GALLET F1 XF fire helmets – **Unique protection**

Electrical risks on vehicle rescue & extrication

Firefighter missions & electrical risks

More than 80% of firefighters' operations are not associated with structural firefighting. A large portion of their activity is devoted to **road traffic collisions or first aid and technical rescues** in various fields.

In these missions, firefighters and rescuers are exposed to specific risks including **electrical risks** – rescue close to high voltage lines, extrication after a car collides with an electric pylon, smoke that becomes charged and conducts electrical current. In addition, 30% of fire incidents are associated with incidents involving domestic electrical networks or photovoltaic panels.

But now and for many years to come, the main electrical risk for firefighters and other first responders, will occur when responding to **hybrid and electric car crashes**. Due to the increasing cost of fuel, and in order to reduce negative contributions to global warming, electric vehicles have increased in popularity every year for the last decade. During the past few years, there has been a remarkable surge in demand for electric and hybrid vehicles in Europe with the current fleet exceeding 600,000 cars. By 2030, the percentage of electric and hybrid vehicles could account for 20 to 30% of the total vehicle fleet.

The basics on electrical risks

Although some firefighters may have previously trained as electricians, few are experts in electrical hazards. The dangers arising from electrical utilities have killed and injured many firefighters. The main electrical risks comprise:

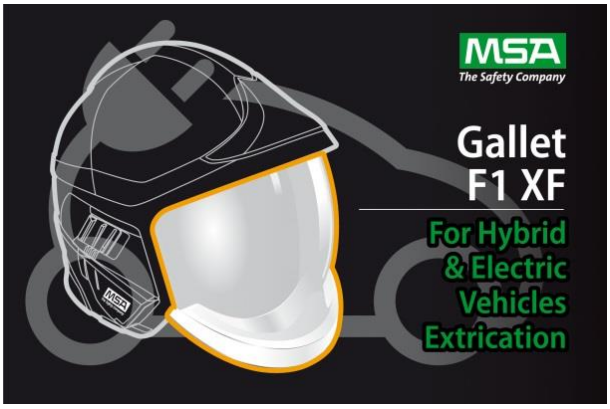
- **Electric shocks**: Short-term, accidental contact with live electrical conductors
- **Arc flash**: Short circuit through the air between conductors or conductor and ground.

Electric shocks can cause fibrillation of the heart and tissue damage. Death caused by an electric shock is called electrocution. The PPE used for protection against electrical shocks aims to ensure electrical insulation.

The risks from an **arc flash** are more diverse and include high temperatures (up to 19,000°C), explosive forces (pressure waves), high noise levels, flying molten metal debris and very bright lights including UV light. As a result, injuries can include burns, blindness, lung damage, blunt trauma injury and hearing damage. The risk of **thermal injury** from an electric arc is high, with the majority of such injuries located on the hands or head. The PPE used to protect against these hazards must cover the body and the head/face to avoid second-degree burns.

Focus on new energy vehicle rescue and extrication

New energy (hybrid or electric) cars contain specialised electrical systems from 100 V to 600 V (for electric trucks). These battery packs are usually located in the rear of the vehicle or under the back seat. Power is transmitted to the electric engine via high-voltage cables situated under the floorboards. Firefighters need to be sure not to cut, crush or touch these cables during extrication or towing. Before starting extrication of a person from a hybrid or electric car, they must disconnect the batteries. Some vehicles have an automatic system which disconnects the batteries in the event of a collision and for others, disconnection is via a manual Service Plug system. Most electric car makers publish emergency response guidebooks that can be accessed on the Internet to identify whether there is a service plug and its location.



The CTIF (International Association of Fire & Rescue Services) extrication commission rewarded two French firefighters for their research and development of a *Best Practices Procedure* for this type of situation, which is now used by more than 40 countries.

PPE standards & electrical risks

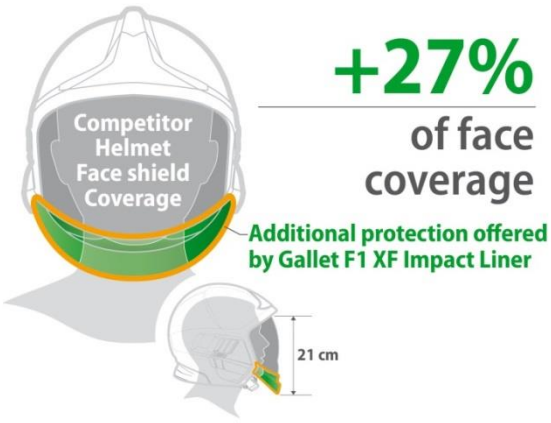
For the **electric shock** risk, the PPE standardisation background is pretty clear. The **EN 443** standard ("*Helmets for firefighting in buildings and other structures*") covers this specific risk, using 3 different tests to assess the conduction. In all three tests, a voltage of 1200 V AC is applied, and a maximum measured leakage current of 1.2 mA is permitted. This test is intended to ensure protection of the user for voltages up to approximately 440 V AC. If voltages in excess of 440 V AC are expected, helmets complying with both **EN 443** and **EN 50365** 1000 V AC ("*Electrically insulating helmets*") would be required (testing at 10,000 V). The **EN 14458** standard ("*Face shields and visors for use with firefighters' helmets*") also addresses the risk of electrocution in order to ensure face protection for voltages up to approximately 440 V AC with 2 tests: Conductive head form test and surface insulation test.

Concerning the risk of an **arc flash**, there is currently a gap in the firefighting PPE standardisation. Neither **EN 443** nor **EN 14458** cover this specific risk or part of the risk, and EN 14458 refers to EN 170 ("*Personal eye protection – ultraviolet filters*") for UV radiation. So the PPE standards used in industrial and electrical applications should be considered in the risk analysis:

- **EN 166** optional marking '8' indicates visors and frames which protect against an open circuit electric arc of 12 kA max., 380-400 V, 50 Hz nominal for 1 sec max. The requirements are: defined face coverage, minimum visor thickness of 1.4 mm, UV filtration and clear material. These specifications have been derived from a series of tests using these parameters. Visors certified today are not actually tested with a genuine arc flash.
- **GS-ET-29** ("*Supplementary requirements for the testing and certification of face shields for electrical works*"). This is 'Arc-in-the-Box' testing with parameters of 400 V AC; 50 or 60 Hz for 500 ms, 35 cm distance and with 2 classes (Class 1: 4 kA, 135 kJ/m³ & Class 2: 7 kA, 423 kJ/m³). EN 166/8 does not consider the high radiation/temperature. **The main difference with EN 166/8 is that each visor needs to be tested with a real arc flash.** The temperature behind the visor at eye, mouth and chin level of the test head is measured – maximum safe temperatures are given to ensure that users will not be injured.

Gallet F1 XF unique protection v. electrical risks

MSA never compromises on the safety of wearers. Because exposure to an arc flash could be fatal, MSA chose to go above and beyond the EN 14458 standard requirements to ensure maximum safety for wearers. The coverage provided by the Gallet F1 XF face shield has been considerably increased to protect the entire face and sides of the head against arc flash effects.



Only total face coverage (more than the minimum required by EN 14458) and an appropriate visor thickness can guarantee full face protection against projections and other electrical arcs risks. Our face shields (gold coated and clear) were tested successfully to **GS ET29 standard (class 1)** for this purpose. As mentioned above, this standard requires real arc flash testing to prove the performance (test reports available).

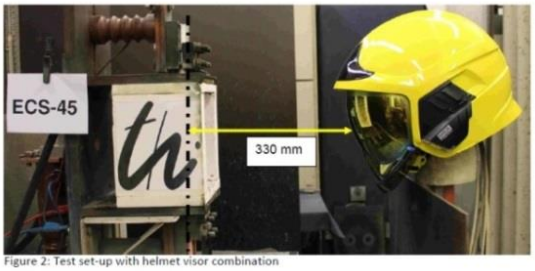


Figure 2: Test set-up with helmet visor combination

In addition, the Gallet F1XF was tested according to the EN 50365:2002 standard ("*Insulating helmets for use on low voltage installations*") and its face shield is certified according to EN 170 for the UV radiation. MSA's unique fire helmet can also integrate hearing protection muffs, to reduce the impact of noise hazards, whether from power-driven tools used for extrication or arc flashes.

Other MSA helmets v. electrical risks

Concerning former generations of MSA fire helmets (such as F1S/F1E/F1SF), MSA recommends the use of both an ocular visor and face shield because only ocular visors filter UV (according to the applicable standard when products were certified), while the face shield complies with other EN 166/8 requirements.

Moreover, in some countries F2 X-TREM helmets are used for rescues from road traffic accidents. Even if EN 16473 "*Helmets for technical rescue"* allows vented helmets, MSA recommends the use of non-vented versions (higher electrical protection) combined with a frame and external polycarbonate visor certified according to EN 166 **optional marking '8'**.

But the optimal protection against the thermal effects of an arc flash will always remain the Gallet F1 XF.