INSTRUCTION IN WINTER SERVICE
WINTER INJURIES

English edition
ABOUT UD 6-81-4 E

Metadata

<table>
<thead>
<tr>
<th>SHORT TITLE::</th>
<th>UD 6-81-4 E</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECURITY GRADE:</td>
<td>UNCLASSIFIED</td>
</tr>
<tr>
<td>VALIDITY:</td>
<td>2011-01-01</td>
</tr>
<tr>
<td>LEGAL AUTHORITY:</td>
<td>LETTER FROM INSPECTOR GENERAL OF THE NORWEGIAN ARMY - DELEGATION OF AUTHORITY.</td>
</tr>
<tr>
<td>ANSVARLIG FAGMYNDIGHET:</td>
<td>Commander of the Norwegian School of Winter Warfare</td>
</tr>
<tr>
<td>VALID FOR:</td>
<td>ROYAL NORWEGIAN ARMED FORCES</td>
</tr>
<tr>
<td>PREVIOUS VERSION:</td>
<td>UD 6-81-4 Frostbite and other injuries of 1st December 1987</td>
</tr>
</tbody>
</table>

Background

UD 6-81-4 E is produced in accordance with the armed forces standard for electronic publications - FS 7610-1900. Both the electronic version and the paper edition is produced from a single information source, based on the eXtensible Markup Language standard, XML.

Web edition

Web edition of UD 6-81-4 E can be found on the Armed forces database for "Rules, Regulations and directives" (FOBID). This database will hold at all times the current edition of the publication as well as previous editions.

Paper edition

Paper edition can be ordered from FLO Base Østerdalen, Grafisk (LMS), Rena Military camp. The address is listed in the next section.

- FLO Base Østerdalen, Grafisk (LMS), Rena leir
- PB 24
- 2451 RENA

Contributers in production

- Photos on cover: Defence Media Centre (FMS) edited by M&K DOK AS
- Production: LWC and M&K DOK AS.
- Illustration and photos: FMS/M&K DOK AS
- Printing and binding of the paper edition: AIT Otta
UD 6-81-4E

Instruction in Winter Service
– Winter injuries

Stipulated by the Norwegian School of Winter Warfare
UD 6-81-4E Instruction in Winter Service
– Winter injuries for use in the Norwegian Armed Forces

Rena, 14.12.2010

[Signature]

Major General
Per Sverre Opedal
Inspector General of the Norwegian Army

[Signature]

Lieutenant Colonel Harald Østbye
Commander of the Norwegian School of Winter Warfare
# Sections

<table>
<thead>
<tr>
<th>Table of Content</th>
<th>ToC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAPTER 1: INTRODUCTION</td>
<td>From pt 1 Chap-1</td>
</tr>
<tr>
<td>CHAPTER 2 PHYSIOLOGY</td>
<td>2 Chap-2</td>
</tr>
<tr>
<td>CHAPTER 3 ESSENTIAL NEEDS</td>
<td>3 Chap-3</td>
</tr>
<tr>
<td>CHAPTER 4 COLD TOLERANCE</td>
<td>4 Chap-4</td>
</tr>
<tr>
<td>CHAPTER 5 GENERAL HYPOTHERMIA</td>
<td>5 Chap-5</td>
</tr>
<tr>
<td>CHAPTER 6 NON-FREEZING INJURIES</td>
<td>6 Chap-6</td>
</tr>
<tr>
<td>CHAPTER 7 FREEZING INJURIES</td>
<td>7 Chap-7</td>
</tr>
<tr>
<td>CHAPTER 8 PREVENTION OF FREEZING INJURIES</td>
<td>8 Chap-8</td>
</tr>
<tr>
<td>CHAPTER 9 FALLING INTO COLD WATER</td>
<td>9 Chap-9</td>
</tr>
<tr>
<td>CHAPTER 10 OTHER INJURIES</td>
<td>10 Chap-10</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>Appendix</td>
</tr>
</tbody>
</table>
# Table of Content

## Chapter 1. INTRODUCTION

### Preface

- Objective ................................................................................................... 1.1.1
- Entry into force .......................................................................................... 1.1.2
- General ....................................................................................................... 1.1.3

## Chapter 2. PHYSIOLOGY

### General

- Physiological regulation of temperature ................................................. 2.1
  - Heat production ........................................................................................ 2.2.1
  - Heat loss from the body .......................................................................... 2.2.2
- Behavioural temperature regulation ......................................................... 2.3

## Chapter 3. ESSENTIAL REQUIREMENTS

### Water

- Fluid balance in the body ......................................................................... 3.1
- Food and nutrition ..................................................................................... 3.2
- Sleep ............................................................................................................ 3.3
- Acclimatisation

## Chapter 4. TOLERANCE OF THE COLD

### Age

- Geographic and ethnic origin ................................................................. 4.2
- Diurnal rhythm .......................................................................................... 4.3
- Nutritional status ....................................................................................... 4.4
- Gender ....................................................................................................... 4.5
- Body shape ................................................................................................. 4.6
- Physical endurance .................................................................................... 4.7
Physical activity 4.9
Alcohol and tobacco 4.10
Medication 4.11
Previous cold-related injuries 4.12
Sickness and injury 4.13
Wind 4.14

Chapter 5. GENERAL HYPOTHERMIA
General 5.1
The 3 stages of general hypothermia 5.2
35-33 °C: Mild hypothermia 5.2.1
33-30 °C: Moderate hypothermia 5.2.2
Below 30 °C: Deep hypothermia 5.2.3
Treatment 5.3
Conscious patients: 5.3.1
If the patient is unconscious and/or deeply hypothermic: 5.3.2
Evacuation 5.3.3

Chapter 6. NON-FREEZING INJURIES
General 6.1
Symptoms 6.1.1
Treatment/First aid 6.1.2
Prevention 6.1.3

Chapter 7. FREEZING INJURIES
General 7.1
Superficial freezing injury 7.2
Symptoms 7.2.1
Deep freezing injury 7.3
Symptoms 7.3.1

Chapter 8. PREVENTION OF FREEZING INJURIES
Hygiene 8.1
The skin 8.2
The feet 8.3
The hands 8.4
Earrings and piercing 8.5
Clothing (Refer to UD 6-81-2 E Personal Clothing) 8.6
Weapon handling and contact with metal in cold conditions: 8.7
Toilet hygiene 8.8
Inspection routines and leadership 8.9
Operational risk assessment 8.10
  General ..................................................................................................... 8.10.1
  Experiences ............................................................................................ 8.10.2
  Examples of risk assessment regarding winter injuries ...................... 8.10.3

Chapter 9. FALLING INTO COLD WATER
  General ..................................................................................................... 9.1
    Immersion ............................................................................................. 9.1.1
  Cold shock ................................................................................................ 9.2
  Diminished ability to swim ...................................................................... 9.3
  Hypotermia .............................................................................................. 9.4
  Post rescue collapse ................................................................................ 9.5
  Measures to take when falling into cold water ..................................... 9.6

Chapter 10. OTHER INJURIES
  Sunburn .................................................................................................... 10.1
  Snow blindness ....................................................................................... 10.2
  Carbon monoxide poisoning .................................................................. 10.3
    General .................................................................................................. 10.3.1
    Symptoms ............................................................................................ 10.3.2
    Treatment ............................................................................................. 10.3.3
  Risks associated with the handling of fossil fuels (Petrol, diesel, F-34) 10.4
1 INTRODUCTION

1.1 Preface

1.1.1 Objective

During the winter, vigilance must be exercised by both officers and soldiers in order to operate as effectively as possible. Body temperature must be conserved through the use of appropriate clothing, activity, shelter, maximum utilisation of food and drink, as well as minimum possible loss of energy from the body.

All winter injuries can be prevented! Handling such types of injury can be very demanding and, in worst case scenarios, may result in disablement, to a greater or lesser extent. There is probably no chapter within the whole of pathology where the statement ‘prevention is better than cure’ is more apt. The object of this publication is to provide the individual with an understanding of the body’s defence mechanisms against hypothermia, how the surroundings affect the body and how we can protect ourselves against diminished ability and injury. The preventive measures specified stem from many years’ experience of winter service, as well as experiences gleaned from reports about situations that have resulted in winter injuries.

In these instructions, ‘winter injuries’ refer to: frostbite, non freezing injuries, hypothermia, falling into cold water, sunburn, snow-blindness and carbon monoxide poisoning.

1.1.2 Entry into force

UD 6-81-4 E Instruction in Winter Service – Winter injuries came into force on 1st January 2011. At the same time, UD 6-81-4 Frostbite and other injuries of 1st December 1987 was withdrawn.

1.1.3 General

History

History has shown that general hypothermia, freezing injuries and non freezing cold injuries can create major problems for soldiers in combat. During the Falklands War, 20% of all injuries requiring hospitalisation related to non freezing cold injuries. Of personnel who sustained non freezing cold injuries, only 15% returned to the battlefield.

This publication should be read in relation to publications UD 6-81-2 Personal Clothing, as well as UD 6-81-3 Provisions, which all make suggestions regarding important measures in respect of the prevention of winter injuries.
2 PHYSIOLOGY

2.1 General

A person’s core temperature is precisely regulated at a constant level regardless of variations in external temperature. Measured rectally, body temperature is 37 °C. In order to maintain normal bodily functions this temperature must be constant (natural variation +/-0.7 °C). If body temperature should change beyond this then fundamental chemical processes taking place in cells which produce heat will gradually weaken and eventually stop working. This means that a person who has a fever or who is hypothermic is no longer capable of regulating heat production in the same way as a healthy person. Thus, such a person has no place in the field. However, skin temperature varies significantly in relation to the ambient temperature. With clothing and normal room temperature, mean skin temperature is 32-35 °C, which an individual will perceive as agreeable. In other words, next to the skin there is a ‘tropical microclimate’. Temperature regulation is physiologically and behaviourally conditioned.

2.2 Physiological regulation of temperature

Physiological regulation of temperature is controlled by the hypothalamus in the brain, regardless of the influence of willpower (autonomic). This affects:

**Heat production:**
- Basal heat production
- Extra heat production

**Heat loss:**
- Circulatory regulation
- Sweat production

2.2.1 Heat production

Heat production in the human organism comprises chemical energy-releasing cellular processes. This heat production is also referred to as metabolism and is a constant process. The transformation rate of chemical processes may increase with, for example, physical activity or muscular work. Basal heat production is fundamental heat production that is constantly taking place in cells. The process comprises sugar, amino acids or fatty acids that transform into high-energy compounds in which heat is released and carbon dioxide is a by-product. Intake of protein-rich food such as meat or fish increases heat production by up to 25% in the hours following consumption.

Extra heat production may be affected by food, intentional physical actions, or through involuntary actions such as shivering. Muscular work increases metabolism and thus heat production, as cells must increase their transformation rate. Heat production is most effective during physical activity. Exercising the body’s major muscle groups is the most efficient way of achieving heat production.

With a moderate level of physical activity the body’s calorific requirement is around
3000 kcal/day. During winter movement on skis with a heavy load, the calorific requirement may rise to more than 5000 kcal/day. If the body temperature falls to below 37 °C, mild shivering will occur. This may be suppressed at will for a short period of time. In the case of body temperature that falls below 36 °C, shivering will be more pronounced and will hamper the individual’s ability to move and speak; nor will it be suppressible. Whilst shivering, heat production may increase by 100-200%. However, with prolonged shivering, the body’s energy reserves will become depleted and the individual will feel exhausted.

Summary of the body’s heat production in different types of activity:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Heat Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>When resting</td>
<td>100 W</td>
</tr>
<tr>
<td>Shivering</td>
<td>200-500 W</td>
</tr>
<tr>
<td>Medium heavy work</td>
<td>400 W</td>
</tr>
<tr>
<td>Heavy work</td>
<td>600-800 W</td>
</tr>
<tr>
<td>Short and extreme bouts of exertion</td>
<td>2000 W (only of extremely short duration)</td>
</tr>
</tbody>
</table>

The picture illustrates that the body regulates body temperature so that core functions of vital organs are preserved, while extremities such as the hands and feet receive
much less heat. The figure indicates that a 2 degree drop in core temperature will be equal to an 8 degree temperature drop in the fingers and feet.

Body temperature is regulated by blood flow to the skin, among other factors. If the body is warm, the veins will open so that warm blood may flow to the extremities. Blood flow may increase up to 10 times compared to a normal situation. When the core temperature drops the body will do the opposite by closing the veins so that the body’s core functions are preserved. This will result in a rapid drop in temperature in the hands and feet. Thus, an individual will be more readily susceptible to cold-related injuries to the hands and feet when the core temperature drops.

Ethnic groups with origins in cold regions have a genetic reflex (‘Hunting reflex of Lewis’, henceforth referred to as the ‘hunting reflex’) which, at intervals of a few minutes, opens the veins in the extremities in order to create blood flow, thus causing an increase in temperature in the extremities. This reflex gradually disappears as the core temperature drops and will disappear completely when an individual becomes hypothermic, i.e. body temperature lower than 35 degrees. Mental stress also reduces this effect.

! Hands will be more susceptible to freezing injuries if the core temperature is low.

2.2.2 Heat loss from the body

Heat loss from the body to the surroundings primarily occurs in four different ways:
A significant amount of body heat loss is from the head.

1. **Through circulation** (convection principle)
   The heated air layer closest to the skin flows away and is replaced by cold air. This is particularly noticeable when an individual is exposed to extreme, cold wind.

2. **Through contact or conduction** (conduction principle)
   Contact with the body, e.g. the surface that an individual is lying or sitting on. An example of this is the cold soles of shoes that ‘steal’ heat from the body. Water conducts heat 26 times faster than air. Thus, cooling will occur rapidly when an individual is wet.
3. **Through radiation**
   When an individual without clothing remains static in a temperate room, 60% of total heat loss will occur through heat radiation. To a large extent, such heat loss is regulated and restricted by clothing.

4. **Through evaporation**
   Heat loss will occur when sweat on the skin and in clothing evaporates. During physical activity, evaporation is the most important method of heat transfer (over 50% of heat loss). Moisture in clothing or on the skin uses energy to evaporate and cool the skin which, in turn, extracts heat from the body.

In order to maintain a stable body temperature, heat loss to the surroundings is precisely regulated through circulatory regulation and regulation of sweat evaporation.

- **Circulatory regulation**
  Blood flow to the skin and subcutis determine the skin’s thermal conductivity. The effects of cold causes the veins in the skin to contract. Blood flow reduces, skin temperature decreases and skin insulation increases. When exposed to heat the veins expand, blood flow increases, skin temperature rises and skin insulation diminishes. Circulatory regulation, which is precise, mainly affects the arms and legs.

- **Regulation of sweat evaporation**
  For every 1 litre of evaporated sweat, the body releases 570 kcal of heat to the surroundings. The evaporation of sweat is a prerequisite. If sweat is secreted from the body, fluid and salt loss will occur, but not heat loss. The sweat mechanism is an effective yet less accurate regulating mechanism than circulatory regulation.

Heat loss through the respiratory passages occurs through a steady rewarming of exhaled breath and through loss of water vapour. Heat loss is estimated at around 200 kcal/day and fluid loss at around 300 ml/day. In Arctic regions with dry, severe cold, heat loss from the respiratory passages is significant and may represent around 10% of the body’s total heat loss.

Total heat loss is the sum of circulation, conduction, radiation and evaporation and is not subject to any kind of regulation.

2.3 **Behavioural temperature regulation**

'Behavioural temperature regulation' refers to:
- The adjustment of clothing (e.g. adjustment of headgear/zips)
- Seeking shelter
- Avoiding the cold
- Intentional physical activity (indirect metabolic impact)

An individual’s ability to adapt to a colder climate depends on behavioural modification because the physiological changes to the organism are minimal and
secondary. Only during extreme and prolonged exposure to cold may an individual achieve a degree of physiological resistance, which nevertheless diminishes rapidly if such exposure should cease.

In order for clothing to be effective, attention should be paid to the parts of the body (extremities) that are most susceptible to heat loss. A significant amount of body heat is lost from the bare head and neck.

Veins on the head will not contract in the cold to the same extent as the rest of the body, thus resulting in major heat loss when an individual experiences cold temperatures without the protection afforded by a cap. While at +20 °C only 5% of the body’s heat loss occurs from the head, in cold temperatures as much as 80% of heat loss occurs from the head. It should also be noted that blood flow to the nose, ears, chin and cheeks is not the same as to the rest of the head. Thus, these parts of the head are susceptible to freezing injuries.

The head and neck are important parts of the body in respect of releasing heat (bare head and unbuttoned neck), as well as to conserving body temperature (cap, scarf, balaclava). The hands, feet and face are the parts of the body most susceptible to freezing injuries. Small, cylindrical parts of the body such as fingers also lose a lot of heat as they have a large surface area in relation to their volume. If mittens are used instead of gloves, the total surface area is less and it is easier to keep the hands warm.

Male genitalia can be susceptible to freezing injury during physical training if clothing is too thin.

*Body temperature may be effectively regulated by adjusting headgear.*
3 ESSENTIAL REQUIREMENTS

3.1 Water

Water is a prerequisite to the body maintaining its normal chemical balance, as well as to the normal function of vital organs. In this respect, water intake during the winter should be at least 2 1/2 litres per day in order to avoid dehydration. Additional to this is water that enters the body via food. The need for fluid increases during physical activity and an individual should attempt to consume water at frequent intervals so that the body has time to absorb the water. The ideal amount of water would be around 1 litre per hour or 1-2 dl per 10 mins. If an individual drinks a large amount of water over a short period, much of the water will be excreted from the body before being sufficiently utilised.

3.2 Fluid balance in the body

The human organism comprises 60% water. The kidneys excrete waste products produced by metabolism and regulate the excretion of water and waste products from the body so that the tissue fluid’s internal composition and amount is kept constant. If the water deficiency is too great (>2 litres) this may result in disruption to bodily functions. A loss of water equal to around 12% of body weight may be life threatening.

When the body does not contain a sufficient amount of water the condition is referred to as ‘dehydration’. Dehydration increases the risk of sustaining winter injuries because dehydrated soldiers have:
- Reduced capacity to regulate temperature
- Diminished resistance to the cold
- Reduced physical working capacity

During winter, fluid loss from the body can be significant. Physical activity may result in an individual sweating several litres of fluid per day. Moreover, an individual will continuously lose fluid through the skin and the respiratory organs, as well as when stationary and while asleep. Evaporation is considerable, around 1/2 litre of water per day. Even a relatively low degree of hypothermia may cause disruption to the kidneys and increase water excretion through urine. Coffee and tea are diuretics and should therefore be consumed as little as possible. Even though a lot of fluid is lost in the cold, there is no corresponding thirst. When the colour of urine changes from light to dark yellow, orange to brown, this is a sign of dehydration. Visible indications of dehydration are headaches, listlessness, irritability, constipation and increasing degrees of impaired awareness. Thus, it is vital that the body receives sufficient fluid during the winter.
3.3 **Food and nutrition**

Personnel who are appropriately clothed do not, as a rule, require a higher calorie intake than normal because of cold weather. The need for a higher calorie intake arises from physical activity such as, for example, movement in snow with heavy equipment, either on foot, on skis or snowshoes (increases from 3000 kcal to over 5000 kcal per day). Hot food and drink provide energy and constitute a vital heat supplement. In cold surroundings, body temperature is kept higher through the night if food is consumed before resting.

When personnel are obliged to operate in cold weather for prolonged periods, they should consume more fat in relation to proteins and carbohydrates. 1 gram of fat provides the organism with more than twice the amount of energy as 1 gram of proteins or carbohydrates.
3.4 Sleep

Sleep is the most effective form of rest. In order to maintain a normal level of activity both physically and mentally, over a prolonged period, an individual requires at least 6 consecutive hours of sleep per day in safe and peaceful surroundings. A lack of sleep will particularly affect mental performance such as reaction time, learning aptitude, the ability to perform complicated tasks, alertness, etc. During operations of around 1 week’s duration, a dramatic reduction in performance will be observed in individuals who have slept for less than 3-4 hours per day.

A healthy and reasonably well rested person will awaken long before reaching the dangerous limit for general hypothermia. When suffering from a lack of sleep and exhaustion it will be easier for an individual to ignore the body’s signals concerning winter-related injuries.

*The body should receive fluid on a regular basis.*
4 TOLERANCE OF THE COLD

The body’s ability to tolerate the cold varies significantly from one individual to another and is influenced by a number of factors, both physical and mental.

4.1 Acclimatisation

Acclimatisation is exposure to cold surroundings for an extended period. Acclimatisation may be divided into physiological and psychological adaptation. Physiological adaptation may comprise changes to metabolism, changes to the nervous system, increased tension in the muscles, hormonal changes and/or cellular changes, as well as an increased capacity to shiver. Approx. 70% acclimatisation may be achieved after 10 days and full acclimatisation after around 30 days. Psychological resistance may comprise a heightened tolerance to exposure to cold insofar as cold is perceived as being less unpleasant. Psychological acclimatisation takes around 2-3 days and means that an individual comes to accept lower temperatures.

Methods of acclimatisation such as, for example, systematic bathing in cold water or spending time outside with minimal clothing should be avoided.

4.2 Age

Within the age limits applicable to the Norwegian Armed Forces, age is of little consequence. However, younger personnel are more resistant to cold, while older personnel are somewhat more susceptible to freezing injuries.

4.3 Geographic and ethnic origin

Ethnicity refers to people of common origin who share a specific culture. A biologist describes race as genetically diverse populations in which the individuals of each respective population share common genetic or observable traits. It has been noted that the various races have different tendencies to develop certain types of illness (e.g. increased blood pressure), as well as having different tolerances to the cold. Several studies have, in certain cases, indicated major differences in cold tolerance among persons of diverse ethnicity.

It can be generally stated that people with genetic origins in cold regions are better equipped to tolerate the cold than people from warm regions. The aforementioned hunting reflex is absent or weak among people with genetic origins in warm regions.

4.4 Diurnal rhythm

Temperature regulation changes at night. Human beings have diurnal rhythms that regulate awareness, performance ability, body temperature and a number of hormones. Temperature regulation changes at night (decreases) and, during night work, increased heat loss and diminished sensitivity to the cold has been indicated.

4.5 Nutritional status

Undernourishment and hunger decrease cold tolerance significantly in the same was as water deficiency (dehydration). A lack of nutrition will result in poorer/lower heat
production in the body.

4.6 Gender

Several studies have indicated that men can withstand cold more than women. There may be several reasons for this. However, it is important to point out that there are major individual differences.

Women and men have significantly different levels of sex hormones. Women of menstrual age have major cyclical variations in the female sex hormones. Several of the sex hormones considerably affect the veins and circulatory system and may therefore greatly impact upon both cold tolerance and adaptation mechanisms.

Men have greater muscle mass than women. Muscles play a major part in metabolism and therefore also in heat release when resting and during physical activity.

4.7 Body shape

The relative skin surface is greater in a person of slight build than in a stout person. This means that a small, thin person would freeze more easily. A certain amount of body fat is an advantage as it will insulate against the cold.

4.8 Physical endurance

In respect of cold tolerance, being in good physical shape is one of the most significant factors. Good physical shape means that an individual works more effortlessly, sweats less and possesses reserves of mental strength. These factors diminish the risk of sustaining cold-related injuries.

4.9 Physical activity

Strenuous physical activity leads to significant sweat production. The evaporation of moisture from sweat results in heat loss from the body. Damp clothing significantly reduces the clothing’s insulating properties. The risk of hypothermia increases when an individual is stationary, which, in turn, results in less heat production. This causes hypothermia of the body, particularly the arms and legs. Ideally, an individual should work at a steady, even pace in cold weather.

4.10 Alcohol and tobacco

Alcohol causes an increase in blood circulation in the skin and subcutis whereby heat loss from the body increases. Heat loss may result in a reduction in core temperature. Alcohol decreases shivering, judgement becomes impaired and the risk of general hypothermia and cold-related injuries increases significantly. Tobacco contains nicotine, which reduces the diameter of the veins, decreasing blood circulation. This, in turn, leads to an increased risk of freezing injuries.

4.11 Medication

Certain types of medication affect blood circulation and sweating. If medication is being used on a regular basis, it is recommended that advice is sought from a doctor.
4.12 Previous cold-related injuries

Previous freezing injury significantly increases the risk of freezing injury occurring again in the same location. This is particularly the case following deep, local freezing injury and non-freezing injury (trench foot). An previous injury will cause the veins to contract more rapidly, providing less heat to the skin. Nor will the hunting reflex function in cases where previous freezing injuries has occurred.

4.13 Sickness and injury

Sickness and injury are particularly dangerous during the winter as such conditions can result in soldiers being more stationary than usual and thus more susceptible to winter injuries. A number of illnesses result in diminished or severely disrupted temperature regulation. Blood loss or loss of circulation following an injury reduces blood supply to the arms and legs and an individual will be more susceptible to freezing injuries. During the Korean War, 2/3 of American soldiers who suffered freezing injuries had already been immobilised by a previous injury.

Skin that has been burnt will be extremely susceptible to freezing injuries because the nerves have diminished capacity and skin tissue is damaged, reducing blood flow.

Previous injuries, wounds and scar tissue have poorer blood flow and are thus more susceptible to freezing injuries and non freezing injuries.

4.14 Wind

In virtually calm air, a boundary layer is formed with stationary air. Because air is a poor heat conductor (good insulator) this boundary layer will act as an insulating layer. During windy conditions, the air next to the skin is transported away, the boundary layer becomes thinner and heat loss to the surroundings increases. Thus, wind increases cooling (at temperatures below skin temperature).
The table shows how the effects of cold on exposed/bare skin rises as wind velocity increases. The table shows the perceived skin temperature at different temperatures with varying wind velocity. A combination of moderate cold and wind may be more hazardous than extreme cold and calm air.

! It should be noted that people tolerate cold differently. Thus, allowances should be made for the individual adjustment of clothing.
5 GENERAL HYPOTHERMIA

5.1 General

Hypothermia is defined as a cooling down of the body’s core temperature to below 35 degrees.
Hypothermia may result in arrhythmia and cardiac arrest.
General hypothermia is a hazard that is often not taken seriously enough. In Norway, such injuries may occur throughout the year due to the country’s latitude and topography:
- Mountain and plateau during the summer: Damp climate with rain, wind and air temperature between +10 and 0 °C may result in hypothermia if inadequate clothing is worn
- Mountain and plateau during the winter: Hypothermia most frequent among personnel who are insufficiently dressed, possess poor quality equipment and who are exhausted. Wind significantly increases the risk of hypothermia
- Injured personnel in exposed terrain while awaiting assistance are especially susceptible to general hypothermia. Even in warm weather, major heat loss may occur when personnel lie in wet clothes on a damp surface, in addition to being injured
- Cold water, vessel capsized: Only in tropical water at a temperature of around 25 °C will an individual be capable of maintaining normal body temperature for a prolonged period. The most common cause of death as a result of falling into cold water is hypothermia, not drowning

5.2 The 3 stages of general hypothermia

It is of practical value to divide general hypothermia into 3 stages. The respective degree values refer to the body temperature measured rectally. Some symptoms or signs of hypothermia are described below. It should be emphasised, however, that hypothermia can be difficult to detect and that symptoms may vary and are extremely individual. It should be noted that many thermometers are unable to give readings low enough to detect hypothermia.

5.2.1 35-33 °C: Mild hypothermia

The individual is conscious. If the individual is not exhausted, he/she feels very cold and will shiver violently. Increased lethargy and indifference sets in. The individual is generally capable of generating body heat.
- Symptoms or signs:
  - Changes to states of consciousness – listlessness, confusion, apathy
  - Cold hands and feet
  - Muscle tremors (the body’s natural reaction)
  - Normal to rapid pulse and respiration
  - Diminished fine motor skills, eventually diminished gross motor skills
5.2.2 33-30 °C: Moderate hypothermia

The individual requires assistance to increase body temperature and must therefore be regarded as a patient. Shivering ceases. Increased muscular rigidity. The patient feels comfortably warm. Heightened drowsiness that gradually changes to unconsciousness. Slow breathing and pulse.

- Symptoms or signs:
  - Further diminished/ altered awareness/ tiredness/ listlessness/ unconsciousness
  - Muscular rigidity
  - Slow pulse and respiration
  - Irrational behaviour – paradoxical undressing
  - Shivering ceases

5.2.3 Below 30 °C: Deep hypothermia

The patient may be unconscious and is white as a sheet. Breathing and pulse may be extremely difficult to detect. In this condition the patient may easily be regarded as dead.

- Symptoms or signs:
  - Unconsciousness or coma
  - Pale, cold skin
  - Dilated pupils with no light reflex
  - Slow pulse – difficult to detect
  - Low respiration – difficult to detect
  - Vital signs may appear to be absent but the patient is NOT necessarily DEAD

When the body temperature falls below 28 °C, there will be an increased risk of atrial fibrillation which, in turn, may lead to cardiac arrest. The patient will eventually die of cardiac arrest and not of poor respiration.

5.3 Treatment

5.3.1 Conscious patients:

- Active rewarming through physical activity. Activation of major muscle groups
- Monitor the patient
- Provide the patient with shelter immediately; remove the patient from cold surroundings at once. If possible, take the patient to a heated tent or building as soon as possible
- Remove all wet clothing and replace with dry clothing, preferably wool
- Look for signs of local freezing injury
- Prevent further heat loss by wrapping the patient in bubble-wrap, a sleeping bag, patient warming blanket, blanket, etc.

- If dry clothing cannot be found, the patient may be placed, in an emergency, in a plastic bag or Jerven bag that should then be tied at the neck to prevent evaporation (heat loss), prior to the patient being transported to a hospital.

- A conscious patient may be given a hot drink.

- Avoid smoking and alcohol.

- Place hot water bottles close to the arteries and on the stomach.

- In cases of mild hypothermia, the patient may be given a hot bath or shower. In cases of moderate or deep hypothermia, the patient should NOT be given a hot bath or shower.

- Use the Patient Warmer and a blanket. If this is not available further hypothermia may be prevented by a colleague lying close to the patient, skin-to-skin, until such time as competent personnel are in attendance and can continue with further treatment.

5.3.2 If the patient is unconscious and/or deeply hypothermic:

- Perform ABCDE and check for vital signs. These must be monitored for an extended period as vital signs (pulse and respiration) may be extremely slow.

- The patient must be treated, transported and evacuated gently. This is to prevent cold blood from the extremities returning to the heart, which may cause cardio-vascular complications.

- If necessary, perform HLR, although not before ascertaining that the patient has no pulse or respiration.

- The patient may be laid in a stable, lateral position if a pulse and respiration are present.
5.3.3 Evacuation

- After first aid has been administered the patient should be transported in a heated, closed vehicle to the final place of treatment. It is important to avoid further hypothermia during transportation. The patient should always lie in a stable, lateral position.
- Use the Patient Warmer and a blanket.
- Final treatment: Patients suffering from mild hypothermia may receive final treatment in a heated tent or building providing the conditions are appropriate. The patient must be continuously monitored by competent personnel.
- It should be noted that an individual who is not hypothermic will quickly grow cold and therefore cannot remain lying close to a hypothermic patient for an extended period.

*In the case of moderate and deep hypothermia, final treatment should be carried out at a hospital.*
6 NON-FREEZING INJURIES

6.1 General

A non-freezing injury is a local injury that usually occurs at temperatures of between 0- +10 degrees. The temperature may be lower or higher but the injury occurs when skin temperature is 8 degrees or less over an extended period (often more than 12 hours).

Non freezing cold injuries are the result of prolonged exposure to a combination of dampness and cold. The veins contract as a consequence of heat loss, reducing blood flow to the extremities and preventing cells from receiving oxygen and nutrition. Tissue temperature under such conditions does not fall below 0 degrees. Thus, ice crystals do not form in skin tissue. For this reason, the term ‘Non-freezing injury’ is used, or ‘trench foot’.

In certain cases, trench foot may develop within 6-8 hours but generally takes longer to develop. However, there are examples of this injury occurring more quickly. The colder and damper the body part is, the more rapidly the injury occurs. The same applies to skin that has sustained pressure injuries.

Figure: 6.1

*Boat in snowy weather*

The condition usually afflicts the feet but may also afflict the hands. The injury will often be symmetrical, i.e. it may appear on both sides simultaneously, for example. It may cause lasting damage to nerves, blood vessels and skin tissue. It may also cause delayed injury such as hypersensitivity and diminished cold tolerance.
Be particularly aware of Non Freezing cold injuries when the terrain is very damp. This will heighten the risk of freezing injury when the temperature reaches 0 degrees and slush, or during snow melt in spring.

Figure: 6.2
Early stages of Non-Freezing injury

Figure: 6.3
Non-Freezing injury

6.1.1 Symptoms
- Numbness, prickling sensation in the skin
- Loss of sensation
- Pallid skin complexion, delayed capillary filling
- Loss of cold sensation
- Weak pulse in the extremities
- Walking disorders, unsteady walking
- Oedema/swelling, pain when rewarming

In many cases it is difficult to detect mild forms of non freezing cold injuries. Often the only symptoms are numb toes. On many occasions, pain in the toes will not occur before several days have elapsed.

6.1.2 Treatment/First aid
- Remove the patient immediately from cold/damp surroundings
- Carefully warm the patient (the patient will have a diminished sensitivity to pain and will be susceptible to burns from a heat source)
- Avoid rewarming the patient if the patient cannot be kept warm
- Give the patient a hot drink
- Avoid massaging or rubbing the patient with snow, etc., as this may damage skin tissue
- Any swelling or pain will require the patient to be carried on a stretcher (in serious cases)
- Elevate the extremities
- The patient may require pain relief following rewarming

6.1.3 Prevention
- Dry boots and socks
- Change socks regularly
- Rest/sleep with dry feet
- Towel dry feet once per day
- Cold feet must be treated swiftly. It is a generally held belief that it is acceptable for feet to be slightly cold. However, this may quickly result in injury

**Non-freezing injury occurs most rapidly in a combination of cold and damp conditions. Skin temperature never falls below 0 degrees.**
7 FREEZING INJURIES

7.1 General

![Figure: 7.1](image)

*Figure: 7.1*
*A frostbitten hand thawing*

Local freezing injury is, essentially, destroyed tissue, insofar as ice crystals rupture and split cells. This often leads to fluid accumulation at the point of injury once the injury has thawed. Degrees of frost must be present in order for a freezing injury to occur.

Local freezing injury may occur even when the core temperature is normal. However, there is a greater likelihood of sustaining such injuries when the core temperature is low.

When cell and tissue temperature fall below freezing point freezing injury occurs. When the skin cools, the veins in the exposed location will contract and the skin will turn pale. With a skin temperature of 10 °C, a transient redness will be present. This is caused by an oxygen surplus due to the metabolism – and thus the oxygen requirement – being significantly reduced. At this temperature, pain will occur. With a continuing drop in temperature the skin will remain red as the veins start to expand again. When skin temperature reaches around freezing point the skin will become pale again due to contraction of the blood vessels in this area.

The Norwegian Armed Forces divides freezing injuries into *superficial* and *deep* types. The difference is in how deep, and therefore how serious, the injury is. Both types of injury will cause permanent tissue damage.
Figure: 7.2
The figure shows areas susceptible to freezing injuries

Figure: 7.3
Superficial freezing injury

Figure: 7.4
Superficial freezing injury, deep
7.2 Superficial freezing injury

7.2.1 Symptoms

The skin is pale at skin temperatures around 0 °C. A moderate degree of pain and a prickling sensation will be felt in the skin, followed by cessation of the feeling of cold and discomfort. Initially, ‘white spots’ will appear on the nose, cheeks, ears and fingers. This is the initial stage of tissue freezing. When the skin freezes, ice crystals form, primarily in tissue fluid between the skin cells. The skin is now numb, white and hard but may be moved in relation to the subcutis. Skin above joints may be moved.

- White or grey spots appear in the skin
- The skin is waxy but can be moved above the underlying musculature and hard tissue
- This is divided into 2 stages:
  1. White skin that warms up and which appears healthy after a maximum of 15 minutes. The skin is red, not white, following first aid.
  2. An injury that extends deeper into the skin will typically have swellings or blisters containing transparent fluid once the injury has thawed.

Figure: 7.5
Local freezing injury after thawing

Figure: 7.6
Local freezing injury. Warms up via the skin-to-skin method
Treatment/First aid
Local superficial freezing injuries should be treated in situ, ideally in a sheltered location. Warm skin placed against the injured area is extremely effective. Place the palms of the hands against the nose, ears, cheeks and chin. Do NOT rub or chafe. Frozen fingers or hands should be placed in the armpit. Toes and feet should be placed upon a colleague’s stomach beneath clothing (see figures below).
Give the patient a hot drink and provide warm, dry clothing. Following rewarming, the injured area must be covered with clothing as frostbitten skin offers extremely poor resistance to the onset of new hypothermia.
Frostbitten skin should be warmed up against skin at normal temperature, skin-to-skin:
Superficial freezing injuries is best treated via the skin-to-skin method.
If the frostbitten parts of the body do not warm up within 10-15 minutes, the soldier must be evacuated/taken to a heated tent or building as soon as possible.

Final treatment:
- Rewarming at normal room temperature
- Do not rub or massage, use the skin-to-skin method
- Ensure that frozen parts of the body are not too close to a primus stove or oven as the patient will have a diminished sensitivity to pain and will thus be more susceptible to burns
- Give the patient a hot drink
- Hospital treatment is mandatory in cases of extensive superficial freezing injuries

7.3 Deep freezing injury

7.3.1 Symptoms

Deep freezing injury extends deeper than the skin into the subcutis and musculature. The frozen part of the body is pale, hard and numb. The skin and musculature above the bone cannot be moved. This hardness is the result of tissue freezing to ice in the exposed areas.

Treatment/First aid

This injury should not be treated in situ. Wrap the injured party well to prevent the freezing injury from spreading. NB! Watch out for signs of general hypothermia. The patient should be wrapped in warm, dry clothing (ideally wool against the body) and blankets. Provide the patient with a hot drink, if possible.

Figure: 7.12

First aid being administered for local deep freezing injury. Treatment following local DEEP freezing injury. Note that the right hand has been wrapped up and NOT thawed.
If necessary, the patient may walk on a frozen foot. However, as soon as the foot starts to rewarm, the patient should be carried on a stretcher. Deep freezing injury that has thawed is extremely susceptible to new freezing injury. Repeated freezing injury will significantly worsen the injured body part. The patient should therefore be evacuated to a location at which final treatment may be carried out.

Final treatment should begin and end at an appropriate location, preferably a hospital.

Measures to be taken by non-medical personnel away from a hospital:
- Maintain normal body temperature

Never rub the patient!

*If there is doubt as to whether the freezing injury is superficial or deep, it should be treated as deep freezing injury.*
8 PREVENTION OF FREEZING INJURIES

"...all local cold injuries should be regarded as preventable during peacetime in the military noncombat situation..."


8.1 Hygiene

Individuals are responsible for taking care of themselves and attending to their own health. Furthermore, during winter it is more important to ensure that appropriate hygienic measures are implemented. Even at low temperatures and with a restricted water supply, proper hygiene may be practiced.

The armpits, crotch and feet should be washed more than once per week. Washing in snow or snow bathing are very suitable alternatives to water when conditions are appropriate. Be aware of the risk of sustaining freezing injuries on the feet when snow bathing, and particularly on parts of the body that have previously suffered cold-related injuries.

8.2 The skin

It is recommended that individuals do not wash or shave on the last day prior to prolonged exposure to severe cold. Water and soap remove the skin’s natural fat layer.

The hands and face should be massaged before setting out in severe cold. At the initial stage of departure an individual should: Make grimaces and use chewing gum to maintain blood circulation/blood flow in the face. Freezing injuries should be prevented by regularly inspecting colleagues to check for signs of white spots.

To a certain extent, beards and moustaches will insulate the skin.

Research has indicated that cold cream provides little or no protection against the cold and may, in certain cases, have the opposite effect. Therefore, it is recommended that cold cream is not used in the Norwegian Armed Forces. Oily, water-free cream may be used on the fingers to prevent skin from becoming dry and cracked.

8.3 The feet

The feet should be kept clean, dry and warm. If the legs become cold it is difficult to remain warm, even if an individual has dressed appropriately. Exercise the legs!

A spare pair of dry socks for use at night should always be kept in kit bags. Boots must be large enough to permit the free movement of toes. During the winter, it is recommended that footwear 1-2 sizes larger than footwear used in the summer is worn. This will provide sufficient space for 2 pairs of socks, as well as air. It is recommended that foot muffs are worn during the winter.

8.4 The hands

Metal objects must not be touched with bare hands as metal is an extremely effective cold conductor. Mittens/contact gloves should always be worn. Mittens that are not being used should be placed on the body.
Handwear must also be adjusted in relation to whatever activity is being carried out in order to avoid moisture accumulation. Personnel should train in proficiency in performing tasks whilst wearing mittens. The temperature of the hands and feet should be adjusted according to the body’s core temperature (fig. 1). Ensure that the body has sufficient clothing in order to adjust handwear.

8.5 Earrings and piercing
Earrings and piercing conduct the cold and should therefore not be used.

8.6 Clothing (Refer to UD 6-81-2 E Personal Clothing)
A good rule of thumb for clothing in winter conditions is: Adjust clothing regularly to suit the activity being carried out. Keep reasonably warm throughout. These days, net underwear is used next to the body to create an air pocket, followed by a wool layer. It is preferable to use several thins layers of clothing than fewer thick layers. The outside layer should be windproof. Utilise the options for ventilation provided on the field uniform by using the zips beneath the armpits, at the hips, crotch and chest, as well as at the wrists and neck. Uses braces instead of a belt as braces provide more effective air circulation. Self-discipline will be really put to the test when the option to dry wet clothing is no longer present, or is severely restricted. However, personnel may remain reasonably comfortable over prolonged periods by ensuring that discipline is maintained within the division, through prevention, and by taking the following precautions:
- Adjust the pace of a march so that heat loss and heat production compensate each other
- Always change into dry clothing before settling down for the night
- Rest in dry clothing, work in ‘wet’ clothing

8.7 Weapon handling and contact with metal in cold conditions:
Contact with metal in cold conditions may easily result in freezing injuries. The hands and face are particularly susceptible. When firing in cold conditions, it is advantageous to place a cloth between the weapon and the face, e.g. balaclava or face mask. The handling of weapons with mittens in cold conditions requires practice. This must therefore form part of your training!

8.8 Toilet hygiene
The latrines must be constructed in such a way that they do not ‘repel’ soldiers. Tent canvas or a Jerven bag should be used to provide shelter from the elements. Toilet facilities should be provided for both men and women.
If an individual fails to use the latrine this results in body energy being used to keep foeces warm, which, in turn, leads to the individual feeling cold more easily. Moreover, the individual will become unwell and possibly constipated if bowel movement is withheld for an undue length of time.
8.9 Inspection routines and leadership

For the officer in charge, SIBIR is one of the most vital tools for the prevention and detection of freezing injuries. SIBIR (Norwegian Armed Forces jargon) refers to a visual inspection of the extremities and general physical condition of soldiers, undertaken by the officer in charge, with a view to preventing and/or detecting the development of early stages of freezing injuries.

Here are some general tips on SIBIR that may be used as a check list in the field:
- inspections should be undertaken by the division’s most experienced officers
- carry out the inspection as an informal chat so that the inspection may be ‘rendered harmless’
- touch the skin to feel whether it is cold or damp
- check for cuts, blisters and strain injuries
- you must touch the skin directly with your bare hands/fingers
- use a pointed and a blunt object (safety pin, etc.) to check for signs of response. The individual being inspected should be able to distinguish between the blunt and sharp end of the object. If the individual is unable to do so, this is a sign of injury
- particular attention should be paid to susceptible areas such as the face, fingers and toes
- check that field boots are dry. If field boots are wet, this is an indication of the condition of the feet (2 pairs of socks are recommended as they are warmer and also prevent blisters from forming)
- Self-inspection and verbal feedback will not suffice

Before departing on exercises, a thorough SIBIR should be carried out on all divisional personnel in order to gauge the normal condition as a reference point for further inspections. This should be recorded in a log. It would be an advantage to carry out this inspection several weeks before departing on the exercise so that feet in poor condition may be attended to.

! Prevention of freezing injuries during the winter is largely a question of leadership. All personnel must be familiar with the division’s preventive measures and it must be ensured that such preventive measures are carried out.

8.10 Operational risk assessment

8.10.1 General

Risk assessment is an effective tool to guard against and prevent freezing injuries and non-freezing injuries. Experience has shown that certain factor recur when a division experiences winter injuries. By being ready to identify risks at an early
8.10.2 Experiences

A summary of experiences and reports from units who have had to deal with winter injuries confirms the following factors/shortcomings:

- an absence of hot food in the previous 14 hours, as well as too little to drink
- demanding weather conditions with severe cold (colder than -10 degrees) and extreme wind
- little or no time to take breaks
- unclear instructions to the officer/s in charge or an absence of leadership
- verbal assurances should have been replaced by actual physical controls and inspections
- deficient follow-up of soldiers
- deficient establishment and follow-up of inter-soldier inspection
- a combination of dampness and cold (e.g. boat operations or floodwater)
- clothing not sufficiently prepared (footwear too tight, holes, and missing items)
- too high ambitions for the exercise in relation to the level of training
- outdoors for 24 consecutive hours without access to a heat source

A proper and thorough risk assessment will ensure that many of these factors are addressed. Risk assessment through planned evaluation of the type undertaken in advance of exercises in which a 5-stage model is utilised will ensure that risks associated with winter injuries may be identified and assessed. Based on this, a range of necessary measures should be developed that may later be translated into practice during the exercise. (Ref. UD-2-1 Risk Assessment).

At the planning stage, it is important to arrive at, and establish, a number of preventive measures aimed at averting winter injuries in a division. This should be clearly noted in the risk assessment.

With regard to the actual implementation, it is vital that the necessary routines that have been established are followed up, including the implementation and reinforcement of inspection at the lower levels of the division. The commander’s ability to raise awareness among his/her own officers regarding this time-critical assessment is crucial. The officers in charge should have established cutoff criteria in respect of winter injuries, appropriate to the activity to be undertaken.

It is crucial to ensure that officers in charge at a low level are prepared and possess the requisite knowledge to assess situations during the actual exercise, as well as when unexpected hazards arise. This is important given that the outcome of the initial symptoms and stages of general hypothermia, non-freezing injuries and freezing injuries will be easily exacerbated if immediate measures are not taken in situ, as well as in the situation itself.
8.10.3 Examples of risk assessment regarding winter injuries

Assignment/task: Norwegian winter course 2010 – The BIRKEBEINER exercise

Date: 19\textsuperscript{th} – 27\textsuperscript{th} januar 2010

Undertaken by: The Norwegian School of Winter Warfare

Page: 1 av 12

Example:
9 FALLING INTO COLD WATER

9.1 General

The body will lose heat in water at a temperature of less than 28 °C. Heat loss will be more rapid the lower the temperature of the water. The table below indicates what happens when an individual falls into water at different seawater temperatures.

<table>
<thead>
<tr>
<th>Temperature in Celsius</th>
<th>Exhausted</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>Unlimited</td>
<td>Unlimited</td>
</tr>
<tr>
<td>21-27</td>
<td>3-12 h</td>
<td>3- Unlimited</td>
</tr>
<tr>
<td>16-21</td>
<td>2-7 h</td>
<td>2-40 h</td>
</tr>
<tr>
<td>10-16</td>
<td>1-2 h</td>
<td>1-6 h</td>
</tr>
<tr>
<td>4-10</td>
<td>30-60 min</td>
<td>1-3 h</td>
</tr>
<tr>
<td>0-4</td>
<td>25 min</td>
<td>30-90 min</td>
</tr>
<tr>
<td>0</td>
<td>&lt; 15 min</td>
<td>15-45 min</td>
</tr>
</tbody>
</table>

*Figure: 9.1

*Table for falling into cold water*

The reason why the body cools so rapidly in water is that water conducts heat 26 times faster than air. Immersion in water causes an individual to lose the insulating air pocket provided by clothing. However, it has been demonstrated that a fully clothed individual will tolerate cold water better than an unclothed one insofar as water flowing into the various layers of clothing will be heated by the body. Thus, all clothing and footwear should be kept on the body.

It is important to stay as calm as possible in order to try and remain ‘warm’. External waterproof clothing is therefore an advantage as the water cannot flow in and out as easily. The ‘foetal position’ should be adopted. Avoid inhaling cold water as it may induce a coughing fit and uncontrollable reflexes. At the same time, the head should be prevented from becoming immersed in water as research has indicated that this will increase the risk of cardiac arrest.

In water at a temperature approaching 0 °C, all individuals, regardless of their proficiency level, will have a diminished ability to move. It should be noted that an individual who has been brought ashore following a fall into water is extremely susceptible to hypothermia through exposure to cold and/or wind. Thus, the individual should be taken directly to a sheltered location and wet clothing should be removed before it freezes to ice. The individual should be changed into dry clothing. The individual should be followed up in respect of hypothermia symptoms and first aid should be administered, if necessary.
9.1.1 Immersion

Immersion is defined as sinking in water to shoulder level. In the case of immersion, there are four clear stages that individually or collectively may result in death. These four stages are:

- Cold shock
- Diminished ability to swim
- Hypothermia
- Post rescue collapse (collapse at the moment of rescue, or up to several hours after being rescued)

This depends, however, on external effects, as well as a number of individual factors:

**Individual factors:**
- Age
- Nutritional status
- Endurance
- Physical activity
- Lack of sleep
- Sickness and injury
- Alcohol and tobacco

**External effects:**
- temperature
- Wind
- Air humidity

9.2 Cold shock

Cold shock is a reaction that is triggered immediately following a fall into cold water. How cold the water needs to be to induce such a reaction varies from one person to another. The reaction is stronger if the individual has fallen into the water unexpectedly. An example of this would be falling from a boat or through a hole in the ice. Thus, mental preparedness is a vital factor.

A reaction is generally only noted at a water temperature of less than 25 °C. Maximum response at around 10 °C. The shock quadruples the oxygen requirement in the first minute. There is an imminent risk of drowning. Cold shock leads to significant inspirational gasping followed by a short period (minutes) of uncontrollable hyperventilation.

Hyperventilation may also affect levels of consciousness.

9.3 Diminished ability to swim

Contraction of the veins causes the extremities to become cold, reducing muscular strength. Even good swimmers will become incapable of swimming in cold water
after a relatively short period of time.

9.4 **Hypotermia**

Refer to item 8.1 in this publication regarding symptoms and first aid.

9.5 **Post rescue collapse**

This is a generic term for complications that may arise following rescue in respect of both afterdrop and rewarming, which may cause arrhythmia.

9.6 **Measures to take when falling into cold water**

- the individual should be removed from the water as quickly as possible
- the individual should change to dry clothing
- if dry clothing is not to hand, the individual may be wrapped up to avoid heat loss
- the major muscle groups should be activated
- shelter should be sought and a heat source activated
10 OTHER INJURIES

10.1 Sunburn

Sunburn is caused by direct harmful effect to skin cells by ultraviolet (UV) rays in sunlight. The amount of UV light an individual can be exposed to increases in relation to how high the sun is in the sky, as well as how high above sea level an individual is (lower atmospheric pressure).

UV radiation is also heightened by an increase in ambient light reflection, such as from sea and snow. The extent of the skin’s reaction is dependent upon the intensity and duration of the radiation. The skin initially reacts by reddening, which occurs several hours after solar radiation has ceased. If the radiation was strong, blisters may also form. The skin will be extremely painful. It will start to peel after 1-2 days. The skin that remains after peeling is extremely susceptible to new burning. The skin cell pigment is the defence against the sun’s rays. Pigment production increases during solar radiation. Thus, an individual’s tolerance of UV rays will increase with gradual exposure to the sun.

The skin can be protected from the effects of radiation by clothing (e.g. triangular scarf in front of the face), by remaining in the shade as much as possible and through the use of sun tan cream/lotion that reduces the effects of UV rays. Burnt skin should be covered in order to prevent further solar radiation. Skin should also be kept clean to avoid infection. In the event of intense itchiness or major swelling it may be necessary to use some form of medication (an antihistaminic agent and steroid cream). It is therefore recommended that a doctor is consulted.

10.2 Snow blindness

Snow blindness occurs because the eyes are unable to tolerate the effects of ultraviolet (UV) rays in sunlight.

When an individual walks across a snow-covered surface, rays are reflected from the snow crystals. UV rays which, to a limited degree, may be restricted by clouds, fog and snowy weather, cause an inflammation in the outer part of the eye (the cornea). Symptoms of snow blindness usually appear several hours after exposure to light and are characterised by severe stinging or itchiness in the eyes, as if the eyes had been infected by sand. Light in the eyes worsens this condition, which is troublesome but not dangerous.

Snow blindness in the high mountains during winter can be prevented by effective protection of the eyes through the use of the supplied sun goggles/shooting goggles/ski goggles. The colour of the glass has no bearing on the level of protection but lightly coloured glass is comfortable. Sun goggles may, if necessary, be improvised by cutting out a slit for each eye in a piece of cardboard or wood as shown in figure 23. A triangular scarf may also be used with small holes made for the eyes.
If the eyes are protected against further UV radiation (with compresses or a scarf), the condition will pass in the course of a couple of days.
10.3 Carbon monoxide poisoning

10.3.1 General

Carbon monoxide (CO) is an extremely toxic and dangerous gas. It is odourless, colourless and tasteless. Thus, the gas will not be noticed until its toxicity has taken effect. Carbon monoxide is heavier than air and will therefore be more highly concentrated on the ground than, for example, beneath the roof of a tent.

The risk of carbon monoxide poisoning is present when carbon compounds (paraffin, propane, etc.) burn without a sufficient influx of air, or the combustion is defective for other reasons, such as, for example, when melting snow.

Specific sources of carbon in the Norwegian Armed Forces are:
- Cooking apparatus, vehicle engines and petrol/diesel heating units.

Poisoning is caused by carbon monoxide entering the blood more easily than oxygen, even when the air contains sufficient oxygen. The oxygen is ‘blocked’ from entering the red blood corpuscles and a form of internal suffocation occurs. The first sign of carbon monoxide poisoning is a light headache, followed by nausea. With more severe poisoning, the headache worsens, listlessness sets in, then the individual eventually collapses and loses consciousness. An individual suffering from carbon monoxide poisoning will have a conspicuously red skin colour. Poisoning will be effectively prevented by good ventilation. As mentioned previously, poisoning occurs before the symptoms become visible.

It is the point at which a kettle is placed on a cooking apparatus that the greatest amount of caution should be exercised. When melting snow and boiling over an extended period, an individual is exposed to high values of CO. This is because the snow keeps the kettle at a low temperature, as well as the period during which an individual is exposed to the gas.

It is important to ventilate during boiling/snow melting. Particular attention should be paid to ice-covered and snow covered tents. Heat sources are not permitted in a snow hole due to the concentrations of carbon monoxide and the risk of glazing the snow cave.

Modern tents made from plastic material have less draughts. It is important that vents remain open at all times and that extra ventilation is provided during snow melting and cooking inside a tent.

CO has a long half-life, which means that it is possible for CO poisoning to build up over time if an individual is exposed to high concentrations over a period of several consecutive days.

10.3.2 Symptoms

- Headaches, dizziness, nausea, vomiting, impaired vision, high pulse, short windedness
- Diminished awareness, tending towards coma and spasms, circulatory collapse
- Pink skin (mucous membrane/beneath nails) = serious
If the patient has minor symptoms such as headache, dizziness, nausea, and appears to make a rapid recovery in fresh air, the exercise/activity may continue.

**NB: Due to the long half-life of CO further exposure should be avoided**

It should be noted that the effects of carbon monoxide poisoning occur BEFORE the symptoms become visible. There are few symptoms and they are mild.

### 10.3.3 Treatment

- Take the patient outside in fresh air
- ABCDE
- In serious cases, the doctor will administer 100% oxygen
- The half-life with rest is around 4.5 hours
  - Residue after 9 hours = 1/4, after 13.5 hours = 1/8
  - Half life of 80-90 mins with adm. of O2, 30 mins in a pressure chamber (3atm)

In the event of serious symptoms such as vomiting, impaired vision, high pulse and short windedness, spasms, unconsciousness or coma, the patient should be transported immediately in order to receive medical treatment. The emergency service (telephone 113) should be contacted, if necessary. This also applies if the skin beneath the nails or the mucous membrane turns pink, or if circulatory failure is suspected (high pulse and low blood pressure/rapid, weak pulse).

**! If symptoms of carbon monoxide poisoning are present, ensure that the patient receives fresh air as soon as possible.**
10.4 Risks associated with the handling of fossil fuels (Petrol, diesel, F-34)

Attention is drawn to the cold properties of these products. This also applies to a wide range of related products such as paraffin, white spirit, lighter fuel grills, lamp oil, etc.

- These products will stay liquid, even at extremely low temperatures. As fluids conduct heat more quickly away from the body than air, it is easy to imagine the heat loss that occurs if a finger is dipped into liquid fuel at a temperature of minus 30 degrees. Also, these combustibles evaporate more quickly than water. They cause greater heat loss than water. Clothing upon which a combustible has been spilt feels colder than clothing on which water has been spilt. A combustible will also steal more heat from the body for evaporation.

- During the winter, air is dry and the skin can more easily dry up and crack. These combustibles have fat-soluble properties and will remove the protective fat layer in the skin. This increases the risk of skin ailments and winter injuries. In addition, many of these fluids irritate the skin. In the case of prolonged exposure, e.g. if an individual spills F-34 on field trousers and allows it to remain in place without changing clothing this may result in chemical burns, which can be extremely painful.

- Fossil fuels have a harmful effect on the intestinal system if they enter the body. If fuel products are spilt onto provisions this will cause diarrhoea and, in the worst case, more serious symptoms of poisoning (nausea, vomiting, nervous system symptoms).

! Protect the hands when handling fuel during the winter.
### Risk Assessment Form Example

**Task:** Norwegian winter course 2010 – Exercise BIRKEBEINER  
**Executed by:** Land Warfare Center (LWC)

<table>
<thead>
<tr>
<th>Nr</th>
<th>Main activity</th>
<th>Danger</th>
<th>Cause</th>
<th>Consequence</th>
<th>Probability</th>
<th>Responsibility and deadline</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Frost / Cold / Injury</td>
<td>Team members are more susceptible to local frostbite on exposed parts of the body when marching.</td>
<td>Natural: the wind chill factor and general severe level of cold heighten the risk of local frostbite occurring.</td>
<td>5 – Critical</td>
<td>2 – Minor</td>
<td>Focus on inter-colleague inspection routines.</td>
<td>Equipment, mask, goggles.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Human: insufficient clothing, improper use of clothing. In spite of indications of local frostbite, the unit does not implement immediate measures/inter-colleague help.</td>
<td></td>
<td>8 – Probable</td>
<td></td>
<td>Carry out SIBIR at least once every 24 hours, as well as when the situation demands. Necessary training in respect of correct use of clothing before and during the exercise. Prior to the exercise, train in immediate measures to be implemented in the event of local frostbite, including inter-colleague inspection and quick treatment.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Personnel permit metal to come into direct contact with skin.</td>
<td>3 – Moderate</td>
<td>9 – Severe</td>
<td>Use handwear to avoid metal in direct contact with skin.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Personnel use footwear that is too small.</td>
<td>2 – Minor</td>
<td>4 – Moderate</td>
<td>Check size of footwear prior to commencement of exercise.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Bare skin</td>
<td>2 – Minor</td>
<td>2 – Minor</td>
<td>Cover all exposed skin, use of mittens, wind mask, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Wet clothes</td>
<td>2 – Minor</td>
<td>4 – Severe</td>
<td>Dry clothing at every available opportunity.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Poor hygiene</td>
<td>2 – Minor</td>
<td>3 – Moderate</td>
<td>Follow-up hygiene in respect of implementation of SIBIR.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>General hyothermia</td>
<td>Team members not maintaining sufficient combat capability and becoming depersonalised and exhausted whilst marching.</td>
<td>Natural: influencing factors: severe cold, heavy marching conditions, wind, etc.</td>
<td>2 – Minor</td>
<td>Skin to skin. Follow-up hygiene in respect of implementation of SIBIR.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Human: Poor reconditioning in respect of: fluid, nutrition, hygiene and sleep. Generally, the unit has not been given adequate time to conserve its own combat capability. The unit keeps marching in spite of clear signs of exhaustion among certain individuals.</td>
<td>3 – Moderate</td>
<td>6 – Very Severe</td>
<td>Lining up of measures/impossible prior to STARTEX. Special focus on fluid and nutrition supply in bivouacs and whilst marching. Make it easy for the individual to express what is on his/her mind. The individual should be capable of carrying 2 litres of fluid, of which 1 litre is in a thermos.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Particular attention should be paid to the following points during difficult weather conditions: Optimise the marching route by avoiding natural obstacles, steep descents, areas with loose snow, etc.</td>
<td>2 – Minor</td>
<td>4 – Severe</td>
<td>Dry clothing. General rewarming of the patient incorporate routines for hot food and drink. The individual is in good physical shape and has tested his/her own ski equipment prior to STARTEX.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Utfyllende kommentarer:**

1. Consequence: 5-Critical, 4-Serious, 3-Moderate, 2-Minor, 1-Slight  
2. Probability: 5-Probable, 4-Possible, 3-May occur, 2-Unlikely, 1-Improbable  
3. Consequence * Probability  
4. Responsibility and deadline  
5. E.g.: Requirement for clarification from a higher commander, new facts, requirement to carry out a separate ORM for the main activity, etc.