FEDERATION INTERNATIONALE DE L'AUTOMOBILE

FORMULA ONE WORLD CHAMPIONSHIP

Safety in Grand Prix racing in the 38 years from 1963-2000

A Study by the Circuits and Safety Department

This document indicates the development of Formula One racing and the corresponding increase in the number of race incidents, over the period 1963-2000, in which unprecedented advances in the application of technology and aerodynamics to the cars produced remarkable potential for increasing performance. It shows for each period considered the continuous action taken by the FIA and the Formula One Teams in developing and applying measures to progressively contain the consequences of accidents, latterly achieving levels of risk which are minimal for participants and negligible for spectators.

Although the example of Formula One only is considered here, the increases in both racing activity and safety have been reflected in every branch of motor sport under the control of the FIA.

FIA FORMULA ONE WORLD CHAMPIONSHIP

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PERIOD	ACCIDENTS	INTRODUCTION OF SAFETY REGULATIONS BY THE FIA			
		CARS	CIRCUITS	DRIVERS	ORGANISATION
1963-1967	GP races: **50** Estimated racing kms: **256,000** Accidents in races: **47** Injuries, drivers: **2** Fatalities, drivers: **3** Fatalities, officials: **0** Fatalities, spectators: **0**	**1963-65**: Pump fuel only. Automatic starter; rollbar; double braking system; rules for seatbelt anchorages, fire protection, fuel tanks, fillers and breathers.	FIA begins to organize circuit safety inspections (previously done by national authorities).	Protective helmet and overalls obligatory.	**1963:** Flag signalling code.
1968-1972	GP races: **59** Estimated racing kms: **227,000** Accidents in races: **88** Injuries, drivers: **3** Fatalities, drivers: **4** Fatalities, officials: **0** Fatalities, spectators: **0**	**1968**: Electrical circuit breaker; reverse gear; cockpit designed for easy evacuation; oil catch tank; rollbar 5 cm above driver's helmet. **1969**: Two extinguisher systems; parts with aerodynamic influence must be immobile, fixed to sprung parts of car only; maximum bodywork height & width limits. **1970**: Safety bladder fuel tanks **1972**: Safety foam in fuel tanks; no magnesium sheet less than 3mm thick; 15W red rear light; headrest; minimum cockpit dimensions; combined electrical cut-off/extinguisher external handle; FIA/spec/FT3 fuel tank.	**1970**: Considerations on circuit design published: track verges minimum 3m.;double guardrails; spectators at least 3m. behind fencing; barrier between pitlane and track; track width, surface, and gradient change regulations; strawbales banned; mandatory FIA inspections. **1972**: Circuit Safety Criteria published; debris fence specifications.	**1968**: Recommendations on seat harnesses, fire-resistant clothing, shatter-proof visors. **1971**: Max. 5 seconds for driver evacuation from cockpit. **1972**: 6-point harness. Drivers' Code of Conduct published. **1973**: International medical card & examination for all drivers.	**1971**: Personnel, equip-ment and duties specified in race super-vision, marshalling, signals.
1973-1977	GP races: **77** Estimated racing kms: **446,000** Accidents in races: **250** Injuries, drivers: **5** Fatalities, drivers: **5** Fatalities, officials: **1** Fatalities, spectators: **6** N.B: the spectators killed had all penetrated prohibited areas.	**1973**: Crushable structure round fuel tank ; no chrome plating of suspension parts. **1974**: Self-seal breakaway fuel coupling. **1976**: "Safety structures" around dashboard and pedals. **1977**: Pedalbox protection defined.	**1973**: Catchfences; rescue equipment; starting grid dimensions. **1974**: Catchfences + sand. **1975**: Marshal posts; service roads. **1977**: Gravel arrester beds defined.	**1975**: FIA standard for fire resistant clothing. **1977**: Helmets must be to FIA-approved standards.	**1973**: Fire service regs. **1975**: Medical service; resuscitation centre; obligatory rescue exercise. **1974**: 2x2 staggered starting grid with 12m length per car.

1978-1982	GP races: **76** Estimated racing kms: **399,000** Accidents in races: **283** Injuries, drivers: **3** Fatalities, drivers: **3** Fatalities, officials: **1** Fatalities, spectators: **0**	**1978**: Bulkhead behind driver and front rollbar defined. **1979**: Bigger cockpit opening; 2 mirrors; improved extinguisher system. **1981**: Reinforced "survival cell" introduced and extended in front of driver's feet.	**1980**: Obligatory permanent medical centre. **1981**: Tyre barriers; pitlane minimum width 10m.	**1978**: Licence qualification requirements. **1979**: Life support system (medical air) obligatory.	**1978**: Grid 14m per car. **1979**: FIA-appointed permanent race starter. **1980**: FIA approval of medic. service obligatory; fast rescue car regulations. **1981**: Grid 1x1x1.
1983-1987	GP races: **79** Estimated racing kms: **428,000** Accidents in races: **218** Injuries, drivers: **2** Fatalities, drivers: **0** Fatalities, officials: **0** Fatalities, spectators: **0**	**1983**: Flat bottom obligatory; skirts banned; red light increased to 21W. **1984**: Refuelling in races banned; fuel tank in centre of car. **1985**: Frontal crash test.	**1984**: Concrete wall may replace guardrails. **1985**: Catchfences banned. **1987**: Criteria for temporary circuits.	**1984**: F1 "Super licence" required.	**1986**: Permanent FIA medical service inspector. Medical helicopter obligatory. **1987**: Grid 16m per car.
1988-1992	GP races: **80** Estimated racing kms: **478,000** Accidents in races: **305** Injuries, drivers: **1** Fatalities, drivers: **0** Fatalities, officials: **0** Fatalities, spectators: **0**	**1988**: Driver's feet behind front wheel axis; static crash test of survival cell and fuel tank. **1990**: Larger mirrors; quickly detachable steering wheel. **1991**: FIA tested seatbelts; FT5 fuel tanks; rollbar test; dynamic test of survival cell. **1992**: More severe impact tests: water-filled fuel tank fitted to test strength of seat back bulkhead and 75 kg dummy fitted with maximum deceleration figure for the torso (also verifies harness anchorage strength).	**1989**: Trackside barrier min. height 1m.; pitwall min. 1m35. **1992**: Kerbs lowered; pitlane min. width 12m.; pit entry chicane obligatory.	**1989**: Dope testing on IOC model, introduced.	**1988**: Permanent FIA race director. **1990**: Driver extrication exercise obligatory. **1992**: Safety Car introduced. **1993**: Pit lane speed limited to 50kph in practices.

1993-1997	GP races: **82** Estimated racing kms: **450,000** Accidents in races: **382** Injuries, drivers: **11** Fatalities, drivers: **2** Fatalities, officials: **0** Fatalities, spectators: **0**	**1993**: Headrest area increased (from 80cm² to 400cm²). Front overhang reduced (100cm to 90cm). Rear wing height above ground reduced (100cm to 95cm). Distance of front wing endplates above the flat bottom increased (25mm to 40mm). Complete wheel width reduced (18 to 15"). Fuel regulations restricted to permit only fuels of a kind used by the general public.	**1994**: Pits spectator gallery fire shield obligatory. Identification of 27 "very high risk" corners by computer analysis: 15 removed from list by 1994 performance reductions. Tyre wall deceleration tests, analysed relative	**1993-on:** Severe end-of-race crowd control measures imposed. **1994**: Approved helmet standards reduced to 3 most stringent (Sell/BSI/SFI). Ear-phones banned; weight 1800gr max. Check-tests made on clothing and helmets in use. **1995**: 3-inch wide seat	**1994**: Pit lane speed limited to 80kph in practice, 120 kph in the race. Fire-protective clothing for all refuelling crews Burns treatment material in each pit obligatory.

1993-1997 continued		**1994**: Wheels must be made from an homogeneous metallic material. More stringent fire extinguisher regulations Minimum thickness of the headrest 75mm, (no minimum previously). Cockpit area side load test increased (from 2000daN to 3000daN). Driver aids (traction control, anti-lock and power brakes, automatic gears) banned. Four wheel steering no longer permitted. Downforce reduced: smaller front wing endplates, shorter diffuser, deflector panels restricted. Pump fuel compulsory. 10mm skid block under reference plane. **1995**: Engine capacity reduced: 3.5 to 3.0 litres. Chassis must extend at least 30cm in front of driver's feet (previously 15cm). Frontal impact test speed increased (from 11 to 12m/s). All deformation after the test must be confined to the nose box. Load in the nose push-off test increased (by 33% from 3000daN to 4000daN). Survival cell side impact test introduced. Obligatory automatic neutral selection when the engine stops. Introduction of a stepped flat bottom. Reduce front wing endplate heights (to between 5cm and 25cm above flat bottom) and length (must not extend further back than 35cm in front of the front wheel axis). No bodywork (wings) above rear wheels. Rear wing max. height reduced by 10cm. **1996**: Front wing endplates min. 10mm thick to prevent tyre damage to cars in front. Data storage unit to be within survival cell. Higher cockpit sides. 75mm side headrests compulsory.	to human tolerance levels, produce a standard by which to judge new barriers. Use of conveyor belting in front of tyre walls recommended. **1995**: Smooth raised kerbs recommended for F1. Gravel bed waves and furrows deleted. First pit wall debris shields installed. **1996**: Corners classified "high risk" reduced to 2 through circuit safety improvements and track modifications. Temporary circuit wall and debris fence specification guidelines. FIA test requirement for 'thin' energy absorbing barriers. **1997**: FIA circuit approval required for F1 testing. Kerb types and heights standardised after year of investigation. Bolted tyre wall construction obligatory. Analysis of the performance of safety measures with data recorded on the cars' ADR's.	harness shoulder straps obligatory. F1 drivers Super licence criteria more stringent. **1996**: Safety belt release lever must point downwards. **1997**: FIA supervision of conditions for private testing.	Pit lane access new restrictions. Creation of the Advisory Expert Group, to apply new technology to safety in F1. **1995**: Minimum safety services recommended for private testing. Clarification of blue, yellow, and white flags rules. FIA Doctor given Tech. Assistant. **1996**: Standardisation of FIA medical and safety cars. Improved Safety Car procedure. Fire exercises with Teams. Transformation of starting lights and procedure. **1997**: FIA approval for all Chief Medical Officers and medical centres. Revised accident intervention plan. Safety Car : more powerful; may be used for wet race starts; permanent

1993-1997 continued		Static load test both sides of cockpit rim. Size of rear "winglets" reduced. **1997**: FIA Accident Data Recorder obligatory on all cars (ADR). Energy absorbing structure on gearbox imposed, with rear impact test. Energy absorption of steering wheel, column and rack must be shown by impact test. Bodywork rules to exclude rear "winglets" and midship wings. Suspension must be designed to prevent contact of a front wheel with the driver's head in an accident and to provide 120° articulation of the forward lower arms, front and rear, to help retain the wheels.			professional race driver engaged.
1998-	GP races: **16** Estimated racing kms: **83000** Accidents in races: **60** Injuries, drivers: **1** Fatalities, drivers: **0** Fatalities, officials: **0** Fatalities, spectators: **0**	**1998:** Overall width reduced from 2m to 1.8m; grooved tyres made obligatory, to reduce cornering speeds. Single fuel bladder mandatory. Refuelling connector must be covered. Cockpit dimensions increased; side headrests extended to steering wheel. Mirror size increased, 5cmx10cm to 5x12. Front roll hoop test introduced; survival cell dimensions forward of dash increased; side impact test speed increased (nearly 100% more energy), site moved forward 200mm.	**1998:** High performance tyre barrier test specification established. Pit lane should be straight 100m before pits. Increased use of full light sets to supplement flag signals.	**1998:** Two shoulder strap anchorages recommended. Driver must be able to exit and replace steering wheel, in 10 seconds.	

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2000 -	GP races: **17** Estimated racing kms: **92000** Accidents in races: **62** Injuries, drivers: **0** Fatalities, drivers: **0** Fatalities, officials: **1** Fatalities, spectators: **0**	**2000:** Standardisation of removable seat fixing**.** Top of roll hoop 3 cm max. behind cockpit. Survival cell side height regulated. Survival cell side panel outer skin laminates must be made to FIA specifications, for increased penetration resistance. Static load side test in driver's leg area increased 20%. Rear impact structure minimum cross section regulated.	**2000:** FIA Standard for tyre barrier inserts to increase energy absorption.	**2000:** Additions to the Drivers' Code of Conduct, Appendix L, Sporting Code: - defensive changes of direction ; - pit exit lines.	**2000:** Minimum Chief Medical Officers' qualifications.

NOTE: "Estimated kms." refers to racing only; practice sessions at events would increase this by up to 150%.