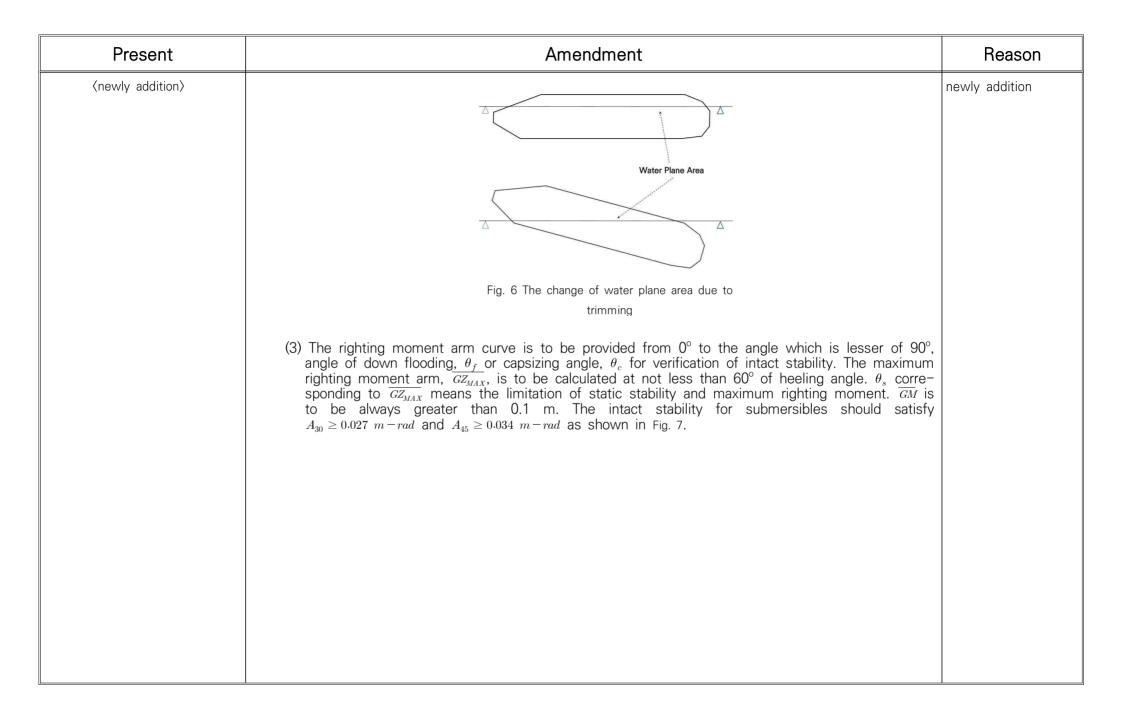


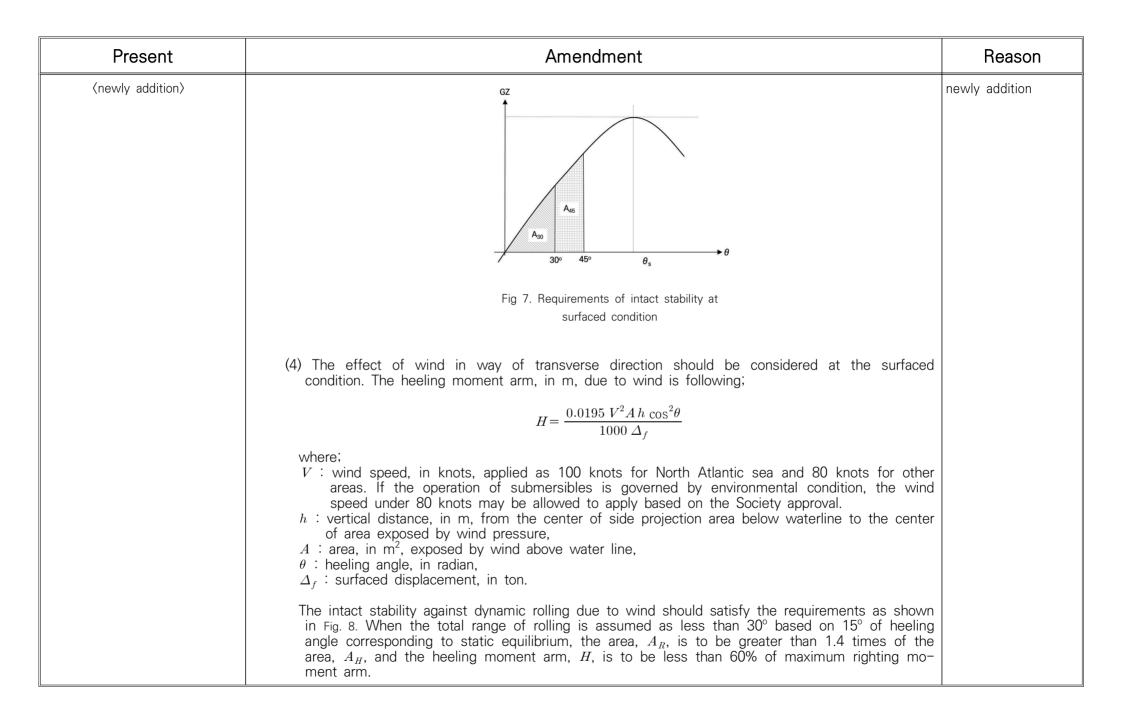


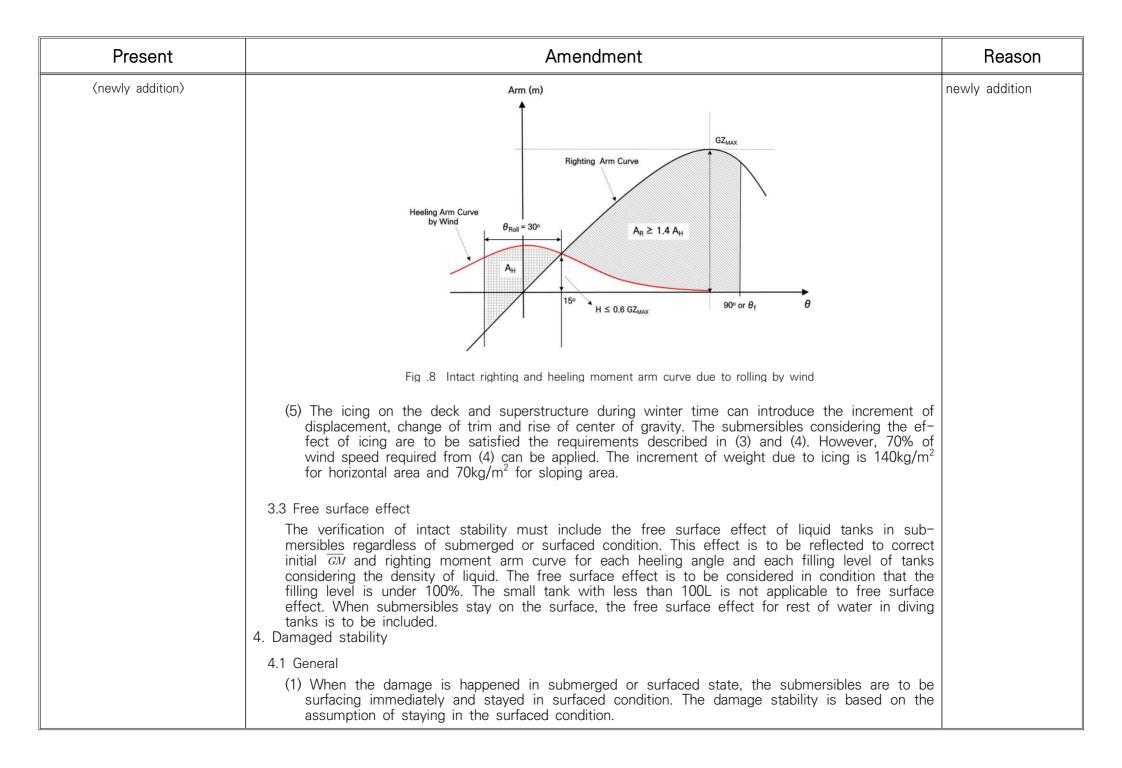
Present	Amendment	Reason
<pre>(newly addition)</pre>	 (4) The trim of submersibles is to be less than 0.1° and the number of tanks filled with liquid should be minimized if possible. The free surface effect of tanks is to be considered precisely while test is progressing(refer to 3.3). The capacity and weight of all liquid tanks and compartments are to be checked and recorded. Especially, the bilge tank should be empty and rested air pocket in trimming and air pipes should be emptied. (5) The experimental weight for inclining must be sufficient to heel and trim 1 ~ 3 degree of angle in way of vessel's longitudinal and transverse direction. If not available to use solid weight, liquid transference between two symmetric tanks located for each direction may be substituted under approval of the Society. (6) Several certificated clinometer or pendulums are to be used for correcting the error of measurement. (7) For verifying submerged displacement, diving tanks are to be fully filled and compensating tanks are to be partially filled to ensure staying in submerged condition with neutral buoyancy. Submerged inclining test must carry out under the condition below Sea-state 2. (8) For verifying surfaced displacement, the draught data measured from starboard and port sides at amid ship, stern and bow should be averaged. Especially, the capacity of unventilated water in diving tanks is to be reported. Also, all bilge and decks should be dried. (9) If the change of weight is occurred due to maintenance or conversion, weighting and inclining test should be carried out again in case that the change of weight can not be controlled by the weight compensation tank and affect to stability. 	newly addition
	3. Intact stability	
	3.1 Submerged intact stability (1) Heeling in submerged condition does not induce volumetric change and move the center of buoyancy of submersibles. Also, the location of metacenter is the same as center of buoyancy because water plane is not exist. As shown in below formulas, the height of metacenter, \overline{GM} , is the same as \overline{GB} (refer to Fig. 3). In below formula, I means 2^{nd} area moment of water plane and ∇ is volume of displacement. The center of gravity is always to be below the center of buoyancy in order to maintain stable state in submerged condition. $\overline{KM} = \overline{KB} + \frac{I}{\nabla} = \overline{KB} + \frac{0}{\nabla} = \overline{KB}$ $\overline{GM} = \overline{KM} - \overline{KG} = \overline{KB} - \overline{KG} = \overline{GB}$	

Present	Amendment	Reason
<pre></pre>	\mathbf{G}	newly addition
	κ / Fig 3. GB in submerged condition	
	(2) For all loading cases in submerged condition, \overline{GB} is to be not less than the greater of 0.05 m or as following value (refer to Fig. 4);	
	$\overline{G^1B} = \overline{GB}\tan\alpha$	
	$\overline{GB} \ge \frac{w d}{\Delta \tan \alpha}$	
	 where; w : moveable weight, in ton, generally 10% of total weight of boardable passengers (73kg/passenger) or cargo, d : maximum transformable distance, in mm, in way of longitudinal direction in pressure hull for moveable weight, Δ : total weight, in ton, of submerged displacement with subtraction of water weight in diving tanks, α : maximum allowable trimming angle for normal operation of equipments installed in pressure hull, not greater than 25°. 	









conditions, pening installed at the bulkhead
 each by each before starting be provided from 0° to the an- acorrected by considering free for submersibles should satisfy
→ θ f
curve o

Present	Amendment	Reason
<pre>(newly addition)</pre>	(2) The damage stability against dynamic rolling due to wind should satisfy the requirements as shown in Fig. 10. When the total range of rolling is assumed as less than 30° from the 22.5° of heeling angle corresponding static equilibrium, the area, A_R , is to be greater than 1.4 times of the area, A_H . ψ (2020)	newly addition
	Arm (m)	
	 Heeling Arm Curve Heeling Arm Curve θ_{nol} = 30° θ_{nol} = 1.4 A_H 4A_H ≥ 1.4 A_H 60° or θ_t 60° or θ_t Fig. 10 Damage righting and heeling moemnt arm curve due to rolling by wind 	