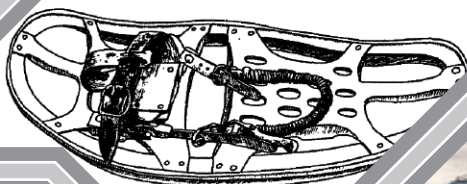




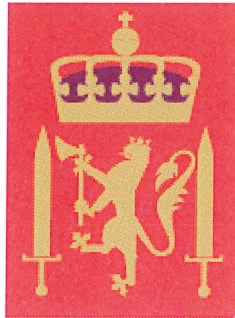
**Hæren**

**UD 6-81-7 E**

# **INSTRUCTION IN WINTER SERVICE USE AND MAINTENANCE OF EQUIPMENT**



**English edition**



**UD 6-81-7E**

**Instruction in winter service  
– Use and maintenance of equipment**

Norwegian School of Winter Warfare  
UD 6-81-7E Instruction in winter service  
– Use and maintenance of equipment is approved for use for  
The Norwegian Armed Forces

Rena, 06.11.2014

A handwritten signature in blue ink, which appears to read 'Aril Brandvik'. The signature is stylized and written over the printed name.

Aril Brandvik  
Brigadier  
CO Army Land Warfare Center

## ABOUT UD 6-81-7E

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# 1 Introduction

## 1.1 Objective

These instructions have been drawn up by the Norwegian School of Winter Warfare. The aim of this booklet is to provide officers and units with information on the use and maintenance of equipment during winter conditions, and on the impact of winter in terms of the equipments service life and properties. It will also provide units with guidance on the importance of good maintenance routines in a military unit in winter. The publication is aimed at officers, but is also useful for soldiers.

Chap-1

## 1.2 Application

These instructions are applicable to the entire Norwegian Armed Forces.

## 1.3 Responsibility

Commanding Officer of the Norwegian School of Winter Warfare is responsible for initiating updates of the publication if needed.



## 2 Skis



Chap-2

*Figure: 2.1*

*Winter duty*

### 2.1 General

The correct use and maintenance of skis is essential for preserving their properties as well as maintaining the service life of the equipment. A good approach in respect of equipment maintenance will result in an increased understanding of the area of use and therefore greater combat capability amongst the units that use skis in the performance of their duties.

The Norwegian Armed Forces' skis are divided into two main categories. Norwegian Armed Forces' old M/58 wooden skis and more recent models of fibreglass skis such as the most common, Åsnes Combi Combat, Nordic Combat and Nato Combat, for example. These regulations will address the most important differences in terms of use and maintenance.

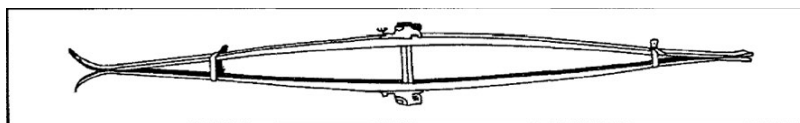
### 2.2 The Norwegian Armed Forces' M/58

In historical terms the M/58, is the ski most people associate with the Norwegian Armed Forces, and even though recent years have seen considerable development in skis, the M/58 continues to remain in use in many units. The ski is simple in construction and is intended for use with the M77 combat boot, and also in combination with overboots.

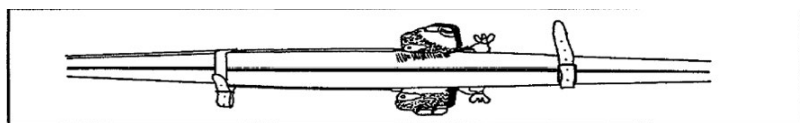
#### 2.2.1 Adjusting the M/58 ski

The standard lengths of the skis are 1.85m and 2.10m. The camber of the skis is individual, sometimes requiring specific adjustment for each individual user. If most of the wear to the skis is under the mid section, this could indicate that there is too much flex in the skis. If the greatest wear is at the back and to the front, behind the tips, this may indicate that the skis are too rigid. Both can limit the user's ability to make optimal use of the skis' properties. The camber of the skis can be adjusted as follows: To increase the camber, insert a block between the mid sections and then

fasten the skis together, sole to sole, using the toe straps or similar around the front and back of the skis (see figure 2.2). To reduce the camber in the skis, strap them together, sole to sole, without anything between them (see figure 2.3). When adjusting the camber in the skis, they should be warmed up, both on the decks and the running surfaces, using a burner, for example. To check whether the camber is correct, do as follows: Put a sheet of paper beneath the skis while they are standing on a flat surface, and then get the user to strap on the skis. With the bodyweight evenly distributed between the skis, it must be possible to move the sheet of paper freely beneath the mid sections of the skis (the grip-waxing zone). With the full bodyweight on one ski should not be possible to move the sheet of paper.



*Figure: 2.2  
Increasing the camber in skis*



*Figure: 2.3  
Decreasing the camber in skis*

## **2.2.2 Impregnating the M/58 ski**

To protect the skis against moisture, make them more hard-wearing and to create a good basis for waxing, they must first be impregnated. We distinguish between two methods, these being rapid impregnation and burn-in impregnation. Before starting to impregnate the skis, they must first be clean and dry, and all residues of old wax must be removed. The best result is achieved by using Base Cleaner or white spirit and cotton waste, often in combination with a scraper. In some cases where the old grip or glide wax is particularly stubborn, a ski burner can be used to soften it up before removing it using cotton waste. Note that particular caution is required when doing this, because if the burner is set too high it can easily char the ski's running surface. New, unused skis are supplied with a thin coat of varnish on the running surface. This has to be polished off prior to use, using fine grade sandpaper for example.

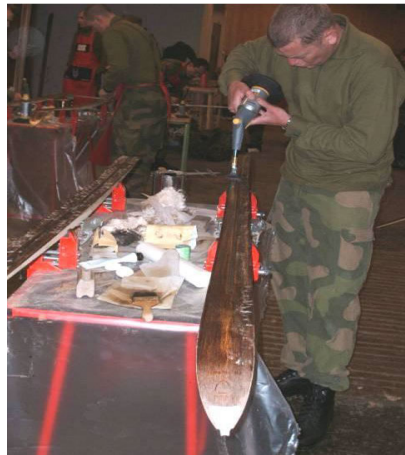
### **Rapid impregnation**

Used to maintain the ski's running surface. This is a rapid method, but the resultant surface is not as hard-wearing as that produced by burn-in impregnation. Rapid impregnation can be done as follows:

- Clean the ski of any old grip and glide wax.
- Moisten a little cotton waste with the impregnating agent (Swix tar impregnating agent), and rub it backwards and forwards over the ski's running surface until it is covered with a thin and even coating.
- Polish the impregnating agent using clean cotton waste until the impregnating agent is no longer tacky.
- Clean the edges and the deck using Base Cleaner or white spirit.
- Leave the ski to dry for 4-8 hours at room temperature before applying wax and using.

### **Burn-in impregnation**

Chap-2



*Figure: 2.4*

This method is more time-consuming than the rapid method, but it produces a more hard-wearing result. It is best employed when taking the skis out before the winter season, prior to lengthy ski marches and before putting the skis into storage at the end of the season. Burn-in impregnation can be done as follows:

- Clean the ski of any old grip and glide wax.
- Moisten a little cotton waste with the impregnating agent and rub it backwards and forwards over the ski's running surface until it is covered with a thin and even coating.
- Use a ski burner with an open flame on the running surface until small bubbles can be seen in the impregnating agent (i.e. the agent is boiling).
- Use a scraper to remove any impregnating agent that has not soaked into the running surface.

- Apply a new thin coat of impregnating agent and repeat use of the burner and a clean scraper until the impregnating agent is no longer tacky.
- Clean the edges and the deck using Base Cleaner or white spirit.
- Leave the ski to dry for 8-12 hours at room temperature before applying wax and using.
- 2-3 coats of impregnating agent will usually be sufficient.
- Be particularly careful when using an open flame as too much heat can cause charring of the ski's running surface. To avoid warping the skis or changing the tension in them, be careful when applying intense heat to their decks.

### 2.2.3 Waxing the M/58 ski

The skis must be impregnated and dry before they can be waxed. It is better to wax skis at room temperature than outdoors in cold weather, but this is not essential when using wax. Wooden skis should be waxed from tip to tail. It may be sufficient just to apply grip wax to the mid section of the running surface, i.e. the part of the ski that is active when kicking back (the wax pocket). Often it is best to apply a hard wax to the entire length of the running surface. The coats must be thin and thoroughly rubbed in, ideally using a cork with a fast action until the wax is even and transparent. If possible, use a burner or a waxing iron. The grip wax should be applied beneath the mid-section of the ski, in the area from just behind the heel to just in front of the tow (the wax pocket). This allows the skis to glide while also giving good grip. It also makes it easier to clean the old wax off the skis when conditions change and the wax has to be replaced. As a general rule, it is better to apply a wax that is too hard (on hard snow) than too soft (on soft snow), as it is easier to replace hard wax with soft wax than the other way around. If you choose to use soft ski wax, this should be applied in short strips in a herringbone pattern on the skis' wax zone. It is often useful here to melt the soft wax into the running surface using a waxing iron in order to produce a good, smooth coating.

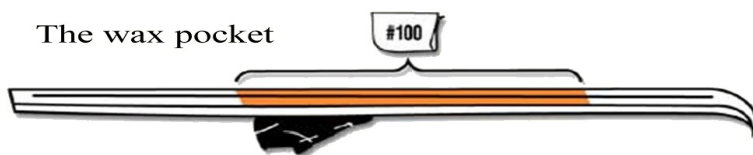


Figure: 2.5

### 2.2.4 Removing wax

The easiest way to remove old wax is to use a scraper together with cotton waste in combination with Base Cleaner or white spirit. If old wax is particularly stubborn, you can use a burner or a waxing iron to heat it up until it becomes nearly liquid, then remove it with cotton waste in combination with Base Cleaner or white spirit.



Figure: 2.6

### 2.2.5 Adjusting bindings

In order to allow the user to derive optimal use of the skis, the bindings must be correctly adjusted for the boots being worn. This is easily done by loosening the wing nuts in front of the toe piece and adjusting the width and toe angle to fit the shape of the boot. Once you are satisfied, hand-tighten the wing nuts. Adjust the tension of the side straps or the length of the heel binding to fit the boot size. If the heel binding is too loose, this will make it harder to manoeuvre in difficult terrain. If the heel binding is too tight, this restricts movement and causes the sole to buckle, which in turn can cause blisters and chafing. If using overboots in addition to combat boots, the binding must be re-adjusted for these.

Chap-2

*Proper impregnation of skis and adjustment of bindings are both essential for comfortable skiing.*

## 2.3 The Norwegian Armed Forces' fibreglass ski



Figure: 2.7  
Ski preparation

There are currently many different types of fibreglass ski in use by the Norwegian Armed Forces, and a feature common to all the various models is that correct maintenance is still one of the criteria for success in preserving the skis' properties and for maintaining the service life of the equipment for as long as possible. All types of ski running surfaces should be treated, maintained and cleaned so as to obtain the best possible gliding characteristics by achieving the lowest possible level of friction between the running surface and the snow.

### 2.3.1 Maintenance of fibreglass skis

The ski's running surface and core are comprised of "living" materials that react to their environment. Temperature, humidity, light and dust all affect the materials, and new skis should therefore be waxed and treated before use. With new or newly-polished skis, microhairs should be removed using a nylon brush and Fiberlene paper. With regard to the steel edges, these must be treated as on ordinary alpine skis, and they can be ground and filed in the same way. Remove any rust spots using emery paper or a file.

### 2.3.2 Waxing fibreglass skis

**Glide wax:** In order to reduce friction between the running surface and the underlying snow as much as possible, we need to apply glide wax. This is done by using a waxing iron to drip soft glide wax onto the glide zones of the running surface. These are on either side of the wax pocket i.e. from the ski tip to just before the toe of the boot, and from just behind the heel to the tail. Next, use the waxing iron to melt the glide wax into the running surface. With new skis, it can be a good idea to repeat melting-in of the glide wax several times to achieve the best possible result. Once the glide wax has been melted into the running surface, wait until it has cooled before scraping off the surplus wax with a scraper. Also exercise caution when melting in wax, especially if using a gas burner. Excessive temperatures can easily damage the running surface and result in blistering. It is best to use a waxing iron set to low heat. Remember that the wax should not smoke when it is being melted in. Finally, brush down the running surface using a nylon brush and Fiberlene paper.



*Figure: 2.8*  
*Glide wax zone*



**Grip waxing:** To achieve the best possible transfer of power to the underlying snow when kicking back, it is desirable to create friction between the running surface and the snow at the time of kick-back. This is achieved by the correct use of grip waxing. First you have to locate the ski's wax pocket, as this varies from one ski to another and from one user to another, depending on bodyweight and force of the kick-back. Put a sheet of paper beneath the skis while they are standing on a flat surface, and then get the user to strap on the skis. With the bodyweight evenly distributed between the skis, it must be possible to move the sheet of paper freely beneath the mid sections of the skis (the wax pocket). With the full bodyweight on one ski should not be possible to move the sheet of paper. Use emery paper or fine sandpaper to scuff the running surface's grip-waxing zone in order to provide the best possible adherence surface for the grip wax. Next, use a fairly hard wax, e.g. green or blue, as a base and melt it in to create a thin coat on the running surface. The next stage is to apply 3-4 coats of grip wax. The best method is to rub the various coats in vigorously using a cork. If using soft ski wax, one coat will usually be enough. If you choose to use soft ski wax, this should be applied in short strips in a herringbone pattern on the skis' wax zone. It is often useful here to melt the soft wax into the running surface using a waxing iron in order to produce a good, smooth coating. If in doubt about what type of wax to use, it is often best to go for the harder/colder type of wax, as warmer/softer wax can be applied later on to obtain a better grip.

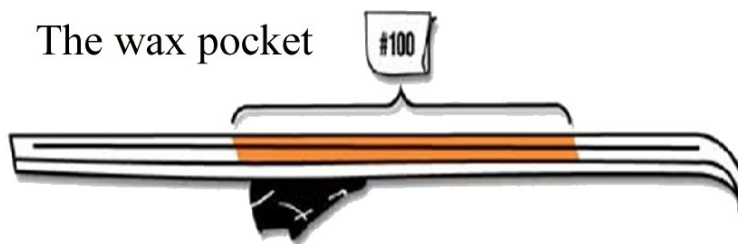


Figure: 2.9  
Grip waxing zone

### 2.3.3 Removing wax from fibreglass skis

Remove old wax by using a plastic scraper to take off as much wax as possible, and then using Base Cleaner and Fiberlene paper to remove any final residue. Finally, dry the running surface using clean Fiberlene paper to remove any final traces of cleaner.

### 2.3.4 Storing fibreglass skis

To prevent the skis' running surfaces from drying out, they should be treated with

wax before being placed into storage between skiing seasons. Use a very soft glide wax, e.g. yellow, and melt it in along the whole length of the running surface. The skis should be stored in such a way that they are not exposed to damp, heat, direct sunlight or dust and dirt. When taking the skis out for a new season, start by removing the old wax applied at the end of the previous season.

## 2.4 Climbing skins

As an alternative or supplement to grip-waxing, the Norwegian Armed Forces' fibreglass skis are also supplied with skins. These are made from synthetic materials (70% mohair and 30% nylon) and are designed so as to provide considerably greater friction between the running surface and the underlying snow when kicking back. The skins are attached to the ski tip and glued onto the running surface. The Norwegian Armed Forces makes a broad distinction between two types of skins:

**Long skins:** These are attached to the ski tip and then stretched back along the full length of the ski and glued to the running surface. They are attached to the ski tip using either a standard steel clip or a so-called Combi-Fix attachment, which consists of an end hook for attaching at the tail and a rubber tip which stretches over the ski tip. Long skins are supplied in various widths, with 4.5 cm and 6.0 cm being standard within the Norwegian Armed Forces.



*Figure: 2.10*

**Short skins:** These are 70 cm long and made to sit only in the skin's grip-waxing zone, allowing the glide zones at the front and back of the ski to be preserved. They are attached using a skin lock that is recessed into the ski, and glued onto the grip-wax zone on the running surface. Short skins are supplied in various widths, with 3.5 cm, 4.5 cm and 6.0 cm being standard within the Norwegian Armed Forces. Whereas long skins should normally be removed before skiing downhill, short skins can be left on without having any noticeable effect on gliding and turning characteristics.



Figure: 2.11

### 2.4.1 Maintenance of climbing skins

The best way to look after the climbing skins and to preserve their properties even on long ski marches is to keep them as dry as possible. You should ensure that the glue is kept free from snow, ice and water, and dry the skins as thoroughly as possible after use. When the glue no longer provides sufficient adhesion, a new coat of skin glue can be applied, and when removing the skins, they should be folded with the glued surfaces together. Alternatively you can store them in the plastic film provided. To achieve the best possible adhesion to the running surface, you should avoid using skins over soft wax and wax tape.

## 2.5 Ski poles

The Norwegian Armed Forces' ski poles are available in standard lengths of 5 cm intervals between 130 and 160 cm. When selecting the correct pole length, the pole should ideally reach from the ground to the armpit (see illustration). Poles that are too long can result in reduced arm strength on uphill slopes and cause unnecessary strain in the shoulder joints, especially when carrying a backpack. Poles that are too short often result in pain and stiffness in the back on longer ski marches. The wrist straps should be tightened so that the grip is just below the strap attachment. By removing the locking pin, the pole's handle and disc can be removed, allowing two or more poles to be assembled to make a provisional avalanche probe that can be used for companion rescue following an avalanche.

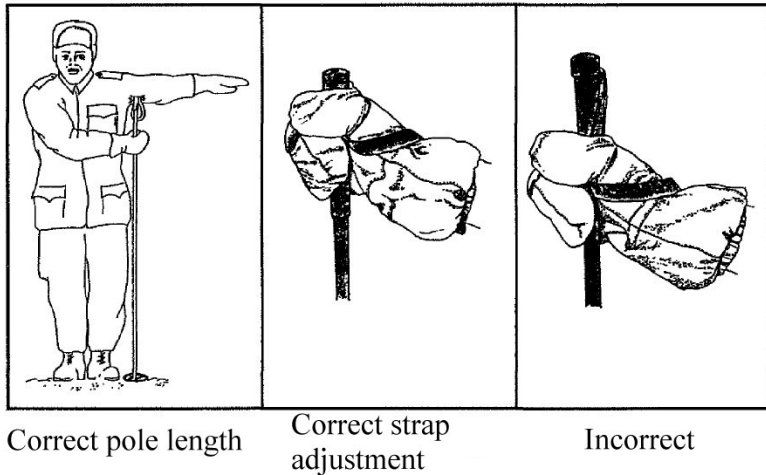


Figure: 2.12

## 2.6 Snowshoes

The Norwegian Armed Forces' units currently use several different types of snowshoes. The most common is the Norwegian Armed Forces' M/85 snowshoe and various types procured from the civilian market, such as the Tubbs Army. This latter model is supplied in several different sizes adapted to the weight of the user, snow type/depth and area of application. Modern snowshoes are almost maintenance-free, though they should still be checked before and after use. The checkpoints that should be reviewed are to ensure that the snowshoes do not have any cracks or deformations in their structure, and that the bindings are not defective and permit adjustment of the shoe. Snowshoes should be cleaned using warm water and soap. The Norwegian Armed Forces' M/85 uses the same heel binding as the M/58 wooden ski, and it is adjusted in the same way.

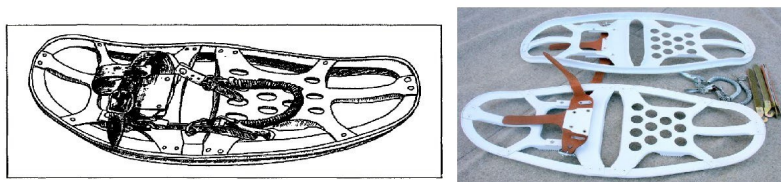


Figure: 2.13

M/85

## 2.7 Pulkas



Chap-2

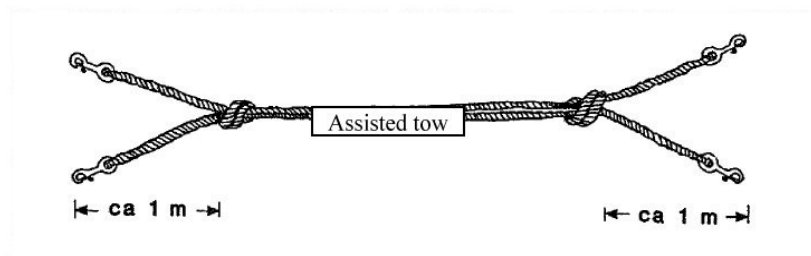
*Figure: 2.14  
Trip with pulka*

### 2.7.1 General

The pulka has traditionally been an important transport aid during winter. The Norwegian Armed Forces currently uses several different types of pulka, for towing behind snowmobiles or to be pulled by personnel on skis. The original M/38 wooden pulkas has been in use by the Norwegian Armed Forces for several decades, though it is currently being replaced by various new models made from fibreglass and plastic materials.

### 2.7.2 Towing a pulka

Most pulkas are supplied with a tow bar or a harness with a pulling belt that is designed to provide optimum power transfer between the soldier pulling and the pulka. In some cases there is a rigid frame that functions as a tow bar back to the pulka, while in other cases there may be just a loose rope, usually elastic, which functions as a towing device. The solution using a braced frame to tow the pulka is often preferred in rugged and undulating terrain as this makes it easier to steer the pulka. The solution using the elastic rope to tow the pulka is preferred in flat terrain as this makes it easier for the person towing. Use of brake and steering ropes is a good way of controlling heavier pulkas on steep downhill gradients. This involves a person at the rear of the pulka holding it steady to prevent it from skidding sideways or exerting too much pressure on the person pulling the pulka. When pulling heavier pulkas, and especially on uphill gradients, it may be advisable to attach an additional pulling rope. This is achieved via two extra connected ropes, each measuring 4-5 m, which are used to connect an extra person in front, who pulls on the ropes in order to transfer more force to the pulka in the line of march.



*Figure: 2.15*

*Pulka towline*

### **2.7.3 Packing a pulka**

The pulka long and low cargo compartment provides good protection for the transportation of equipment. Incorrect weight distribution in the pulka can easily lead to unnecessary use of force to pull the pulka, especially in loose snow. If the centre of gravity is too high, this can also entail a risk of the pulka overturning when manoeuvring in uneven terrain. As well as maintaining a low centre of gravity, you should also try to load the pulka so that it is slightly back-heavy and therefore easier to move and turn. The principle of modular packing is a good routine, with food and fuel, for instance, being stowed in separate water-tight containers. If operating as part of a larger unit with several pulkas, it may be a good idea to have separate "clean" and "dirty" pulkas. Note that if fuel is packed in plastic bottles or containers at the rear of the pulka, these could accidentally be punctured by the soldier at the rear using his pole incorrectly to push on uphill gradients.

### **2.7.4 Maintaining a pulka**

The pulkas running surface is impregnated and glides in the same way as the glide zone on a ski, in order to reduce friction with the snow surface. The canvas should be checked for tears and holes, and impregnated with a fabric-impregnating agent. In addition, any clips and ties should be checked, and replaced if defective. The same applies to the clips and attachments on the pulka harness and pulling belt. These checkpoints should be a natural part of the Combat Ready routine (KTS) before setting off on assignments with a pulka.

## 3 Stoves

### 3.1 General

In order to be able to maintain combat capability in winter, a stove or a cooking device will often be required, e.g. in order to be able to melt snow for drinking water, prepare food and as a heat source in a bivouac. There are currently several types of stoves from various suppliers in use by the Norwegian Armed Forces' units that have been adapted for different areas of use. The design of stoves will vary depending on the area of use and type of fuel for which it was designed. The standard fuel used in the Norwegian Armed Forces is F34. Most units use stoves adapted for this, but in some units there are exceptions in which the stoves is adapted for other fuel types, such as gasoline.

### 3.2 Different types of stoves

The various types of stoves can be divided into main groups based on construction and mode of operation.

**Stoves with tanks and burner heads in an integral unit**, such as the Optimus 111, Optimus Hiker and Coleman. These cooking devices use liquid fuel, produce a high output, and are relatively easy to use. They require pre-heating with either methylated spirit or priming paste.



Figure: 3.1

*Stoves with tanks and burner heads in an integral unit*

**Stoves with separate burner heads and tanks**, such as the Primus Omnifuel, MSR Dragonfly/XGK, Soto Muka and Optimus Nova. These cooking devices are often designated multi-fuel stoves as they are designed to run on most types of liquid fuel, and some of the models will also run on gas. They produce a high to very high output, depending on the type of fuel being used. These are versatile and operationally safe cooking devices that work well in all conditions, though they are often slightly more difficult to use than gas stoves, for example. These stoves also require pre-heating.



*Figure: 3.2*

*Stoves with separate burner heads and tanks*

**Gas stoves**, such as the Jetboil, MSR Reactor / PocketRocket, Primus Eta / Express and Optimus Crux. These are often low-weight but high-output stoves. They are extremely easy to use, though they have evident limitations during the winter as they are less efficient at low temperatures. These stoves do not require pre-heating.



*Figure: 3.3*

*Gas stoves*

**Spirit stoves**, such as the Trangia Stormkjøkken and the HeatMate Spritovn. Extremely simple stoves without any mechanical parts and external fuel tanks. They are very easy to use and work by filling e.g. methylated spirits into a "cup" and lighting it. They burn with a medium output and work fine at outdoor temperatures above zero, though they have considerable restrictions at sub-zero temperatures.





*Figure: 3.4*  
*Spirit stoves*

**Survival stoves**, such as Ebsit stoves. Small, simple, low-weight and very easy-to-use stoves. They often use spirits, priming paste or solid fuel tablets as fuel. Most models have a relatively low output, especially at low temperatures, and they are not recommended as the primary cooking device in a unit.

Chap-3



*Figure: 3.5*  
*Survival stoves*

### 3.3 Different types of fuel

#### 3.3.1 Gasoline-type fuels

Gasoline-type fuels, such as petrol, heptane, Polar fuel and heptanol. These produce a very high output and leave only light soot deposits in the cooking device. Be aware that ordinary petrol contains a number of substances that are harmful to health and it should not therefore be used in tents or other closed spaces. Heptane, Polar fuel and heptanol are better suited in these cases, though they are also more expensive. If you use environmental gasoline, it should be the type intended for use in 4-stroke

engines, since 2-stroke gasoline has oil added to it, and this can block tubes and nozzles. Although gasoline works very well in most stoves, it has a tendency to dry out gaskets, so lubricate them with silicone at regular intervals. Be particularly aware of the risk of fire, as gasoline is highly flammable and is explosive.

### **3.3.2 Kerosine-type fuels**

Kerosine-type fuels, such as paraffin, F34, diesel, heating oil, jet fuel and purified paraffin. These have many of the same characteristics as gasoline-like fuels, though they have a tendency to leave heavier soot deposits and produce a slightly lower output. This is particularly the case with the industrial products, though less so in the case of those that are purified. They might not work as well at extremely low temperatures as they often have a tendency to become more viscous. Paraffin-like fuels often require pre-heating prior to lighting, they are not as highly flammable as the gasoline-like fuels, nor as explosive .

### **3.3.3 Gas**

Gas, such as butane, isobutane and propane. Gas is one of the most efficient fuels; it burns very clean and produces a high output. The output however is drastically reduced at low temperatures and therefore it is not recommended as a primary cooking fuel for outdoor use in winter. A number of gas mixtures have been developed which are more suited for lower temperatures, but even these have nothing like the same properties in terms of output during winter as the gasoline-like fuels. They are often supplied as disposable cannisters with capacities of between 100 g and 500 g, with a 250 g cannister for instance burning for about 1 hour at 3,000 watt in good conditions. To obtain the best possible output, it is recommended that the gas cannisters are stored in a warm place, either inside a tent or vehicle, possibly beneath clothing if you are outside and on foot.

### **3.3.4 Alcohol**

Alcohol, such as methylated spirits, for example. There are several types of alcohols that can be used in spirit stoves, but methylated spirits is definitely the most common. Methylated spirits is highly flammable and is therefore also used for preheating other types of fuel, though it contains minimal energy for its weight. Since it burns unpressurised in a spirit stove, it produces a significantly lower output than the alternatives. Spirit stoves can emit large quantities of carbon monoxide (CO).

***! Be aware of the danger of carbon monoxide and carbon monoxide poisoning. Only use approved stoves and kettles that are suitable and approved for use within the Norwegian Armed Forces.***

***Use the fuel recommended by the stove's manufacturer. Read and follow the safety instructions.***

## 3.4 Use



Chap-3

*Figure: 3.6*  
*Cooking devices in use*

Most cooking devices that use pressurised liquid fuel need to be preheated before lighting. If using a gasoline-like fuel, this can be used for preheating, whereas if using a Kerosene-like fuel, a spirit or priming paste is usually used for preheating. The reason for preheating is that the pressurised liquid fuel has to be converted to gas before being forced through the nozzle and burning in the cooking device. If the cooking device is not sufficiently preheated, this will result in insufficient combustion and soot will build up in the device within a short time.

At extremely low temperatures, stoves will often have to be preheated several times before the desired output is obtained. Gas stoves do not need to be preheated, but the gas used should be kept in a warm place in order to obtain the best possible output in the stove. No preheating is required for spirit stoves as the fuel burnt is not pressurised.

In the Norwegian Armed Forces, stoves are used primarily as heat sources in tents and for melting snow and boiling water for preparing food, etc. The type of cooking device used often depends on the intended primary use, and it is therefore an advantage for the Norwegian Armed Forces to use stoves that are suitable for varied areas.

When using a stove as a heat source in a tent, a device should be used that produces a high heat output while also being cost-effective in terms of fuel consumption.

Combustion is generally complete and the carbon dioxide (CO<sub>2</sub>) produced is non-hazardous where there is good circulation and a supply of fresh air. If a cooking device is used together with a kettle, for example to melt snow or boil water, the flame will cool down much quicker and combustion will be less complete.

The incomplete combustion of fossil fuels (carbon) will result in the production of carbon monoxide (CO), which is a colourless, practically odourless and highly toxic gas. Caution should therefore be observed when using stoves together with a kettle in a tent or enclosed space, and adequate ventilation and venting must be maintained at all times.

Refilling fuel or changing fuel containers should always be carried out in a safe and controlled way so as to avoid spillage or unintentional ignition. Gasoline-like fuel and spirits are highly flammable and it is therefore advisable to wait until the cooking device has cooled before refilling or replacing the fuel container. The use of funnels or small cans with spouts is highly recommended.

Considerable caution must be exercised when lighting a hot cooking device. If the stove uses paraffin-like fuel, it may sometimes be possible to start lighting it without preheating it again as long as the stove is still hot enough. If the stove uses gasoline-like fuel or spirits, it will be necessary to wait until the stove has cooled down before re-starting the lighting procedure. This is because these fuel types are highly flammable and there is a risk that the vapour produced may explode.

To get the best possible output from a cooking device, and to ensure correct and safe use of the device, it must be continuously monitored and checked by personnel. This is undertaken in the Norwegian Armed Forces by employing a fire watch. The job of the fire watch is to ensure that there is sufficient pressure in the device, for example by pumping the tank or fuel bottle. If the pressure is too low, the output will fall and there will be increased production of carbon monoxide (CO).

The job of the fire watch is to refill fuel as required and also to ensure that there is no unwanted ignition or out-of-control fire, for example inside the tent. Many of the Norwegian Armed Forces' units also have their own routines that specify tasks and allocate responsibility for the fire watch.

***Regulations for heating a tent and lighting cooking equipment is also described in UD2-1, The Norwegian Armed Forces Safety Rules and Regulations for landbased military activities.***

## 3.5 Maintenance

Keeping the equipment in good condition and deriving the maximum benefit from its properties is dependent on good and appropriate maintenance routines. When setting out to use stoves, it is advisable beforehand to set aside time to test-burn the equipment in order to ensure that it is functioning and to be certain how to operate it. This should be a natural part of the Combat Ready routines in the various units. It can be very advantageous to bring a set of spare parts containing the parts most prone to wear, such as gaskets, nozzles and needles.

You should also ensure that you know how to replace these. When cleaning equipment, you should focus on external surfaces, and remove any soot and deposits from the burner head and nozzle. It is not necessary to dismantle the entire cooking device down to the smallest component, as this often results in extra and unnecessary wear on the device.

Defective components should be replaced as soon as they are discovered, and gaskets should be checked at regular intervals and lubricated or replaced; fuel and rubber are often a bad combination, and gaskets quickly become worn or defective.

Chap-3

***Be careful when using stoves in combination with boilers in tents and closed rooms, and always ensure good ventilation.***

***Be aware of how flammable gasoline-like fuel and alcohol is, therefore wait until the stove has cooled down before refilling the fuel. Avoid spilling!***



## 4 Radio equipment



Chap-4

*Figure: 4.1*

*Military operations in cold regions*

### 4.1 General

Operational communication is one of the most important prerequisites for being able to conduct military operations, and properly functioning communications equipment is often a critical resource in combat situations. Winter places additional demands on our ability to maintain equipment, and to be able to use and operate it in a way that does not impair its capability.

Electronics will generally present a challenge with regard to moisture combined with cold, and together with battery life, this is one of the most significant factors to be considered when discussing the effect of winter. The preventive measures we can take with respect to communications equipment are therefore possibly the most important factors for success in terms of good and proper maintenance.

### 4.2 Use

At low temperatures, plugs, gaskets and buttons will often become stiff and brittle. It is therefore necessary to be cautious about using force so as not to damage the equipment. It is better instead to try to warm up or defrost those parts that become stiff or which are frozen solid before using them. Wherever possible, efforts should be made to prevent water, snow or ice penetrating into connections and terminals by protecting the equipment from the effects of the elements.

This applies when equipment is in use, during transportation and when in storage. Antennas that are covered in snow will quickly become ineffective, so any snow should be removed as soon as it appears. When using microtelephones, the moisture in your breath can condense and deposit on the microphone, which will result in poor

modulation. If this moisture freezes, the ice formed might break the microphone. To prevent this happening, it may be a good idea to protect the microphone with an improvised hood made from fabric or plastic before using it outdoors in winter. Low temperatures also make various types of cables more rigid and they can become brittle. You should therefore avoid bending these at sharp angles, as this is one thing that can damage the cable's screening. This is particularly important for multi-strand cables used on command post vehicles and such.

During winter, cables should be laid above ground wherever possible in order to prevent them freezing to the ground and being exposed to unnecessary wear and tear. Also remove any moisture, snow or ice from the cables before rolling them onto a drum for storage.



*Figure: 4.2*

### 4.3 Battery life

The batteries currently used in communications equipment in the Norwegian Armed Forces are mostly Lithium-Ion or alkaline batteries, such as AA and AAA. Low temperatures have always been a challenge with regard to battery life, and even though modern batteries are better able to withstand cold, this is still a problem. Low temperatures slow down the chemical process in dry batteries, resulting in a reduction in useful capacity. The following table is based on a useful capacity of 100% at 20 °C:



Temperature	Zinc	Alkaline	Lithium
20 °C	100%	100%	100%
10 °C	75%	95%	95%
0 °C	60%	85%	90%
-10 °C	40%	70%	80%
-20 °C	10%	30%	60%
-30 °C	0%	20%	50%

## 4.4 Maintenance

Good and correct maintenance routines are of crucial importance to the unit's ability to keep its communications equipment in good condition before, during and after performing its duties. One of the most important criteria for success is the ability to keep the equipment free from moisture and ice. Thus, wherever possible the equipment should be kept in a heated tent, vehicle or room. To avoid condensation, equipment brought in from the cold should be covered to allow it to warm up slowly and dry thoroughly before it is taken back out into the cold. Do not expose the equipment to strong heat from stoves or such to dry or thaw it out. Spare batteries for essential equipment such as communications, night vision equipment and GPS units should be stored at room temperature prior to use, for example on the body or in a heated vehicle.

Chap-4

***Protect the equipment against water, snow and ice. Always have a spare battery available for all critical equipment.***



## 5 Optical and electro-optical instruments



*Figure: 5.1*  
*Optical equipment with camouflage*

### 5.1 General

The Norwegian Armed Forces' range of equipment is becoming increasingly advanced, and there have been major advances in recent years, especially in the fields of optical (op) and electro-optical (el-op) instruments. This equipment is often expensive and sensitive to external influences, and therefore has to be handled properly in order to retain its functionality. This equipment group covers a large number of different items, each with their own area of application, properties and requirements in terms of use and maintenance. It is nevertheless possible to draw up a number of general rules.

### 5.2 Prevention and use

- To prevent condensation on the eyepieces of electro-optical equipment, anti-mist filters must be used if available.
- If an anti-mist filter does not produce the required effect, the eyecups can be folded back to prevent moisture from the eye collecting on the anti-mist filter or the eyepiece. Remember however that you might then be visible to the enemy's light intensification equipment.
- The eyepiece can also be held away from the eye for periods in order to avoid a build-up of condensation. This will result in a somewhat reduced optical image, but it will still be better than mist and ice forming on the eyepiece.
- If possible, electro-optical instruments should be kept at the same temperature to prevent the formation of condensation. This may be difficult when

operating from vehicles, but here bags or cases can be used to provide the eyepieces with the "softest" possible transition from cold to warm temperatures. Remember to clean the equipment before packing it away.

- Avoid breathing directly onto optical surfaces.
- Never apply more than finger pressure to buttons, switches or other moving parts. If anything is stuck, it can be carefully thawed out before repeating the procedure. Excessive force may snap or cause cracks in these parts as they will often be more brittle at low temperatures.
- Battery life is shortened at cold temperatures. It is hard to say by how much the output is reduced, but in many cases battery life may be halved.
- Pack spare batteries around your body to keep them warm. They must be kept in waterproof packaging so as to keep condensation formation to a minimum.

## 5.3 Maintenance

- Do not use wind mittens, gloves or fingers to clean optical surfaces.
- Only approved cleaning agents are to be used to clean optical surfaces.
- If there is any dust or similar (dry) contaminants on the surfaces, these must be cleaned off using a brush. The camel-hair brush supplied in the F6015PA monacle set or the Schmidt & Bender telescopic sight is very good for this. Use gravity to your advantage so that anything you brush off falls away from the lens.
- If any optical surfaces have grease marks or fingerprints, these can be removed by breathing on them and wiping with a clean lens cloth. Dry very carefully.
- If any snow or ice has got on an optical surface, this can be removed by carefully warming it up (place electro-optical instruments against the body or take them into a tent/vehicle) before removing it using lens paper. Press the lens paper onto the optical surface to lift the moisture away from the surface. Do not rub the surface. as this will result in scratching.
- Anti-mist filters for light-intensification equipment must be handled and maintained as an optical surface.
- All parts that are not optical surfaces can be cleaned using the clothes brush (the blue one) for removing snow and light ice formation.
- Never remove ice with a knife or other sharp object. This will ruin surfaces and can cause worse damage. If ice has formed that cannot be removed with a clothes brush, the instrument must be carefully warmed up. The ice that has turned to moisture can then be removed using dry paper.
- If equipment is stored for a fairly long time, lids or zips on the storage cases or bags must be left open in order to allow any condensation to escape.
- Do not use a heat source to warm up instruments/equipment directly.

## 6 Vehicles



*Figure: 6.1*

*BV 206*

### 6.1 General

In order to keep the unit's range of vehicles operational throughout the winter, good maintenance routines are required before, during and after use. The Norwegian Armed Forces currently has a very large number of vehicle categories and their maintenance is described in detail in Technical Manuals for the respective vehicle types.

Chap-6

### 6.2 Maintenance

Warm clothing, and in particular good gloves, are essential when undertaking maintenance of vehicles outside during the winter. A large pair of oil and fuel-resistant gloves are good, ideally combined with a thinner pair for more detailed work. Keep any work without gloves to a minimum! When measuring volumes and filling various fluids, remember that both volume and viscosity are affected by temperature. Filling a tank to the top in a cold vehicle could mean a risk of leakage as the fluid expands once the vehicle warms up. With several types of vehicle, volumes must therefore be measured only once the vehicle has warmed up. It is necessary to be thorough when removing foreign bodies such as snow and ice in order to prevent wear, and to make it easier to detect damage to e.g. caterpillar tracks and drive units. Water that freezes to form ice on caterpillar tracks, in wheel arches or on various moving parts can prevent these components from working and therefore prevent the vehicle from moving. There are numerous examples of even large combat vehicles of 1,500 hp being disabled due to their caterpillar tracks being frozen up.



## 7 Weapons



*Figure: 7.1  
.50 cal rifle practice*

### 7.1 General

A weapon is one of the soldier's most important instruments, and winter and cold present particularly severe demands in terms of maintenance in order to retain full functionality at all times. Although the Norwegian Armed Forces now has countless different weapons systems, it can nevertheless identify a number of common features with regard to maintenance during the winter.

Chap-7

### 7.2 How winter affects weapons

- Snow and water will penetrate the weapon and freeze to ice.
- Extremely low temperatures will cause lubricants to harden and impede functioning of the weapon.
- Snow and ice on cartridges and magazines will result in less reliable feed and reduced function.
- Rapid temperature variations, resulting from e.g. entering or leaving tents or vehicles, cause condensation to form, which then freezes to ice.
- At low temperatures plastic and metal are more likely to crack.
- Low temperatures cause metal to contract, resulting in greater wear to weapon components such as barrels, for example.

### 7.3 Maintenance

- The weapon must be kept free from ice and snow as much as possible. A

small nylon brush is still a good tool for this task.

- Cover any weapons that are not in use, for example unit weapons on vehicles.
- Function-test the weapon at regular intervals to ensure that the cocking handle and bolt move freely.
- Use a muzzle cap or similar to prevent snow and ice from penetrating the barrel.
- Try to avoid rapid temperature fluctuations, for example resulting from entering or leaving tents, vehicles or buildings. This can cause condensation which can later freeze inside the mechanism.
- Use sufficient oil on the weapon's moving parts.
- Try to protect the barrel from snow and ice, especially when it is hot.
- Always close the dust cover if the weapon is fitted with one, even during short intervals between shots.
- Avoid laying your weapon down directly in the snow.
- Spirits can be used to defrost frozen weapon components, but remember to apply oil afterwards as spirits erode the browning on the weapon.
- Do NOT use methylated spirits in weapon oil during the winter as this will result in a deterioration in the oil's properties and thus damage the weapon.



## 8 Conclusion

This booklet does not replace the current Technical Handbooks and User Manuals that accompany each item of equipment, but instead specifies general guidelines for how to cope with the challenges related to winter and cold within the relevant material categories. Proper use and good maintenance require knowledge of and familiarity with the equipment being used, and also adherence to the stipulated routines.



## 9 Entry into force

UD 6-81-1 Instruction in Winter Service, Booklet 7 – Use and maintenance of materiel, came into force on 01/11/2014. At the same time UD 6-81-7, dated 31/10/1988 was withdrawn.