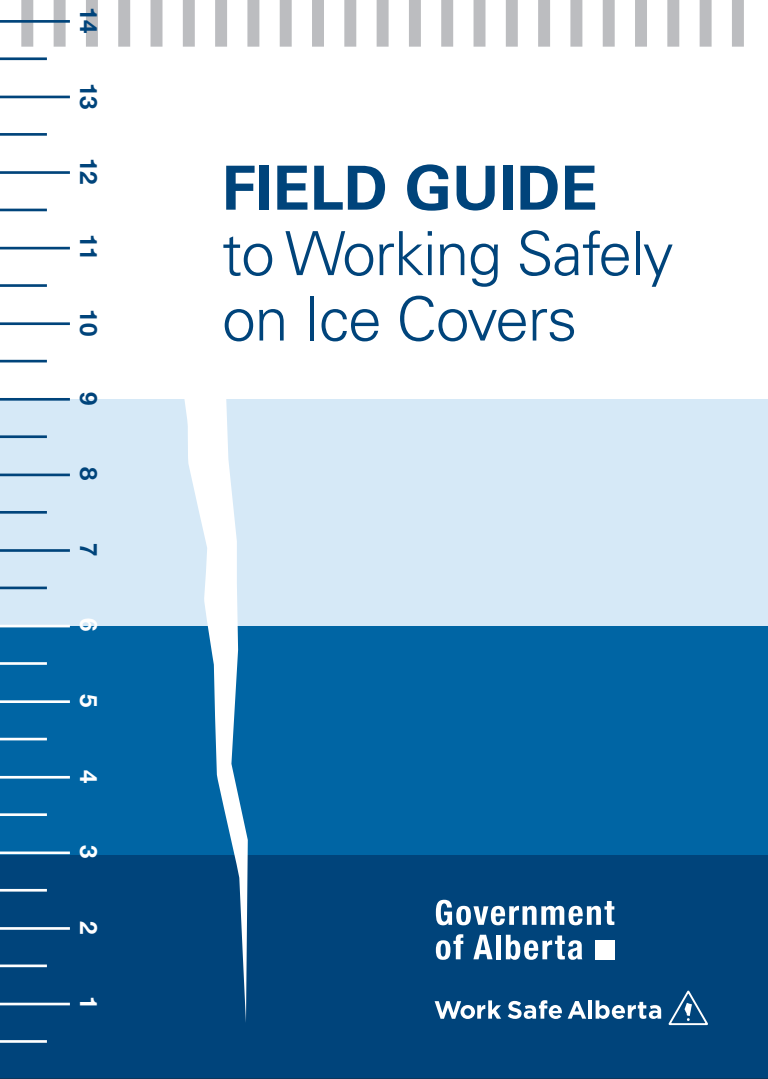
FIELD GUIDE
to Working Safely on Ice Covers



Government of Alberta

Work Safe Alberta

Plan | Ice Cover | Limits | Emergency

Ice covers can be dangerous.
Not knowing what to watch out for can kill you.

How to use this guide

This guide is for people who work on freshwater floating ice covers. It is based on the Government of Alberta's *Best Practice for Building and Working Safely on Ice Covers in Alberta*.

Use it to support what you learn in:

- your employer's safety orientation and ice cover training
  No orientation? No work!
- your employer's *Ice Safety Plan* for this project
  If you don't know the plan, you're not ready to work.
  No *Ice Safety Plan*? No work!
- your own observations
  Watch for cracks and other signs of stress on the ice.

Published November 2009
Publication Number SH011

ISBN 978-0-7785-8738-5

If you have questions about this safety guide, please contact:
Occupational Health and Safety Contact Centre
Throughout Alberta: 1-866-415-8690
Edmonton and area: 780-415-8690
Deaf or hearing impaired: 1-800-232-7215

Website: www.worksafely.org

Plan

Before starting work on an ice cover, know your numbers.

Know your numbers

Check the ***Ice Safety Plan*** for the ice thickness and maximum load and speed allowed on the ice cover. **If you don't know your numbers, don't go on the ice!**

Know and watch for:

- current **conditions** at the site: temperature, wind speed, ice thickness, areas under repair, thin ice
- sudden **changes** in conditions: cracks, water on the ice, extreme weather changes (±20°C in 24 hours)
- what to do and who to **call** when you need help

Record your numbers

Today's **temperature** / wind chill _____ °C

Total weight of vehicle, cargo, fuel and people (**GVW**) _____ kg

Minimum **ice thickness** for this GVW _____ cm

Check your *Ice Safety Plan* for these numbers:

Maximum **load** allowed on ice cover _____ kg

Maximum **speed**: in drive lane _____ km/h near shore _____ km/h

Minimum **distance** between vehicles _____ m

Maximum parking **time** on the ice cover _____ hrs

Emergency **contact** numbers / radio frequency

_____

You and your employer share responsibility for safety.

Plan to stay safe

The best tools for safe work are:

- your **team**
  Your supervisor and co-workers are your safety team. Always maintain **contact** by radio or phone. Know and follow the **call-in** schedule in your employer's working alone policy.
- **training** and ***Ice Safety Plan***
  Use this guide as a quick reference to support what you learn in your employer's safety orientation and ice cover training programs. Know your *Ice Safety Plan* numbers for ice thickness, GVW limits and speed limits.
- **questions**
  The only dumb question is the one you didn't ask. If you don't know, find out from someone who does.
- safety **checks**
  Check **PPE** (personal protective equipment), **emergency supplies** and **vehicle** safety equipment before you start work.

Check your equipment—and yourself

- Check your PPE and emergency equipment.
- Know your vehicle GVW and its safety equipment.
- Watch for early signs of frostbite and hypothermia.

Eyes and ears are safety tools. Pay attention to what's happening around you.

Personal safety equipment

When working on ice covers, make sure you've got the right equipment for the job and the conditions, check your *Ice Safety Plan*. Then check your PPE.

Suggested PPE	What you need it for
• warm clothing worn in layers	• to protect your face, head and neck, and maintain core body temperature
• rubber-soled, felt-pack winter boots	• to walk without slipping and keep your feet warm and dry
• insulated waterproof gloves, mittens and overmitts	• to keep your hands warm enough to work and carry out emergency tasks
• sunglasses	• to protect your eyes from snowblindness and glaring reflections off ice and snow
• whistle	• to call for help or signal others
• high visibility flotation suit	• to keep yourself afloat and warm in icy water
• 30 metres of 10-mm thick buoyant polypropylene rope	• to rescue others or be rescued if the ice fails
• ice rescue picks	• to grip and move along the ice to complete a self-rescue if the ice fails

If you don't know the GVW, weigh the loaded vehicle.

Vehicle and equipment

GVW (gross vehicle weight): equipment, cargo, people—*and* your fully fuelled vehicle. Record the GVW and date on a sticker in the vehicle and on equipment.

Safety equipment in vehicle	What you need it for
• axe or ice chisel, ice auger, and air temperature thermometer	• measure ice thickness and air temperature
• two-way radio, phone (on cellular or satellite service) or other electronic communication device	• stay in contact with your team • call for help
• warning devices (pylons, reflectors, flares, flags)	• warn others; close danger areas • attract attention in emergency
• fire extinguisher	• put out vehicle/equipment fires
• first aid kit	• treat minor injuries
• metal or ceramic coffee mug	• melt snow or ice for drinking
• emergency rations: energy bars/ food; hot beverage mixes (instant coffee, tea, hot chocolate)	• sustain energy and keep warm
• snow shovel	• remove snow if vehicle is stuck
• sleeping bag (or blankets), backup warm clothing	• keep warm and dry
• candles, flashlight • waterproof matches/lighter, material to start fires	• see what you're doing • keep warm and signal others

About 50 people die each year on ice over fresh water in Canada.

Know what you're doing on the ice

Work on ice covers starts with recognizing hazards and knowing how to handle them. Plan your work—and your safety—with the following in mind.

- **what** you plan to do, **where**, and for **how long**
  Check your *Ice Safety Plan*. Talk to your supervisor.
- **conditions** and **limits** on the ice cover
  Check your *Ice Safety Plan* for ice thickness, speed, load and time limits.
- **weight** of the load you plan to put on the ice cover
  Know your GVW.
- **sudden changes** in temperature (±20°C in 24 hours)
  Check current conditions. Look at the ice.
- **extreme cold** that affects **equipment**
  Check operator's manuals and manufacturer's product data sheets for minimum operating temperatures of the equipment and fluids used.
- **extreme cold** that affects **personal safety**
  Check yourself and your team for signs of frostbite and hypothermia, which can set in gradually, before you notice them.

River ice can be more dangerous than lake ice because currents can erode ice and create thin spots.

Setting up an ice cover (profiling)

If you are the first person on the ice, you **must** have these safety measures in place:

- an *Ice Safety Plan* for pre-construction and construction stages of building the ice cover that follows best practices
- ice safety training that includes self-rescue techniques
- a partner who knows rescue and self-rescue techniques

Walking or working on foot

Before you step on the ice, check your *Ice Safety Plan* for:

- required minimum ice **thickness**—There must be at least **10 cm of clear, good quality ice** before you can walk on it. If you plan to stand in one area for more than 2 hours, the ice cover must be at least **15 cm** thick.
- local **conditions**—Ice thickness can vary a great deal, particularly near shore, around the bend of a river, or near snowbanks. If there is open water nearby, you need specialized PPE, ice safety and rescue training.
- type of **work**—Checking ice thickness requires working and walking in pairs. Both members of the team must wear flotation suits and remain at least **10 metres** apart. They must be trained in rescue and **self-rescue techniques** and use the appropriate equipment for ice testing.
- your **team—Do not work alone** when taking initial ice thickness measurements or during initial construction of ice covers.

On an ice road, the driving lane is the safer area. Edges are danger zones. Never drive or park on the "shoulder" or near a snowbank.

Parking a vehicle or equipment

Before you park a vehicle or equipment on the ice cover, check:

- your **GVW**—Vehicle including fuel, equipment, cargo and people

Check your ***Ice Safety Plan*** for:

- maximum **time** on the ice and minimum **ice thickness**—For example, a light truck parked for more than 2 hours but less than 7 days requires at least **55 cm** of clear, good quality ice.
- **variations** in ice thickness—Ice is often thicker in a driving lane, but thinner and weaker near and under snowbanks beside driving lanes.
- **distance**—Park vehicles and equipment at least **2 lengths** apart—vehicle plus equipment lengths.

Driving a vehicle

Before driving any vehicle on the ice cover, even a snowmobile, check:

- your **GVW**—Vehicle including fuel, equipment, cargo and people

Check your ***Ice Safety Plan*** for:

- **ice thickness**—One snowmobile needs at least **18 cm** of clear, good quality ice to support GVW less than 500 kg. A light truck (GVW less than 5,000 kg) needs at least **38 cm** of ice thickness.
- **speed limits**—Always drive slower than the maximum posted speed.
- minimum **distance between vehicles** on the same route
  - > GVW **under 5,000** kg stay **200 x ice thickness** apart
  - > **heavier** vehicles stay **500 x ice thickness** apart
- special **conditions** along the route—for example, areas under repair, **thin ice** caused by river currents, snowbanks, or near islands and shores

Extreme cold is hard on vehicles, equipment—and people

Plan for cold weather

Working on ice covers means working in cold weather. Both present risks of injury.

- **frostbite:** Skin tissue freezes, looking white or waxy. Exposed skin is at greatest risk.
- **hypothermia:** Body cools faster than it can generate warmth. Signs are slower pace, fatigue, lack of coordination, vigorous shivering, personality changes: Fumbles, Stumbles, Tumbles, Mumbles, Grumbles.
- **wet clothing:** Wet clothing accelerates heat loss. Wear multiple layers and adjust them to avoid sweating, overheating. Avoid cotton—once wet, it stays wet.
- **windchill:** Wind speed of 20 km/h can make –25°C feel as if it's –37°C.

Cold weather hazards	What to do
air temperature 0°C to –20°C • at –20°C and 15 km/h wind, exposed skin is at risk of frostbite in 10–30 minutes	• avoid hypothermia with warm clothing • take regular breaks to warm up • make sure equipment is in good working order at start of shift
air temperature –20°C to –45°C • increased risk of frostbite, hypothermia • outdoor travel can be dangerous • equipment failure has serious consequences	• take breaks in a warm, heated place such as a truck cab or shelter • check self and others for frostbite and hypothermia
air temperature colder than –45°C • serious threat to health, safety • serious risk of equipment failure • gasoline freezes at –56°C	• **stop** all non-emergency work • check equipment hourly • avoid skin contact with gasoline and metal objects

Wind chill chart

T air = air temp in ˚C

V_{10} = wind speed at 10 m above the ground in km/h

T air	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
V_{10}												
5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47	-53	-58
10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63
15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54	-60	-66
20	1	-5	-12	-18	-24	-30	-37	-43	-49	-56	-62	-68
25	1	-6	-12	-19	-25	-32	-38	-44	-51	-57	-64	-70
30	0	-6	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72
35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60	-66	-73
40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61	-68	-74
45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62	-69	-75
50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63	-69	-76
55	-2	-8	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77
60	-2	-9	-16	-23	-30	-36	-43	-50	-57	-64	-71	-78
65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79
70	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-80
75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80
80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81

Source: Environment Canada

Frostbite guide

- Low risk of frostbite for most people
- Increasing risk of frostbite for most people in 10 to 30 minutes of exposure
- High risk for most people in 5 to 10 minutes of exposure
- High risk for most people in 2 to 5 minutes of exposure
- High risk for most people in 2 minutes of exposure or less

Ice Cover

Clear, good quality ice has uniform thickness and strength.

Types of ice on an ice cover

- Clear ice is relatively free of air bubbles and vegetation.
- On any body of water, ice can be thinner and weaker around islands, shoals and shorelines.
- Water currents, heavy snowfall, high winds and sudden changes in temperature can all affect the strength of ice.

Ice type & variation in ice thickness	Ice quality and strength
Blue ice on lakes and rivers	
Freshwater lake ice (blue) • thickness **varies little** over an area	• higher strength due to uniform thickness and quality
River ice (blue) • **medium to high** variation in thickness • more prone to losing underside ice thickness due to water currents	• fairly uniform ice quality • variable load bearing due to variable ice thickness
White ice from natural or manual flooding	
Constructed flood ice (white) • good practices yield uniform thickness	• good ice quality due to uniform thickness
Natural flood or overflow ice (white) • ice thickness **varies greatly** • higher potential for water and air pockets that reduce ice thickness	• ice strength varies with variations in thickness • variation in quality due to higher air content
Ice formed over muskeg or peatland	
• **highly** variable over the entire area • surface can quickly change from frozen peat to ice floating on peat • ice cover requires special analysis (see *Best Practice*)	• strength varies due to variations in water chemistry, temperature • frost depth depends on air temperature, peat composition, its thickness and ground cover

Ice types

Clear blue lake ice

Ice that grows below the layer of surface ice under calm conditions. It usually forms in vertical, columnar crystals that contain few air bubbles. It appears to be blue because it's clear enough to see the water underneath it.

Clear blue river ice

White ice (snow ice)

Ice that forms on top of the surface ice by natural or man-made flooding of snow. It's white because it contains a significant number of air bubbles.

Frazil ice (slush ice)

Ice made up of disk-shaped ice particles that form and gather together in agitated water. It is usually found in rivers or streams with turbulent waters.

Jam ice

Accumulation of ice on rivers or streams when currents move pieces of ice to an area where they freeze together to form very rough and thick ice covers.

Types of ice cracks on an ice cover

Type of crack & what it means	What you should do
Crack caused by change in temperature & ice thickness	
Dry cracks • do not reach bottom of ice cover • caused by ice bending due to weight of load, temperature changes	• crack through ¼ to ½ ice thickness: **flag area, monitor and repair,** record repairs • crack through >½ ice thickness: **flag and close area** • report cracks to your supervisor
Wet cracks • crack reaches bottom of ice cover, allowing water to reach the surface	• **flag and close area to others** • report cracks to your supervisor
Crack caused by overloading	
Radial cracks • look like spokes in a wheel • a warning that ice is overloaded—load may break through the ice	• **immediately** remove load from ice • report cracks to your supervisor
Circumferential cracks • form a circle around the load • a warning that ice is overloaded—load is about to break through	• **immediately** make sure everyone leaves the area • report cracks to your supervisor
EXTREME DANGER: **Circumferential cracks connected with radial cracks** • form pie-shaped wedges • ice has failed; if not already broken through, it can do so at any minute	• **immediately** make sure everyone leaves the area • report cracks to your supervisor

Limits

Limits

Moving vehicles stress the ice.
NEVER exceed the posted speed limit.

Know your limits

Ice cover limits

Never travel outside the boundaries of the ice cover. Travel only within the lane(s) of an ice road or bridge.

Passing limits

A loaded vehicle must **never** overtake and pass another loaded vehicle moving in the same direction.

Speed limits

- Posted limit is the **maximum** safe speed.
- Slow down in bad weather, low visibility, when passing workers or meeting vehicles coming in the other direction.

If speed limits are not posted, use these recommended maximum speeds.

Vehicle / Ice Conditions	Maximum Speed
Vehicle profiling during construction	10 km/h
Vehicle approaching shore	10 km/h
Vehicle passing flood crews	10 km/h
Load vehicles travelling in opposite directions	10 km/h
Meeting oncoming vehicles	10 km/h
Vehicle at minimum ice thickness for GVW	25 km/h
Vehicle at 2x minimum ice thickness for GVW	35 km/h

Time limits for a disabled vehicle

- Move a disabled vehicle off the ice cover as soon as possible.
- If you cannot remove it, move it to the driving lane where ice is thicker.
- Be prepared to abandon the vehicle within the time limits stated in your *Ice Safety Plan.*

The higher the GVW, the more distance needed between vehicles.

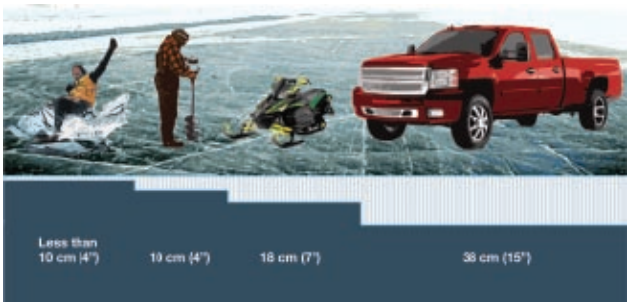
Minimum distances between vehicles

- **GVW up to 5,000 kg:** Distance between vehicles must be at least 200 *x ice thickness*, e.g., on ice 1 m thick, a 4,500 kg vehicle must be 200 m distance from the next vehicle.
- **GVW 5,000 to 63,500 kg:** Distance between vehicles must be at least 500 *x ice thickness,* e.g., a 10,000 kg vehicle on ice 1 m thick, must be 500 m distance from the next vehicle.
- Some ice covers are on bodies of water too small to allow for the minimum distance between vehicles. In that case, there should be only **one vehicle at a time** on the ice cover.
- If there are no markers to judge distance between vehicles, wait at least 2 minutes before you follow a light truck, if both vehicles are of similar weight and are travelling no more than 10 km/h. At 10 km/h, wait at least 5 minutes before you follow a heavy truck (up to 63,500 kg). In both cases, the ice must have the minimum thickness needed to support the GVW.

Minimum ice thickness for *slow* moving loads or loads parked less than 2 hours

Use this table together with the hazard controls outlined in the *Ice Safety Plan* for the ice cover you are working on.

Slow Moving Loads (maximum 10 km/h)	Minimum Ice Thickness
Person walking (120 kg)	10 cm
Snowmobile: machine & rider less than 500 kg	18 cm
3/4–ton 4x4 vehicle: GVW up to 5,000 kg	38 cm
Loads over 5,000 kg	refer to *Best Practice*



Minimum ice thicknesses for parked or slow moving loads less than 2 hours. For heavier vehicles, refer to the Best Practice and your Ice Safety Plan.

The longer a load stays in place, the greater the stress on the ice.

Minimum ice thickness for loads parked for more than 2 hours and less than 7 days

To know how long a load or vehicle can remain in one place on the ice, you need to know the GVW and ice thickness.

Load in place more than 2 hours but less than 7 days

After two hours under a load, ice begins to sag and bend, until the ice cover fails. Greater ice thickness usually means a load can be on the ice cover longer, if it's clear, good quality ice.

Load Parked or Stationary >2 hours <7 days	Minimum Ice Thickness
Person standing	15 cm
Snowmobile: machine & rider < 500 kg	25 cm
Loaded vehicle: GVW 500 to 1,000 kg	32 cm
Loaded vehicle: GVW 1,000 to 2,000 kg	41 cm
Loaded vehicle: GVW 2,000 to 3,000 kg	46 cm
3/4–ton 4x4 vehicle: GVW up to 5,000 kg	55 cm
Loads over 5,000 kg	refer to *Best Practice*

Load in place for more than 7 days must be reviewed by a professional engineer

Emergency

Emergency procedure

When something happens on the ice cover that threatens your own or someone else's safety, work with your team to:

- **Stop** all work in the area.
- Rescue the victim if it is safe to do so.
- Provide first aid and CPR as needed.
- Take steps to **prevent** hypothermia (dry clothing, sleeping bag / blankets, sweetened hot liquids).
- **Call** for help (air or road ambulance).
- Take those in need of care to the nearest medical facility.
- Clear the area / road near the incident site to allow rescue vehicles to reach the victim.
- Mark and **close** the incident site and area with reflective pylons or flags, to warn others of potential danger.

Evacuation by helicopter or vehicle

Serious incidents may require evacuation of the victim.

- Call 911 or the nearest hospital or helicopter company.

  Tell the dispatcher:

  > Your name. _____
  > Do not say the name of an injured worker over the radio.

  > The location of the incident _____

  > Latitude & longitude _____

  > Radio frequency to use _____

  > Number of people hurt _____

  > Type of injury(ies) _____

  > Ambulance & paramedics needed _____

  > Equipment or supplies
  > that may be needed _____

- Mark the incident site with brightly coloured or reflective pylons.
- **Evacuation by helicopter**

  > Identify a landing area about 30 metres wide, with a clear approach such as open ground, stable ice cover or a straight section of road. Make sure the landing area is clear of debris, vehicles and equipment.

  > Assign someone to monitor a two-way radio on the specified frequency, to help the helicopter find the landing site.

  > Prepare the casualty for transport, making sure to protect the casualty from rotor wash (air movement from the helicopter's blade).

Self-rescue in freezing water

If you fall through the ice, you have time to save yourself.

1 minute to control your breathing

For about one minute, you'll gasp for air, in reaction to the extreme cold. After one minute, the gasping gets less, the skin numbs and the feeling of intense cold lessens.

10 minutes to get out

You have about 10 minutes to get out of the water:

tread water: Don't panic and thrash about. Resist the urge to gasp. Instead, slowly tread water or grasp the edge of the ice to keep your head above water.

kick and pull: Keep your hands and arms on the ice and kick your feet. This brings your body to a horizontal position, parallel to the ice surface.

horizontal kick and pull: Once you're horizontal, continue to kick your feet, while pulling with your hands. Draw yourself up onto the ice.

roll onto the ice: Keep your weight spread out as you roll, crawl and slide to reach ice that can support your weight.

1 hour before losing consciousness

After 10 minutes your muscles will not have the strength to get you out of the water. Eventually, you will lose consciousness. If your arms or beard are not frozen to the ice, you will slip below the surface and drown.

2 hours to be found and rescued

If you stay above the surface of the water, rescue is still possible within 2 hours. At about 2 hours, your heart will stop when your core temperature drops below 28°C.

Recommended Minimum Ice Thicknesses
For heavier vehicles, refer to the Best Practice and your *Ice Safety Plan*.