CHAPTER 6 Hull Air Lubrication System

Section 1 General

101. General

1. This chapter applies to hull air lubrication systems for improving energy efficiency of ships by reducing hull resistance.
2. This chapter provides requirements on the design, installation and testing of air lubrication systems for hull, stability, machinery, piping systems and electrical systems.
3. As separate from requirements in this Chapter, when the improved energy efficiency of ships through the hull air lubrication system is counted to energy efficiency indexes such as EEDI and EEXI, verification or test procedure should be complied with in the international conventions and guidance such as the **MEPC.1/Circ.896** and/or requirements from the Administration.

102. Definitions

The definitions of terms are to follow **Rules for the Classification of Steel Ships**, unless otherwise specified in this chapter.

1. **"Hull Air Lubrication System"** means to reduce Ship frictional resistance by covering the ship surface with air bubbles, which are injected from the fore part of the ship bottom by using blowers, etc. The systems can consist of a cooling system, pressure vessel, etc. as well as air compressors.
2. **"Air Chamber"** means small spaces where pressurized air from air compressors stays shortly prior to flowing across the hull.
3. **"Air Injection valve"** means a valve located on the most downstream in front of the air injection hole or air chamber. A distance piece can be arranged between the hole or chamber and the air injection valve.

103. Class notations

Ships equipped with hull air lubrication system complying with this chapter excluding **Sec 4** may be assigned one of the additional installations notation of **ES-ALS**. Furthermore, **ES-ALS1** may be assigned if the additional requirements in **Sec 4** are satisfied.

104. Equivalency

The equivalence of alternative and novel features which deviate from or are not directly applicable to the guideline is to be in accordance with **Pt 1, Ch 1, 105.** of **Rules for the Classification of Steel Ships**.

Section 2 Basic Requirements for Hull Air Lubrication System

201. General

1. This section provides the minimum requirements for ships with hull air lubrication system installed.
2. The section provides requirements on technical and design to mitigate risks from flooding and fire and to enhance the crew's safety, caused by the installation of hull air lubrication system.
3. Ships in compliance with the requirements of this section may be assigned a notation **ES-ALS**.
4. Designs that are not in compliance with this Section may be approved after evaluation by the Society, provided that it can be demonstrated that the design represents an equal or better level of safety.

202. Strength and Structure

1. The hull air lubrication systems are to be in accordance with **Pt 3, Ch 14, 201.** and **Pt 5, Ch 6, 107.** of **Rules for the Classification of Steel Ships** in the case of being located forward of the collision bulkhead.
2. The openings, such as air chambers that blow air through the hull, affect the longitudinal strength members used in the hull guider section modulus calculations. The hull structure and openings for air injection are to be designed in accordance with **Pt 3, Ch 3** of **Rules for the Classification of Steel Ships**, and drawings and data are to be submitted to the Society in accordance with **402. 1** of this Guidance. Local stress concentrations due to openings are to be evaluated so that they meet applicable strength and fatigue requirements.
3. All openings are, if necessary, to be properly reinforced and to be provided with sufficient roundness at the corners in accordance with **Pt 3, Ch 4, 701.** of **Rules for the Classification of Steel Ships**.
4. Design and test of air injection valves are in accordance with **204.** of this Guidance.

203. Stability

1. In the case of existing ships, data on light weight that is changed according to the installation of hull air lubrication systems is to be submitted, and if necessary, a revision of data related to stability may be requested.
2. For new ships, it is to be in accordance with **Pt 1, Ch 1, 307.** of **Rules for the Classification of Steel Ships.**

204. Auxiliaries and Piping Arrangement

1. Piping systems of hull air lubrication systems are to comply with **Pt 5, Ch 6** of **Rules for the Classification of Steel Ships**~~, unless otherwise specified in this section. In this case, air supply pipings in the hull air lubrication system are regarded as compressed air piping~~.
2. Efficient means such as non-return valves or equivalent are to be provided in air supply piping system to prevent ingress of water through air chamber.
3. Air injection valves for hull air lubrication system can be arranged in double bottom ballast tanks, voids and so on. And Indicators are to be provided local to the valves or cocks showing whether they are open or shut.
4. Power operated air injection valves are to be arranged for manual operation in the event of failure of the power supply.
5. Distance pieces connected an air chamber to an air injection valve are to comply with **301. 2 of Pt 5, Ch 6** of **Rules for the Classification of Steel Ships**. Where applicable, adequate arrangements are to be provided to prevent galvanic corrosion due to the use of dissimilar metals.
6. Pressure vessels including heat exchangers are to comply with the requirements specified in **Pt 5, Ch 5, Sec 3** of **Rules for the Classification of Steel Ships**. (**403. Table 6.4.1**) *(2024)*

205. Electrical Equipment and Controlgears for Motors

1. The ships' number and capacity of generators are to be sufficient in accordance with **202. of Pt 6, Ch 1** of **Rules for the Classification of Steel Ships** under normal seagoing conditions, taking into account with the operation of hull air lubrication system.
2. The electrical loads related at hull air lubrication system is to be included in the electrical load analysis and submitted for approval.

206. Control, Alarm and Safety Systems

1. Control, alarm and safety systems are to be designed to avoid a single failure event leading to a potentially dangerous situation for human safety and/or the ship.

2. Control, alarm and safety systems are to be designed based on the fail-safe principle.

~~3. The parameters for the operation of air lubrication system are to be available at the local and remote stations and include, but not exhaustive, the following:~~

~~(1) Operation status of air compressors~~
~~(2) Status(open/close) of air injection valves~~
~~(3) Operational status (e.g. run, alarm and shutdown)~~

~~4. Hull air lubrication system is to be controllable from the local when the system is a failure.~~

3. The safety system for hull air lubrication system is to be designed independently as practicable.

~~6. An emergency shutdown system is to be provided at the local and remote control stations~~

207. Ventilation system

A ventilation system having sufficient air exchange capacity is to be provided for a space where hull air lubrication system is arranged including air compressors. International standards such as ISO 8861:1998 may be considered to determine air exchange capacity.

208. Fire safety

1. A space where hull air lubrication system is arranged is to be regarded as an other Machinery Space, Unless the system is installed in Machinery spaces of category A defined in **Pt 8, Ch 1** of **Rules for the Classification of Steel Ships**.
2. Fire integrity of the space is to comply with **Pt 8, Ch 7** of **Rules for the Classification of Steel Ships**.
3. Fire extinguishing arrangements are to be provided for the space in accordance with **Pt 8, Ch 8, Sec 4** of **Rules for the Classification of Steel Ships**.

Section 3 Additional Requirements for Hull Air Lubrication System

301. General

1. This section provides additional requirements for equipment and systems for hull air lubrication system such as air compressor(s), pressure vessel(s), piping system and electrical equipment.
2. The ships complied with this section can be assigned a notation **ES-ALS1**, in addition to the **Sec 2**.
3. When ships are assigned the **ES-ALS1** notation, equipment and systems for hull air lubrication system are to be certified by the Society in accordance with **Table 6.4.1**.
4. The hull air lubrication system is to be monitored and controlled from wheel house or engine control station other than the equipment side, providing to control operation of the air compressor and air injection valves at least for the hull air lubrication system.

302. Auxiliaries and Piping Arrangement

1. Construction, materials, and strength of air compressors for hull air lubrication system are to comply with the requirements specified in **Pt 5, Ch 6, Sec 11** of **Rules for the Classification of Steel Ships**. Where deemed appropriate by the Society, international/national Standards may be applied as equivalent instead of requirements of the aforementioned.

303. Electrical Equipment and Controlgears for Motors

1. Motors and controlgears for motors are to be ceritified in accordance with the relevant requirements specified in **Pt 6, Ch 1** of **Rules for the Classification of Steel Ships**.

304. Control, Alarm and Safety System

1. Control, alarm and safety systems are to comply with the requirements of **Pt 6, Ch 2** of **Rules for the Classification of Steel Ships**, as applicable for Category I systems, in accordance with **Pt 6, Ch 2, Table 6.2.2** of **Rules for the Classification of Steel Ships**.

2. The parameters for the operation of air lubrication system are to be available at the local and remote stations in **301. 4.** and include, but not exhaustive, the following:
   (1) Operation status of air compressors
   (2) Status(open/close) of air injection valves
   (3) Operational status (e.g. run, alarm and shutdown)

3. Hull air lubrication system is to be controllable from the local when the contorl an monitoring system at remote control station in **301. 4.** is a failure.

4. An emergency shutdown system for stopping air compressor and closing air injection valves is to be provided at remote control stations in **301. 4.**.

5. Certification of the control, alarm and safety systems is to be in accordance with **Table 6.4.1**.

Section 4 Survey

401. General

For ships in which the hull air lubrication system are installed, the drawings and documents in **402.** are to be submitted to the Society before commencing construction. In addition, if deemed necessary by the Society, additional drawings and data other than those specified below may be requested.

402. Drawings and documents to be submitted

1. For ES-ALS notation

~~(1)~~ The following drawings and documents associated with the hull air lubrication system and shipboard installation are to be submitted to the Society ~~for approval~~.

(1) Drawings and documents for approval
   (A) General arrangement of hull air lubrication system
   (B) Documentation detailing the effect on Stability (where necessary, Refer to **203.**)
   (C) Piping diagram
   (D) Details of air chamber and air injection hole
   (E) Detail of distance piece
   (F) Wiring diagram for hull air lubrication system
   (G) Diagrams for the control, alarm and safety systems
   (H) Investigation table of electrical load analysis (where necessary)

(2) Drawings and documents for reference
   (A) Specification of hull air lubrication system
   (B) Calculation of ventilation for installed place of hull air lubrication system

2. For ES-ALS1 notation

~~(1)~~ In addition to the drawings and documents in 1, the following are to be submitted for the ES-ALS1 notation:

(1) Drawings and documents for approval
   (A) Detail of air compressor (rated output 100kW and above) (Refer to **210. of Pt 5, Ch 1** of **Rules for the Classification of Steel Ships**)
   (B) Detail of Cooling pump (rated output 100kW and above) (Refer to **210. of Pt 5, Ch 1** of **Rules for the Classification of Steel Ships**)

(2) Drawings and materials for reference
   (A) Operating scenario

403. Production Survey

1. For ES-ALS notation

(1) The inspection of the hull air lubrication system is to be carried out at each stage under the responsibility of the manufacturer, according to the manufacturer's own inspection plan, and the report is to be submitted to the Surveyor in charge. And, in accordance with the manufacturer's inspection plan, testing and inspection may be carried out on behalf of the manufacturer by an institution recognized by the manufacturer.

(2) The materials and welding of hull used for hull air lubrication system are to comply with **Pt 2, Ch 1** of **Rules for the Classification of Steel Ships**.

(3) The qualifications of welding and non-destructive inspection personnel engaged in all construction and assembly steps for air chamber and air supplying piping including air injection valve of hull air lubrication system are to be defined.

(4) Air chamber and air supplying piping including air injection valve of hull air lubrication system are to complying with **Pt 2, Ch 1** and **Pt 5, Ch 6** of **Rules for the Classification of Steel Ships**.

(5) ~~Construction and materials of~~ Distance pieces of hull air lubrication system are to complying with **Pt 5 Ch 6** of **Rules for the Classification of Steel Ships**.

(6) Non-destructive test

Ships installed hull air lubrication system are to be carreid out non-destructive testing at the welded joints of air chamber to hull, structural members and piping system in accordance with **Pt 2, Ch 2, Annex 2-7 "Guidance for non-destructive testing of ship hull steel welds"** of the **Rules for the Classification of Steel Ships** or other approved code. The non-destructive inspection scope and methods are to be submitted with the design drawings.

2. For ES-ALS1 notation

(1) Equipment and components for hull air lubrication system are to be certified and tested in accordance with **Table 6.4.1**.

Table 6.4.1 Test and Survey for components of Hull air lubrication system

No	Equipment and system	Drawing approval	Test and inspection
1	Air compressor for hull air lubrication system	●(1)	●
2	Control panel for hull air lubrication system(2)	●	●
3	Controlgears for air compressor or cooling system	●(1)	●
4	Cooling pump (if installed)	●(1)	●
5	Heat exchanger or pressure vessel(3)	●(4)	●
6	Control, alarm and safety system	●	●

Note.
(1) Only applicable for rated output 100kW and above
(2) Where equipment specified in **Guidance relating to the Rules for the Classification of Steel Ships Pt 6, Ch 1** and **Pt 6, Ch 2, 301. 1** is installed, Regardless of class notation, the type approval product is to be installed.
(3) Regardless of the Class notation, it shall be inspected based on the **Pt 5, Ch 5, Sec 3** of **Rules for the Classification of Steel Ships**.
(4) Only applicable for PV-1 and PV-2

~~**3. Non-destructive test**~~

~~(1) Ships installed hull air lubrication system are to be carreid out non-destructive testing at the welded joints of air chamber to hull, structural members and piping system in accordance with **Pt 2, Ch 2, Annex 2-7 "Guidance for non-destructive testing of ship hull steel welds" of the Rules for the Classification of Steel Ships** or other approved code. The non-destructive inspection scope and methods are to be submitted with the design drawings.~~

404. Installation Survey

The following items are to be verified by the attending Surveyor:

~~1. Installation and arrangement~~

~~(1) Hull air lubrication system is to be installed according to the approved drawings, and attending Surveyor is to confirm the following items.~~

~~(A) Piping systems including air supply pipes of hull air lubrication system is to complying with Pt.5, Ch.6 of Rules for the Classification of Steel Ships.~~

~~(B) Visual inspection for welded connection of installation for air chamber~~

~~(C) Non-destructive testing in accordance with 403. 3~~

~~2. Testing~~

~~Testing for hull air lubrication system is to follow the approved testing procedures and is to include at least the following items:~~

~~(1) For ES-ALS notation:~~

~~(A) Operation of air injection valves~~

~~(B) Operation of Fire detection system and fire fighting system (if installed)~~

~~(C) General examination of machinery, piping, and electrical equipment (see Ch 2)~~

~~(D) Operational tests of machinery, electrical units, and control systems~~

1. Visual inspection for welded connection of installation for air chamber
2. Non-destructive testing in accordance with 403. 3
3. Operation of air injection valves
4. Operation of Fire detection system and fire fighting system (if installed)
5. Operational tests of machinery, electrical units, and control systems

405. Sea trials

~~1. For ES-ALS notation, the followings are to be verified.~~

(1) Operation of air injection valves
(2) Visual check of air chambers from inside of ships (as possible)
(3) Function test of the safety systems
(4) Function test of emergency stops
(5) Operational tests of machinery, electrical units, and control systems

406. Annual survey

~~1. For ES-ALS notation, the followings are to be included in the annual survey.~~

(1) Operation of air injection valves
(2) Visual check of air chambers from inside of ships (as possible)

407. Special Surveys

~~1. For ES-ALS notation, in addition to the annual survey items in 406, special survey shall include the following items, at least :~~

(1) Outer part of air chambers
(2) Distance pieces connecting air injection valve to air chamber (if installed)
(3) Function test of the safety systems
(4) Function test of emergency stops
(5) Operational tests of machinery, electrical units, and control systems ⚓