



F1 Safety – Series Omnibus

F1 Safety – Helmets and Clothing

Hello and welcome to Sidepodcast, this is a new mini series called F1 Safety. We'll be taking a closer look at all the things that minimise the risks of driving at 300km/h. We'll be covering various topics over the next seven shows, and today our attention turns to helmets and clothing.

Every Formula 1 ticket across the globe heralds the warning: "Motorsport is dangerous." And it is. No one could argue that driving at enormous speed around a narrow circuit would be anything but. However, F1 has taken great strides forward in safety since its early days, and now even the smallest details are covered with precise requirements.

The driver's helmet is a perfect example. For a driver, his head, neck, and arms are the most exposed areas during a race. The rest of his body is tucked away behind sheets of carbon fibre, but his head takes the full brunt of any oncoming forces. Putting aside what could happen in an accident, every single corner taken by a driver can be a strain on the head.

It is no surprise, therefore, that every driver wears a helmet. They can weigh anywhere between 1250 grams and 1800 grams, and not only are they designed for safety, but also try to blend well with a car's aerodynamic profile. Made out of layers and layers of carbon fibre for strength, the helmet is lightweight, virtually indestructible, with fireproof materials forming the cushioning on the inside.

There are a few main helmet suppliers, including Bell and Schubert, and all are subjected to strict crash test procedures by the FIA. Each helmet is fully customised for the driver and most include holes for breathing, ventilation and drinking straws. The ventilation does include some filters to keep out elements of carbon, brake dust, oil and fuel vapours. The helmets also block out a lot of the surrounding noise, which allows for drivers to be in radio communication with their engineers in the pits.

As well as being able to hear, it also helps if a driver can see, obviously. The visor is about 3mm thick, and fireproof, with variable tinted shades depending on the time of the session, the state of the weather, and the track. At Singapore, many of the drivers had lighter visors to help visibility, whilst we know Felipe Baby wanted a lighter visor during the bad rain in Malaysia. Technology also exists to allow the tinting to adjust, as some sunglasses do. In the tunnel at Monaco, it can be slightly brighter, whilst at the exit it can darken again.

Underneath the helmet, the driver wears a balaclava made of Nomex, and this is a name you'll hear a lot when it comes to safety clothing. Nomex is supremely flame retardant material, in that it can be subjected to open flames of about 300 to 400 degrees C temperature without igniting. It's used for the drivers balaclava, as we've already mentioned, plus overalls – with elastic cuffs on the wrist and ankles – for drivers and the pit crew, gloves, socks and underwear.

The overalls also have zips that are designed to be flame retardant and more importantly, not to transfer heat onto the drivers skin, as regular metal zip would. Racing shoes continue the fireproof trend, but are also lightweight, with thin soles and plenty of grip to allow maximum control in the car.

Once the driver is kitted out and ready to race, he needs just one more piece of equipment – the HANS device. This Head and Neck Support device is a way of tethering the helmet so that a drivers head won't flail around in case of an



accident. The system consists of a so-called shoulder corset, made of carbon fibre, which is then connected to the helmet by small straps, and to the safety belts as well. The device is designed to allow the natural movement of racing, but it should restrict the impact of an accident. That kind of force could increase the weight of a helmet to as much as 560kg, which can be absorbed by HANS.

The FIA commissioned the development of the design from Dr Robert Hubbard of the University of Michigan in the mid-1990s, but HANS didn't become mandatory until 2003.

There is so much technology involved in these helmets and clothing elements already, but developments are happening all the time. Recently, some drivers have tested out heated visors to try and help with the problem of fogging up in humid conditions. There's plenty more innovation still to come.

That's all for this first episode of F1 Safety. Tomorrow we'll take a look at another element of safety within Formula 1 and until then, your comments and feedback are always welcome. You can email me Christine@sidepodcast.com.

F1 Safety – The Car

This is Sidepodcast and the second episode of our latest mini series F1 Safety. Yesterday we covered all things helmets and clothing, and today we're going to take a closer look at the safety of a Formula 1 car.

We talked about carbon fibre briefly in the previous show, as the material is supremely strong but very light weight, ultimately a designers dream. Apparently there is also such a thing as carbon-fibre reinforced plastic but I think that's taking it too far. The majority of a Formula 1 car is made from the lovely carbon fibre, and in terms of safety, the driver is encased in a strong, reinforced tub. No matter what happens to the car, the tub should remain in tact.

There are a few rules to be followed when designing the cockpit. Firstly, no oil, fuel or water lines are allowed to pass through the area where the driver sits. The cockpit sides have very specific dimensions – specified to be even higher in 2008 after we saw cars flying over each other in '07.

Drivers are strapped into their custom made seat, moulded to them both for comfort and to stop them sliding around every lap. They have six point harnesses, which can be unclashed with one hand. A driver has to be able to get out of a car within five seconds, and replace the steering wheel in another five. If, in an accident situation, he is unable to get out of the car, marshals and rescue crews are able to pull both the driver and the seat from a car together.

Another useful safety feature is wheel tethers. In case of an accident, the tyres are tethered to the car so that some of the forces are absorbed. The idea is that a wheel doesn't go bouncing off down a track, but at the same time, the tethers shouldn't hold on to a wheel at all costs. If the forces are great enough that a wheel does get loose, it's speed should have been reduced to make it mostly harmless.

Before being allowed anywhere near a track, the cars must go through thorough crash tests, usually performed at the Cranfield Impact Centre, in Bedfordshire. The FIA set the standards and supervise the tests, to ensure the cars can survive all kinds of impacts. There are two main types of crash test – dynamic and static.

Naturally, the dynamic tests are ones in which the car is moving, and the effects of an accident are monitored. The impacts are tested on the front, sides and rear, with speeds of up to 15 metres per second. A crash test dummy situated inside the car is hooked up to monitors, and the deceleration on the chest shouldn't exceed 60G within three milliseconds. These are numbers that are almost meaningless to me, but it shows the detail the crash tests go into.



The static tests put the cars through their paces by applying pressure to the various sides, again with the intent of keeping the tub, the gearbox and the roll bar in good and safe condition. In these instances, the steering wheel needs to remain removable for easy access to the driver in case of an accident.

Once the car is cleared to race, it needs to have a black box installed on it. This is similar to the boxes on aircraft, that record all the important car information so that if an incident does occur, then it should be straightforward to find out what happened, and why. This box, the accident data recorder, is also linked to a medical warning system, which will give warning to the FIA and the medical car, ahead of the streamed pictures on the world feed. The black box needs to be accessible without having to remove any other parts of the car, but naturally it is tucked away so as not to interrupt with the aerodynamic design. It's required on all cars when they are on track with other teams, but not necessary if there is just a single team at a circuit for a testing session.

With all this on board, the car is now ready to leave the garage and get moving. There are some additional safety measures in place for when a car is out on track and far from the controlled environment of the pitlane. An onboard fire extinguisher must be executable from within the cockpit. There is also a master switch inside the cockpit to deactivate the electronics and fuel pumps in case of emergency.

The drivers have in-dash flags to let them know the state of the track as they go around it – whether there are yellow flags, or if the safety car is being deployed. Two more small things to finish, the rear view mirrors are supposedly a safety device but are to all intents and purposes useless – David Coulthard proved that – and the rear light is there to try and reduce pileups. It comes on when a driver is slowing to enter the pitlane, or if there is reduced visibility because of the weather.

F1 Safety - Circuits

Welcome to F1 Safety – the latest mini series from Sidepodcast, focusing on the elements that make Formula 1 as safe as it can be. We've already looked at clothing and the car, now it's time to concentrate on circuits.

Although FOM, and therefore Bernie, is currently in charge of deciding which circuits should get on the calendar for each year, the FIA have plenty of say about what goes on where. Safety Delegate Charlie Whiting is sent to each circuit before a race to inspect the safety facilities and make sure it is up to scratch. So, what kind of things does a circuit need to provide in terms of safety?

Firstly, the track has a designated direction. Most of the races on the calendar travel clockwise, but a select few run anti-clockwise. This will affect which side the pit lane is in relation to the track, and how the entrance and exit is designed. Cars must only go around the track in the stated direction, even the safety and medical cars have to adhere to this, no matter how far around they have to go. There can be access roads linking sections of track to make life a little easier though.

If a driver can stick to the asphalt, all is well. Otherwise, there are various features to the area surrounding the track that are there to help. The kerbs were originally designed to make going off track safer, with the raised bumps intended to slow a car down. However, these days, drivers try and use the kerbs to make the track just that little bit wider. It might be uncomfortable, but hitting the right line could save a tenth or two each lap.

If there is no space around the tarmac, for example in Monaco or Valencia, then crash barriers are in place. There is often high fencing as well, to protect the crowd from any wayward car parts. The barriers vary from concrete to tyres, depending on if they're just lining a straight, or in a potential crash zone. Where there is room, run off areas will be introduced to allow space for a car to slow down.



Now, run off area has become quite a contentious issue in the last few years. There are two options – gravel or tarmac. Gravel is ideal for slowing a driver down, hopefully bringing the car to a stop before it hits the barriers. However, if a car rolls on the gravel, then the roll hoop can dig in and get buried. This would put weight onto the drivers' helmet which is obviously not a good situation. That's where tarmac comes in. The downside to this is that a car won't be slowed down in the same way as on gravel, and if it is a brake failure or similar cause for the accident, the car will smash into the barriers without losing speed.

At various points around the track, marshals are posted. They are there to wave flags to advise drivers of the track status and any potentially dangerous things to be aware of. They also secure accident sites, operate fire extinguishers, recover cars and clear away any debris. They are not allowed to get involved with medical procedures. This year, the marshals safety has been called into question with the introduction of KERS, with the solution seemingly to be an extra pair of rubber gloves! It looks as though this problem will go away next year, as KERS is likely to be ditched.

One of the most dangerous parts of an F1 track is the pitlane. This is the only place where cars and people, aside from drivers and marshals, interact, and speeds are reduced instantly. There's a white line on the entrance and exit of the pitlane, and this means a driver must reduce his speed to 60km/h during Free Practice, and 100 km/h during qualifying and the race. In Monaco, this is even slower due to limited space in the pitlane.

Whilst we're in the pitlane, there's a couple of things to note from a stop during a race. The fuel rigs have specially designed valves that try and limit the exposure and release of fuel and vapours to the extreme temperatures in the air. It is oh so easy for those fumes to catch fire and a car can be engulfed in flames in an instant. There is always a fire extinguisher near by, though. The lollipop man helps guide a car to his pit box, but is also there to release the car when the coast is clear. Those rear view mirrors we discussed yesterday are not good enough for a driver to note when it's safe to move off.

There are also lights at the end of the pitlane to indicate when it is safe for the cars to move out on to the track. This can signal when a session starts and ends, they will be red if the safety car train is passing, and they will be blue if a driver is exiting his pit stop and another car is approaching out on track.

Circuits also need to provide exceptional medical facilities but we'll talk about those next time.

F1 Safety – Medical Facilities

Hello and welcome to F1 Safety, a mini series from Sidepodcast. We're covering the big and small of Formula 1 safety, with helmets, clothing, cars and circuits already completed. Today we're going to focus in on medical facilities.

We've already looked at a lot of the preventative measures Formula 1 instigates to keep drivers safe. However, sometimes accidents happen, and there are medical facilities and procedures at circuits to try and control any situation.

Around the circuit, there are several rapid response vehicles, including salvage cars known as S-cars, rescue cars known as R-cars, plus plenty of cranes and tractors to extricate stricken cars. There are four S-cars, who have fire rescue equipment on board, such as extinguishers and cutters. There are two R-cars which can bring one doctor and four paramedics to any point on the track within 30 seconds.

The FIA employ a chief medical delegate, currently Doctor Gary Hartstein. He is on call in the medical car, sitting at the end of the pitlane. If there is a big crash that requires medical intervention, the medical car will be employed,



along with the safety car. To quickly assess an accident, every F1 car has a warning light which immediately shows the doctor how serious the crash has been.

The Medical Car actually follows the pack around on the first lap, as they vie for position in the opening corners. These are considered to be the most dangerous and crash-prone corners of the entire race, so the medical car is nearby if the worst happens. It will pull into the pitlane at the end of the first lap and hopefully the race would continue unimpeded.

If a driver requires immediate attention, then he will be taken to the medical centre at the circuit. Although these vary in size, and can be relatively small, they are as equally equipped as most hospitals emergency department. It is staffed 24 hours a day during a race weekend, with a surgeon and anaesthetist who have their own operating theatre, plus several paramedics, and resuscitation equipment if the worst should happen. Drivers will often be sent to the medical centre for checks, even if they emerge from an accident unscathed. It is up to the FIA to clear a driver to race and ensure he is physically fit to do so.

The majority of concern surrounds head injuries, as these are harder to diagnose from the outside and can seriously affect a drivers ability. The doctors also need to ensure that if the driver suffered a secondary head trauma without allowing time for a full recovery, the implications could be far worse. Several drivers have had to sit out the rest of a weekend if they crash early on, and are sometimes even forced to sit out the next race if they have a particularly bad accident.

Toyota actually have their own doctor travelling with them, Dr Riccardo Ceccarelli, who turns up to every race weekend. He works with the drivers and all within the team to make sure they are fully fit. He concentrates on general wellbeing as well, for example, keeping hydrated during the hotter races. He will also decide whether any Toyota personnel need to be transferred to the medical centre, and he'll keep an eye on their treatment. Dr Ceccarelli has also helped with other teams, for example, if there is an incident in the pitlane, however his duty is with Toyota.

There will be at least one hospital in the surrounding area that is on stand-by as the weekend progresses. There are ambulances stationed at the medical centre to make their way to the nearby hospitals, but the preferred method of transportation is helicopter. Within the circuit there is a MedEvac chopper ready to go at all times, with a doctor, paramedics and pilot on standby. There is also a spare helicopter outside the track just in case. This is a vital part of the safety procedures, as a session will not go ahead if the helicopter cannot take off or land at the hospital. Normally, this is a weather issue, fog or extreme rain, and we saw this happen in Fuji 2007. That supremely wet weekend saw Saturday practice delayed by thirty minutes, and in the end there were only four minutes of running before it was red flagged. Race Control were not happy with the low-lying clouds.

As long as the weather holds, though, there are enough procedures in place to cover every eventuality, and first class medical treatment is available throughout an entire race weekend.

F1 Safety – The Accident Process

Welcome to Sidepodcast, this is the fifth episode of our miniseries F1 Safety. We've looked at the safety of the cars, what circuits do to help, and the medical facilities in place. Today we're going to put them all together and run through the accident process.

Starting at the very beginning, to have an accident, first you need drivers. To participate in an F1 weekend, you need to have an FIA superlicence, and these are granted based on good results in some of the feeder series, or perhaps another exceptional circumstance. If a driver is not well before the weekend begins, he can be replaced by the teams



third driver, and substitution is acceptable up until the start of qualifying. Otherwise, the team will just have to run with one car.

Once a session is underway, then the cars will head out onto the track and do what they do. If a mild incident occurs, such as a driver running wide and having to regain the track, then the marshals will wave a single yellow flag. This is an indication to other drivers that there is something to be wary of and they need to reduce their speed. Overtaking is also prohibited under yellow flag conditions. Double waved flags are for a slightly more serious incident, as it tells approaching cars that they need to be prepared to stop if necessary. If the danger is easily removed, ie the off-road car regains the track and continues on it's way, then green flags will be waved to show that it is all clear.

If the danger is too great, then the red flag is waved. This can either mean that an accident has left a car in a precarious position, that there is too much debris on track for conditions to be safe, or that the weather is too hazardous to continue. The red flag means the session is instantly stopped. Cars must return to the pit lane unless the race has begun, in which case they head to the main straight to wait further instructions.

Whilst we're on the subject of flags, there are a few others to be aware of. The blue flag is waved to tell a car that it needs to move out of the way of a faster car behind it – this occurs during a race when the leader is lapping back markers. A black flag means a driver's race is over, and this is usually because he has been driving without due care. This often occurs if a car leaves the pitlane when the light is red. A white and black diagonal flag is a pre-cursor to the fully black flag, a sort of warning for bad behaviour. A black flag with orange circle indicates to a particular driver that his car is dangerous and needs to pit, whilst a flag of red and yellow horizontal stripes means the track surface is slippery and due caution is required. This is commonly shown after an incident leaves oil on the track. Finally, a white flag occurs if there is a slow-moving vehicle on the track, for example one of the rescue vehicles – however this is rarely seen as the safety car or a red flag situation has usually been employed at this point.

Moving on to the safety car, then, the Mercedes-Benz will be deployed during a race if conditions are hazardous and require cars to slow down, but it is not quite severe enough to bring proceedings to a complete halt. The Safety Car will pull out from it's position at the end of the pitlane, pick up the race leader, and guide the train of cars round the track at a controlled speed, taking whatever safe line avoids the scene of an accident. It has been known for the cars to have to navigate through the pitlane, if an accident has occurred on the main straight. Behind the safety car, there is no overtaking, and drivers are tasked with making sure their tyres stay warm for the restart. It is the Safety Car drivers responsibility to make sure speeds are low, but not so slow that tyre temperatures become dangerous themselves.

Bernd Maylander has been behind the wheel of the Merc since 2000, having progressed through the ranks of karting, Formula Ford and DTM. He is in charge of the car through the entire weekend, including the support series as well. Bernd also attends the drivers briefings to be aware of any specific safety worries for the weekend. There are two safety cars, and two mechanics are employed to make sure they are in tip top condition.

Peter Tibbetts is the co-driver in the car, and both men are in contact with Race Control and Race Director Charlie Whiting throughout the Safety Car period. The Safety Car has flashing lights on top of it, and when the track conditions are safe these will go out to indicate to the F1 drivers following behind that it is returning to the pitlane, and the racing can restart.

F1 Safety – How Safety Has Improved

Welcome to the sixth episode of F1 Safety. Having covered pretty much everything in modern safety from the helmet to the Medical Car, today we're going to look back through the years and see how safety has improved.



The first race of the new F1 World Championship took place at Silverstone in 1950. Grand Prix racing had been around for years, but this was the start of the official competition. Back then, Silverstone was simply an unused airfield, there was no particular thought to the safety of racing high speed cars. No medical backup was around, the only run off areas were a happy accident rather than a planned safety feature. The cars were built simply to be fast, to get round the lap in the quickest time, and that was all that mattered.

By the 1960s, it was clear that things had to change and safety needed to be a consideration. In 1961 the first rollover bars were introduced on the cars, and in 1963 helmets and fireproof overalls became mandatory. This same year, the FIA took over responsibility for safety during Formula 1 events, building procedures into the regulations. Fire extinguishers were introduced in 1969, and the next year circuit inspections were introduced. By this point, crash barriers were beginning to take shape, and a wall was mandatory between the pit lane and the home straight.

In 1972, the red rear lights on the cars were introduced, the aim being to try and reduce pileups. Circuits had benefitted from marshals and some even had a medical centre, but in 1975 these two safety features became part of the regulations. Permanent medical centres were mandatory in 1980.

A couple of years earlier, the FIA introduced the rule that a driver had to have a super licence to take part in a Formula 1 event. By this point, the car had the safety cell, otherwise known as the tub, that was strong enough to keep a driver safe. In 1981, the cell was extended so that it covered the driver's feet as well.

With medical centres a big part of each circuit, the next stage was to bring the helicopter in, and by 1986 the chopper had to be on stand by at all times. In 1988, we saw the introduction of crash tests for the safety cell and the fuel tank, and in the same year, Charlie Whiting was appointed as the permanent Race Director for the FIA.

We're into the '90s now, and entering the new decade saw the rear view mirrors grow larger – still useless though – and the steering wheels now had to be detachable and quickly removable in case of an accident. In 1992, the Safety Car was introduced, and so the regulations were tweaked to allow for a period following the slower car.

Next up, pit lane safety, as the refuellers and mechanics had to wear fireproof overalls, plus the speed through the pit lane was reduced. The FIA also began to take a dim view to the crowds of fans gathered at the circuit breaking onto the track at the end of the race. They started to encourage more stringent crowd control measures. Following a tough year in 1994, the FIA undertook some computer analysis of the circuits on the calendar and found 27 corners that were high risk and needed to be improved. The governing body also tightened up restrictions on getting a superlicence, only the best need apply.

In 1997, the black boxes were introduced, meaning accident data could be recorded and reviewed after the event. Preventative measures were also improved, with the crash tests broadened to include rear impact and gearbox safety as well.

Towards the millennium, we started to see safety improvements that have shaped how Formula 1 is, including tethered wheels, the introduction of asphalt run offs rather than gravel, increased number of medical cars, and the ability to remove a driver with his seat in case of emergency. In 2001, the FIA turned their attention to marshal safety, and specified some more stringent protection for them.

In 2002, the crash tests became even more detailed, and in 2003, five tracks had to tighten up their run offs and safety zones to be allowed on the calendar. HANS also became mandatory.

Whilst safety improvements are happening all the time, little by little, most of the massive things that can be done have been done already. The FIA are turning to a new bigger picture, and following the McLaren fine of \$100 million,



they set up a Motor Sport Safety Development Fund. The idea is that within five years they will have organised a safety program for young drivers, and set up training programs for officials and potential new circuits. There is plenty more still to be done.

F1 Safety – Defining Moments

Hello and welcome to the last episode of this miniseries, F1 Safety, brought to you by Sidepodcast. We've covered all the small details that go into making a race weekend safe, so today we're going to look at the bigger, more defining moments.

One of the most important moments in the history of F1 safety is the appointment of Professor Sid Watkins to the FIA. Watkins was a neurosurgery specialist and was based near the Watkins Glen circuit in the US. He moved to London and joined the RAC Racing Medical Panel and then he found the FIA.

Watkins became Formula 1's on-track doctor. He travelled to the circuits, and campaigned for the medical facilities at each track to become better and better. When he started, it wasn't unheard of for the medical centre to be a marquee tucked away in one corner of the grounds. Professor Watkins also expanded his campaigns to the local hospitals, ensuring that they could deal with any Formula 1 related emergencies, and he brought the MedEvac helicopters into the circuits.

In 1994, Formula 1 lost two drivers in one weekend, Roland Ratzenberger and Ayrton Senna. This provided the much-needed wake-up call that safety wasn't something to be messed around with. The FIA created the Advisory Expert Safety Committee who came up with many initiatives, including commissioning the HANS device. Sid Watkins was the head of this group, and was instrumental in what they achieved. Watkins retired from his roles within the FIA in 2005 to be replaced by his deputy Dr Gary Hartstein.

It would be impossible to talk about safety in Formula 1 without mentioning Jackie Stewart. The former F1 driver suffered a huge accident in 1966, which left him trapped in the car, and when finally extricated, he had to wait for an ambulance to come from a local hospital and pick him up. Stewart began to campaign for better medical facilities, and whilst waiting for this to be picked up and implemented, hired a private doctor to turn up to races with him. Stewart's legacy includes improved seat belts and helmets, crash barriers, run off areas and fire extinguishing equipment. Many people suggest that Stewart's safety work is as great as, if not better than, his legacy as an F1 champion.

Stewart is one of the drivers to have participated in a Grand Prix on the full length Nurburgring. If ever there was an advert for an unsafe track, it was this circuit in Germany. Some exceedingly dangerous corners, less than adequate barriers and run off areas, plus the fact that it could take too long for emergency vehicles to reach some parts of the circuits, meant that a much reduced version of the track is run today. It isn't unusual for some of the older circuits to be revised to meet current safety requirements. In some cases this can remove some of the much-loved elements and perhaps some of the charm of them, but the FIA need to put safety first.

The deaths of Senna and Ratzenberger took place over a tragic weekend but it is a testament to how much safety has improved that Senna was the last F1 driver to be killed during a race, well over a decade ago. More recently, in 2007, Robert Kubica had a jarring accident at the Canadian Grand Prix. His BMW tapped the rear of Jarno Trulli's Toyota, which set off a chain reaction of events. The car hit a bump in the grass which made it airborne. It contacted the wall on one side of the track, spinning it off in the other direction. It rolled over, spun round, and hit the barrier on the other side of the track, narrowly missing passing cars as it went.

It was a violent and horrifying accident, but Kubica was fine. All that was left of the car was the safety cell but that had done its job. Kubica had to be removed from the car, and was taken to the medical centre, but escaped with a



light concussion and a sprained ankle. He missed one race as a precautionary measure, but was back on fighting form to finish fourth in the next Grand Prix. An amazing moment that proved F1 safety really works.

That's it for this episode and this miniseries. I hope you've enjoyed these seven shows, as we visited all the various elements of safety that Formula 1 employs. If you've got any comments or feedback about this series, please email me: Christine@sidepodcast.com. Thanks for listening.

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