GUIDANCE NOTES
GD 10-2019

GUIDELINES FOR SURVEYS ON IMPLEMENTATION OF THE REQUIREMENTS OF U.S. ENVIRONMENTAL PROTECTION AGENCY ON ENVIRONMENTALLY ACCEPTABLE LUBRICANTS

Effective from 1 July 2019

Introduction

According to the requirements of Vessel General Permit for Discharges Incidental to the Normal Operation of Vessels (hereinafter referred to as VGP(2013)) released by U.S. Environmental Protection Agency, all commercial vessels entering the waters of the United States must use Environmentally Acceptable Lubricants (hereinafter referred to as EAL) in their oil-to-sea interfaces, unless "technically infeasible". EPA's mandatory requirement for the use of EAL in oil-to-sea interfaces has raised the environmental protection requirements of the industry to a whole new height, and thus attracted much attention from the industry. Oil product suppliers, stern tube sealing device suppliers, ship designers, ship owners/ship companies, shipyards and classification societies have all carried out research on EAL to different extents. In 2016, China ISClass (ISC) released the *Guidelines for Surveys on Implementation of the Requirements of U.S. Environmental Protection Agency on Environmentally Acceptable Lubricants, 2016* (hereinafter referred to as 2016 Guidelines). The Guidelines provide amendments to the 2016 Guidelines based on the feedbacks from users. The 2016 Guidelines will be revoked from the date of entry into force of the Guidelines.

The Guidelines fall into three parts. The first part clarifies EPA's technical requirements for EAL and describes in detail the relevant terms regarding EAL in VGP(2013). The second part makes clear the relevant survey requirements and procedures based on relevant provisions of EPA. And the third part provides specific requirements and operation methods with regard to the techniques to address existing problems occurred during the use of EAL for guidance of the industry.

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Chapter 1 GENERAL

Section 1 General Provisions

1.1.1 Purpose

1.1.1.1 According to the Vessel General Permit for Discharges Incidental to the Normal Operation of Vessels (hereinafter referred to as VGP (2013)) that came into force in 2013, commercial vessels entering the waters of the United States must use Environmentally Acceptable Lubricants (hereinafter referred to as EAL) in all oil-to-sea interfaces. The Guidelines are drafted to help the industry better understand and implement relevant requirements for EAL in VGP (2013).

1.1.1.2 The Guidelines propose the key control points for ships using EAL in shafting, including design, installation technology and operation methods, with the aim to reduce the potential risk of high temperature of stern tubes that may be occurred in the construction stage and preliminary stage of delivery of ships.

1.1.2 Scope

1.1.2.1 The Guidelines apply to the following circumstances:

(1) Ships applying to ISC for the class notation of “EAL”;

(2) Ships applying to ISC for the issuance of “EAL Document of Compliance ”.

1.1.3 Core requirements for EAL in VGP(2013)

1.1.3.1 The VGP (2013) released by EPA entered into force on 19 December 2013. According to regulation 2.2.9 of VGP (2013), all commercial vessels greater than 79 feet (about 24m) in length entering the waters of the United States must use EAL in all oil-to-sea interfaces, unless technically infeasible.

Section 2 Definitions

1.2.1 For the purpose of the Guidelines:

1.2.1.1 *Environmentally acceptable lubricants* (hereinafter referred to as EAL) mean lubricants that are “biodegradable” and “minimally-toxic” and are “not bioaccumulative”.

1.2.1.2 *Waters of the United State* refer to 3 nautical miles along the coast as defined in 40 CFR§122.2 of the Code of Federal Regulations (hereinafter referred to as CFR).

1.2.1.3 *Commercial vessel* means any vessel for commercial use other than a private yacht or a vessel of the U.S. armed forces as defined in Appendix A of VGP(2013).

1.2.1.4 *Oil-to-sea Interfaces*. Regulation 2.2.9 of VGP(2013) specifically identifies several types of equipment that have oil-to-sea interfaces, including but not limited to controllable pitch propeller, thruster hydraulic fluid and other equipment that might have lubrication discharges from oil seals and surfaces, such as paddle wheel propulsion, stern tubes, thruster bearings, stabilizers, rudder bearings, azimuth thrusters, podded propulsors, and wire rope and mechanical equipment subject to immersion.

1.2.1.5 *Technically Infeasible*. Technically infeasible mainly means the following circumstances:

(1) No EAL products (e.g. oil seal) are approved for use in a given application that meets manufacturer specifications for that equipment

(2) Products which come pre-lubricated (e.g. wire ropes) have no available alternatives

manufactured with EAL;

(3) EAL products meeting a manufacture's specifications are not available within any port in which the vessel calls;

(4) Change over or use of EAL must wait until the vessel's next drydocking.

Note: The stern tube high temperature alarm which may activate during the use of EAL is not regarded as the sufficient condition to be "technically infeasible".

1.2.1.6 *New ship*. For the purpose of regulation 2.2.9 of VGP(2013), a new ship means a ship the keel of which is laid or which is at a similar stage of construction on or after 19 December 2013.

1.2.1.7 *Existing ship*. For the purpose of regulation 2.2.9 of VGP(2013), an existing ship means a ship which is not a new ship.

1.2.1.8 *Air control unit* refers to the provision of appropriate air to other units within the air seal system and the establishment of pressure association among relevant units through the adjustment of the pressure and flow of air. Air control unit serves as the core unit in the air seal system.

1.2.1.9 *Water lubricated bearing* means the bearing which is cooled/lubricated by (fresh or sea) water.

Section 3 Plans and Documents

1.3.1 Shipyards, shipowners or ship companies are to submit an EAL Report to ISC for approval. Explanations are to be made on the use of EAL in all oil-to-sea interfaces in the Report. The Report is to be prepared according to the requirements of Appendix 4 of Chapter 6.

1.3.2 If an air seal system is adopted, the following plans and documents are also to be provided in addition to the relevant plans and documents required by *ISC Rules for Classification of Sea-going Steel Ships*:

1.3.2.1 Schematic diagram of air seal system;

1.3.2.2 Stern tube lubricant daily service system plan;

1.3.2.3 List of Air seal system alarms; and

1.3.2.4 Modification plan (if applicable).

Section 4 Assignment and Maintenance of EAL Class Notation

1.4.1 Upon the request of shipyards, shipowners/ship companies, the class notation of EAL may be assigned to ships in compliance with the requirements of the Guidelines (except for technically infeasible) after satisfactory survey by ISC. Where the application for the assignment of the class notation of EAL is necessary for ships in service, an application is to be submitted to ISC in conjunction with relevant surveys in dry-dock as far as possible.

1.4.2 Unless otherwise expressly provided, where ships under the following circumstances apply for the class notation of EAL, the requirements in Chapter 4 of the Guidelines may be exempted with the consent of ISC:

1.4.2.1 Ships adopting the air seal system for the stern tube sealing and using mineral oil as lubricants; or

1.4.2.2 Ships using water lubricated shafting system;

1.4.2.3 Ships already put into service for 2 years or longer at the time of applying for the class notation of EAL and with shafting well running-in.

1.4.3 Maintenance of the class notation of EAL

1.4.3.1 The periodical survey is to be carried out for ships assigned with the class notation of EAL according to 3.2.1 of the Guidelines. When the requirements of the Guidelines are met, the class notation of EAL will continue to be valid.

Section 5 Issuance of EAL Document of Compliance

1.5.1 Upon the request of a shipyard, shipowner/ship company, an EAL Document of Compliance may be issued by ISC, based on the EAL Report prepared by the shipyard, shipowner or ship company, to ships in compliance with the requirements of the Guidelines after satisfactory survey carried out by ISC.

1.5.2 Upon the request by the shipowner/ship company, EAL Document of Compliance may be directly issued by the surveyor to a ship assigned with “EAL” class notation.

Chapter 2 TECHNICAL PROVISIONS OF EAL

Section 1 General Provisions

2.1.1 Requirements related to EAL in VGP(2013) apply to new ships and existing ships;

2.1.2 “Technical infeasible” as defined in VGP(2013) only applies to existing ships in principle;

Section 2 Definitions and Distribution of EAL

2.2.1 Approved labels for EAL

2.2.1.1 EPA recommends that a lubricant should be certified and receive a label from the following labeling programs as an environmentally acceptable lubricant:

(1) German Blue Angel;

(2) European Eco-label;

(3) Nordic Swan;

(4) the Swedish Standards SS 155434 and 155470;

(5) Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) requirements);

(6) EPA’s Design for the Environment ~~(DfE)~~.

2.2.1.2 On the other hand, EPA stated on its official website that products that are not included in one of the above labeling programs may also be considered as EAL in compliance with the requirements of VGP(2013) provided that they have been tested to sufficiently demonstrate compliance with the requirements to be “biodegradable” and “minimally-toxic” and are “not bioaccumulative” as defined in Annex A of VGP(2013). Under this circumstance, EAL providers are requested by EPA to provide information on internal certification or third-party certification.

2.2.1.3 Except for special cases, shipyards, shipowners or ship companies are to use products labeled as EAL as far as possible.

2.2.2 Distribution of and requirements for EAL onboard ships

2.2.2.1 According to the requirements of VGP(2013), all oil-to-sea interfaces onboard ships should use EAL. Paragraph 1.2.1.4 of the Guidelines is to be referred to for the equipment containing oil-to-sea interfaces and the sketch in Figure 2.2.2.1 is for reference (but is not limited to this).

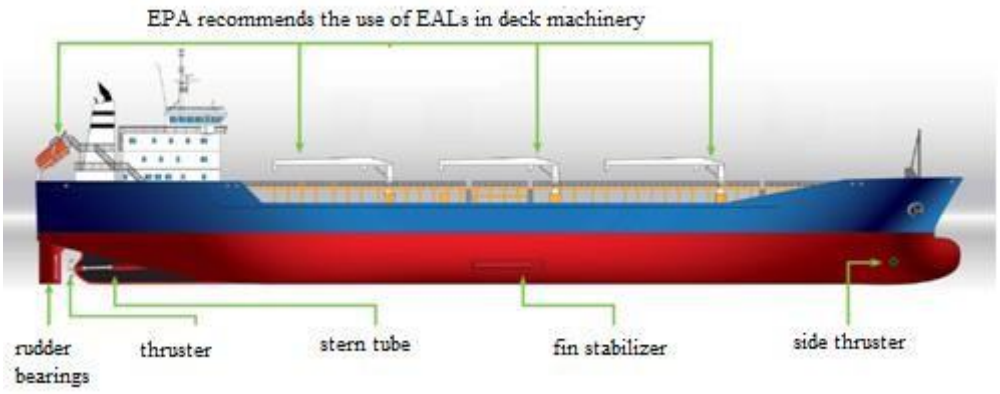

Figure 2.2.2.1 Sketch of the distribution of oil-to-sea interfaces onboard ships

2.2.2.2 Where there is sufficient evidence showing the non-existence of oil-to-sea interfaces onboard ships, e.g. the seawater-lubricated rudder bearings, water-lubricated bearings, and air seal system, then it can be regarded as meeting the requirement of 2.2.9 of VGP(2013). Where the issuance of the EAL Document of Compliance or the assignment of class notation of EAL is requested under the above circumstance, descriptions are to be given in the EAL Report.

2.2.2.3 The leakage of lubricants on deck machinery resulting from the rain wash is not subject to the mandatory provisions of VGP(2013). EPA recommends the use of EAL for this type of equipment.

2.2.2.4 Except for special cases, wire ropes of cranes and material hoists that will not be immersed beneath the water surface during usage are not subject to the provisions in relation to EAL in oil-to-water interfaces.

2.2.2.5 For wire ropes or mechanical equipment that are intended to be immersed in water, EAL is to be used. Excessive lubricants are to be removed before the immersion, unless the captain deems it is unsafe to do so.

CHAPTER 3 EAL-RELATED SURVEY REQUIREMENTS

Section 1 General Provisions

3.1.1 Ships applying for EAL class notation or EAL Document of Compliance by ISC are to be subject to survey according to the requirements of this Chapter.

3.1.2 Shipyards and shipowners/ship companies are to prepare EAL Report according to the requirements of Appendix 4 of the Guidelines based on the actual ship condition and update it in real time .

3.1.3 Replacement of environmentally acceptable lubricants is to be carried out in dry dock as far as possible, but in special conditions, replacement of lubricants under floating condition is allowed with the consent of ISC. Shipyards and shipowners/ship companies are to ensure sufficient replacement of lubricants under the guidance of lubricant suppliers, update EAL Reports in time according to the requirements and submit the reports to site surveyors for approval.

3.1.4 Using EAL does not mean that random discharge is allowed, so the amount of oil spill still needs to comply with the requirements of 40CFR110.3.

3.1.5 If air seal is intended to be used in the existing stern shaft tube or existing oil seal is to be transformed, the requirements of Chapter 5 of the Guidelines may be referred to.

3.1.6 The Guidelines are the supplement of the inspection requirements for conventional stern shaft seals under the frame of VGP(2013). If air seal system is adopted, function tests are to be carried out on air control units, drain collection and alarm systems.

Section 2 Survey for EAL Class Notation

3.2.1 General requirements

“Technically infeasible” is not a sufficient condition for assigning EAL class notation. For a ship obtaining EAL Document of Compliance through “technically infeasible”, EAL class notation is not to be assigned in principle.

3.2.2 Survey type and period

3.2.2.1 Ships applying for EAL class notations are to be subject to following surveys:

(1) Initial survey, i.e. survey of a ship applying for EAL class notation for the first time. Initial survey is to include overall inspection for the relevant requirements for environmentally acceptable lubricants in paragraph 2.2.9 of VGP(2013), documents described in the Guidelines as well as arrangement, installation and test of air seal system so as to ensure that relevant requirements of the Guidelines are complied with.

(2) Annual survey. The interval of annual survey is the same as that of annual survey for ship classification certificate. EAL annual inspection is generally carried out in conjunction with annual inspection for ship classification certificate. Annual survey is to include inspection of documents, appliances and equipment relating to paragraph 2.2.9 of VGP(2013) in the Guidelines, in order to confirm the validity of relevant documents such as EAL Report, confirm that the arrangement and condition of air seal system have not undergone changes which may affect the validity of class notation, confirm on relevant alarm positions and safety valves and ensure that relevant requirements of the Guidelines are complied with.

(3) Intermediate survey. The interval of intermediate survey is the same as that of intermediate survey for ship classification certificate, and the survey scope is in accordance with that of annual survey.

(4) Special survey. The interval of special survey is the same as that of special survey for ship

classification certificate, and the survey scope is in accordance with that of annual survey..

3.2.2.2 An interim survey may be requested in either of the following conditions:

(1) in case of survey due to equipment repair involving EAL class notation;

(2) in case of survey involving a ship with valid EAL class notation or EAL Document of Compliance applying for oil-to-sea interface, modification or lubricant replacement.

3.2.3 Initial survey

3.2.3.1 Document check

(1) The EAL Report submitted by the shipyard and shipowner/ship company is to be checked, to confirm that the report provides detailed description of the usage of lubricants in all oil-to-sea interfaces onboard the ship, and confirm that its usage is in compliance with the requirements of the Guidelines. Attention is to be paid that supporting documents such as oil product approval label and compatibility reports, etc. are to be examined;

(2) Where air seal system is adopted for stern shaft tube, it is to be examined whether relevant drawings have been approved or not, and air seal system product type approval certificate and manufacturer's VGP(2013) Document of Compliance are also to be examined, indicating "no oil-to-sea interface under normal condition" in the DOC.

3.2.3.2 Site survey requirements

(1) Where EAL is used in onboard oil-to-sea interfaces, attention is to be paid to the examination according to the following requirements:

1) Checking EAL approval document and confirming whether EAL approval label complies with EPA requirements. Where necessary, the EAL supplier is required to supply a copy of approval certificate, and relevant documents are to be attached to the EAL Report;

2) Confirming that EAL is compatible with stern shaft tube sealing material, and compatible material is to be attached to the EAL Report;

3) All EAL brands used in oil-to-sea interfaces are to be recorded in the report, and all EALs need corresponding Material Safety Data Sheet (MSDS/Part 4.2.9);

4) Condition of lubricants in oil-to-sea interfaces is to be recorded in detail in the EAL Report, including MSDS, evidence of approval label and compatible material;

5) The EAL Report is to be prepared by the shipyard or shipowner/ship company, submitted to site surveyor for approval and kept on board;

6) In U.S. waters, maintenance outside dry dock is to be avoided as far as possible;

7) If maintenance or emergency repair is unavoidable, attention is to be paid to oil spill amount control and oil spill recovery. For example, proper leakage handling devices (e.g. oil fences) are to be used to control oil spill, and in addition, direct means of access to leakage handling devices is to be provided to remove oil spill (for the requirements for oil spill amount, refer to the requirements of Appendix 3 of the Guidelines);

8) Maintenance of oil-to-sea interfaces is to be record in the logbook;

9) If propeller shaft adopts EAL and oil-to-sea interface exists, attention is to be paid to following requirements:

① For newbuildings, first sampling and analysis is to be carried out 6 months from the date of put into service of EAL with ISC approval of shipowner's application, and then periodical sampling and analysis is to be carried out every 6 months;

② For existing ships, the shipowner is to submit a complete copy of recent stern shaft lubricant analysis record and analysis report together with an application. An annual survey is to be carried

out according to the requirements of paragraph 3.2.3 of this Section.

(2) If air seal system is adopted for stern shaft tube to replace EAL, the following requirements are to be complied with:

1) If air seal is adopted instead of EAL, the requirements of Chapter 5 of the Guidelines are to be complied with;

2) The shipyard or shipowner/ship company is to pay attention to requiring the air seal system manufacturer to provide Statement of Compliance with VGP(2013) and the type approval certificate of stern shaft seal. The surveyor is to confirm the Statement of Compliance and the type approval certificate of stern shaft air seal provided by the manufacturer;

3) Stern tube lubricant consumption is to be recorded and examined periodically on board ships according to the form of the Consumption Record of Stern Tube Lubricant System;

4) Operational oil spill is not to take place for air seal system within its service life;

5) Condition of stern shaft tube air seal system is to be described in EAL Report, including type, type approval certificate and VGP(2013) Document of Compliance of the manufacturer;

6) EAL Report is to be prepared by the shipyard or shipowner/ship company, submitted to site surveyor for approval and kept on board;

7) In the U.S. waters, if mineral oil leakage occurs due to adoption of air seal system, record is to be made according to paragraph 4.2.3 of VGP(2013). For lubricant leakage due to special conditions, detailed record is to be made on the accident and its cause in accordance with the form in paragraph 4.4.3 of VGP(2013), including cause of leakage and how it is handled.

(3) If water lubricated bearing is used for the ship, the following requirements may be applied:

1) For a ship using water lubricating system for stern shaft, if its other areas satisfy the requirements of the Guidelines, upon the request of the shipowner/ship company or shipyard and on completion of satisfactory survey according to the requirements of ISC, EAL class notation may be assigned.

3.2.4 Annual survey

3.2.4.1 Document check:

(1) Checking class certificate;

(2) Checking EAL Report, confirming whether lubricants have been replaced in oil-to-sea interfaces. If they have been replaced, confirming that EAL Report is renewed on board the ship and ensuring that the replaced lubricants are provided with complete documents and are in compliance with relevant requirements;

(3) Checking Record of Stern Tube Lubricant Consumption onboard the ship and its validity.

3.2.4.2 Survey requirements

(1) Checking that the arrangement and condition of air seal system have not undergone changes which may affect the validity of class notation, and confirming that relevant alarm positions and safety valves are in compliance with relevant requirements of the Guidelines;

(2) For propeller shaft lubricated by EAL, confirming that the ship is to be subject to the following action at least once every 6 months, i.e. submitting propeller shaft EAL sample to a recognized lubricant analysis organization for testing and analyzing viscosity, water content, chloride content, content of metal particles in bearings and lubricant aging condition (antioxidant capability);

(3) Verifying that analysis record of a recognized lubricant analysis organization is kept on board the ship with conclusion on lubricant condition and suitability;

(4) The surveyor is to verify lubricant oil analysis report since last annual survey/renewal survey.

3.2.5 Intermediate survey

3.2.5.1 In principle, intermediate survey is to be carried out according to the scope of annual survey. If stern shaft survey is involved, air seal system is to be retested for verification. If air seal spares are replaced, replacement is to meet the requirements of the seal manufacturer.

3.2.6 Special survey

3.2.6.1 In principle, special survey is to be carried out according to the scope of annual survey. If stern shaft survey is involved, air seal system is to be retested for verification. If air seal spares are replaced, replacement is to meet the requirements of the seal manufacturer.

Section 3 Survey for EAL Document of Compliance

3.3.1 Except for paragraph 3.3.2 of this Section, survey of EAL document of compliance may be carried out with reference to requirements for initial survey in Section 2 of this Chapter.

3.3.2 If using EAL onboard for oil-to-sea interface is technically infeasible, the issue of EAL Document of Compliance may be requested, but attention is to be paid to the examination of following requirements:

3.3.2.1 Checking whether the ship satisfies the conditions for "technically infeasible". VGP(2013) provides clear definition of "technically infeasible". For the implementation in relation to "technically infeasible", reference may be made to Appendix 2 of the Guidelines;

3.3.2.2 If using EAL onboard for oil-to-sea interfaces is technically infeasible, the shipowner/ship company is to fill in the report (Recordkeeping/Part 4.2) onboard according to form required by VGP (2013), and state the reason for not using EAL;

3.3.2.3 Each year the shipowner/ship company is to submit the information on the usage of non-EAL to EPA by means of an annual report, and rectify this during next dry docking survey;

3.3.2.4 The positions where non-EAL are used are to be described in EAL Report, stating reason for "technically infeasible" and providing corrective measures;

3.3.2.5 EAL Report is to be prepared by the shipyard or shipowner/ship company, submitted to site surveyor for approval and kept on board;

3.3.2.6 Maintenance outside of the dry dock is to be avoided as far as possible;

3.3.2.7 If maintenance or emergency repair in the U. S. waters is unavoidable, attention is to be paid to oil spill amount control and oil spill recovery. For example, proper leakage handling devices (e.g. oil fences) are to be used to control oil spill, and in addition, there is to be direct means of access to the leakage handling device to remove oil spill;

3.3.2.8 Maintenance of oil-to-sea interfaces is to be record in the logbook.

3.3.3 Issuance of EAL Document of Compliance

3.3.3.1 For ships which have been surveyed and comply with applicable requirements of the Guidelines, EAL Document of Compliance may be issued by ISC;

3.3.3.2 For ships with EAL class notation, EAL Document of Compliance may be issued directly at shipowner/ship company's request.

3.3.4 Invalidation of Document of Compliance

3.3.4.1 EAL Document of Compliance is automatically invalidated in either of the following conditions:

(1) the ship replaces brand or type of environmentally acceptable lubricants, but EAL Report is not revised timely and classification society is not informed in time;

(2) the air seal of stern shaft tube air seal system is out of work, but repair is not carried out in time and classification society is not informed of survey;

(3) air seal system is not used in the stern shaft onboard ships, and environmentally acceptable lubricants are replaced by mineral oil.

CHAPTER 4 REQUIREMENTS FOR ALIGNMENT OF SHAFTING USING EAL

Section 1 General Provisions

4.1.1 The provisions are intended to provide guidance on design, technique and operation to help to adapt to the potential difference between certain performance of EAL and conventional mineral oil at present stage.

4.1.2 Calculation and technology in relation to alignment of shafting using EAL are to satisfy, in addition to the requirements of relevant ISC rules, the requirements of this Chapter.

4.1.3 This Chapter is not applicable to ships with new means of propulsion, such as podded propulsion and azimuth propulsion.

Section 2 Key Points for Control

4.2.1 Requirements for shafting design and alignment calculation

4.2.1.1 Forward stern tube bearing is to be used on stern shafts of ships as far as possible. For ships without forward stern tube bearing, in order to facilitate site calibration and confirmation of stern shaft, displacement of certain positions relative to the shafting reference centerline is to be provided in the shafting alignment calculations, e.g. providing displacement of shaft in the position of forward seal;

4.2.1.2 Relative angle of inclination between ship stern shaft and aftermost stern tube bearing is to be reduced as far as possible;

4.2.1.3 In shafting alignment calculation, full consideration is to be given to the effect of hull deformation under different loading conditions. If effect of hull deformation is not considered in the calculations, at least the load of bearings is to be measured when the ship is ballasted and aft peak tank is fully loaded and when the ship is ballasted and aft peak tank is empty. The measurement results are to satisfy relevant requirements of ISC rules.

4.2.2 Requirements for shafting installation and alignment technique

4.2.2.1 The shipyard is to give full consideration to the influence of deflection of boring equipment on the machining precision of stern tubes.

4.2.2.2 After finish machining of stern tubes, sizes of bores on stern tubes are to be measured to confirm the deviation of center lines of the stern tube body (in vertical and horizontal directions).

4.2.2.3 The above deviation is to be taken into consideration during cylindrical grinding of stern bearing and compensation during machining is to be made for deviation from stern tube center line as appropriate. (Direct modification of stern tube size is to be avoided on site).

4.2.2.4 Aftermost stern bearing is fitted with pressure, displacement, straightness and slope in way of stern bearing are to be measured and calculated. When verifying the slope of stern bearing relative to the reference line, at least 4 peripheral sections (or at an interval of at least 300mm) are to be taken in aft bearing for measurement.

4.2.2.5 For the stern tubes fixed by pouring of epoxy resin, on completion of pouring by epoxy resin, the displacement, straightness and slope of stern tubes are to be measured and verified according to the requirements of 4.2.2.4.

4.2.2.6 For ships without forward stern tube bearing, prior to installation of forward seal, the position of stern tube in way of forward seal is to be marked according to the requirements in shafting alignment calculations, and original measured value is to be recorded. Installation of forward seal is not to affect retesting of this value.

4.2.2.7 For ships without forward stern tube bearing, random adjustment of height of intermediate bearing and main engine is to be avoided as far as possible. If there is big deviation of the bearing load and fine adjustment of intermediate bearing height is necessary, it is to be ensured that the height of the marked position as specified in above 6 is not higher than the original measured value, while the loads of bearing are to meet the requirements of shafting calculations.

4.2.3 Sea trial of ships

4.2.3.1 In addition to meeting relevant requirements of sea trial, ships using EAL are to satisfy the following requirements:

(1) Prior to sea trial, the shipyard is to submit the running-in procedure for sea trial of a newly built ship to the site surveyor. Prior to steering test and turning test, ship shafting is to run in fully under the condition of low speed and small rudder angle;

(2) During sea trial of the ship, including during implementing running-in procedure, the shipyard is to record data of temperature of all bearings (including last three bearings of main engine crankshaft, if fitted), main engine speed and rudder angle periodically. The surveyor is to collect the recording of relevant data during the implementation of running-in procedure.

4.2.4 Ship operation

4.2.4.1 When the ship is in no-load and light draught condition, especially when the propeller is not fully immersed, high-speed running of propeller is to be avoided.

4.2.4.2 Under severe weather condition, sufficient ballast condition of the ship is to be ensured to avoid free running of propeller.

4.2.4.3 At the initial stage of ship delivery, full rudder in light draught condition is to be avoided, and at the same time, change of bearing temperature is to be monitored closely.

4.2.5 Others

4.2.5.1 Discharge and sampling of lubricants in the stern tube is to be optimized, and the stern tube lubricant discharge and sampling ports are to be arranged in way of stern aft bearing as far as possible. On one hand, lubricant residue in stern tube is to be reduced as far as possible during the replacement of lubricants, on the other hand, lubricants in stern tube may be sampled through stern tube lubricant discharge outlet so as to help crew to carry out sampling and analysis of lubricant in stern tube on a regular basis;

4.2.5.2 If specific pressure of thermal stern bearing exceeds 0.6 N/mm^2 or the relative inclination angle of stern tube rear bearing and shaft exceeds 0.2×10^{-3} rad as specified in shafting alignment calculations, the ship is to be deemed as a target ship for close attention on the temperature of stern bearing;

4.2.5.3 If EAL is selected, attention is to be paid to EAL shear stability curve as far as possible. For test standards, it is recommended to refer to experimental standards for tapered roller bearing CEC L-45-A-99.

CHAPTER 5 AIR SEAL SYSTEM

Section 1 General Provisions

5.1.1 This Chapter applies to ships with air seal system for stern shaft tube.

5.1.2 In principle, requirements for air seal modification survey is similar to that for newbuildings, and relevant modification plan is to be approved by ISC.

5.1.3 Air seal for stern shaft sealing is to be subject to ISC type approval.

5.1.4 Condition of air seal system is to be recorded periodically on board ship according to the form of Consumption Record of Stern Tube Lubricant System.

5.1.5 In addition to the requirements of the Guidelines, air seal system is to satisfy the requirements of ISC Rules for Classification of Seagoing Steel Ships.

Section 2 Survey Requirements for Air Seal System

5.2.1 If air seal system is used onboard a ship, the shipyard and shipowner/ship company may apply to ISC Plan Approval Center. Upon approval by Plan Approval Center, site surveyors are to make confirmation of relevant condition according to documents approved by Plan Approval Center, and an EAL Document of Compliance is to be issued or EAL class notation is to be assigned after satisfactory survey/confirmation.

5.2.2 Plans and documents

5.2.2.1 Shipyards and shipowners/ship companies are to submit the following documents to ISC:

(1) Schematic diagram of air seal system;

(2) Stern tube lubricant daily service system plan;

(3) List of Air seal alarms;

(4) Modification plan (where applicable).

5.2.3 Design and construction

5.2.3.1 Stern seal of air seal system is functionally to at least include seal against seawater leakage and oil leakage to ensure an air space between seawater and lubricant to recover oil and water so that there is no oil-to-sea interface in the integral construction of air seal system.

5.2.3.2 Air seal system is to, according to the draught condition, provide clean compressed air with relatively stable pressure to ensure that no oil-water interface exists in the entire construction of the air seal system under normal conditions. Pressure difference between each chamber is to be in conformity with the data provided by the product supplier, by taking into account of the service life of seal ring.

5.2.3.3 If there is transient failure of air supply, sufficient measures are to be taken to ensure that air seal system has same sealing effect as oil seal, or other equivalent measures are to be taken to ensure safe navigation of the ship.

5.2.3.4 Under all draught conditions, when seal system loses air supply, sufficient measures are to be taken to ensure that there is no risk of lubricant leakage.

5.2.4 Air control units

5.2.4.1 Air control units are to be able to provide clean air with relatively stable pressure.

5.2.4.2 At least one set of air indicator is to be provided.

5.2.4.3 Air seal system is to be provided with pressure adjusting device.

5.2.4.4 For system with automatic air pressure adjustment, when air pressure is connected to stern tube lubricant tank, the tank is to be provided with safety valve to prevent overpressure. At the same time, stern tube lubricant tank is to be provided with high and low level alarm.

5.2.4.5 At least one set of air pressure alarm system is to be provided to give visual and audible alarm when the pressure of air supply is low. For AUTO-0 ship, air supply pressure alarm is to be able to be displayed at the navigation bridge.

5.2.5 Drain collection units

5.2.5.1 Air seal system is to be provided with drain collection units or other equivalent devices as far as possible.

5.2.5.2 Drain collection units are normally to be lower than the bottom of stern seal.

5.2.5.3 Drain collection units are to be provided with high level alarm as far as possbile.

5.3.5.4 If drain collection units or high level alarms are not provided, other appropriate measures and methods to verify the effectiveness of air seal system are to be provided by the manufacturer to ensure that no oil-water interface exists in stern seal.

5.2.6 Requirements for air seal system alarm positions

5.2.6.1 Air seal system is to be provided with alarms mentioned in Table 5.2.6.1 to monitor system operation.

Table 5.2.6.1 Air Seal System Alarm positions

Items	Centralized control station (room) in engine room	
	Display	Limit alarm
Pressure of air control system		Low
Level in drain collection unit or other equivalent devices (to be provided as far as possible)		High
Level in stern tube lubricant tank		High
		Low

5.2.7 Requirements for automatic monitoring of air seal alarm positions in periodically unattended machinery spaces

5.2.7.1 Table 5.2.7.1 is supplementary to Automatic Control and Monitoring Items for Ships with Class Notation AUT-0 (Table 3.10.1.1, PART SEVEN of ISC Rules for Classification of Seagoing Steel Ships).

Table 5.2.7.1 Automatic Control and Monitoring Items for Air Seal System Alarm positions

Items	Centralized control station (room) in engine room		Mode of protective control action	Mode of alarm at BCS
	Display	Limit alarm		
1	2	3	4	5
26 Air seal system				
Pressure of air control system		Low	-	Y
Level in drain collection unit or other equivalent means (to be provided as far as possible)		High	-	Y

Level in stern tube lubricant tank		Low	-	Y
		High	-	Y

5.2.8 Installation and inspection

5.2.8.1 Checking product certificate;

5.2.8.2 Checking that the whole arrangement of system is consistent with the requirements of the drawing, and attention is to be paid to checking installation height of stern tube lubricant tank and drain collection unit;

5.2.8.3 After the air seal system is installed on board the ship, pressure test and function test are to be carried out;

5.2.8.4 Alarm position simulation test.

Section 3 Modification of Existing Ships for Air Seal System

5.3.1 If an existing ship has been subject to modification of stern seal system, application for interim survey is to submitted to ISC. For details, see Section 5.2 of this Chapter.

5.3.2 When an existing ship with automation class notation is subject to modification, requirements of 5.2.6 and 5.2.7 of this Chapter are to be satisfied as far as possible. For old ships, if it is confirmed that it is difficult to provide additional alarm positions in the centralized control room or navigation bridge, arrangement of a single alarm position may be exempted with the consent of surveyor and the alarm function may be achieved through general alarm positions in the navigation bridge or centralized control room.

5.3.3 On completion of modification, functional test is to be carried out according to 5.2.8 of this Chapter.

Section 4 Consumption Record of Stern Tube Lubricant System

5.4.1 Consumption Record of Stern Tube Lubricant System is to be prepared by the shipyard and shipowner/ship company and submitted to ISC for review. It is recommended that relevant requirements be incorporated into company ISM quality management system.

5.4.2 Consumption Record of Stern Tube Lubricant System is to include the following contents:

5.4.2.1 Defining management responsibilities, requiring that a designated person be arranged on board the ship to check stern tube lubricant consumption at regular intervals and make relevant record;

5.4.2.2 Defining inspection period and scope;

5.4.2.3 Form of record is to be provided.

5.4.3 Inspection period and scope

5.4.3.1 Air seal system (including lubricant system) is to be subject to inspection on board ships according to the following requirements and relevant records are to be made:

(1) Daily inspection items:

1) Inspecting and recording level of stern seal lubricant tank;

2) Inspecting and recording level of forward seal lubricant tank;

3) Inspecting and recording bearing and stern tube oil temperature;

4) Visual inspection of forward seal to confirm whether there is lubricant leakage or not;

5) Inspecting and recording level of drain collection unit

6) Checking whether other parts of air seal system are in good condition, including lubricant pump, cooler and filter, etc.

(2) Monthly inspection items:

1) Checking normal opening and closing conditions of valve or components of air seal system according to the system diagram;

2) Confirming that level alarm of lubricant tank and forward seal tank is good condition;

3) Testing and recording relevant alarming positions of the air seal system (according to the scope given in 5.2.6 or 5.2.7 of this Chapter).

(3) Other inspection items:

1) Lubricant sampling and analysis (according to the requirements of ISC Rules for Classification of Seagoing Steel Ships);

2) Stern bearing offset measurement (according to the requirements of ISC Rules for Classification of Seagoing Steel Ships).

CHAPTER 6 APPENDICES

Appendix 1 Typical Air Seal System

6.1.1 This Chapter only provides introduction of the fundamentals of air seal system instead of requirements for product inspection.

6.1.2 In general, an air seal system is mainly composed of the following units:

6.1.2.1 Air control unit;

6.1.2.2 Drain collection unit;

6.1.2.3 S/T L.O. tank unit;

6.1.2.4 S/T L.O. circulation pump.

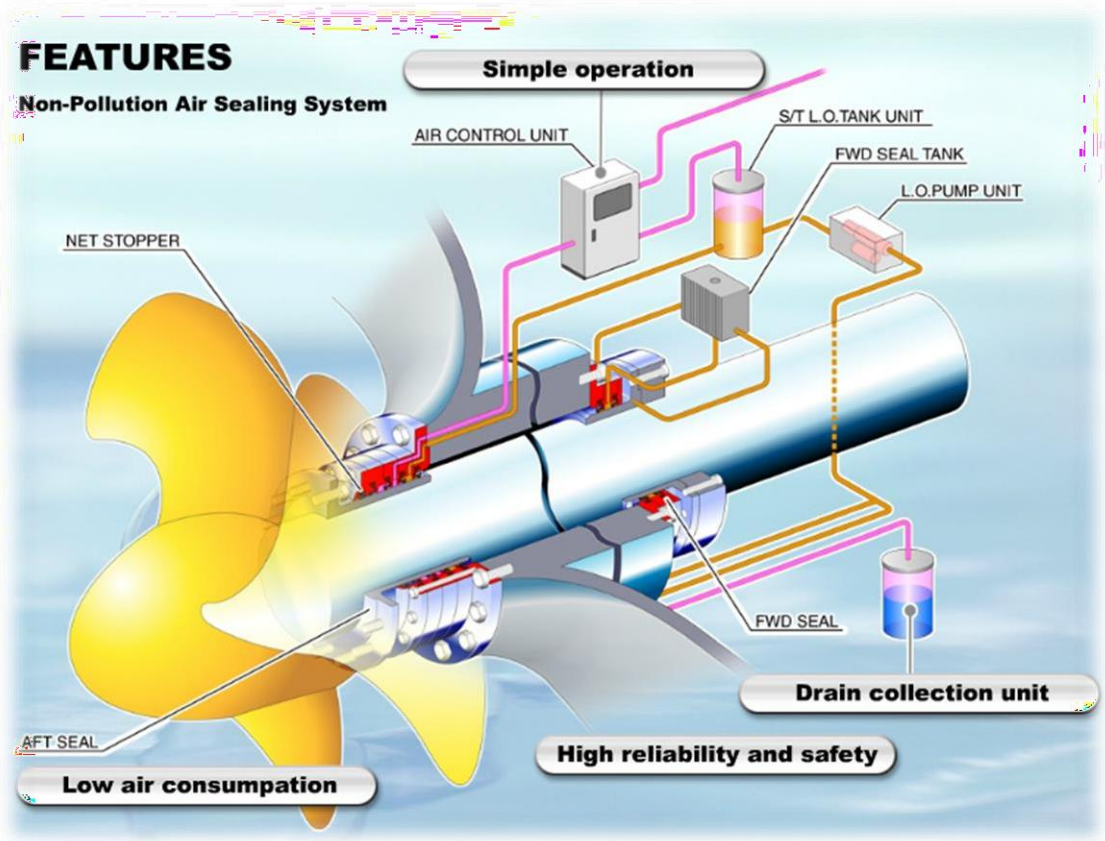

Figure 6.1.2(1) Schematic diagram of air seal system

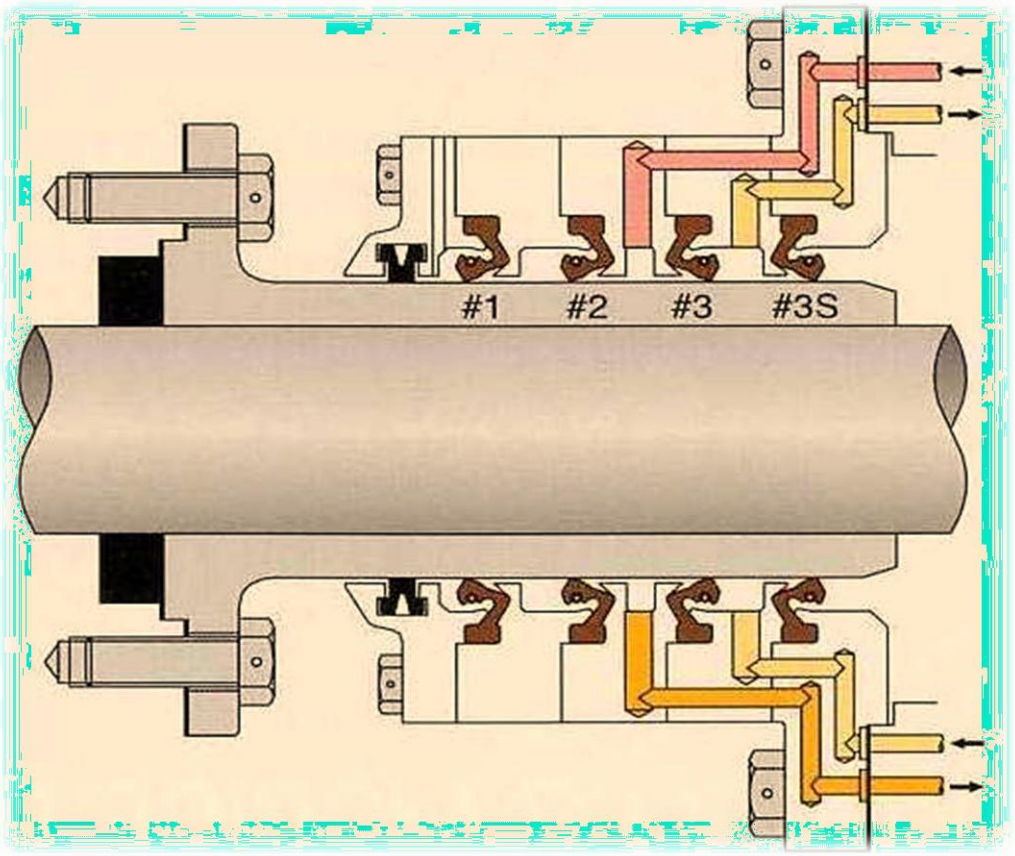

Figure 6.1.2(2) Schematic diagram of internal structure of stern seal

6.1.3 Air seal type

6.1.3.1 In general, air seal may mainly composed of following three types:

(1) Stern shaft air seal I. Pressure of air in air chamber is constant and will not change automatically with draught change;

(2) Stern shaft air seal II. Pressure of air in air chamber changes automatically with draught change, but pressure oil tank is not provided;

(3) Stern shaft air seal III. Pressure of air in air chamber changes automatically with draught change, and pressure oil tank is provided, pressure of which changes with draught change.

6.1.3.2 Selection of air seal type is generally relating to the difference between ship full-load waterline and ship light-load waterline. Switching principles provided by individual manufacturers are different slightly, depending on the requirements of the seal manufacturers in principle. Figure 6.1.3.2 is schematic diagram of a certain air seal type, i.e. when the draught difference of the ship reaches a certain value, two oil tanks are required and subject to manual switch in way of waterline H_{SOP}.

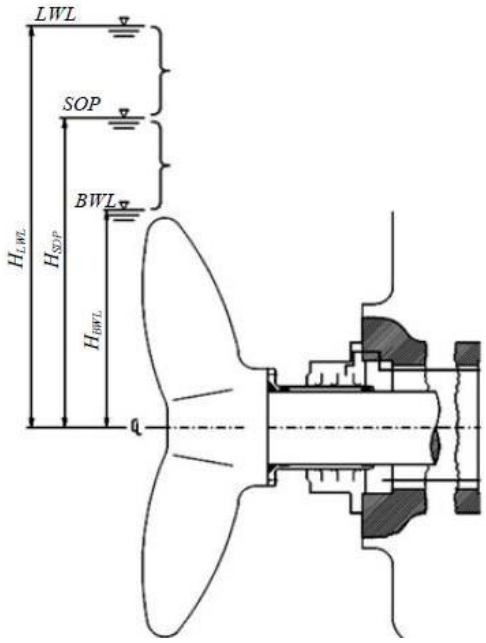

Figure 6.1.3.2 Schematic diagram of selection of stern seal

where:

H_{LWL} (Height of Load Water Line) is the height between ship's full-load waterline and shafting centerline;

H_{BWL} (Height of Ballast Water Line) is the height between ship's ballast waterline and shafting centerline;

H_{SOP} (Height of Switch Over Point) is the height when oil tank 1 and oil tank 2 are switched over with each other.

6.1.4 Working principle of a certain type of air seal

6.1.4.1 Compressed air of ships goes through air control units by means of pipes and pressure is adjusted by means of pressure adjusting valve;

6.1.4.2 Air control units are provided with air flow gauge, which can adjust air flow as needed;

6.1.4.3 Compressed air is divided into two ways by air control unit, one way is connected to lubricant tank unit, and the other is connected into #2/#3 seal chamber which can be entered from top by compressed air;

6.1.4.4 Left side of #1 sealing ring is subject to seawater pressure P_{SW}, and pressure in #2/#3 seal chamber is generally as such: $P_{\#2/\#3}$ = 0.02~0.04 MPa + P_{SW}. Assuming tension from #1 sealing ring is 0.01~0.02 MPa, then pressure in #1/#2 seal chamber is: $P_{\#1/\#2}$ = 0.01~0.02 MPa + P_{SW}. Therefore, pressure in #2/#3 seal chamber is always 0.01~0.02 MPa higher than that in #1/#2 seal chamber, and pressure in #1/#2 seal chamber is 0.01~0.02 MPa higher than the seawater pressure on #1 sealing ring. Compressed air enters #1 and #2 seal cavities through #2/#3 seal chamber, and then is discharged to seawater through #1 sealing ring, in this way seawater is kept out.

6.1.4.5 Note: Generally speaking, air control units can adjust air supply pressure according to the changes of draught. Air control units for air seal system provided by some manufacturer are not fitted with specific pressure testing and adjusting device, and the set pressure difference is guaranteed by achieving equilibrium through continuous feedback of pressure change by the flow.

6.1.4.6 The system is provided with drain collection units from #2/#3 seal chamber into the inside of the ship, and drain collection units are generally positioned below the axis. When seawater leaks from #1 and #2 sealing ring and lubricant leaks from #3 sealing ring, leaked seawater and lubricant may be drained to the drain collection units. Common failures of air seal system can be identified on a preliminary stage through the composition in drain collection units

and different alarm signals;

6.1.4.7 The system is provided with two lubricant circulation pumps which serve as spare to each other. Lubricant in lubricant tank unit is pumped into #3/#3S seal chamber and stern shaft tube, and oil pressure in #3/#3S seal chamber is controlled as 0.03~0.05 MPa higher than air pressure in #2/#3 seal chamber by adjusting the needle valve on circulation pump unit, i.e. adjusting oil return amount. For automatic pressure adjusting system, when ship draught increases, seawater pressure on the left side of #1 sealing ring increases, gap between sealing ring and lining becomes smaller and therefore air discharged from #1 sealing ring to seawater decreases, causing pressure in #1/#2 seal chamber rises and pressure in #2/#3 seal chamber rises accordingly. For automatic pressure adjusting system (stern shaft air seal III), lubricant tank units are directly connected with #2/#3 seal chamber through air pipes, therefore pressure of lubricant tank units increases with pressure rise in #2/#3 seal chamber, and resistance of lubricant flowing back from seal chamber and stern shaft tube to lubricant tank unit increases and pressure of oil in #3/#3S seal chamber and stern shaft tube increases gradually, and then new balance is reached.

6.1.5 Reliability analysis of air seal system

6.1.5.1 Air seal system is generally composed of three chambers formed by four sealing rings, as shown in Figure 6.1.2-2. When air supply fails or there is transient low pressure, pressure in #2/#3 chamber is lower than that in #1/#2 chamber, and there is no leakage risk for lubricant;

6.1.5.2 #3S sealing ring is a spare ring, and under normal condition, $P_{\#3/3S}=P_{S.T.}$ ($P_{S.T.}$ is pressure in stern tube lubricant tank), when #3 sealing ring fails, oil supply valve of #3/#3S chamber is closed and #3S sealing ring is put into use, and thus ingress of seawater into stern tube is avoided, as shown in 6.1.5-1;

6.1.5.3 When #1 sealing ring fails, #2 sealing ring may avoid ingress of seawater into the air chambers;

6.1.5.4 Oil-water mixture in air chambers may be recovered by drain collection units.

Note: For the fundamentals of air seal, see Figure 6.1.5(2).

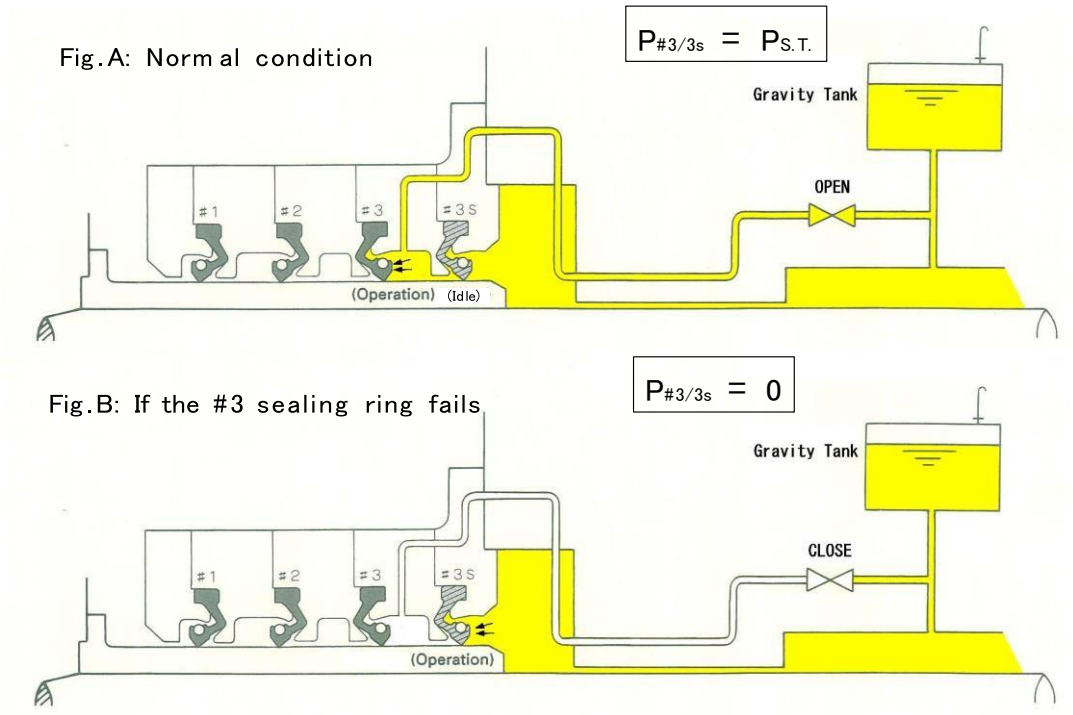

Figure 6.1.5(1) Failure mode switching over principle

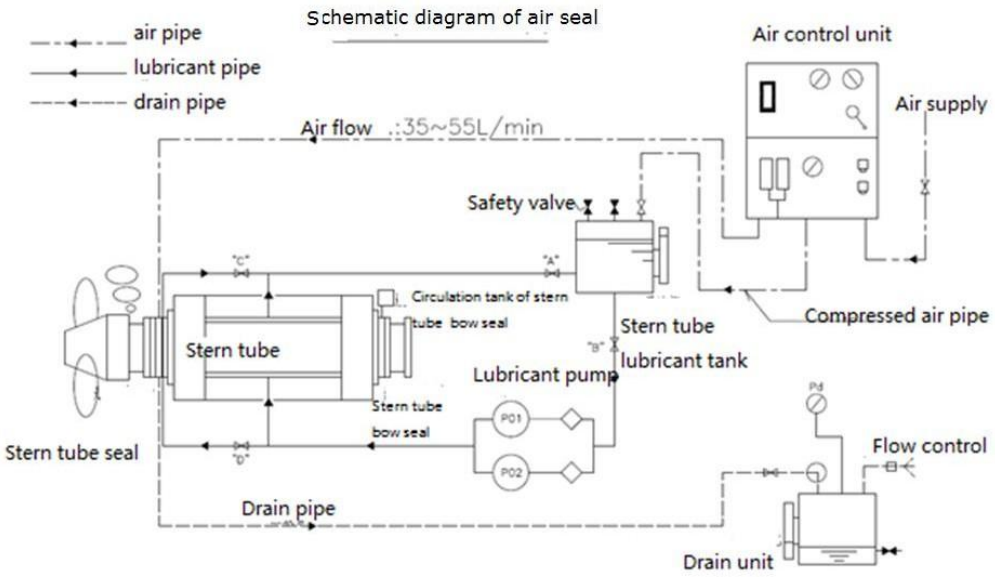

Figure 6.1.5(2) Schematic diagram of air seal system (simplified diagram)

Appendix 2 Technically Infeasible

6.2.1 For the purpose of paragraph 2.2.9 of VGP(2013), a new ship is defined as a ship the keels of which is laid or which is at a similar stage of construction on or after 19 December 2013. For the applicability of paragraph 2.2.9, EPA does not give clear explanation, and in paragraph 2.2.9, it is recommended that new ships should adopt seawater lubricating systems. According to the information released on EPA website, in principle, implementation of EAL immediately took effect as of 19 December 2013, but certain period of relaxation may be granted under the premise of "technically infeasible".

6.2.2 In principle, EPA is of the view that a new ship does not have technically infeasible conditions, because at the design and type selection stage, a new ship can select products in compliance with EAL requirements or similar products. In addition, systems such as Seawater Based System and Air Space Seal may also be adopted to avoid requirements for EAL.

6.2.3 To facilitate to understand "technically infeasible", EPA gives examples in its official website as follows:

6.2.3.1 Take newbuildings for example, if a certain ship has signed a contract with a stern seal product supplier, but the stern seal product supplier cannot provide EAL products to match the seal system. In such condition, explanation of EPA should not be regarded as "technically infeasible" condition, and despite of contract, the shipyard may select other types of seal system;

6.2.3.2 Take existing ships for example, prior to next drydocking, failure of mixed use of two lubricants in existing equipment or failure of replacing sealing material and lubricant can be deemed as "technically infeasible". For such case, the ship operator is to explain the reason for not being able to use EAL and make relevant record (Reportkeeping/Part4.2). This situation should be indicated in the annual record and the positions where non-EAL is used (oil-to-sea interfaces) should be described until the replacement by EAL at next drydocking;

6.2.3.3 It is mentioned in the official website of EPA that in principle, VGP(2013) applies to all ships, but during initial implementation of the requirements for EAL in paragraph 2.2.9, there may be small differences between newbuildings and existing ships. Such differences are mainly reflected on understanding and application of "technically infeasible".

Appendix 3 Control of Oil Spillage

6.3.1 Using EAL does not mean that arbitrary discharge is allowed, and oil spillage amount still need to satisfy the requirements of 40CFR110.3, i.e. discharge of lubricant at oil-to-water interfaces cannot exceed the standard of "may be harmful" as given in 40CFR110.3.

6.3.2 "May be harmful". Discharge of oil in such quantities as "may be harmful" pursuant to section 311(b)(4) of the Act is defined as follows:

6.3.2.1 Discharge of oil in such quantities that the Administrator has determined may be harmful to the public health or welfare or the environment of the United States include discharge of oil that:

(1) Violate applicable water quality standards; or

(2) Cause of film or sheen upon or dis-coloration of the surface of the water or adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines.

The original English text is as follows:

"**§ 110.3 Discharge of oil in such quantities as ''may be harmful'' pursuant to section 311(b)(4) of the Act.**
For purposes of section 311(b)(4) of the Act, discharges of oil in such quantities that the Administrator has determined may be harmful to the public health or welfare or the environment of the United States include discharges of oil that:

(a) Violate applicable water quality standards; or

(b) Cause a film or sheen upon or dis-coloration of the surface of the water or adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. "

Appendix 4 Requirements for preparing EAL Reports

6.4.1 An EAL Report is to be prepared by the shipyard and shipowner/ship company according to the facts, which is at least to include main parameters of the ship such as ship name and IMO No.

6.4.2 The EAL Report is to describe and illustrate the distribution or location of all oil-to-water interfaces onboard the whole ship. If water lubricated bearing or air seal is adopted, relevant marks are to be provided which should be distinguished from the marks of oil-to-water interface;

6.4.3 The EAL Report is to be attached with the designation of EAL, material safety data sheet (MSDS/Part 4.2.9) and documents proving compatibility of EAL and stern shaft seal material;

6.4.4 If “technically infeasible” is applied, reasons for technically infeasible are to be stated and corrective measures are to be provided, including correction time (not exceeding next drydocking or 5 years, whichever is earlier). It is to be indicated that the shipowner or ship company must notify U.S. Environmental Protection Agency every year in the form of an annual report;

6.4.5 If an air seal system is adopted, type approval certificate of the air seal system and statements provided by the air seal supplier are to be attached.