



Anti Rolling Gyro

ARG250T OPERATION INSTRUCTIONS

Model : MSM-25000T-A1



Preface

This operation instructions summarized important information for proper operation of Anti Rolling Gyro (**ARG**). Please be sure to read this manual before operation.

Please be sure to submit this manual to customers who operate the **ARG**.

Important Notice

■ Purpose and Application of Use

- The **ARG** suppresses rolling motion of the ship.
- The **ARG** applies a principle that the Gyro torque (force) is generated by inclination of the flywheel rotation at high speed.

■ General Information

- In order to safely operate the **ARG**
 - (a) Only the repairmen, who have received the specified training about the **ARG**, are permitted to perform maintenance and inspection other than items mentioned in this manual.
 - (b) Before operation of the **ARG**, carefully read this manual of the **ARG** for comprehending the details. If starting the work with insufficient knowledge, it may cause the **ARG** failure or an accident resulting in injury or death.
 - (c) Do not disassemble and modify the **ARG** by yourself.
 - If the **ARG** is disassembled or modified by the customer,
 - It may cause a decrease in the **ARG** performance.
 - It may endanger human life.
 - It may cause a health problem.
 - It may cause damage to the **ARG** or ship.
 - (d) Please contact the Sales Agent for installation or removal of the **ARG**. If installation or removal of the **ARG** is performed by the customer, it may result in injury and damage to the **ARG** and ship.
- Please observe the applicable governmental and local laws and regulations.
- Mitsubishi Heavy Industries, Ltd. is not responsible for any damages and losses that happened to the customer except for the first customer who purchased from the Sales Agent.

■ General Information (continue)

- Please observe the governmental and local regulations for exportation of the **ARG**.
- Please observe the governmental and local regulations for disposal of the **ARG**.

■ Important Information for Operation Safety

- The most important purpose of safety measures is to prevent the persons from an accident resulting in injury or death as well as to protect the **ARG** and ship from avoidable trouble.
- For preventing injury/death in an accident and the **ARG** from damage, follow the cautions, rules, and instructions described in this manual giving the top priority to safety. If ignored,
 - a) It may endanger human life.
 - b) It may cause a health problem.
 - c) It may cause damage to the **ARG** or ship.
- Mitsubishi Heavy Industries, Ltd. cannot foresee all possible danger existing in the **ARG**, resulting from human error, and in the environment where the **ARG** is used. There are many "Musts", "Can'ts" and "Don'ts", and it is impossible to mention all in this manual or warning labels. Therefore, general safety measures must be taken in addition to the instructions described in this manual.
- Mitsubishi Heavy Industries, Ltd. is not responsible for any damage and hindrance resulting from customer's carelessness or lack of required attention to the specified rules shown in this manual.

■ About Operation Instructions

- This operation instructions are written for native readers of English. When this **ARG** is handled by non-English-speaking people, give the people fully training on safety.
- The copyright of this manual is held and reserved by Mitsubishi Heavy Industries, Ltd. No drawing and no technical description in this manual regardless of partial or whole may be published, reproduced, copied, photographed, translated, or transcribed into electronic medium without written permission of MHI in advance.
- The **ARG** may differ from the pictures and drawings shown in this manual.
- The contents of this manual may be changed without prior notice.
- Carefully keep this manual in a certain place so that anybody can read it as the need arises.
- If there are any questions or doubts, please contact the Sales Agent. (“Contact” (last page))

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1. For your Safety










1.1 Warning description

■ Description of Labels

“Warning labels” and “Warning descriptions” in this manual warn expected dangerous situation that may occur during operation. If they are ignored, serious injuries or accidents corresponding to the respective warning sign may result. In extreme case, there is also a possibility of death, damage to the **ARG** or ship, and environmental fracture.

Warnings	Meanings of Warnings
IMPORTANT	Indicates “IMPORTANT” subjects that are observed in handling the ARG . If the ARG is handled with ignoring this indication, it could result in death or serious accident.
 DANGER	Indicates a dangerous situation. If ignored, it could result in death, serious injury, serious property damage or environmental damage.
 CAUTION	Indicates a dangerous situation. If ignored, it could result in minor injury, property damage or environmental damage.

■ Meanings of the symbols

Symbols	Meanings	Examples
 Prohibition sign	“  ” indicates prohibition. Detail is shown in the inside of the symbol, or shown by illustration or sentence near the symbol. The right illustration means “ DO NOT DISASSEMBLE ”.	 (DO NOT DISASSEMBLE)
 Caution sign	“  ” indicates danger or caution. Detail is shown in the inside of the symbol, or shown by illustration or sentence near the symbol. The right illustration means “ DANGER OF ELECTRIC SHOCK ”.	 (DANGER OF ELECTRIC SHOCK)
 Direction sign	“  ” indicates mandatory contents. Detail is shown by illustration, or sentence near the symbol or inside the symbol.	 (General direction)

Anti Rolling Gyro Model : MSM-2500T-A1

1.2 Warning labels

Do not disassemble.

	危険 DANGER 分解禁止 分解、改造や機能部品の流用はしないで下さい。 DO NOT DISASSEMBLE Do not disassemble or modify the ARG or use a substitute for any of its parts.
--	---

Do not place objects.

	注意 CAUTION 積載禁止 ARG 本体カバーの上に物を載せたり、人が乗ったり、腰掛けたりしないで下さい。 DO NOT PLACE OBJECTS Do not place objects, sit on or step on the ARG cover.
--	---

Danger of electric shock.

	危険 DANGER 感電危険 コネクタを外さないで下さい。 DANGER OF ELECTRIC SHOCK Do not remove electrical connector.
--	--

Hot Surface (Both covers)

	注意 CAUTION 高温注意 ARG 本体(特にダンパ)は高温になるので手を触れないで下さい。 HOT SURFACE Do not touch ARG (e.g. damper) during operation.
--	---

Hot surface (Both dampers)

	注意 CAUTION 高温注意 ARG 本体(特にダンパ)は高温になるので手を触れないで下さい。 HOT SURFACE Do not touch ARG (e.g. damper) during operation.
--	---

Do not close.

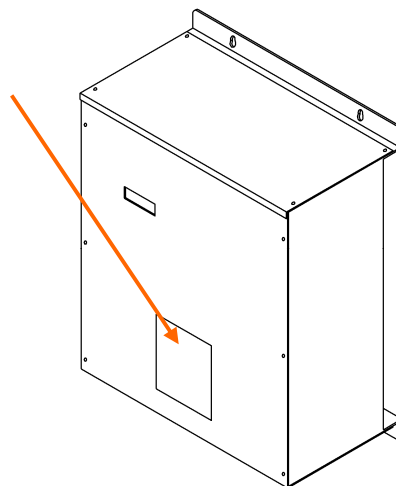
	危険 DANGER 閉塞禁止 ARG 本体の通風口をふさがないで下さい。 DO NOT CLOSE Do not close the blowholes of the ARG unit.
--	---

Connector

ARG unit

Danger of electric shock.
Do not disassemble.
Do not close.






	危険 DANGER 感電危険 電気配線作業は電気工事の有資格者が行って下さい。 DANGER OF ELECTRIC SHOCK Wiring must be performed by qualified personnel.
	分解禁止 モーターライバのふたを開けないで下さい。 DO NOT DISASSEMBLE Do not open the Motor Driver's lid.
	閉塞禁止 モーターライバの通風口をふさがないで下さい。 DO NOT CLOSE Do not close the blowholes of the Motor Driver.



Motor Driver

1.3 Precautions of Operation.

Observe the following when operating.

IMPORTANT	
	<p>General Precautions Be sure to read this manual and understand the contents.</p>
	<p>Operation Environment</p> <ul style="list-style-type: none">• Do not operate under stormy weather and excessively high wave (2.0m) conditions.• The ARG is designed to improve the comfort of you and passengers on a ship. The ARG is not the equipment which enables a ship to sail under stormy weather and excessively high wave (2.0m) conditions.• Do not quick-turn repeatedly during the ARG operation.
	<p>Maintenance</p> <ul style="list-style-type: none">• Perform the pre-operational inspection.• Have the periodic inspection performed by the Sales Agent every two years.• Contact the Sales Agent for wiring of the ARG.
	<p>Operational problems If abnormalities occur during operation, immediately turn off switch to shut down the ARG. Contact the Sales Agent. ("Contact" (last page))</p>
	<p>Installation The model, numbers of the ARG unit and the Motor Driver are decided for each ship. Never divert the ARG unit and the Motor Driver to other ships.</p>
	<p>Disposal Observe the governmental and local regulations for disposal of the ARG.</p>

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2. Configurations

2.1 **ARG** unit

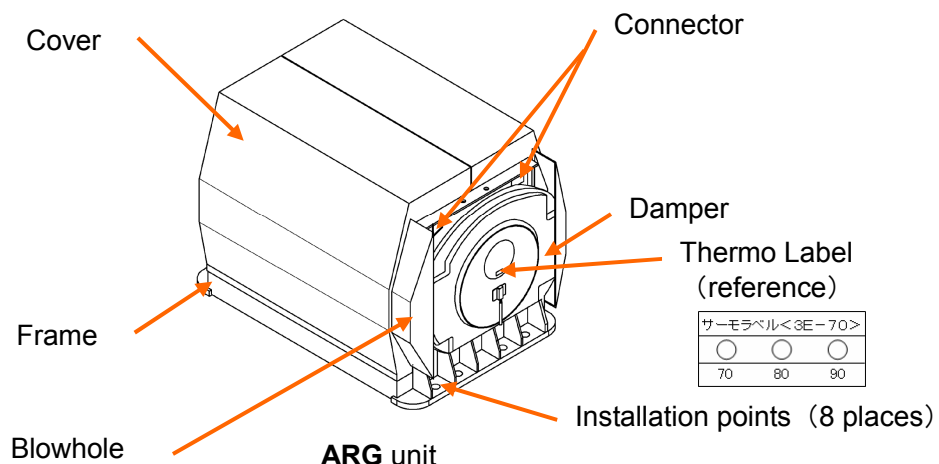
Table 2-1 **ARG** unit (1EA)

Item	Specifications
Name	ARG250T
Model	MSM-25000T-A1
Dimensions	1020mm(width) x 720mm(depth) x 700mm(height) 40.2 inches(width) x 28.3 inches(depth) x 27.6 inches(height)
Weight	Approx. 700kg / 1543 lbs
Power supply	Supplied exclusive Motor Driver(MAA-2000/4000A-A200) (Single-phase 220 to 240VAC 50/60Hz / Three-phase 200 to 240VAC 50/60Hz)
Ambient temperature	-10 to 40°C
Power consumption *1)	Single-phase : Approx. 4.8kW(Max) 3.5kW(Max) (Steady-state) Three-phase : Approx. 4.3kW(Max) 3.0kW(Max) (Steady-state)
Angular momentum	Approx. 5000Nms
Rotational speed	Approx. 3750rpm
Noise *2)	80dBA maximum
Vibration *2)	1 m/s ² maximum
Performance	<ul style="list-style-type: none"> • The ARG suppresses rolling motion of the ship. • The ARG applies a principle that the Gyro torque (force) is generated by inclination of the flywheel rotating at high speed. • The ARG stops automatically in abnormal circumstances (excessive load, abnormal temperature, etc.).
Others	Start up duration to the rated speed: Approx. 40 minutes To stop the operation completely from the steady state: Approx. 60 minutes.

*1) Power consumption varies with the customer generator.

*2) Measurement as per MHI's specification.

The measurements data depend on measurements conditions (installation place, measurements method, etc.).

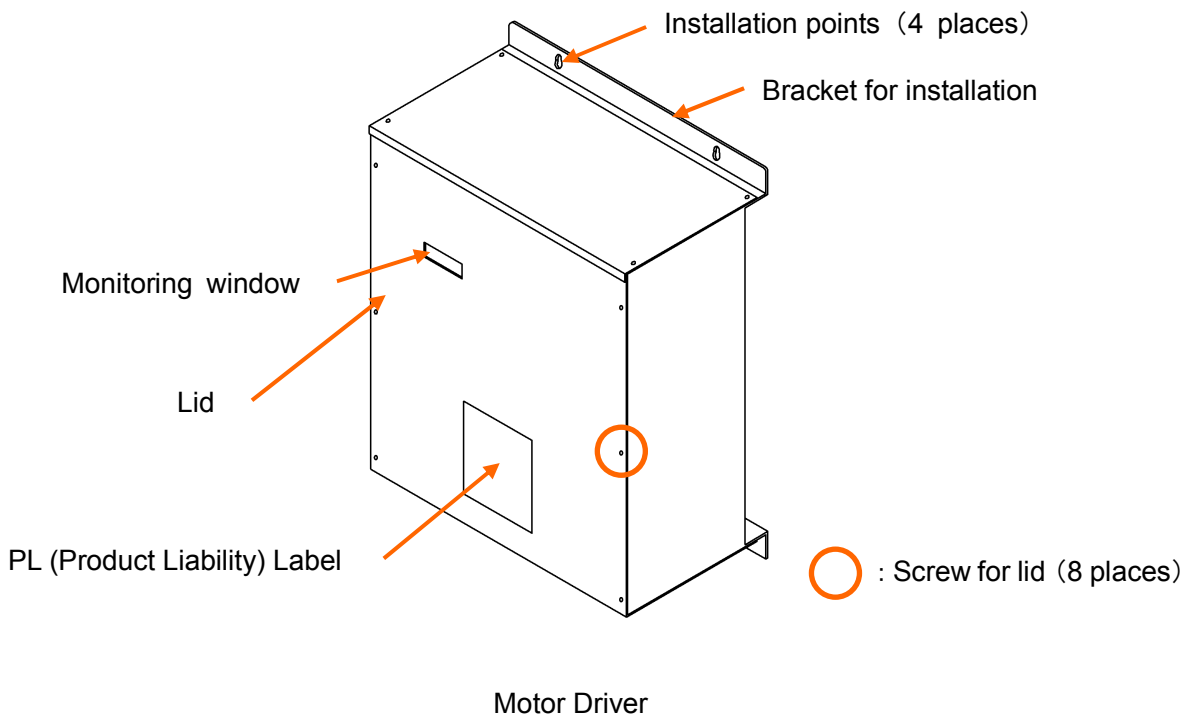


2.2 Motor Driver

Table 2-2 Motor Driver (1EA)

Item	Specifications
Model	MAA-2000/4000A-A200
Dimensions	350mm(width) x 189mm(depth) x 400mm(height) 13.8 inches(width) x 7.4 inches(depth) x 15.7 inches(height)
Weight	Approx. 15kg / 33.1 lbs
Control method	Inverter control
Ambient temperature	-10 to 40°C
Humidity	5 to 95% (with no condensation)
Power supply *3)	Single-phase 220 to 240VAC 50/60Hz / Three-phase 200 to 240VAC 50/60Hz
Options (outer connecting terminal) (Please prepare by customer)	<ul style="list-style-type: none"> ① Remote switch: connect to the Motor Driver to remote control the ARG operation (ON/OFF). The ARG can be switched on /off by this remote switch. ② Start check lamp: connect to the Motor Driver to make sure the ARG is in operation or not. ③ Rotation rate check lamp: connect to the Motor Driver to make sure the ARG had reached the rated rotational speed (steady state) or not.
Others	The ARG 's operating condition is checked by Monitoring window.

*3) The Motor Driver is able to use both single-phase and three-phase. Please choose appropriate power input as needed.



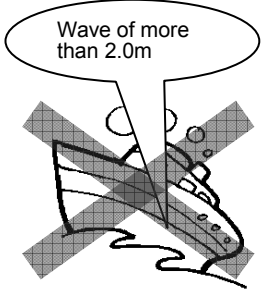
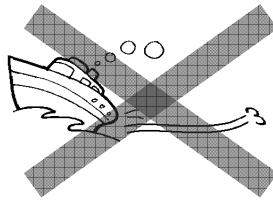
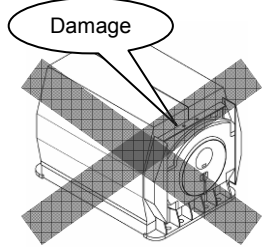


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3. Check before operation

Please inspect the items in Table 3-1.

Please make sure of “Warning” and “Caution” in this manual.

 DANGER	
 <p>Do not operate under stormy weather and excessively high wave (2.0m) conditions.</p> <p>The ARG is designed to improve the comfort of you and passengers on a ship. Do not operate under stormy weather and excessively high wave (2.0m) conditions.</p> <p>Doing so could result in damage to the ship, or malfunction of the ARG.</p>	
<p>Do not quick-turn repeatedly during the ARG operation.</p> <p>The ARG is intended to suppress rolling of the ship at anchoring or trolling. Repeating quick-turn (6 turns a minute) could change a sense of control of ship.</p> <p>Doing so could result in damage to the ship, malfunction of the ARG or accident.</p>	
<p>Do not use damaged parts.</p> <p>Do not use damaged parts.</p> <p>Doing so could result in injury or malfunction. Please contact the Sales Agent whose address is shown at the end of this manual.</p>	



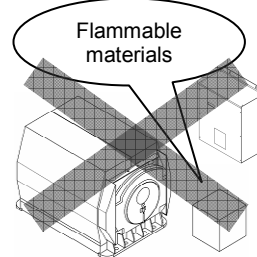
DANGER



Do not place flammable materials near the ARG.

When the **ARG** is in operation, it is heated. Do not place flammable materials or heat-sensitive items (which are deformed or damaged e.g. by heat) near the **ARG**.

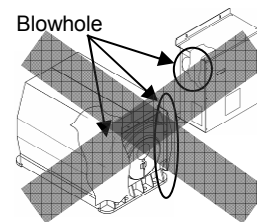
Doing so could result in malfunction or fire.



Do not close blowholes of the ARG.

Do not close blowholes of the **ARG**.

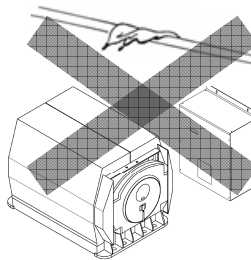
Closing blowholes will heat the inside of the **ARG**. Closing a blowhole of the **ARG** could result in malfunction or fire.



Never operate the ARG when it is exposed to the seawater / rain.

The **ARG** is not waterproof. Never operate the **ARG** when it is exposed to the seawater / rain.

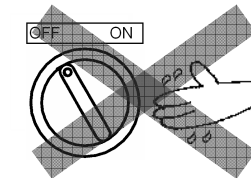
Doing so could result in electric shock or malfunction.



Do not operate switches with wet hands.

Do not operate switches with wet hands.

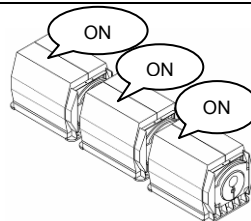
Doing so could result in electric shock.




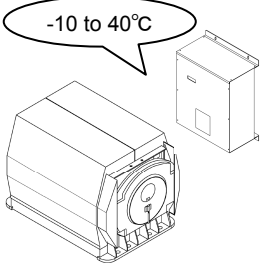
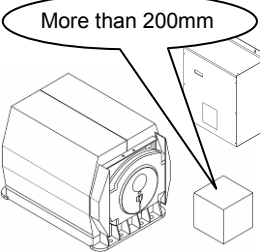
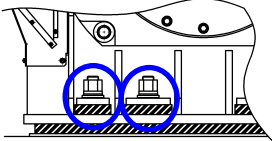
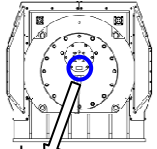
Use all installed ARG units.

Use all installed **ARG** units.

Using only a few of them could lead to excessive load and it could result in malfunction.



 **DANGER**

	<p>Use the ARG at the specified temperature.</p> <p>Use the ARG in the location that ambient temperature range is from -10°C to 40°C considering that the ARG generates heat. If the temperature is expected to be 40 °C or higher, ventilate to cool them down.</p> <p>Not doing so could result in malfunction or fire.</p>										
	<p>Keep a space of 200mm (7.9 inches) around the ARG.</p> <p>Since the ARG takes in outside air to ventilate, the space of 200mm (7.9 inches) is required around the ARG (ARG unit and Motor Driver) to provide enough ventilation.</p>										
	<p>Make sure that there is no vertical gap in the anti-vibration rubber, plate or washer.</p> <p>If your ARG uses the anti-vibration rubber, make sure that there is no vertical gap in the anti-vibration rubber, plate or washer.</p> <p>Not doing so could result in damage to the ARG or ship.</p>										
	<p>Check the discoloration of the thermo label attached to damper.</p> <p>If the 80 or 90 of the thermo label discolors, contact the Sales Agent.</p> <p>Not doing so could result in damage to the ship, malfunction of the ARG or injury.</p>	 <p style="margin-top: 5px;">Thermo label</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td colspan="3" style="text-align: center;">サーモラベル<3E-70></td> </tr> <tr> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> <tr> <td style="text-align: center;">70</td> <td style="text-align: center;">80</td> <td style="text-align: center;">90</td> </tr> </table>	サーモラベル<3E-70>			○	○	○	70	80	90
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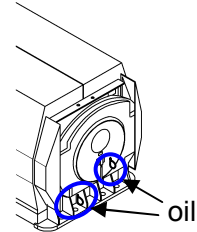
DANGER



Do not use the ARG, if there is any oil leakage from the damper.

If there is any oil leakage from the damper, contact the Sales Agent.

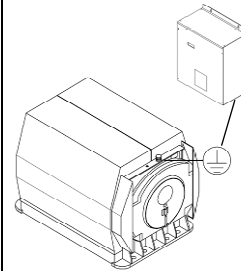
Not doing so could result in damage to the ship, malfunction of the **ARG** or injury.



Connect the ship's ground lead and the ARG unit's ground lead.

Connect the ground lead of each Motor Driver to the ground connection point in the ship. Ground the **ARG** unit using one of the bolts that secure the unit to the ship.

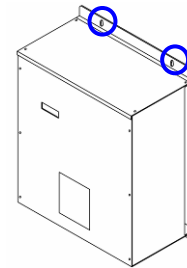
Not doing so could result in electric shock.



Check installation screws of the Motor Driver for looseness every three months.

Re-tighten the four installation screws after operating the **ARG** at sea for a month. After that, make sure that screws are not loosened every three months.

Not doing so could result in damage to the ship, malfunction or injury.



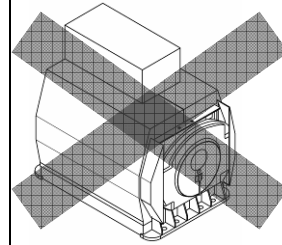


CAUTION



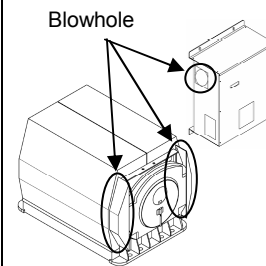
Do not place objects, sit on or step on the ARG cover.

The **ARG** cover is not made of strengthened material.
If you place objects, sit on or step on the **ARG** cover, it could result in damage.
During operation, the **ARG** components inside the cover are rotating at high speed.
Therefore, the broken **ARG** cover could cause injury or malfunction.



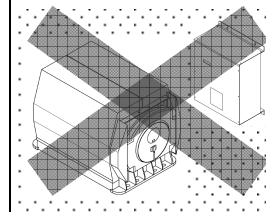
Do not allow extraneous materials and dust to enter through the blowholes of the ARG.

The **ARG** cover has blowholes for inside cooling.
Do not allow extraneous materials and dust to enter through the blowholes of the **ARG**.
Doing so could result in malfunction.



Do not use the ARG in locations exposed to dust.

The **ARG** cover has blowholes for inside cooling.
Do not use the **ARG** in locations exposed to dust.
Doing so could result in malfunction.





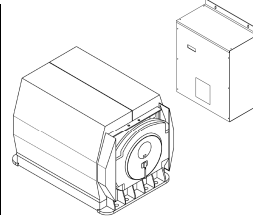
CAUTION



Be sure to use an exclusive Motor Driver for the ARG.

Be sure to use the Motor Driver supplied by MHI.

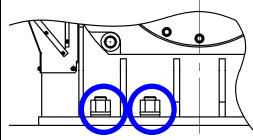
Not doing so could result in malfunction.



Check bolts and nuts (eight installation bolts and nuts) for looseness every three months.

Re-tighten the eight installation bolts or nuts after operating the **ARG** at sea for a month. After that, make sure that bolts or nuts are not loosened every three months. If you found loosening bolts or nuts, contact the Sales Agent.

Not doing so could result in malfunction.



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Model : MSM-25000T-A1

(1) Pre-operational inspection

Please perform pre-operational inspection shown in table 3-1.

Table 3-1 **ARG** Pre-operational inspection List (1 / 3)

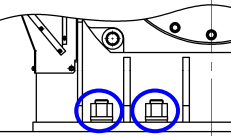
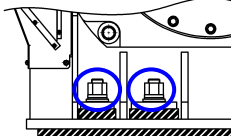
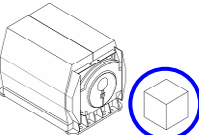
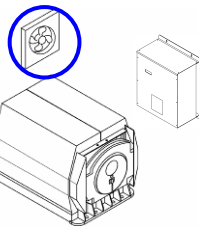
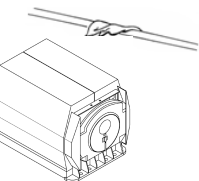
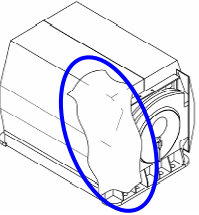
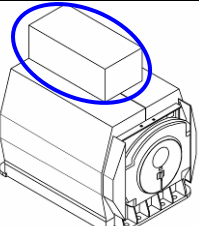
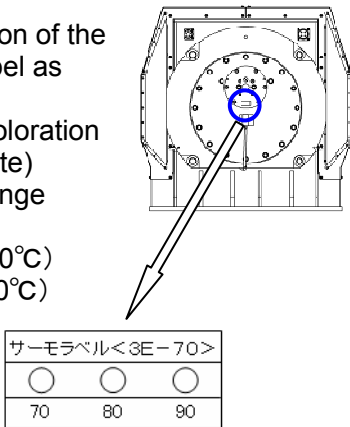
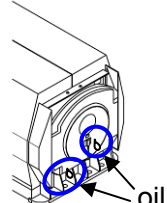
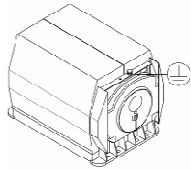
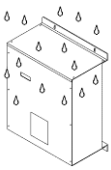
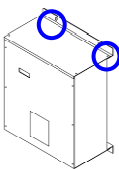
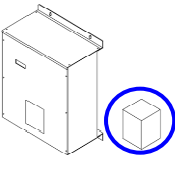
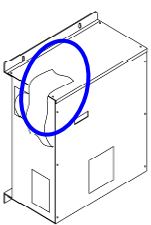
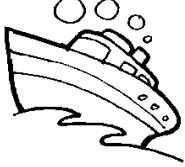
No	Inspection Area	Inspection Item	Priority	Result	Countermeasures
1	ARG installation	<p>There must be no looseness in the installation bolts, nuts (eight bolts and nuts) and spring washer.</p>  <p>Without anti-vibration rubber</p>  <p>With anti-vibration rubber</p>	○		<p>Re-tighten bolts or nuts.</p> <p>〔 Tighten Torque 〕</p> <p>Without anti-vibration rubber: 300N·m</p> <p>With anti-vibration rubber: 130N·m</p>
2	ARG unit	<p>There must be no dust, combustibles/flammable materials or seawater/water near the ARG unit.</p> 	◎		<p>Improve installation environment.</p>
3		<p>There must be enough ventilation provided to cool the ARG down.</p> 	○		
4		<p>There must be no trace of being exposed to seawater / water on the ARG unit.</p> 	◎		
5		<p>The blowhole of the ARG unit must not be closed.</p> 	○		<p>Improve the ARG unit to solve the problems.</p>
6		<p>There must be no objects on the ARG cover.</p> 	○		

Table 3-1 ARG Pre-operational inspection List (2 / 3)

No	Inspection Area	Inspection Item	Priority	Result	Countermeasures
7	ARG unit	Check the discoloration of the thermo label as follows. ①No discoloration (all white) ②Red orange (70°C) ③Blue (80°C) ④Red (90°C) 	◎		①② : No problem ③④ : Problem Contact the Sales Agent. [Change the Damper]
		There must be no oil leakage from the Damper. 	◎		Contact the Sales Agent. [Change the Damper.]
		There must be no looseness in the grounding bolt. 	○		Re-tighten grounding bolt. [Tighten Torque 65N・m]
10	Motor Driver	There must be no trace of being exposed to seawater / water on the Motor Driver. 	◎		Contact the Sales Agent. [Do not operate the ARG.]
11		There must be no looseness in the installation screws (four screws). 	○		Re-tighten screws.
12		There must be no dust, combustible /flammable materials or seawater/water near the Motor Driver. 	◎		Improve installation environment.
13		The blowhole of the Motor Driver must not be closed. 	○		Improve the Motor Driver to solve the problem.



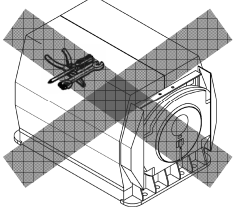
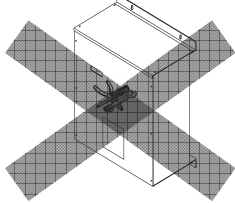

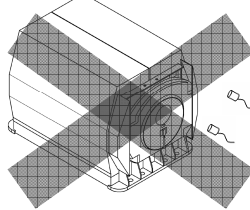
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Table 3-1 **ARG** Pre-operational inspection List (3 / 3)

No	Inspection Area	Inspection Item	Priority	Result	Countermeasures
14	Others	Check sea area that the ARG is operated. • Do not operate under stormy weather. • Do not operate when wave is higher than 2.0m. 	◎		—

4. Operating the ARG

Please operate the **ARG** according to the procedure below.
Please make sure of “**Warning**” and “**Caution**” in this manual.

 DANGER		
	<p>Do not remove the ARG cover.</p> <p>During operation, the inner parts of the ARG are rotating at high speed. Do not remove the ARG cover. Doing so could result in injury.</p>	
	<p>Do not open the Motor Driver's lid.</p> <p>Do not open the Motor Driver's lid. And do not touch the inside of the Motor Driver. Doing so could result in electric shock, malfunction or fire.</p>	
	<p>Do not remove the ARG connector during operation.</p> <p>Do not remove the ARG connector during operation. Doing so could result in electric shock.</p>	



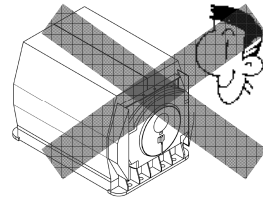
CAUTION



Do not approach the ARG unit during operation.

Do not approach the **ARG** unit during operation.

Doing so could result in injury.

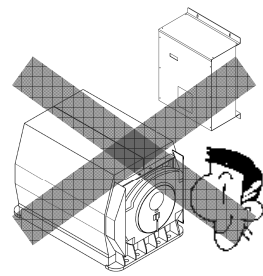


Do not approach the ARG unit and the Motor Driver until the ARG completely stops.

It takes approximately 1 hour until the **ARG** completely stops after the remote switch has been turned off.

Do not approach the **ARG** unit and the Motor Driver until the **ARG** completely stops.

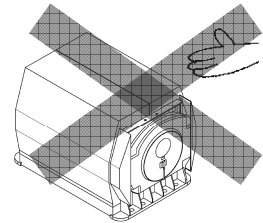
Doing so could result in injury.



Do not touch the ARG unit.

Do not touch the **ARG** unit during operation or soon after the **ARG** stops because the **ARG** is hot.

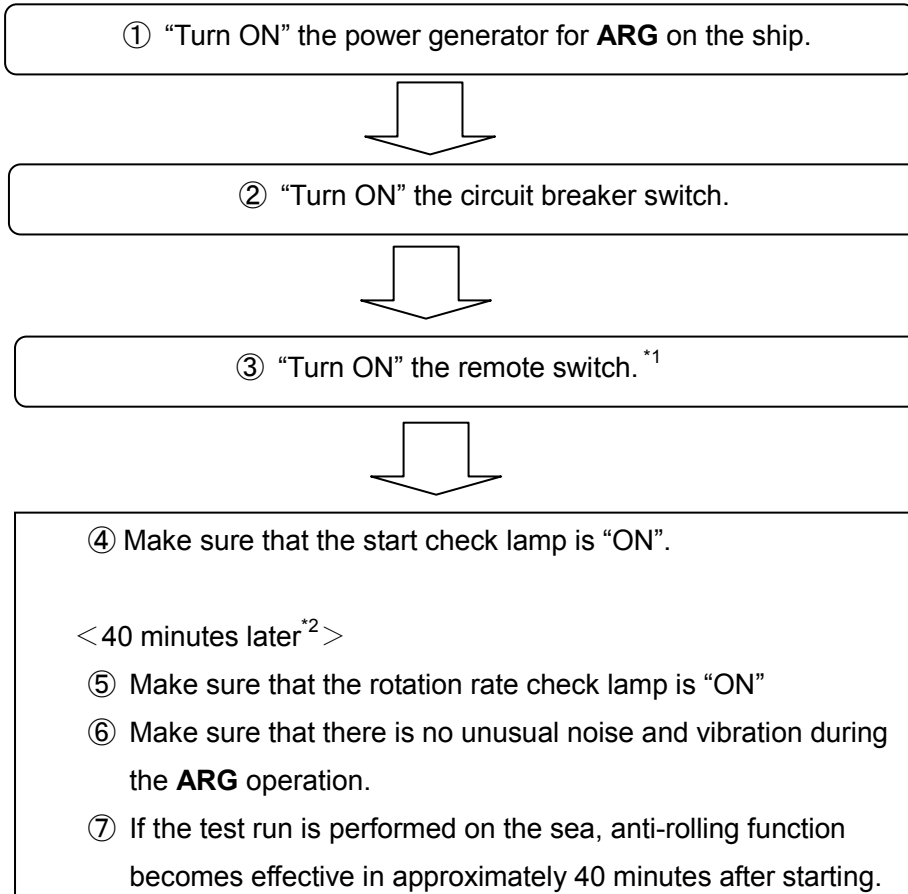
Doing so could result in a skin burn due to the hot surface.



4.1 Method of operation

Please operate the **ARG** according to the procedure below.

(1) Starting



*1) If number of the Monitor window is same as below number shown in table 4-1, the **ARG** is normal.

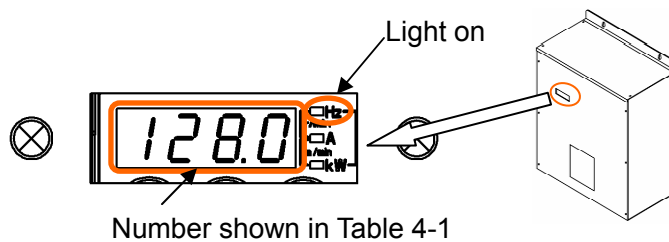


Table 4-1 Indication of the Monitoring window

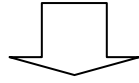
Elapsed Time	Standing	0 to 40 min	40 min after
Indication	Blink number between 126 and 133	Increase number from 0 to 126	Steady state between 126 and 133

*2) The **ARG** takes approximately 40 minutes to reach rated rotational speed after turning on the remote switch.

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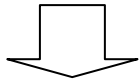
(2) Stopping

① "Turn OFF" the remote switch. *1



② Make sure that the start check lamp is "OFF".
③ Make sure that the rotation rate check lamp is "OFF".

④ "Turn OFF" the circuit breaker switch.



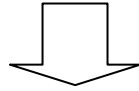
⑤ "Turn OFF" the power generator for **ARG** on the ship.

*1) After turning off the power supply to the **ARG**, the **ARG** stops its operation gradually.
It takes approximately 1 hour until the system stops completely.

4.2 Restarting

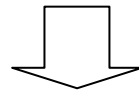
Please operate the **ARG** according to the procedure below if the **ARG** is restarted due to any kind of anomalies.

① "Turn OFF" the remote switch.



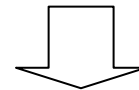
② Make sure that the start check lamp is "OFF".
③ Make sure that the rotation rate check lamp is "OFF".

④ "Turn OFF" the circuit breaker switch.

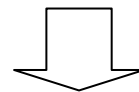


⑤ Make sure that the **ARG** is stopping completely 1 hour later.

⑥ "Turn ON" the circuit breaker switch. *1



⑦ "Turn ON" the remote switch. *2



⑧ Make sure that the start check lamp is "ON".

< 40 minutes later*3 >

⑨ Make sure that the rotation rate check lamp is "ON".

⑩ Make sure that there is no unusual noise and vibration during the **ARG** operation.

⑪ If the test run is performed on the sea, anti-rolling function becomes effective in approximately 40 minutes after starting.

*1) It takes approximately 1 hour until the **ARG** completely stops after the remote switch has been turned off. If you turn on the switch back before the **ARG** unit has stopped completely, self-shutdown circuit may occur due to over current. In this case, release the over current of the Motor Driver and then restart the **ARG**. It will be better not to restart the **ARG** for at least 1 hour after shutdown.

*2) If number of the Monitoring window is same as shown in Table 4-1, the **ARG** is normal.

*3) The **ARG** takes approximately 40 minutes to reach rated rotational speed after turning on the remote switch.

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4.3 Automatic Fast return functions

(1) Description of the functions

The **ARG** has a function called “Automatic Fast return functions”. It is a function that the **ARG** will not be turned off even when the main power generator is turned off for a moment. This function is valid under the following conditions.

- If the ship temporary uses an electricity from the ground to start the **ARG** and then change it from the ship (power generator) to supply the electricity.
- If there are some power generators on the ship and want to change the generator to get applicable electric capacity during the **ARG**'s operation.

A customer does not need to prepare extra parts or wirings to get this function.

(2) Procedure for Automatic Fast return function

A customer does not need to do special operation to get this function.

Table 4-2 describes the procedure to automatically recover the **ARG** after the main power generator is temporarily turned off. When you use this Automatic Fast return function, check carefully this procedure, the start check lamp and rotation rate check lamp all the time.

Table 4-2 Procedure for Automatic Fast return function

No.	Operation	ARG 's condition	Power generator	Remote switch	Start check lamp	Rotation rate check lamp
1	The ARG is in operation	Steady-state rotational speed	ON	ON	ON	ON
2	Change the power generator (Turn off the main power generator)	Reduce the rotational speed	OFF		OFF	OFF
3	Change the power generator (Turn on the main power generator)	Restarting	ON		ON	OFF
4	_____	Steady-state rotational speed	ON		ON	ON

Note1) When temporarily turning off the main power generator with the Automatic Fast return function used, keep the remote switch ON all the time. If you change it to OFF during its operation, the **ARG** will be applied with excessive current and it will start the protective function of the Motor Driver, causing the whole system to stop.

Note2) If you operate the **ARG** for the first time, follow the procedure below and Section 4.1 “Method of operation”. If you turn on the **ARG** by the main power generator or the circuit breaker switch with a remote switch set to ON, it starts the Automatic Fast return function. Then the **ARG** takes for a while to start.

- ①Main power generator is ON → ②Circuit breaker switch is ON
 → ③Remote switch is ON

4.4 Safety functions

The **ARG** has a safety device to stop the **ARG** automatically.

When the **ARG** is operated under the following conditions, the safety device operates and the **ARG** stops.

- Ambient temperature of the **ARG** becomes high.
- The **ARG** generates excessive load by the operation under stormy weather or excessive high wave condition.
- One of the Damper breaks down.

If the safety device operates, the start check lamp and rotation check lamp are turned off even when the remote switch is still “on”. (Refer to Table 4-3)

Please contact the Sales Agent according to No.5 of Table 5-1 in paragraph 5, if there is possibility that the safety device operates.


Table 4-3 The safety device operates


No.	Operation	ARG 's condition	Power generator	Remote switch	Start check lamp	Rotation rate check lamp
1	The safety device operates	Stop (Reduce the rotational speed)	ON	ON	OFF	OFF

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5. What to do in case of problems

Before contacting to the Sales Agent, please check your problems according to Table 5-1. If problems are not applicable to Table 5-1, please enter in Table 5-2 and contact the Sales Agent.


DANGER



Turn off the power supply if you notice abnormal conditions.

If you notice an unusual noise, vibration or any other abnormality during operation of the **ARG**, immediately turn off the power supply to shut down the **ARG**. Keeping the **ARG** running under abnormal conditions could result in unexpected accident.

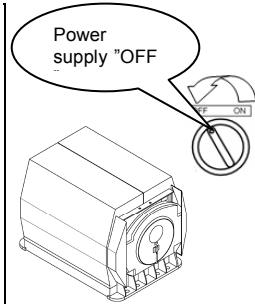


Table 5-1 Fault finding table for the **ARG**

No.	Problem	Possible cause	Step to take
1	The ARG does not operate even though the power switch is ON.	Power circuit is incorrectly wired.	<ul style="list-style-type: none"> • Check if primary power is available. • Check the connection between the power supply and the ARG. The connector of the ARG must be latched completely.
		Signal circuit is incorrectly wired.	<ul style="list-style-type: none"> • Check the remote switch wiring is not open-circuited. • Check the safety device wiring is not open-circuited. • Check the connection between the Motor Driver and the ARG unit. The connector of the ARG for the safety device must be latched completely.
		Circuit breaker switch is not turned on.	<ul style="list-style-type: none"> • Turn on the circuit breaker switch again according to the procedures in this manual.
		Power generator is not producing enough power.	<ul style="list-style-type: none"> • Check the capacity of the power generator, which must exceed the mass of the total ARG's power used.
		Restart of the ARG is attempted before it completely stops after shutdown.	<ul style="list-style-type: none"> • Stop the ARG completely, and then restart according to the procedures in this manual.
		Remote switch is not "ON"	<ul style="list-style-type: none"> • Turn on the remote switch.
		Wrong starting steps were taken (turned on the Automatic Fast return function).	Restart the ARG as follows. <ol style="list-style-type: none"> ① Power generator supply: ON ② Circuit breaker switch: ON ③ Remote switch: ON

Table 5-1 Fault finding table for the **ARG**

No.	Problem	Possible cause	Step to take
2	Circuit breaker switch trips immediately after it has been turned on.	Power circuit is incorrectly wired.	<ul style="list-style-type: none"> Check the short circuit of the power circuit between the power generator and the ARG unit.
		Ground fault.	<ul style="list-style-type: none"> Check the short circuit of the power circuit between the power generator and the ARG unit.
3	Start check lamp does not light on.	Lamp bulb has blown.	<ul style="list-style-type: none"> Change the lamp bulb.
		Connection failure	<ul style="list-style-type: none"> Check the start check lamp wiring is not open-circuited.
4	Rotation rate check lamp does not light on.	Lamp bulb has blown.	<ul style="list-style-type: none"> Change the lamp bulb.
		Connection failure	<ul style="list-style-type: none"> Check the start check lamp wiring is not open-circuited.
5	The ARG stops after turned on or during the operation	Power generator is not producing enough power.	<ul style="list-style-type: none"> Check the capacity of the power generator, which must exceed the mass of the total ARG's power used. The power generator to supply the ARG is also used for another equipment, which consumes big amount of electricity, and it causes the power generator produce to produce insufficient power.
		Electric shutdown because other equipment is turned on.	<ul style="list-style-type: none"> If other equipment is turned on, it decreases the voltage momentary and it stops the ARG. Please turn on the equipment first, and then turn the ARG on.
		Operation of the safety device	<ul style="list-style-type: none"> When the ARG is operated under high ambient temperature, stormy weather or excessively high wave (2.0m) conditions, the ARG may stop. Cool the ambient temperature to 40°C or less by ventilation, and contact the Sales Agent.
6	GPS , radio or other equipment makes noise after the ARG is in operation.	The ARG 's noise is affecting the other equipment's noise.	<ul style="list-style-type: none"> Keep the distance between the other equipment and the ARG and/or its wirings. Check the ground lead between the ARG and the ship. <u>Adjust sensitivity when the image of the Fish Finder is noisy and distorted. Refer to the operation instructions of the Fish Finder.</u>
7	The ARG makes unusual noise or vibration.	Selected wrong rotational direction.	<ul style="list-style-type: none"> Make sure that the serial numbers of the ARG unit and the Motor Driver are the same.
		Effect of resonance	<ul style="list-style-type: none"> There is a mechanical resonance point in the ARG during the time that rotational speed becomes steady. Please wait until it becomes steady rotational speed. If there is a resonance in the hull or wall, take appropriate measures to increase the strength and rigidity of the material of the hull or wall.
		Effect of environmental temperature.	<ul style="list-style-type: none"> When the environmental temperature is low, the bearings might make some noise especially just after the starting. Wait until the rotational speed becomes steady, and then make sure that it does not make the noise any longer.

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Table 5-2 Check sheet

1.	Please fill in the blanks after TYP, P/N and S/N with the appropriate indications on the information plate of ARG.		TYP:	P/N:	S/N:
2.	Information on user	User name			
		Name of ship			
		Material and application of vessel	Material: iron, aluminum, GFRP, others () Application:		
		Size of vessel	Overall length:	overall width:	displacement:
3.	Mounting method and operation of ARG	Mounting method (directly or through anti-vibration rubber)	Anti-vibration rubber: provided · not provided		
		Number of units installed			
		Number of units showing discrepancy			
		Condition for operation	Duration in service:		
		Mounting position of ARG showing discrepancy, and peripheral devices			
		Capacity of power generator	Single-phase · 3-phase, 200·220·240V, ()KVA, ()A		
4.	Date of last inspection and inspection results	About what time was the last inspection?	About (Year) (month)		
		Were there found any results related to the event of this time?	YES · NO · Unknown		
5.	Approximate cumulative operation time or approximate period of operation time		Hr		
6.	Time at or duration in which you feel there is some discrepancy, and symptom making you feel so	Time at which you recognized discrepancy and duration in which operation has been sustained after that	Operation has been sustained · stopped from (year/month /day).		
		Describe differences in conditions of ARG before and after discrepancy was revealed.			
		Describe operating conditions of ship before and after discrepancy was revealed.			
		Large rolling caused by sharp turning, unexpected big wave, sudden gust, etc. or changes in power supply conditions resulted from installation of new auxiliary			
7.	Kind of discrepancies (Select appropriate items and explain conditions.)	Kind of discrepancies	Tick off	Answer to questions in following items if appropriate.	Conditions
		Start check lamp and/or rotation rate check lamp not illuminated		13. ~ 17.	
		Operation not started even if switch is turned on.		13. ~ 17.	
		Operation interrupted (impossible to restart)		8. ~ 11.14. ~ 17.	
		Noise increased (larger than in conventional operations)		8. ~ 11.14. ~ 17.	
		Vibration increased (larger than in conventional operation)		8. ~ 11.14. ~ 17.	
		Abnormal noise generated (not experienced in conventional operations)		8. ~ 11.14. ~ 17.	
		Abnormal odor generated (not experienced in conventional operations)		9.10.12. 15.	
Other abnormal conditions		9.10.15. ~ 17.			
8.	Is mounting to hull free from any loose bolt?		YES · NO (Conditions:)		
9.	Is damper free from any oil leaks? (Note that oil is transparent.)		YES · NO (Conditions:)		
10.	What degree of temperature is indicated by thermo label attached to damper?		White: normal Other colors: 70°C 80°C 90°C		
11.	At a time of what have noises or vibrations occurred, at starting, at a steady rate operation or at all times? How long did they last, for a certain period or continuously? How is the noise heard? (What kinds of sound are generated?)		Abnormal noise · vibration Occurred at: starting · a steady rate operation · all times · others (Conditions:)		
12.	Kind of abnormal odor	Examples: smell of burnt oil, smell offensive to eyes, smell of burnt bakelite			
		What is source of odor?	ARG proper · motor driver · lamp · switch · others (Conditions:)		
13.	Findings from electrical system	is Primary power available?	YES · NO (Conditions:)		
		Is Power cable free from open-circuit?			
		is the Breaker on?	YES · NO (Conditions:)		
		Is ARG connector free from loose contact? (Is it latched properly when plug ring is turned?)	YES · NO (Conditions:)		
		Is motor driver fan in operation? (Fan rotation sound heard?)	YES · NO (Conditions:)		
		Is remote switch wiring free from any open-circuit?	YES · NO (Conditions:)		
		Is system free from any blown lamp bulb?	YES · NO (Conditions:)		
		Is grounding to hull in good condition?	YES · NO (Conditions:)		
14.	Are starting and stopping performed in the same procedure as specified in Operation Manual?		YES · NO (Conditions:)		
15.	What degree is the ambient temperature? What is the atmospheric temperature in ARG installation place when ARG is in operation?		Approx. °C		
16.	Has ARG been protected against splashes of sea water? (Is it free from any trace of exposure?)		YES · NO (Conditions:)		
17.	Is ARG free from any accumulation of powder or dust?		YES · NO (Conditions:)		

6. Maintenance

Please Inspect the **ARG** every two years. (Refer to Table6-1)
Please read and understand the “**Warning**” and “**Caution**” in this manual before inspection.
MHI recommends you to have the periodic inspection performed by the Sales Agent every two years to make sure you can use it safely for a long time. This inspection will be charged for. Please contact the Sales Agent for details.

MHI recommends changing the Damper every four years, and changing the Motor Driver every two years.



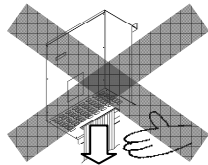

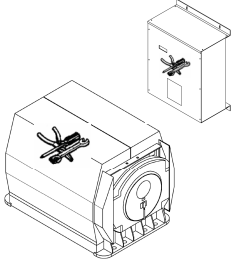
Especially, if there is oil leakage from the Damper, it may result in decline of the Damper’s function. Please have the periodic inspection of the Sales Agent.

And change the Cover, anti-vibration rubber, connector and so on in accordance with results of periodic inspection.

Change interval

Parts	Interval
Damper	4 years
Motor Driver	2 years
Cover	appropriate time
Anti-vibration rubber	
Connector	

Please contact the Sales Agent for the periodic inspection or change of the **ARG**’s parts.

 DANGER		
	<p>Do not pull on the cables from the Motor Driver.</p> <p>Do not pull on the cables from the Motor Driver. Doing so could result in electric shock.</p>	
	<p>Do not disassemble or modify the ARG or use a substitute for any of its parts.</p> <p>Do not disassemble the ARG by yourself, change the component (without authorized modification), or use it for any purpose other than that for which it was designed. Doing so could result in damage to the ARG, malfunction, injury or electric shock.</p>	

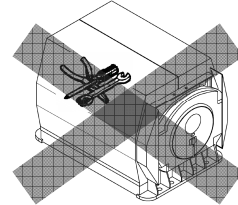
 **DANGER**



Do not remove the ARG cover.

During operation, the inner parts of the **ARG** are rotating at high speed.
Do not remove the **ARG** cover.

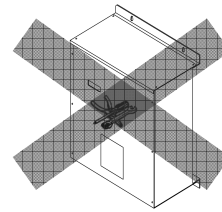
Doing so could result in injury.



Do not open the Motor Driver's lid.

Do not open the Motor Driver's lid. And do not touch the inside of the Motor Driver.

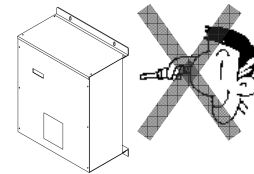
Doing so could result in electric shock, malfunction or fire.



Contact the Sales Agent for wiring of the ARG.

Be sure to contact the Sales Agent for wiring of the **ARG**.

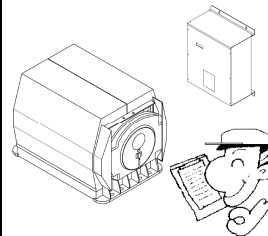
Incorrect wiring could result in electric shock, malfunction or fire.



Have the periodic inspection performed by the Sales Agent every two years.

Have the periodic inspection performed by the Sales Agent every two years. MHI recommends changing the Damper every four years, and changing the Motor Driver every two years. Change the Cover, anti-vibration rubber, connector and so on in accordance with results of periodical inspection.

Not doing so could result in electric shock, damage or malfunction.



 **CAUTION**


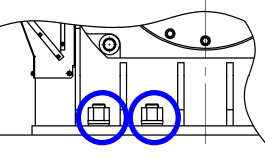
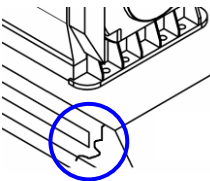
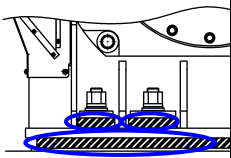
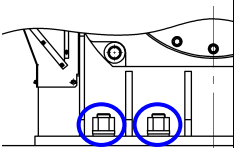
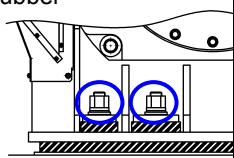
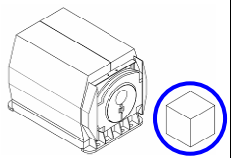
	<p>Check the bolts and nuts (eight installation bolts and nuts) for looseness every three months.</p> <p>Re-tighten the eight installation bolts or nuts after operating the ARG at sea for a month. After that, make sure that the bolts or nuts are not loosened every three months. If you found loosening bolts or nuts, contact the Sales Agent.</p> <p>Not doing so could result in malfunction.</p>	
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Table 6-1 **ARG** Periodical inspection List (1 / 4)

No	Inspection Area	Inspection Item	Priority	Result	Countermeasures
1	ARG Installation	There must be no rust, crack or gap on the installation part of the hull. 	○		Improve the hull to solve the problem.
2		There must be no permanent deformation in the anti-vibration rubber if it is used. 	○		Contact the Sales Agent. (Change the anti-vibration rubber)
3		The installation bolts and nuts must be tightened to the regular torque as below. 	○		Re-tighten bolts or nuts.
		Without anti-vibration rubber : 300N · m With anti-vibration rubber : 130N · m 			
4	There must be no dust, combustibles /flammable materials or seawater/water near the ARG unit. 	◎		Improve installation environment.	

Anti Rolling Gyro
Model : MSM-25000T-A1

Table 6-1 **ARG** Periodic inspection List (2 / 4)

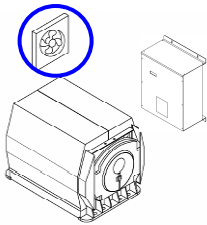
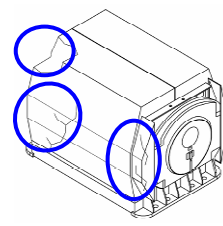
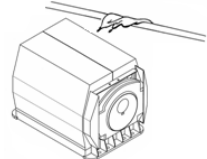
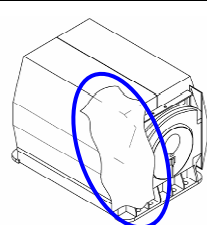
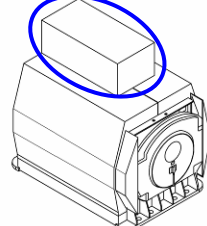
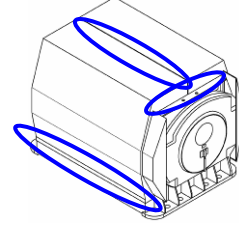
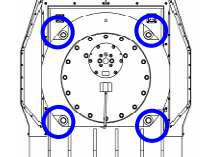
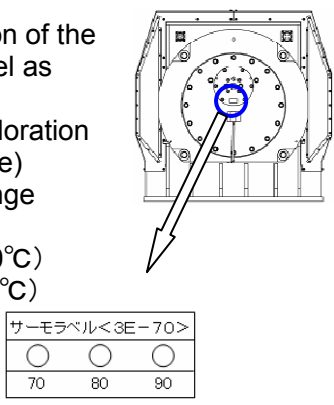
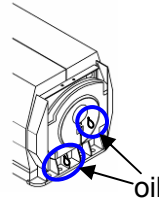
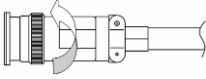
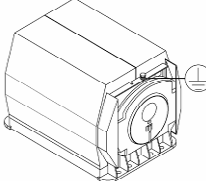
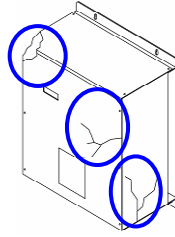
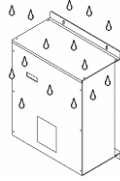
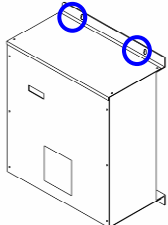
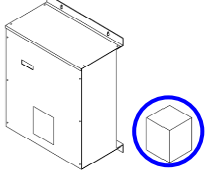
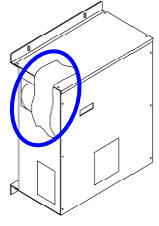
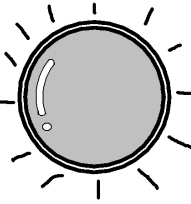
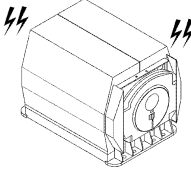
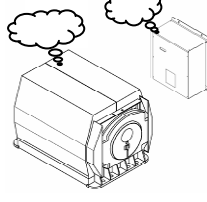
No	Inspection Area	Inspection Item	Priority	Result	Countermeasures
5	ARG installation	There must be enough ventilation provided to cool the ARG down. 	○		Improve installation environment.
6	ARG unit	The ARG unit must be no rust, crack or damage caused by interference of the ARG unit and other equipment. 	○		Contact the Sales Agent. [Change the damaged parts or the ARG unit.]
7		There must be no trace of being exposed to seawater / water on the ARG unit. 	◎		Contact the Sales Agent. [Do not operate the ARG .]
8		The blowhole of the ARG unit must not be closed. 	○		Improve the ARG unit to solve the problem.
9		There must be no objects on the ARG cover. 	○		
10		There must be no looseness in the screws of the Cover. 	○		
11		There must be no looseness in the bolts of the Damper. 	◎		Contact the Sales Agent. [Inspect the ARG and, change damaged parts.]

Table 6-1 ARG Periodic inspection List (3 / 4)

No	Inspection Area	Inspection Item	Priority	Result	Countermeasures
12	ARG unit	Check the discoloration of the thermo label as follows. ① No discoloration (all white) ② Red orange (70°C) ③ Blue (80°C) ④ Red (90°C) 	◎		①② : No problem ③④ : Problem Contact the Sales Agent. (Change the Damper.)
		There must be no oil leakage from the Damper. 	◎		Contact the Sales Agent. (Change the Damper.)
		The connector of cable side must be locked properly to the connector of the ARG unit side. 	○		Re-lock. If can not, contact the Sales Agent. (Change the connector.)
		There must be no looseness in the grounding bolt. 	○		Re-tighten grounding bolt. (Tighten Torque 65N·m)
16	Motor Driver	There must be no rust, deformation or crack. 	○		Contact the Sales Agent. (Change the Motor Driver.)
		There must be no trace of being exposed to seawater / water on the Motor Driver. 	◎		Contact the Sales Agent. (Do not operate the ARG.)
		There must be no looseness in the installation screws (four screws). 	○		Re-tighten screws.



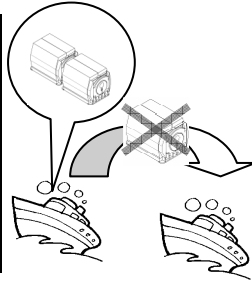
Anti Rolling Gyro
Model : MSM-2500T-A1

Table 6-1 **ARG** Periodic inspection List (4 / 4)

No	Inspection Area	Inspection Item	Priority	Result	Countermeasures
19	Motor Driver	There must be no dust, combustible /flammable materials or seawater/ water near the Motor Driver. 	◎		Improve installation environment
20	Motor Driver	The blowhole of the Motor Driver must not be closed. 	○		Improve the Motor Driver to solve the problem.
21	Operation	When the remote switch is on, the start check lamp must light and after 40 minutes, the rotation rate check lamp must light. 	○		Contact the Sales Agent. [Change lamp.]
22		There must be no unusual noise or vibration. 	○		Contact the Sales Agent. [Inspect the ARG .]
23		There must be no abnormal odor from the ARG proper and Motor Driver. 	○		

7. Installation

To install the **ARG**, it is necessary to reinforce the ship appropriately and to provide an appropriate power supply (generator).
Please be sure to contact the Sales Agent.

 CAUTION		
	<p>Do not divert the ARG unit or the Motor Driver already installed to other ships.</p> <p>The model and numbers of the ARG are decided for each ship.</p> <p>Diverting them to other ships could result in malfunction.</p>	

Sales Agent _____

Manufacture _____



Anti Rolling Gyro



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