

Tests and Assessments of the Secondary Barrier Effectiveness

Object of Amendment

Rules for the Survey and Construction of Steel Ships Parts B and N
Guidance for the Survey and Construction of Steel Ships Parts B and N

Reason for Amendment

The secondary barrier in membrane-type liquefied gas carriers is an essential element intended to contain cargo leakage envisaged in the event of the failure of the primary barrier and to protect the hull structure from unsafe cold spots. The IGC Code requires that the secondary barrier perform effectively against any envisaged leakage of liquid cargo and that no unsafe cold spots occur in the hull structure.

IACS established IACS Unified Interpretation (UI) GC12 related to the testing and effectiveness assessment of secondary barriers, and the Society has already incorporated its UI GC12 (Rev.2) into Part B and Part N of its Rules for Survey and Construction of Steel Ships.

Thereafter, based on the accumulation of operational experience and technical knowledge regarding membrane tanks with glued secondary barriers, IACS revised UI GC12 in order to clarify the concepts relating to methods for verifying the effectiveness of secondary barriers and the assessment of indications.

In UI GC12 (Rev.3), for membrane tanks with glued secondary barriers, the combined use of thermography testing and acoustic emission testing is accepted as a more appropriate and rational method for verifying the condition of a secondary barrier.

Furthermore, with regard to the assessment of the effectiveness of a secondary barrier, the concept that said assessment be based on the liquid level resulting from a failure of the primary barrier causing the inter-barrier space to be filled with liquid until a static equilibrium state is reached between the tank space and the inter-barrier space is also introduced.

Accordingly, based on UI GC12 (Rev.3), the relevant requirements are amended.

Outline of the Amendment

Main amendments are as follows:

- (1) Verification of the effectiveness of the secondary barriers at renewal surveys (Rules/Guidance for the Survey and Construction of Steel Ships Part B)
Specifies that, for all indications of leakage detected at renewal surveys, an assessment is to be carried out as to whether the function of the secondary barrier is impaired, and that such assessment is to be confirmed by the Society. In this assessment, taking into account the liquid level in the inter-barrier space calculated based on the envisaged leakage conditions, where the indication is judged to be located above the maximum liquid level envisaged, special consideration may be accepted under conditions deemed appropriate by the Administration. On the other hand, where, as a result of the assessment, a location is judged to impair the liquid-tight effectiveness of the secondary barrier, repair is to be required.
- (2) Test methods for secondary barriers (Guidance for the Survey and Construction of

Steel Ships Part N)

Previously, verification of the gas-tightness level was carried out, and where the permissible criteria were exceeded, thermography testing, acoustic emission testing, and the like were conducted as additional tests. This amendment specifies that these test methods may be used for verification of the effectiveness of the secondary barrier, without being limited in application to being only additional tests.

- (3) Leakage envisaged for the secondary barriers (Guidance for the Survey and Construction of Steel Ships Part N)

Specifies that the condition in which liquid leaked into the inter-barrier space due to damage to the primary barrier fills the space until a static equilibrium state is reached is to be taken as a premise for the effectiveness assessment of the secondary barrier carried out by the cargo containment system designer.

Effective Date and application

Effective date of this amendment is 1 January 2027.

An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

ID:DH26-01

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks						
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS Part B CLASS SURVEYS Chapter 3 ANNUAL SURVEYS 3.9 Special Requirements for Ships Affixed with the Notation “<i>CybR</i>” 3.9.3 Surveys*	RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS Part B CLASS SURVEYS Chapter 3 ANNUAL SURVEYS 3.9 Special Requirements for Ships Affixed with the Notation “<i>CybR</i>” 3.9.3 Surveys*							
Table B3.9 Special Requirements for Ships Carrying Liquefied Gases in Bulk <table><tr><th>Items</th><th>Examinations</th></tr><tr><td>1 Cargo containment system</td><td>(1) (Omitted) (2) <u>Where special consideration is accepted for the secondary barrier, it is to be verified that the monitoring system and associated procedures continue to function effectively.</u></td></tr><tr><td>2 to 9</td><td>(Omitted)</td></tr></table>			Items	Examinations	1 Cargo containment system	(1) (Omitted) (2) <u>Where special consideration is accepted for the secondary barrier, it is to be verified that the monitoring system and associated procedures continue to function effectively.</u>	2 to 9	(Omitted)
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1 Cargo containment system	(1) (Omitted) (2) <u>Where special consideration is accepted for the secondary barrier, it is to be verified that the monitoring system and associated procedures continue to function effectively.</u>							
2 to 9	(Omitted)							
		(2) UI GC12 4.3.3						

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks								
Chapter 5 SPECIAL SURVEYS 5.9 Special Requirements for Ships Affixed with the Notation “CybR” 5.9.2 Surveys	Chapter 5 SPECIAL SURVEYS 5.9 Special Requirements for Ships Affixed with the Notation “CybR” 5.9.2 Surveys									
Table B5.27 Special Requirements for Ships Carrying Liquefied Gases in Bulk <table><tr><th>Items</th><th>Examinations</th></tr><tr><td>1 Cargo tanks</td><td>(Omitted)</td></tr><tr><td>2 Hold spaces and secondary barriers</td><td> (1) (Omitted) (2) For membrane containment systems, it is to be verified that secondary barriers keep a specific level of tightness required in liquid tight effectiveness is ensured in accordance with the system design inspection/survey plan approved by the Society in accordance with programs and acceptance criteria approved in advance. However, low differential pressure tests<u>4.3.6, Part N of the Rules</u>. Where indications are not detected, all detected indications are to be considered an acceptable test for the tightness of secondary barriers. For membrane containment systems with glued secondary barriers, if the verification results do not satisfyevaluated to confirm whether or not they preclude the approved acceptance criteria, an investigation is function of the secondary barrier. Indications assessed as preventing said function are to be carried out and additional testing such as thermographic or acoustic emissions testing is to be carried out<u>repaired</u>. (3) (Omitted) </td></tr><tr><td>3 to 7</td><td>(Omitted)</td></tr></table> Notes: (Omitted)			Items	Examinations	1 Cargo tanks	(Omitted)	2 Hold spaces and secondary barriers	(1) (Omitted) (2) For membrane containment systems, it is to be verified that secondary barriers keep a specific level of tightness required in liquid tight effectiveness is ensured in accordance with the system design inspection/survey plan approved by the Society in accordance with programs and acceptance criteria approved in advance. However, low differential pressure tests<u>4.3.6, Part N of the Rules</u>. Where indications are not detected, all detected indications are to be considered an acceptable test for the tightness of secondary barriers. For membrane containment systems with glued secondary barriers, if the verification results do not satisfyevaluated to confirm whether or not they preclude the approved acceptance criteria, an investigation is function of the secondary barrier. Indications assessed as preventing said function are to be carried out and additional testing such as thermographic or acoustic emissions testing is to be carried out<u>repaired</u>. (3) (Omitted)	3 to 7	(Omitted)
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Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS Part N SHIPS CARRYING LIQUEFIED GASES IN BULK Chapter 4 CARGO CONTAINMENT 4.4 Cargo Containment Safety Principles (<i>IGC Code</i> 4.4) 4.4.1 General*	RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS Part N SHIPS CARRYING LIQUEFIED GASES IN BULK Chapter 4 CARGO CONTAINMENT 4.4 Cargo Containment Safety Principles (<i>IGC Code</i> 4.4) 4.4.1 General	Due to the introduction of Section N4.4.1 of the Guidance.

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks
GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS Part B CLASS SURVEYS B3 ANNUAL SURVEYS B3.4 Special Requirements for Ships Carrying Liquefied Gases in Bulk B3.4.2 Examinations <u>2</u> “Special consideration” stipulated in item 1(2) of <u>Table B3.9, Part B of the Rules</u> refers to cases that are subject to <u>B5.4.2-5</u>. <u>3</u> In applying item 3(1)(b) of Table B3.9, Part B of the Rules, cargo and process piping (including the expansion arrangements, insulation from the hull structure, pressure relief and drainage arrangements, and water curtain protection as appropriate) are also to be examined. <u>4</u> In applying item 4 of Table B3.9, Part B of the Rules, the examination of high level alarms on ships at beginning stage of construction on or after 1 July 2017 is to include the functional test as specified in 13.3.6, Part N of the Rules. <u>5</u> In applying item 5 of Table B3.9, Part B of the Rules, for membrane containment systems, proper operation of the nitrogen control system for insulation and interbarrier spaces is to be confirmed to the Surveyor by the Master. <u>6</u> With respect to the functional tests specified in item 8	GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS Part B CLASS SURVEYS B3 ANNUAL SURVEYS B3.4 Special Requirements for Ships Carrying Liquefied Gases in Bulk B3.4.2 Examinations (Newly added) <u>2</u> (Moved) <u>3</u> (Moved) <u>4</u> (Moved) <u>5</u> (Moved)	UI GC12 4.3 Moved from 3.4.2-2 Moved from 3.4.2-3 Moved from 3.4.2-4 Moved from 3.4.2-5

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks
of Table B3.9, Part B of the Rules, reference is to be made to the requirements related to annual surveys specified in Chapter 4, Part B of <i>IMO resolution MSC.267(85) “International Code on Intact Stability, 2008 (2008 IS Code)”</i>. 7 “Alternative examinations considered appropriate by the Society” stipulated in item 9 of Table B3.9, Part B of the Rules refers to performance tests of cross flooding equipment to confirm whether the equipment is in good working order. 8 In applying item 9(1)(c) of Table B3.9, Part B of the Rules, examination of the arrangements for the mechanical ventilation of spaces in the cargo area normally entered during cargo handling operations need only be carried out as far as practicable. 9 In applying item 9(1)(g) of Table B3.9, Part B of the Rules, it is to be confirmed that any liquid and vapour hoses are suitable for their intended purpose and, where appropriate, type-approved or marked with date of testing. 10 In applying item 9(1)(i) of Table B3.9, Part B of the Rules, it is to be confirmed that electrical equipment in hazardous areas is in a satisfactory condition and is being properly maintained.	6 (Moved) 7 (Moved) 8 (Moved) 9 (Moved)	Moved from 3.4.2-6 Moved from 3.4.2-7 Moved from 3.4.2-8 Moved from 3.4.2-9

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks
B5 SPECIAL SURVEYS B5.4 Special Requirements for Ships Carrying Liquefied Gases in Bulk B5.4.2 Examinations <u>2 The effectiveness of the secondary barrier is to be verified based on the designer's procedure and acceptance criteria specified in the approved inspection plan required by 4.3.6, Part N of the Rules. Examples of such methods include, but are not limited to, the following.</u> (1) <u>Tests for verification of the tightness</u> <u>If the approved threshold values are exceeded, an investigation is to be carried out along with additional testing, such as thermographic or acoustic emissions testing, to locate any secondary barrier indications exceeding threshold values as per the approved method. However, low differential pressure tests may be used for monitoring cargo containment system performance but are not acceptable as tests for verifying the tightness of the secondary barrier.</u> (2) <u>Thermographic testing of the cargo tank boundaries</u> <u>In combination with acoustic emission testing in areas, such as the domes, where thermographic testing cannot be performed effectively.</u> (3) <u>Other equivalent methods suitable for the specific cargo containment system design</u> <u>3 In evaluating whether detected indications compromise the liquid-tight effectiveness of the secondary barrier as referred to in item 2 (2) of Table B5.27, Part B of the Rules, consideration is to be given to the primary barrier</u>	B5 SPECIAL SURVEYS B5.4 Special Requirements for Ships Carrying Liquefied Gases in Bulk B5.4.2 Examinations (Newly added) (Newly added)	UI GC12 4.1.1~4.1.3 UR Z16 2.2.8 UI GC12 4.2

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks
<u>leakage scenario described in N4.6.2-2 to confirm that the interbarrier space will not be filled with cargo liquid above the position of the detected indication.</u> <u>4 Furthermore, N4.6.2-3 to -5 may be applied in the evaluation if it is demonstrated to represent an equivalent level of safety considering the probability and extent of tightness failures of the primary barrier. The evaluation is also to take into consideration 4.6.2(1) and (2), Part N of the Rules.</u> <u>5 Where detected indications are confirmed to be located above the anticipated highest liquid level inside the interbarrier space, special consideration may be given, as deemed appropriate by the Administration. Where special consideration is requested, the owner is to submit to the Society, in collaboration with the cargo containment system designer, suitable documentation to demonstrate the equivalent level of safety and describe the necessary mitigating measures to be implemented to ensure that the function of the cargo containment system is not compromised. In addition, following requirements are to be satisfied.</u> <u>(1) Arrangements are to be made for owners to submit an annual health monitoring report to confirm that the cargo containment system remains satisfactory for the service for which the ship is intended.</u> <u>(2) Monitoring arrangements and procedures are to be documented, endorsed by the cargo containment system designer and submitted to the Society.</u> <u>(3) Verification of the continued effectiveness of the monitoring arrangements and procedures is to be carried out at each Annual survey and Intermediate survey.</u> <u>(4) Those indications under special considerations are to</u>	(Newly added) (Newly added)	UI GC12 4.2 UI GC12 4.3, 4.3.1~4.3.5

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks
<u>be documented and information is to be made available to the next survey's attending surveyor.</u> (5) <u>At renewal surveys, a tightness test is not considered to be an acceptable test method to determine the effectiveness of the secondary barrier. Approved testing procedures capable of localising the indications are to be used.</u> <u>6</u> The wording "hazardous areas" in item 6 of Table B5.27, Part B of the Rules refers to the hazardous areas specified in 4.2.3-3, -4 and -5, Part H of the Rules as well as in 1.1.5(23), Part N of the Rules. <u>7</u> In applying 5.4.2, Part B of the Rules, with respect to the functional tests specified in item 8 of Table B3.9, Part B of the Rules, reference is to be made to the requirements related to renewal surveys specified in Chapter 4, Part B of <i>IMO resolution MSC.267(85) "International Code on Intact Stability, 2008 (2008 IS Code)"</i>, notwithstanding the requirements of B3.4.2-6.	<u>2</u> (Moved) <u>3</u> In applying 5.4.2, Part B of the Rules, with respect to the functional tests specified in item 8 of Table B3.9, Part B of the Rules, reference is to be made to the requirements related to renewal surveys specified in Chapter 4, Part B of <i>IMO resolution MSC.267(85) "International Code on Intact Stability, 2008 (2008 IS Code)"</i>, notwithstanding the requirements of B3.4.2-4.	Moved from B5.4.2-2 Moved from B5.4.2-3 Due to the revision of the reference rule.

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks
GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS Part N SHIPS CARRYING LIQUEFIED GASES IN BULK N4 CARGO CONTAINMENT <u>N4.4 Cargo Containment Safety Principles</u> <u>N4.4.1 General</u> <u>The “full secondary liquid-tight barrier” referred to in 4.4.1, Part N of the Rules means a secondary barrier forming a liquid-tight secondary containment capable of containing any envisaged leakage from the tank through its primary barrier in accordance with N4.6.2.</u> <u>N4.6 Design of Secondary Barriers</u> <u>N4.6.2 Standards of Secondary Barrier</u> <u>2 “Any envisaged leakage of liquid cargo” referred to in 4.6.2(1), Part N of the Rules means a leakage which may result from a failure of the primary barrier and may fill the interbarrier space with liquid until a static equilibrium state is reached between the tank space and the interbarrier space.</u> <u>3 For ships in service equipped with containment</u>	GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS Part N SHIPS CARRYING LIQUEFIED GASES IN BULK N4 CARGO CONTAINMENT (Newly added) (Newly added) (Newly added) <u>N4.6 Design of Secondary Barriers</u> <u>N4.6.2 Standards of Secondary Barrier</u> (Newly added) (Newly added)	UI GC12 3 UI GC12 1.1 UI GC12 1.2

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks
<u>systems where potential failure modes for primary barrier tightness have been identified and documented through in-service experience, envisaged leakage scenarios may be determined by suitable engineering and risk analyses carried out by the cargo containment system designer.</u> <u>4 Envisaged leakage scenarios calculations are to demonstrate the probability of tightness failure of the primary barrier, cargo flow analysis and thermal analysis within the interbarrier space and thermal effects to the inner hull structure.</u> <u>5 The flow and thermal analyses are to determine the cargo liquid filling level of the interbarrier space at the end of a 15-day period.</u> <u>6 The studies leading up to the conclusions for -3 to -5 are to be to the satisfaction of the Society.</u> <u>7 In principle, Openings such as manholes are not to be provided in secondary barriers.</u> <u>8 “Effectiveness” referred to in 4.6.2(4), Part N of the Rules means the ability of the secondary barrier to prevent the passage of liquid cargo, in ways and quantities likely to cause unsafe cold spots to the ship structure, in case of any envisaged leakage.</u> <u>9 “Capable of being periodically checked” referred to in 4.6.2(4), Part N of the Rules means that the design arrangement of the containment system and the secondary barrier is to be such that the effectiveness of the secondary barrier may be reliably confirmed by suitable test and/or inspections specified in the inspection/survey plan approved by the Society in accordance with 4.3.6, Part N of the Rules.</u>	(Newly added) 2 For the purpose of the requirements in 4.6.2(1), Part N of the Rules, <u>no special analysis of the complete secondary barrier for verifying that “it is capable of containing any envisaged leakage of liquid cargo for a period of 15 days” may be carried out except for cases where the Society deems it specially necessary.</u> (Newly added) 3 (Moved) (Newly added) (Newly added)	UI GC12 1.2 UI GC12 1.2 UI GC12 1.2 Moved from N4.6.2-3 UI GC12 4.1 UI GC12 2.1

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks
10 For the purpose of the requirements in 4.6.2(4), Part N of the Rules, the test procedure where visual inspection of the secondary barrier is not possible is to be in accordance with the following requirements (1) to (3): (1) The inspection method of the secondary barrier and its criteria relating to the performance to act as the secondary barrier are to be verified for their effectiveness through model test. (2) The secondary barrier is to be verified by model test for the required performance. This model test is to be capable of verifying that the secondary barrier can maintain the necessary performance throughout the life of the ship. (3) When sufficient data to prove the effectiveness and reliability relative to the preceding (1) and (2) are submitted to the satisfaction of the Society, this model test may be omitted. 11 For the purpose of the requirements in 4.6.2(6), Part N of the Rules, the extent of the secondary barrier is, at least, to cover the surface of leaked liquid cargo corresponding to a static heel angle of 30°. 12 The “surface of leaked liquid cargo” referred to in the preceding -11 means a surface of fully leakage of fully loaded cargo for the complete second barrier, and of liquid cargo determined in accordance with the requirements in 4.7.2, Part N of the Rules for the partial secondary barriers. 13 For spaces outside the extent of the secondary barriers specified in the preceding -11, the hull structures are to be protected against splashes of leaked cargo by the spray shields specified in the requirements in 4.7.1, Part N of the Rules, or the extent of the secondary barrier is to be suitably extended.	4 (Moved) 5 (Moved) 6 The “surface of leaked liquid cargo” referred to in the preceding -5 means a surface of fully leakage of fully loaded cargo for the complete second barrier, and of liquid cargo determined in accordance with the requirements in 4.7.2, Part N of the Rules for the partial secondary barriers. 7 For spaces outside the extent of the secondary barriers specified in the preceding -5, the hull structures are to be protected against splashes of leaked cargo by the spray shields specified in the requirements in 4.7.1, Part N of the Rules, or the extent of the secondary barrier is to be suitably extended.	Moved from N4.6.2-4 Moved from N4.6.2-5 Moved from N4.6.2-6 Due to the revision of the reference rule. Moved from N4.6.2-7 Due to the revision of the reference rule.

Amended-Original Requirements Comparison Table (Tests and Assessments of the Secondary Barrier Effectiveness)

Amended	Original	Remarks
N4.20 Construction Processes N4.20.3 Testing 2 With respect to <u>4.20.3-3, Part N of the Rules, for cargo containment systems with glued secondary barriers</u>, it is to be verified that secondary barriers keep a specific level of tightness required in the system design <u>before and after initial cool down</u>, and the effectiveness of the secondary barrier is to be verified by <u>confirming compliance with the permissible criteria in accordance with the approved system designer's procedures</u>. <u>Initial cargo tank cool down may be achieved during gas trial or may be carried out prior to proceeding with gas trial with a limited amount of cargo or another refrigerating medium inside the tank</u>. In case there is a refrigerating medium inside the tank, details of the minimum average temperature and cooling time to be achieved at the secondary barrier during tank cool down are to be agreed between the cargo containment designer and the Society. Furthermore, related values obtained in the tests are to be recorded for <u>future assessment of secondary barrier tightness</u>. <u>For containment systems with welded metallic secondary barriers, a tightness test after initial cool down is not required.</u>	N4.20 Construction Processes N4.20.3 Testing 2 With respect to <u>the requirements of 4.20.3-3, Part N of the Rules</u>, it is to be verified that secondary barriers keep a specific level of tightness required in the system design <u>in accordance with an appropriate procedures</u>. However, <u>low differential pressures tests are not to be considered an acceptable test for the tightness of secondary barriers</u>. <u>For cargo containment systems with glued secondary barriers, tests for verification of the tightness are to be carried out before and after initial cool down and related values obtained in the tests are to be recorded for the use as reference for periodical surveys</u>. If the verification results do not satisfy acceptance criteria approved in advance, <u>an investigation is to be carried out and additional testing such as thermographic or acoustic emissions testing is to be carried out</u>.	UI GC12 2.1.1, 2.1.2 UI GC12 4.1 At the construction stage, a tightness test is to be carried out in accordance with UI GC12, paragraph 2.1.1. On the other hand, the methods for verification of effectiveness indicated in paragraphs 4.1.1 to 4.1.3 are examples of methods to be specified in the inspection programme and are to be carried out at Renewal surveys after the ship enters into service.
EFFECTIVE DATE AND APPLICATION		
1. The effective date of the amendments is 1 January 2027.		