

A GUIDE TO

FREEZE PROTECTION & COLD WEATHER OPERATIONS

KEEPING CRITICAL PRODUCTS WORKING IN THE COLD

powerblanket

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A GUIDE TO FREEZE PROTECTION & COLD WEATHER OPERATIONS

KEEPING CRITICAL PRODUCTS WORKING IN THE COLD

With many unpredictable weather conditions year after year, it is critical that your equipment and materials are protected from freezing through the winter months. In a study conducted by the University of California for Atmospheric Science in 2000, they noted that more economic losses occur due to freeze damage in the United States than to any other weather related hazard (Toledano).

INDUSTRIES

Many industries are negatively impacted by cold weather. Among these are the oil and gas, water treatment, transportation, agriculture, construction and mining industries. These industries have many applications where critical materials and equipment are outside, and exposed to extreme temperatures throughout the winter months.

Freeze protection is vital for water based products, as they begin to crystallize and freeze at 32°F/0°C. When dealing with oil-based products however, it becomes more difficult as the weather and temperature change. Fuel oils (both clear Diesel fuel and dyed home heating oil) do not freeze, but rather turn into gel or a thicker wax. This process begins to occur below 32°F/0°C., and continuously thickens the colder it gets. Once the temperature drops below 15°F/-9°C the wax or paraffin in the fuel begins to crystallize and separate from the oil, making it extremely difficult to handle or to remove from its container. In certain applications, where these fuel oils are transported through a pipeline, insulate any piping that may be exposed to extreme temperature and winds in order to avoid any clogged pipes.

For motor oil, gear oil and hydraulic oil each

has a different freezing temperature range,

WHAT'S MY FREEZE POINT?		
SUBSTANCE	FREEZING POINT	
	CELSIUS	FAHRENHEIT
Butane	-140	-220
Carbon Dioxide	-78	-108
Chloroform	-63.5	-8.3
Chlorine	-101.5	-151
DEF	-11	12.2
Diesel (begins to gel)	-6	-21
Ethanol	-114	-173
Gasoline (begins to gel)	-40	-40
Gear and Hydraulic Oil	-23	-10
Glycerol	17.8	64
Helium	-272.2	-458
Hydrogen	-259.1	-434
Iodine	113.7	237
Mercury	-38.8	-38
Motor Oil 10W30	-20F	-4
Motor Oil 15W30	-55F	-67
Nitric Acid	-42	-44
Nitrogen	-210	-346
Propane	-188	-306
Sea Water	-2	28
Sulphuric Acid	10.3	51
Water	0	32

for instance motor oil (10W30) freezes at $-20^{\circ}\text{F}/-29^{\circ}\text{C}$, but from $50^{\circ}\text{F}/10^{\circ}\text{C}$, to $0^{\circ}\text{F}/-18^{\circ}\text{C}$ the viscosity of the oil becomes more and more difficult to deal with. With gear oil and hydraulic oil their freezing temperature is $-10^{\circ}\text{F}/-23^{\circ}\text{C}$ and, just like motor oil they become more viscous the colder it gets. Certain oils do work at very low temperatures, generally the thicker kind of motor oil, like 15W30, which freezes at $-55^{\circ}\text{F}/-48^{\circ}\text{C}$. Outside of water and oil-based products, other liquids and gases have freeze points that will affect performance.

WHAT IS FREEZE PROTECTION

Freeze protection means preventing the temperature of your product from going below $32^{\circ}\text{F}/0^{\circ}\text{C}$, below this temperature freezing begins.

HEATING OPTIONS

There are a variety of ways to protect your assets from freezing. It is important to evaluate the options and determine which will work best for your application.

INSULATION







Insulation, or more correctly thermal insulation,

is a general term used to describe products that reduce heat loss or heat gain by providing a barrier between areas that are significantly different in temperature. Insulation is the first step to best protect against freezing. Use insulation as your primary protection method when the item being protected generates heat or has something heated running through it. Insulation is a good solution when you only need to reduce heat loss, not raise temperature. It requires little to no maintenance.

EXTERNAL HEATERS

An external heater is a heat source that is outside/separate from your equipment/product that provides heat. Propane heaters are included in this category. Use an external heater with temporary structures and on job sites. They are easy to setup and take down, self contained, and easily moved from site to site. The disadvantage of an external heater is that heat for objects like pipes and valves must be transmitted through air with no direct contact. This is less efficient, requires more time, and requires proper ventilation.

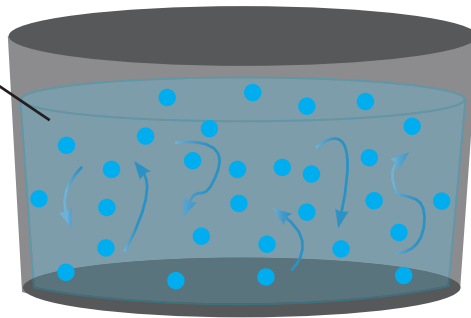
HEAT TAPE

HEATING OPTIONS		
<p>INSULATION</p> 	<p>EXTERNAL HEATER</p> 	<p>HEAT TAPE</p> 
<p>HEATING BLANKET</p> 	<p>HEAT TRACE SYSTEMS</p> 	<p>IMMERSION HEATER</p> 

THREE FUNDAMENTAL MODES OF HEAT TRANSFER

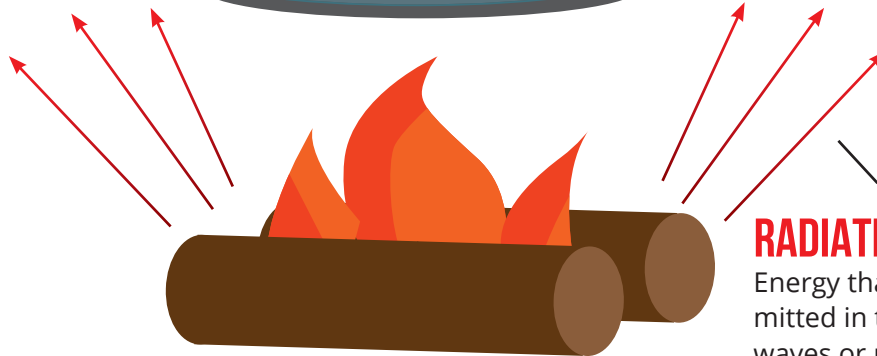
CONVECTION

The transfer of heat through a fluid (liquid or gas) caused by the tendency of hotter and therefore less dense material to rise, and colder, denser material to sink under the influence of gravity, resulting in heat transfer.



CONDUCTION

The transfer of heat through matter from particle to particle by direct contact.



RADIATION

Energy that is radiated or transmitted in the form of rays or waves or particles without the aid of fluids or solids.

When water pipes are exposed to cold temperatures either outdoors, underground or in a crawl space, heat tape can offer protection from freezing. Heat tape is actually a cord or heat cable with encased electrical wire that when plugged in heats up to protect whatever it might be wrapped around. It is best to use on exposed pipes and equipment like valve actuators, transmitters. Heat tape is extremely flexible and better for tight contours and odd shapes. There are a few disadvantages to heat tape. Normally, it comes in fixed lengths, and unfortunately can damage itself if not installed carefully. In most cases it must be insulated, and requires multiple trades to uninstall cladding, insulation, and heat tape to service equipment that is heated.

HEATING BLANKETS

Heating blankets wrap around or lay over a wide variety of equipment and products to provide heat. Heat blankets, if installed properly, apply heat directly to the medium, eliminating heat loss that comes from exposed surfaces. They are easy to install and remove for equipment requiring service. They offer integral temperature control and heat larger areas with a lower temperature gradient.

HEAT TRACE SYSTEMS

Heat trace is common in applications like exposed pipes and equipment, valve actuators, transmitters, roofs and gutters. Electric heat

tracing or surface heating, is a system used to maintain or raise the temperature of pipes and vessels. Trace heating takes the form of an electrical heating element run in physical contact along the length of a pipe. A heat trace system does not shrink and can be cut to length and terminated in the field. Self-regulating heat trace is available. These systems are somewhat stiff. As with heat tape, it must be insulated in most cases, requires multiple trades to remove cladding, insulation, and heat trace to service equipment that is heat traced.

IMMERSION HEATER

An example of an immersion heater is an electric liquid heater that sits inside a hot-water cylinder. It acts a bit like a kettle, using an electric resistance heater (which looks like a metal loop or coil) to heat the surrounding water. These are most commonly used in tanks or reservoirs of fluid. Immersion heaters are connected to their own power supply via a cable. They can be easily switched on and off, if there is no need to constantly heat the water in your hot-water cylinder. An advantage to an immersion heater is that the heater is directly in contact with the fluid being heated. They are, however, difficult to service or replace, and you may have to drain system.

These options can be used independently and sometimes together. It is important to understand the needs of your equipment when choosing the solution that is best for your operation.

HEAT TRANSFER

Heat transfer is the exchange of thermal energy between objects/mediums. Temperature plays a critical role in heat transfer. If temperatures are low and cold, transferring heat where you need it can be difficult, requiring much more energy to overcome losses to the surrounding system. The rate of heat transfer is dependent on the temperatures of the objects and the properties of the medium through which the heat is transferred. The three fundamental modes of heat transfer are conduction, convection and radia-



tion.

Heat transfer occurs from a region of high temperature to another region of lower temperature, and is governed by the Second Law of Thermodynamics (*the relations between heat and other forms of energy, such as mechanical, electrical, or chemical energy, and, by extension, of the relationships between all forms of energy.*). Heat transfer changes the internal energy of the mediums from which and to which the energy is transferred. Heat transfer will occur in a direction that increases the entropy (*a thermodynamic quantity representing the unavailability of a system's thermal energy for conversion into mechanical work, often interpreted as the degree of disorder or randomness in the system*) of the collection of systems.

Heat transfer ceases when thermal equilibrium is reached, at which point all involved bodies and the surroundings reach the same temperature. Heat transfer rates vary based on the system you choose.

WINTERIZING

CHECKLISTS TO PREVENT FREEZING AND INCREASE SAFETY

It is time to plan ahead. Checking your facility and systems for efficiency and safety before winter hits is always a good idea. Below is a general checklist to help improve your freeze protection. This is not inclusive to all operations. Consult your company policy for additional measures and/or implement those applicable to your safe workplace practices.

INDUSTRIAL FREEZE PROTECTION CHECKLIST			
Preventative Task	Assigned to	Date Completed	Official Signature
Clean, service, and test all heating systems.			
Roof and gutter: Inspect, remove debris, and patch/repair (if needed): roof drains, scuppers, canals, gutters, down spouts before first frost. Inspect and functionally test installed roof and gutter heat trace system.			
Inspect wet-pipe sprinkler systems for areas susceptible to freezing. Apply heat in susceptible areas.			
Identify and test main water supply cutoffs for each facility. Ensure these areas are readily available to emergency personnel responding to a freeze/thaw incident.			
Identify materials that are susceptible to freeze damage in outside storage pads and unheated storage areas. Develop plan to ensure these materials can be easily heated and thawed to maintain production.			
Check and place antifreeze used in cooling systems as necessary.			
Drain and remove water from all seasonal cooling systems (unless protected by heating tapes or antifreeze).			
Protect heating system power and temperature controls against inadvertent deactivation.			
Inspect, test, and stage portable auxiliary heaters.			
Inspect conditions of all surface heaters such as heating tapes, heating cable, drum heaters, IBC heaters, tank heaters, and pipe heaters. Verify operation and temperature settings and test ground-fault equipment protection. <i>Tip: Look for damaged insulation on all exposed portions of the power cord. If possible, check both ends of the cord for loose connections. An exposed conductor may come in contact with personnel during maintenance activities resulting in sparks or injury.</i>			
Inspect, test, and repair heat trace heating cable located on cooling tower supply and return lines.			

Preventative Task	Assigned to	Date Completed	Official Signature
Inspect and identify remaining water and air lines susceptible to freezing. Install appropriate heat and insulation. <i>Tip: Pay special attention to valves. This is a major choke point and susceptible to damage if frozen.</i>			
For steam systems: Blow down drip legs, clean strainers, test temperature sensing devices for actuation of control valves and dampers, check steam traps, control actuators/valves, face and by-pass dampers, linkages, and temperature controllers. Ensure that a vacuum breaker is installed and in working order on all preheat and heating coils which may be exposed to freezing conditions.			
For ventilation systems: Test and calibrate all temperature sensing devices, and check operation of valves, dampers, linkages, control actuators, and temperature controllers.			
Identify control panels and electronic devices susceptible to condensation. Install enclosure heaters to prevent short-outs and corrosion.			
Identify areas where personal safety is at risk due to icy conditions. Develop a slip prevention maintenance plan.			
Institute a facility-wide awareness plan to identify and report any suspected problems with heating or other cold weather protection equipment during the cold season.			
Have plan in place to remove temporary cold weather protection items after the cold weather season.			



COLD WEATHER OPERATIONS

HOW TO KEEP THE JOB GOING, EVEN IN THE COLD

INDUSTRIAL WINTER SAFETY

Cold weather can pose some major hazards if you haven't prepared for it. Failing to recognize and respect the dangers of winter is not recommended. Whether you are traveling through, working in, or enjoying the weather, the following tips are helpful to ensure your safety and good health.

WEAR LAYERED CLOTHING

Multiple layers of loose-fitting clothing allow the worker to adjust their comfort level and protection based on the current temperature. Tight fitting clothes reduce blood circulation.



Many forget the danger of sunburn when it is cold outside, but it is always important to protect from the sun. Wear a hat, scarf or face covering and always wear waterproof gloves. Also, it is wise to keep a change of clothes with you in case your existing clothes get wet. Being wet can increase the rate of heat loss from the body.

Always use proper engineering controls, safe work practices, and personal protective equipment (PPE) required by your employer in all work conditions.

STAY HYDRATED

It's easy to forget the simple importance of hydration when it is cold outside. It's not like the steamy summer months when we know we are sweating. You still sweat—even in cold temperatures. For optimal performance, keep the body hydrated.

BREAKS ARE GOOD

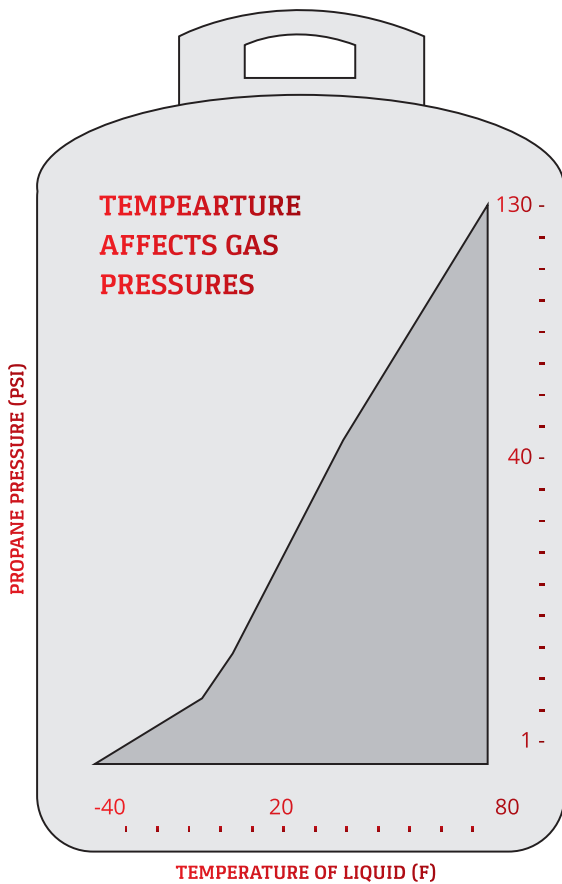
When the weather is particularly cold and/or windy, regular breaks are important. If possible, take a break inside or under shelter where you can warm up a bit. If it gets very cold, get inside and warm up.

KNOW THE SIGNS

Frostbite and hypothermia can set in unexpectedly. Get inside if you begin to experience either. If a co-worker seems to be manifesting signs, help them get help immediately. Be aware of those around you and take care of each other.

PROPER HEAT VENTILATION

If using a non-electric heater, ensure that there



is proper ventilation to let gases like carbon monoxide escape.

People often use temporary, propane-powered heating equipment at home and on the job site, making it easier to finish projects on time and on budget. In addition to providing more comfortable working conditions, propane-powered heaters can also maintain the ambient temperatures necessary for common tasks like drywall installation or painting. However, like any portable heating device, propane-powered heaters must be used and maintained properly.

When temperatures get too low, the propane will not flow consistently or effectively, and you may lose your heat altogether. Propane-tank efficiency will fall substantially as the temperature drops. As the temperature drops, so does

the pressure in your propane tank, and the pressure in your propane tank directly affects the flow of propane you have to work with. Your extraction rate (how quickly and smoothly you can extract propane from the tank) will suffer. Without a heating source to assist in the pressure maintenance of your tank, you will have to top your tank off more often in order to keep it working, even if temperatures are mildly cold.

PREPARE FOR WINTER DRIVING

Top off your fluids, drive slowly and allow yourself additional time to travel. Pay attention to changing road conditions.

WEAR GOOD SHOES

Wear proper footwear when tackling winter weather. A pair of water resistant and insulated boots with rubber treads is important for industrial winter safety. Slow your pace and shorten your steps when navigating snowy/icy walkways.

CLEAR THE PATH

Make sure that walkways, paths, stairs, and entries are free from snow and ice. Do this as quickly as possible when a winter storm sets in. Slips, trips, and falls will decrease dramatically when the path is clear. On January 4, 2017, Doctors in Germany prescribed a strategy to avoid slipping on ice: walk like a penguin. Imagine all your employees waddling back and forth like a rookery of penguins! This is not exactly what the German trauma surgeons meant. The technique involves leaning forward so that a person's center of gravity is over the front leg rather than divided evenly between both legs. "When humans walk normally, body weight is split almost evenly over both legs, which the surgeons say increases the risk of a person losing their balance and falling on slippery surfaces." It's a comical visual; however, slipping on ice is a serious workplace concern during icy and cold conditions.

SLIP AND FALL STATISTICS

- Falls account for over 8 million hospital emergency room visits per year, representing the leading cause of visits (21.3%). Slips and falls account for over 1 million visits per year, or 12% of total falls.
- Fall fatalities are nearly equally divided between men and women. However, more women will experience a slip-and-fall accident. According to the Bureau of Labor Statistics, falls accounted for 5% of the job-related fatalities for women compared to 11% for men.
- Fractures are the most serious consequences of falls and occur in 5% of fall cases.
- Slips and falls do not constitute a primary cause of fatal occupational injuries, but represent the primary cause of lost days from work.
- Slips and falls are the leading cause of workers' compensation claims and are the leading cause of occupational injury for people aged 55 years and older.

SNOW SHOVELING

While snow shoveling can be good exercise, it can also be dangerous for the optimistic shoveler who takes on more than he/she should. Shoveling snow is extremely strenuous, especially for those individuals who do not engage in regular cardiovascular activity. According to the Cleveland Clinic, approximately 11,000 people seek shoveling-related hospital treatment each year for injuries (93%) or cardiac issues (7%). Here are some tips from the National Safety Council for safe snow shoveling:

- Individuals over the age of 40 and/or those who are relatively inactive, should be especially careful.
- If you have a history of heart trouble, do not shovel without a doctor's permission.
- Avoid shoveling after eating or while smoking.
- Take it slow! Shoveling (like lifting weights)

can raise your heart rate and blood pressure dramatically; so pace yourself. Stretch out and warm up to prepare your body before taking on the task.

- Shovel only fresh snow. Freshly fallen, powdery snow is easier to shovel than the wet, packed-down old snow.
- Push the snow as you shovel. It's easier on your back than lifting the snow out of the way.
- Don't pick up too much at once. Use a small shovel, or fill only one-fourth or one-half of a large one.
- Use proper technique. Lift with your legs bent, not your back. Keep your back straight. By bending and "sitting" into the movement, you'll keep your spine upright and less stressed. The strongest muscles in your body (your shoulders, torso and thighs) can do the work for you.
- Do not work to the point of exhaustion. If you run out of breath, take a break. If you feel tightness in your chest, stop immediately.

VISCOSITY AND FLOW CONTROL

Viscosity is a complicated and sometimes confusing topic and achieving lower viscosity is a challenge during cold winter months.

VISCOSITY REDUCTION BASICS

A fluid that is viscous will be thick, sticky, and semi-fluid in consistency. Viscosity can be affected by friction and/or temperature. For example, consider what happens when you need some ketchup on your burger. If you simply invert the bottle and expect the ketchup to flow freely, you are a rookie in the sport of burger-eating. A pro knows to shake the bottle and then to proceed with caution, because once you have decreased viscosity, due to the shaking, the ketchup can flow quite rapidly. Now think about honey, certainly a substance that is thick, sticky and semifluid. Simply shaking a jar of honey will not guarantee any flow. Honey cooled in a refrigerator will have little to



no flow because it has been cooled, but when warmed appropriately (Do not heat honey much above 100°F/38°C to avoid nutritional loss), there is a viscosity reduction and honey will flow smoothly.

LOWER VISCOSITY AND TEMPERATURE

For many fluids, viscosity strongly depends on temperature. Along with the shear rate, temperature really is the dominating influence. The higher the temperature is, the lower a liquid's viscosity is. The relationship between temperature and viscosity is inversely proportional for all liquids. A change in temperature affects the viscosity – it depends on the substance just how much it is influenced by a temperature change. For some fluids a decrease of 1.8°F/1°C causes a 10 % increase in viscosity.

FLUIDS WITH VISCOSITY ISSUES

Acetone
Automatic Transmission Fluid, Antifreeze, and Brake Fluid
Aviation Fuels
Benzene
Bunker Oil-Marine Fuel Oil

Chloroform
Crude Oil
Diesel Fuel
Ethanol
Gear Oil
Heavy Fuel Oil
Honey
Hydrofluoric Acid
Ink
Mercury
Methanol
Molasses
Citric Acid
Paraffin Wax
Pentane
Sulfuric Acid
Tetrahydrofuran
Toluene

DEF IN COLD WEATHER

DEF is essential for many industrial operations and when the temperatures drop, there are some important things to understand about caring for DEF.

UNDERSTANDING DEF AND SCR

Diesel Exhaust Fluid (DEF) is a non-hazardous solution, which is 32.5% urea and 67.5% de-ionized water. DEF is sprayed into the exhaust stream of diesel vehicles to break down dangerous NOx emissions into harmless nitrogen and water. NOx is an element in exhaust that has been blamed for acid rain, smog and raising the overall greenhouse gas levels of the planet. DEF is not a fuel additive and never comes into contact with diesel. It is stored in a separate tank, typically with a blue filler cap. This system is called Selective Catalytic Reduction (SCR). SCR and DEF have been used for decades in commercial and agricultural applications.

STORING DEF

DEF should be stored in a cool, dry, well-ventilated area. The ideal storage temperature for DEF is between 15°F and 77°F (-9°C and 25°C). It should not be exposed to direct sunlight for long periods of time as the urea will decompose. When possible, DEF packages and bulk storage should be kept indoors in temperature-controlled environments. Use the right container. DEF is mildly corrosive, and should be stored in containers of HDPE plastic or stainless steel.

**DEF EXPIRES**

Check the expiration. The storage life of DEF varies. The urea is vulnerable to degradation from sunlight and higher temperatures. In favorable storage conditions (proper container, away from direct sunlight, temperatures between 15 and 77°F (-9°C and 25°C)), DEF can maintain its qualities for about 12 months.

BE GOOD TO DEF

Handle it like fuel. Per EPA guidelines, vehicles using DEF must include sensors to continually analyze the quality of the DEF being consumed. These sensors will trigger a fault code whenever an imbalance is detected. Most commonly, this results from a higher percentage of water as a result of foreign matter, condensation or rainwater in the DEF storage container or unintentionally added during transfer. The quality and integrity of DEF must be maintained for

proper machine operation. It must be protected against evaporation and temperature extremes, and kept free of contaminants.

WHEN DOES DEF FREEZE?

DEF, because of the urea, doesn't have the freezing point of water. The urea mixture has a much lower freezing point of 12°F/-11°C. This solution doesn't break down into urea and water, either. The solution freezes at the same rate, and also thaws at the same rate. This means that at no point does the DEF freezing cause the solution to become over concentrated or diluted. DEF will begin to slush and then freeze. There is no harm to the product which means that the urea solution is still safe to use if it has been frozen.

DEF FREEZING AND EXPANSION

Though it is safe to use again once thawed, expansion from freezing could cause problems. Since DEF is a mixture of deionized water and urea, it reacts some-

"Upon the implementation of using our new DEF system to stay compliant with EPA regulations, Powerblanket provided an effective and energy efficient freeze protection system with its DEF Tote Heater System. We installed the unit and forgot about it, knowing our product is being protected, which gives us peace of mind."

— Jerri Brumfield

what like water in that it does expand when frozen. DEF freezing usually causes about a 7% expansion. It is important to note that DEF freezing is usually taken into account when creating the packaging and tanks that are supposed to hold DEF. DEF packaging and tanks allow for expansion. However, one must be aware of the expansion of DEF when filling. When storing equipment overnight or longer in temperatures that could result in DEF freezing, it is important to make sure the DEF tank on the equipment is not completely full or that it has an appropriate heat source that will heat when the equipment is not running. This will allow for expansion and help prevent cracking of the storage reservoir.

HOW TO PREVENT DEF FREEZING?

DEF freezing was taken into account by the OEMs prior to creating the Selective Catalytic Reduction (SCR) systems. Therefore, the SCR systems are designed to provide heating for the DEF tank and supply lines; however, if the vehicle is shut down and exposed to freezing temperatures, then it is possible that the DEF will freeze. Diesel owners do not need to worry about DEF interfering with their vehicle, however. If DEF freezes when the vehicle is shutdown, startup and normal operation of the vehicle will not be inhibited. In most cases, the SCR heating system will quickly thaw the DEF in order to return it to liquid form and resume normal operation.

CAN ANYTHING BE ADDED TO PREVENT DEF FREEZING?

Many want to know if anti-gelling or freeze-point-improver can be added to the DEF mixture to prevent freezing. DO NOT put additives into the urea solution because DEF must remain pure. The quality of DEF is extremely important for proper performance. Adding any additives would damage its ability to perform correctly and could even result in damages to the SCR system. No additives are approved for DEF at this time.

WINTER ROAD MAINTENANCE

Typically, it is unwise to do any major structural winter road maintenance in the cold winter months. Many professional paving companies joke that the best time to do winter repairs is in the summer. Winter road construction is not so much dictated by the season, but rather by the temperature. Warmer states have much longer active road construction periods than states with cold winters. Without special engineering permission, most states prohibit paving in conditions below 45-50°F/4-10°C (for example asphalt conditions must be 50°F/10°C and rising in Utah). Never install asphalt or concrete on a frozen subbase; this will only ensure additional work for you when the conditions improve and you have to redo the job.

EMERGENCY POTHOLE REPAIR

For temporary repairs, such as potholes, use cold mix asphalt. If the temperature is below the recommended level for paving and it is an emergency, cold mix asphalt will work. During this cold weather repair, remove all ice, moisture, and debris from the affected area using a heat source. Keep in mind, this repair is meant to be temporary and should be permanently remedied when conditions improve.

WINTER ROAD REPAIRS

Crack sealing is actually preferred in colder months because pavements expand and contract with seasonal temperature changes. Consequently, cracks and joints can change width when the pavement moves due to temperature changes. Crack sealing is a preventative winter road maintenance practice meant to extend the life of pavement. Since cracks on the pavement surface allow water and incompressible materials such as sand, dirt, and other debris to enter the pavement structure, these cracks can dramatically accelerate deterioration and weakening. Sealing cracks prevents further

deterioration of the pavement and, when properly executed, can extend the life of the pavement anywhere from 6 months to 4 years.

CRACK SEALING TIPS

1. As recommended with the pothole repair, clear the crack of moisture, dirt, debris, vegetation and chemical deicers to make the sealing more effective, use a heat lance and/or compressed air. If using a heat lance take care not to burn or scorch the pavement and to place the sealant before the pavement around the crack cools to allow for the best adherence of the crack fill materials.
2. Seal all cracks from 1/4" to 1" in width the entire length of the crack. Cracks smaller than 1/4" will not retain sufficient sealer to flex in the cold. Cracks greater than 1" will sag and possibly prematurely fail without the installation of HMA (hot mix asphalt) or backer rod.
3. When repairing cracks, fill the entire crack and level any affected area to ensure a smooth and level pavement surface.
4. Apply the sealant or repair material only when the sealant or repair material is within the manufacturer's recommended application temperature. Special care must be taken to assure that the sealant temperature does not exceed the manufacturer's recommendations; otherwise the polymers

may be destroyed therefore reducing the sealant performance.

5. Keep in mind that more sealant is not always better. Over applying sealant material can lead to problems when paving over with HMA or bleeding up through the seal or paving application.
6. New sealants are not designed to be "road glue". They are very sticky and have tremendous bonding power; however, they were not made to "hold the road together". Crack sealing has one objective: to prevent water from further damaging roads. Sealing "buys time" and saves money by delaying the expense of major reconstructive pavement work.

WINTER ROOFING

Almost all types of roofing material utilize adhesive during the installation process, and almost all adhesives requires warm ambient temperatures or some type of external heat source to properly cure and bond. Without proper bonding, a roof will often fail quickly, if not immediately. In the summer, the sun's heat will properly adhere most roofing materials: asphalt shingle, EPDM (rubber) single-ply membrane, roll roofing, peel and stick roofing, and modified bitumen. Added effort and expense are required to apply these materials in cold winter weather.



ASPHALT SHINGLES

The ideal temperature range to install asphalt shingles is between 70-80°F/21-27°C. Colder than 70°F/21°C and the adhesive will not reach the ideal elasticity and will not create a perfect seal. If temperatures are warmer than 80°F/27°C, asphalt shingles can become overly pliable and are susceptible to damage during installation. Installers are more likely to overdrive roofing nails, and foot traffic can erode the protective granular layer quite easily in extremely warm temperatures.

If winter installation is unavoidable, most asphalt shingle manufacturers require that a specialized adhesive is manually applied to each shingle for temperatures below 40°F/4°C. If shingles are applied below 40°F/4°C without the specialized adhesive, the manufacturer will void any warranty.

EPDM

EPDM (rubber) membrane roofing is even more temperature sensitive than asphalt shingles. EPDM is joined together using an extensive amount of adhesive, and the adhesive must have high temperatures to be pliable enough to install and cure. EPDM adhesive is very thick and hard to work with even at high temperatures. Manufacturers recommend temperatures be above 45°F/7°C for installation. That recommended temperature is not very practical in the winter unless a warm storage area is made available to keep the adhesive warm until the moment it is used.

MAINTAIN INTEGRITY OF CONCRETE

While most construction tasks can be carried out in cold weather, some operations, such as concrete work, can take much longer and even fail without proper precautions.

If concrete is to reach necessary strength levels, it can't be allowed to freeze for the first 24 hours after being poured or placed. Sheeting

the concrete can help to ensure the required temperature and moisture necessary for curing, if the weather isn't too severe. In severe conditions, supplemental heating systems or enclosures must be brought in to maintain the integrity of the concrete.

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References

"Cold Weather Roofing". ProRoofing.com. 14 November, 2016. www.prorooftingwisconsin.com/cold-weather-roofing.html.

"DEF Freezing". Victory Blue. 7 December 2016. victoryblue.com/2013/10/23/def-freezing/

Discover DEF. 8 December 2016. www.discoverdef.com/def-overview/faq/#def

"Quick Facts." National Floor Safety Institute. 6 January 2017. <https://nfsi.org/nfsi-research/quick-facts/>

"Snow Shoveling". National Safety Council. 6 January 2017. www.nsc.org/NSCDocuments_Corporate/SafetyObservancesDocuments/Snow-Shoveling.pdf

"Snow Shoveling—A Real Risk for Heart Attack". Cleveland Clinic. 6 January 2017. <https://health.clevelandclinic.org/2015/02/snow-shoveling-a-real-risk-for-heart-attack/>

Toledano, Ilan. "Freeze Protection and what you need to know". WATTCO. 25 January 2017. www.wattco.com/blog/2011/12/freeze-protection-and-what-you-need-to-know/

"Viscosity Tables and Viscosity Charts." Viscopedia. 30 December 2016. <http://www.viscopedia.com/viscosity-tables/>

"Walk like a penguin to avoid slipping on ice, German doctors advise". Reuters in Berlin. 6 January 2017. www.theguardian.com/world/2017/jan/04/penguin-walk-german-doctors-advice-slipping-icy-paths

TOTAL TEMPERATURE CONTROL

POWERBLANKET HAS THE SOLUTION YOU NEED

A DILEMMA

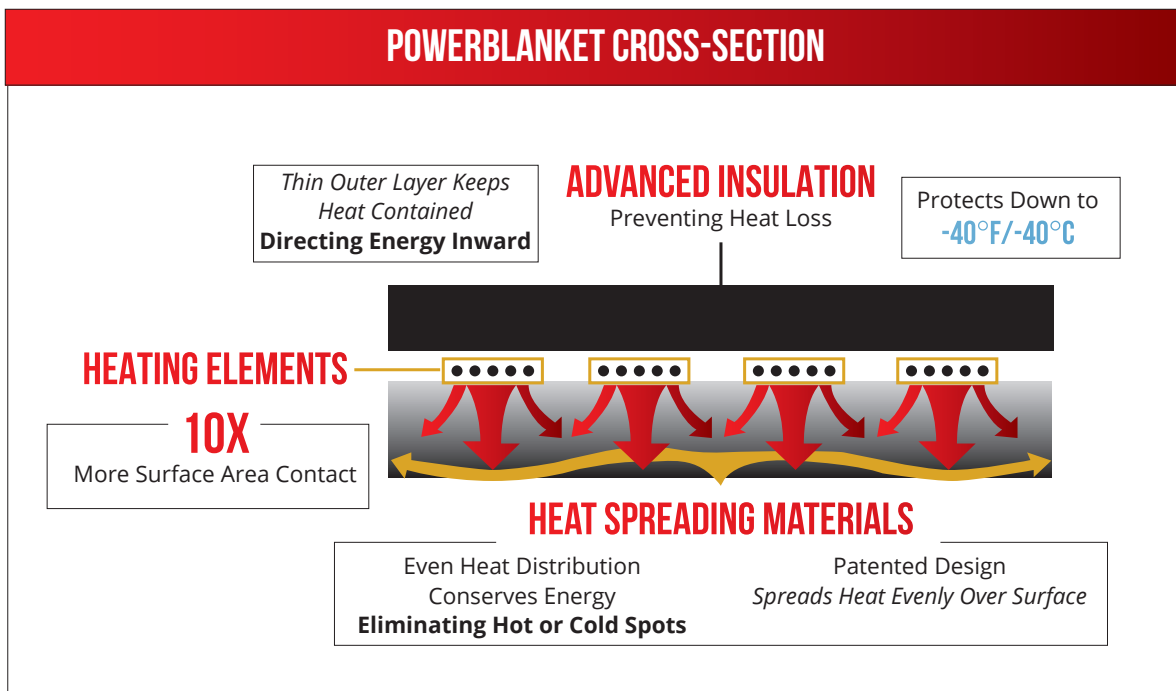
When the chilly Marcellus winters started causing problems with the Catch Tanks White's Equipment Rental used to capture fluids, Buck Binder, VP of Production and R&D lead, realized that the weather could cost the business thousands of dollars in rental fees, replacement costs, and even fines from the EPA, if the Catch Tanks were to freeze. He turned to Powerblanket for a custom solution. Powerblanket engineers designed a custom heating blanket that was fitted precisely to the Catch Tanks. By keeping the tanks warm during the cold weather, the risk that they would freeze was eliminated, and with that, so was the risk that they would cause a loss in revenue.

Powerblanket's custom heating solution

provided White's Equipment Rental with more than freeze protection. It provided both them and their clients with the benefits of sustainability, continuous production, and reduced or eliminated down time, not to mention peace of mind and the earned reputation of being a preferred energy services provider.

ON TRACK

Union Pacific, one of the largest rail companies, is able to keep snow off the tracks by applying the Powerblanket Gas Cylinder Warmers to their 1000 gallon propane tanks which power their generators along the railway system. Before using the Powerblanket heaters, the cold temperatures reduced the amount of propane that could vaporize, which meant there was not enough pressure in the tanks to run the generators.



QUICK ROAD REPAIR

Vern Fiehler, of Quick Road Repair in Alaska, saves money by keeping his product from overheating, which is what happened with his previous method of heating. Vern was meeting with the field maintenance crew of the Juneau Alaska International Airport to demonstrate his product, Instant Road Repair (IRR). For his demonstration, he tried to bring the IRR up to a workable temperature by using a forced air ceramic heater. During his presentation the product was not performing well and to his surprise, he discovered that his product overheated 40°F/22°C above the maximum recommended temperature. That not only cost him the entire pallet of material but he was also embarrassed. Since then, Vern uses the Powerblanket Hot Box (bulk material warmer).

MONEY SAVED

Walsh Construction saved more than \$5.43 for every \$1.00 spent on Powerblanket heating blankets during a wintertime cold weather concrete job. They calculated this based on cost of

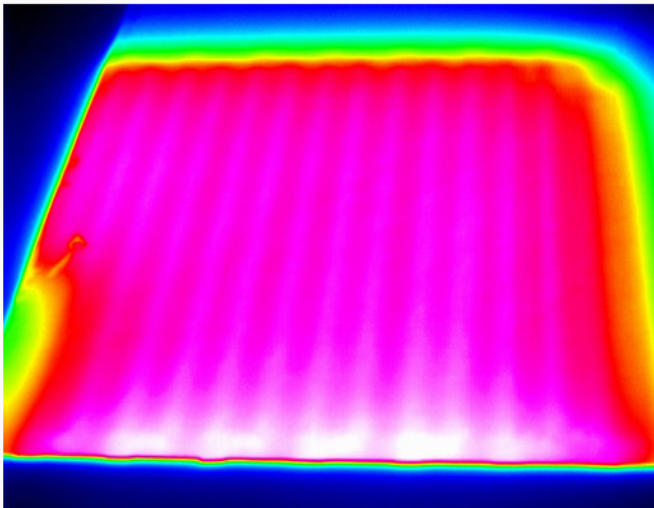
labor and materials to build and move heated enclosures along two-and-one-half miles of a concrete canal wall built for the Illinois Waterway.

Powerblanket freeze protection products are an energy-efficient and cost-effective solution for even the harshest environments. Even heat transfer, easy install and removal, time saving, and cost efficiency are at the top of the list with every Powerblanket freeze protection product.

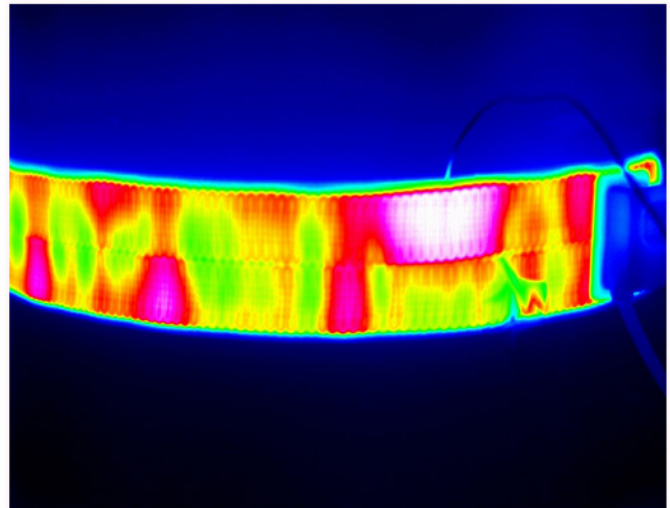
TIME IS VALUABLE

"Your blankets are absolutely excellent. Thanks to the Powerblankets we were able to quickly thaw the ground and complete our job. In fact, we estimate a savings of 10 hours per site equaling a savings of \$5,000 already. Calculating this to our thousands of sites, the savings is huge! We are excited about the time and money Powerblanket has saved us and look forward to future savings."






—Kim Herman OSP/COEI Operations Manager
Precision Utilities Group







Thermal imaging of Powerblanket's patented technology



VS. Uneven heating of conventional heating products.

PRODUCT	USE	POWERBLANKET ADVANTAGES
<p>PIPE, VALVE, & CUSTOM FREEZE PROTECTION</p> 	<p>Powerblanket specializes in freeze protection for wellheads, pipes, pumps, valves, manifolds, tanks, equipment, and much more. Powerblanket freeze protection solutions save on labor costs through each installation, and removal. Additionally, you'll eliminate downtime and expenses associated with replacing frozen equipment.</p>	<ul style="list-style-type: none"> • Provide freeze protection down to -40° F/-40° C • Prepare pipes for coatings and welding • Can be custom made to operate in Class I Div. 2 hazardous locations • More protective and efficient than traditional heat trace • A 20ft section of heat trace could take 6 specialized workers up to 10 hours to install. Powerblanket solutions are per-engineered to save you time and money – the same 20 ft. section could take 2 workers as little as 20 minutes to install a Powerblanket freeze protection product
<p>IBC TOTE /DEF TANK HEATERS</p> 	<p>Powerblanket IBC heaters provide safe, consistent heat, ensuring your totes are stored at optimal temperatures. Maintain desired viscosity of fluids. Deliver uniform heat to temperature sensitive products and preserve expensive materials without scorching or burning.</p>	<ul style="list-style-type: none"> • Distribute heat evenly around the tote • Designed to be durable and weather resistant • Provide easy access with a removable top • Include an adjustable thermostatic controller • Safely heat and protect a wide variety of chemicals and materials • Prevent waste by maintaining consistent temperatures
<p>TANK HEATERS</p> 	<p>Powerblanket Tank Heaters maintain temperature, heat, provide freeze protection, or optimize flow for viscous and temperature sensitive materials.</p>	<ul style="list-style-type: none"> • Maintain optimal temperatures for temperature sensitive materials • Custom designed to fit any tank • Provide freeze protection • Available in 120, 208 or 240VAC • Peace of mind that your valuable materials are protected
<p>GAS CYLINDER HEATERS</p> 	<p>Powerblanket has the best gas cylinder heaters on the market. Our heating blankets will overcome the effects of cold weather and maintain pressure and efficiency on any gas cylinder.</p>	<ul style="list-style-type: none"> • Increase performance and efficiency of gas cylinders • Save money by optimizing gas and material usage • Eliminate unnecessary cylinder refills in cold weather • Insulated full-wrap design
<p>SUMMERSTEP HEATED SAFETY MATS</p> 	<p>Summerstep outdoor heated mats keep stairs, doorways, ramps, walkways and alleyways safe and secure from slip and fall accidents. Stay safe and prevent hazards created by icy winter weather with Summerstep.</p>	<ul style="list-style-type: none"> • Save time and money • Keep walkways clear of ice and snow for your safety • Environmentally safe, requires no chemicals • Durable and long-lasting • More convenient than shoveling snow • Reliable. Even in the worst conditions, SummerStep keeps the path clear

PRODUCT	USE	POWERBLANKET ADVANTAGES
<p>CONCRETE CURING</p> 	<p>Powerblanket Concrete Curing blankets provide a manageable way to cure concrete effectively and confidently in the cold weather months. Even in warm weather, Powerblanket Curing Blankets increase production by reducing cure times with consistent, even heat.</p>	<ul style="list-style-type: none"> • Cure concrete 2.8 times faster than conventional, insulated blankets • Produce cold weather concreting strength of up to 3,925 psi in 72 hours • Maintain moisture throughout hydrating process • Easily installed and removed • Prevent a freeze cycle • Thaw ground and frost from job site prior to pour • Reduce downtime & increase profitability • Maintain ACI compliance for cold weather concreting
<p>DRUM & BARREL HEATERS</p> 	<p>Drum heaters are one of the most popular lines of Powerblanket products. The design provides targeted and distributed heat to the surface of the drum, thus eliminating hot and cold spots.</p>	<ul style="list-style-type: none"> • Work on both steel and poly drums • Provide an insulated, full-wrap design • Deliver safe, distributed heat to temperature sensitive materials • Preserve expensive materials without overheating or burning • Prevent product waste by safely maintaining consistent temperatures
<p>BULK MATERIAL HEATERS</p> 	<p>Powerblanket Hot Boxes efficiently heat temperature sensitive materials. Hot Boxes can heat paints, roofing materials, chemicals, epoxies, resins, equipment, and pallets of any material.</p>	<ul style="list-style-type: none"> • Preserve and protect temperature sensitive materials • Quickly and easily install the compact portable design • Localize heat and save money by not heating a warehouse or building • Lower energy-related costs with the highly efficient design
<p>GROUND THAWING HEATERS</p> 	<p>The high power density in Powerblanket Ground Thawing Blankets helps tackle the difficulty of thawing ground in harsh climates.</p>	<ul style="list-style-type: none"> • High power density thaws frozen ground • Quickly remove frost prior to concrete pour • Melt snow and ice from roofs, walkways, and construction areas • Easily installed and removed • Provides greater temperature control when combined with a thermostatic controller, available separately • Saves time, money, and labor



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