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Safety Guidelines on Ship Watertight Door



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Safety Guidelines on Ship Watertight Door



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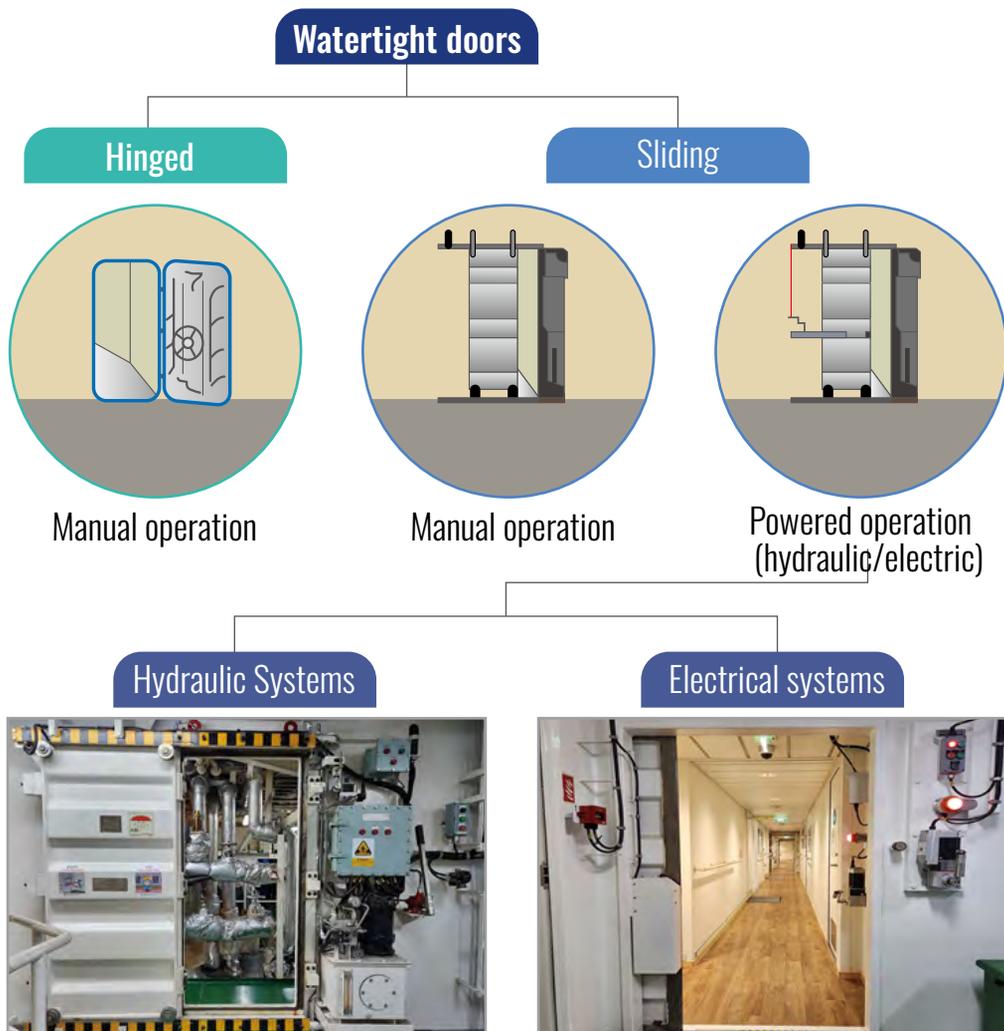
Chapter 1

Types of Watertight Doors and How They Work

1 Types of watertight doors

A watertight door is a door installed on a watertight bulkhead to prevent the ship from sinking by preventing water from entering the other watertight compartment if one watertight compartment is flooded due to a collision or running aground.

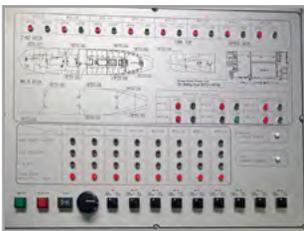
Depending on the opening and closing mechanism, there are hinged and sliding types, and it can be opened and closed by manual operation or power operation (hydraulic, electric).



2 How to control watertight doors

There are three ways to control watertight door operation: ① bridge control, which is controlled from the bridge; ② local control, which is controlled from the site where the watertight door is installed; and ③ emergency remote control, which is controlled from an accessible location above on the bulkhead deck.

① Bridge control



Bridge



Central operation panel

② Local control



Hydraulic

Location where the watertight door is installed

Control Levers



Passive devices



Electric

Control Buttons



Passive devices



③ Emergency Remote Control



Hydraulic

Upper part of bulkhead deck



Electric

3 Bridge Control

It is a control method to open/close the watertight door from the bridge. Normally, the master mode switch on the bridge central operating panel is set to 'local control'. In the event of an emergency, such as a collision, stranding, or fire, if the master mode switch is set to 'close', any door can be automatically closed from the bridge.

Bridge control



When the master mode switch on the bridge central operating panel is set to "Closed"

The warning light is activated for 5 to 10 seconds before the watertight door moves.

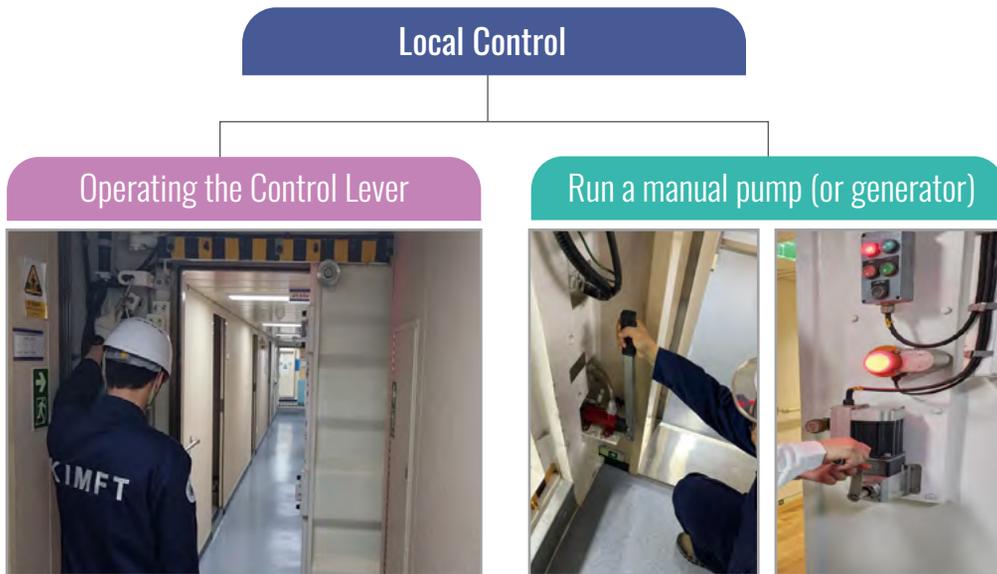


The warning light will activate until the watertight door is completely closed.



4 Local Control

It consists of an operation lever, a manual pump (or generator), and a hydraulic accumulator (or battery) in both directions of the watertight door as a method of controlling it in the place where the watertight door is installed. The capacity of the hydraulic accumulator (or battery) is sufficient to operate the watertight door at least three times (closed ⇨ open ⇨ closed).



When the operating lever is placed in neutral during watertight door operation, the opening and closing operation stops.

※Operate manually if there is not enough drive power.



5 Emergency Remote Control

If control of the watertight door is not possible due to loss of power to the hydraulic power unit, failure of the hydraulic pump, or loss of capacity of the hydraulic accumulator, the watertight door can be controlled by an emergency remote manual device (emergency manual pump or emergency generator) installed in an accessible location above the bulkhead deck.

Emergency remote control

Emergency manual pump operation



Individual type: Installation of individual hydraulic pumps in watertight doors
 Collective type: Installation of common hydraulic pumps in all watertight doors
 *Opening of stop valve before hydraulic pump operation

Activate the emergency generator



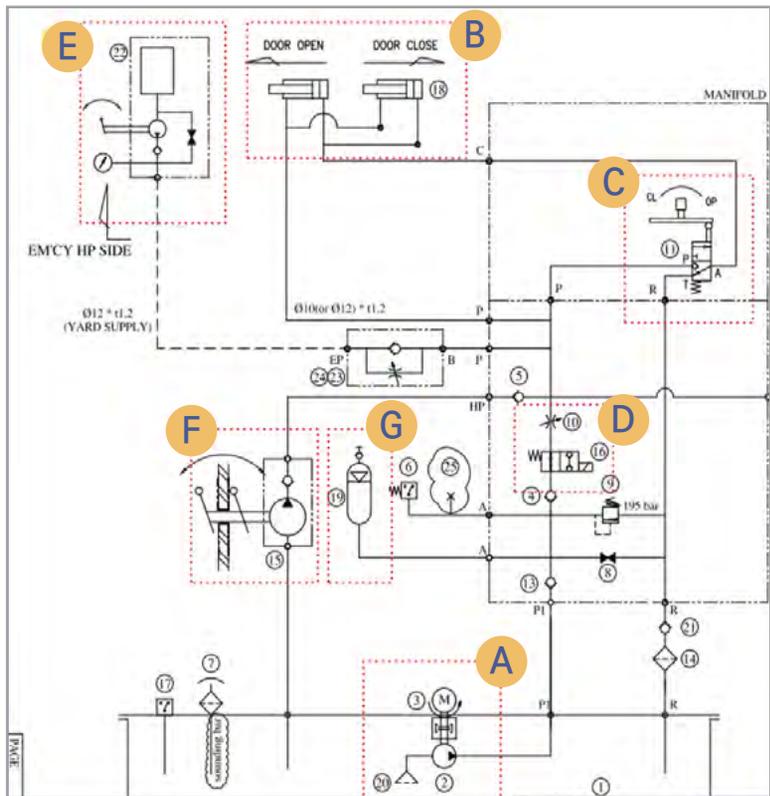
Individual type: Installation of individual generators in watertight doors
 Collective type: Installation of common generators in all watertight doors
 *Setting the selection switch before generator operation



6 How hydraulic watertight doors work

The bridge control and local control generate the hydraulic pressure necessary for watertight door control in the hydraulic pump, and the emergency remote control generates the hydraulic pressure necessary for watertight door control in the manual hydraulic pump installed on the upper part of the bulkhead deck. The operating procedure for each control is as follows.

1. Bridge Control	A	→	D	→	B	→	C
2. Local Control	A	→	D	→	C	→	B
· Manual pump operation	F	→	C	→	B		
· hydraulic accumulator operation	G	→	D	→	C	→	B
3. Emergency Remote Control	E	→	B	→	C		



- A** Hydraulic Power
- B** Hydraulic actuator(cylinder)
- C** Operating lever(open/close)
- D** Electronic Control Valve (Hydraulic Shutoff)
- E** Emergency Remote Control Unit
- F** Manual hydraulic pump
- G** Hydraulic accumulator

7 How electric watertight doors work

Bridge control and local control operate by converting 220 to 400 volts of alternating current (AC) to 24 volts of direct current (DC) to supply electric motors for watertight door control. Emergency remote control is operated by supplying power by operating an emergency manual generator installed on the upper part of the bulkhead deck. The operating procedure for each control is as follows.

1. Bridge Control



2. Local Control



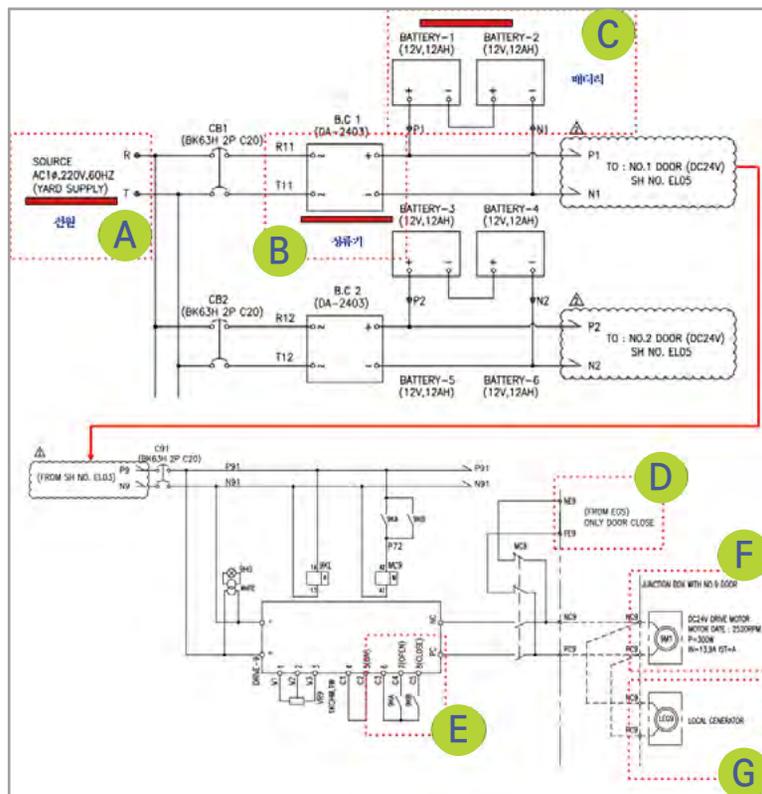
· Manual generator operation



· Emergency battery operation



3. Emergency Remote Control



- A** Power supply **B** Rectifier (alternating current to direct current) **C** Battery (24 volt) **D** Emergency manual generator
E Control Lever (Open/Close) **F** Electrical drive source (electric motor) **G** Manual generator

Safety Guidelines on Ship Watertight Door



Chapter 2

Watertight door safe passage procedures and precautions

1 Watertight door safe passage procedure

1.1 Routinely inspect the watertight door operating facilities and surroundings.

- Visual inspection of watertight door operating facilities
- Check for obstacles around the watertight door
- Check for foreign substances such as oil leakage around the watertight door



1.2 Familiarize yourself with the operating and safety instructions posted at the watertight door control location on a regular basis.

유압 수밀문 작동 및 안전 수칙

본 유압수밀문은 국제 작업 규준원에 따라 작동되며, 관련 규준, 유압 규준 등의 준수는 반드시 지켜야 하며, 수동 컨트롤에 의해 작동시킬 수 있다.
 비상 작동수밀문의 작동은 국악수밀문은 설치 위치에서 작동시키며, 비상시 항해 선교의 비상 작동 제어만 지켜 원칙으로 폐쇄시킬 수 있으며 유압수밀문의 폐쇄에 필요한 시간은 아래와 같다.

1. POWER OPERATING : MORE THAN 20 Sec. , LESS THAN 40 Sec.
 2. REMOTE POWER OPERATING : LESS THAN 10 Sec.
 3. HAND PUMP OPERATING : LESS THAN 130 Sec.

유압수밀문 작동방법

1. 지 역제어에 의한 수밀문이 작동법

가. 작 유압수밀문 구역에 설치된 상태 표시(INDICATION BOX)의 코드 LAMP 상태 확인.
 만약 점멸(켜졌다, 꺼졌다)인 경우 제어판(LABEL PANEL) 내부의 신호 스위치를 "ON" 한다.
 (점멸이긴 한데 스위치는 꺼진 상태에 있으면 스위치를 꺼야 함) (이것이 중요)
 만약 30초 지체된 기밀을 제거 할 후 내부에 있는 전원 스위치를 (ON)이도록 한다.
 상태 표시(INDICATION BOX)의 코드 LAMP가 점멸 상태라면 POWER FAILURE를 먼저 사정시킴.)

나. 유압수밀문 작동에 유압 수동조작 손잡이에 의해 유압수동으로 제어 시킨다.

다. 비상 긴급 차은, 유압 규준원의 손잡이에 비상시에는 국악기의 국악편 작업법에 의해 유압수밀문을 개폐시킨다. 이 작업기는 적어도 3방향(상향-평행-하향)이 가능한 용장이다.

라. 전원 셧다운, 국악기의 국악 수동 스위치인 경우 비상 수동 컨트롤에서 수밀문을 개폐시킨다. 유압수의 손잡이를 쥘 때는 방향대로 조작할 수 수동 컨트롤의 방향을 수밀문에 표시된 방향대로만 해도 작동 시키면 된다.

미. 작 유압수밀문 제어판에 위치 표시기(제어판)는 원천 차단 경고, 국악기의 입작 준비 경고, 원시 제어 경고 (작동전 5-10초 경고) 알림, 열릴 표시등(단일) : 녹색, 열릴(적색)이 부착되어 있다.

마. 문이 작동중일때 유압수밀문 상부에 부착된 경고 정지등이 작동되며, 문이 동작이 완료되면 작동이 멈춘다.

2. 원격제어에 의한 유압수밀문의 작동법

가. 선박의 필수등 비상시에는 항태신호(M/D)와 중앙 작동 제어실에서 원격으로 문을 폐쇄(CLOSE)시킬 수 있다.
 중앙 작동 제어실의 원격 스위치를 수동모형(LOCAL CONTROL)이나 자동모형(MASTER MODE)으로 전환시킬 수 있다.
 비상 선박 스위치를 수동모형(LOCAL CONTROL) 상태로 만들어 하며, 비상시나 시정시 자동모형(MASTER MODE) 상태로 전환시킨다.

나. 원격 스위치를 "자동모형(MASTER MODE)"로 전환하면 문이 열려 있을 경우 5-10초 동안 정지후 작동으로 개폐된다.

다. 본선의 항태등에는 항상 유압수밀문은 폐쇄되어야 하며, 작동 표시기 및 경고 장치의 작동 여부를 주시도 점검하여야 한다.

3. 비상 핸드펌프에 의한 유압수밀문의 작동법 (UPPER DECK)

가. 핸드펌프의 정보를 숙고 한다.
 나. 핸드펌프에 작동 방향을 연결한다.
 다. 도어가 완전히 닫히게 까지 핸들을 위/아래로 작동한다.

*** 문이 작동중에는 열릴 표시등(적색) 점멸(켜졌다, 꺼졌다) 되어진다.***

1.3 Move the operating lever on the watertight door to the open direction.



1.4 Wait for the watertight door to open completely.



1.5 When the watertight door is fully open, continue to hold the operating lever in the open position and use your other hand to hold the opposite operating lever in the open direction to cross over.



- 1.6** After fully crossing to the other side of the watertight door, operate the operating lever in the closed direction.



- 1.7** Hold the operating lever in the closed direction until the watertight door is completely closed.

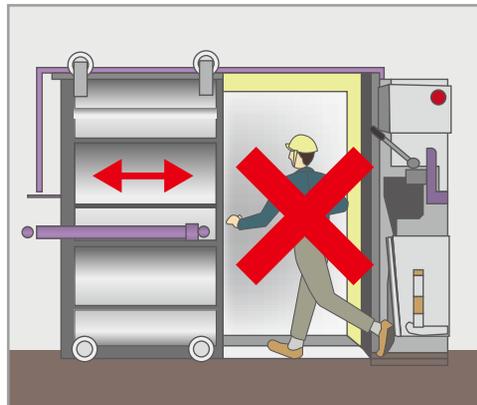


- 1.8** Once the watertight door is fully closed, check the position of the operating lever, the watertight door closure, and any foreign objects entrapment.

2 Precautions for watertight door passage and operation

2.1 Prohibit passage during watertight door operation

- An accident from watertight doors is caused by passing through watertight doors when they are operating.
- Under no circumstances should you pass through a watertight door when it is operating.
***The watertight door is designed to keep closing under strong pressure, which can result in serious injury or loss of life if the body gets stuck.**



2.2 Be careful when carrying or inspecting items

- When you want to transport goods or move equipment, a person who operates the watertight door must accompany you to help you pass safely .
- When inspecting and maintaining the operation status of the watertight door, it should work in groups of two, and notify the bridge of the work.
- During inspection or maintenance, care must be taken to prevent the watertight door from moving unintentionally.



2.3 Bridge Control Precautions

- Normally, the master mode switch of the central operation panel is placed in the 'local control' position.

If the master mode switch of the central operation panel is set to 'closed' position, it should be noted that placing the operating lever in the neutral position during watertight door operation will cause the automatic closure of the door.



2.4 Avoid entrapment accidents when closing watertight doors

- Watertight doors are generally opened and closed with a force of 2 tons for hydraulic and 1 ton for electricity, so if you are trapped in a watertight door while it is closing, you can lose significant injury or life.
Therefore, you must never pass through the watertight door while it is closing.
- In the event of an entrapment accident, if you can reach the operation lever, immediately operate it to open it and attempt to escape.

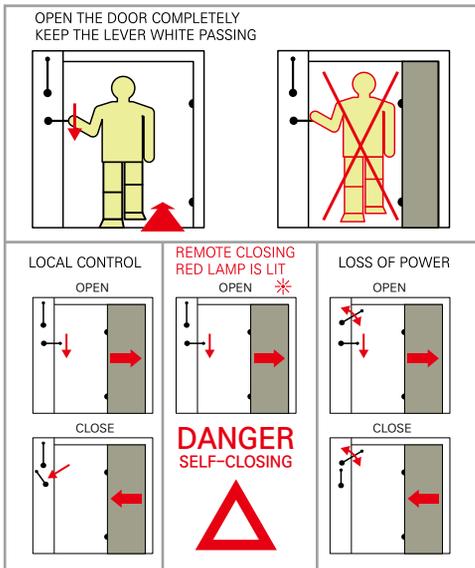
2.5 Strongly prohibited to adjust the rate of open/closure

- According to the International Convention , the rate of closure of the watertight door under power shall in no case be less than 20 seconds or more than 40 seconds with the ship in the upright position. Therefore, It is strictly prohibited to change the setting of the hydraulic flow regulation valve to adjust the rate of closure arbitrarily.
- The flow regulation valve may be set manually with permission, only if the rate is outside of the range prescribed in the convention.



2.6 Operating instructions should be posted and familiarized with.

- The operation instructions for the watertight door should be posted near the watertight door.
- Crew members must be familiar with operation instructions and safety rules for the operation of watertight doors.



2.7 Watch out for falls through watertight doors

- Pass with caution to avoid tripping over the watertight door substructure.
- Be aware that hydraulic watertight doors can cause slipping and falling due to oil leaks around them.
- Organize and tidy the area around the watertight door and keep it clean at all times.



2.8 No modifications for work or mobility

- Securing pins, rings, or wedges should not be installed arbitrarily to hold the watertight door open or closed.
- Do not arbitrarily change the state of the watertight door operating lever.

2.9 Other precautions

- The watertight door is an important facility for securing reserve buoyancy in the event of damage to the hull and flooding, so it should remain closed at all times during navigation.
- It shall not be operated in a state in which the function of the watertight door is impaired (closed at all times or opened at all times after the power is cut off, maintaining an open state during navigation, etc.).
- If there is excessive hull movement due to the rough sea, etc., the operation of the watertight door is prohibited.

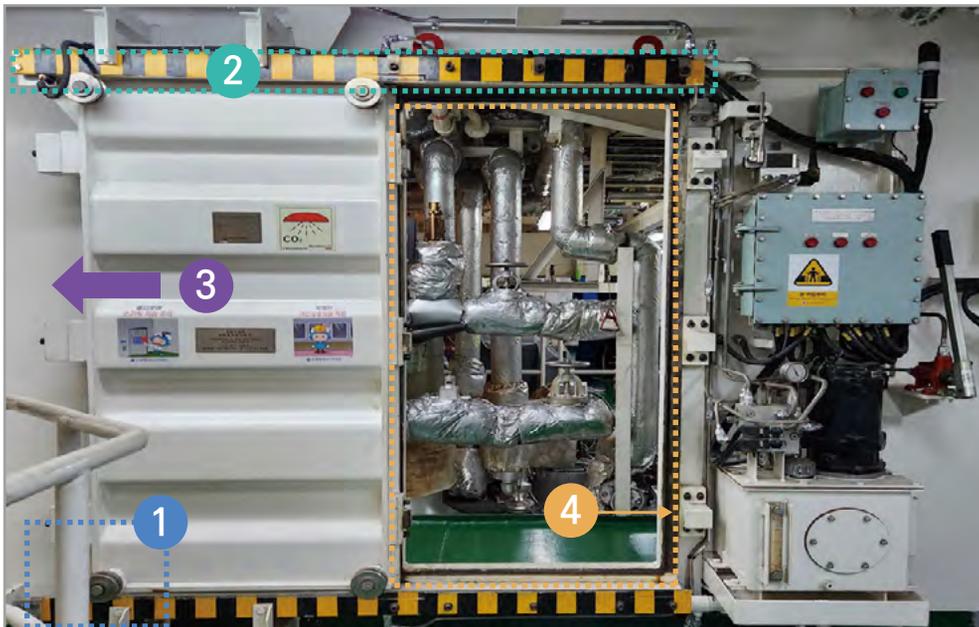
Chapter 3

Maintenance and inspection of watertight doors

1 Maintenance of watertight doors

1.1 Rubber Seal

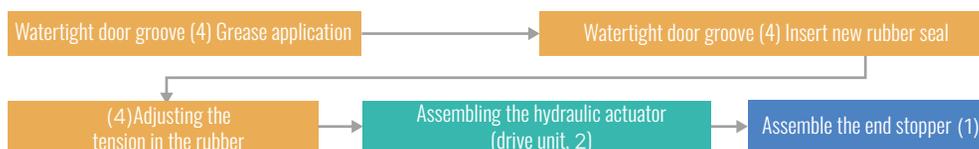
- If a defect is found in the rubber seal as a result of routine checks or inspections, it should be renewed immediately according to the following procedure.



Rubber seal removal procedure

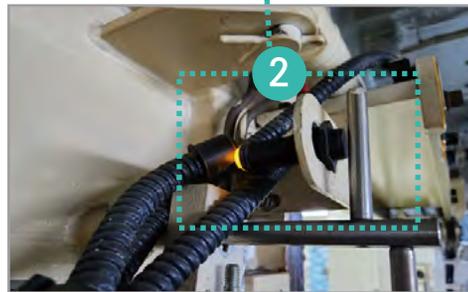
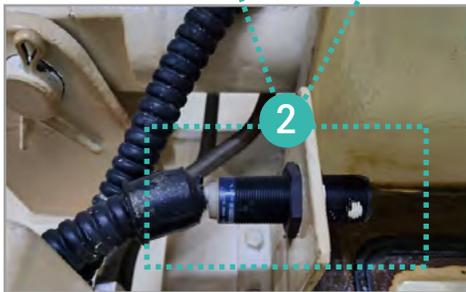


Rubber seal transfer procedure

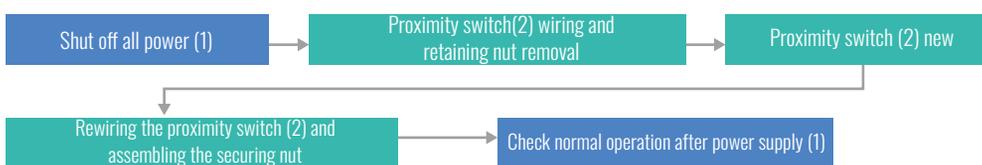


1.2 Proximity Switch

- The proximity switch is a component that provides basic signals used for opening and closing watertight doors and for bells, buzzers, etc. to bridge and local control.
- Periodic operation checks of proximity switches are required and, in case of malfunction, maintenance shall be performed according to the procedure below.



Proximity switch replacement procedure



2 Watertight Door Checklist

2.1 Hydraulic Watertight Door Checklist

No.	Check item	Inspection the result
1	Rubber seal visual inspection	<input type="checkbox"/> Good <input type="checkbox"/> Bad
2	Functionality operation handle	<input type="checkbox"/> Good <input type="checkbox"/> Bad
3	Watertight door Closing time $20 < \text{time} < 40$	<input type="checkbox"/> Good <input type="checkbox"/> Bad
4	Watertight door position indicator in the control station	<input type="checkbox"/> Good <input type="checkbox"/> Bad
5	Hydraulic Pump pressure of start & stop	<input type="checkbox"/> Good <input type="checkbox"/> Bad
6	Loss of power alarm at bridge in central control panel	<input type="checkbox"/> Good <input type="checkbox"/> Bad
7	Operation of hydraulic accumulator 3 strokes, closing/opening/closing	<input type="checkbox"/> Good <input type="checkbox"/> Bad
8	Manual hand pump/emergency hand pump	<input type="checkbox"/> Good <input type="checkbox"/> Bad
9	Low oil level of hyd. oil tank	<input type="checkbox"/> Good <input type="checkbox"/> Bad
10	Alarm before door close	<input type="checkbox"/> Good <input type="checkbox"/> Bad
Remark		

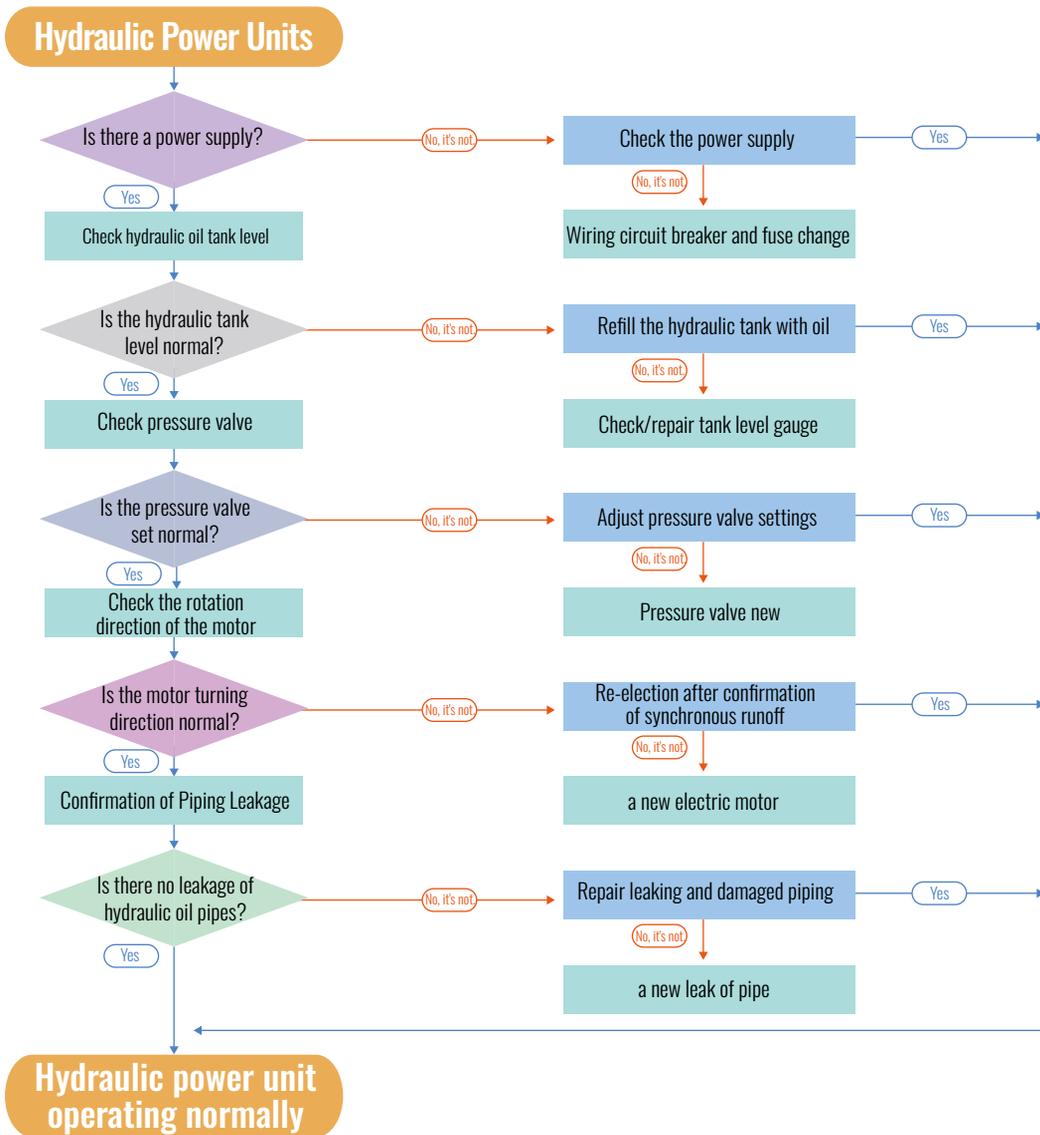
2.2 Electric watertight door checklist

No.	Check item	Inspection the result
1	Rubber seal visual inspection	<input type="checkbox"/> Good <input type="checkbox"/> Bad
2	Functionality operation handle & locker	<input type="checkbox"/> Good <input type="checkbox"/> Bad
3	Watertight door closing time $20 < \text{time} < 40$	<input type="checkbox"/> Good <input type="checkbox"/> Bad
4	Position indication at control station	<input type="checkbox"/> Good <input type="checkbox"/> Bad
5	Electric motor visual inspection	<input type="checkbox"/> Good <input type="checkbox"/> Bad
6	Loss of power alarm at bridge central panel	<input type="checkbox"/> Good <input type="checkbox"/> Bad
7	Operation of Emergency Battery 3 strokes (Closed/Open/Closed)	<input type="checkbox"/> Good <input type="checkbox"/> Bad
8	Manual hand generator/ Emergency hand generator	<input type="checkbox"/> Good <input type="checkbox"/> Bad
9	Control cabinet power status (Bridge control/Local control/Emergency control)	<input type="checkbox"/> Good <input type="checkbox"/> Bad
10	Alarm before door close	<input type="checkbox"/> Good <input type="checkbox"/> Bad
Remark		

3 Diagnosis and resolution of watertight door failures

3.1 Hydraulic Power Units

- Check whether the hydraulic pump of the hydraulic power unit is operated and whether pressure is generated and take action according to the flow chart below.



3.2 Watertight doors

- Check the operation status of the watertight door with bridge control, local control, and emergency remote control and take action according to the flow chart below.



Appendix 1

Watertight Door Accident Case

1 Accident Case vessel "I"

1.1 Accident overview

- A operator was found stuck in a watertight door and deceased during a voyage to the Indian Ocean in July 2022.

1.2 Accident Cause

- It is believed that the engineer involved in the accident tried to pass through the moving watertight door without implementing basic safety procedures.



The door involved with the accident
(lever in closed position and set securing pin)



The door involved with the accident
(lever open position)

*The operation lever of the watertight door where the accident occurred had a securing pin installed arbitrarily.

1.3 Recommendations

- The operator of the ship is recommended to set procedures for systematic management of the watertight doors.
- The operator of the ship is recommended to develop systems for periodic inspections and maintenance of the watertight doors, and to strengthen shipboard drills and training for the safe operation of the watertight doors.

2 Accident Case vessel "E"

2.1 Accident overview

- In November 2008, a ship sailing on the Belgian and British routes was found with a crew trapped in the watertight door of the engine room, causing serious injury.



▶ The watertight door involved with the accident

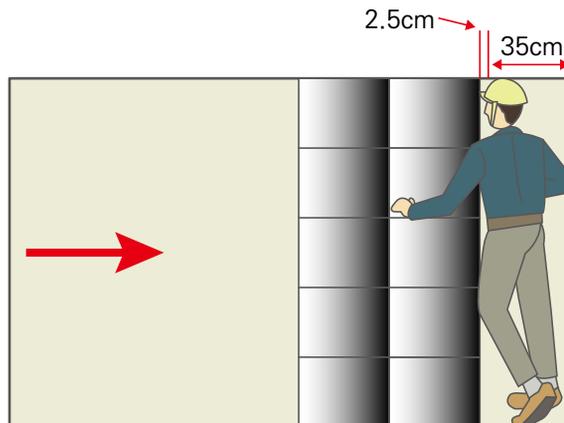
2.2 Accident Cause

- VDR records show that the watertight door installed in vessel E is set to close at 7 seconds, up to 3 times faster than the 20 to 40 seconds required by SOLAS Convention.

Door ID	Opening [seconds]	Closing [seconds]	Total [seconds]
WTD1	7	7	14
WTD2	12	8	20
WTD3	8	7	15

- ▶ The rate of closure of watertight doors installed in vessel E measured after accident
- At the time of the accident, the master mode switch on the bridge central operating panel was set to 'closed' position in preparation for the ship survey.

- When the master mode switch set to 'closed' position, the watertight door closes automatically if the local operating lever is not held open continuously. (in normal condition -the master mode switch is set to 'local control'- the open/close operation of the door stops)
- The crew member tried to pass through the door with partial open and without holding the operating lever as usual, but the door was closed immediately, causing the accident.



Door open 50%

- ▶ Crew member passing through the watertight door at the time of the accident

- When the watertight door was opened with a width of 35 cm for the body to pass through, it only takes 0.3 seconds for the door to close, which is not enough time to pass through the partially opened door.

2.3 Conclusion

- At the time of the accident, the mastermode switch on the bridge central operating panel was set to 'closed' position, and the watertight door was immediately closed when the crew releases the operating handle to pass through the partially opened door.
- The crew should have waited until the watertight door was fully open before passing through but was injured when he impatiently attempted to pass through when it was not fully open and was stuck in the watertight door.