

Here's what a safety expert thinks of Formula One's 'ugly' new head protector

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Credit: Srdjan Suki/EPA

Formula 1 drivers have the most effective safety helmets in the world. But thanks to F1 cars' open cockpits, drivers are inevitably exposed to greater head injury risk than those in other high-speed sports. Now the body that governs F1 (the FIA) has [decided to introduce](#) a new head-protection system into the cars known as the Halo.

Set to be deployed by the FIA in 2018, the Halo system consists of a

large, U-shaped bar that encircles the driver's head, attached to either side of the rear of the cockpit, and a single central support column at the front.

[Its advocates argue](#) it will prevent large objects (such as wheels) from hitting the driver's head during a crash and partially protect the driver from smaller impacting projectiles. Others, such as [driver Lewis Hamilton](#), accept that a solution is needed but have criticised the Halo [for being ugly](#). Some have also raised concerns that it will [affect F1's popularity](#), given how grounded the sport is in its aesthetically pleasing cars. So is this really the answer?

Head injuries are a serious risk in motorsport. Over the last decade, there have been fatal incidents involving head trauma caused by the [impact of a wheel](#) and [other car debris](#). In F1 in 2009, Felipe Massa was given a skull fracture by a spring that [struck his helmet](#).

Direct helmet impacts probably carry the greatest risk of [head injuries](#) in F1. The [drivers'](#) helmets contain the latest, [high-performance materials](#) that minimise the [impact](#) energy transferred to the head. A number of external shells (which are also resistant to fire) flex to partially absorb an impact and distribute its force to a crushable plastic foam liner inside.

This design is especially good at reducing the risk of skull fractures and associated injuries, but is only effective in impacts of up to approximately 225 joules of energy. Thanks to the open-cockpit design, there are scenarios where a direct impact could exceed this energy threshold, exposing the driver to a high risk of serious or fatal head injury.

Crude calculations indicate that the examples mentioned above all involved impact energies similar to or greater than the helmet design threshold. Felipe Massa's injury arguably was caused by the lowest

energy impact of the three incidents, yet it was still probably more than twice that protected by the F1 helmet performance standard. This shows the potential that a new protection system has to prevent potentially fatal accidents.



High energy protection. Credit: Srdjan Suki/EPA

Test results

The Halo is made from carbon fibre, a strong, lightweight material that is ideal for this application. Its main function is to deflect larger objects away from the driver's head, transferring the impact energy to the car's chassis via the two rear supports. The FIA have performed extensive tests that demonstrate that this should be successful in relatively high

energy impacts, [like striking a loose wheel](#).

The research also suggests the Halo would stop smaller objects [in 17% of possible scenarios](#). But it doesn't demonstrate how likely each of these scenarios would be, whether the system would prevent the most severe impacts or whether the researchers considered incidents where the Halo actually deflected an object towards the driver's head. Given how serious we know smaller object impacts can be, it seems critical that the FIA conduct more research.

The Halo will also function as a roll-bar, distributing load predominantly through the central pillar. This will protect the driver from the potential of an impact to the top of head, perhaps when over-turned, or when another car rides over theirs. But the system wouldn't be strong enough to withstand impacts into rigid structures, like the fatal accident [involving Jules Bianchi](#) in 2016.

Overall, the Halo seems a pragmatic solution that is moving F1 towards reducing serious and fatal incidents. F1 teams have been approved to further develop the Halo, meaning a more attractive version should be seen when it is used for the first time in the grands prix from March 2018. But it doesn't address the significant risk of impacts from small objects which, as was seen with Massa, can cause severe head injury.

In an attempt to address this issue – and provide a more attractive solution – the FIA is also trialling a curved windscreen known as the "shield". But further work is needed following initial tests, including one by driver Sebastian Vettel who [recently reported](#) being buffeted by wind and feeling dizzy when driving with the shield, after only one lap.

An alternative approach would be to improve the drivers' helmets. At Cardiff University, we are using a combination of 3-D printing, mechanical testing, and advanced simulation software to produce

motorcycle helmets tailored to collision scenarios and the drivers' [head](#) measurements in order to better dissipate impacts. This research could ultimately be adapted for F1. Until then, however, fans and drivers may just have to put up with the "ugly" Halo.

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