

WHY DOES A DIVER NEEDS A HEATER

Unless the water temperature is greater than 32° C (90° F), you will lose heat. The human body must maintain a constant core temperature for efficient metabolism. Even a minor drop of only a degree or two can cause some adverse effects. Our body's response to decreased core temperature is a complex process. A diver experiencing "mild" hypothermia will feel cold, most noticeably in the extremities. Also common is an accelerated heart rate and increased urge to urinate.

Vasoconstriction (narrowing of the blood vessels) will shift the blood from the periphery into the core, which is interpreted by the body as a state of over-hydration. The brain shuts off production of antidiuretic hormones, causing the diver to urinate frequently. As the urine is at body temperature, significant heat is lost along with the fluid output. Shivering usually occurs as an early symptom only if the diver isn't vigorously swimming or is not engaged in other physical activity. That means the diver can delay shivering or completely suppress it depending on activity.

When we're exposed to cold on land, an effective way to warm up is by exercising. As you know, even on the coldest days, you can exercise to a point where you perspire. Some assume that these techniques can work well underwater. Unfortunately, that's not the case. While increased exercise may make you feel warmer, it masks what's actually happening to your body. Increased exercise does increase heat production, but the water drains the heat away faster than you can produce it. So the net effect of trying to warm up by vigorous swimming is merely to increase the amount of heat lost. The inevitable outcome of this practice is a cold and tired diver with shorter than otherwise bottom time.

Scientists have demonstrated that nitrogen narcosis can inhibit the shivering response, eliminating an important warning sign of hypothermia. Most divers assume that only "northern divers" need to worry about heat loss; tropical divers have nothing to worry about. In reality, understanding heat loss is critical to all divers, because of a phenomenon known as warm-water or undetected hypothermia. Unlike in cold water, heat loss in warm water is slow and gradual. This long, slow cooling of the body can significantly lower core temperature. The phenomenon has been documented in divers engaging in diving for several days in temperatures as high as 27° C (81° F) without long periods of rest between dives, a typical scenario for a diving vacation. Under these circumstances, the skin temperature remains within comfort range, while the core temperature slowly and insidiously drops over time. The most common symptoms of undetected hypothermia are fatigue, loss of motivation and impaired mental ability. The research has indicated that this form of cooling may not stimulate shivering until the diver is significantly hypothermic.

Upon immersion, a diver begins losing heat by conduction. Even in the full 7mm wet suit, heat loss can be accelerated by water flushing through the suit due to vigorous swimming or improper fit. On descent, the wet suit compresses and loses its effectiveness. On a deep dive, the 7mm wet suit might only provide the protection of a 3mm suit. A dry suit offers better protection; however, it also has its limitations. It uses air as an insulator, which is trapped in the undergarment. The otherwise fluffy undergarment will be also compressed by the water pressure, thus losing its full effectiveness. Adding more air into the suit to increase the airspace between the suit and the skin will only create a bubble at the highest point of the suit. If the diver could wear a more rigid undergarment, which would not compress as easily, he would then be excessively buoyant, requiring enormous weight to descend. The wet suit diver could increase the suit thickness, but besides losing his mobility he would face the same dilemma trying to descend. The diving suit manufacturers have reached a dead end in the development of **PASSIVE THERMAL PROTECTION SYSTEMS**. Regardless of the effectiveness of any exposure suit, no suit used by sport divers can stop heat loss. At best, even the most expensive suit can only slow the process. With the introduction of rebreathers, mixed gases, underwater propulsion vehicles etc. our bottom times have increased. However, the bottom time, until now, has always been limited by the EXPOSURE TIME. Not any more!

ACTIVE THERMAL PROTECTION SYSTEMS

As you now know, the only way to keep warm while diving is with supplemental heat. The diver simply takes the heat with him on the dive. You won't have to worry about cold water, wind or thermo clines. **ADITECH** has developed 3 different heating systems:

- ➔ **Dividing Chemical Heater (DCH):** The **DCH** is a re-usable chemical heater integrated in an elastic neoprene belt (**DCH-B**) or vest (**DCH-V**), compatible with wet and dry suits. The heat pack contains a non-toxic liquid solution of sodium acetate in a sealed bag, flexing the stainless steel button within the sealed container causes a single molecule of liquid to crystallize which starts a chain reaction causing the entire solution to change from liquid to a solid. This phase change causes the pack to heat to 54°C (130°F), and the generated heat will last up to 30-40 minutes, depending on the water temperature and insulation of the exposure suit. By placing the pack in boiling water, the crystals are returned to a liquid state, this process can be repeated hundreds of times, provided the container remains sealed.



➤ **Diving Electrical Heater DEH:** The **DEH** is an electrical heater integrated in an elastic neoprene belt (**DEH-B**) or vest (**DEH-V**), compatible with all wet and dry suits. The belt/vest contains a 50 Watts heating element, the DEH is a fully modular system that can be powered directly by the **PEH-4** NiMH battery or by three different battery packs; the **P-HS4** (NiMH 3800 mAh), the **P-PS9** (NiMH 9500 mAh) and finally the **P-PS21** that features an amazing 20800 mAh state of the art Lithium-Ion-Mn battery. The PEH-4 fits inside the BCD pocket and comes with a dial to select a comfort level between 100% (50 Watts) and 60% (30 Watts). The other battery packs (P-HS4, P-PS9 and P-PS21) require additionally the electronic control unit **EHC** to be operated. The heater is turned ON and OFF by a magnetic switch, it means that there is no risk of water leakage, which is typical on mechanical switches. The battery pack P-HS4 can be used to power the optional **AMS** light head instead of the heater. The battery packs P-HS4, P-PS9 and P-PS21 can also be used to power the optional **APS** light head instead of the heater system, the electronic control unit EHC allows the heater and the APS light head to be used at the same time.



This is a lot of heat considering that the human body produces in the relaxed condition, only about 60 Watts of heat. With the proper heater you can dive wet in North Pole waters and enjoy unprecedented comfort. Supplemental heat is the future of diving!

Mangrove's Personal Diving Heaters let you extend your dive season for year-round diving in oceans, lakes, or quarries. Stamina, alertness, dexterity, and coordination will not be compromised by the numbing loss of body heat. Diving with any of these heaters is less stressful, more enjoyable, and much safer.

The **DCH** and **DEH** heaters were designed not only for diving, but other sport activities as well, such as hunting, motorcycle riding, snowmobiling, camping and even skiing. You can take it to the ball game or use it while working on your car. Its use is limited only by your imagination.

The conclusion from this discussion is clear. Unless the water temperature is above 32° C (90°F), the question isn't whether or not you are losing heat; it's how much you are losing. We rate the core temperature on a scale from zero to ten. At ten you are fully regenerated. One more point and you will start sweating. If you reach zero, you have lost so much heat that you will start shivering. As you learned previously, the shivering point will be delayed unless the diver is motionless. If the diver's core temperature is anywhere between one and ten, he will not have any symptoms of being cold.

If you are ten before jumping into water, you will have a great advantage over divers who are, let's say, five or even three. Your core temperature will drop, but hopefully, you will finish your dive before it drops to zero. So the next time someone tells you they dive in cold water but don't get cold, you'll know better. Just because they don't feel it, doesn't mean their body isn't cold. They are either delaying the shivering point or they just don't have enough bottom time.

Scuba diving is a beautiful and exciting sport. We need to be warm to maximize our enjoyment. There are sometimes rough seas, cold water, strong currents, bad visibility, and gloomy weather and sometimes you get cold. There is not much we can do about the diving conditions, but you can always dive warm. The new technology is here and it is for everyone.

Heating Element	DCH-B	DCH-V	DEH-B	DEH-V
Support system	Belt	Vest	Belt	Vest
Support Material	3 mm neoprene		3 mm neoprene	
Thermal Element	solution of sodium acetate		Polyimide-insulated electrical heater	
Puissance	-		50 W	
Temperature max. (on air)	54° C		62° C	

Power Source	DCH	PEH-4	P-HS4	P-PS9	P-PS21
Capacity	812 g	3800 mAh	3800 mAh	9500 mAh	20800 mAh
Voltage	-	14.4 V	14.4 V	14.4 V	14.8 V
Battery type	-	NiMH	NiMH	NiMH	Lithium-Ion-Mn
Variable power output	-	100-60 %	100-60% (EHC)	100-60% (EHC)	100-60% (EHC)
Heating time	30-40 minutes	60-110 minutes	60-110 minutes	160-293 minutes	6-11 hours
Switch	SS Activator	Magnetic	Magnetic (EHC)	Magnetic (EHC)	Magnetic (EHC)
Low battery alarm	---	Acoustic	Acoustic (EHC)	Acoustic (EHC)	Acoustic (EHC)
Dimensions battery pack		183 x 60 mm	183 x 60 mm	229 x 100 mm	295 x 110 mm
Weight / Buoyancy	0,9 / 0 Kg	1,2 / -0.7 Kg	1,2 / -0.7 Kg	2,9 / -1.36 Kg	3.94 / -.74 Kg
Recharging time (Charger)	+/- 10 min	4 hours (ACS712pt) 2 hours (ACS712pt+) 7 hours (ACS712)	4 hours (ACS712pt) 2 hours (ACS712pt+) 7 hours (ACS712)	5 hours (ACS712pt+)	10 hours (9C94140)
Depth rating	200 m / 660 feet				