



Guidelines for Controlling Hypothermia at Sea



The Maritime Human Resource Institute, Japan



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<http://mhrij.org/>

Forward

All seafarers face various risks during operations of a seagoing vessel. For example, you may get caught up in a mooring line (net) and sustain an injury. You may also fall into the ocean while performing your duties on deck and suffer from hypothermia as a result of the ensuing decrease in your body temperature.

Among these risks, hypothermia can be especially perilous. Even without falling into the ocean, you may begin to develop symptoms simply during your normal duties, and not even realize it. By that time, it may be too late. You may consider the symptoms of hypothermia to be exhaustion or generally just feeling unwell, and you may overlook them.

This may be your first time hearing the word "hypothermia", but it is actually a very serious condition with a mortality rate of 20% - 90%.

The SOLAS Convention, the International Convention for the Safety of Life at Sea, also stipulates that seafarers must be sufficiently educated regarding hypothermia.

It is, therefore, extremely important to foster a wide understanding among seafarers and everyone else involved in maritime matters concerning exactly what hypothermia is and what can be done in order to prevent it.

That is why these guidelines have been created. We hope that they will prove useful.

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Chapter 1

Hypothermia

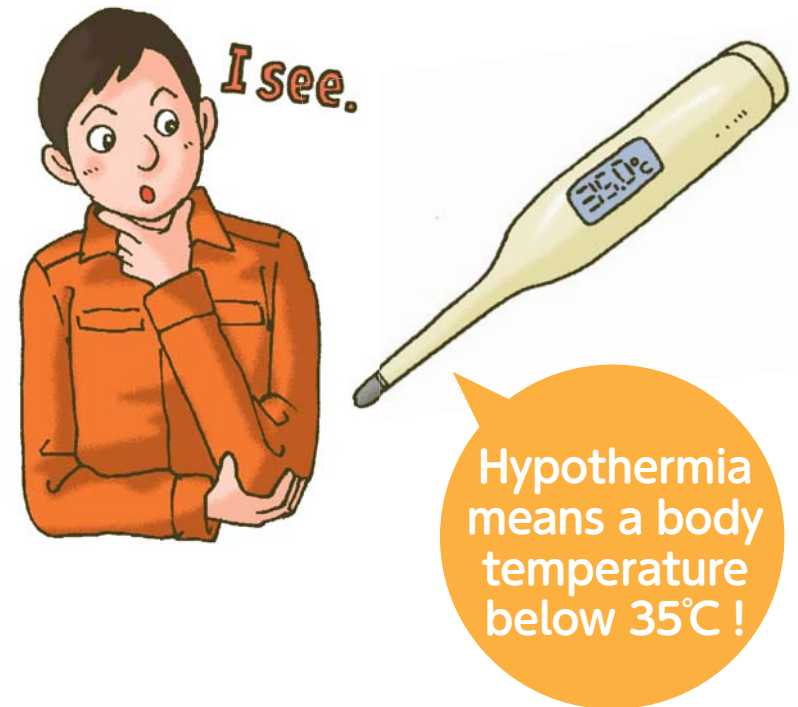
Q What is Hypothermia?

A Hypothermia occurs when your body temperature falls below 35°C . It is an extremely dangerous condition with a mortality rate of 20% - 90%!

Further Details

"Body temperature" as used above refers to what is known as "core temperature". Core temperature refers to such things as rectal temperature, bladder temperature, esophageal temperature and pulmonary artery temperature, but it is generally taken as rectal temperature (to be precise, a measurement taken at a depth of about 7cm from the anus).

It is not possible to measure body temperature correctly in regard to hypothermia by using the same methods as when taking your temperature normally, such as under the armpit or under the tongue. A true measurement of core body temperature can be taken, be it rectal, bladder or esophageal. The easiest and so most commonly used method to gain such a reading is a rectal measurement.



There are two types of hypothermia.

Accidental Hypothermia

Caused by accidents or unforeseen circumstances

Secondary Hypothermia

Caused as a secondary result of illness, drugs, poor health or other factors

These guidelines focus on "accidental hypothermia," which all seafarers must be aware of in the course of performing their duties.

Q What causes hypothermia?

A Hypothermia is caused by exposure to a cold environment!

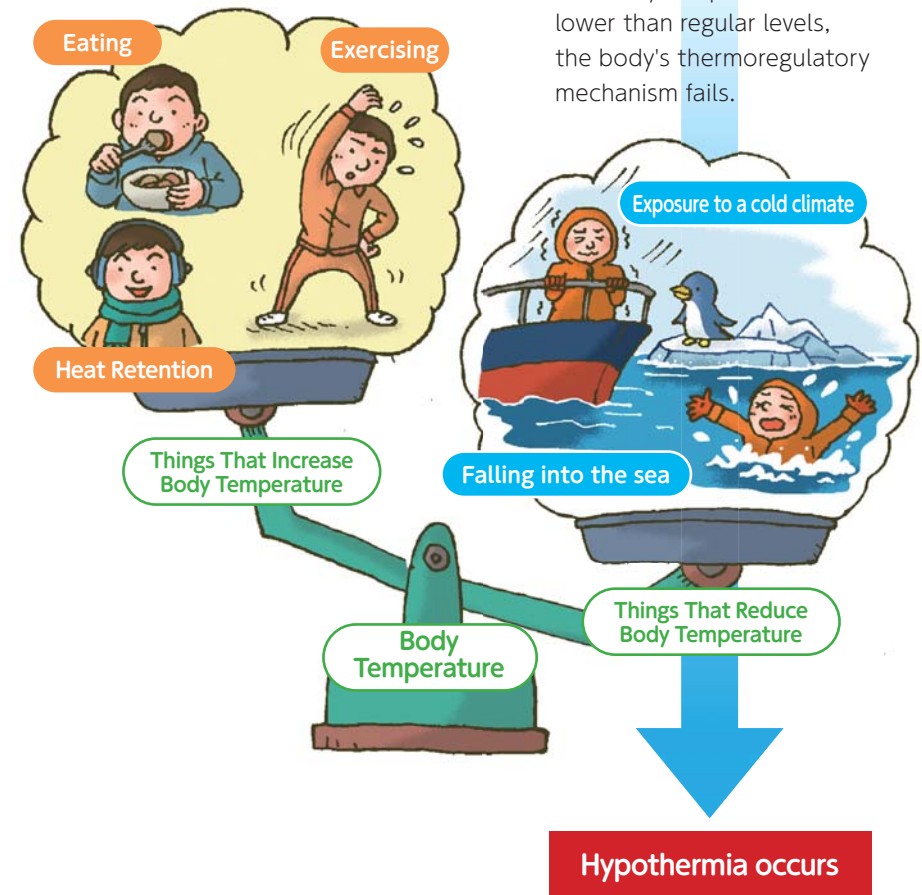
Further Details

The surface of the human body, in particular the skin, is layered with nerves that detect temperature, which maintains the normal body temperature within a fixed range of approximately 36 - 37 °C. If this range is deviated from, that information is transmitted to the body temperature center of the hypothalamus in the center of the brain and measures such as contraction or expansion of blood vessels are used in order to adjust body temperature accordingly.

However, exposure to an excessively cold environment means that these adjustments can no longer be performed.

*Cold environment: cold outdoor climate, cold storage, wet clothing, cold water, etc.

When physical conditions exceed regulation limits and body temperature falls lower than regular levels, the body's thermoregulatory mechanism fails.



Q How is hypothermia classified?

A Hypothermia can be divided into three types: mild, moderate, and severe.

Further Details

Hypothermia is generally classified as follows in accordance with body temperature.

Mild hypothermia	35 - 32°C
Moderate hypothermia	32 - 28°C
Severe hypothermia	Lower than 28°C

The mortality rate increases as the body temperature falls.

Q What kind of symptoms appear with hypothermia?

A The representative symptom of mild hypothermia is "shivering". As hypothermia progresses the symptoms change and become severer.

Further Details

The following is an explanation of the changes that occur within the body depending on the type of hypothermia.

Onset of Hypothermia



- When body temperature starts to fall, first the body temperature center and peripheral mechanisms come into operation, attempting to return body temperature to above 36°C through the action of sympathetic nerves, causing vasoconstriction, tachycardia, shivering, cold extremities, hyperventilation and excessive urination.

35 - 32°C :
Mild hypothermia



- Mainly suppresses function of the central nervous system, reducing cognitive capabilities and impairing judgment.
- Also makes feelings slow and sluggish.
- Shivering becomes apparent.

32 - 28°C :
Moderate hypothermia



- Extreme suppression of the central nervous system impairs consciousness and can lead to coma.
- Heartbeat goes into arrhythmia and cardiac output slows.
- Suppression of breathing means that oxygen and carbon dioxide cannot be exchanged, and oxygen levels in the blood fall.
- Functions of organs other than the nervous system, heart and lungs are also affected.
- Functioning of the digestive system is also reduced, causing intestinal obstruction, and muscles become rigid and unable to move.
- Impediments to the blood and metabolic systems suppress the action of organs such as the liver, kidneys and pancreas.

Lower than 28°C :
Severe hypothermia



- Coma, respiratory failure, heart failure and low blood pressure can all occur in a short period of time.
- **Although each case is different, there is still a chance of recovery. Resuscitation should be performed immediately.**

Lower than 22°C



- Breathing stops.

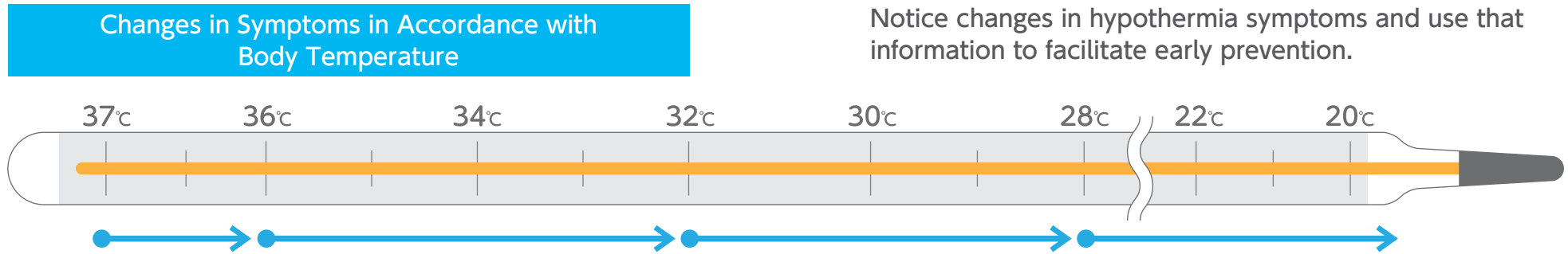
Lower than 20°C

- Immediate heart failure.

As seen above, hypothermia mainly appears with symptoms relating to the nervous system, respiratory system and skeletal muscle, all of which should be relatively easy to observe. Symptoms relating to the blood and metabolic systems are harder to notice.

Taking all of these points into account, observe those around you from the perspective of their potentially suffering from hypothermia.

You should also use your own body as a basis for making judgements.



Normal conditions
(less than 37°C→36°C)

Mild hypothermia
(less than 35°C→32°C)

Moderate hypothermia
(less than 32°C→28°C)

Severe hypothermia
(less than 28°C)

The body works to maintain this body temperature range.



Below 35°C **Below 32°C** **Lower than 28°C**

When body temperature falls below the normal level:

- Shivering*
- Overpowering exhaustion
- Inability to move as desired
- Hyperventilation
- Excessive urination

- Incessant shivering
- Impaired cognition and judgment
- Inability to stand
- Vacant expression

- Impaired consciousness
- Inability to get up or move
- Muscle rigidity
- Weakened breathing and pulse

- Deep coma
- Loss of consciousness
- * There is still potential for revival at this stage**

22°C • Respiratory failure

20°C • Heart failure

*Shivering: When the body starts shaking in order to generate heat, or when muscles react involuntarily due to inability to create heat.

Chapter 2

Conditions that Cause Hypothermia

Q Under what kind of circumstances can seafarers suffer from hypothermia?

A Potential causes of hypothermia for the crew of a seagoing vessel include “falling into the ocean,” “being adrift in the ocean,” “working in a cold environment on deck,” and “working inside onboard cold storage.”

Further Details

The primary cause of hypothermia symptoms is a decrease in external temperature. In an environment with an external temperature below 10 - 15°C, it can become difficult for the human body to maintain the regular body temperature of 36 - 37°C.

However, even within the permissible range of external temperature, the risk of hypothermia can still increase as a result of extended exposure, clothing conditions, nutritional conditions, the presence of chronic disease and other factors.

Q Can the individual physical conditions of each seafarers also make a difference?

A Yes, the individual physical conditions of each seafarers can make a difference. Please take all due care.

Further Details

When fatigue from work and lifestyle accumulates, seafarers may feel exhausted, suffer from pneumonia, influenza or other illness, or go for long periods with insufficient sleep, they are more prone to developing hypothermia; hence, extra caution is required.

Failure to eat after drinking alcohol also reduces the body's capacity to generate heat and makes a person more likely to develop hypothermia.

Sufferers of diabetes, chronic cardiopulmonary disease or endocrine disease are also more likely to develop hypothermia, so caution should be paid accordingly.



Chapter 3

Saving and Treating Hypothermia Victims

Q What is the first thing to do if a seafarers falls into the ocean?

A The most important thing is to get them out of the water as quickly as possible! If they have stopped breathing, perform artificial respiration.

Further Details

The longer a person is left exposed in the sea, the lower their chances of survival. The mortality rate climbs very high if they are not pulled quickly out of the cold seawater.

If the victim has drowned, securing respiratory function must be the first step. Start by administering cardiopulmonary resuscitation while blowing five times into the mouth of the victim, (while two times is the generally accepted practice, in the case of respiratory failure due to drowning, five times is more suitable in order to clear the airway obstruction).

If the drowning victim's heart has stopped, perform heart massage at a rate of 100 - 120 times per minute. If you have an AED, then you may use that. (However, if body temperature is low, in the 32 - 35°C degree range, you may

use an AED only once).

Once cardiopulmonary recovery has been achieved, next it is vital to warm the body.

Rescue from Falling into The Ocean



Q What can be done in order to quickly identify seafarers who have developed hypothermia for reasons other than falling into the ocean?

A The early identification of hypothermia requires "noticing for yourself" and "identification through observation by a third party".

Further Details

Apart from actually falling into the ocean, seafarers are at risk of hypothermia due to such factors as "being adrift in the ocean," "working in a cold environment on deck" and "working inside onboard cold storage." As hypothermia proceeds gradually under these circumstances, it is more than possible for individuals themselves and those around them to not notice it's advance.

For example, even if you experience feelings such as "I'm kind of cold and my body feels sluggish," "I can't concentrate" and "I just don't have any energy" you still may not suspect hypothermia, allowing it to proceed into more serious symptoms.

If the people around you also notice that "something about you is different," they need to ask if you have been in a situation placing you at risk of hypothermia, observe you closely, and make a suitable judgment. This can lead to rescue before it is too late.

Key Points for Noticing Yourself and Observing by Others

Key points for noticing in yourself and by others are such things as an "exhausted expression," "sluggish movements," "dulled emotions," "impaired judgement," "slow response to questions" and "cold body".

In particular, you should maintain a firm understanding of the changes in symptoms due to body temperature as outlined earlier in these guidelines.

Check 1
Is there shivering?



Check 2
Does the expression look exhausted?



Check 3
Have movements become sluggish?



Check 4
Can the person converse normally?



Check 5
Are hands, feet and body surface cold?



- * Is speech slower than normal?
- * Is a response slow or delayed?



What kind of emergency treatment should be provided after cardiopulmonary resuscitation?



The basics of emergency treatment are "change out of wet clothing," "carry to a warm place" and "raise body temperature."

Further Details

Whether hypothermia is caused by falling into the ocean or other factors, the best method for recovery is to "warm the body." In order to achieve this, first the victim needs to be placed in a warm environment (heat retention).

After achieving that, you will need to immediately begin increasing the body temperature of the victim (warming).

During this step you should increase the temperature at a rate of 0.5 - 2°C per hour, rather than all at once. This is because a rapid increase in body temperature can also induce shock.

Furthermore, while the order presented here is "heat retention first, followed by warming," these steps should actually be performed almost simultaneously.

If the victim is in a condition that allows eating or drinking, food and drink are also effective to raise temperature.

Heat Retention

- Immediately change wet clothes into dry clothing.
- Move the victim to a heated room at 21 - 25°C and warm using blankets and warm clothing.
- If you don't have items like blankets at hand, use anything and everything that can shut out the cold, including newspapers, cardboard, vinyl and sleeping bags.

Raising Body Temperature

- Use heating materials such as hot water bottles and thermal patches to heat just the trunk of the victim's body (stomach, chest, back, around the neck).
- Avoid heating the victim's extremities. Heating the extremities will cause cold blood from the hands and feet to circulate into the heart, suddenly lowering core temperature and causing cardiac shock (rewarming shock).
- For the same reason, there is no need to massage the victim's hands and feet.
- **When applying heat, be careful of low temperature burns.**
- **The victim can also be placed in a bath of warm water (40 - 45°C), but unless you have access to facilities for monitoring body temperature, this approach is not recommended.**

Raising Body Temperature Using Food and Drink

- It is advisable to offer warm and easy to eat food and drink such as warm sugar broth or soup. Chocolate and other sweet foods are also effective (glucose and carbohydrates are good because they are absorbed quickly, while protein and fats are bad because they are absorbed slowly).
- Alcohol, coffee and tea promote the production of urine. This can lead to dehydration, so they should not be provided in excess.
- Do not allow the victim to smoke.
- **Do not offer food and drink if the victim is unconscious.**

Q Once a person has recovered consciousness from hypothermia, should he/she be allowed to move around?



In the period immediately after the victim has regained consciousness, suddenly moving the person's muscles will cause cold blood to flow into the heart and lead to arrhythmia or shock, so massaging them or having them move around is prohibited.

Do not let the person walk around or do exercise!

* However, once body temperature has returned to 32 - 35°C and stabilizes, it is fine for the person to move around.

Q What is the next step after emergency treatment?

A In principle, you should consult a specialist (doctor).

Further Details

If emergency treatment does not seem to have had a full effect, continue to perform as many measures as possible while seeking radio medical consultation or requesting maritime rescue from the closest land-based medical facility.

- Even if the symptoms appear to have improved, be mindful of the following points.
- The symptoms of hypothermia can recede, and the victim can appear to be healthy again, but internal changes still happening inside organs can cause sudden change in condition.
- Blood irregularities, arrhythmia, changes in blood pressure and changes in the respiratory functions of the lungs can all lead to death, meaning that observation (overall expression and responses when talked to) is required until the victim can be taken to a doctor.
- The victim's vital signs (consciousness level, state of breathing and breathing frequency, pulse and rectal temperature) should be observed, and state of urination, etc. be recorded for reference.

It is very difficult to tell the difference between apparent death and actual death in hypothermia victims. Even if the victim has been in cardiorespiratory failure for a comparatively long period of time there are still cases in which brain death is yet to occur and resuscitation is possible. It is therefore vital to keep conducting emergency lifesaving procedures without giving up until a specialist is consulted. Do not stop cardiopulmonary resuscitation or observation until the victim's body temperature is back to 32 - 35°C .

Keep conducting emergency lifesaving procedures without giving up until a doctor confirms death. Also continue observation.



Chapter 4

Prevention of Hypothermia



What can we do in order to prevent hypothermia?



The basics of hypothermia prevention are to have a thorough knowledge of the causes and symptoms of hypothermia and to thoroughly protect against the cold. Paying due attention to the working environment of seafarers and their physical health can also aid in prevention.

Further Details

The following points can help to prevent hypothermia.

- **Thorough preparation of clothing to prevent the cold**

When working in low temperatures, a full range of clothing should be prepared, including thermal underwear, gloves, hats and cold resistant clothing.

The use of disposable thermal patches is also effective.

- **Not working for many hours in low temperatures**

Change assigned duties frequently, keeping work times in low temperatures as short periods as possible.

- **Maintenance of temperature inside the vessel**

Maintain a suitable temperature inside the vessel, in working areas, cabins, etc.

- **Provision of sufficient nutritional intake from meals**

While maintaining health by eating sufficient meals, avoid damaging health and lowering stamina due to excessive drinking or eating.

- **Relieve exhaustion through sufficient rest**

Avoid the accumulation of exhaustion due to long working hours or insufficient sleep.

- **Full understanding of hypothermia**

Having a full understanding of hypothermia allows you to realize and avoid the potential risks, or to notice and halt symptoms before they become too far advanced. This knowledge can also lead to prevention and early discovery of hypothermia in the people around you.

Clothing is ultimately the best way to prevent hypothermia. In principle, you can take reference from the kind of protective clothing used in mountain climbing in cold seasons. These kinds of clothing include the following.

Protective Clothing

- Cold resistant clothing (top)
- Heat-retaining shirt, sweater, etc. (more effective if worn in multiple layers)
- Cold resistant, waterproof trousers
- Heat-retaining underwear for both upper and lower body (more effective if worn in multiple layers)
- Heat-retaining socks (more effective if worn in multiple layers)
- Cold resistant hat (including one that can be worn as a hood covering the entire head, mask type, etc.)
- Cold resistant gloves
- Use of heat-retaining scarves is also effective

In addition to the above articles of clothing, cold resistant shoes are also effective.

Items Other Than Clothing

- It is also effective to put items that will help to keep you warm, such as disposable thermal patches, inside your clothing.
- If adrift in a lifeboat, etc. after an accident at sea, wearing an immersion suit or heat insulation device (insulation sheet) equipped to the lifeboat is also effective.
- Carrying around a thermos flask containing a hot drink and drinking from it while at work as required is also effective.

Examples of Heat-retaining Clothing etc.

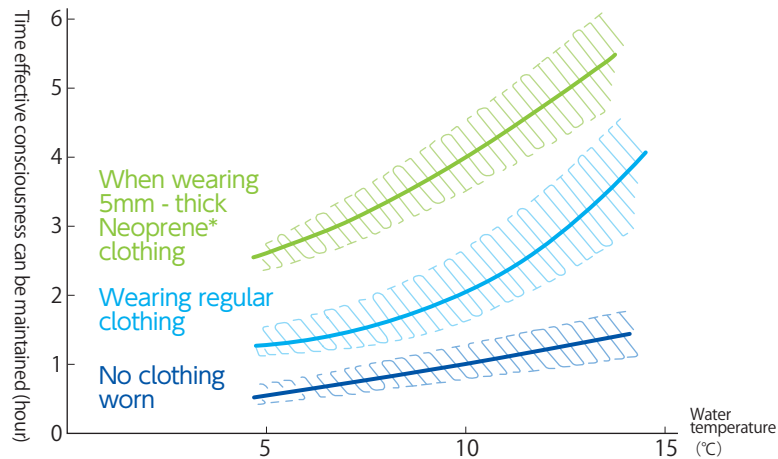


Examples of items for maintaining body heat



Reference: Hypothermia Related Materials

1. Relationship Between Water Temperature and Length of Time Consciousness Can be Maintained in Water (F. Golden R.N.)



*Neoprene: a wetsuit made from rubber
(Provision of materials: The Association for Promoting Safety and Sanitation for Seafarers)

2. Relationship Between Water Temperature, Loss of Consciousness and Survival Time

Water Temp	Time Until Losing Consciousness	Estimated Survival Time
Below 0°C	Within 15 minutes	15 - 45 minutes
0°C - 5°C	15 - 30 minutes	30 - 90 minutes
5°C - 10°C	30 - 60 minutes	1 - 3 hours
10°C - 15°C	1 - 2 hours	1 - 6 hours
15°C - 20°C	2 - 7 hours	2 - 40 hours
20°C - 25°C	2 - 12 hours	More than 3 hours

(Provision of materials: Tokyo University of Marine Science and Technology Graduate School, Marine Sport Health Research Lab)

3. Using the “HELP” (Heat Escape Lessening Posture) Position in the Water



- Body temperature can fall 25 times faster in water than in air.
- Factors such as water temperature, body size, volume of fat and movement in the water all influence survival.
- Moving your body in the water greatly accelerates decline of body temperature. Unless there is someone nearby trying to save you, do not move around.
- Heat is lost rapidly from the head, so try to keep it out of the water as much as possible.
- The more of your body you can keep out of the water, the less volume of heat will be lost and the higher your chances of survival.
- Using the HELP position (as shown above) to keep your arms and legs close to you and, if there are other people nearby, wrapping your arms around each other's shoulders, will increase your chances of survival.

(Provision of materials: Takashina Life Preservers Co., Ltd.)

Closing Remarks

We have tried to describe hypothermia in the simplest possible terms.

Occurrence of hypothermia is not only limited to seafarers on vessels sailing through arctic waters. It can easily occur in environments, both natural and artificial, that are simply a bit cold.

It is, therefore, important for all seafarers and those affiliated with shipping companies to remain aware of how hypothermia can affect them.

We hope these guidelines will prove useful as a point of reference.

We wish you all safe voyages and good health in your work.



Reference Materials

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