

# HELMET TECHNOLOGY (SNOW)

## THE INTENTION OF A HELMET

The purpose of a helmet is to reduce the risk of injury to both the skull and the part of the head surrounded by the helmet. The protection the helmet gives you depends on the circumstances of the accident and wearing a helmet cannot always prevent death or long term disability. To see how a helmet reduces the risk of injury, we need to look at the laws of physics. Sir Isaac Newton made three laws about motion, and his 2nd law is the one that's most relevant; the law of acceleration. Acceleration is changing the speed or direction of an object, not only speeding up, but also slowing it down to a stop.

**Newton's 2nd law goes like this:**

$$F = ma = \frac{m(v-v_0)}{t}$$

*\*F is force, m is mass, a is acceleration, v is velocity and t is time.*

Here Newton is saying that the rate of change in the momentum (mv) of an object is directly proportional to the amount of force exerted upon the object. In real life, while skiing or snowboarding, there's only one factor a helmet is able to influence in this equation, and that's the time. When you fall, you have a certain weight and speed, which is pretty much up to you. From the equation above you can see that the greater the time within the impact, the less force is subjected to your head. In other words, a helmet absorbs energy by increasing the duration of the impact.

There are several certification standards for helmets, and SWEET helmets are certified according to the CE EN 1077, which is the European standard for skiing and snowboarding. It makes sure that SWEET helmets fulfill all requirements for a skier or snowboarder, including the ability to absorb energy.

## THE CE EN 1077 STANDARD

There are six major requirements:

### 1. Field of vision

Making sure the helmet design does not interfere with the user's field of vision

### 2. Extent of coverage

Making sure the helmet covers all necessary parts of the head

### 3. Shock absorbing capacity

The most important is the shock absorbing capacity of the helmet. This is tested in a specialized instrument where the helmet is dropped from 1.5m onto a solid metal anvil with a 4 kg metal head inside. Inside the metal head there's an accelerometer that measures the forces within the impact. The helmets are tested in three conditions: Room temperature, -25°C, and after artificial aging. Each helmet is tested on several areas (crown, side, rear & front). The peak acceleration must not exceed 250G for any of the impacts.

### 4. Resistance to penetration

While skiing or snowboarding there's a risk of poles, skis or branches penetrating the helmet. The resistance to penetration is tested by dropping a hammer with the mass of 3 kg from 75cm onto a sharp cone shaped metal punch placed against the helmet. The point of the metal punch must not reach the head inside the helmet.

### 5. Retention system performance

This test covers the strength of the retention system (webbing), as well as its effectiveness, i.e. the webbings ability to keep the helmet securely positioned on the head.

### 6. Durability

After all these tests the helmet should not show any damage that would cause any additional damage to the wearer.

## HELMET CONSTRUCTION IN GENERAL

There's usually two ways of constructing a helmet to fulfill the requirements in the CE EN 1077 standard:

### 1. In-mould

An in-mould helmet is characterized by a very thin shell, usually made of Polycarbonate, where the foam padding is molded into the shell in one process. This is a very effective production process and gives the benefit of a very light helmet. The downside is that in-mould helmets have a lot of volume, and they're not very durable.

### 2. Plastic shell

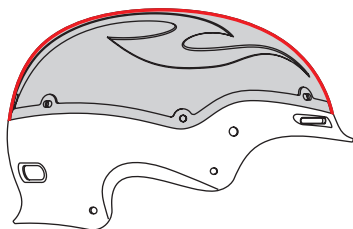
A plastic shell helmet is generally manufactured in two pieces that are produced separately. One is the shell, which usually is an injected molded ABS plastic. The other is the padding. The two parts are assembled, and give a very durable helmet. The downside is that plastic shell helmets are usually heavier, and despite having a thicker outer shell, they still need some volume in order to fulfill the requirements of the standard.

## SWEET HELMET CONSTRUCTION

Our goal when constructing helmets is to make a very durable construction that protects the head with less volume than usual. We also want an excellent fit, and a relatively low weight. In order to accomplish this, we have developed a brand new way of constructing a helmet. The most striking features are the carbon fiber reinforced composite main shell, but also the fact that all SWEET helmets are constructed "neck hugging", which means the shell curves around the head and hugs the nape of the neck. This is solved by either splitting the shells in two pieces or by molding the shell in one piece, using a very sophisticated collapsible core tool with several sliders.

All our helmets share the same basic construction, with the following main components with regards to the protection performance:

1. Carbon fiber reinforced composite shell
2. Neck-hugging construction
3. Expanded Polypropylene (EPP) padding
4. Fit Pads



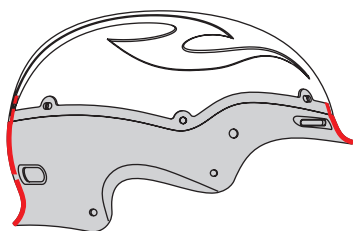
### 1. Carbon fiber reinforced composite shell

All SWEET helmets are constructed from continuous carbon fiber reinforced thermosetting resin composites. They're produced by arranging the carefully selected fiber-resin mixture into the desired shape. The configuration and direction of the fibers are optimized to provide maximum performance before they are cured inside a matching mould. The curing process in the mould is accomplished by exposing the material to elevated temperatures and pressures. The applied pressure provides the force needed to squeeze excess resin out of the material, to consolidate individual plies, and to compress any voids. The technology involved is hard core, and often used in the aerospace and car racing industry, where performance of the material is crucial.

Carbon fiber reinforced composite key features:

- Light weight
- Extreme strength to weight ratio
- Extreme stiffness / rigidity
- Corrosion resistant
- Fatigue and crash resistant
- Impact absorbent
- Temperature resistant

The carbon fiber reinforced composite shell is vital in distributing the forces, and makes sure that the padding will largely deform from the inside, rather than from both sides which would be the case with a soft outer shell. This means the padding is using its energy absorbing properties to slow your head down, not in being deformed by surrounding environment. When protection relies on padding alone, all the energy must be absorbed through a concentrated point of impact, rather than distributed over a large surface area. By distributing the forces we're able to increase the duration of the impact with less helmet volume.



### 2. Thermoplastic occishell

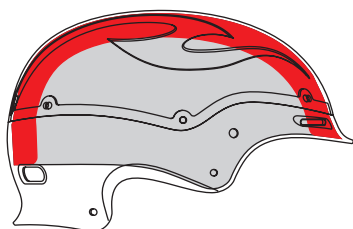
All SWEET helmets are constructed "neck hugging", offering great fit and comfort while keeping the volume as low as possible. This is unique to all SWEET helmets, and a crucial part of the fit and performance. It's designed to grip your skull from underneath, which prevents the helmet from rolling on your head. However, its most important task is to protect your occipital lobe and surrounding hemisphere.

### 3. Expanded Polypropylene (EPP) padding

Crushable foams are ideal for helmets designed for one hard impact. The usual padding material in most sports helmets is EPS (Expanded PolyStyrene), which is very effective foam for absorbing impact. The impact is absorbed as the cell walls in the foam crush on impact and slow the head down gradually.

SWEET, however use another crushable foam called Expanded Polypropylene (EPP). EPP is more expensive, but it also has its technical benefits; better performance in cold weather and a higher 'memory', allowing the padding to return to its own shape after impact. This is also why EPP often is referred to as multi-impact foam.

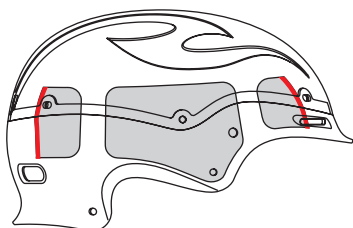
SWEET protection AS recommend you to replace a helmet after a severe blow because there's no way of monitoring the forces the helmet has been exposed to, and despite the foams high memory, the cell walls are still crushable if the forces are great enough (and then they won't offer sufficient protection during the next impact.)



### 4. Fit Pads

A properly fitted helmet will be the most comfortable, but more importantly, the better the fit, the better the performance upon impact. Helmets offer optimal protection only when fitted and worn properly, thus, finding the right size and model is crucial. If the helmet does not fit correctly, your head will accelerate across the gap before it hits the padding, making it harder for the padding to slow down the impact. If a helmet is properly fitted, it will start to slow down the impact immediately, thus reducing the peak G force on the head.

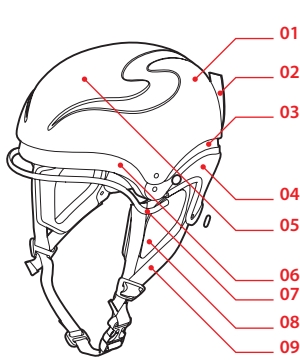
Every SWEET helmet comes with a fitting kit consisting of several different self adhesive fitpads. This will ensure you get as good a fit as possible. There's also a fitting manual that explains how to proceed, step by step. Note that there are circumstances where the helmet will not fit due to the difference between the shape of the helmet and the shape of your head. In cases like this, you may have to try on a few different models to find the right one.



## CERTIFICATION

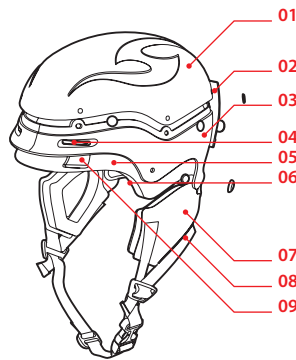
All SWEET products are CE EN certified and type examined by:  
 SP - Swedish National Testing  
 and Research Institute  
 Box 857  
 SE-501 15 Borås  
 Sweden  
 Notify Body No. 0402

## CONSTRUCTION/COMPONENTS



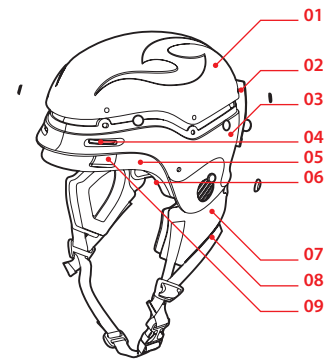
### Rooster

- 01 Carbonfiber reinforced composite shell
- 02 Silicon gogglestrap
- 03 EPP padding w/ Coolmax® liner
- 04 High Impact ABS occipital shell
- 05 Coolmax® crown pad
- 06 Self adhesive Fitpads
- 07 TPU Edge Protector
- 08 Removable ear pads with EVA frame
- 09 PP Straps w/ PA buckles



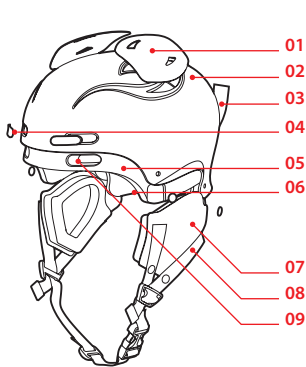
### Trooper Halfcut

- 01 Carbonfiber reinforced composite shell
- 02 Silicon gogglestrap
- 03 High Impact ABS occipital shell
- 04 Ventilation
- 05 EPP padding w/Coolmax® liner
- 06 Occi-grip tensioning system
- 07 Removable ear pads with EVA frame
- 08 PP Straps w/ PA buckles
- 09 Internal ventilation channels



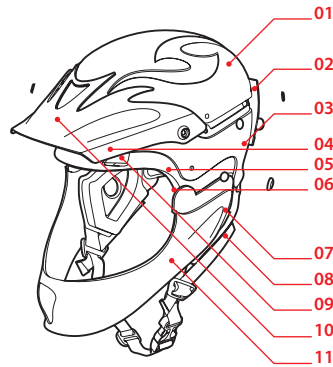
### Trooper Fullcut

- 01 Carbonfiber reinforced composite shell
- 02 Silicon gogglestrap
- 03 High Impact ABS occipital shell
- 04 Ventilation
- 05 EPP padding w/Coolmax® liner
- 06 Occi-grip tensioning system
- 07 Removable ear pads with EVA frame
- 08 PP Straps w/ PA buckles
- 09 Internal ventilation channels



### Rambler Helmet Construction

- 01 Carbonfiber reinforcement
- 02 High Impact ABS shell
- 03 Silicon gogglestrap
- 04 Removable vent plugs
- 05 EPP padding w/Coolmax® liner
- 06 Occi-grip tensioning system
- 07 Removable ear pads with EVA frame
- 08 PP Straps w/ PA buckles
- 09 Direct ventilation



### Trooper Fullface Construction

- 01 Carbonfiber reinforced composite shell
- 02 Silicon gogglestrap
- 03 High Impact ABS occipital shell
- 04 Ventilation
- 05 EPP padding w/Coolmax® liner
- 06 Occi-grip tensioning system
- 07 Removable ear pads with EVA frame
- 08 PP Straps w/ PA buckles
- 09 Ventilation channels
- 10 Adjustable High Impact ABS visor
- 11 Carbon fiber reinforced jaw protector