



TRACK OPERATOR'S SAFETY GUIDE

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1 Introduction

"Track Safety is the Art of the possible"

Roger Peart

*President, FIA Circuits Commission,
2003*

This Guide is an important initiative linked directly to the *CAMS Safety 1st Strategy* and is underpinned by the combined significant expertise which has been gathered by the FIA, CAMS and its volunteer officials over many years.

The Guide has been compiled to assist Venue Operators of potential and existing race venues. It is also intended to provide a reference for a CAMS Appointed Track Inspector when assessing the suitability and compliance of a venue.

Except where expressly stated, the concepts and principles contained in this guide are not absolute and in some circumstances will not be applicable for existing circuits. By necessity venue guidelines are subject to interpretation depending upon each individual venue's particular circumstances. These include the conclusions of any specific risk assessments, local conditions, new or relevant laws which may be applicable to that circuit along with the type of activity planned to be undertaken at the venue. Operators of a new venue are encouraged to include the relevant recommendations contained in this document during the planning and development stages of a venue and ideally prior to construction in order to gain the optimal benefits of the information provided.

It is also intended that this Guide provide appropriate and useful information which will assist Venue Operators to facilitate an appropriate and practicable level of safety at their Venue. As you will appreciate this document cannot cover all possibilities at existing venues and/or all designs and engineering possibilities for appropriate safety installations. *This document must be considered as a general guide to what solution/s may be appropriate and how CAMS safety standards may be achieved, rather than it being seen to be an absolute standard in all cases.* Where a requirement is imperative though, this has been expressly identified.

This Guide is also a reference document for CAMS Appointed Track Inspectors to use when assessing, inspecting and/or auditing a venue. There are many resources available on the subject of roadside safety and this document references some of those standards where they may be applicable. Similarly, motor sport venue safety follows many of the principles and designs which have been proven to be valuable on the suburban road traffic network; however, motor sport has several significant differences. These include the one way nature of the competition course or circuit, the speeds attained by the competition participants and of course the general "edge of the envelope" environment which often leads to narrow safety margins being created by participants.

Whilst the Guide aims to provide guidance on most areas related to the operation of a CAMS Licensed Venue, it is the Venue Operators responsibility to undertake relevant research with the support of CAMS to produce a result which offers as much margin for safety, over and above the minimum required, as is reasonably practicable and/or possible to achieve. Indeed, the operators of a venue are at all times responsible for the management of risk within their venue's precinct. Venue Operators are referred to the Australian Standard AS/NZS 4360:2004 - Risk Management, which details a generic framework for establishing the context, identification, analysis, evaluation, treatment (management controls), monitoring, recording and communication of risk.

In addition, the Guide for Managing Risk in Motor Sport, published by SAI Global (HB 197) is a useful tool for Venue Operators in establishing the risk environment and how the Risk Management process applies to a motor sport application.

Inspections of venues, documentation of risks and controls and an on-going and continuous improvement process relating to the operation and safety of a venue are vitally important components of the risk management process, collectively referred to as the "CAMS Safety 1st Strategy".

CAMS is continually upgrading its knowledge of track and venue safety principles and encourages a close relationship with Venue Operators and/or their representatives in order that soundly based and well documented proposals which deviate from these guidelines may be considered on a case by case basis. CAMS encourages Venue Operators to embrace the concepts and principles contained within this guide so that together we can provide all motoring enthusiasts with a safe environment to participate in the sport we all enjoy.

Disclaimer

For the purposes of licensing venues for International events additional guidelines are required. The FIA publishes information to assist those track operators wishing to develop their circuits for international competition.

Note that this document is not the only information to be used when assessing a venue. An inspector may use other applicable criteria when establishing the required safety standards for a circuit.

The Confederation of Australian Motor Sport Limited does not accept responsibility for the use of information contained in this guide for any purpose other than establishing appropriate conditions which may be necessary for a CAMS Track Licence to be either issued or maintained or in respect of events for which a CAMS Organising Permit, or other specific authorisation for an activity which is granted by CAMS, is in force. It should be noted that a CAMS Track Licence is only valid for such periods as a CAMS Organising Permit, or other specific authorisation for an activity which is granted by CAMS, is in force.

Any advice given by CAMS, its authorised representatives and/or agents, to the Venue Owner and/or Operator arising out of an inspection and/or in relation to the safety requirements of the track has been given solely to enable the CAMS Track Licence to be granted for the purposes of the Venue Owner and/or Operator and/or party to which the CAMS Organising Permit, or specific authorisation for an activity which is granted by CAMS, has been issued to, in undertaking events covered by a CAMS Organising Permit, or other specific authorisation for an activity which is granted by CAMS, and for no other purpose.

If the Venue is to be used for activities other than those authorised by CAMS in accordance with a CAMS Organising Permit, or other specific authorisation for an activity which is granted by CAMS, it is the Venue Owner/Operator's responsibility to satisfy itself/themselves as to the nature and extent of safety requirements appropriate to those activities. CAMS does not accept any responsibility in relation to any activities not specifically covered by a CAMS Organising Permit or other specific authorisation for an activity which is granted by CAMS and therefore the Venue Owner/Operator should seek independent advice as to the standards of safety which it considers to be appropriate to those activities.

The CAMS Track Licence, the content of this report, any related correspondence from CAMS or advice given by CAMS, its servants or agents whether oral or in writing only relates to CAMS authorised activities and should not be relied upon for any other purpose.

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2 Definitions and Terms

The following definitions and terms apply insofar as these guidelines are concerned:

DEFINED TERM	MEANING
Apex of Corner	A point in a corner where the theoretical racing line or trajectory approached the closest point to the inner track edge.
Apex Kerb	Kerb located on the inside (the side of the track with the lesser radius) of a corner, usually over several meters on the approach and departure side of the apex or clipping point of the corner.
Audit	A check of the works undertaken at a venue against the works program and the Track Inspection Report
Barrier	An obstacle (deemed to be impenetrable and have minimal crushability) serving to bar the passage of a car – generally the 1LoP.
Braking Distance	A measurement commencing from the turn in point of a corner and extending along the trajectory of the car immediately prior to the turn in point, and calculated by application of an approved formula
Brake Marker	Sign located near the track edge indicating a specific distance in meters before the following corner
Buffer	A deformable apparatus used for partially dissipating the kinetic energy of a car striking the apparatus.
CAMS	The Confederation of Australian Motor Sport Limited – the body appointed by the FIA to regulate motor sport in Australia.
CAMS Track Inspector	An official accredited by CAMS, assigned to undertake inspections of venues and to formally report findings as appropriate in a CAMS Track Inspection Report.
Category A Race Circuit	A race circuit licensed by CAMS for which a current FIA Track Licence has been issued
Category B Race Circuit	A race circuit licensed by CAMS for races various levels of status which may be authorised by CAMS
Category C Track Licence	A document certifying that a circuit has been approved by CAMS for the conduct of Speed Events of a style specified on the Track Licence and which may specify the conditions or restriction under which competition may be held at the venue.
Category C Venue	A motor sport venue for which a CAMS Category C Track Licence is required in order to conduct a specific event or portion of an event.
Check Inspection	An inspection conducted to assess works programs and the general condition of a circuit from time to time in between Triennial Inspections

Chicane	Artificial feature creating additional turns in a race track used to slow a vehicle's speed
Circuit	A closed course, permanent or temporary, beginning and ending at the same point, built or adapted specifically for motor car racing.
Competition Area	The area at a motor sport venue to which spectators or the general public are not admitted, where vehicles can drive at unrestricted speed and including circuit entry and exit roads.
Conveyor Belt Facing	A strip of suitable conveyor belt (as described in Appendix 16) attached to the front of at least two parallel rows of tyre bundles.
Corner	A significant change of direction of the layout of a race track
Corner Speed	The minimum speed attained by a car through a corner
Course	A road or track, and the relevant installations, used for motor sport competitions. A course might be temporary, semi-permanent or permanent depending on the venue's location and the character of its installations and its availability for motor sport competitions. It is not necessary for a "course" to start and finish at the same location
CSAS	Circuit Safety Analysis System – a computer software program used by the FIA to predict escape line lengths
Deceleration on Track	Rate of change of speed of a car having lost control whilst travelling along the trajectory of the racing line whilst within the confines of the race track
Deceleration off Track	Rate of change of speed of a car having lost control whilst travelling along the trajectory of the racing line, whilst traversing the verge. The rate of deceleration will change depending on the verge surface, e.g., gravel, bitumen, grass
Dragstrip	A straight, purpose-built racetrack, typically an eighth or a quarter mile long, with an additional <i>shutdown area</i> to allow vehicles time to stop after crossing the finish line.
Entry Speed	The fastest speed attained by a car on the approach to a corner prior to any deceleration
Escape Line	A line extending along the trajectory of the car immediately prior to the turn in point, whose length commences at the track edge and is calculated by application of an approved formula
Exit kerb	Kerb located on the outside (the side of the track with the greater radius) of a corner, usually located at some point past the apex of the corner
FIA	Federation Internationale de l'Automobile – the world controlling body of four wheeled motor sport.
First Line of Protection (1LoP) – Level 1	A barrier (the specifications of which are included with in this document) required to maximise protection of persons at a race circuit

First Line of Protection (1LoP) – Level 2	A barrier (the specifications of which may be less than that required for Level 1 1LoP) and which are specifically approved by CAMS for the protection of property or non-human hazards.
Guideline	A condition or physical object or process which is recommended to be undertaken. Non-conformity with a guideline will usually require a risk assessment of the specific matter being undertaken to determine acceptability or otherwise of the foreseeable risk.
Geometrical Curve	The curve generated by following the geometric centreline of the competition circuit or course.
Gravel Trap	That portion of a run off area of a circuit or course which incorporates a specified type of gravel, designed specifically to slow the progress of a competition vehicle if/ when entering it.
Kerb	Device located at track edge, usually at a corner, designed primarily to prevent track edge disintegration.
Marshal Control Post	Location of a Flag Marshal Post at which various services are provided e.g. Flag Marshals, Fire Marshals, Observers, Trackside Marshals
Marshal Post	Location of officials, usually performing singularly specific duties e.g. Fire Marshal, Relay Flag Marshal
Marshal Zone	The area between the third line of protection (public/spectator enclosure) and the first line of protection and reserved for the exclusive use of authorised personnel, usually event officials.
Must	An obligatory or mandatory requirement to carry out a task, duty or instruction as may be required by this document. If a requirement or action which <i>must</i> be implemented or introduced is deemed not to have been implemented or introduced, an appropriate notation will be required to be made on the Track Licence or Track Inspection Report to that effect.
Non-Permanent Circuit	a course temporarily set up for a specific event in the form of a continuous road or track, beginning and ending at the same point, of which the operation is restricted by non-racing activities and where the installations are wholly or partly removed between events.
NTSAC	National Track Safety Advisory Committee – a committee whose Chairman and members are appointed by CAMS to advise on safety matters and define and/or review licensed venue standards.
Paddock Area/Competitor Support Area	Area(s) established for use by competitors and their competition and support vehicles whilst not actually competing.
Permanent Course	A course of which the track and all installations are permanent and generally available for motor car competitions and testing.
Pit Entry Road	The part of the circuit between the point at which the part of the circuit diverges towards pit lane and the commencement of the pit lane complex

Pit Exit Road	The part of the circuit between the point at which the part of the pit lane diverges towards the circuit and the commencement of the circuit itself
Public Road Network	Any road network which is not contained within the venue of the circuit and is open to the passage of traffic of the general public.
Race Control	The location at a race circuit where the Clerk of Course and other principal command and control officials are situated.
Racing Line or Trajectory	The theoretical trajectory followed by cars around the circuit, which is determined by using a straight line to link the arc with the largest radius possible around a corner to the respective end of each adjacent arc. This line is used to measure the length of the track.
Risk Management	The systematic application of management policies procedures and practices to the tasks of identifying, analysing, evaluating, treating (management controls), monitoring and communicating risk.
Run Off Area	A region of ground between the track edge and the first line of protection which is beyond the verge, and is the area likely to be crossed by a car leaving the track at racing speed.
Run Off Distance	A figure determined through the application of mathematical formulae to determine a minimum theoretical distance between the track edge and the 1LoP considered to represent the distance for a vehicle to reduce speed to the extent that severe injury following an impact would be unlikely.
Second Line of Protection (2LoP)	A barrier (the specifications of which are included with this document) placed on top of, or behind the first line of protection (1LoP) primarily designed to prevent the passage of vehicle debris beyond the barrier.
Signalling Wall	Area provided for crews to visually communicate with drivers during competition
Significant Upgrade	Changes to the competition area of a motor racing circuit which involve any realignment of the track pavement or introduction of any new spectator viewing facility.
Should	Denotes a duty which, given permitting circumstances, is considered to be beneficial but not imperative. Where it is considered that a duty <i>should</i> be done, but is not done as it is considered to undertake the action (which <i>should</i> be done) results in undesirable consequences or hardship or unacceptable risks, a Targeted Risk Assessment which assesses the risks of the options considered, will be required.
Standard Operating Procedure (SOP)	A document which specifies physical set up and operational requirements of a venue for the conduct of an event for which the Track Licence so authorises.
Starting Grid	Area on the track where cars are parked in a specific pattern in readiness to start a race.

Speed Event	A competition, other than a race, in which automobiles are timed individually along a defined course greater than 200m in length and which is determined solely on the basis of the individual time recorded. The term "Speed Event" includes attempts at Records, Hillclimbs, Rallycross, Sprints, Supersprints, Autocross and speed or acceleration tests by whatever name.
Speedway	A permanent circuit (gravel or sealed bitumen) composed of not more than 4 curves, which all turn in the same direction.
Street Circuit	A race circuit which is composed of mainly public roads specifically closed for the conduct of the race meeting
System	An assembly or combination of objects, facts, principles etc, which are used or assembled in a coordinated manner or practice to form a complex or unitary whole.
Targeted Risk Assessment	A system recognised throughout Australian motor sport as an appropriate method of identifying, assessing and controlling risk/hazards in a manner which meets the methodology of the Australian Standard for risk management.
Temporary Circuit	A course which is temporarily set up for a specific motor sport event in the form of a continuous road or track beginning and ending at the same point and where the installation are partially or wholly removed between a series of motor sport events.
Third Line of Protection (3LoP)	Public enclosures are required to be securely fenced by a <i>Third line of Protection</i> (the specifications of which are included with this document) which surrounds public enclosures at a licensed track.
Track	A road especially built or adapted to be used for vehicle competitions (see also Course).
Track Inspection	A formal, structured check of a prospective or current motor sport venue, for which a Category A, B or C Track licence has been issued or is envisaged to be issued or renewed. A Track Inspection may include assessment of all aspects of the competition area, as well as other safety devices, installations and operations at a Category C Venue.
Track Inspection Report	A report generated by CAMS following a CAMS Track Inspection of a venue
Track Licence	A document certifying that a circuit/course has been approved by CAMS and which specifies the conditions under which motor sports competition may be held on the circuit/course.
Track/Circuit/Venue Operator	The principal person or body controlling the day-to-day operation of a motor sport venue.
Triennial Inspection	A compulsory inspection of permanent venues, undertaken by authorised and assigned CAMS Track Inspectors with other stakeholders, held at 3 year intervals.
Turn	See corner

Turn in Point	The point of divergence from the previous straight of the trajectory/racing line through the corner.
Tyre Bundle	Tyre stacks arranged adjacent to each other in a line to form a buffer and connected together in the manner described in Appendix 15.
Tyre Stack	A vertical stack of tyres, at least 1 metre in height, connected together in the manner prescribed in Appendix 15, herein.
Verge	An area immediately adjacent to the track edge.
Works Program	A program of work, either provided to CAMS by the Venue Operator or agreed between CAMS and the Venue Operator, scheduling the works necessary in order to comply with the requirements of the CAMS Track Inspection Report or other standards or directions, as appropriate.

3 Philosophy of Track Safety

3.1. Background

Motor Racing is an infinite human endeavour. Drivers drive vehicles in races as fast as their ability allows them. Engineers seek to construct vehicles that will go faster than others. A driver seeks to win races. To do that they must drive their vehicle faster and faster for longer, than the other drivers in the race.

Inevitably, such actions lead to an increased risk environment and may result in property damage and/or human injury.

Participants, particularly drivers, must accept a high level of responsibility for their own safety, and that of others. This is particularly so in consideration of the high speed, high concentration, and instantaneous reactions necessary for a driver to succeed in the activity being undertaken.

Organisations involved in motor racing, such as CAMS, seek to protect participants through the application of controls to three primary areas:

- (a) vehicle regulations,
- (b) administrative control over the operational environment and,
- (c) by requiring a race track meets certain design criteria - which will maximize the risk controls of (a) and (b).

It is not the task of this document to labour the various regulations of vehicle designs or driver related matters including licensing, experience and apparel, suffice to say that vehicles in car races held under the sanction of CAMS are subject to appropriate design and modification regulations and drivers who operate them must obey regulations for compulsory safety and personal protection equipment, all of which is designed to minimise the likelihood and consequence effects of mechanical failure, fire, vehicle body or chassis deformation and injury to the driver.

However there are several significant areas of "Track Safety" which do require explanation and / or reiteration to the new circuit designer.

Inevitably, during the course of a race the driver will increase risks by undertaking manoeuvres that may not be previously tried or tested. This may lead to the driver losing the control able to be exerted over the vehicle and such loss of control may be to such an extent that the vehicle leaves the track surface and the driver is unable to regain control of the car. In such circumstances, the car may continue on a path until it collides with a trackside object such as a barrier, or overturns, or both, or stops of its own accord.

When such circumstances occur, in many cases there are devices installed which are designed to ameliorate the consequences of a collision. Such devices are placed at locations considered to be high risk for a reasonable number of the participants.

In some cases, however the circumstances surrounding the loss of control, the point where loss of control occurred and the path taken by the vehicle following the loss of control by the driver are so unusual that it was not foreseen that the installation of speed attenuation devices were warranted, or in some cases the installation of speed attenuation devices which may be appropriate for the more frequent incidents may lead to more undesirable outcomes than would have been the case for less frequent incidents.

3.2 The goal of track safety

The ultimate goal of track safety is to decrease the risk to all participants to such a level that no vehicle damage or personal injuries arise from competition activity on a race circuit ("venue"). Clearly, this is not always practically possible to achieve within the constraints of the environment, so therefore the practical aim of track safety is to embrace the reality that incidents will still occur, but the severity and likelihood will have been controlled through a process of continually improving effectiveness and efficiency of design, engineering, construction and operations at a venue to minimize the risks as far as is reasonably practicable and to reduce the incidence of vehicle damage and /or personal injury to that which approaches zero.

3.3 Primary factors influencing safe track design

The following primary control concepts of the physical features at a race track are sought by CAMS to assist CAMS and Venue Operators to minimise risk at race track:

- Design, construction and ongoing maintenance of a venue which provides for a vehicle leaving the intended racing surface to travel for as far as possible with all wheels of the car contacting the ground in order that the driver has the maximum possible opportunity to control the direction and speed of the car
- A barrier surrounding the outside of the actual race track, positioned at an appropriate distance from the track in order to prevent a car from exiting the confines of the competition area.
- Speed attenuating devices installed against the barrier in appropriate locations in order to reduce the speed of the car immediately prior to impact with the barrier, to a speed which is considered to present an acceptable risk.
- Appropriate physically protected areas for officials operating in the trackside environment.
- Appropriate physically protected low risk locations for spectators to view the activity.

3.4 Protection of participants

The ability to influence the risk minimization of a venue when holding motor races accords to the position or status of the participants within the sport. It is considered the definition of such participants include:

- Drivers (of the competition cars)

- Officials - who are necessary for the conduct and control and support to those who are responsible to maintain the risk environment through application of the appropriate regulations which cover the event. These may range from flag marshals, operating in an environment close to high speed competition cars though to administrative office workers, who may never see a race car in action throughout and event.
- Team Members – who assist the driver to compete in the race by providing various labour services to in support of the driver.
- Media – members of the media contingent which includes journalists, photographers, film and television crews, engineers, administrators, presenters and commentators.
- Contractors – engaged by authorised persons and/or organizations to fulfil a specified service.
- Spectators – all other classes of persons attending a race meeting, whether invited or not, having paid an admission fee or not.

Each group of participants has differing requirements from and/or obligations to the Venue Operator, to ensure their safety and that of others, at a motor racing circuit is maximized. Each of the groups of participants are able to affect the level of risk to which they are exposed to some extent, however some to a greater degree than others.

In order to simplify matters, CAMS considers there are three distinct groups of participants which all groups above fall into:

- Drivers
- Officials
- Spectators

Drivers are able to affect the level of risk to which they are exposed, or to which they expose others to, more than the other two groups, as they are the operators of the devices that actually cause the majority of risks – the competition vehicles

Officials are able to control risks by applying administrative and in some cases engineering controls over the drivers. Whilst officials are considered a group of participants who are able to control risks, the ability to do so is significantly less than it is for drivers.

Spectators – which includes all the other remaining groups noted above. It is this group which are least able to control risks and in the main rely on the safe environment created by the Venue Operator or Organiser of the activity, which is then maintained by the drivers and officials. It is however expected that in order to maintain an acceptable risk environment, spectators will obey reasonable directions and instructions (for example, when issued by the Organisers) when at a motor sport event.

Each of the three groups of participants noted above requires an increasing level of risk controls to be placed in them in order to result in acceptable risk environment equilibrium.

CAMS imposes these controls through the regulatory environment of motor racing. (Indeed, without such regulations the level of risk would be significantly higher and would ultimately affect the sport itself.)

For example, the use of fire resistant clothing:

Fire resistant clothing Including socks, gloves, undergarments, outer garments, helmets and boots to a standard which has proven to be satisfactory to prevent burns for a specified time in a petrol fire, is required by regulations to be worn by all drivers. This is due to the high risk of fire in a race car though a reasonably high likelihood and moderate to major consequences.

Engineering controls (car design, fire extinguishers built into cars, a firm environment to keep the driver conscious and free of injury in order that the driver can quickly react to the fire situation and escape from it) as well as the obvious Personal Protective Clothing (fire resistant driving suits) compulsorily worn by all drivers, all combine to reduce the consequences of fire in a race car and thus the overall risk.

Some officials, depending on their duties, are likewise required to wear Personal Protective Clothing (fire resistant clothing), as there is an expectation that they may need to put themselves in a situation where the risk of burns from fire (on an otherwise unprotected body) is high. The fire resistant clothing reduces the consequence and therefore the risk, to an acceptable level given the context of the matter.

Spectators, conversely, do not require fire resistant clothing as the isolation and protection of the spectator area from competition cars together with the administrative and engineering controls resulting from regulations on cars and the requirements of circuit design are such that there is an acceptable level of risk for spectators to remain in designated areas without resorting to the wearing of fire resistant Personal Protective Clothing.

3.5 Conceptual design of a race circuit

Race circuit design is a complex process in which balance must be sought to provide a challenging layout for drivers (in order that they will attend the venue and “compete”) and at the same time offer an arena in which to undertake their chosen activity which is considered not only to be as risk free as reasonably practicable given the circumstances, but also one which must also offer a balance between a challenging circuit for drivers and the provision of interesting opportunities for viewing the activity, by spectators at the circuit and from a media and (particularly) television perspective.

CAMS does not seek to dictate to a Venue Operator the initial concept, shape or layout of a race circuit, however it does require that the design meets its approval for “safety”. This approval will be based on guidelines and parameters developed through worldwide research and experience in motor racing, engineering and associated professions, but will take into account many other individual circumstances and factors which apply to each venue.

Therefore each motor racing circuit, while being required to meet certain conceptual and operational parameters, must however be looked at individually to determine if a design or installation being considered presents an acceptable risk.

The majority of issues which CAMS faces in regard to track safety do not relate to the development of designs of facilities or processes of operations which can be incorporated

into new "green field" or "blank sheet of paper" venues, but rather in determining the most appropriate manner in which to work closely with the Venue Operators of existing venues to continually increase the viability of their circuit by making the venue safer for all participants within the confines of the Venue Operators physical and financial boundaries.

There are, however certain specific requirements which are essential for all new permanent motor racing circuits and for which CAMS encourages for existing motor racing venues, they are:

- A suitable security fence enclosing the property, sufficient to prevent pedestrian and vehicular access. This may be temporary or permanent, but shall be in place for any race meeting for which a CAMS Organising Permit is issued.
- First Line of Protection ("1LoP"): The entire outside of the competition area shall have a continuous (save for appropriately located and designed access openings) First Line of Protection barrier, of a CAMS approved design, installed. A device providing a similar level of protection is also necessary to any areas where persons (officials or spectators) may be permitted on the inside of the competition area or where natural or man-made obstacles (trees, poles, fences, buildings, dams etc) which may be considered to be at risk of being hit by an errant car, exist.
- Second Line of Protection ("2LoP"): All locations where trackside officials or flag marshals are located or where spectator areas are close to the track or behind a straight ahead runoff area, shall be protected by debris fencing.
- Third line of Protection ("3LoP"): All areas where it is envisaged public access or viewing will be provided shall be protected by an approved third Line of Protection barrier/fence, located a defined distance behind the first or second Line of Protection.
- The Start/Finish area must be located on a suitable length of straight track at an appropriate distance from the first corner.
- The starting grid layout shall comply with contemporary requirements of CAMS.
- A suitably sized paddock area, which shall provide direct, secure and protected access to and from the track.
- A pit lane with adequate length to provide a separate stopping space for each car competing in a given race and which is separated from the race track by concrete signalling wall with debris fence protection attached, or a suitable entry/exit to the paddock areas which is safe and appropriately protected (in which circumstance no pit lane would be provided).
- A Pit lane is compulsory for new circuits for any event above State Championship level
- Verges and run off areas which comply with CAMS documented criteria with regard to size and design, as suggested in the Track Operators Safety Guide.
- Installation of speed attenuation devices (gravel traps, multiple row tyre buffers, additional run off area etc) where appropriate.

- Line of sight vision of the entire circuit by trackside flag marshals at appropriate spacing.
- A Race Control room, where the Clerk of Course and the essential personnel for controlling communications networks and emergency co-ordination are based. Vision of the Start line and Pit Lane is required from Race Control. Access to the Race Control room must be restricted to authorised persons only.
- A secure two-way communications system which links each flag marshal point to the Race Control room.
- A Medical Centre, housed in a permanent and dedicated building (e.g. not a caravan or an ambulance) which is situated so that direct access is available both from the race track and to the external public road network by emergency vehicles at all times, without having to cross the race track. This requirement envisages tunnel or bridge access is appropriate.
- Appropriate facilities for the public will be required based on the Venue Operator's expectation as to the envisaged number of spectators.

3.6 Permanent and Temporary circuits

Generally there are two types of race circuits, those which have been constructed for the purpose of motor racing and which are permanently outfitted for such activity (Permanent Circuits); and those race circuits which are derived using predominately or exclusively existing public roads and which require a significant amount of temporary infrastructure in order to be considered appropriate to race on (Temporary or Street Circuits).

Temporary or Street Circuits are created where the commercial imperatives or desires of promoters outweigh the benefits of the use of a permanent circuit for the desired competition.

The main difference between the two types of circuits is the locations of the First Line of Protection barriers, particularly along straights and the exterior of corners and at the exit of corners.

Run off areas for Temporary Circuits can sometimes be less extensive than those at Permanent Circuits. Where streets intersect, buildings or structures may restrict the ability to provide the same shape of the run off area. Generally this is partially offset by creating a "straight on" run off areas of an appropriate length along existing streets.

The general philosophy of barrier alignment principles applying to Street Circuits is modified from that which applies to Permanent Circuits i.e. "provide as much room as possible to allow drivers to run off and regain the track" (at a permanent circuit) to "place the barrier close to the track edge to enclose the incident and to keep cars directed along the envisaged path of travel" (at a temporary circuit). Both philosophies are acceptable and serve different purposes.

3.7 First line of protection

All race tracks are required to have a barrier which surrounds entire outside of the competition area. This is known as the First Line of Protection ("1LoP") and shall be of a CAMS approved design and be "continuous" (save for appropriately located and designed access openings).

This barrier (see specifications of various types of 1LoP) is deemed to be impenetrable and immovable and not to offer any gradual deceleration qualities when hit head –on. Notwithstanding that various types of barriers may in practice on the road network are flexible to some extent, for the purposes of designing and engineering a race circuit, all 1LoP barriers are to be essentially rigid, immovable and non-crushable.

The principal rationale for the requirement for a 1LoP to surround a race track is to offer a guarantee of a level of protection to the area outside of the competition area. The minimum height specified for a 1LoP barrier (1000mm) has been found to be generally effective in providing an appropriately tall stopping device, whilst cars are travelling upright and on their wheels, or in some cases when barrel rolling along the ground.

This offers a low risk to intrusions into non-competition areas, allows designers and engineers to plan for the locations of official's stations and spectator areas with a high degree of confidence that the area will be well protected.

Enclosures for public or other persons and plant or equipment, buildings, poles, trees, fences etc which are located in the areas surrounded by the race track (the "inside" of a circuit) must also be protected by First Line of Protection barriers.

Some circuits do not present continuous protected areas on the "inside" of the circuit. In such cases it is considered that the risk of a car crossing the "infield" from one side of the circuit to the other is assessed at being an acceptably low and a barrier may not be required.

The First line of Protection provides a final obstacle which must confine out of controls vehicles to the competition area of a race circuit. It also provides a significant physical hurdle for persons to cross if they try to breach the confines of the spectator area and trespass onto the competition area of a race circuit. Persons must first cross a 1100mm high steel wire barrier (see "Third Line of Protection") and then undertake some unusual physical activity in order to cross the 1LoP (e.g. step over or down from a 1000mm high barrier).

1LoP barriers provide not only protection of personnel, but protection of property (cars cannot escape the confines of the venue and (for example) crash through a security fence enclosing the property onto a public road)

In order for the theory of the 1LoP to be practical, cars must stay upright and on their wheels for as far and as long as possible. It is not possible to control a vehicle when it does not have all its wheels on the ground. It is for this reason that the principle for use of "New Jersey" shaped highway barriers – that cars, when they hit a barrier with a sloping profile will be deflected not only back onto the road, but also vertically, thus using gravity to help reduce the kinetic energy of a car – is not used in car racing. It has been found that a vertical or very near vertical barrier offers an appropriate and cost effective barrier which as far as practicable will not deflect cars vertically.

Ramping or vertical deflection is to be avoided during a collision. Ramping can have the consequences of directing a car over a barrier and into the spectator area, where there is no further vehicle stopping protection, unless debris fencing has been installed which will mitigate the consequences to some degree,

3.7.1 Concrete barriers

Whilst CAMS provides for 3 different types of 1LoP barriers - Earth Backed tyre barriers, 3 row high guardrail and earth backed or freestanding concrete barriers, the main difference is that the risk of destruction and, consequently, the integrity of earth backed tyre barriers and guardrail is significantly higher than concrete when impacts occur. Concrete is harder and wears better and tends to have lower deflections when impacted at low angles than guardrail or earth backed tyre barriers

3.7.2 Guardrail barriers

Guardrail, or an equivalent specification W shaped overlapping post and beam system is an alternative to concrete barriers or earth backed tyre barriers and it is deemed to have similar vehicle stopping qualities. Over time, however it has been experienced that Guardrail systems may require a higher degree of maintenance and beams and upright posts can become relatively easily damaged and require replacement or rectification.

Guardrail systems used as a First Line of Protection usually comprise of 3 rows of beams, with appropriate spaces between the beams to result in a barrier of 1000mm height, however in consideration to the location, the purpose and the object being protected, the height can be varied by the number of rows of beams in the system.

3.7.3 Earth Backed Tyre barriers

Earth backed tyre barriers tend to be installed in instances where the ability for a venue operator to afford the more expensive and generally aesthetically pleasing, option of guardrail or concrete is not financially appropriate.

New circuits which choose to use earth backed tyre barriers will generally not be envisaged to be high profile venues and in all cases, the use and locations of earth backed tyre barriers are considered in relation to the amount of runoff area which is able to be provided.

3.8 Verges

Verges provide an emergency transition area between the track edge and a barrier, where a driver has the opportunity to drive on a relatively smooth surface but one which presents a diminished level of control over the vehicle, primarily due to the different surface characteristics of the verge compared to the track.

Unless otherwise approved (and in some specific areas where other features, including pit entry/exit roads are located) a permanent race track should be bordered along its entire length on both sides by compacted verges, usually between 1 m and 5 m wide. Verges should have an even surface, be free of loose stones, debris or any other obstacles, and should preferably be grass-covered. Under some circumstances it is preferable to present a bitumen surface of a verge or run off area.

In all circumstances, it is important to provide a verge which a vehicle can drive over without incurring undue damage.

3.9 Run off areas

Permanent circuits normally present an area of ground free of obstacles, which a vehicle can drive over without incurring undue damage, and which is located beyond the normal verge, usually on the outside of corners, which is designated the "run off area". It is the area which is beyond the verge likely to be traversed by a car leaving the track at or near racing speed, the driver having failed to negotiate the corner on the designated track surface. Transitions from verge to run off areas must be seamless.

Generally, the minimum area or length of a nominated run off area is calculated by application of specific mathematical formulae. These formulae take to account the calculated (or determined actual) corner entry speed (the maximum speed obtained by a car prior to braking for the corner generally called "the entry speed") and the minimum speed of the car through the corner ("the corner speed") as well as verge inclination (slope) and deceleration properties of both asphalt or bituminous concrete and verge surfaces.

The result provides a distance considered to be the minimum appropriate "escape line length" and indicates the position where a 1LoP may be located to achieve an acceptable run off area in order for a driver to reduce speed of a vehicle to an acceptable amount, if all normal systems of the car are working and return to the circuit.

3.10 Vehicle speed attenuators

To provide additional protection to drivers against high decelerations and forces experienced when colliding with an immovable and non-crushable object such as the 1LoP barrier, additional speed attenuation devices are sometimes installed at locations where there is a reasonable likelihood of a car leaving the race circuit and impacting with the barrier at an angle of approximately 60 degrees or more and at a speed which is likely to cause injury to the driver.

There are two such devices commonly used:

- an in, or on, ground attenuation device, known as a gravel or sand trap (depending on the material used) and/or
- an above ground attenuation device, which is usually placed against and physically linked to, the 1LoP barrier and acts as a physical buffer (see definition).

The locations of speed attenuation devices, particularly buffers, is not specifically determined by formula or regulations. Devices are installed where it is considered the device will most likely be of benefit to a reasonable percentage of competitors in the case of vehicle impact.

Speed attenuation devices are specifically not located in positions where it has been assessed that the likely outcome of an impact involving an interaction with the speed attenuation device will be usually less desirous than it would be beneficial. For example, gravel traps are not usually placed in locations where there is a significant likelihood of cars

to cross the verge and enter the gravel trap in a rotating (spinning) motion or entering the gravel trap sliding sideways.

3.10.1 Gravel traps

Gravel traps are located on the exterior of corners, usually at the straight ahead location or partially around the corner. They are located at corners where there is a risk of cars to proceed off the track through over driving, mechanical failure etc. so that if a car hits the barrier it is going slower than would otherwise be the case. Generally gravel traps are located where limitations of run area exist or where there is a high risk of cars leaving the track in a "straight-ahead" trajectory on the approach to a corner. Gravel traps are not usually placed in locations where cars cross the verge and enter would the gravel bed in a rotating (spinning) motion or if there is a significant likelihood of entering the gravel trap sliding sideways, as this tends to promote overturning of the vehicle. Outcomes for overturning vehicles are difficult to project or determine (see comments about cars staying on all their wheels)

Gravel beds are more effective if the material used is uniformly sized and has rounded edges (river bed gravel) pebbles. In some cases and in acknowledgement of geographical locations of some circuits, the material used for the bed is sand.

Both gravel and sand beds require frequent conditioning in order to remain effective.

3.10.2 Buffers

CAMS defines a buffer as a deformable apparatus used for partially dissipating the kinetic energy of a car striking the apparatus. It will usually sit directly in front of the 1LoP barrier and is linked to the barrier.

Buffers may be manufactured from various types of materials, however their principle purpose is similar, that being to spread impact load through as many components in the buffer system as possible and decelerate the vehicle at a lower rate which will extend the time of the crash, reducing deceleration peaks and thereby reducing impact loads on the driver to significantly less than could be the case without the buffer.

Buffers are usually constructed using a number of rows of passenger car tyres linked together vertically and horizontally and faced with a sturdy flexible belt, itself attached to the tyres at specified intervals, and fastened to the barrier at each end of the buffer.

Tyre buffers are generally of at least 2 rows deep and are often covered or faced with steel cord conveyor belting, which has been found to improve the performance of the buffer system in many circumstances.

Tyres are commonly used to construct buffers as they are readily available, reliable, and relatively inexpensive and have appropriate elastic properties to provide for virtually instantaneous rebound into their original position and configuration, so that the same level of protection can be offered to cars following the initial impact vehicle.

Other buffer systems include purpose built modular plastic units or blocks, linked together horizontally. The elastic deformation qualities of the blocks can be adjusted by the substance used to fill them. This substance is usually a type of expanding polyurethane foam.

Buffers are normally located against the first line of protection in areas where there is likelihood that cars will leave the track and hit the 1LoP at a reasonably blunt angle. There is no fixed or detailed process for the location of buffers, as they can be used to offer different outcomes in many different situations.

Occasionally freestanding buffers are positioned to provide appropriate vehicle speed attenuation or track separation in some circumstances, where it is assessed as being appropriate and other options are not available.

At some circuits, buffers are placed in relatively low speed areas to assist ameliorating vehicle damage, as opposed to preventing driver injury. In such cases impacts may occur at relatively low speeds and in order to assist operational issues (this is particularly so on street circuits, where the theoretical ideal run off area on the exit of a slow corner may be compromised). For example it may be more desirable to place a buffer in a location which mitigates body/vehicle damage and allows a car to be driven out of an incident site, albeit damaged, than to neutralize the race and extricate the car by deploying vehicle recovery teams and equipment.

3.11 Obstacles in the verge

Small cross sectional and solid obstacles such as poles, trees, fence posts and the like in the verge or run off area are to be avoided, unless a risk assessment can be undertaken to demonstrate their location provides minimal risk exposure and they are protected by buffer devices.

3.12 Kerbs

Most corners are fitted with kerbs which delineate the track extremities and protect the verges and track edges at the corner when drivers short-cut corners. Kerbs are usually quite benign and can be driven over at speed without unduly disturbing the balance of a car. However in some instances active or aggressive deterrent are used to dissuade drivers from using the kerbs as an extension of the race track.

In such cases, all effort is made to “trade off” aggressiveness of the kerb design with relatively safe passage of the car over the kerb.

At some locations, flexible bollards or other types of relatively benign flexible objects may be used to deter drivers from short cutting corners. Administrative controls (time penalties) can also be used in conjunction with physical or engineering controls to ensure drivers use the race track as intended.

3.13 Marshal Zone

In nearly all cases in race tracks in Australia, a space exists between the rear of the 1LoP and the area provided for the public. This is referred to as the Marshal Zone, as the principle occupants of this area are in fact the marshals who control and support the event, however the more correct definition is that this area is restricted to allow only authorised persons, who, in addition to the marshals/officials may include photographers, contractors, civil authorities and emergency crews.

The width of this area provides not only a free space acting as additional protection for spectators, but also offers an area where marshals can undertake their duties (flag waving

etc) and approach stranded cars quickly and unencumbered. It also provides a "safe refuge" for drivers who may have self extricated from their vehicle after having stopped on the circuit.

In a few locations on tracks around Australia, there is insufficient space for a Marshal Zone, however these locations are usually for very short lengths, such as bridges and areas where structures (buildings etc) are located and physical access to the track is unavailable, in such cases, there are usually additional marshals and services located nearby to reduce overall risk and to provide for contingencies in areas where access is not available.

On temporary circuits, whilst a Marshal Zone exists, access to and from the race track is restricted by the location of the 2LoP. At these circuits, suitable arrangements are made to ensure appropriately protected access openings are available at regular and frequent intervals along the track edge.

3.14 Access gaps

Access gaps are provided in the 1LoP barrier for either personal or vehicle access to and from the race track at regular intervals. These gaps are located in areas considered to be low risk – for example, it would be unusual for such a gap to be located on the exterior of a fast corner – and provide an opportunity for emergency cars to access the circuit; an area in which to park retired cars in order to continue racing operations in an efficient manner; for drivers to escape the confines of a circuit if they have self extricated from their cars after stopping during a race and of course for officials and other emergency personnel to access the circuit to attend to the various needs.

Barriers surrounding such access gaps are designed so that they overlap on approach side to such an extent that they present a low risk to drivers and provide appropriate protection for those behind the barrier.

3.15 Flag Points

An essential component of motor racing is the facility to warn drivers of dangers and risks ahead of which they may not be aware (e.g. though inability to see the hazard)

To minimise risks in these situations, motorsport has developed, over many decades, a useful and ubiquitous warning system involving various coloured flags being waved from near trackside positions, by trained marshals.

All such flag points are protected by a 1LoP barrier and where possible are located behind the continuous barrier surrounding the exterior of the track. In many cases flag points are fitted with additional or debris protection for the marshals, in consideration of the increased risk they face due to their position being close to the track edge.

A requirement for all tracks is for the circuit to be able to be observed at all times by the trackside marshals located at flag points. This is referred to as the "continuous line-of-sight" which requires that each flag point must be able to see the previous flag point as well as the next flag point, and have a view of the race track and verge area for that distance.

Actual locations for flag points are chosen having considered a variety of factors, including vision by drivers of the road ahead, severity of the hazards ahead, ability to have visual

contact with the previous and next flag point and the hazards which may be presented at the actual point by competition cars.

3.16 Workplace matters

Notwithstanding it being a largely volunteer based activity, motor racing, the officials who supervise it, the drivers, their teams and motor sports administrators must take into account the requirements of the Australian Workplace Health and Safety Acts and thus acknowledge that they owe obligations to those regulations and laws where appropriate.

3.17 The case for minimizing risks to “as low as reasonably practicable”

On occasions where the solution to an issue is not able to meet the ideals of the issued guidelines, the most desirable solution which can be achieved in the environment, taking all things in to consideration, is sought. This takes into account that the total elimination of the risk may not be able to be reasonably achieved.

In cases where the opportunity for a high level of risk mitigation is not available, it is considered a risk approximately equal to that of an incident of a car colliding head on with a barrier at approximately 80km/h is considered to be a least acceptable outcome. At that speed, whilst injuries are expected, it will in most cases be of a magnitude significantly less than that which would cause fatal injury.

On occasions, the most appropriate solution to a problem may indeed be the least worst of a number of solutions, thus from a casual outsider point of view it may appear as if there may be a better text book solution, however in determining the most appropriate solution many factors would have been considered and inevitably, the least unpalatable solution is the one which is needed to be chosen.

CAMS has developed a suite of systems and processes which are available for Venue Operators to use to assist in the Risk Management of Motor Sport. CAMS has produced a comprehensive “Safety First Strategy” which assists to address general risk and OH&S issues in motor sport.

3.18 Solving specific issues

Whilst CAMS and the FIA have produced information documents, such as this one, on the ideals of safety at race circuits, it is not always appropriate to have a “one rule fits all” solution for all circumstances and venues. CAMS and Venue Operators are often faced with difficult decisions in regard to construction of safety installations, particularly when introducing a new, not previously envisaged, installation at an existing venue.

Thus, whilst every effort is made to comply with the ideals as described in the various guidelines, non-traditional solutions which may be developed by stakeholders for a given situation may sometimes be chosen in cases where “textbook” solutions may be impossible or exceptionally difficult to achieve.

For example:

- A solution is not readily apparent

- A solution may have been utilized as an appropriate installation at one venue but may not be entirely suitable at another
- A “textbook” solution is not reasonably able to be effected due to technical, geographic, time and of course cost implications,

expert advice in the specific area of engineering can be sought and solutions proposed can be evaluated by stakeholders before being presented to CAMS for approval.

In all cases, every effort is made to ensure that the venue can continue to operate in a financially appropriate environment, however when the physical solution to a problem is insurmountable, controls other than engineering controls may need to be placed on a venue in order to create an appropriate risk environment. For example a restriction on the type of cars which will be permitted to use the venue or a higher level of race driver licence may be required.

3.19 Cost vs. benefits

One of the most difficult issues to resolve in installing new safety facilities at a motor race circuit is the matter of the cost of doing something vs. the benefit of doing it. This is especially so if the venue Operator is unable to financially afford the desired installation or modification.

In such cases it has been found useful to refer to risk assessment processes, described in more detail in later chapters.

3.20 Worldwide problems

Problems in motor racing in Australia are not dissimilar to those in experienced in other countries. CAMS is able to, and often does, utilise the network of the FIA to consult with, workshop and help determine appropriate solutions to assist in continually lowering the risk of motor racing to all its participants.

3.21 Grandfathering

It is broadly accepted that, once a venue has been constructed and licensed in compliance with the requirements at that time, there will not be an unreasonable obligation to comply with every evolutionary change which will apply to a later, newer venue. Each circumstance must however, be treated on a case-by-case basis.

CAMS generally applies a “Grandfather clause” against requiring significant changes to the layout of a circuit or modifications which may result in very significant works to be undertaken to meet a new requirement which was introduced after a licence has been issued.

However, at all times if the standard of safety at a venue falls below that which is considered to be acceptable, the CAMS Track Licence may be withdrawn and not re-issued until essential rectification works are completed.

Likewise, if the evolution of safety standards in motor sport is such that a venue can no longer meet community expectations (e.g. times change but the venue does not) the “Grandfather philosophy” may not be appropriate.

3.22 Inspections

CAMS aims to provide for a cascading inspection and certification or licensing process for race tracks. This is based on a 9 year cycle, where a new major hazard audit is completed each 9 years.

This document forms the back bone of the Triennial (3 yearly) inspection and reports.

In the intervening years check inspections or audits against work programs are carried out.

During each year of use of the circuit CAMS officials (Stewards) provide exception reports on outstanding issues.

Track Licenses are issued on an administrative basis each 3 years for permanent tracks (but may be each 12 months, depending on the circumstances) and as required for the time appropriate (usually 3 days) for temporary tracks.

Inspections at temporary circuits are required immediately before the circuit is used for the competition for which the circuit is constructed. Additional inspections may be required during the construction, particularly if it is the initial construction. Such inspections are managed on a case-by-case basis.

4 Risk Management

4.1 Concept of Risk Management in Motor Sport

Motor Sport pits drivers against the clock or each other in an attempt to go one better than the other driver – in other words to win the competition. Basically, much the same as with any other individual sport.

Motor Sport has however an additional significant risk – it must be done in a car – usually a powerful, sometimes heavy (particularly in relation to the weight of the driver) machine which not only stretches the levels of skill or competition intent of the driver, but it tests the mechanical properties of the machine to the limits of its design and engineering.

These additional risks need to be considered when devising reasonable and appropriate controls. In many cases, the controls used include engine capacity or limitations on engine power output, restrictions on some components which influence performance (tyres, aerodynamics) or requirements to enhance safety (apparel, roll over protection). Motor Sport has many risks and for every risk there is a control, usually several controls.

Controls are implemented pro-actively following an assessment of the “raw” risk by appropriate stakeholders. In motor sport terms, that may be by the Committee who is devising new regulations, to first consider what can “go wrong” and how and what can be done to prevent the matter “going wrong”.

“Going wrong” may not always have an immediate safety implication or may not be based on a safety related risk. It may be the introduction of a rule which restricts the height, weight, power output, number of forward gears, final drive ratios etc. Nevertheless it is a control and has been introduced following an assessment of the risk (of the car going too fast, or costing too much to build, or the competition number not being able to be read from a distance or the like).

Risk Management is really looking at a risk and considering what is an appropriate thing to do to control that risk to a level that is acceptable to both the competitors and the community, and doing so before the identified risk situation has a chance to occur.

Consider a fictitious race track without First line of Protection and the spectators standing on flat and level land at the edge of the track, at a 90 degree corner.

A control which results in an acceptable risk may be to locate spectators behind a barrier at a predetermined distance from the track edge and to install a tyre buffer in front of the barrier. A control which results in an unacceptable risk may be to locate spectators at the same distance from the track edge, but not provide a barrier behind which they would stand.

An unacceptable *process* to assess that risk would be to provide the unacceptable risk situation, run events and wait until there is an incident (which may result in injury to one or more spectators) then to consider what controls ought to be introduced to reduce the risk to an acceptable level.

An acceptable level of risk is generally the lowest level of risk which can be attained having given consideration to the circumstances. This is referred to a risk which is "as low as reasonably practicable".

Let's consider the "spectrum" of controls which could be used minimize risk at the corner. We could introduce barriers, spectator fences, tyre buffers in front of the barriers, but perhaps the most simple control to reduce risk of the public being injured may be to simply move the spectators to somewhere else.

As it turns out there is no other corner on the venue where spectators can see anything, so they don't come anymore and the venue becomes financially unviable, this forces the Venue Operator to close and the sport loses an important venue. Possibly a control which is not viable has been implemented. That's probably not considered to be a reasonable control!

Is there any other control which can be introduced to allow spectators to continue to view at that location without banning them from it altogether? Maybe a barrier can be placed at the end of the run off area. Cars may hit the barrier, but they will not hit the spectators as they will be behind the barrier, but the cars continue to be damaged. The spectators have understood that they need to be located behind a debris fence for their protection and have returned. Some have now seen how safe the area is and have brought along their wives and children.

The Venue Operator wants to keep his competitor base which was rapidly decreasing due to the damage on the cars hitting the barrier. He introduces another control – tyre buffers, 3 rows deep and faced with conveyor belt. Cars may still hit the buffer at the corner, but (a) the drivers do not get injured, (b) the damage to the cars is less severe through the energy dissipation qualities of the tyre buffer (c) spectators no longer are hurt when cars hit the barrier (d) more people attend the venue than ever, and (e) the Venue Operator is able to continue improving the safety at other parts of the venue due to the increased return through competitor and spectator attendance increases.

All of the "things" the Venue Operator has done to the exterior of the corner to make it incrementally safer are "Controls", or more appropriately "Risk Minimisation Controls". Each one of the controls serves to reduce the risk of personal injury or property damage. The more controls which can be placed on a hazard, generally the greater the reduction in risk.

Risk is a concept which is considered in two dimensions – the probability or likelihood of a specific action occurring and the consequence of that action occurring. In other words how many times will it happen and how bad will it be when it does happen?

This concept allows a commonly occurring incident which is of very minor significance or consequence to be compared to an incident occurring infrequently but which is of far greater significance or consequence. The method of comparison of the two scenarios is by a matrix, where the vertical columns and horizontal rows are scribed accordingly to intersect at a given cell which determines the scale of risk.

RISK MATRIX	CONSEQUENCE			
	1 Insignificant	2 Minor	3 Moderate	4 Major
LIKELIHOOD				
A - Almost Certain	High	High	<i>Extreme</i>	<i>Extreme</i>
B - Likely	Medium	High	High	<i>Extreme</i>
C - Possible	Low	Medium	High	<i>Extreme</i>
D - Unlikely	Low	Low	Medium	High

The resulting risk will then be used to determine the urgency and extend of introducing the Risk Minimisation Control(s) to the hazard. The greater the control can be, the more it can influence the risk matrix, therefore potentially enabling a risk of significance which may be considered to be totally unacceptable to be reduced to a lesser risk which may be accepted by the parties involved (the “stakeholders”) as being reasonable and therefore is considered “an acceptable risk”.

Motor sport has been applying controls from the days when a poor fellow used to walk in front of cars with a red flag to warn others that a motorised vehicle was approaching. The controls are now somewhat more complicated and significantly greater in number. They have been constantly evolutionarily applied for more than 100 years.

Due to the application and constant development of the controls on motor sport, we now have the situation where motor sport is relatively safe for all its stakeholders – spectators, officials, crews and drivers – provided the mandated controls are applied and acted upon by the participants.

Motor Sport is, with the controls which are applied, considered by the Community to be an acceptable risk.

But given that statement, how do we prove it? The answer lies in the application of a Risk Management process, one which identifies hazards, relates them to the situation to determine the risk, applies controls to minimise the risk, accepts the revised risk, implements the control and then evaluates the control and the hazard.

This is the Continuous Improvement loop which demonstrates the Risk Management System.

4.2 CAMS Safety 1st Strategy

CAMS has developed a sport wide process for identifying hazards and utilising controls and is embedded within the CAMS Safety 1st Strategy.

CAMS is responsible to its members for the provision of well-organised and competently-administered sporting activity, which is conducted safely, fairly and in a socially responsible manner, and which places the interest of the health and safety of all participants above all else.

Compliance is required by civil legislation – both federal and state, by local councils, by sporting rules and even through the due diligence which is entwined through society and is reinforced by the ever-increasing litigious environment in which we now live.

Above all else we have a moral obligation to our fellow participants, families and friends to provide the safest practicable environment which allows them to enjoy their sport and return home safely after each workday and/or event.

With that in mind it is essential that all event motor sport organisers, car clubs and motoring participants are aware that, legally, both they and CAMS have responsibilities and owe a duty of care.

CAMS, which sanctions more than 1,600 motor sport events per year, acknowledges this duty of care in its OH&S policy. The policy states: "It is CAMS responsibility to ensure all motor sport in Australia is conducted in a manner that secures and enhances the safety of all those involved, including participants, officials, spectators and the public."

There are many components, processes and systems that are currently used by CAMS to form its sport-wide safety framework. These are all significant pieces of the safety 'jigsaw'.

Some of these processes and systems are demands from within the sport itself, which include the feasibility and sustainability in a volunteer-based organisation.

The following is a list of the main components of CAMS integrated approach to safety, which form a major component of the CAMS Safety 1st Strategy.



The CAMS Safety 1st Strategy provides for the implementation of a Risk Management Integration Program that offers corporate and sport-wide application of risk management, supported by a framework and tool kit that delivers aggregated risk management information for:

- compliance with appropriate laws;
- protection for CAMS, associated organisations and people from physical and financial harm;
- building a robust defence against civil and criminal allegations brought against CAMS and associated organisations;
- creating value for CAMS and its stakeholders, and
- reinforcement of the legal obligations which are owed under the duty of care to and from all persons. Duty of Care obligations are paramount in the areas of motor sport which are not covered by the OH&S Act in the relevant state.

CAMS members/organisers of all volunteer-based activities are encouraged to adopt a risk management approach. This will assist in providing a safe and healthy work environment which accords with the spirit and intent of – and in many cases parallel – the respective OH&S legislation in each state.

The cornerstone of CAMS Safety 1st and risk/hazard documentation process is the TRA (Targeted Risk Assessment) form. Essentially this is a 'system in a page' created by CAMS motor sport stakeholders based on their experience and expertise. This template meets the requirements of, and uses, the methodology embedded in the risk management process outlined in AS/NZ4360:2004 Risk Management. It provides a systematic approach to identifying and assessing hazards at motor sport events, the likelihood and consequences and proposed treatments. It is designated as a 'tool' to assist the deliberate decision making process to control risks where unusual occurrences are likely to arise.

Information provided on TRA forms is channelled back to CAMS National Office and entered onto the Motor Sport Risk Register for continual improvement of motor sport and by feeding lessons learned back to all parties, to aid communication and consultation processes.

To underline the importance which CAMS and the Australian Sports Commission places on this program, CAMS has been inducted into the Australian Sports Commissions National Officiating Accreditation Scheme (NOAS) administered by ASC Coaching and Officiating Unit.

4.3 Insurance

Included in the CAMS event permit, and for other CAMS-authorised activities, is the provision of the CAMS Public Liability and Professional Indemnity insurance. This insurance cover provides significant protection for CAMS event organisers, affiliated clubs, officials and drivers in the event.

Public liability insurance protects against the financial risk of being found liable to a third party for death or injury, loss or damage of property, resulting from negligent acts. Professional indemnity insurance protects CAMS and motor sport officials from legal action taken for losses incurred as a result of their advice. It provides indemnity cover if the recipient of the advice suffers a loss – material, financial or physical – directly attributed to negligent acts.

4.4 National Track Safety Advisory Committee

The National Track Safety Advisory Committee (NTSAC) oversees the licensing for all venues for which Track Licences are issued by CAMS. Track Licences (from January 2012) will fall into five categories:

- Category A Series – Tracks on which International races may be held;
- Category B Series– Tracks on which competitions, other than International race meetings, may be held, and
- Category C Series– Venues on which competitions other than races may be held.
- Category D Series – Venues on which Off Road Stadium events are held
- Category E Series – Venues not licensed for Category A, B, C or D competition on which special tests, included in Touring Road Events, are to be conducted

The Committee prepares and issues regulations and standards for the design of motor sport venues.

The National Track Safety Advisory Committee analyses the safety performance of all venues for which a Category A or B track licence has been issued by CAMS. It also recommends to CAMS Management those modifications deemed appropriate to improve the basic safety for spectators, officials and competitors.

The Committee also delegates the appropriate authority and responsibility to, and provides the educational resources for, CAMS Track Inspectors to assess Category C venues.

A member of the National Track Safety Advisory Committee represents the interests of CAMS at International level through their membership of the FIA Circuits Commission. This ensures a bilateral exchange of information and continued consultation between CAMS the FIA and similar organisations in other countries on issues dealing with track and venue safety.

4.5 CAMS Medical Processes and Procedures

Whilst the rules, regulations and approved procedures which govern the conduct of motor sport are designed to minimise the potential for accidents and injury, it is necessary that each and every motor sport event be conducted in a manner not only designed to reduce risk prior to injury occurring, but to provide an appropriate environment to achieve desirable outcomes in terms of emergency medical response and patient care commensurate with the level, type and status of the event.

4.6 CAMS Judicial and Supervisory Process

The CAMS judicial process is the overarching of all of the above activities and processes at motor sport events. It ensures that an independent process is available for, and appointed to, each motor sport competition held under CAMS sanction. These are the 'Stewards of the Meeting'.

The duty of the Stewards of the Meeting is to act as the arbiter of any matter brought before them, be it of a compliance matter in respect of driving standards, technical regulation or Health and Safety matters.

Stewards of the Meeting are also invested with the authority to withdraw the CAMS Sanctioning (the Organising Permit) from an event should they determine that the risk of continuing the activity – be it for sporting, commercial or for public safety reasons – is of an unacceptable level.

Stewards of the Meeting have the ability to impose sanctions on various persons including monetary penalties and exclusion from the event.

A hierarchy of judicial appeal processes above the Stewards' level also exists in order to ensure the principles of natural justice are maintained.

4.7 Integration of Risk Management into Venue Operations and Inspections

The Handbook entitled Guide to Managing Risk in Motor Sport, as published by SAI Global (HB 192) is an excellent document which expands on the concepts of Risk Management in Motor Sport.

Similar to the CAMS *Safety 1st* Strategy, the Handbook stems from a simple idea — the attitudes and behaviours of motor sport participants will change when:

- Participants recognise that their behaviour may impact on another's safety;
- It is understood that risk management is what everyone does when making any decision in life; and
- It is realised that by adopting risk management practice they make better decisions about their behaviour hence motor sport becomes safer for everyone.

The concept of Risk Management will be employed by Track Inspectors when assessing a venue, particularly in those areas where the venue and the contents of this guide differ.

4.8 Consideration of the Statutory Civil Authorities Processes (OH&S issues)

All organisations and indeed all persons involved in motor sport in any capacity, be they drivers, co-drivers, team members, officials, the media, organisers, promoters and motorsport contractors owe obligations and have responsibilities under the relevant Occupational Health and Safety Act in each state of Australia.

It is an obligation under law for all organisations to satisfy the requirement of the various OH&S Acts and duty of care responsibilities and to demonstrate that they have safe systems of operation in place which provides evidence that the workplace is as far as practicable, without risks to the health and safety of all persons attending the event.

This obligation applies not only to persons involved with the organisation of all events held under the sanction of a permit issued by CAMS, but also to CAMS itself.

At the time of writing, the Federal Government is introducing a model Act for Occupational Health and Safety which will be very similar to the current Acts which apply in each State and Territory and will provide for identical OHS laws in each state.

Notwithstanding this new Act and the benefits which will accrue to a national organisation such as CAMS, it will remain an essential and primary requirement for a Venue Operators and Event Organisers to meet statutory civil legislation in every aspect of their operations.

In areas where there may not be adequate definition, CAMS should be consulted to establish parameters which are considered to be appropriate for motor sport and the type of event which is being conducted.

By way of example, it is inappropriate for a venue to disregard the requirements of the Dangerous Goods Act when refuelling of vehicles by the competitors is being undertaken in the paddock area. However, CAMS may have been able to assist in seeking a dispensation or understanding with a local authority so that the activity may take place, perhaps with the additional risk control procedures, and be implemented in a manner which causes the least inconvenience for the competitor.

Venue Operators are encouraged to obtain further information from the CAMS Safety 1st area of the CAMS Website www.cams.com.au/safety

4.9 Safety 1st Representatives

At all competitive events there is required to be an OH&S or Safety 1st representative present. With activities being conducted at multiple venues simultaneously, CAMS has appointed the Stewards of the Meeting to be the default Safety 1st representative on its multiple sites as a 'special arrangement' as permitted under OH&S legislation to help facilitate compliance with its duty of care.

The key requirements of a Safety 1st representative are similar as the duties already performed by the steward – to review measures being taken and investigate issues which are brought to their attention that may result in unforeseen risks to health and safety.

Venue Operators are encouraged to obtain further information on the CAMS Safety 1st Strategy from the CAMS Safety 1st area of the CAMS Website www.cams.com.au/safety

4.10 CAMS Commitment

CAMS is committed to maintaining, as much as practicable, the health and safety of its people.

Many of the duties of CAMS members who are involved in motor sport are carried out in an environment which is characterised by hazardous situations. In many cases they are not able to be in control of the situation, particularly in the 'agony of the moment', due to the highly-dynamic and competitive nature of motor sport involving competitors and their machinery.

For those who are in close proximity to the competition, this can result in a low level of predictability and a strong reliance on situational and dynamic risk assessment, strong administrative and engineering controls and a high degree of training and experience.

Many traditional approaches to OH&S management and risk reduction have been developed for the spatially static and more predictable work environments found in industry as opposed to the dynamic and relatively unpredictable nature of motor sport competition. These approaches are highly relevant to many of CAMS sanctioned motor sport activities, as many of its activities do not involve an emergency situation.

The challenge for CAMS is to integrate the principles of risk management for its static and controllable workplaces and appropriately adapt and integrate the principles to moveable and low-predictability workplaces which arise from dynamic competitive situations which are omnipresent in motor sport. This will require the type of commitment from all stakeholders that results in a complete culture change from top down to bottom up, a culture of 'Safety 1st'.

4.11 Tools for Managing Risk in Motor Sport

CAMS has developed a number of tools and processes to assist Venue Operators with assessment and control of the risk environment at a motor sport venue.

Additional resources include:

- TRA (Targeted Risk Assessment) Form and instruction regarding completion thereof
- CAMS Risk Register
- Sample Material Safety Data Sheets
- Safety 1st Checklists
- Sample Site inductions

All of which are available for downloading from <http://www.cams.com.au/Safety.aspx>

5 Principles of Venue Safety

5.1 General Comments

This Chapter sets out some basic principles or guiding statements in respect of establishing the safety environment at a Category A or B Venue.

5.2 Priority for Assessing Risks

The priority of determining the acceptability of a risk of a venue, or if the venue is considered to be "safe enough" for a given competition is based on the following hierarchy:

- 1) Spectators - Spectators will include all those people who are not officials, crew members or competitors/drivers.

Spectators are the least able to influence the outcome of a high risk situation or an incident, therefore they require the most attention in order to ensure their safety

- 2) Officials and Crew Members - Officials will include any person who is appointed by the organisers or CAMS to perform any task in relation to the operations of the event.

Officials are able to influence the outcome of a high risk situation or an incident to some extent by the manner in which they apply controls to the situation before it occurs, for example by waving a warning flag or designing an engineering control (placement of a tyre buffer) or introducing an administrative control (rule/regulation). The attention paid to an official's safety is no less than that of a spectator; however there are more controls which can be activated by an official than by a spectator.

A similar situation applies to crew members; by their actions they have the ability to influence outcomes to a degree higher than a spectator, but not as high as a driver.

- 3) Competitors/Drivers - Competitors and/or drivers are those persons who either provide the vehicles or drive the vehicles in the event.

Drivers are most able to influence the outcome of a high risk situation or an incident as they are the single controlling factor in establishing a high or low risk environment in relation to how they are driving their car at any one time. Therefore they have their own control mechanism for regulating risk.

It follows therefore that the Safety of a circuit must be assessed in respect to each of the above groups of stakeholders.

6 Process for approval of new circuits

6.1 General Comments

The Confederation of Australian Motor Sport is responsible for the conduct of the majority of four-wheel motor sport disciplines in Australia including circuit racing and other automobile activities conducted at motor racing circuits.

CAMS authorises and provides the regulatory framework for approximately 1,700 motor sport events per year. Through its 55 employees, CAMS provides full administrative support to the Board of CAMS, as well as its various Commissions, Committees, State Sport and Development Councils and Advisory Panels which provide expertise in their respective disciplines and areas of the sport.

CAMS Membership comprises of over 370 CAMS affiliated clubs across Australia representing approximately 30,000 people including over 18,000 licensed motor sport competitors and over 11,000 accredited volunteer officials.

CAMS interacts with and receives financial support from many Government Departments including the Australian Sports Commission and the various State Sporting and Recreation Departments.

CAMS is represented on the FIA World Motor Sport Council and its various commissions helping to shape the direction of the sport on the world stage and exerting influence where necessary in the interests of Australian motor sport.

The principal area for the control of standards for race circuits lies with the CAMS National Track Safety Advisory Committee, an Advisory Committee to the CEO of CAMS. Its membership comprises of experts throughout Australia taken from a number of motor sport kindred areas, including:

- Race Circuit Management and Operation
- Civil Engineering and Barrier design
- Race Driving
- Bio Medical and Vehicle Crash Research
- Risk Management
- Project Management
- Motor Race Operations
- Stakeholder Engagement

The NTSAC's main purpose is to ensure appropriate standards of safety are developed, deployed and maintained at motor racing circuits throughout Australia.

This is achieved through a regime of physical inspection, audit and subsequent reporting process of safety installations and facilities at race circuits, which, together with consultative and advisory advice to Circuit Operators see that race circuit meet contemporary expectations of a sporting and working environment for motor sport to be conducted in a safe, fair and responsible manner.

CAMS encourages all potential new venue operators and indeed existing Venue Operators to consult with CAMS, through its Manager – Track Safety, in all aspects of track and venue design and development.

CAMS members and staff have been involved with the design and development, auditing and inspecting and approval process of motor racing tracks for over 30 years. CAMS track inspectors work closely with Venue Operators to understand their needs and to assist where necessary in developing innovative solutions.

6.2 Correspondence

All correspondence for the attention of the Committee must be directed to the Committee Executive Officer, a permanent CAMS employee who is stationed at the CAMS National Office, Melbourne.

This position is currently held by

Bruce Keys
Manager – Track Safety
CAMS
PO Box 147
MALVERN EAST VIC 3145

Email: bruce.keys@cams.com.au
Phone: +61 3 9593 7778 (direct)
Mobile: +61 418 373 118

6.3 Consultation

CAMS welcomes consultation and interaction with its stakeholders. Traditionally requests for approval of new circuits or alteration to operational or safety based installations at existing motor racing circuits come to the Committee directly from Venue Operators, or from third parties with the specific written approval of the venue operator, and fall into three broad categories:

6.4 Approval of new circuits

Initial contact with CAMS will be through its Manager, Track Safety.

This will normally entail a discussion of your project and your initial plans. A time line for future planning and interaction with CAMS and the NTSAC will be discussed.

As plans develop and progress into a firm structure, a presentation will be required to be made to the National Track Safety Advisory Committee at which Engineering plans of the proposed circuit layout, trackside features and other related infrastructure can be tabled and discussed. As a result of this meeting, plans may be required to be amended.

A fee for service will be required to be agreed with CAMS. This will be undertaken with CAMS Commercial Department, through the General Manager – Commercial Operations aided by the Manager – Track Safety

Once the plans are approved by the NTSAC, Site inspections will be agreed and undertaken and report structure will be developed for the venue.

After construction has been completed, a final inspection will be necessary prior to licence issue.

6.5 Track Inspections

Once licensed, a principal manner of consultation and communication between the Committee and Track Operators is through the Track Inspection process.

Each licensed Race Circuit has the following inspection process provided by CAMS:

- Each 9 years – a comprehensive hazard audit and risk assessment is undertaken and delivered to the Track Operator. This forms the basis of the following 3 Triennial Inspection Reports
- Each 3 years – A triennial inspection, carried out by a number of relevant stakeholders, from which hi-ranking existing or new hazards are assessed and a report is drawn up referring to those hazards, together with agreed rectification outcomes. This report is then subject to the delivery of a works program, which provides a priority and proposed date of completion for the agreed rectification.
- Each year – a check inspection or audit is carried out against the agreed works program and any variances discussed and if necessary referred back to the Committee.
- Ad hoc reports – reports on operational or physical features, either existing or proposed which may be generated by CAMS appointed officials (Stewards, Race Directors, Track inspectors or technical Commissioners) in attendance at a circuit for meeting to which they are so appointed.

6.6 Benefits of a CAMS Track Licence

The holding of a CAMS category A or B Track Licence provides the Track Operator the following opportunities:

Entry into the CAMS system for a non-affiliated organisation. The CAMS system provides:

- Access to the Public Liability Insurance scheme
- Access to CAMS TOPCAR process, for non-competitive activities at Licensed Race Tracks which is available exclusively to Venue Operators
- Risk Management processes of CAMS
- Assurance of competitor competence
- Assurance of Official competence
- Standard sporting, technical and safety regulations and environment
- Access to CAMS judicial system
- Support “when things go wrong”

Provides the key to the CAMS insurances available to tracks

Provides for the administration and continuance of the NTSAC, a specialist body within CAMS which in turn provides the following benefits to Track Operators:

- A body which analyses safety trends in motor sport
- The continual development of guidelines/regulations for motor racing circuit design and safety
- A competent and independent body to assess the design of proposed circuits
- A competent and independent body to assess the safety of a track
- A competent and independent body to advise on proposed track improvements
- A systematic approach to inspections and the ongoing assessment of safety of a track
- A link to the FIA for circuit technology issues (both to and from the FIA)
- A link to the FIA to enable International Licensing of circuits (to enable International Races to be held)
- That a system of unified standards of safety is applied across similar status tracks
- A forum for the Track Operators to have input into the development of track safety policies
- A repository of responsibility for track safety issues
- A competent group who advises, on behalf of CAMS, in relevant issues brought about by legal challenges
- Representation by qualified experts at legal and civil hearings (e.g. Bennett matter)
- Training and education of Regional Track Inspectors to enable the licensing of Category C venues

7 Venue Concept

7.1 General Comments

CAMS requires a Track Licence to be issued in order to ensure the venue is considered suitable and presents an acceptable risk for the spectrum of competition envisaged. Motor Racing venues can be generally categorised into four types:

- A Greenfield site – where a permanent motor sport facility is envisaged and there is little, if any pre-existing infrastructure present.
- An existing Motor Racing Facility – generally a permanent motor racing facility where a significant amount of pre-existing infrastructure is present and will be used to dictate at least some of the features or facilities of the proposed venue.
- An existing road network not previously used for motor racing - venues usually based on closed public roads (Street Circuit).
- A road network previously used for motor racing - venues usually based on closed public roads which have been previously licensed by CAMS for racing use.

Each of the above types of venues will require a different approach to the manner in which the track inspectors consider the suitability of the venue for the spectrum of competition envisaged and for the ongoing issue of a CAMS Track Licence.

Bearing in mind the opening comments to the introduction in this document, it must be understood that what is possible – and feasible – to achieve at one venue may not always be able to be achieved at another venue (e.g. in consideration of the resources available to the Venue Operator).

By way of example, when considering a totally new venue at a Greenfield site, the application of newer technology or the ability to easily introduce engineering controls (e.g. movement of significant amounts of earth to remove a hazard) may not be able to be achieved at a pre-existing venue, where there may be substantial infrastructure previously introduced to an identified area and the relocation or destruction of the infrastructure would not be financially viable.

In all cases, CAMS and its Track inspectors should be made aware of these potential limitations through consultation between Track Inspectors and Venue Operators.

In cases where the desires of the venue operators and the acceptability of the matter for the track inspector may conflict, a close and harmonious working relationship between the venue operator and the CAMS track inspectors and NTSAC will assist in achieving reasoned and responsible outcomes.

It will benefit all stakeholders if an acceptable outcome, which at its minimum reduces the existing risk, is agreed and implemented.

7.2 Grandfathering

It is broadly accepted that, once a venue has been constructed and licensed in compliance with the requirements at that time, there will not be an unreasonable obligation to comply with every evolutionary change which will apply to a later, newer venue. Each circumstance must however, be treated on a case-by-case basis.

CAMS generally applies a "Grandfather" against requiring significant changes to the layout of a circuit or modifications which may result in very significant works to be undertaken to meet a new requirement which was introduced after a licence has been issued.

However, at all times if the standard of safety at a venue falls below that which is considered to be acceptable, the CAMS Track Licence may be withdrawn and not re-issued until essential rectification works are completed.

Likewise, if the evolution of safety standards in motor sport is such that a venue can no longer meet community expectations (e.g. times change but the venue does not) the "Grandfather philosophy" may not be appropriate.

7.3 Updating Facilities

Any modifications to a venue, especially those to the competition area, should be advised to CAMS before implementation of plans.

7.4 Significant Upgrades, Major Alterations or Reconstructions

Whilst acknowledging that the determination of what a "Significant Upgrade, Major Alteration or Reconstruction" constitutes may be somewhat subjective, if a venue or part of a venue is added or upgraded or rebuilt, the standards, rules, regulations, requirements or interpretations against which the venue (or part thereof which is affected) is assessed, will be the standards, rules, regulations, requirements or interpretations which exist at the time of the approval of plans for the alteration rather than the standards, rules, regulations, requirements or interpretations which applied when the venue was first licensed by CAMS.

7.5 Work Programs

One of the most useful documents for a venue is a budgeted program of works for any maintenance, upgrade or development of the facility. This document will detail the requirement for the works allowance in the venue accounts and a date which it is agreed that the works will be completed. Such documents have been found to be essential in providing evidence of intention of improvements in civil law cases and also provide a basis for assessment of future risk, which for example may be useful in determining the types of cars which are permitted at a venue.

8 Multi Functional venues

New and existing Venue Operators are encouraged to consider the significant positive benefits given to the funding opportunities available through the State and Federal Governments to assist development of new or existing sports facilities (including motor sports and racing) facilities which may be available if the venue is able to be used by community groups, both within and outside of the direct motorsport community.

The development of a facility which can be utilised by several occupiers at the same time may result in a financial benefit as well as realising opportunities to develop community based support groups and to capitalise on the leverage that such groups can apply.

Motor Sport venues and in particular race tracks are usually large tracts of land of which a relatively small portion is actually used for motor racing, thus in many situations, even when the area is being used for motor racing, careful planning and management of the facilities may result in concurrent and multi-purpose use of the facility.

This concept is even more viable during the times when competition or racing is not taking place. For example the extensive facilities required for housing up to 15,000 spectators may be able to be used for other activities when spectator attendances at race meetings are not high.

Facilities to cater for spectators (toilets, shelters, catering etc) may be able to be used as facilities for other groups – both sporting and otherwise and within and outside of motor sport.

A paved paddock area may provide a useful driver training area, or be able to be used for motorkhanas, other sports (ball sports – netball etc) Spectator banking may be able to be utilised for large public gatherings (concerts etc)

The use of the circuit by non-competitive motor sport related activities on a 7 day per week basis can be facilitated through CAMS TOPCAR program – a product CAMS offers only to licensed motor racing Venue Operators to provide access to the risk management facilities and processes of CAMS with a minimum of administrative downtime being expended.

Use of a circuit on a 7 days per week basis does however have its downsides – continual maintaining and upgrading of the circuit can, without appropriate management and planning, become detrimental to ongoing operations over time – therefore it is recommended that the subject be discussed openly with CAMS during the initial venue development phase.

9 Track Layout & General Design concepts

9.1 General Comments

This section is very relevant for Venue Operators when considering the development of a Greenfield Site. Track Inspectors are encouraged to utilise the principles and theory of risk management when assessing all venues as a yardstick of what is considered to be acceptable risk.

This guide does not set out to overly restrict the conceptual layout of a competition course, as this is usually largely dictated by the geographical features of the property and the perception of the designer or the Venue Operator as to what may constitute a challenging course which meets their sporting and commercial desires and requirements.

However, some parameters are placed on the trackside features and compulsory installations which may have a consequent effect on the overall layout of the circuit e.g. the requirement for a run-off area may result in a corner being placed a certain distance from the property boundary than may otherwise be the case, or contraction of a spectator area to a size where the requirements for protection can be assured.

To establish a set of conditional requirements or standards which must be met irrespective of the venue is considered to be very impractical. Many venues are already operating and have been issued with a Track Licence for the competition desired. To deny the ongoing conduct of motor sport at that venue which has been successfully operated for some time, simply due to the introduction of new technology or availability of a previously appropriate materials is considered to be inappropriate. (See "Grandfathering" – Article 7.2)

To encourage continual improvement, a system of consultation and communication between the circuit and the licensing body is essential. To conduct portions of the consultation process in a formal manner is essential in order to document appropriately and provide proof that not only the venue meets an appropriate level of compliance with CAMS regulations, rules, regulations, requirements or interpretations and/or desirable standards (thereby demonstrating the level of risk of the venue is considered to be acceptable for the conduct of motor sport), but also provides evidence that CAMS and the Venue Operator have an recognised system to continually monitor the venue to assist with improvement programs which are based on assessment, control and acceptability of overall risk.

The determination of acceptable risk should be undertaken in line with the requirements of the CAMS Risk Management process – the *Safety 1st* process. This encapsulates the requirements of the track inspector which in turn is largely based on the information provided in this guide or as otherwise specifically approved by CAMS. It is acknowledged however, that it is unfortunately inevitable that requirements rules, regulations, requirements or interpretations will evolve which may therefore render a once compliant venue effectively outside the future regulations if continual improvement processes are not instituted.

In such circumstances, CAMS seeks to assist the Venue Operator to plan to update the safety features and specifications at existing venues in order to comply with the latest iteration of this guide, within reasonable constraints which may apply e.g. geographical, financial, political etc.

CAMS accepts that the layout of most existing and currently licensed tracks is not easily altered and seeks to use the ALARP principle (see AS/NZ 4360-2004 – Risk Management) of risk reduction/ minimisation by utilising such additional risk minimisation measures as it believes are reasonable in the given circumstance, in those cases where full compliance is unable to be achieved.

9.2 Circuit Layout

As stated earlier conceptual layout of a competition course is usually largely dictated by the geographical features of the property and the perception of the designer or the Venue Operator in regard to what may constitute a challenging course which meets their sporting desires and requirements.

9.3 Straights

The maximum length permitted of any straight section of track is 2km.

9.4 Curves

In addition to complying with the indications concerning width, a curve, or series of curves uninterrupted by a straight, taken at a speed in excess of 125 km/h, should have an increasing, or at least a constant, radius.

9.5 Width

The minimum track width will depend on the application and circumstances. The minimum width of any new race track will be 10m, however 12m is preferable.

When the track widens or narrows, the transition should be made as gradually as possible, at a rate not sharper than 1 in 20.

9.6 Elevation

As far as practicable, a driver's vision of the track surface should be such that it provides for the theoretical ability to stop before contacting any hazard which may be seen on the approach (known as the "stopping sight distance", made up of driver reaction time plus braking distance). If this is not possible to achieve, then appropriate control measures must be introduced to minimise the risk at this location. In particular, the sudden change of direction of a track at the top of an incline or immediately prior to steep drop should be avoided. Control measures may include warning devices (lights, flags) adequate run off space or speed attenuation devices such as gravel traps.

The gradient of the starting straight should not exceed 2% uphill.

9.7 Crossfall (Transversal Inclination)

Along straights, the crossfall, for drainage purposes, between the two edges of the track or between the centre-line and the edge, should not exceed 3% (0.3 m fall per 10 m width), or be less than 1.5%.

In curves, the banking (crossfall or camber) should not exceed 10% (1 m fall per 10 m width).

An adverse crossfall (reverse camber) is not generally acceptable unless dictated by special circumstances and supported by adequate risk minimisation controls.

9.8 Track Surface

The track surface should be smooth asphaltic concrete, similar to that used on modern highways, which will help prevent the formation of a liquid film due to rain, oil or fuel. Preferably the surface should be the same the whole length of the track. If this proves impossible, it should be ensured that no change in surface occurs on sections of hard braking or acceleration, at important changes in gradient or in curves.

The track surface should meet the following requirements:

- The surface should be exempt from any undulations so that a 4 m long straight-edge laid on the finished surface shall uniformly contact it ;
- A tolerance of ± 3 mm will be admitted only in a few points of the entire surface; at least three checks should be made every 100 m of the track length.

No unauthorised advertising or decoration is permitted on the track surface, save in an area near the start/finish line, where advertising may be permitted on the following basis:

- The location, size and design of the sign (artwork) must be approved by CAMS.
- The paint used must be of a CAMS approved anti slip compound.
- The sign must be in a location where there are no lateral or braking loads on cars in wet or dry conditions.
- A plan for the removal of the sign, if and when, it is no longer required

For guidance, the sign should fit into an area no greater than approximately 4 x 9m, which should not extend more than 10m from the start line. It is preferable that the sign lettering be undertaken in outline, rather than solid lettering, however due to the variable nature of the circuits' widths and the actual signage, this will be addressed when considering the artwork.

10 Circuit Design

10.1 Layout

The shape of the course both in plan and profile, is not subject to restrictions in these guidelines, as it is dictated by certain variable factors: the types of competition for which the course is intended, the character of the terrain, considerations of economics, aesthetics, tradition, etc. However, the construction should conform to the technical norms specified in Article 10.2 to 10.5.

10.2 Plan

Unless otherwise stated, all references to straights and curves in these guidelines concern the actual trajectory followed by the cars with the highest performance and not the geometrical form of the layout. (The trajectory, or racing line, when traced on the plan, will generally have the effect of shortening the straights and elongating the curves: when planning or modifying a course, the designer must base their calculations upon it).

10.2.1 Straights

CAMS imposes a maximum length of 2km for straight sections of track. Other specifications regarding straights concern width (see Article 10.2.3) and gradient points (see Article 10.3.1 and 10.3.2).

10.2.2 Curves

In addition to complying with the indications concerning width in Article 10.2.3, a curve, or series of curves uninterrupted by a straight, taken at a speed in excess of 125kph, should have an increasing, or at least a constant, radius.

Curves taken at lower speeds may have a decreasing radius, on condition that it is foreseen to at least fulfil the run-off area requirements of Article 11.2.6.

Unless it is desired to increase the speed at the entry or exit, it is not necessary to provide transitions in plan into and out of curves. The approach to a curve should be signalled by distance sign boards placed, as a rule, at 50m intervals from before the geometrical curve, and extending back to before the deceleration point. Their number and position should be determined according to the circuit layout and they should indicate the distance to the geometrical beginning of the curve. For detailed specifications, see Appendix 16.

10.2.3 Width

The minimum track width for new permanent circuits is 10m, although 12m is preferable and is the minimum acceptable by the FIA for an International Track Licence.

Where the track width changes, the transition must be made as gradually as possible, at a rate not greater than 1 in 20 total width. The width of the starting straight should be maintained up to and through the first corner - see also Appendix 24 for starting grid specifications.

Existing circuits requesting international recognition but which are narrower than 12m may be approved if national championship events have regularly been organised on them.

10.3 Elevation

10.3.1 Longitudinal profile

Any change in gradient should be effected using a minimum vertical radius calculated by the formula:

$$R = V^2 K$$

Where R is the radius in metres, V is the speed in kph and K is a constant equal to 20 in the case of a concave profile or to 15 in the case of a convex profile.

The value of R must be adequately increased along approach, release, braking and curved sections.

Wherever possible, changes in gradient should be avoided altogether in these sections. The gradient of the starting straight should not exceed 2%.

10.3.2 Transversal inclination

Along straights, the transversal incline, for drainage purposes, between the two edges of the track or between the centre-line and the edge (camber), should not exceed 3% (1.7°), or be less than 1,5% (0.9°). In curves, the banking (downwards from the outside to the inside of the track) should not exceed 10% (5.7°) (with possible exceptions in special cases, such as speedway or oval tracks).

An adverse incline is not generally acceptable unless dictated by special circumstances.

Any variation in transversal incline, particularly along the entry and exit sections of a planimetric curve, must have adequate altimetric transitions, based on the trajectory - see Article 10.2 - and on consideration of Article 10.3.1.

10.4 Track edges, Verges and Run off areas

10.4.1 Track Edges

Unless otherwise indicated because of features such as pit exit and entry roads, the track should be bordered along its entire length on both sides by continuous white lines clearly marked in (preferably) anti-skid paint, 100 to 150mm wide. Use of colours other than white require specific approval from CAMS

10.4.2 Verges

Unless otherwise indicated because of features such as pit exit and entry roads, the track should be bordered along its entire length on both sides by continuous and compacted verges, usually between 3m and 5m wide. All verges must present an even surface, be free

of loose stones, debris or any other obstacles (unless specifically approved otherwise), and should where possible, be grass-covered.

Verges should be a continuation of the transversal profile of the track, with no step or gap between track and verge. Should any transition exist, it must be very gradual.

Should a drainage channel be indispensable between the track and the first line of protection, it must be constructed so as not to present any irregularity in the verge surface: e.g., by covering it with smooth metal gratings with robust metal anchorages, or by employing a "French" drain.

Drains on the track edge should be avoided in braking or acceleration zones: if indispensable they should be situated behind the kerb or verge. Where a kerb is installed, the verge shall be flush with the top surface of the kerb.

The width of the verge should be at least 3m (although 2m is acceptable in front of the pit signalling wall). Exceptions may be made by CAMS. In such cases the reduction in width must be made as gradually as possible, the outside of the verge approaching the track at a rate not greater than 1 in 20.

10.4.3 Run-off areas

A run-off area is that section of ground between the verge and the first line of protection and unless otherwise specified - see Article 11.2.5 et al – must have the same basic characteristics as the verge, although it may be less stabilised.

The run-off area must be graded to the verge; if it has a slope, this should not exceed 25% upwards, with a smooth transition from track to run-off area, or 3% downwards in relation to the lateral projection of the track surface.

This paragraph does not apply to gravel beds - see Article 11.2.8.

In certain circumstances a run-off area may incorporate a paved section adjacent to the racing surface. In such cases the paved surface should be constructed to the same standard, composed of similar material and be in the same plane as the adjacent track surface, free from undulations which could unsettle a car.

10.4.4 Kerbs

On those parts of the circuit where the trajectory of the cars coincides with the track edge on the apex or exit of a corner, a concrete kerb may be required. Kerbs are not normally required on the entry to a corner (unless this is the previous apex in a combination).

The principle to be followed is to install the minimum amount of racing has shown it to be essential. Kerbs should be installed flush with the track edge with appropriate, smooth, transitional end pieces over a length of at least 2.5m for kerbs on the apex of a corner and 5m for kerbs on the exit of a corner.

The verge should always be graded, level with the top surface of the kerb, which if necessary should be extended at the rear with properly stabilised asphalt, concrete, grass-supporting modules or concrete based artificial grass, to provide a smooth transition to the verge without a step or rut.

Drainage should be provided wherever the presence of the kerb could cause water to accumulate on the track, for example on corner apexes.

The table at Appendix 1 - Kerbs should be used to determine the type of kerb for a given corner.

Both the Melbourne (Negative) and Vallelunga types of kerb described below should incorporate, for their entire length on the verge side, a flat strip of concrete, at least 15 cm wide and level with the highest points of the kerb, to prevent tyre damage and to stabilise the verge. Care should be taken to eliminate all sharp edges. Provision should be made for the adequate drainage of Negative kerbs.

The Vallelunga design, (Appendix 2) is a progressive, wide-ribbed kerb for the apexes of slow, moderate or combination corners, rising to height "H" above track level at the rear which may be 5 or 10 cm according to requirements;

The Melbourne or Negative design, (Appendix 3) is a progressive, wide ribbed kerb sinking to 2.5cm or 5cm below track level at the rear, for the exits of all corners. The 2.5cm version must be installed in combination with a strip of artificial grass behind it which is no less than 2m wide.

The Bevelled design or FIA kerb, (Appendix 4) is a smooth inclined kerb, with a flat rear surface 5cm above track level, and is used for medium to high speed corners.

The Combination kerb, (Appendix 5) is a short section of smooth profile kerb, 80cm wide, rising to 12cm above track level, for the apex of all corners. This should be installed behind a 5cm Vallelunga or Bevelled kerb.

The Hidden Valley design (Appendix 7) is a smooth profile kerb, 80cm wide, rising to 12cm above track level, for the apex of all corners.

Morgan Park design or Wilson type kerbs (Appendices 6 and 8) are progressive, wide ribbed kerb with varying frequency of peaks (between 400mm and 1500mm) sinking to 5cm below track level at the rear, for the exits of corners.

These may be varied according to the categories of racing to be held and may also be supplemented by additional kerbs approved by CAMS or by marking devices (e.g. "floppies" or "apex tyre bundles") for specific events.

CAMS should be consulted before any kerbs are installed.

10.5 Track Surface

The track surface should be smooth and similar to that used on modern highways, which will help prevent the formation of a liquid film due to rain, oil or fuel. Preferably the surface should be the same the whole length of the track.

If this proves impossible, it should be ensured that no change in surface occurs on sections of hard braking or acceleration, at important changes in longitudinal profile or in curves.

Resurfacing should not be effected less than 60 days before an event.

The plane of the track is dependent upon the geometrical shape of the roadway both in the longitudinal and lateral senses. Differences between the true profile of the surface layer and the line which represents the mean true profile are geometrical irregularities.

The plane equality of the surface should meet the following requirements:

To be exempt from any undulations so that a 4000mm long straight rod laid on any part of the finished surface uniformly contacts it, the tolerance admitted not to exceed 3mm.

The anti-skid properties should be established in consultation with CAMS. No unauthorised advertising or decoration is permitted on the track surface, save in an area near the start/finish line, where advertising may be permitted on the following basis:

- The location, size and design of the sign (artwork) must be approved by CAMS.
- The paint used must be of a CAMS approved anti slip compound.
- The sign must be in a location where there are no lateral or braking loads on cars in wet or dry conditions.
- A plan for the removal of the sign, if and when, it is no longer required

For guidance, the sign should fit into an area no greater than approximately 4 x 9m, which should not extend more than 10m from the start line. It is preferable that the sign lettering be undertaken in outline, rather than solid lettering, however due to the variable nature of the circuits' widths and the actual signage, this will be addressed when considering the artwork.

Paved or run off areas are excepted as provided for in Article 11.2.9

10.6 Dragstrips

The preparation or use of any part of the circuit for drag racing will change the above-mentioned characteristics and in particular the anti-skid properties when wet due to the properties of the preparation compound and the rubber accumulation on the track surface.

For new circuits the inclusion of the start area and/or timed section of a dragstrip in any part of the track surface or asphalt run-off areas is prohibited. Existing circuits incorporating drag strips are must demonstrate to CAMS that all surfaces have been cleaned of excessive rubber deposits before a licence can be granted and this will be a continuing condition of validity of the licence for circuit races. In addition, any Category A, B or C track licence issued to a circuit or part thereof, which incorporates a timed portion of the drag strip will only be considered valid for racing while the active portion of the dragstrip is not wet.

Areas habitually prepared with chemicals for drag racing starts are likely to require resurfacing or to be re-situated outside the race track and its run-off areas before CAMS approval.

11 Protection Systems

11.1 General Comments

Safety installations on a course are intended for the protection of all persons on the site: spectators, race officials, service personnel and drivers, during competitions.

When determining the safety installations, the general characteristics of the course must be taken into consideration (track layout, rock banks and faces, adjacent areas, existing roadside protection, buildings and constructions) as well as the speed attained at any point of the track.

11.1.1 Continuous First Line of protection barrier – A compulsory requirement for all race circuits

All licensed race tracks in Australia *must* present a barrier which surrounds entire outside of the competition area. This is known as the First Line of Protection (“1LoP”) and shall be of a CAMS approved design and be “continuous” (save for appropriately located and designed access openings).

Devices providing a similar level of protection are also necessary to protect any areas where persons (officials or spectators) may be permitted on the inside of the competition area or where natural or man-made obstacles (trees, poles, fences, buildings, dams etc) which may be considered to be at risk of being hit by an errant car, exist.

This barrier (see specifications of various types of 1LoP) is deemed to be impenetrable and immovable and not to offer any gradual deceleration qualities when hit head-on. Notwithstanding that various types of barriers in practice on the road network are flexible to some extent, for the purposes of designing and engineering a race circuit, all 1LoP barriers are to be essentially rigid, immovable and non-crushable.

The principal rationale for the requirement for a 1LoP to surround a race track is to offer a guarantee of a level of protection to the area on the outside of the competition area. The minimum height specified for a 1LoP barrier (1000mm) has been found to be generally effective in providing an appropriately tall stopping device, whilst cars are travelling upright and on their wheels, or in some cases when barrel rolling along the ground.

This offers a low risk to intrusions into non-competition areas, allows designers and engineers to plan for the locations of official's stations and spectator areas with a high degree of confidence that the area will be well protected.

Enclosures for public or other persons and plant or equipment, buildings, poles, trees, fences etc which are located in the areas surrounded by the race track (the “inside” of a circuit) must also be protected by First Line of Protection barriers.

A circuit may not present continuous protected areas on the “inside” of the circuit. In such cases it is considered that the risk of a car crossing the “infield” from one side of the circuit to the other is assessed at being an acceptably low and a barrier may not be required.

The First Line of Protection provides a final obstacle which must confine out of controls vehicles to the competition area of a race circuit. It also provides a significant physical hurdle for persons to cross if they try to breach the confines of the spectator area and trespass onto the competition area of a race circuit.

1LoP barriers provide not only protection of personnel, but protection of property (cars cannot escape the confines of the venue and [for example] crash through a security fence enclosing the property onto a public road)

11.1.2 Protection of Drivers

Whilst when circumstances permit it may be appropriate to provide sufficiently obstacle-and spectator-free spaces for the energy of a car leaving the track out of control to be completely expended, it is most frequently necessary or preferable to contain an accident in relative proximity to the trackside, by providing conditions for the driver to regain control or if in the occasion of an impact, by absorbing as much of the car's kinetic energy as is reasonable.

The type of safety installation to be considered as appropriate to offer a reasonable amount of protection to a driver is dependent on the available space and the likely impact angle. As a general principle, where the likely impact angle is low (generally less than approximately 30 degrees), a continuous, smooth, and vertical barrier is usually preferable. However, where the impact angle increases (greater than 60 degrees approaching a maximum of 90 degrees) and the run-off area is restricted a deceleration system is normally required to be installed in front of the 1LoP to improve outcomes in the event of a collision.

One of the principles applying to race tracks is that the protection available for the first driver in a collision should also be available for the following drivers, the time interval between the drivers may be only tenths of a second. Thus for race circuits, any device used as a buffer must not (unless approved specifically in exceptional circumstances) absorb energy by permanent physical deformation or destruction of the buffer.

11.1.3 Protection of the Public

Protection from wayward cars entering areas designated as being suitable for the public is of particular importance. To ensure such protection all race tracks must meet the following minimum criteria:

- Areas which are designated as being suitable for the public must be located in appropriate areas which are at the same level as, or higher than, the track edge.
- Any areas which are designated as being suitable for the public *must* be separated from the track by a 1LoP barrier of design noted in this document or a specifically approved alternative together with a system of third line of protection (3LoP), i.e. a metallic fence or other equivalent structure at least 1200mm high and at a minimum of 3m from the rear of the 1LoP or a at least 6m from the track edge in all cases. This will ensure that at all times the public will be situated behind at least two lines of track protection..
- Where a public enclosure is situated on a gradient, (e.g. viewing mound) consideration should be given to designing the viewing mound so that it is not steeper

than 1v in 4h, unless the ground is terraced or there is an appropriately designed and engineering grandstand or viewing facility erected on the slope.

- Any public areas where a risk assessment determines that there is a high risk of incursion by debris from an on-track incident should be protected by a "debris fence" or Second Line of Protection (2LoP), in which case the 3LoP must be located at least 3m behind the debris fence (and a minimum of 6m behind the track edge).
- The area between the 3LoP and the 1LoP is reserved for the exclusive use of the authorised personnel and is designated the "Marshal Zone".

If it is not possible to protect areas for spectators in the above manner, spectators must be prohibited from that area. Provisions essential for a spectator area include:

- A firm and stable surface from which spectators can view the track or a portion of the track.
- Firm and stable access tracks suitable for walking on with a minimum of inconvenience.
- An appropriate slope for the viewing area (minimum of 1v in 4h) or a terraced area
- Appropriate way signs
- Availability of toilets (which may be shared facilities with competitors, depending on the distance to the paddock from the spectator area)
- A form of communication (e.g. A Public Address system) which can be used to advise of the need for an emergency evacuation of the venue.

Venue operators are encouraged to undertake a cost/benefit analysis of providing significant facilities for spectators at a venue, considering the relatively few spectators which attend the majority of venue based motor sport activities.

Competitors and crews not immediately involved or participating in competition must also be restricted to areas considered to be an acceptable risk area for spectators.

11.2 Specific comments

11.2.1 First line of Protection

Also referred to as 1LoP, Primary Protection Barrier, or Stopping Device.

See Articles 3.7, 11.1.1 and Appendices 10, 11, 12, 13, 14, 15 and 19

First Line of Protection barriers (also referred to as 1LoP, Primary Protection Barriers, or Stopping Device, (which may physically incorporate a degree of energy dissipation but for the purposes of design and engineering a race circuit are not deemed to), include:

- 3 row high Guardrail - see Specifications at Appendix 12
- Earth backed or freestanding concrete barriers – see Appendix 10

- Earth backed tyre barriers - Compacted earth banks of minimum 1m high, stabilised by a tyre wall of the same height embedded in the track side face – see Appendices 14 and 15
- Freestanding Tyre Buffers – Some designs of tyre buffers may be utilised as barriers in some exceptional circumstances. When tyres are used as 1LoP, the minimum specification is a 3 row tyre buffer, comprising of sections of 3 dimensionally linked (each tyre is mechanically linked to the next tyre vertically, and horizontally [width and depth wise]) vertical tyre stacks at least 1000mm in height and at least 10 stacks (approx 6500mm) in length per section. Where more than one section (6500m in length) is deployed, each 6.5 m section should be linked to each adjacent section. This will provide a mass of approximately 1750 kg for each 6.5 m of tyre buffer. *Under no circumstances however will tyre barriers to this specification be permitted where protection of public or officials is required.*

11.2.2 Deceleration systems

Also referred to as Speed Attenuation devices, Vehicle speed attenuators.

See Article 3.10, 11.2.8 and Appendices 16, 17 and 18

Deceleration systems comprise of a device or a combination of devices which are used to provide an opportunity to reduce the speed of a car within the confines of the run off area in cases where the driver has lost control. They also provide additional protection to drivers against high decelerations and forces experienced when colliding with an object such as the 1LoP barrier. They include:

- Gravel Traps (also referred to as deceleration beds), which are beds of gravel or equivalent material, to slow a car efficiently with minimal damage - see Article 11.2.5:
- Paved braking surfaces on which a car may lose speed – see Article 11.2.9.

In addition, deceleration systems include Energy Dissipating devices, which may be used in conjunction with all of the above or as a stand-alone mechanism and include

- Tyre Buffers, which may be faced with sturdy flexible belt facing. See Article 11.2.14, Appendix 18
- Other devices which present similar performance qualities to tyre buffers but with different physical properties and which are shown to meet the CAMS requirements in performance testing.

Each installation is subject to individual approval by CAMS. Other deceleration or stopping devices may be approved by CAMS. In exceptional circumstances, tyre buffers may be utilised as a 1LoP barrier - See Article 11.2.1.

11.2.3 First line of protection: straights

The 1LoP barrier used will take into account the drainage, signalling and service road requirements and the nature of the ground, The 1LoP barrier will be placed along the outside edge of the verge.

The 1LoP barrier should normally be located not be more than 5m from the track edge on straight sections, unless specific conditions dictate that a greater distance is desirable, will reduce risks and is approved by CAMS.

The face of the barrier (exposed to the track) should be vertical, unless the verge rises from the track edge to the first line of protection, in which case the barrier face should be perpendicular to the plane of the verge.

In locations where there is significantly less than 5m available between the track edge and the 1LoP barrier, the issue must be considered by CAMS on a case-by-case basis

In area in front of the pit signalling wall, the 1LoP barrier may be located at a minimum of 2m from the track edge.

1LoP barrier alignment should be as straight as practicable over as greater distance as possible to reduce the overall angle of the 1LoP Barrier in relation to the track edge.

11.2.4 First line of protection (1LoP): interior of curves

The 1LoP barrier should be aligned parallel to the trajectory and as far from the track edge as the nature of the ground and the needs of the emergency services permit, in order to provide maximum vision along the track and "around the corner".

There should be a correctly overlapped access point in a suitable location at the interior of each corner.

After the exit of the corner it may be necessary to provide a deceleration/vehicle speed attenuation device in front of the barrier to aide risk minimisation of cars "spinning under acceleration to the inside" of the corner exit, however a gravel trap is not generally considered to be appropriate in these locations. See Article 3.10.1.

11.2.5 First line of protection (1LoP): exterior of curves

The location of the barrier on the exterior of a corner can be determined by the application of the methodology noted at Article 11.2.6

The 1LoP barrier should be a continuation of and installed in appropriate relation to, the 1LoP for both the preceding and following straights.

Between the track and the 1LoP barrier, a run-off area should be provided in which the speed of a car which has left the track towards the outside of a corner can be reduced to a stop - see deceleration systems in Article 11.2.2.

The run-off area should be delimited by a 1LoP barrier as defined in Article 11.2.1.

The run-off area may be used for the installation of a deceleration bed/gravel trap of gravel or a CAMS approved alternative material, or a paved braking surface, both of which are intended to slow down a car. (see Article 11.2.8 for Gravel Trap specifications, Article 11.2.9 for Paved Braking Surface specifications)

In all cases, the surface of the run off area should be in the same plane as the track surface, or inclined progressively upwards from it. (An inclined verge is preferable in the case of a gravel verge)

It is essential that the transition from the track, across the verge and into the run-off area should be made smoothly and be free of irregularities (bumps, steps, depressions, humps etc) likely to unsettle a car.

If there is an access road in the verge/run off area, it must be constructed so that any transitions of a car's path across the access road is made as smoothly as possible and should not be located within, or on the departure side of, any gravel bed.

The 1LoP barrier should be installed at the exterior boundary of the area. It should follow a continuous line, which may however include access points made as illustrated at Appendix 22 if deemed necessary.

On existing circuits, where the space available does not meet the requirements specified in Article 11.2.6, the use of a deceleration bed or paved braking surface placed close to the track-edge and in front of a stopping barrier may be approved CAMS.

On the entry to the corner, the Gravel Trap/deceleration system should normally extend both longitudinally and laterally up to the 1LoP barrier or the tyre buffer/energy dissipating device.

Openings for vehicle access and evacuation must be provided where necessary – Article 12.6.2.

Means should be provided for removing cars, immobilised during a race, from gravel traps/deceleration beds.

Only in those cases where the space available is insufficient to install an effective gravel trap/deceleration bed and tyre buffer system (as described above) or if it is considered by CAMS that there is adequate run-off area not to require a deceleration device, a 1LoP barrier by itself may be used on the exterior of a curve. However, such cases are normally only accepted where the corner is taken at a moderate constant speed or under acceleration.

In all cases where the likely impact with a 1LoP barrier is greater than approximately 30 degrees, the use of energy dissipating devices may be recommended.

Notwithstanding that a barrier or section thereof meets all requirements and irrespective of the likely impact angle, the use of (tyre) buffers may be required by CAMS in any situation.

Advice in relation to design and construction of tyre buffers is offered at Appendices 16 and 17.

In exceptional cases, where the situation dictates it, an escape road may be acceptable at the entry to the curve as a component of the deceleration system.

11.2.6 Location of First line of Protection (1LoP): exterior of curves

See also Appendix 19.

The dimensions of the run-off area on the exterior of a corner should be calculated according to the following formulae, based on the deceleration of Formula One cars on asphalt and gravel from the point of loss of control on the track; adjustments to these dimensions may be made, for varying run-off area surfaces and in consideration of the categories of cars using them, in consultation with CAMS.

Note: the table at Figure 19.1.2 may be used to obtain approximate dimensions rapidly, for designing new circuits or modifying existing ones, once the speed at any given point on the trajectory has been calculated and the distance along the tangent to the trajectory from that point to the track edge measured.

The tangents to the car's ideal racing line, simulating possible trajectories of the car in case of a loss of control – See Figure 19.1.1 -, are termed “escape lines”. All the escape lines in a corner should be included within the limits of the run-off area. The length of each escape line is calculated in two steps:

- Step 1: deceleration on-track On asphalt, the car decelerates at a non constant rate γ depending on its instant speed along the escape line: $\gamma = 0.89 + 0.0057.V$ with γ in g V in kph. Owing to this rate γ , the speed at which the car leaves the track is deduced from the speed at which the car loses control.
- Step 2: deceleration off-track – In gravel, the car decelerates at a non constant rate γ depending on its instant speed along the escape line: $\gamma = 0.70 + 0.0030.V$ with γ in g V in kph. This deceleration rate is applied in respect of the speed at which the car leaves the track as calculated in step 1.

The escape line lengths are calculated so that the speed of the car is zero at the outer boundary of the run-off area. – On a paved braking surface, the value for the rate of deceleration γ in Step 1 is maintained.

The escape line lengths are calculated so that the speed of the car is zero at the outer boundary of the run-off area.

Whilst this formula is preferred for new circuits and for significant upgrades of existing circuits, it can only be used effectively when an accurate speed of the cars at any given point on the circuit is known or is calculated.

11.2.7 Previous formula for calculating the location of First Line of Protection (1LoP)

A previously used formula, on which most currently licensed tracks in Australia have had their run off areas determined, and which takes into account only two speed variables (entry and corner speed), has shown to produce similar results and can be used to offer a circuit designer a relatively quick and simple process for determining approximate values of escape lines. It is based on the following:

The location of the 1LoP barrier should be at the edge of a shape of which is determined by the application of the following formulae, using the trajectory/racing line as a datum.

- a) Extending along the tangent to the track edge, from the beginning of the point of divergence from the previous straight of the trajectory/racing line through the corner (“the turn in point”), extending over a distance at least equal, in meters, to:

$$\frac{V^2}{300}$$

Where: V is the greater of:

- i. the average of the maximum speed attained on the section of the track preceding the corner and the speed of entry into the corner, or
- ii. the speed of entry into the corner, expressed in km/h.

This distance will be referred to as D1.

- b) Then connecting the end of a number of lines, where such lines are drawn at any point tangential to the trajectory/racing line, (such lines should be drawn at least at 10 degree increments from the turn in point) through an arc of up to 80 degrees from the turn in point into the corner. The length of each line must be measured from the track edge and be at least equal to "the braking distance".

The "braking distance", in meters, is calculated using the formula:

$$\frac{V^2}{340 \pm (260 \times i)} \text{ metres,}$$

Where: V were is the maximum speed in the corner in km/h and i is the gradient in percentage and is -ve for a down grade and +ve for an up grade.

This distance will be referred to as D2.

See Appendix 19 for further explanation and examples.

11.2.8 Specifications – Deceleration beds (gravel traps)

A Deceleration Bed/Gravel Trap is defined as a run off area of a track which incorporates a bed of a specified type of gravel, designed specifically to slow the progress of a car entering it.

Gravel traps are generally located so they extend from the "head on" position on the outside of a corner to a point towards the end of the curve.

The installation of gravel traps on the inside of corners is permitted only after consideration by CAMS of a risk assessment to be prepared by the venue operator as such installations tend to result in unfavourable outcomes, as cars tend to enter gravel traps on the inside of corners with a significant yaw rate, which encourages rollovers.

In all gravel trap installations, tyre buffers or other energy dissipating devices approved by CAMS should be used to face the 1LoP at the rear of the gravel trap, according to the directions of the inspector in each case.

Deceleration beds should have a minimum depth of 250mm, and should be composed of either spherical, river-washed stones or an approved equivalent having a diameter of 5 to 15mm preferably of uniform size (note: crushed stone is not acceptable), or an alternative approved by CAMS.

Care should be taken to prevent the growth of vegetation, which produces undesirable binding. For each event the gravel bed should be turned over/scarified to ensure that it has not become compacted. In all cases, the surface of the run-off area should be in the same plane as the track surface, or inclined progressively upwards from it (preferable in the case of gravel).

It is essential that the transition from the track, across the verge and into the run-off area should be made smoothly and free of irregularities (bumps, steps, depressions, etc.) likely to unsettle a racing car.

If there is an intervention vehicle access road in the area (Article 12.6), it should be made in complete respect of the foregoing and should not be situated within, or immediately downstream of, any gravel bed.

11.2.9 Specifications – Paved braking surfaces

A run-off area may incorporate a paved section adjacent to the racing surface or behind the verge, to enable a driver to regain control of his car or slow it down.

The paved braking surface should be constructed to the same standard and be composed of similar, non-flammable material as the track surface. It must be in the same plane as the adjacent track surface and free from undulations which could unsettle a car.

The paved braking surface should not be located so as to enable drivers to gain an advantage.

The skid resistance value should be at least that of the track surface, wet or dry, and be maintained to the same standard.

Any advertising on or decoration of the surface must be effected such that there is no lessening of this value.

11.2.10 Second line of protection (2LoP)

In general, this will normally consist of reinforced wire fencing as defined in Article 12.2.10.1, although other materials and/or specification may be approved by CAMS.

2LoP may be omitted with the agreement of CAMS if the public enclosure is situated high above or at a great distance from the track, as in Article 11.2.10.2 below.

Where openings are required in the 2LoP, e.g. for track access by marshals, they should be constructed in accordance with the conditions of Article 11.2.10.3

11.2.10.1 Reinforced wire fencing

Reinforced wire fencing, or debris protection, is required for all new circuits. As of January 2012, CAMS is working in consultation with Circuit Operators to determine minimum specifications for design and location criteria for existing circuits.

Specifications of the reinforced wire fencing as suggested by the FIA are enclosed at Appendix 29.

In any barrier or fence which restricts access to and from the track, suitable access points for marshals must be provided.

Alternative systems to those noted in Appendix 29 may be used, subject to the approval of CAMS. Although the reinforced wire fencing may be situated immediately behind or above the first line of protection, the maximum permitted distance between the two will be decided for each case individually.

Where the fence is on the same level as, and no more than 1500mm behind, the first line of protection (1LoP, 1000mm high barrier), the wire netting and cables may be omitted up to a maximum of 800mm above ground (to allow the passage of marshals beneath), provided that this does not affect the integrity and resistance of the rest of the fence.

The 3LoP barrier (fencing for retaining the public) must be retained and it must be located at least 3m behind the reinforced wire fence.

In determining the locations for debris fences, the following criteria should be taken into consideration in determining areas of a race track where the protection to spectators may be enhanced by the addition of debris fencing:

- Areas where greater than normal likelihood of wheel-to-wheel contact between cars, particularly open wheel cars, exists
- Areas where vehicles attain high speeds and then have to rapidly slow for an approaching a low-speed corner e.g. approach to the corner
- Areas following where vehicles attain high speeds and then have to rapidly slow for an approaching a low-speed corner. e.g. straight ahead and around the corner
- Areas where competitive overtaking opportunities exist (as opposed to vehicles passing other vehicles whilst the slower vehicle is being lapped or is travelling slowly).
- Areas which represent a greater than normal possibility of vehicles "digging in" and overturning in gravel traps.
- Pit signalling areas
- Areas where the public are located close to the track in sustained high speed areas, either along straights or on the exterior of corners

11.2.10.2 Locations where 2LoP may be omitted

Should the first row of the public enclosure be situated on top of bank at a height in metres equalling more than 1/75 of the speed attained on that part of the circuit, expressed in kph, the minimum height being 2.50 m above the level of the track edge, and the face of this bank presents an minimum angle of at least 45° to the horizontal, this definition may be considered as a second line of protection, the fence retaining the public being at least 3 m behind this protection and 6 m from the track edge.

It may also be possible to omit the second protection in cases where the public is situated very far away from the track. The distance required will be decided for each case individually by CAMS.

11.2.10.3 Openings in the 2LoP

The following dimensions, which reflect real time installations throughout the world are provided for guidance. All openings in relation to location and size at permanent circuits must be approved by CAMS. In addition, it may be necessary to provide additional protection at the rear of the opening to assure protection of persons behind e.g. spectators.

Type of likely access	Vertical opening dimension	Horizontal opening dimension	Height above ground of the lower extremity
Marshal Signalling	600mm	300mm	1000mm
Driver exit/marshal access	1000mm	600mm	0 (if debris fence is behind 1LoP), 1000mm otherwise
Driver exit	600mm	1000mm	0 (if debris fence is behind 1LoP), 1000mm otherwise
Photographers openings	250mm	400mm per person, max 5 windows adjacent to each other	1400mm

The openings should ideally be boarded by rigid metallic frames, finished with no abrasive edges, with if necessary a profile at top and bottom which fits the fence cables (e.g. 10-15mm channel).

Openings designated for photographers or videographers may be fitted between the cables. See example at Appendix 29, Figure 29.3.

For circuits employing cable reinforced fencing, the strength of the exit/entry frame should be such that the affected cables can be attached to either side in order to maintain the tension of the cable systems, e.g. as illustrated in Appendix 29, Figure 29.3.

Fence netting must be securely attached all around the frame with no loose ends or intrusions within the window.

Whether the design is based on that of a FIA Cable reinforced debris fence, wire mesh debris fence panels or other types of fencing, the frames must be integrated and supported in such a way as to maintain the original design resistance of the particular construction. In all cases they must be firmly attached to the structure supporting them.

The driver exit frames should be painted in the same "dayglo" orange colour as access points (as specified in Article 12.6.2) and indicated on the track side with a sign fixed to the fence above them, for example as illustrated in Photo 29.17

All vehicle access/exit points should be marked with "fluorescent" orange paint (recommended colour reference: Pantone 15-1364 TC "Orange crush") so they are able to be identified by drivers on the track.

For access/exit openings to or from the circuit designed only for personnel only, the barrier should be painted in the colour specified above, to a height of 1000mm from the ground and for a distance of 500mm on the immediate approach side of the.

11.2.11 Third Line of Protection (3LoP)

This is also referred to as Spectator Fence.

All areas designated as being suitable for the public must be separated from the rear of the 1LoP zone by at least a system of third line of protection (3LoP). This must be a metallic fence or other equivalent structure at least 1200mm high. This will ensure that at all times the public will be situated behind at least two lines of protection. 1LoP and 3LoP is the minimum required and in areas which may be considered hazardous to spectators they should be separated from the track by 1LoP, 2LoP and 3LoP barriers.

The 3LoP barrier should be situated:

- at least 3m clear of the first or second line of protection (whichever is the closer to the spectators)
- In all cases, at least 6m from the track-edge.

11.2.12 Obstacles

It is a generally accepted principle that track verges and run-off areas must be free of obstacles.

However, it may be not feasible for marshal/observation posts or other immovable obstacles not to be placed in track verges and run-off areas. In these cases, as a general principle, the verge should be reduced so that the obstacle can be protected by the first line of protection (the barrier is moved closer to the track edge than would be normally accepted) however, each individual case should be considered separately to find the best solution.

There must be no obstacle or observation post on or in front of the first line of protection, or closer than 1000mm behind it, unless specifically authorised by CAMS.

In cases where hazardous obstacles or terrain (such as ditches, escarpments, rocks, trees, etc.) are located immediately behind the first line of protection, additional protection devices may be required.

Bridges or other overhanging objects such as signs etc must have a minimum clear height of 4 m over the track or include some form of risk minimisation.

Verges under a bridge should be at least 3 m wide unless otherwise approved by CAMS. Where the track layout creates any restriction on driver vision e.g. a hump in the road or a corner, the bridge structure should not further reduce driver vision.

11.2.13 Protection of Access Points

Any opening in the first or second line of protection system should be affected so that:

- a) The barrier following the opening forms an angle of maximum 3° (1 in 20) with the general line of the protection;

- b) A straight line passing through the extremities of the barriers preceding and following the opening forms an angle of minimum 90° with the tangent to the cars' trajectory, where this tangent diverges from the edge towards the opening. This will ensure a sufficient overlapping of the preceding over the following barrier to protect the opening;
- c) additionally, and where practical, the barrier following the opening further should extend on the approach end for a distance equivalent to the width of the opening itself. For non-permanent barriers forming non-permanent or alternative circuit installations, a reinforcement (spreader bar) to maintain the opening in case of impact may be necessary.

Appendix 21 illustrates an opening for the entry of a service vehicle or withdrawal of a car from the track; the dimensions of personnel passages should be adjusted appropriately.

11.2.14 Tyre Buffers (see also Appendix 15)

Tyre buffers are an effective means of dissipating the energy of a vehicle in the event of a car to barrier collision.

Tyre buffers should not be used where the normal trajectory of the vehicles is parallel to or at a low angle (e.g. less than 30 degrees) to the barrier. In all cases the installation of conveyor belt facing will improve the performance of tyre buffer systems.

Tyre buffers should use the vertical pile or "barrel" method of stacking. The tyres forming each vertical *stack* should be securely fastened to each other, as should adjacent *stacks*, to form a tyre *bundle*.

Three methods of fastening are recommended (see Appendix 15). Where possible, it is recommended that several tyre *stacks* be fastened together, to form a tyre *bundle*.

After positioning, these *bundles* should be secured to each other and also to the first line of protection by means of bolts, cable or chaining or as approved by CAMS, to form an integrated buffer.

All tyre buffers should be at least two rows deep, with more rows being recommended for the ends of run-off areas.

Tyre buffers should be high enough to completely cover the first line of protection against which they are stacked.

All buffers should be composed of passenger car tyres of uniform size. Light Truck tyres or Race car tyres (slicks) should not be used as the deformation properties of these tyres are generally incompatible with progressive load absorption and energy dissipation required for this purpose.

12 Circuit Installations

12.1 Start and Finish

12.1.1 Start and finish line

The positioning and equipping of the start line, starter's platform and starting lights, will be decided in consultation with CAMS, as will that of the finish and timing line ("the Control Line") if different from the start.

The start line will be 15 to 30 cm wide, painted across the track, with anti-skid paint, 1 m in front of the Pole Position.

There should not be more than 25 m from the start line to the starting lights.

The starter's platform should be in a position close to the starting line, from which the starter can see the complete starting grid area between the barriers and which should be visible to all the drivers, in closed or open cars.

A position 3 or 4m above track level can typically achieve this, with a sight line from the car in pole position not exceeding 45° to the track centre line. It should be protected from debris coming from the direction of the grid.

Recommendations concerning the starting lights are given in the CAMS Manual of Motor Sport, Appendix H to the NCR at Articles 4 and 5.

12.1.2 Starting grid

The width of the track for the starting grid should be at least 12m, or 15 m for new circuits; this width must be maintained up to and through to the exit of the first corner (as indicated by the racing line).

For a standing start, the grid should be arranged in the following manner:

The Pole Position will be specified on the circuit licence. It will be 1 m behind the start line, normally on the side of the track on which is the "racing line".

A box as shown in Appendix 24, Figure 24.1 should be painted on the track, with antiskid paint, for each car; an optional yellow driver's sighting line may be to the left or right or both.

Figure 24.1 shows the approved CAMS grid design, compulsory for all National Circuit races in Australia.

The spacing between consecutive cars (front of one to front of next) should never be less than 16m

12.2 Pit Area

12.2.1 Location

The pits and pit area - see Appendix 22, including entry and exit lanes, should as a rule be located along a straight line or on the inside of a large radius curve allowing full visibility.

Moreover, the intersections of the entry and exit lanes with the track should be so located as to avoid any interference between the path followed by incoming or outgoing cars and the path followed by the cars racing on the track.

12.2.1 Pits

In all cases, the pits installation must be studied with the Circuits Commission.

12.2.1.1 Facilities for international events

A pit in its simplest form is a paved area adjoining but distinct from the pit lane, from which team personnel operate during a practice session or race.

For circuits approved by the FIA for international events, this will normally entail a robust structure providing partitions between each team and shelter from the elements, although different, traditional interpretations may be approved for particular types of racing. For permanent circuits the structure would be expected to take the form of a building containing secure garages with basic services, including waste oil disposal.

Each pit should have a length of at least 4m and the number of pits should be at least equal to that of the cars in the race. The partitions between pit units should be mobile. On each circuit the number and length of pits can be established on the basis of the number of cars allowed to start in all categories of races for which the circuit is intended (see Appendix 28).

Where there is a pit garage, it should have a front door or opening at least 2.5m wide, and a rear door.

Behind the pits a free space should extend back at least 30m, reserved for team vehicles and equipment and paddock pedestrian and vehicle traffic.

12.2.1.2 Example of a modular pits unit

The model unit (See Appendix 24) will be used by the FIA as an example for comparison when evaluating pit facilities for FIA circuit championship events. The final pit design of pit garages for any Australian circuit must be made in consultation with CAMS and the promoters of the championships concerned. The model is conceived so as to provide pits for large and small teams by moving the partitions.

- Area: each pit is at least 7 m (pit lane frontage) x 18 m (depth) from axis to axis.
- Ceiling height: minimum 3 m
- Doors: should be in articulated sections but not roller shutters. Widths at least 6 m on the pit lane side and at least 3 m on the paddock side. Height at least 2.75 m. There should be a small door within each main door to enable the team direct pit lane or paddock access without opening the whole door.

- Services: mains electricity and water; internal telephone/ TV as required.
- Sanitation: 1 toilet block per pit.
- Partition: the pits are separated with removable elements (pre-galvanised steel structures recommended).
- Recommended disposition: construction in groups of six units (which can be divided into 2, 3 or 6 pits) with personnel/ services access between blocks and 36 pits in total, excluding the scrutineering bay.
- Scrutineering Bay: 3 pit units, but including an office of approx. 12m². and situated at the beginning of the pit lane. For circuits where a number of major teams from overseas will be competing in the principal events, an additional office and hospitality area may be situated adjoining or close to each pit, recommended size between 250 and 270m².

12.2.3 Pitlane

The pitlane in front of the pits should have a minimum width of 12m.

The pitlane shall be divided into two lanes.

The lane closest to the pit wall is designated the "fast lane", and the lane closest to the garages is designated the "working lane".

The working lane should be as wide as possible, fuel resistant and have similar anti-skid properties to the track.

There should be at least 4m of free height above the working area.

The fast lane should be 3.5m wide, save as otherwise authorised by CAMS.

The two lanes should be divided by a white line at least 150mm wide. All markings should be affected with anti-skid paint.

The only area where any work can be carried out on a car is between the beginning and the end of the pitlane, which must be defined by CAMS inspectors and marked with white lines across the pitlane.

12.2.4 Pit wall and Signalling platform

A platform intended for pit signalling should be built between the pitlane and the verge of the track. The verge may be reduced to a width of 2m along the pit signalling platform area.

This platform should be at least 1200mm wide.

For all new circuits intended for Formula 1, the signalling platform should be at least 1700mm wide with the 50cm closest to the pitlane marked and kept free for circulation and emergency access; this measure is recommended for existing circuits.

Unless the platform stands at least 350mm above ground level it should be protected, towards the pitlane, by a 350mm high barrier (concrete, or guard-rail without ground clearance).

On the pitlane side of the platform, there must be a handrail or barrier minimum 1000mm high, normally in 3m sections with 1000mm wide access gaps. Towards the track there must be a barrier at least 1000mm high above the level upon which the signaller stands, consisting of a concrete wall, at least 1350mm high above track level, and built to the specifications detailed in Appendix 10 at Article A10.4.

If required this may be extended in height by the addition of a transparent shield designed to prevent debris from an accident on the track penetrating the pit area. It should be at least 2.5m above track level and 2.0m above the level upon which the signaller stands.

The debris shield will normally consist of a mesh fence or laminated glass screen (for which a matt finish may be advisable), calculated to provide protection at least equivalent to the specification given in Appendix 29. Its supports should be either integral to the wall or fixed to the signalling platform side face of it. In front of each pit, or at least every 7m, there should be a 500mm wide break or a window 500mm wide and 1000mm high, for the passage of signalling boards (if signalling is normally done from the pit wall).

These gaps may be effected by angling the adjacent sections of debris shield so as to obtain a protective overlap relative to the direction of cars approaching on the track.

On circuits where the starting procedure will take place in front of the pits, there should be one or more gates in the pit wall, for removing stalled cars from the track to the pit lane. The gates should be in the same plane as and flush with the wall surface and as strong as the first line of protection.

The pit wall should normally be extended by at least 25m at both ends, i.e. beyond the first and last pits.

At the pit lane entry, the protection of the platform should be extended by a guard-rail terminating with a semi-circular section of 1m diameter. In front of this termination, a multi-row tyre buffer faced with conveyor belt or another energy absorbing device is recommended to be installed to minimise the consequences of a direct impact.

12.2.5 Pit entry road

The pit entry road should have a length at least equal to the distance necessary for the fastest car to decelerate from the maximum speed attainable on the track at the point where it enters (intersection point), to a standstill before the first pit.

The entry road should form an angle of 3 to 5 degrees with the track at the intersection point. Its width should increase gradually from 5m at this point to the pit lane width at the point where the entry road joins the pit lane.

The longitudinal profile of the entry road should be graded to the pit lane as specified in Article 10.3.1.

Figure A16.1 shows a pit-entry road designed with a chicane to protect a vulnerable guard-rail terminal and to prevent a car out of control on the track from directly penetrating the pit area. However a chicane is not required on the entry road unless the location of the pits does imply such dangers.

The maximum speed permitted for any vehicle in pit lane is 40 km/h.

The commencement of the speed restriction zone should be clearly marked with a white line across the road, sufficiently in advance of the first pit, with a sign indicating the limit applying.

The entry lane should preferably be visible from the first pit space/garage to the point where the cars leave the track; visibility should in any case be ensured over at least 50m before the first pit space/garage.

The first line of protection, as specified in Article 11.2.1, should be continued along the entry road, up to the first pit space/garage.

12.2.6 Pit exit road

The pit exit road should be long enough to allow the outgoing cars to attain at least 70% the speed normally attained by the cars racing on the track, at the intersection point.

The trajectory of cars leaving the pits should not coincide with that of cars on the track.

The exit road should form an angle of 3 to 5 degrees with the track at the intersection point.

The width of the pit exit road should decrease gradually from the width of the pit lane to 5m at the intersection point.

The longitudinal profile of the exit road should be graded to the pit lane as specified in Article 10.3.1.

The first line of protection, as specified in Article 11.2.1, should be continuous along the inside of the exit road from the last pit space/garage.

The cessation of the pit lane speed restriction zone should be clearly marked with a white line across the road and the international road sign of a white disc with black diagonal indicating the end of a limit.

Red and green lights, must be installed at a point prior to the end of the protection and between the exit road and the track. The lights must not be visible to the cars on the track.

Other markings and signals will be as specified in consultation with CAMS.

12.3 Paddock Area, Competitors Support Area and Scrutineering areas

All adjoining areas to the pits and pit lane, including the paddock area and service roads used by competition cars, should be paved and secure from the general public.

The area should be of adequate size to house at least 6 times the number of cars which will be entered in an event. The area should be secured from the spectator area and general public and be located on as level surface as is possible. If area permits, separate areas should be provided for competitor's vehicle trailers to be unhitched and parked for the duration of the event.

Within the paddock, an area must be set aside for the use of the scrutineers. This should include a level, covered section for the examination of vehicles and provision for the installation of weighing equipment and document checking.

An area should be set aside for unloading/loading of competition cars onto trailers. This is a high risk area of a venue, as operations are undertaken here which have the potential to cause serious injury and the area is not generally controlled by officials.

This area must be:

- delineated by easily visible devices, signed appropriate to restrict the area to persons actually engaged in loading/unloading cars,
- smooth and level and present a solid non-slippery surface and
- be located in such a position that there is adequate room for a large 4WD vehicle and a tandem trailer to park and provide at least 5m space between the rear of the trailer and the front of the car being loaded/unloaded.

It is recommended a tyre buffer be installed in an appropriate position in order to minimise damage and/or injury and subsequent disruption if a car "rolls off the back" of a trailer.

12.4 Observation Posts

These areas are intended to provide Officials with the necessary facilities to safely perform their duties, including track supervision and flag marshalling during the events.

In their simplest form these areas will be adjacent to the track and should provide

- a sufficient stabilised area for officials to perform their necessary duties
- shelter from the elements for the officials
- a location behind a 1LoP, and be constructed so that marshals in their normal working position operate behind a 1LoP and if required a 2LoP.

12.4.1 Number and location

These will be determined for each circuit in accordance with the CAMS National Competition Rules, Appendix H, Article 2 (i) and the characteristics of the subject circuit, bearing in mind prevailing light and weather conditions and ensuring that :

- no section of the road may escape observation;
- each post can communicate by sight with the preceding and the following one;
- the distance between consecutive posts shall not exceed 500m.

All main posts must be located at an opening in the protection system as specified in Article 12.6.2.

Each post must be marked by a sign-board bearing a number of the location (as determined using the concept of 0.0 at the start line and adding the percentage distance to the next turn. I.e. 0.5 LH indicates a location halfway between the start line and turn 1 on the left hand side. 4.8 RH indicates a right hand location 80% of the distance between turns 4 and 5). Location sign boards must be clearly visible from the track. It is suggested they be black numerals on white background, with the height of numeral being at least 250mm.

CAMS must approve the locations and any subsequent modification in number and/or location of the posts.

12.4.2 Protection

The posts should be situated so that only in case of an incident should their staff be compelled to operate unprotected. The posts should have the same type of protection as provided for the public - see Article 10.2. In addition, for all new tracks, 2LoP (debris protection) must be provided for all trackside marshal posts

Where this is not practical, due to the distance from the track, bad visibility or other hindrance, the minimum protection acceptable for the flag marshals will be as defined in Article 11.2.12.

However, the remaining staff of the post must always be behind a first line of protection barrier.

12.5 Race Control Post

Race Control or Event Control Centre is considered to be the centre of competition supervision and direction and should normally provide the Clerk of the Course and his assistants with all facilities necessary to perform their duties in suitable working conditions.

Ideally it should be a "soundproof" room accessible only to the necessary staff.

Race control should normally be located in a building as close to the start line as possible and no more than one floor above ground level and have an independent exit to the track or pit lane. For all new circuits locating the race control room at one end of the pit buildings will be compulsory.

In order to have maximum visibility over the track and the pit lane, the room should project from the line of the pit buildings.

All communications systems used in an event should be centralised in this room.

Facilities for the management of the event in race control should include:

- a) A hard wired or secure radio communications system to enable duplex communications between Race Control and all trackside marshal posts, appropriate officials and emergency vehicles;
- b) Access to a telephone connected with the public network;
- c) A microphone connected with paddock and general public address systems;
- d) A large plan of the track showing the location of all marshal locations and safety services.

12.6 Service Roads and Access Points

The efficiency of the emergency service (See Article 15) requires an adequate number of vehicle holding areas behind the first line of protection, access points to the track and service roads, to enable the emergency vehicles to reach, unimpeded, any point of the track and the

medical centre and the exits from the circuit as quickly as is consistent with the efficient intervention of medical, fire and extrication services in an accident on the track.

NB: Facilities for emergency services destined for public areas should respect the civil in the relevant State of the circuit.

All vehicle access/exit points should be marked with "fluorescent" orange paint (recommended colour reference: Pantone 15-1364 TC "Orange crush") so they are able to be identified by drivers on the track.

- For access/exit openings to or from the circuit designed for vehicles, the barrier should be painted in the colour specified above, to a height of 1000mm from the ground and for a distance of 2m on the immediate approach side of the opening
- For access/exit openings to or from the circuit designed only for personnel only, the barrier should be painted in the colour specified above, to a height of 1000mm from the ground and for a distance of 500mm on the immediate approach side of the opening.

12.6.1 Service roads

Any service roads must be situated behind the first line of protection or, where practical, behind the second line of protection.

Considering that generally more run-off areas are required on the outside of the track, it is usually more convenient to situate this road on the inside, particularly if the paddock and medical centre are on the inside.

Service roads should be reserved exclusively for emergency vehicles and be connected to other roads leading to the medical centre and the exits, at points chosen to reduce to the minimum the distance to be covered. These roads should be kept as free as possible from other traffic.

All roads of the service network should be wide enough, or provided with lay-bys, to permit emergency vehicles to pass each other.

At access points to the track, sufficient space should be allowed for vehicles to turn into and out of them.

The exit from the interior of the circuit should be affected by bridges or underpasses.

12.6.2 Access points and roads

Along the track sides there should be access points to allow the entry and evacuation of vehicles and/or personnel.

The location of these access points should be established in consideration of the track layout, service roads, observation posts and other installations.

Any service roads must be situated behind a 1LoP barrier if they are to be used whilst competition is in progress. At all times they should be kept as free as possible from other traffic.

Roads permitting intervention vehicles access to run-off areas or to the track may be necessary, if this is the case they should comply with the requirements of Article 11.2.5

Where the requirement for access results in an opening in the protection systems, this should be affected as specified in Article 11.2.13

All vehicle access/exit points should be marked with “fluorescent” orange paint (recommended colour reference: Pantone 15-1364 TC “Orange crush”) so they are able to be identified by drivers on the track.

- For access/exit openings to or from the circuit designed for vehicles, the barrier should be painted in the colour specified above, to a height of 1000mm from the ground and for a distance of 2m on the immediate approach side of the opening
- For access/exit openings to or from the circuit designed only for personnel only, the barrier should be painted in the colour specified above, to a height of 1000mm from the ground and for a distance of 500mm on the immediate approach side of the opening.

12.7 Permanent Medical Centre

Further information in regard to Medical Services at Race Meeting is available in the CAMS Manual of Motor Sport – General Requirements – Medical Services. The following is a summary of the minimum physical requirements deemed necessary for a medical facility at a race circuit.

Additional requirements are imposed for National and Major National Championship and International race meetings.

Requirements for Medical Services at International Race Meetings are contained in Article 2.7 of Appendix H to the International Sporting Code (See www.fia.com)

The following is a précis of the salient information contained in the CAMS General Requirements – Medical Services

12.7.1 Medical Centre

A Medical Centre must be provided at each circuit. It may be a permanent or a temporary building or a combination of both. It must be readily accessible from the track and have ready access to public roads for subsequent transport of patients to hospital. It must be so situated to ensure security and privacy. Generally a secure location adjacent to the Pit Entry road and accessible from the circuit via the Pit Entry road is preferable.

The Medical Centre must be so constructed that patients on stretchers can be readily taken into and out of the centre and must contain adequate space and an appropriate clinical environment for further assessment, treatment, stabilisation, and preparation for transport. It must include climate control, specialised lighting and hot water supply.

The Medical Centre must be also able to accommodate ambulatory patients and have facilities for the assessment of fitness to compete.

Communication facilities for the Medical Centre must include radio communication with Race Control and with trackside emergency services. A direct telephone line for contact with the receiving hospital must be provided.

12.7.2 Personnel – Medical Officer/s

At each meeting at least one medical practitioner who is registered in Australia shall be appointed and on duty during any track activity.

A medical practitioner shall be appointed as the Chief Medical Officer (CMO) for each event. The CMO shall have full responsibility for the organisation and operation of the medical services.

At each meeting of Major National status there shall be at least two medical practitioners appointed.

For an international meeting, refer to Article 2.7 of Appendix H to the International Sporting Code (See www.fia.com)

12.7.3 Personnel - Paramedical

Initial trackside response may be provided by paramedical personnel, qualified in Advanced Life Support, who are authorised by a statutory authority to initiate advanced life support treatments.

In all cases, the CMO shall be responsible for the deployment and operation of the medical services under the authority of the Clerk of the Course.

Paramedical personnel are not authorised to determine medical fitness to compete.

12.8 Constructions in front of the First Line of Protection

Overhead structures extending in front of the first line of protection, with the exception of distance sign boards on the verge as described in Appendix 20, must be certified by an engineer as complying with the relevant standards of strength and stability.

Bridges and any structures overhanging the track must have a minimum clear height of 4m above ground.

The verges under a bridge must be at least 3m wide unless specifically permitted by CAMS.

Where the track layout creates any restriction of visibility by the driver of the track ahead, the structure should not further reduce that visibility.

12.9 Constructions behind the First Line of Protection

Any structure behind the first protection should be at least 500 mm from the most rearward portion of the barrier and it must not obstruct the passage of officials or emergency services in any way.

Should a structure be positioned so that it could, if it fell, cross a 1LoP barrier, it should have additional stays behind it to prevent this.

12.10 Advertising

Advertising structures (signs, hoardings, banners etc) should be stable and secure. Location and characteristics of advertising should be such as not to interfere with drivers' and officials' visibility and not to produce an adverse or misleading optical effect (e.g. bewildering repetition of brightly contrasting posters; badly placed hoarding inducing misjudgement of the road layout, sign colours matching flag signal colours etc.).

All advertising between the track and the first protection barrier, including on the face of concrete barriers and/or guardrail, save as specifically otherwise approved by CAMS, must be either painted (on the barrier, buffer or verge) or in the form of adhesive posters which in particularly in the case of guardrails, follow exactly the contours of the barrier.

The use of banners or corflute or sheet steel or similar signs attached to the track side of the 1LoP are forbidden unless specifically authorised by CAMS.

The use of lightweight, flexible panels fixed to the front of the first line of protection, but not extending above it may be authorised only in areas that are far from the track and where impacts will in all probability be perpendicular to these structures. The use of advertising panels is prohibited on barriers parallel, or near parallel to the track and/or to the trajectory of the racing vehicles. Any such installations may only be approved by CAMS.

Any other form of advertising between the track and the 1LoP barrier must be individually approved by CAMS (see also Article 12.12)

For overhead structures (e.g. cantilever signs, overhead sign, or "bridges") extending in front of the first line of protection (with the exception of distance sign boards on the verge as described in Appendix 16) each design and installation must be certified by a professional engineer as complying with the relevant and appropriate standards of strength and stability.

12.11 Advertising on the Track Surface

No advertising or decoration is permitted on the track surface, save in an area near the start/finish line, where advertising may be permitted on the following basis:

- The location, size and design of the sign (artwork) must be approved by CAMS.
- The paint used must be of a CAMS approved anti slip compound.
- The sign must be in a location where there are no lateral or braking loads on cars in wet or dry conditions.
- A plan for the removal of the sign, if and when, it is no longer required

For guidance, the sign should fit into an area no greater than approximately 4 x 9m, which should not extend more than 10m from the start line. It is preferable that the sign lettering be undertaken in outline, rather than solid lettering, however due to the variable nature of the circuits' widths and the actual signage, this will be addressed when considering the artwork.

No advertising or decoration is permitted on the track surface, save within 5m of the start or finish line, where advertising may be permitted on the following basis:

See also Appendix 25 – Starting Grid Layout.

Any advertising on or decoration of the surface of a paved run-off area must be effected such that there is no lessening of its skid resistance value.

12.12 Advertising on Verges

See also Appendix 20.

Any advertising in front of the first line of protection, including any buffer and buffer facing system attached to the 1LoP barrier, will be required to be painted on the verge/run off surface.

All other advertising between the track and the first protection barrier is prohibited, with the exception of advertising panels added for an event. The location of each such sign must be approved (a) by the Clerk of the Course, or (b) the appointed CAMS Race Director (if there is one so appointed by CAMS), or (c) alternatively, be agreed by CAMS.

They must be positioned so as to in no way obstruct the vision of marshals or drivers in race conditions.

They must not be positioned on the exterior or on either side of the exit, of corners and must not be situated less than 3 m from the track edge.

All such signs must be frangible and designed to break if impacted by a car into lightweight, harmless pieces but also to withstand the wind conditions in which racing may take place.

Non-flammable, expanded polystyrene or similar, maximum 100 mm thick, is generally acceptable. Under no circumstances will metallic sheet or other metallic materials or corflute (twin wall Polypropylene sheet) be permitted.

It is suggested that 38mm polypropylene conduit, located in the verge by suitable sockets be used to support the signs. Signs will be bored with appropriately sized partial-depth holes, into which the conduit is fitted. The bottom on the conduit is cut approximately 1/3 of the diameter immediately below the ground level to promote bending at the desired location to reduce a hazard should it be struck by a car.

Tethers must not be used; any articulations and ties should be in lightweight fabric.

13 Temporary Circuits

13.0 General Comments

The following recommendations are applicable to non-permanent circuits used for racing.

A non-permanent circuit is defined as a course temporarily set up for a specific event in the form of a continuous road or track, beginning and ending at the same point, of which the operation is restricted by non-racing activities and where the installations are wholly or partly removed between events.

All remaining paragraphs of Chapters 2 to 12 are applicable where not in conflict with the contents of this chapter.

13.1 Layout Requirements *(see also Article 10.1 and 10.2)*

13.1.1 Curves

A curve or series of curves uninterrupted by a straight, taken at a calculated speed in excess of 125kph or where the run-off area requirements of Article 11.2.5 are not fulfilled should have an increasing, or at least constant, radius.

13.1.2 Forward Vision

Wherever the length of track visible to the drivers is less than the braking distance of the cars from that point, adequate flag or light warning systems should be provided.

13.1.3 Track edges, verges and kerbs

Where local conditions make it practically impossible to have proper verges as specified in Article 10.4; verges can be part of the road surface and delineated by the white painted line marking the edges of the track.

Where the width of the verge is less than 3m particular attention is needed to providing adequate access points conforming to Article 12.6.2.

Footpaths not higher than 150mm above track level can be used as verges where the calculated speed does not exceed 120kph ; however

- the edge of the footpath must be chamfered to form an angle with the road surface not exceeding 25°.
- The kerbs required at those parts of the track where the trajectory is tangent to the verge as specified in Article 10.4 may be of a removable type, provided they are firmly anchored to the road surface.

13.2 Circuit Protection *(see also Article 11.1.1 to 11.2.7)*

13.2.1 First Line of Protection (1LoP)

Alternatively to the systems specified in Article 11.2.1, removable guard-rail or concrete block barrier systems (see Appendix 10), firmly located by gravity or anchored to the ground by any other approved method are also permitted, as a separate first line of protection (1LoP) or in combination with a second line of protection (reinforced fence), subject to prior approval of the design, by CAMS.

These systems must provide continuity and uniform resistance of their surface towards the track. The design must be calculated to provide equivalent performance to the designs specified in Appendix 10 and Article 11.2.10 et al and they should be employed as specified in 11.2.10.1.

On the exterior of a curve the prescriptions of Article 11.2.5 should be respected in the straight-ahead situation.

In the other parts of the curve, where the space available is insufficient and the calculated speed does not exceed 120kph or the car is under acceleration, the prescribed depth of the run-off area may be reduced on condition that adequate protection is provided by tyre walls or other energy absorbing devices. Article 10.4.1 (Verges), does not necessarily apply.

13.2.2 Second line of protection (debris fence) (see also Appendix 29))

Debris fencing is mandatory in all locations where, in the event of an incident, a competing vehicle or parts thereof could reach areas accessible to the spectators or the public.

It is also strongly recommended in areas of likely impact, and for the protection of trackside personnel.

The supporting posts may be mounted directly into the ground, or attached to the guard-rail supporting posts or concrete blocks forming the first line of protection.

The posts should be of heavy-wall tubular steel or equivalent, having a minimum outside diameter of 50mm and a minimum wall thickness of 5mm. The spacing between the posts should be not more than 2m.

The top of the fencing should be at least 2.5m above the track surface; at the top of the fence there should be an extension, angled towards the track at 45° to the vertical, so as to add 200mm to the height.

The fence should consist of steel wire mesh with a minimum wire diameter of 4mm in a 90mm x 90mm (approximately) chain-link mesh. The fence should be supported by at least three horizontal runs of multi-strand steel cable having a minimum diameter of 12mm, tensioned to at least 300kg/sq.cm.

Additional reinforcing cables may be necessary, depending on the position of the fence relative to the track and the speeds common at that point.

All cables must be securely clamped to the supporting poles and the ends anchored to maintain the tension. This may be achieved by triangulation of the end posts; such reinforcement may also be employed for other posts.

Alternative systems may be used, subject to the approval of CAMS and to the design performance being certified by a structural engineer to be equivalent to that of the above mentioned specifications.

13.2.3 Tyre Buffers *(see also Appendices 16, 17 and 18)*

Tyre barriers have been shown to be an effective means of absorbing the energy of a vehicle in the event of a collision, significantly reducing the severity of the impact and therefore the risk of injury to the driver and damage to the vehicle.

They should be installed wherever there is a risk of vehicles striking the first line of protection (guard-rail or concrete wall) at an angle greater than 20 degrees.

They should not however be used where the normal trajectory of the vehicles is parallel or tangential to the barrier.

13.3 Circuit Installations

The provisions of Chapter 12 should be respected even if of temporary construction.

13.4 Construction and Approval

CAMS will examine the circuit documentation, on the basis of the present guidelines.

Non-permanent circuits must be constructed to the same standards as permanent circuits excepting the derogations given above.

On each and every occasion a temporary circuit is constructed a mandatory inspection by CAMS will be necessary to ensure the detail agreed in the plans is replicated in the physical construction. Such inspections are usually held over a period of several days and will ensure that the CAMS appointed inspector becomes familiar with the circuit environs and will allow a time for corrections to the construction program where necessary to rectify areas of non-compliance.

In all cases, for all temporary circuit constructions, a formal inspection, attended by the CAMS appointed Track Inspector, the principal construction project manager and agreed senior circuit personnel, together with others as agreed, must be conducted in the afternoon, the day prior to the first on-track activity.

Members of the media will not be permitted to be included with the inspection personnel.

14 Races run entirely or partially at night

14.1 General

The following recommendations are in addition to those contained in Articles [1] to [5] and Appendix [H] issued by the FIA. (See www.fia.com)

Article 14.2 (below) describes the conditions to be respected for running circuit events at night for cars with lights conforming to normal road requirements.

Article 14.3 (below) concerns the safety of floodlighting systems installed for circuit events for cars without lights. If the track illumination is in conformity with an FIA Performance Specification, the precautions described in Article 14.2 should not be necessary.

For any races held at night which do not meet these requirements, specific approval must be sought from CAMS.

14.2 Recommendations specific to events run at night for cars with headlights

The preliminary condition is that the participating vehicles be fitted with the regulation lights.

In order to determine the compliance of the circuit and its services with the following conditions, the organiser shall submit to the FIA a general plan of the circuit, indicating all installations and arrangements, including a report illustrating in detail the services provided.

14.2.1 Distance sign-boards

For corners - see Article 9.4, the warning signs and signs marking the location and numbers of observation posts - see Article 12.4 should be illuminated or reflective, but should not conflict with the normal race signalling.

14.2.2 Lines painted on the track

The line along the outside edge of corners, from the start of the braking area, should be reflective. Kerbs, if any, should also be painted with reflective paint for at least 2.5m on the approach end of each kerb.

14.2.3 Signs on vertical surfaces

Reflective signs should be placed on the shoulders of bridges and on fixed obstacles adjacent to the track which reduce the verge width (observation post protections, beginning of narrower parts and similar obstructions).

14.2.4 Illumination of service areas

The paddock, pits and service areas should be sufficiently illuminated but the light sources must on no account disturb the racing drivers.

The pitlane should be lighted by fixed, non-adjustable overhead lights and the entry and exit guard-rails to the pitlane and, in particular, the start of the protection for the signalling platform should be provided with reflective surfaces e.g. "cat's eyes" or be painted with bands of reflective paint.

14.2.6 Prevention of dazzling and false signalling

The following measures shall be adopted:

- prohibition of illuminated or reflective advertising bordering the track;
- prohibition of the use of vehicle head-lights or flashing lights visible from the track (or erection of adequate shielding).

14.2.6 Timekeeping

Adequate lighting must be provided in front of the timekeepers' box, to enable the competition numbers of cars crossing the timing line to be read. The lighting should extend from around 80m before the line, to around 50m after it.

The vertical light intensity recommended is 100 Lux. The lighting should extend beyond 50m after the line, diminishing progressively in intensity.

14.2.7 Supervision of the road, signalling, intervention services

The special provisions in Article 2.10 of FIA Appendix H should be respected.

14.2.8 Supplementary regulations and driver briefing

Information must be given concerning arrangements which differ from normal daylight events. For example:

- Number and location of Safety Cars and their identification lights,
- Location of all signals for stopping the race,
- Period when the use of headlights is compulsory,

The Supplementary regulations must mandate that the signs and operating handles for the electrical circuit breaker and the extinguisher on the competing cars must be reflective, as well as door handles and tow-hooks.

14.3 Safety recommendations concerning circuit floodlighting infrastructures for competitions for vehicles without lights

14.3.1 General

This Article considers the safety of the power supply and structural elements required to physically carry the lights.

14.3.2 Objective

The aim of this article is to provide a guide for the design of lighting systems that meet, in safe conditions, the performance criteria to deliver the quality of illumination of a motor racing circuit necessary for drivers and officials to perform their tasks. adapted to specific circuits and situations.

14.3.3 Risks

The main concerns treated here are:

- System & component failure
- Accidents
- Interference
- Logistics
- Weather

14.3.4 Priorities

The performance targets in this document are set to produce the required safety driven design outcome based on the following fundamental principles in order of priority:

Minimize the risk of damage or injury to participants, officials and the public by the lighting system.

Minimize the risk of causing effective darkness on all or part of the track during a race due to a failure of some part of the lighting system or by a reasonably foreseeable event on the circuit.

14.3.5 Lighting Equipment specification

In addition to the normal safety procedures associated with large lighting systems in public places it is vital to ensure that the lighting system does not introduce new impact risks to competitors.

The design must minimize the possibility that competitors might come into contact with the mechanical and electrical equipment in the lighting system, its supporting structures or the power supply during an accident.

Standard electrical, structural and mechanical regulations and good practice are considered as the minimum required for any competently designed system.

The installation must legally comply with such safety regulations as are in force at the location.

Electrical:

- All electrical equipment, cables and controls should be physically located where they cannot come into direct contact with an out-of control competitor, or debris caused by an accident.

- Where it is impossible to locate the equipment as specified in the above, additional passive physical barrier safety measures must be provided to deliver the same protection.
- All electrical equipment must be designed and located so that it does not impede operational safety of the race officials, media and other support staff.
- All electrical equipment must be located out of reach of the public.
- Circuits and connectors must be designed so that exposure to live electrical equipment will not occur in case of the accidental detachment of exposed elements of the system. Mechanical & Structural:
- All equipment must be designed and located to operate safely in normal contact with the race officials, media and other support staff.
- The equipment must remain safe after damage by an accident to allow operational safety of the race officials, media and other support staff.
- Where it is foreseeable that a car or parts of it could contact the lighting equipment, it must be designed to minimize the possibility of elements falling on the track or any occupied areas.

Thermal:

- The equipment must be designed to ensure that all elements exposed to normal contact with the race officials, media and other support staff remain sufficiently cool not to cause harm to exposed skin on contact.
- Components that operate at elevated temperatures must be protected from contact by suitable enclosures, where forced ventilation is used the system must include at least one level of redundancy.
- Equipment outside normal contact must be clearly marked with warning labels.

Location & Aiming:

- The lighting equipment should be designed to allow accurate and repeatable adjustment of orientation to occur.

Materials:

- All lighting equipment, cables and controls should be produced from materials that will not introduce new fire or pollution risks in case of an accident.
- The materials must be able to withstand exposure to race fuel, fire suppression and cleaning chemicals with no reduction in the safety of the equipment.
- Insulation materials must not produce any toxic smoke and must be flame retardant. Maintenance Requirements:
- The equipment must be designed to allow immediate safe repair to ensure that an accident in one race does not affect the lighting of following events on the same day.

If a lighting installation is installed for a significant period or permanently it is important that the design allows easy cleaning, lamp replacement etc.

Operation, Control & Procedures:

- Clear and comprehensive manuals should be established for the installation and operation of the structural, lighting, electrical, control and communication equipment under normal as well as emergency conditions.
- The necessary documentation must be made available and the systems tested and demonstrated to the satisfaction of the relevant approval authority before an event is held using the lighting system.

14.3.6 Electrical Power Supply

Specific measures are required to ensure that the system will remain safe and continue to operate normally under most reasonably foreseeable race conditions, and some level of lighting will be delivered under abnormal conditions.

15 Emergency Facilities and Services

15.1 General Comments

The provision of appropriate emergency services is a shared responsibility by the Venue Operator and the event organiser. CAMS places the onus of the Event Organiser to ensure the event is conducted under the appropriate rules and regulations, which includes the establishment of a Medical Response Plan which is appropriate for the type and status of the event.

15.2 Fire Fighting Services at Motor Sport Events

Each motor sport event conducted at a licensed venue must have an appropriate fire fighting service which will be used for combating fires resulting from incidents on the track, or in paddock. For all other areas (i.e. public areas, buildings etc) there must be an independent service arranged by the organisers which will be in conformity with the requirements of the relevant civil authorities.

A significant factor in any successful fire-fighting operation is the interaction between personnel, therefore the importance of properly trained operators cannot be over emphasised.

Fire-fighting arrangements should fulfil two basic requirements.

- to reach the fire and isolate the driver from it within a definite time;
- to have an adequate and appropriate means to completely extinguish the fire.

To achieve these goals it is recommended that an appropriate number of portable fire extinguishers be located around the track, for use by Marshals who may be first to arrive (on foot) at the scene of the fire, backed up by at least one suitably equipped mobile appliance ("Fire and Rescue" tender vehicle) which will carry range of extinguishers (in both type and quantity) and a more extensive range of rescue equipment than could be expected to be provided at each Observation/Flag Marshal Post.

15.3 Apparel

All dedicated fire fighting personnel should wear fire-resistant clothing, boots, gloves, cap or balaclava and eye-protectors. No skin shall be exposed.

15.4 Attendance at the Scene

Arrangements should be made for the nominated "mobile appliance" vehicle to be dispatched from the appropriate area (which will normally be immediately prior to start of pit lane, should only one device be employed) with a minimum of delay. The vehicle must not move onto the competition surface without the express permission of the Clerk of Course or his nominee.

15.5 Trackside Equipment

Portable extinguishers should be placed at 500m intervals along at least one side of the track. This is the maximum acceptable interval. It is recommended to provide a portable extinguisher (without operator) every 250m. Locations should be identified appropriately.

Marshal posts should also be equipped with extinguishers.

15.6 Mobile Appliances – non-race speed events

For non-race speed events a vehicle equipped with at least 2 suitable fire extinguishers and an appropriate selection of equipment (See Article 15.7) and available at a suitable entry point to the track, is required. This vehicle should preferably be in radio contact with the Clerk of Course or his nominee.

15.7 Complimentary Equipment

The mobile appliance or an allied but separate Rescue Unit should be on site and have the following complementary equipment:

- a) Tools for righting an overturned car, i.e. ropes, hooks, long crowbars;
- b) fire-resistant blankets for smothering fire (6ft x 6ft / 1.8m x 1.8m minimum size);
- c) aluminium-covered fire-resistant gloves;
- d) pliers or hydraulic tools for bending sheet-metal and other specialised tools for releasing persons trapped by damaged bodywork;
- e) large shears (suitable for cutting cyclone wire fencing).

15.8 Equipment in the Paddock

The paddock and areas used by competing or trade vehicles connected with the event, should be provided with sufficient portable extinguishers as well as being easily accessible to mobile appliances.

15.9 Extinguishants

The factors to be considered in choosing the extinguishant are: efficiency, speed, absence of slippery residues, minimal effect on visibility, low toxicity, and reasonable price, given the relevant Federal and State Government Authorities policies on fire extinguishing equipment.

The two most common extinguishants used in motor sport in Australia are:

- Foam (ATC or AR AFFF (Alcohol Resistant Aqueous Film Forming Foam) or similar alcohol resistant foam is a newer version of AFFF (Aqueous Film Forming Foam) and is more appropriate for use on Ethanol mix fuel fires)
- Dry Powder (Monnex or similar)

Each is available in a variety of sizes. Generally referred to "Hand-held" size is 9kg (dry powder) and 9 litre (ATC/AR AFFF/AFFF foam).

15.10 Medical Services and Medical Response

All events must confirm with minimum requirement in respect to the provision of an appropriate emergency medical service for the type and stats of the event being conducted.

CAMS Requirements for Medical Services are described in detail at Section 2 – Medical Requirements of the CAMS Manual of Motor Sport.

16 Integration of events other than races

16.1 General Comments

From time to time, events other than races may be held at a race track which has been issued with a CAMS Category B or A licence. The following has been included to offer some guidance to Venue Operators and Inspectors of areas of concern and methods which may be able to be employed to reduce risk in these instances.

16.2 Existing Race Tracks – *partial use, reverse direction use*

The partial use of a currently licensed race track for activities which require a lower grade of track licence is permitted automatically whilst the direction of competition is as described on the Category B or A CAMS track Licence and the circuit is presented in the condition which is appropriate for racing.

However, all areas where there exists any divergence from the existing Category B or A track licence must be noted and a track inspection must be undertaken to approve any divergences. An extension to the existing category B or A licence will then be undertaken and a Category C licence which specifically notes the divergence will be issued to the Circuit Operator.

For example a circuit may be used for a partial circuit sprint, where the finish location is the start/finish line used for races however the start line is at a location approximately half lap distance. Before issue of the extension to the existing Track Licence, this location will be assessed for:

- Accessibility by competitors from the paddock
- Accessibility by emergency vehicles
- Safe operations by officials of the start line activities
- Location of spectators

When assessed as being an acceptable risk, the Track Licence will be amended and the event permit can be issued.

The use of an existing circuit in other than the direction of travel noted on the Track Licence will require a specific inspection to be carried out to determine the hazards and if they are able to be adequately controlled. Attention should be paid to pedestrian (official) and vehicle access openings in first line of protection barriers (which will of necessity be constructed so that they are meant to be used in the direction noted on the Track Licence) and will therefore normally present a significant blunt barrier end requiring the hazard to be subject to intensive engineering controls.

Other hazards which may present are:

- Pit lane exit barriers
- Flag point protections

- Decreasing run off areas (as they will have been designed and constructed so that they are meant to be used in the direction noted on the Track Licence)
- Position of tyre buffers and gravel traps may no longer be appropriate for the intended direction
- Signage facing the "wrong way"

In all cases where a circuit is envisaged to be used in the opposing direction to that which it is licensed for circuit racing, consultation with CAMS Manager – Track Safety must occur.

16.3 Integration of Touring Road Events at Licensed Venues

Activities which are classified as "sub-events" of Touring Road Events and which are considered to be speed events in accordance with the National Competition Rules will be required subject of a Category C Track Licence for each individual activity, unless the entire sub-event is being conducted on the licensed portion of a venue (i.e. the track or circuit) which holds a current and valid CAMS track Licence of Category A, B or C status.

As an example, if a Touring Road Event was to use the entire portion of a race track for a sub-event, effectively becoming a "lap dash", the circuit shall be subject to the same set-up provisions ~~is~~ required for a race meeting, unless otherwise specifically approved by CAMS, in which case, an inspection and additional track licence is not required. If the course is different to the layout already licensed, a separate inspection may be required and that configuration shall be subject of a Category C track licence.

If a Touring Road event included several sub-events which were held within the same venue, which are considered to be "speed events" a separate inspection may be required to be undertaken and a Track Licence which details each approved sub-event/track configuration must be issued prior to the commencement of the competition.

It may be appropriate to issue the sub-event track licence to the event organiser rather than the venue owner, however in all cases the permission of the venue owner (or authorised representative) must be provided to CAMS in writing.

17 Venue Maintenance

This information has been provided as example advice to all Venue Operators and is particularly relevant to Operators of permanent facilities.

The main items which need regular attention at a motor sport venue include:

Area	Attention
Track surface	Should be checked frequently for cleanliness and general condition – serious deterioration or cracking should be noted and attention commenced urgently. The profile should be checked particularly in areas known to be bumpy and unsettling to cars during competition. A log should be kept to determine rate of deterioration over a period.
Edges, verges, run off areas and gravel traps	<p>All edges and verges should be level with the edge of the track and all areas behind kerbs should be filled in and level. In all grass-covered areas, the grass should be kept trimmed; dry grass and all solid vegetation should be removed. All vegetation and foreign matter should be removed from gravel beds. Gravel beds/traps should be regularly scarified and levelled</p> <p>All verges between the track and the first protection should be kept clear of any obstruction.</p>
Guard-rail	<p>Guard-rail supports should be checked for firm location in the ground.</p> <p>Rail joins (8 bolts each) and posts (1 bolt per rail) should be checked to ensure that bolts are in place, with washers under the head of post bolts. Nuts and bolts should be regularly checked for tightness as they are prone to loosening over time.</p> <p>Correct overlaps for the direction of intended travel should be maintained in all guardrail installations.</p> <p>The maximum spacing between the bottom rail and the ground should be not greater than 120mm and between the upper rails should be 40 mm.</p> <p>At existing venues, where a guard-rail 1LoP is supported on wooden posts, these posts should be regularly inspected for deterioration.</p> <p><i>Wooden posts are not acceptable for any new or replacement barrier installations.</i></p>
Tyre buffers	Tyre buffers should be checked for firm ties (linking) to existing structures and tight attachment together. Tyres should be assembled as per Appendix 15.

Spectator and debris fencing	Spectator and debris fences should be checked regularly for support and tensioning. The fences should be checked for deterioration.
Kerbs	Kerbs should be checked for damage. Broken kerbs should be repaired/replaced promptly. Backfilling of kerbs should be checked and any operations required completed prior to each use of the track.
Drains and drainage	Drains should be cleaned regularly.
Service roads	Service roads should be kept in good condition with smooth surfaces, and should be kept clear of all obstructions.
Circuit demarcation lines	All demarcation lines for Track and Pits should be kept clear and clean and regularly repainted.
Observation and vision	Clear "line of sight" vision should be maintained at all times between consecutive Marshals/Observation Posts/Signalling locations etc. Trees and vegetation should be cleared or trimmed to maintain good vision.
Communications	Telephone and other permanent communications should be checked.
Starting Equipment	The operation of the starting equipment and timing lights/equipment/displays etc should be checked and their visibility from the start line should be verified
Emergency Equipment	The guaranteed immediate operation of all equipment and supplies which are to be used in an emergency situation cannot be understated. Equipment should be regularly checked before storage and prior to events. Any supplies of consumables should be checked for currency (use by date) and quantity.

18 Venue Inspections

CAMS aims to provide for a cascading inspection and certification or licensing process for permanent race tracks. This is based on a 9 year cycle, where a new major hazard audit is completed each 9 years.

This document will then provide the basis for the Triennial (3 yearly) inspection and reports.

Triennial inspections should ideally include other appropriate “stakeholders” – representing the track operator, track users (4 wheel and 2 wheel), government authorities (Police, Dept of Labour and others whose legislation requires an interest), Track Operators, drivers and officials. Points of interest/risk should be discussed openly with all interested parties.

In the intervening years annual check inspections may also be conducted to audit progress with the documented works program, together with regular maintenance operations. Such inspections will normally be carried out by CAMS staff, who may be accompanied by an appointed Track Inspector, as such occasions have been found to be valuable for training purposes.

CAMS Triennial Inspections should include the following people:

- 2 CAMS inspectors
- At least 1 experienced driver who has regularly competed at the venue in one of the faster classes
- At least 1 experienced official who has held a senior position on several occasions (i.e. Clerk of Course)
- An authorised representative of the track operator, who is authorised to make decisions on future planning and budgetary expenditure

During each year of use of the circuit CAMS officials (Race Directors, Stewards and Technical Commissioners) may provide exception reports on outstanding issues in regard to events which they have been appointed to.

Any required modifications or work will require a works program (See Article 19) to be established, and appropriately documented. It will be this works program against which the yearly check inspections will be considered and works progress assessed.

Inspections at temporary circuits are required immediately before the circuit is used for the competition for which the circuit is constructed. (See Article 13.4)

Track Licenses are issued on an administrative basis each 3 years for permanent tracks and as required for the time appropriate (usually 3-4 days) for temporary tracks (See Article 20).

19 Work Programs

19.1 General Comments

The information contained in the foregoing chapters provides an insight into the possibilities of provision of safety at a race track. In order to turn the contents of the inspection reports, the discussions between the Venue operators and the Inspectors and other stakeholders into reality, a position needs to be determined in respect to what condition a venue will be presented, and in what time frame.

These factors will then determine what works are required, either in the short or long term, in order to conduct motor sport at the venue.

Those matters will then be noted and a time frame for completion of each outstanding issue established. This relatively simple step forms the "works program" for a given period.

Works programs are simply a date by which it is expected that an item appearing in a Track Inspection Report will be completed.

It is important to understand however, that the works program can be altered as circumstances change. For example a lean financial period for the venue may see an agreement to extend the time frame from completion of some components of a works program. In such cases, a Risk Assessment should be undertaken to ensure that the highest risk rating items are completed first and in addition, which items must be completed before events are held.

19.2 Works Program example

A works program may be as simple as the following fictitious example :

WORKS PROGRAM

FOLLOWING TRIENNIAL TRACK INSPECTION OF 6 SEPTEMBER 2011

NOTE: The numbers shown under the heading 'Location' commence at the start line and indicate the percentage distance to the next turn. I.e. 0.5 LH indicates a location halfway between the start line and turn 1 on the left hand side. 4.8 RH indicates a right hand location 80% of the distance between turns 4 and 5.

ITEM	LOCATION	DESCRIPTION	PROPOSED COMPLETION DATE
010	0.6 to 0.8 RH	The existing primary barrier in position at this location must be extended back towards the paddock area and link up with the barrier North of the medical centre. It will be necessary to install an earth bank with the front face as near vertical as possible as an interim measure. The facing of the bank with tyres can continue as the tyres become available. This barrier can be installed on the Eastern side of the existing roadway but must be kept close to the road in order to maintain the wide verge at this location.	1 January 2012

ITEM	LOCATION	DESCRIPTION	PROPOSED COMPLETION DATE
		There must also be a 1.2 metre high spectator type fence along the earth bank at least 3 metres from the front face of the bank in order to prevent photographers from gaining access to the track.	1 January 2012
020	1.6 to 2.0 RH	Reconstruct tyre wall behind sand trap and raise to at least 1 metre in height.	1 April 2012
		Tyres must be properly stacked. earth filled and backed.	1 April 2012
		The top two rows of tyres must be properly tied together.	1 April 2012
		The tyre wall must also be properly backed to the full height of the tyres.	1 April 2012
		This work must include the wall in front of the flag point at Turn 2.	1 July 2012
030	2.9 RH	The existing flag point at the right hand entry to turn 3 is to be relocated to the left hand side directly opposite. The barrier for this point must be earth backed with a 3 high guardrail section on top of the earth backing. A double row of buffer tyres must be installed in front of the barrier.	1 December 2011
040	3.0 to 3.1 LH	The existing single tyre buffer is to be enlarged to two rows for the full length of the concrete wall around the turn. (not completed from 1996 report)	30 September 2011
050	5.1 to 6.0 LH	If spectator access is required for this area a proper first line of protection and spectator fencing must be installed.	Spectators will not be permitted in this area
060	9.0 RH	Conveyor belting on tyre buffer needs tidying up to remove sags and unevenness.	1 January 2012
070	8. to 9.9 RH	Relocate the light poles to points at least 1 metre from the front face of the concrete barrier. These poles can either be socketed into the ground so that they may be removed or the poles may be installed adjacent to the existing spectator fence. Inspection of the lighting capabilities would suggest that their value to night racing is very questionable.	31 December 2012
090	11.4 RH	Track edge drop off must be filled and levelled.	Immediate, prior to next circuit activity
100	11.1 to 11.8 RH	The tyre wall in this area is below height and needs raising. The earth backfill will need to be raised accordingly. The verge will also need to be graded at the base of the wall.	Immediate, prior to next circuit activity

20 Track Licences

CAMS issues Track Licences to venues when it is satisfied that the venue meets appropriate safety standards. The requirements of the standards are based on the type of competition at the venue and the level of competition. An example of a Track Licence is included below.

Track Licences are divided into the following

VENUE TYPE	EVENT STATUS	TYPE OF EVENT	CATEGORY NOTATION
CAR RACE CIRCUITS	FIA INTERNATIONAL	FIA Grade 1 (FIA F1)	A1
		FIA Grade 2	A2
		FIA Grade 3	A3
	NATIONAL RACE	National Championship Races	B1
		State Championship Races	B2
		Club and Multi Club Races	B7
SPEED EVENT VENUES	NON-RACE SPEED EVENTS	Other events for which CAMS requires a Track Licence to be issued	C
OTHER EVENTS	STADIUM OFF ROAD	All status Stadium Off Road Events	C
TOURING ROAD EVENTS	SPECIAL TESTS	In cases where a Category A, B or C licence does not exist for a particular location and/or layout when held in conjunction with a Touring Road Event	C

Track Licences include certain condition under which the licence is issued and include a track density schedule for as many different types and classes of cars permitted by CAMS as is considered appropriate. The track density advises of the maximum number of cars which may be permitted to be used in races and other competitions.

The Venue Operator (or the organisation to which the licence is issued) will receive the original of the Track Licence from CAMS. Organisers of all events which are not organised by the Venue Operator but are required to utilise the Track Licence should arrange for evidence demonstrating the Venue Operators has given permission to utilise the CAMS track licence.

The track licence contains some specific conditions under which the licence is issued by CAMS and also lists details of the track density applicable to the various classes or groups of cars and the types of competition which is permitted for the track. The track density document refers to a master document which lists the types or classes of cars which comprise each group. The density for most activities is calculated by the application of a formula (see Appendix 28) which is then ameliorated by other conditions, including number of pit lane spaces available, to determine a final figure.

Figure 20.1 Example of a CAMS Category B Race Track Licence

Track Licence

2014

Licence granted to
Motorsports Tasmania Pty Ltd

For the venue known as
Symmons Plains Raceway

Period of Validity 1 January 2012 to 31 December 2014

Licence Number SYP B 14

Highest Status Category B - National Championship

Layout

The validity of this Track Licence is subject to the conditions as specified on page 2 and 3 of this Track Licence being met. If any special conditions or requirements, specified, and any other requirements of CAMS are observed for authorised activities held under the sanction of CAMS.

This licence is granted at Melbourne

CAMS Limited

Page 1

TRACK LICENCE SYP B 14 - SPECIAL CONDITIONS

- The issue of this Track Licence by CAMS does not release the Promoter / Organizer or any other party from any other obligations which may arise otherwise than under the CAMS and/or FIA rules relating to safety and organisational standards required to be met in respect to the track or any event held under the sanction of CAMS which may be staged at the venue.
- Although this licence, issued by CAMS in accordance with agreed trackside installation designs and plans, is obligatory for specified competition held under the auspices of CAMS, it cannot be considered as providing effective safety in motor sport events, which by their nature are not devoid of risk, regardless of the precautions taken in accordance with the most appropriate criteria. The conditions for issuing a track licence cannot constitute an absolute guarantee of the safety of the venue or of an event.
- Any inspection(s) going into a report and/or this licence has been carried out solely for the purposes of establishing what changes or work (if any) may be necessary for a CAMS Track Licence, of an appropriate status with, or without, further restrictions, to be either issued or maintained for the Venue in respect of events for which a CAMS Track Licence and Organising Permit is in force.
- Any advice given to the Venue Owner and/or Operator arising out of an inspection and/or in relation to the safety requirements of the track has been given solely to enable the CAMS Track Licence to be granted for the purposes of the Venue Owner and/or Operator undertaking events authorised by CAMS at the Venue and for no other purpose.
- If the Venue is to be used for activities other than those authorised by CAMS, it is the Venue Owner/Operator's responsibility to satisfy themselves as to the nature and extent of safety requirements appropriate to those activities. CAMS does not accept any responsibility in relation to any activities not authorised by CAMS and the Venue Owner/Operator should seek independent advice as to the standards of safety appropriate to those activities.
- The CAMS Track Licence, the content of any reports, any related correspondence from CAMS or advice given by CAMS, its servants or agents whether oral or in writing only relates to CAMS authorised activities and should not be relied upon for any other purpose.
- The Track Operator must maintain the venue to the standard approved in the most recent FIA and/or CAMS Track Inspection Report together with any additional works and/or works program agreed with the Track Operator and approved by the FIA or CAMS.
- Any modifications or installations to the competition area, the first line of protection or other safety oriented structures must be approved by CAMS. Any changes made without approval will invalidate the Track Licence until approval is obtained.
- This Track Licence will be temporarily suspended if at any time the relevant safety standards are not complied with.
- This Track Licence is valid only when:
 - Activities are conducted under the sanction of an Organising Permit or other valid authority issued by CAMS.
 - All activities conducted under the sanction of CAMS at the venue are conducted under the provisions of the FIA International Sporting Code and/or the CAMS Manual of Motor Sport and the National Competition Rules (NCR) and any appendices thereto, including any Bulletins issued by CAMS, as may be relevant to the activity.
 - All participants in recognised activities held under the sanction of CAMS are subject to the National Competition Rules of CAMS.
 - The requirements of CAMS in respect of the organisation of race meetings, speed events and other authorised activities held under the sanction of CAMS being complied with.
- Any variations to the conditions under which competition takes place, as specified in the CAMS Manual of Motor Sport, must be approved by the Stewards of the Event.

CAMS Limited

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TRACK DENSITY DOCUMENT SYP B 14

CIRCUIT NAME SYMMONS PLAINS RACEWAY

LENGTH 2.41km

TRACK LICENCE NUMBER SYP B 14

VALID TO 31 December 2014

LAST INSPECTION DATE 16 June 2010

NEXT INSPECTION DUE 2013

NO. OF PIT LANE SPACES 32

TOPCAR ACTIVITY? YES

DAYLIGHT HOURS ONLY? YES

GROUP OR FORMULA	PERMITTED DENSITY
GROUP 1	20
GROUP 2	26
GROUP 3	32
GROUP 4	37
GROUP 5	42
ENDURANCE REGULARITY	30
MODERN REGULARITY	37
HISTORIC REGULARITY	48
SUPERSPRINTS	16
SUPERKARTS	53
TRUCKS	N/A

Notes:

- Permitted Density is for races of less than one hour duration and which do not require pit stops to be made.
- For races which require pit stops, or National Championship races of any duration, the absolute density (including for practice and/or qualifying) will be equal to either the permitted density (noted above) or the number of available pit lane spaces (noted in the top box) - whichever is the lesser figure.
- For other races, the track density of the relevant category may be increased by up to 20% for practice and/or qualifying.
- N/A signifies that races for this Category may not be conducted at this circuit.
- Track Density for races outside the scope of this document will be advised individually by CAMS as a g. races of greater than 1 hour duration.
- Track Densities for various activities conducted under the TOPCAR agreement apply and make reference to the above table.

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Figure 20.2 Example of a FIA Circuit Licence



FÉDÉRATION INTERNATIONALE DE L'AUTOMOBILE

CIRCUIT LICENCE

GRADE 2

NON-PERMANENT CIRCUIT

VALID FROM 22.10.2010 EXPIRING ON 22.10.2013

Issued for the circuit of **SURFERS PARADISE (AUS)** in the configuration below which, at the date of issue of the present licence, complied with the minimum safety conditions and standards required by the FIA for the running of international motor races organised in accordance with the FIA regulations and only for the categories of cars included in the grade of the licence as specified above, in accordance with the definition given in Appendix O to the International Sporting Code.

The granting of this licence is a pre-requisite for the submission of an application to organise an event on the circuit, for the categories of cars covered by this licence, but is not in itself sufficient for an event to be entered on the calendar in the context of an FIA championship.



Length of the track measured in conformity with Appendix O to the Code: **2.984 km / 1.854 miles**

Direction of the track: **Anticlockwise**

Reference width: **10 m**

Pole position for standing starts: **Left**

Pole position for rolling starts: **Left**

Date of the definitive inspection: **24.10.2008 / 21.10.2010**

Inspector: **Tony Cotman / ASN**

Circuit plan reference: **FIA Licence 10 - Surfers Paradise - 03-09-2010**

The FIA shall only issue a circuit licence upon proposal from the ASN of the country of the circuit.

Paris, 28.09.2010


President of the FIA
Jean Todt

CONDITIONS OF ISSUE OF THE LICENCE

Art. 1: The FIA issues to the ASN a licence attesting that the circuit meets the minimum safety conditions required by the FIA according to the vehicles specified in the licence grade. The issue of the licence by the FIA does not relieve the ASN or any other party from any obligations which may arise otherwise than under the FIA's rules relating to the safety and organisational standards required to be met in respect of the circuit or any event staged at the circuit.

Art. 2: The validity of the licence is subject to the minimum standard of safety required by the FIA being maintained, within the period of validity specified. The FIA reserves the right to withdraw, suspend or modify this licence, on the recommendation of its Circuits and Safety Commissions.

Art. 3: The licence shall be obliged to comply in all respects with the terms and conditions of the FIA International Sporting Code and all the other FIA regulations which shall apply to this licence. The validity of the Formula One Test licence is subject to compliance throughout each test with the recommendations concerning emergency services in Article 16 of Appendix H and to the provision of a service of observation, signalling and communications, for which a minimum must be defined by the ASN on the basis of chapter 2 of Appendix H, under the control of an experienced clerk of the course.

Art. 4: The ASN shall inspect the circuit and report to the FIA on the condition of the circuit towards the end of each year of validity. The FIA reserves the right to intervene or to inspect the circuit itself, should this be considered necessary.

Art. 5: The configuration of the circuit and its installations at the time of the FIA inspection will be shown on a dated plan which will be held by both the FIA and the circuit management, which will form an integral part of the present licence and which the management will make available, on request, to the clerk of the course, race director or stewards of any international meeting. The plan will be updated by the management and communicated to the FIA by the ASN every time a change is made in agreement with or to conform to a request from the FIA. Changes made which have not specifically been agreed to on the plan and confirmed in writing by the FIA beforehand, to the layout or to any safety-related item, shall cause the licence to be retroactively annulled as from the date of the modification.

Exceptions may be permitted for repairs or modifications made at or immediately before an international event (to the exclusion of events counting for an FIA World Championship), to counter damage from causes beyond the control of the management, or to resolve a problem revealed only during the running of the event, always subject to the following conditions:

- the clerk of the course, race director (if appropriate) and stewards of the meeting must be satisfied that the changes are in the best interests of maintaining the minimum standard of safety consistent with the FIA licence and do not compromise the safety of spectators, officials or competitors;
- such modifications must be documented by the stewards of the meeting and reported to the FIA through the ASN at the first opportunity

Art. 6: Every year, an FIA inspection is mandatory before the first World Championship event to be held on the circuit.

Art. 7: Subsequent to the issue of this licence, drawn up in accordance with the most recent safety standards in force with regard to the layout, the installations or the arrangements of the circuit, the FIA may not be held responsible in any way whatsoever, should an incident or an accident occur during an event or practice session. If an accident occurs, in testing or racing, which causes the hospitalisation of any person, significant distortion of the car's cockpit or of track safety features (or demonstrates the efficiency of such features in a high-energy accident) the circuit owner will be responsible for ensuring that a detailed report on the circumstances, the injuries and any damage to cars and circuit features is submitted to the ASN and, where the laws of the country allow, to the FIA. If the laws of the country do not allow this, the ASN should keep the FIA informed. The report should as far as possible include: video recording of the car and scene made immediately after the accident; team data recordings from the car; an engineer's report on the condition of the car; medical reports; marshals' and eye witness reports.



21 Appendices

Appendix No	Description
1	Kerb type determination process
2	Vallelunga Kerb
3	Melbourne Kerb
4	FIA Apex kerb
5	FIA Combination Kerb
6	Morgan Park Exit kerb
7	Hidden Valley Apex Kerb
8	Wilson Wave Kerb
9	Additional Kerb Design and comments
10	Concrete Barrier Specifications
11	Examples of Concrete Barriers
12	3 Row high guardrail specification
13	Examples of Guardrail use
14	Earth Backed Tyre Barriers Specification
15	Examples of Earth Backed Tyre Barriers
16	Tyre Buffers
17	Conveyor Belt facing
18	Examples of Tyre Buffers
19	Run Off Area Formulae and Application
20	Distance Sign Boards
21	Advertising in front of First Line of Protection
22	Openings in the First Line of Protection
23	Pit Lane, Entry and Exit roads
24	Pit garage dimensions

25	Starting grid layout
26	Model Medical Centre layout
27	Miscellaneous information
28	Track Density Formula
29	Second Line of Protection specification
30	Acknowledgements

Appendix 1 - Kerbs

As kerbs are devices located at track edge, usually at a corner, designed primarily to prevent track edge disintegration, careful selection of the type of kerb and the installation to a track is important to the performance of the kerb and longevity of the track surface.

Kerbs should be installed flush with the track edge with appropriate, smooth, transitional end pieces over a length of at least 2.5m for kerbs on the apex of a corner and 5m for kerbs on the exit of a corner.

The verge (behind the kerb) should always be graded, level with the top surface of the kerb, which if necessary should be extended at the rear with properly stabilised asphalt, concrete, grass-supporting modules or concrete based artificial grass, to provide a smooth transition to the verge without any step or rut.

Drainage should be provided wherever the presence of the kerb could cause water to accumulate on the track, for example on corner apexes.

Both the Melbourne (Negative) and Vallengunga types of kerb described below should incorporate, for their entire length on the verge side, a flat strip of concrete, at least 15 cm wide and level with the highest points of the kerb, to prevent tyre damage and to stabilise the verge. Care should be taken to eliminate all sharp edges. Provision should be made for the adequate drainage of Negative kerbs.

Appendices 2 through 9 illustrate various types of kerbs used at Australian race tracks.

The following table must be used for new circuits in determining the type of kerb to be installed.

TYPE OF KERB SUGGESTED FOR EACH PART OF A CORNER (LEFT-HANDED OR RIGHT-HANDED)			
Type of corner		Apex Kerb	Exit Kerb
"Fast".	speed generally expected to be greater than 200 km/h at apex	none or 50 mm Bevelled ⁽¹⁾	80mm negative Melbourne or Morgan Park
"Medium":	speed generally expected to be between 120 and 200 km/h at apex	50 mm Bevelled	80mm negative Melbourne or Morgan Park
"Slow":	<i>speed generally expected to be less than 120 km/h at apex</i>	<i>100 mm Vallengunga or Hidden Valley</i>	<i>80mm negative Melbourne or Morgan Park</i>

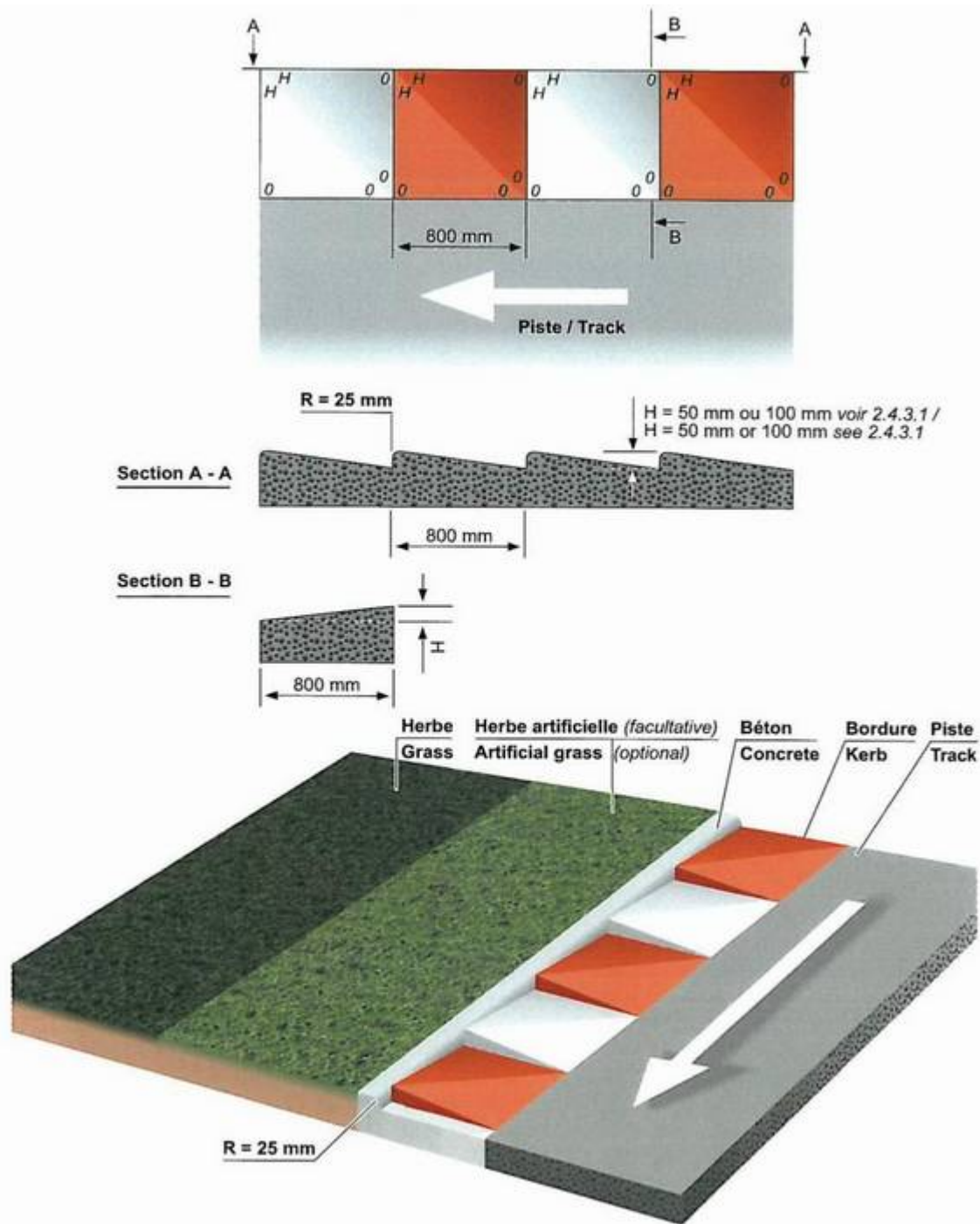
"Fast" Combination (LH/RH or RH/LH):	<i>speed at first apex generally expected to be greater than 200 km/h</i>	<i>50mm Vallengunga or Hidden Valley</i>	<i>80mm negative Melbourne or Morgan Park</i>
"Medium" Combination (LH/RH or RH/LH):	<i>speed at first apex generally expected to be between 120 and 200 km/h</i>	<i>50mm Vallengunga or Hidden Valley</i>	<i>80mm negative Melbourne or Morgan Park</i>
"Slow" Combination (LH/RH or RH/LH):	<i>speed at first apex generally expected to be less than 120 km/h</i>	<i>100 mm Vallengunga (100 may be too high, in which case advice will be provided by CAMS)</i>	<i>80 mm negative Melbourne or Morgan Park</i>

(1) the installation of a kerb may be necessary to prevent dirt being drawn onto the track in some cases.

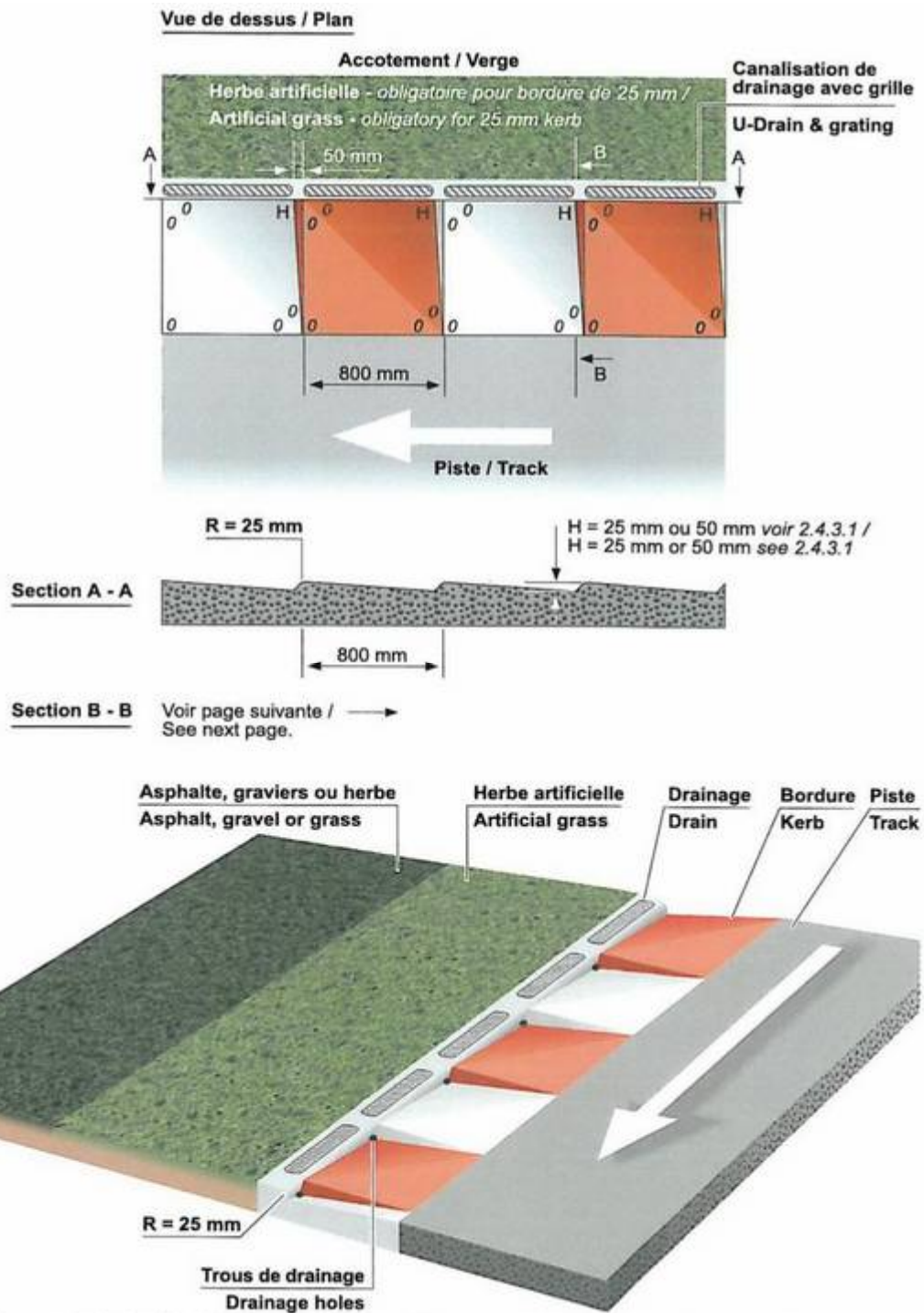
Some existing tracks may have kerbs installed at some corners which do not meet the above specification, and will require specific approval of CAMS if replacement is undertaken.

All new tracks should be designed and constructed with kerbs which are in compliance with the above table.

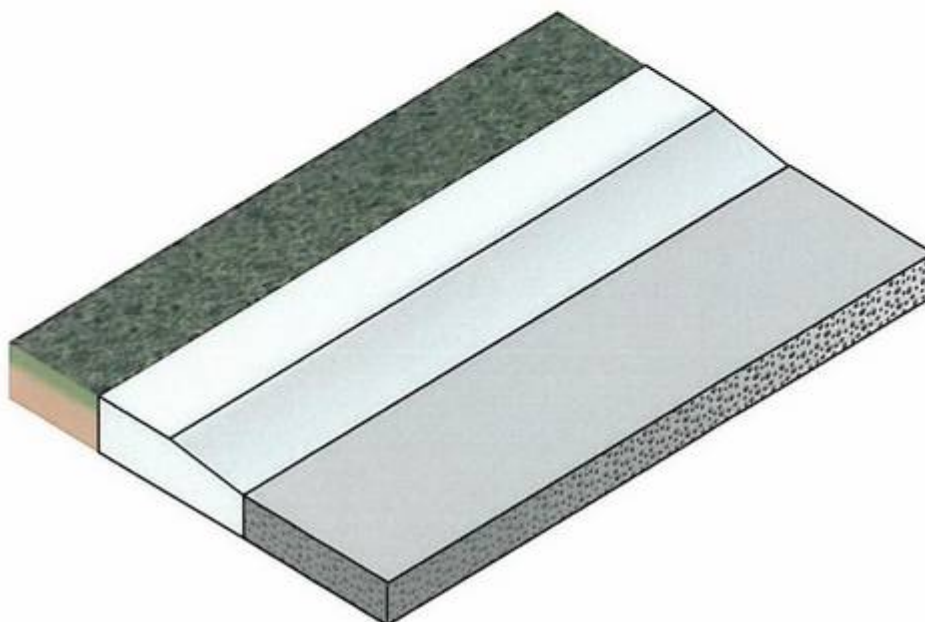
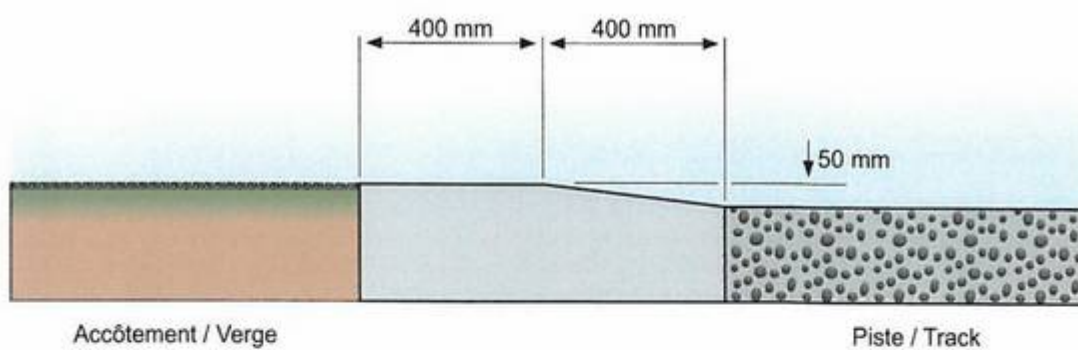
Appendix 2 - Vallelunga Kerb



Appendix 3 - Melbourne Kerb



Appendix 4 – FIA Apex Kerb



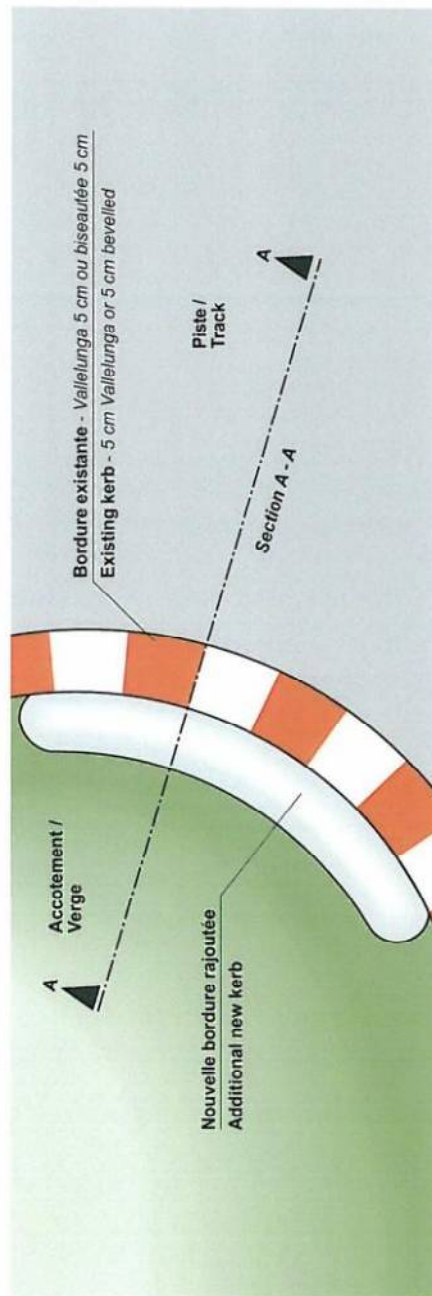
Appendix 5 – FIA Combination Kerb

BORDURE COMBINEE / COMBINATION KERB



Figure 1d

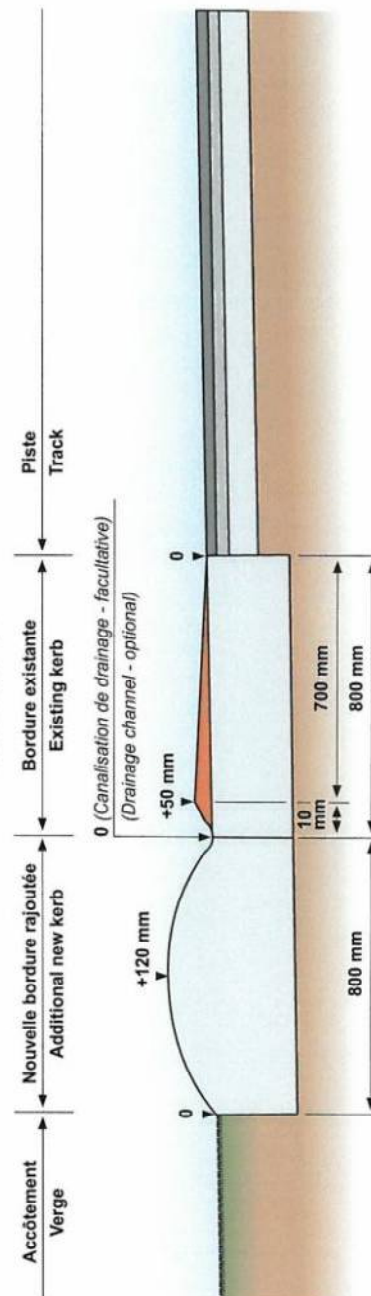
- 12CM DE HAUT POUR CORDE DE VIRAGE
- 12CM HIGH FOR CORNER APEX



Lignes directrices internes pour la construction et la sécurité des parcours de course automobile – Édition 7.3

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Section A - A



Internal guidelines for motor racing course construction and safety – Issue 7.3

Appendix 6 – Morgan Park Exit Kerb

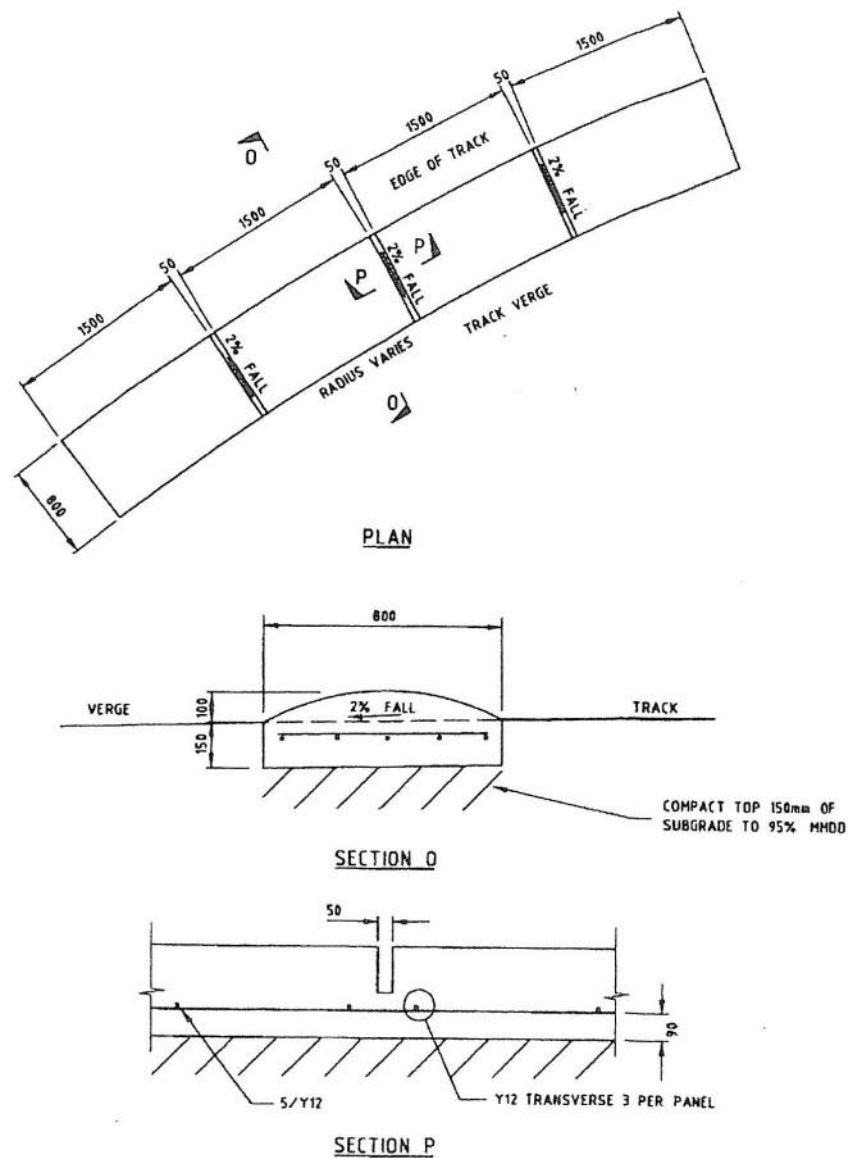


Kerb width: 800mm

Height: 0 mm at track edge with troughs falling to 80mm beneath track surface at rear of kerb.

Frequency of peaks: approx 400mm

Appendix 7 – Hidden Valley Apex Kerb



Appendix 8 - Wilson Wave Kerb



Kerb width: 1000mm

Height: 0 mm at track edge with peaks rising to 40 at rear of kerb

Frequency of peaks: approx 1250mm

Appendix 9 – Additional kerb design and comments

Photo 1 **Vallelunga Kerb**



Direction of Travel of race traffic is from left to right. This type of kerb is only used on apexes. The design is such the intensity of the hazard (the wheel riding up and over the kerb, and dropping off onto the sudden void at the end of each section) becomes progressively more aggressive as the wheel progresses from the outer edge of the kerb to the inner edge. Peaks are approx. 40mm high. Kerb dimension is approx 800 (W) x 1100 (L)

Photo 2 **FIA Apex Kerb**



Standard FIA Apex kerb

Photo 3 FIA Combination Kerb



Photo 4 Combination Kerb Mallala SA



A variation on the FIA Combination Kerb, which does not have the aggressive profile as the unit shown in this picture, which is principally a Vallelunga kerb mounted on top of a Flat face kerb. This arrangement has proved to be a very effective deterrent, which can be judged by the retention of a lush growth of grass behind the upper portion of the kerb.

Photo 5 Barbagallo Apex Kerbs



Sections of serrated top kerb rise approximately 50mm above the existing kerb for a length of about 5m and are located at 20m intervals.

Photo 6 Bathurst Combination Kerb



This style of kerb has been used to good effect in two locations at Mt Panorama. Its feel for the driver is similar to the Hidden Valley kerb and with the flat kerb on the track edge creates a benign physical feedback through the steering for the driver to determine the lateral location of the car through the corner.

Appendix 10 – Concrete Barriers

A10.1 Specification

Two types of concrete barriers may be used at motor racing circuits: freestanding and earth backed.

Earth backed concrete barriers may be constructed to the appropriate following design specifications

Freestanding concrete barriers are required to meet either a design and specification approved by the NTSC for the purpose, or should be approved by the NTSC following certification by an appropriate professional engineer that the design meets the requirements noted below.

A10.2 Design

The barrier shall have a minimum height of 1m above ground level.

The side facing the track should have a smooth vertical ($\pm 2^\circ$) and continuous surface, such as is obtained by casting the concrete in suitable plywood, metal sheet or plastic forms.

Joints, approximately 2cm wide, may be provided at suitable intervals to prevent cracks from thermal expansion or shrinkage. These joints shall be designed such that there is no relative displacement each side of the joint under the design impact on one side.

Small (approx 50mm diameter) holes may be provided at 1-2m intervals for fastening tyre or other protection barriers to the wall. Suitable holes may be made for drainage as necessary.

A10.3 Earth Backed Concrete barriers

The minimum thickness of earth backed concrete barriers should be 120mm.

The grade of concrete used should not be less than 30 Mpa.

Barriers should be backed by earth fill (free of tyres or other compressible debris) to no lower than 300 mm from the top of the barrier, for a distance of at least 1 m. The fill may then taper off gradually to ground level over at least another 2 m.

A10.4 Free Standing Permanent Concrete barriers

The minimum thickness of freestanding concrete barriers is 200 mm.

The barrier should be designed to withstand an impact at an angle of 20° of the heaviest car likely to race on the track, moving at the theoretical maximum speed attainable at the point on the track adjacent to the barrier.

To assist with calculation of the speed, particularly when considering the design for walls which will be located behind gravel traps, it should be assumed that deceleration on verge or run off area is 0.23g and that of a gravel trap is 0.46g

In any case the minimum value of the frontal impact force, applied at 400 mm above ground level, should be evaluated as follows:

- a) For speeds over 250km/h 70.000 kg,
- b) For speeds over 150 up to 250km/h 50.000 kg,
- c) For speeds up to 150km/h 30.000 kg.

The calculation shall assume the distribution of the impact load between two consecutive joints in the wall, the maximum length of the sector sustaining the impact being 5 times the height of the vertical wall section above the base plate on each side of the point of impact.

For example: for a wall 1m high, with a base plate 200 mm underground, in a section with speeds between 150 and 250 km/h, the static load on the wall may be considered thus:

$$\frac{50.000 \text{ kg}}{2 \times 5 \times 1.2 \text{ m}} = \frac{50.000}{12} = 4\,166 \text{ kg/m}$$

An adequate reinforcement in the wall and in the foundation plate along the entire length of the section shall be provided to ensure an effective distribution of the load.

The wall ends at joints and terminals shall be suitably reinforced to compensate for the discontinuity of the structure. In planning the dimensions and calculation of the reinforcement of the foundation, particularly against overturning, the nature of the ground shall be taken into due consideration.

If the wall is built on the top of an embankment, the distance between the wall and the edge of the embankment shall be at least three times the depth under ground level of the foundation bottom.

The conformity of the construction with the requirements of this appendix should be certified by a qualified engineer and a signed declaration to this effect should be available to the NTSC inspector at the circuit inspection.

NB: These specifications, for permanent reinforced concrete barriers, are not applicable to any other form of protection.

A10.5 Free Standing Temporary Circuit-type concrete barrier

When using portable concrete blocks as the first line of protection, the basic principle is to ensure that the linked blocks have sufficient mass to ensure the effectiveness of the 1LoP while adequately dealing with the kinetic energy of the most severe impact anticipated and the safety of the driver.

It is not necessary to ensure that the blocks will retain their position in the event of a collision; in fact some movement reduces the peak deceleration of the impacting vehicle thus lessening the severity of the impact transmitted to the driver. Therefore, blocks positioned

on a uniform, flat surface, not backed up by kerbs or other irregularities will reduce the peak deceleration.

The severity of the impact on the driver will be determined by the mass of the barrier (greater than necessary is worse for the driver), the distance that the block can move in the collision (more is better subject to the integrity of the 1LoP), deformation of the colliding vehicle and the orientation of the barrier system to the impacting vehicle.

The positioning of the blocks for the 1FLoP at temporary circuits needs extensive engineering and design, to consider a range of possible vehicle trajectories and impacts, and their risk. It is recognized that different parts of a circuit may require barriers to operate in different ways and in some circumstances barrier deflection may create other issues. The need to restrict the movement of the barriers and to locate or "key" them into other features, e.g. gutters or kerbs, should be evaluated through a risk assessment when designing a temporary circuit.

Dimensions for a typical block are shown below. Ideally the blocks should have a mass of at least 1000 kg per linear metre and a base width of at least 500 mm.

- All blocks should present a smooth, face perpendicular to the racing surface.
- Minimum height is 1 m.
- Recommended length is 4 m.
- Blocks should contain adequate steel reinforcing. Since the blocks may be subjected to repeated handling, it is recommended that the corners be protected by angle-section steel, securely anchored to the internal steel reinforcing.
- The blocks should, where necessary, provide suitable mounting points for the type of debris fencing envisaged. If the method of mounting includes vertical holes cast in the blocks, a means of drainage should be provided to prevent water accumulation and to eliminate the risk of frost damage.
- Suitable recesses should be cast in the base of each block to facilitate drainage and to accommodate the forks of a lift truck.
- Various methods of connecting adjacent blocks may be used. A common and acceptable method is to cast two loops of 25 mm reinforcing steel into each end of each block. The loops should be securely anchored to the internal reinforcing structure and vertically staggered at one end of each block relative to the other end, so as to permit overlap of the loops of adjacent blocks.
- The blocks should be connected by pins of heavy-wall steel tubing (min. 50 mm O.D.). The system of connecting the blocks should provide a certain degree of flexibility, but should have sufficient strength to withstand the heaviest impact anticipated, so as to form an integrated structure by sharing the load with adjacent blocks.

- WALL ELEMENT FOR TEMPORARY CIRCUIT

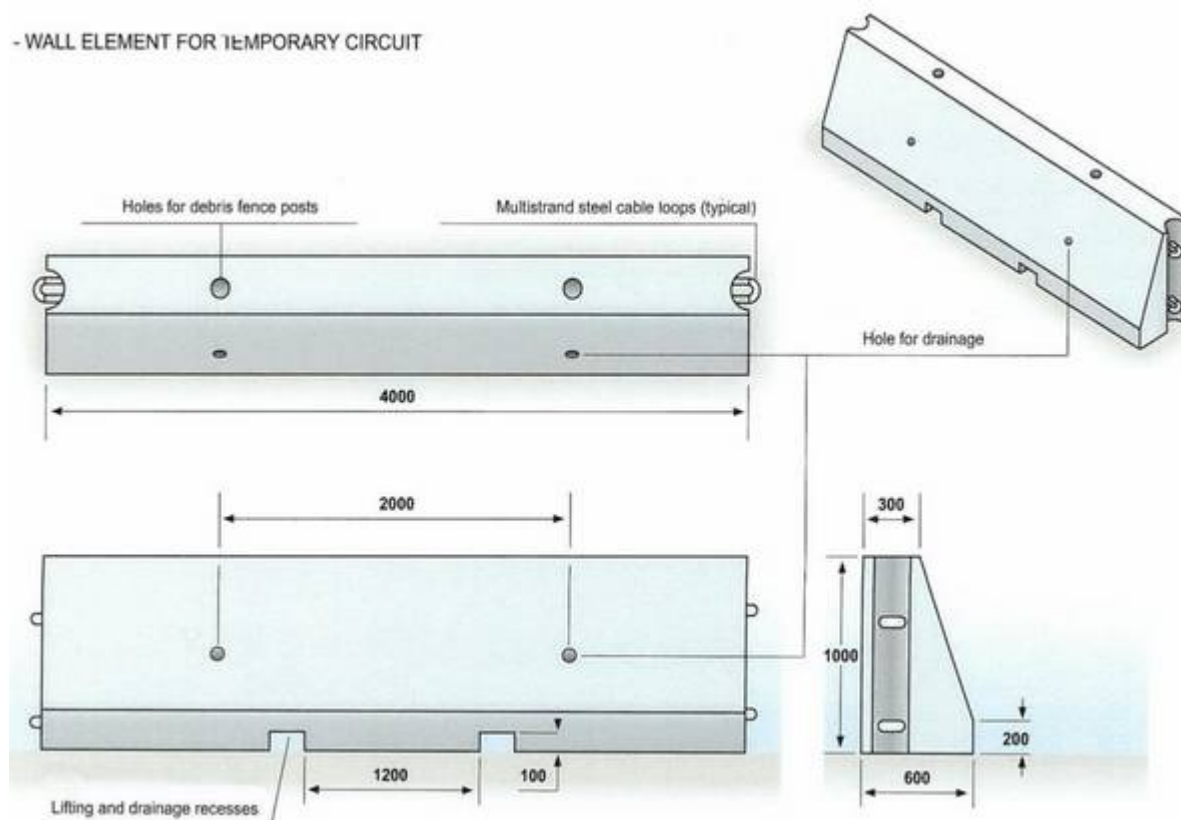


Figure A10.1 Generic design of typical 1LoP barrier element used at a temporary circuit.



Figure A10.2 Depiction of a typical deployment of 1LoP barrier blocks at Adelaide Parklands

Appendix 11 – Examples of Concrete Barriers

Photo A11.1



Excellent example of 1m high, good quality concrete barriers. On left the barrier is free standing, on the right the barrier is earth backed. Note narrow verge on both sides, which is an essential requirement due to topographical conditions.

Photo A11.2



Earth backed concrete barrier. Note distance between barrier and spectator areas is less than considered ideal.

Photo A11.3



Effective semi-earth backed concrete barrier constructed of a number of linked concrete blocks. The pole on the foreground at left is used as a mounting for a remotely controlled warning light system.

Photo A11.4



Another example of the semi-earth backed concrete barrier constructed of a number of linked concrete blocks

Photo A11.5



End of pit lane signaling wall, showing gradual taper

Photo A11.6



Runoff at straight ahead position of a 90 degree right hand corner of temporary street circuit.

Photo A11.7



Rear view of shape of concrete blocks used at temporary motor racing circuits. Each block weights approx 4.2 Tonne,

Photo A11.12



Transition of concrete barrier into earth backed tyre barrier. Note chaining of tyre buffer stacks to each other and also linking the buffer system back to barrier.

Photo A11.13



Rear view of linked concrete barriers.

Photo A11.14



View of freestanding concrete barrier. The barrier is keyed into a substantial plinth which extends below the surface.

Photo A11.15



Vertical concrete barrier in front of near vertical cliff face. Note concrete fill between barrier and cliff face.

Photo A11.16



Earth filled concrete barrier with flag point atop. Note area beautification. This has no real affect on the barrier and has been encouraged to engage local community in support of circuit.

Photo A11.17



Private testing day. Inexperienced driver in high powered car. Destroyed concrete barrier does not exhibit signs of reinforcing.

Photo A11.18



These concrete barriers have been designed by the track operator and are made locally. When assembled in a run of more than about 10 blocks, and suitably linked by pins, they act as a suitable Level 1 First Line of Protection.

Photo A11.19



These two photos show an undesirable outcome when a car hit a concrete barrier which did not have sufficient mass to stop the car without further implications and also demonstrates the benefits of linking barriers together. The movement of the barrier in the photo below is a direct result of it being hit by the Ford Escort. Following this incident, the organizers developed a method of attaching the barriers together by utilizing chain of a substantial cross section.

Photo A11.20



See comments above. This also reinforces the need for a system whereby the public are required to remain some distance behind the 1LoP barrier!

Photo A11.21



These two photographs also clearly demonstrate the folly of using unlinked barriers (even high mass highway type barriers) and single row tyre buffers.

Photo A11.21



See comments above.

Photo A11.22



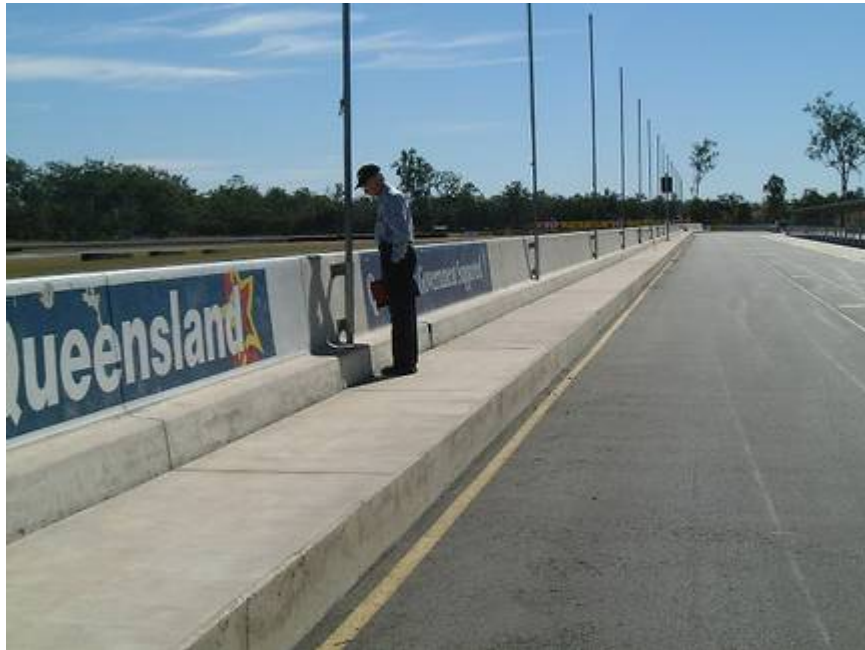
Shows steel advertising signs attached to rear of concrete blocks. Such signs, located as they were in pit lane are potentially major hazards to approaching drivers as the leading edge could act like a knife in a narrow angle incident.

Photo A11.23



Shows loops in concrete barrier ends. A suitable diameter steel pin is inserted to link each barrier to the next one.

Photo A11.24



Shows very substantial protection for pit lane signaling wall. Not long after this photograph was taken a system of barricades was installed to minimize the likelihood of persons stepping off the concrete plinth and straight into the pit lane.

Photo A11.25



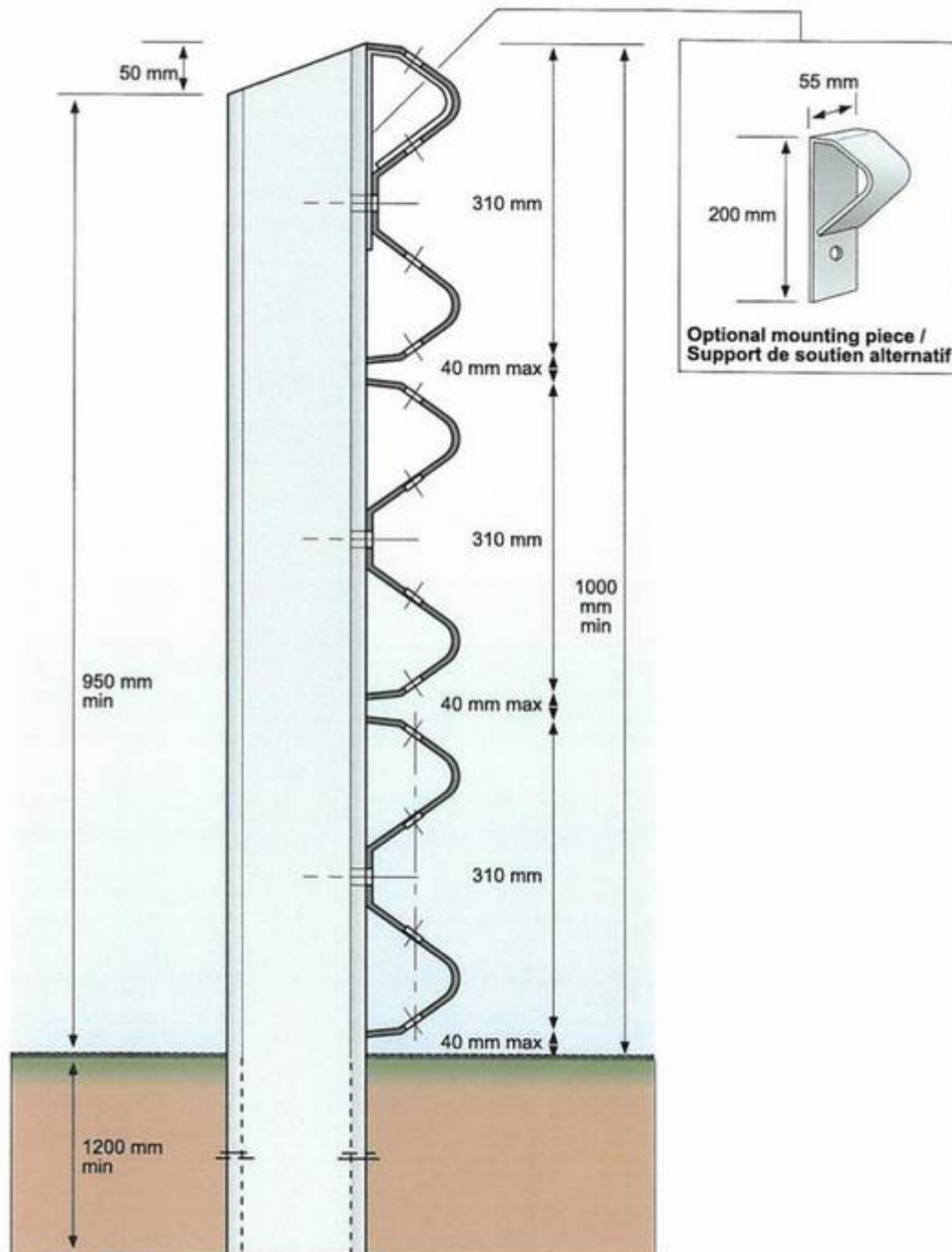
End section of pit lane signaling platform

Photo A11.26



Shows simple and effective protection of starter's box, the supports for which protrude into pit lane.

Appendix 12 – 3 Row high Guardrail specifications



A12.1 SPECIFICATIONS

A12.1.1 General Characteristics

For general characteristics of the standard type, see Drawing 2. All parts of a guard-rail should be hot-dip galvanised. Repairs should be painted with a zinc-rich paint. The end of each rail element should be provided with a standard curved terminal piece (or "fishtail").

NB: The connection of two sections of guard-rail (i.e. the overlaps) should always be made so that the surface presented to oncoming cars is completely devoid of projections or discontinuity.

A12.1.2 Rail Elements

a) The standard rail elements are in mild steel sheet meeting the following requirements:

- Ultimate tensile stress: 42kg/sq mm,
- Thickness: 2.7 mm,
- Moments of inertia: X-X 1248,7cm⁴
Y-Y 96,1cm⁴

NB: Non-standard type rail elements should meet at least the above specified requirements.

b) Spacing: maximum 40 mm between rails and 100mm between the bottom rail and the ground.

A12.1.3 Supports

a) Metal supports: should be in mild steel, 120 standard profile U-NP 120 (U-section with reinforced angles, 120 mm wide). They should be set directly into the ground without concrete to a minimum depth of 1200 mm (more in soft ground). However, in order to maintain the regulation height protruding above ground, it may be desirable to set some of the posts in concrete. 990 mm for triple type standard guard-rail will protrude above ground, with rails bolted in position (as shown above) on the side of the post. Bolts should be at least 16 mm diameter. Shear bolts must not be used. Metal supports should not project above the level of the top guard-rail.

b) Spacing of supports: maximum 2000 mm.

c) Wooden supports are only permitted upon the specific approval of CAMS.

NB: For non-standard types, all elements differing from the above specifications should be submitted for CAMS approval.

A12.1.4 Washers

Adequate washers should be used under post-bolt heads. The following specification is recommended, based on the standard Guardrail-type bolt.

- Cut steel washer of 45 mm diameter (bolt hole approx. 18 mm diameter), 4 mm thick. Where the bolt head is provided with an oval shoulder, a circular seat should be milled in the washer to fit it (2 mm deep, 29 mm diameter).

NB: With the washer, it may be necessary to wedge the bolt head when tightening or undoing it. (For non-standard rails, appropriate washers should be adopted with the advice of the makers).

Appendix 13 – Examples of Guardrail use

Photo A13.1



Section of 2 row high guardrail, to which additional sections have been added to provide additional protection at a Flag Marshal Post.

Photo A13.2



Section of 3 row high guardrail. Note attachment of Braking Marker to guardrail post.

Photo A13.3



Section of 4 high guardrail provided for additional protection for signaling area, which at this circuit is restricted to an area of about 20m in length. This allows the Circuit Operator to provide adequate front and rear protection to pit crews while at the same time containing costs.

Photo A13.4



Guardrail in this location appears to be less well aligned than desirable, however due to the need to constantly remove and replace some sections to provide for horse racing requirements and due to the low speed nature of the area, and that it is not protecting any spectators or officials, it has been tolerated as an acceptable risk.

Photo A13.5



This section of guardrail is frequently hit by cars and is constantly being replaced. A yearly operation is undertaken to right the alignment of the guardrail posts.

Photo A13.6



Shows an unorthodox, but effective method of restoring alignment of guardrail beams during an event.

Photo A13.7



These two photographs demonstrate the effect of an impact on a guardrail barrier which was not connected or attached in an appropriate manner. Each Guardrail beam must be attached to the next beam by the specified number of bolts and then attached to suitable posts by a bolting system which included appropriate sized washers to prevent the heads being pulled through the guardrail holes.

Photo A13.8



As above. This guardrail barrier system failed when the impact destroyed the integrity of the horizontal beam as well as the vertical fixation of the beams to the posts. Fortunately no one was injured.

Photo A13.9



An example of the type of engineering which is undertaken to provide an access gate in a guardrail system.

Photo A13.10



Another example of a guardrail gate design, which when closed provides the correct overlapping process.

Appendix 14 – Earth Backed Tyre Barriers

In essence this device is simply a mound of earth (which provides the mass for the system) which presents a near vertical face which is stabilised by earth filled car or light truck tyres stacked in a house brick pattern in front of the vertical face. This will provide a longer stability of the near vertical earth face than would otherwise be the case.

Earth backed tyre barriers are not deemed to offer any significant buffer protection, therefore they should not be confused with buffers tyres, which are not earth filled and provide a degree of “cushioning”.

Earth backed tyre barriers tend to collapse after a number of years and after a relatively short time require maintenance to add tyres to the top. At longer intervals, the complete barrier may require dismantling and rebuilding, as earth in the tyres is eroded/washed out of the tyres and the system collapses under the combined weight of the tyres and earth.

An appropriate amount of earth must provide the necessary mass for the barrier. This has been determined to be equal to the height of the barrier plus 150mm (to provide earth cover for the top tyres to assist to reduce the effects of UV light on the tyres and any polypropylene rope which may be used to fasten the two row of tyres) and 2 metres to the rear, gradually tapering off over that distance.

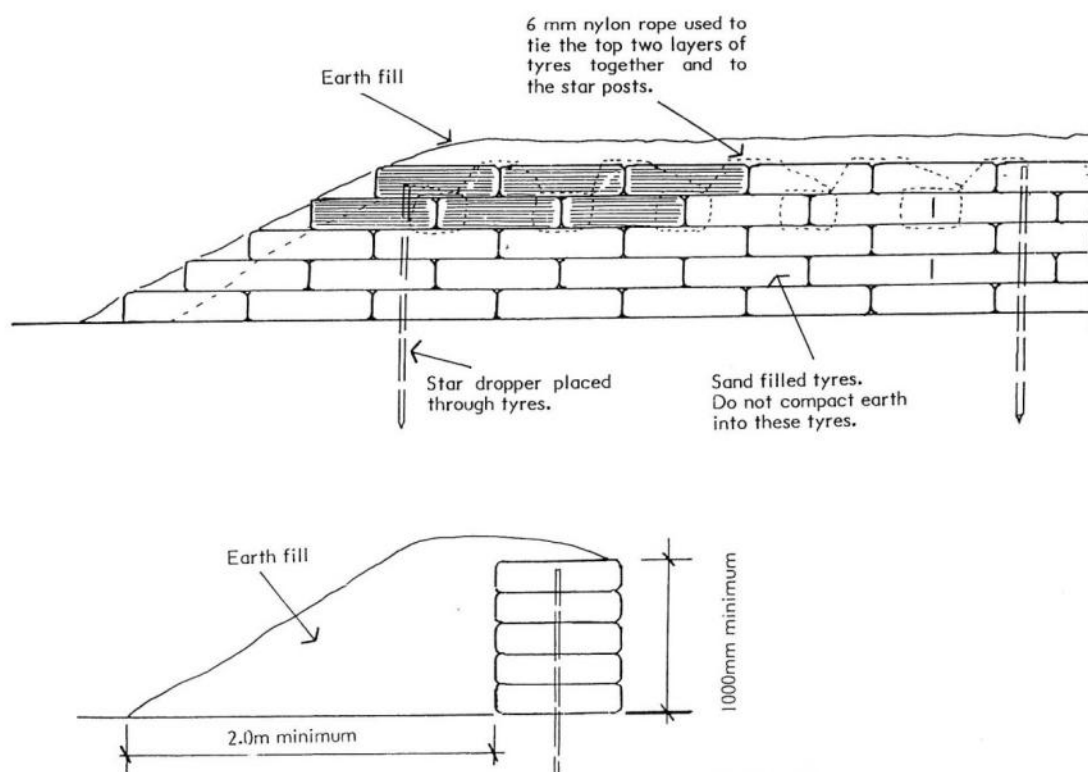


Figure A14.1 Typical design of earth filled tyre barrier

Appendix 15 – Examples of Earth Backed Tyre Barriers

Photo A15.1



Car failed to stop on verge due to action of ABS and interaction with gravel trap. Earth bank providing mass stopped the car from careering through the barrier.

Photo A15.2



Indentation made when a 4WD production car hit barrier at angle of about 90 degrees at 110km/h. This tragic incident, which claimed the life of the driver, could have been significantly worse if the barrier had failed to stop the progress of the car. The relatively crowded paddock areas which was protected by the Earth backed tyre barrier, is immediately behind the barrier.

Photo A15.3



Demonstrates the damage which can occur to Earth Backed tyre barriers when hit by cars in non-serious incidents. Note the disturbance of the blue painted tyres, which requires a significant amount of effort to return to a "new" condition, mainly due to the essential interlocking pattern in which the tyres need to be assembled.

Photo A15.4



Shows the extent of collapse of earth backed tyre barriers of a period. The height of the barrier is well under 1000mm at the time of the photo being taken. Corrective measures included addition of additional rows of tyres, linking them to the other rows, filling the tyres with earth and covering them to protect the rope from UV degradation.

Photo A15.5



Shows house brick pattern of construction essential for Earth Backed Tyre Barriers.

Photo A15.6



Demonstrates good vertical alignment and excellent continuity of face of barrier.

Photo A15.7



Shows the difficulty in constructing an Earth Backed Tyres barrier on the ridge of a hill. There is a considerable amount of earth required to provide an adequate earth backing to provide appropriate mass behind the tyre face.

Photo A15.8



The earth backed tyre barriers at this race track have been constructed using light truck tyres, which tend to be more robust and resist collapsing. An important consideration in approving the use of light truck tyres over passenger car tyres was the acceptance to the principle of “greater than adherence to the minimum ideal requirements for run off area and verge width” by the track operator when the layout of the track and the barrier alignment was being considered.

Photo A15.9



Another view of the earth backed tyre barriers at Morgan Park. This photo was taken to demonstrate the preparation of the area which was undertaken to afford a flat and level base for the barrier to be constructed. The tyres were built up row by row, to aid ease of filling with earth and the tyres were backfilled using a grader and a front end loader.

Photo A15.10 Lydden Hill UK



Shows the use of light truck tyres, used against a cut-in bank to retain a vertical face, and a single row of passenger car tyres, to which a long run of conveyor belt facing would later be added.

Photo A15.11



Shows a partial use of an earth backed tyre barrier sitting on top of a graded vertical earth face, the combination of both producing the required height of 1000mm.

Appendix 16 – Tyre Buffers

A16.1 General

CAMS uses the term “buffer” to describe a deformable apparatus used for partially dissipating energy of a car striking the apparatus. A tyre buffer therefore is a buffer constructed of tyres. There are other buffer systems used in motor sport, such as the “Tyson” buffer and the “TecPro” barrier. Tyre buffers are normally placed where an impact with a barrier is likely to occur at an angle generally of between 30 degrees and 90 degrees to the barrier.

The ideal buffer system will comprise of car tyres of uniform diameter which are vertically linked by bolting to form a “stack”. Adjacent stacks are linked into stacks of e.g. 2 x 3 stacks, to form a “bundle” and the bundles are then linked to adjacent bundles to form a homogenous buffer which is placed in front of, and linked securely to, permanent 1LoP barrier. At least two rows of such a buffer are required at all location where tyre buffers are used, and three is preferable, unless specific approval to the contrary is obtained from CAMS.

All tyre buffers perform more effectively and suffer less damage under most impacts if they are faced by a steel corded conveyor belt of the same height as the buffer. The facility is more difficult to repair if extensively damaged, but damage is generally contained by the conveyor belt. Conveyor belt facing also presents a face suitable for sign writing.

A16.2 Tyre Buffer Construction

Severely worn tyres, which provide reduced impact resistance, should not be used. New “reject” tyres are ideal, and can often be obtained from local tyre manufacturers.

The tyre buffer should be at least as high as the permanent barrier which it will be placed in front of (1000mm minimum height).

Three types of tyre buffer construction are suggested viz., rodded, chained and bolted with the bolted construction method being preferred, although other types of construction may be approved, individually, by CAMS for particular applications.

The 3 types permitted are illustrated herein and are subject to the following general considerations:

- Individual tyres should be vertically secured to each other to form a “stack”.
- Stacks of tyres should be horizontally secured to each other (5 or 6 stacks) to form a “bundle”
- Bundles may then be horizontally secured to each other (both to the side and to the front) to form a double row tyre “buffer”.
- There should be a firm, smooth surface under the tyre buffer.
- A tyre buffer in contact with a first line of protection should be securely attached to it at least at 4m intervals.

- Where the first line of protection is constructed of steel beam guard rails, the first tyres should be placed behind the line of the preceding guardrail (mandatory for all new installations). This guardrail will retain its original alignment, the rail behind the tyres being moved back to achieve an overlap.
- Narrow walled or "racing" tyres may not be used as the front row in a tyre buffer installation.
- If marshals' access is required across the top of the barrier, conveyor belting should be placed on top of the buffer to minimise risks.
- Other types of tyre buffer not fixed to a rigid structure, may be authorised for particular cases (e.g. overlapping bundles to form a chicane in an escape road), but should be a minimum 1 metre high and of least three rows attached to each other.
- Note: Since rubber deteriorates in time from exposure to the elements, tyre buffers will require to be replaced or supplemented as necessary.

A16.3 Rodded construction tyre buffer

Rods of 6mm round mild steel bar stock are used to secure each stack of tyres.

Two 25mm holes are cut in both sidewalls at 180 degrees around the tyre.

Each rod is passed through only the lower sidewall of the top tyre in each stack, although through both sidewalls of the other tyres. A lifting ring is inserted at the top tyre. The rods are then bent over through the middle of the tyres to overlap and arc welded together.

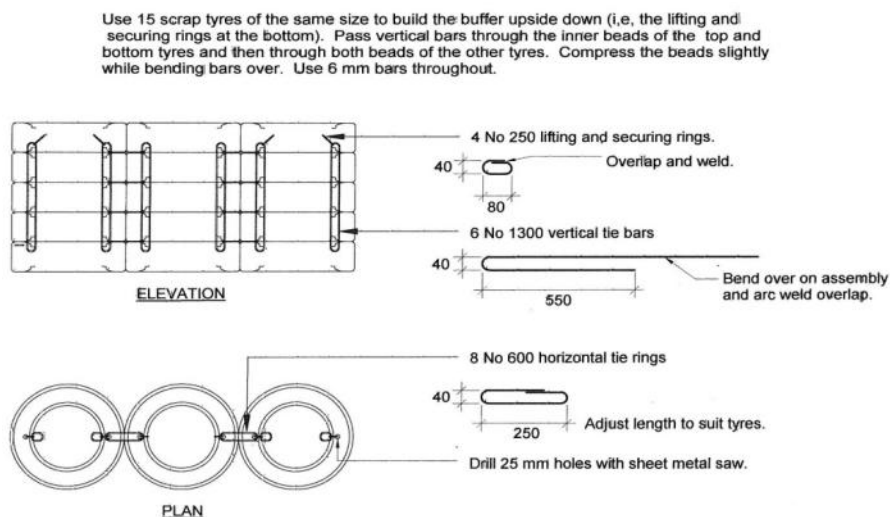
Each stack is then joined horizontally to the next by using 2 tie rings of 6mm rod for each pair of stacks.

Stacks may be joined in infinite numbers, however for convenience (for moving bundles etc); stacks of 5 or 6 are practical.

A further row is then required to conform to the minimum criteria of a two row tyre buffer.

The front row and any subsequent rows should be attached to row behind with at least 3 attachments for each bundle.

The following drawing shows a typical example of a rodded tyre buffer and offers some guidance in assembling the system.



A16.4 Chained construction tyre buffer

5mm chain is used to secure each stack of tyres. Chain ends and other connections are made using "D" shackles.

Two 25mm holes are cut in both sidewalls at 180 degrees around the tyre.

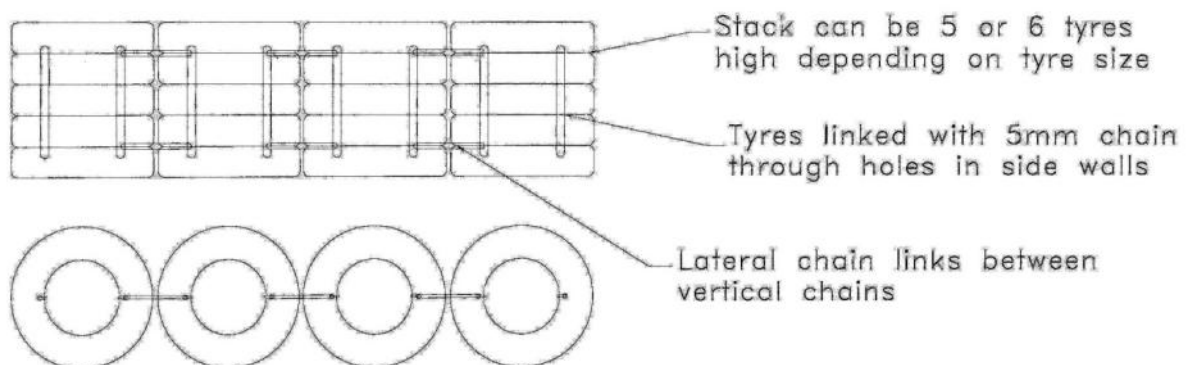
A length of chain is passed through both sidewalls of all tyres. The tyre stack is compressed and a "D" shackle connects each end of chain.

Each stack is then joined horizontally, at the top and bottom, to the next stack by using short lengths of chain and "D" shackles.

Stacks may be joined in infinite numbers, however for convenience (for moving bundles etc); stacks of 5 or 6 are practical.

A further row (offset horizontally by $\frac{1}{2}$ a tyre stack) is then required to conform to the minimum criteria of a two row tyre buffer.

Each tyre stack in the front row and any subsequent rows should be attached to each adjacent tyre stack in the row behind with at least 2 attachments for each stack.



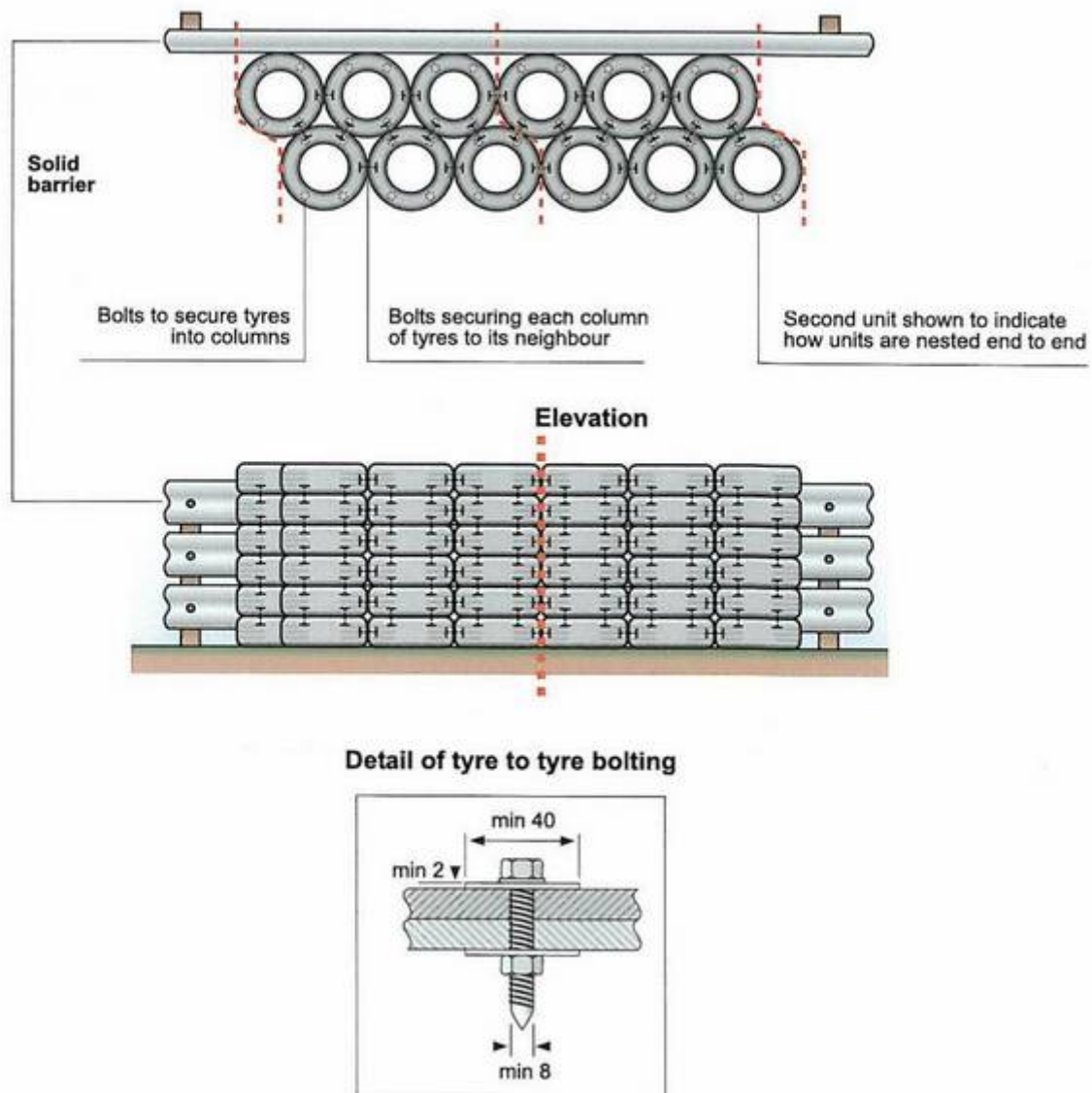
Note: This is the basic configuration to show the principle
Extra links and layers can be added as required

A16.5 Bolted construction tyre buffer

Individual tyres are to be secured to each other, vertically and horizontally using adequate bolts, min. 8mm, and hexagonal nuts with large steel washers or plates, min. diameter 40mm, min. thickness 2mm, on both sides.

Tyres are placed so that the one above overlaps two below it, as in a brick wall construction.

This method is primarily used for an in-situ tyre buffer which is unlikely to require moving. Additional tyres can be placed into the buffer, both in width and depth, as required.



Appendix 16 – Conveyor Belt facing

A16.1 General

It is strongly recommended that the outer vertical face of the completed tyre buffer be covered by a continuous, reinforced flexible sheet or belt to increase the vehicle attenuation properties and to substantially improve the integrity and effectiveness of the tyre buffer system.

Reinforced steel corded rubber industrial conveyor belting (either new or used) of minimum thickness of 14mm, is appropriate for this purpose.

Conveyor belting can be used at many places around a circuit but is most useful in front of multi row tyre buffers. It is recommended for those areas where head on impacts or impacts at greater than 60 degrees are likely.

Conveyor belting can be used in other areas, for example for facing an earth backed tyre wall in order that advertising sign writing may be applied or in areas where simple containment of tyre buffers is required.

The thickness and type of conveyor belting will depend on the purpose of which it is being used. Generally, areas where the facing material is used to assist the load transfer in a tyre buffer system should utilise thicker, steel belted/corded conveyor belt.

Experience with fabric cored conveyor belt indicates that it tears on impact so repair costs increase significantly.

A16.2 Assembly

The lower edge of the belt should be in contact with the ground and the upper edge should be at least the same height as the top of the tyre buffer.

It is essential that each end of the conveyor belt is securely attached to the first line of protection and that any joints or attachments of the conveyor belting to the first line of protection are protected from any possible impact by vehicles.

It may be possible for the conveyor belt to be “wrapped around” concrete barriers or triple high guard rail.

The belt should be fixed directly to the wall or guardrail at each end. The preferred attachment is to sandwich the conveyor belting between two 10 mm by 75 mm steel strips, fastened by 12 mm bolts, positioned each 200 mm. These attachments should then be anchored to the first line of protection via at least four lengths of 5 mm chain or the equivalent wire strand cable. Separate (round) washers should not be used for this purpose.

The belt should also be bolted to the tyre buffer in at least two points in every third tyre stack at the second tyre from the bottom and the second tyre from the top of the stack, using either min. 8 mm round head bolts with round steel washers at least 40 mm in diameter, or by inserting long self drilling screws into the belting from through the tyres and grinding off the excess thread. Belts should not be joined, however if there is any overlap, the lapping should

be in the appropriate method and the overlap should be equal to at least twice the height of the belting and be bolted to the tyre barrier in at least four points using min. 8 mm round head bolts with round steel washers at least 40 mm in diameter on the conveyor belt and the inside of the tyre.

Should the conveyer belt be higher than the tyre stack, it may be bent over at the top and fastened appropriately.

Photo 59 Conveyor Belt facing



Photo 60 Conveyor Belt facing



Photo 59 Conveyer Belt facing – Marshals Access



Photo 60 Conveyer Belt facing



Appendix 17 – Examples of tyre buffers

Photo A17.1 Two row tyre buffer



Tyres stacks in this example are linked vertically by a series of threaded rods through the tyre sidewalls and horizontally by a chain (some of which is visible at the front). The horizontal chain is connected to the concrete 1LoP at intervals of about 8m.

Photo A17.2 Two row tyre buffer with conveyor belt facing



Tyres stacks in this example are linked vertically by chains through the sidewall (holes are spaced at 90 degrees) and then the stacks are linked to each other by a further system of chain, effectively allowing several stacks to react together when one stack is deformed by an impact, thus spreading a load over several stacks. The conveyor belt is attached to each second stack by bolts with 50mm washers under the bolt head. A steel sandwich plate which is in turn attached to a chain and tensioning arrangement behind the belting (a simple turnbuckle) is visible.

Photo A17.3 Five row tyre buffer with conveyor belt facing.



This is a similar arrangement to that noted above at Eastern Creek, but with an additional three rows of tyres. The additional 3 rows require significant chaining systems to ensure consistent load spreading and resistance to bunching to form a ramp. This buffer system is placed at a location where the speed of an impact can be upwards of 200 km/h

Photo A17.4 Tyre buffer “Mushroom” Lydden Hill UK



Example of a system of tyre buffers which are designed to be fitted to the exposed end of a barrier or guardrail. Note the inclusion of a truck tyre stack around which the car tyre stacks are located. This improves load distribution over a greater area.

Photo A17.5 Conveyor belt facing attachment Lydden Hill UK



Shows relative size of washers used to fasten conveyor belt to the tyre stacks

Photo A17.6 Free Standing tyre buffer



This unusual arrangement is designed to provide an effective barrier between two portions of a race circuit, where there exists a risk of cars on the track being (T Boned) hit by errant cars driving over a verge. The arrangement provides an appropriate amount of buffering, as it will slide along the grass surface as well as deform the tyres, and acts as a barrier to prevent a T Bone (this type of buffer weights about 1.7 Tonnes per 10 tyre stacks). A three row depth is important to reduce the risk of the tyre buffer overturning on impact and creating a ramp effect.

Photo A17.8 Two row tyre buffer with Conveyor belt facing



Demonstrates the high number of collisions with conveyor belt facing, which may have resulted in significantly higher levels of maintenance to the tyre buffer4s if the facing had not been installed and also the effect of weathering on some types of conveyor belt rubber. This installation is fabric-corded. Steel-corded belting is stronger and in some cases more resistant to the effects of weathering.

Photo A17.9 Tyre buffer protection of barrier end



This tyre buffer arrangement was considered to be insufficient and was required to be replaced by a number of tyre stacks surrounding the earthmover tyre and then faced with conveyor belt, as is shown in the following photograph.

Photo A17.10 Tyre buffer protection of barrier end



Photo A17.11 Tyre buffer protection of pole



This pole is located in a very low risk area; nevertheless it is required to be suitably protected.

Photo A17.12 Linked Tyre Buffers



Tyres in vertical stacks, linked by 1/4 inch rod with horizontal linking by chain and D shackle. The system could be improved by adding a D shackle to the lower attachment.

Photo A17.13 Methods of linking stacks of tyres



Shows a typical rodded construction technique. It is essential that the rods (or chains) are passed through the tyre sidewalls and then bent and connected (welded) together in the internal circle (hole) of the tyre.

Photo A17.14 Methods of linking stacks of tyres – Lydden Hill UK



Shows bolting of tyre stacks, using large diameter washers on all connections

Photo A17.15 Methods of linking stacks of tyres – Not recommended!



This sample buffer stack was constructed to demonstrate how something which may look right does not actually perform as it may be first expected. The wire holding the tyres together has a low tensile strength which leads to easy deformation of the tyre buffer system. The tyres used for this example are racing car tyres, which generally do not demonstrate the same performance that passenger car tyres do.

Photo A17.16 Methods of linking stacks of tyres.



Clearly shows the propensity for tyres to collapse over time. The protruding rods are a significant risk to drivers, particularly in open cars. Overall, the collapse of the tyre buffers has reduced the performance of the buffer system

Photo A17.17 Methods of linking stacks of tyres.



This is a very good demonstration of a pattern for linking tyres to spread the load of the impact through several tyres stacks when hit by a car. However the strength of the rope is probably the limiting factor in the determination of the performance of the system. Repairing these tyres would be time consuming. Use of appropriate chain (5mm wire diameter of links) may produce a far more robust buffer.

Photo A17.18 Methods of linking stacks of tyres



Shows neat and tidy construction of tyre stacks by bolting, using appropriately sized washers on each fastener.

Photo A17.19 Methods of linking stacks of tyres



Each stack of buffer tyres has a pair of eye bolts inserted on top and bottom to allow rapid deployment and adequate linking by chains.

Photo A17.20 Methods of linking stacks of tyres



An in-situ arrangement demonstrating use of chain to link tyre stacks together and also tie them to the rear barrier. Linking tyre stacks in this manner provides for energy dissipation throughout the system and retains tyres in position in relation to the barrier.

Photo A17.21 Methods of linking stacks of tyres



At some temporary circuits, tyres have been permitted to be linked using several nylon packaging strap as links for each tyre stack. This method of tyre buffer construction is not considered appropriate for permanent venues as the strapping tends to deteriorate though exposure to Ultra Violet light and the degradation of the linking systems tends to be not visible. A more recent application at this venue has seen tyre stacks bolted together, which tends to offer superior performance as well as longevity of the buffer arrangement.

Photo A17.22 Methods of linking stacks of tyres – Not recommended!


Demonstration of what can happen to an ill-designed and incorrectly assembled buffer – it is easily distorted after a single low speed impact and no longer offers the high degree of integrity which it may have once had. Note how the easy distortion of the stack has been accelerated by the linking arrangements not protruding through the tyre wall and the use of wide and narrow sidewall race car tyres.

Photo A17.23 Deployment of temporary tyre buffers


Preparation of tyre buffers in advance and linking them together in an appropriate manner saw that the deployment of a tyre buffer in an emergency was a relatively easy method to provide surety for the continuation of a race meeting after the 1LoP barrier was destroyed in an incident.

Appendix 18 – Run off area Formulae and Application

A18.1 Current FIA formula for Calculating Escape Line Lengths

For all new circuits, run off area calculation will be undertaken using the current FIA formula.

Calculating the run off area is undertaken in two steps.

The purpose of step 1 is to deduce a figure which represents the speed at which the car leaves the track edge. This takes into account the cars speed at the point at which is deemed to lose control and also the distance on the track available for decelerating along a path tangent to the racing line. This line commences at the point at which the car was deemed to lose control.

The figure deduced from the equation is then used in step 2.

The purpose of step 2 is to deduce the distance required over the verge so that the car can decelerate from the speed at which it left the track edge to 0 kph.

This distance will become the length for the escape line of the point at which loss of control occurred. An example is given below:

Figure A18.1.1 Example of calculation of the area on the outside of a corner

- EXAMPLE OF CALCULATION OF THE AREA ON THE OUTSIDE OF A CORNER

(this calculation shall be repeated for all escape lines in a corner)

Step 1 : Deceleration on-track

The purpose of step 1 is to deduce the speed at which the car leaves the track (V_{track}) taking into account the distance on the track available for decelerating (d_{track}). The initial speed is the speed at which the car loses control (i.e. 230kph).

The deceleration rate on track is: $y_{\text{track}} = 0.0057 \cdot V + 0.89$

d_{track} (measured on the plan) = 64.37 m

$$d_{\text{track}} = \frac{(V_{\text{track}} - 230)}{-0.0057 \times g \times K^2} + \frac{0.89}{0.0057^2 \times g \times K^2} \times \ln \left\{ \frac{0.0057 \times V_{\text{track}} + 0.89}{0.0057 \times 230 + 0.89} \right\}$$

with $g = 10 \text{ m/s}^2$ and $K = 3.6$

The speed V_{track} is deduced by a numerical method. In this case, $V_{\text{track}} = 142 \text{ kph}$

Step 2 : Deceleration off-track

The purpose of step 2 is to deduce the distance ($d_{\text{off-track}}$) so that the car can decelerate from $V_{\text{track}} = 142 \text{ kph}$ to 0 kph.

The deceleration rate off track is: $y_{\text{off-track}} = 0.0030 \cdot V + 0.70$

$$d_{\text{off-track}} = \frac{142}{0.0030 \times g \times K^2} + \frac{0.70}{0.0030^2 \times g \times K^2} \times \ln \left\{ \frac{0.70}{0.0030 \times 142 + 0.70} \right\}$$

with $g = 10 \text{ m/s}^2$ and $K = 3.6$

$d_{\text{off-track}} = 80 \text{ m}$

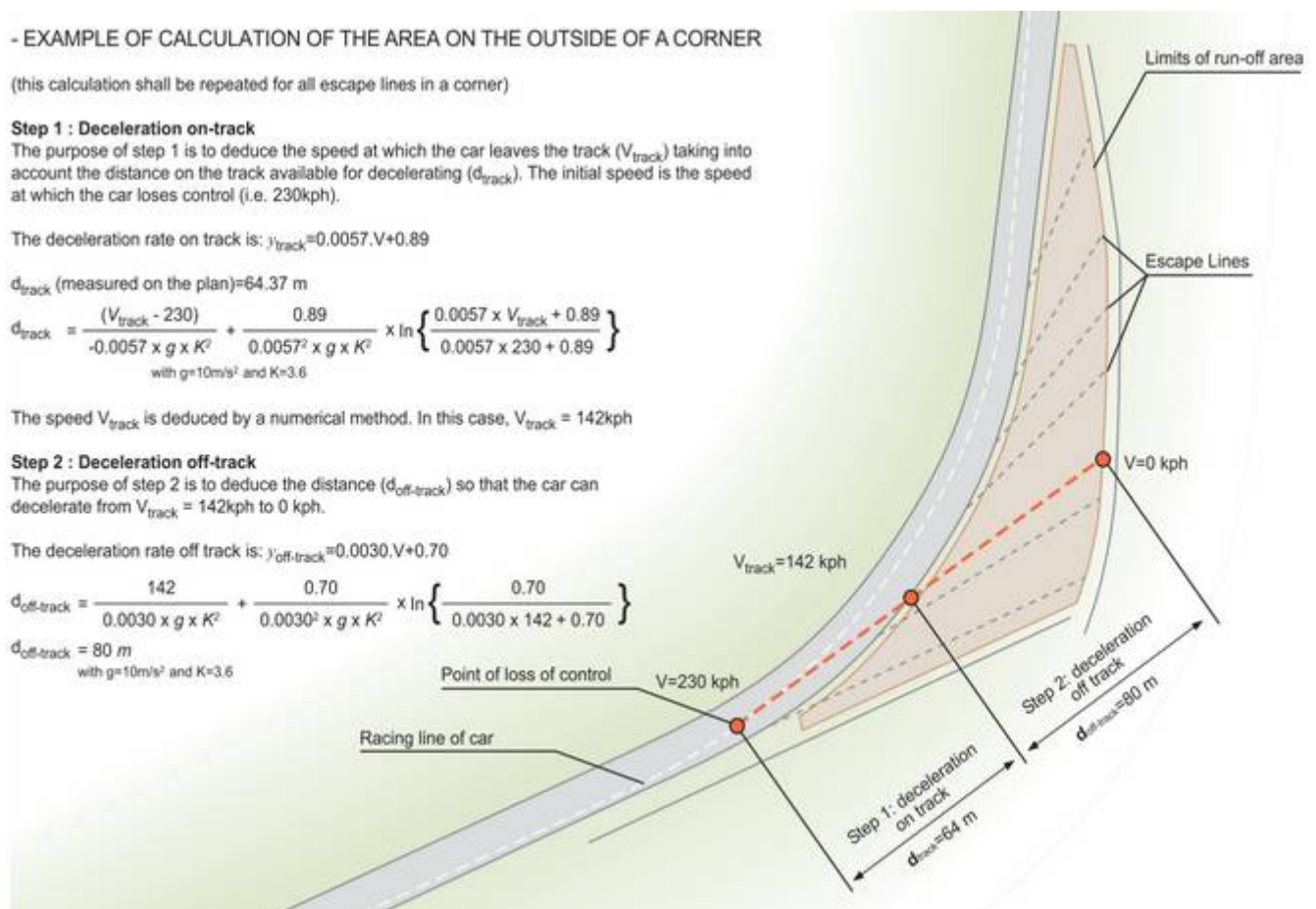


Figure A18.1.2 Table for determining the escape line length

Vitesse lors de la perte de contrôle (km/h) Loss of control speed (kph)	Longueur de décélération jusqu'au bord de la piste (m) Length of deceleration up to the track edge (m)																											
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	
60	17	10	3																									
65	20	13	6																									
70	23	15	8	2																								
75	26	19	12	5																								
80	29	22	15	8	1																							
85	32	25	18	11	4																							
90	36	28	21	14	8	1																						
95	39	32	25	18	11	4																						
100	43	36	29	21	14	8	1																					
105	47	40	33	25	18	11	5																					
110	51	44	37	29	22	15	8	2																				
115	55	48	41	33	26	19	12	5																				
120	60	52	45	38	30	23	16	9	3																			
125	64	57	49	42	35	28	20	14	7																			
130	69	61	54	46	39	32	25	18	11	4																		
135	73	66	58	51	44	36	29	22	15	8	1																	
140	78	70	63	56	48	41	34	27	19	13	6																	
145	83	75	68	61	53	46	38	31	24	17	10	3																
150	88	80	73	65	58	50	43	36	29	22	15	8	1															
155	93	85	78	70	63	55	48	41	34	26	19	12	6															
160	98	90	83	76	68	61	53	46	38	31	24	17	10	3														
165	103	96	88	80	73	65	58	51	44	36	29	22	15	8	1													
170	109	101	94	86	79	71	63	56	49	41	34	27	20	13	6													
175	114	107	99	91	84	76	69	61	54	46	39	32	25	18	11	4												
180	120	112	105	97	89	81	74	67	59	52	44	37	30	23	16	9	2											
185	125	118	110	102	95	87	80	72	65	57	50	42	35	28	21	14	7											
190	131	123	116	108	100	92	85	78	70	63	55	48	41	33	26	19	12	5										
195	137	130	122	114	106	99	91	83	76	68	61	53	46	39	31	24	17	10	4									
200	143	135	127	120	112	104	97	89	81	74	66	59	52	44	37	30	23	16	9	2								
205	149	141	134	126	118	110	102	95	87	80	72	65	57	50	42	35	28	21	14	7								
210	155	147	139	132	124	116	108	101	93	85	78	70	63	55	48	41	34	27	19	12	6							
215	161	153	145	138	130	122	114	107	99	91	84	76	69	61	54	47	39	32	25	18	11	4						
220	167	160	151	143	136	128	120	113	105	98	90	82	75	67	60	52	45	38	31	23	16	9	3					
225	174	165	158	150	142	134	127	119	111	103	96	88	80	73	65	58	51	44	36	29	22	15	8	1				
230	180	172	164	156	148	140	132	125	117	110	102	95	87	79	72	64	57	49	42	35	28	21	13	7				
235	186	179	170	163	155	147	139	131	124	116	108	100	93	85	78	70	63	55	48	41	33	26	19	12	5			
240	193	185	177	169	161	153	145	138	130	122	114	107	99	91	84	76	69	61	54	47	39	32	25	18	11	4		
245	199	192	184	175	168	160	152	144	136	128	121	113	106	98	90	82	75	67	60	53	45	38	31	24	17	10	3	
250	206	198	190	182	174	166	159	151	143	135	127	119	112	104	97	89	81	74	66	59	51	44	37	29	22	15	9	
255	213	205	197	189	180	173	165	157	149	142	133	126	118	110	103	95	88	80	73	65	58	50	43	36	28	21	14	
260	219	211	203	195	188	179	172	163	156	148	140	132	125	117	109	102	94	87	79	71	64	57	49	42	35	27	20	
265	226	218	210	202	194	186	179	170	162	155	147	139	131	124	116	108	100	93	85	77	70	63	55	48	41	33	26	
270	233	225	217	209	201	193	185	177	169	162	154	146	138	130	123	115	107	99	92	84	77	70	62	54	47	40	32	
275	240	232	224	216	208	200	192	184	176	169	160	152	145	137	129	121	114	106	98	91	83	76	68	60	53	46	39	
280	247	239	231	223	215	207	199	191	183	175	167	159	151	143	136	128	120	113	105	97	90	82	75	67	60	52	45	
285	254	246	238	230	222	214	206	198	190	182	174	166	158	151	143	135	127	119	111	104	96	89	81	74	66	59	51	
290	261	253	245	237	229	221	213	205	197	189	181	173	165	157	149	142	134	126	118	111	103	96	88	81	73	65	57	
295	268	260	252	244	236	228	220	212	204	196	188	180	172	164	156	149	140	133	125	118	110	102	94	87	80	72	64	
300	275	268	259	251	243	235	227	219	211	203	195	187	179	171	163	155	148	140	132	124	116	110	101	94	86	78	71	
305	283	275	267	258	250	242	234	226	218	210	202	194	186	179	170	162	155	147	139	131	124	116	108	100	93	85	78	
310	290	282	274	265	258	250	241	233	225	217	209	201	193	186	177	170	162	154	146	138	131	123	115	107	100	92	84	
315	297	289	281	273	265	257	248	241	232	225	217	209	201	193	184	177	169	161	153	145	138	130	122	114	107	99	91	

A18.2 Previous Formula for calculation of run off area on the exterior of a corner:

This formula represents the method of calculation used for most existing Australian race circuits. It requires inputs of the speed of the car, the known or anticipated turn in point and the gradient of the verge on the exterior of the corner.

The barrier should be a continuation of the protection for both the preceding and following straights, installed at an appropriate location beyond the edge of an area of free space, the shape of which is determined by the application of the following formulae, using the trajectory/racing line as a datum. (See also Figure A18.2.1)

a) Extending along the tangent to the track edge, from the beginning of the point of divergence from the previous straight of the trajectory/racing line through the corner ("the turn in point"), extending over a distance at least equal, in meters, to $V^2/300$.

Where V= the greater of the average of the entry speed and the corner speed (expressed in km/h); or, the entry speed (expressed in km/h).

The result of this calculation will be known as distance D1.

b) Then connecting a point on a number of lines, drawn at any point tangential to the trajectory/racing line, (such lines should be drawn at least at 10 degree increments from the turn in point) through an arc of up to 80 degrees from the turn in point into the corner. The length of each line must be measured from the track edge and be at least equal to "the braking distance".

The "braking distance" is calculated using the formula $v^2/340 \pm (260 \times i)$ metres.

Where V = the corner speed in km/h; i = gradient of the verge in percentage - -ve for a down grade and +ve for an up grade

The result of this calculation will be known as distance D2.

Only in those cases where the space available is insufficient to use a gravel bed/buffer/barrier system as specified above, may a barrier be positioned at the edge of the track to provide the first line of protection of the exterior of a curve. Such cases are normally only accepted where the corner is taken at a moderate constant speed or under acceleration.

Notwithstanding that the barrier meets all requirements the use of tyre buffers may be required by NTSC Inspectors in any situation.

In exceptional cases, where a risk assessment produces an acceptable result, an escape road may be acceptable at the entry to the curve in lieu of the required amount of free space.

See example at Figure A16.2.1

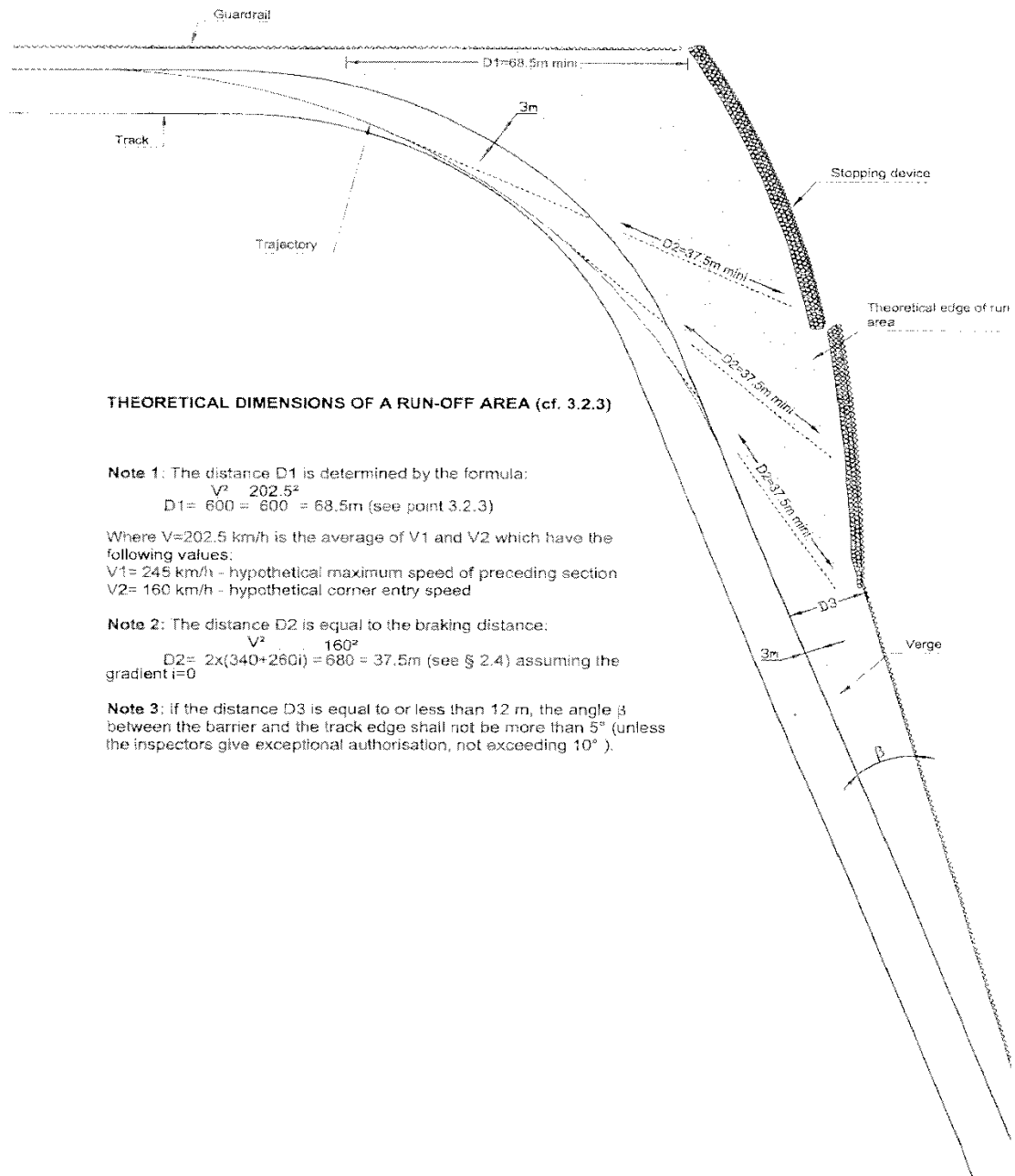


Figure A16.2.1 Calculation of the run off on the outside of a corner

Appendix 19 – Distance Sign Boards

FIA specification for number and background size. In this example, the material proposed is expanded polystyrene foam.

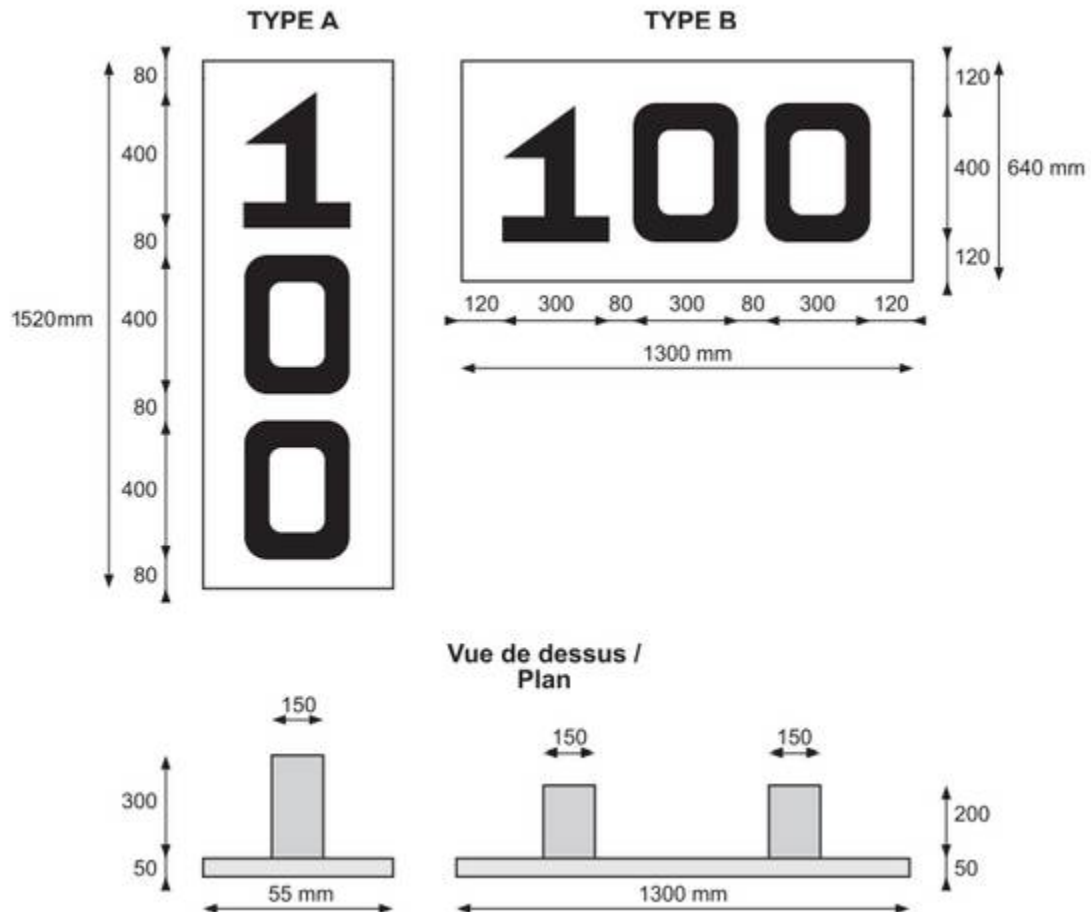


Figure A19.1 FIA specification for number and background size.

Distance signboards, or “brake markers” are important to drivers as it gives them an indication of their location on the track. Thus it is imperative that the location of the board is at the precise location in relation to the corner. For example a 50m sign board must be located 50.0m prior to the point at which the track commences its bend in to the corner viz:

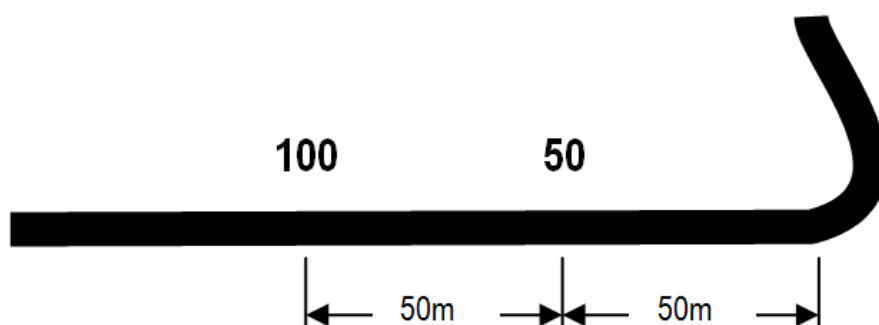


Figure A19.2 – method of calculation of distance from corner for brake markers

Other examples of usable distance sign board constructions are:



Figure A19.3 This example of a 10mm thick corflute panel supported on each side by 38mm conduit. A slot has been cut into the conduit and the brake marker sandwiched between the uprights. Silicone has been used to adhere the corflute to the conduit. The bottom on the conduit is cut approximately 1/3 of the diameter immediately below the ground to promote bending at the desired location should it be struck by a car.

Appendix 20 – Advertising in front of the First Line of Protection

See also Article 12.2.

Any advertising on the walls or guardrails of the first line of protection should be either painted on or in the form of adhesive posters which, in the case of guardrails, should follow exactly the contours of the rail.

The use of lightweight, flexible panels fixed to the front of the first line of protection, but not extending above it may be authorised only in areas that are far from the track and where impacts will in all probability be perpendicular to these structures. The use of advertising panels is prohibited on barriers parallel, or near parallel to the track and/or to the trajectory of the racing vehicles. Any such installations may only be approved by CAMS.

All other advertising between the track and the first protection barrier is prohibited, with the exception of advertising panels, which must meet the specifications noted below and which are added to the venue for an event.

Location:

The location of each such sign must be approved (a) by the Clerk of the Course, or (b) the appointed CAMS Race Director (if there is one so appointed by CAMS), or (c) alternatively, be agreed by CAMS.

They must be positioned so as to in no way obstruct the vision of marshals or drivers in race conditions.

They must not be positioned on the exterior or on either side of the exit of corners.

They must not be situated less than 3 m from the track edge.

Design:

All such signs must be frangible and designed to break if impacted by a car into lightweight, harmless pieces but also to withstand the wind conditions in which racing may take place.

Non-flammable, expanded polystyrene or similar, maximum 100 mm thick, is generally acceptable. Under no circumstances will metallic sheet or other metallic materials or corflute (twin wall Polypropylene sheet) be permitted.

It is suggested that 38mm polypropylene pipe/conduit, located in the verge by suitable sockets be used to support the signs. Signs will be bored with appropriately sized partial-depth holes, into which the conduit is fitted. The bottom on the conduit is to be cut approximately 1/3 of the diameter immediately below the ground level to promote bending at the desired location to reduce a hazard should it be struck by a car.

Alternative constructions may be considered by CAMS on application..

Tethers must not be used; any articulations and ties should be in lightweight fabric.

Photo A20.1 Polystyrene sign in Verge



Note support for sign using 38mm polypropylene pipe/conduit. When hit by a car the sign disintegrates into virtually weightless pieces.

Photo A20.2 Polystyrene sign in Verge



This sign has been constructed using two 50mm polystyrene sheets laminated together.

Appendix 21 – Openings in the First Line of Protection

The following is an example of the manner in which openings in the first line of protection barriers must be incorporated.

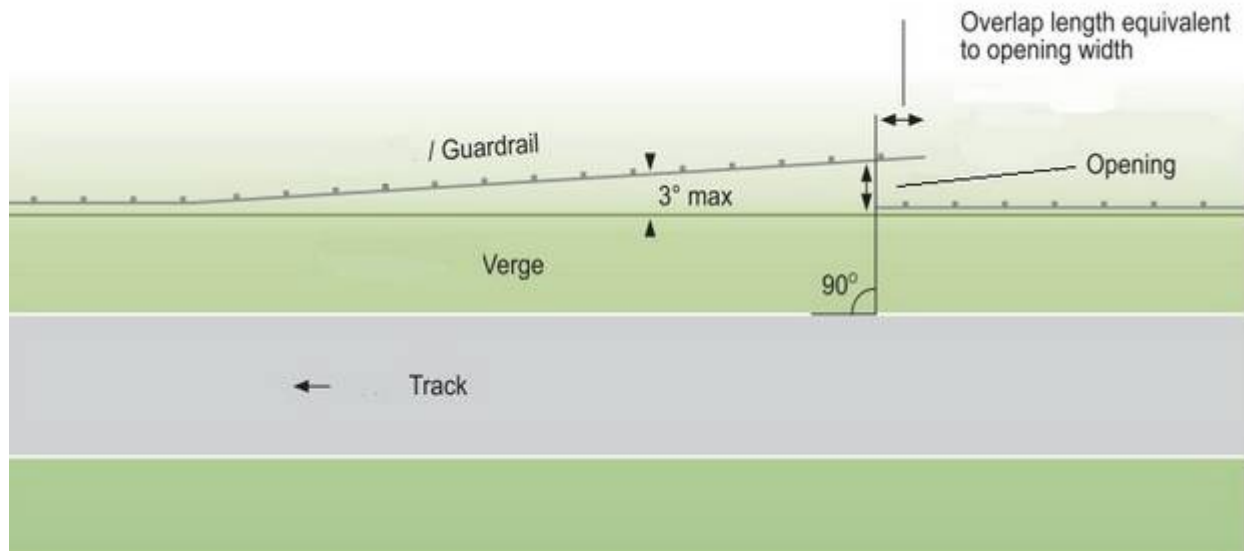


Figure A21.1

Openings of less than 90 degrees are not permitted in new circuits. Existing circuits which do not meet this requirement are required to be specifically approved by CAMS.

Appendix 22 – Pit lane, Pit Entry and Pit Exit Roads

Figure A16.1 Pit Entry Road layout example

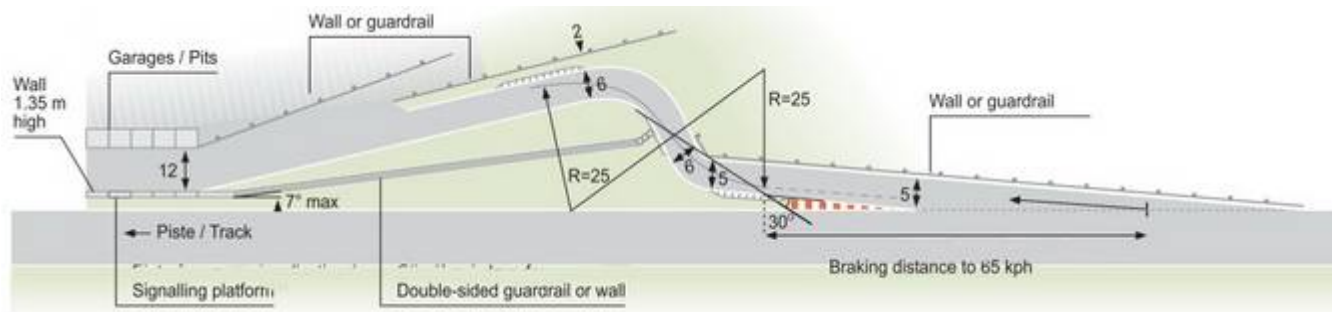


Figure A16.2 Pit Exit Road layout example

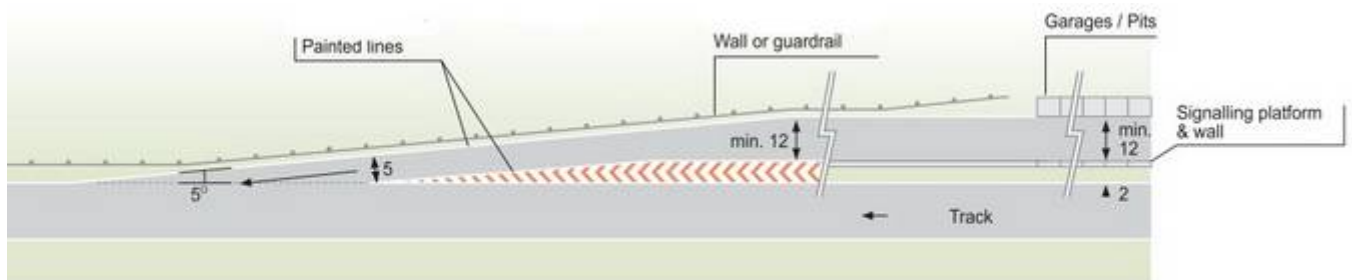
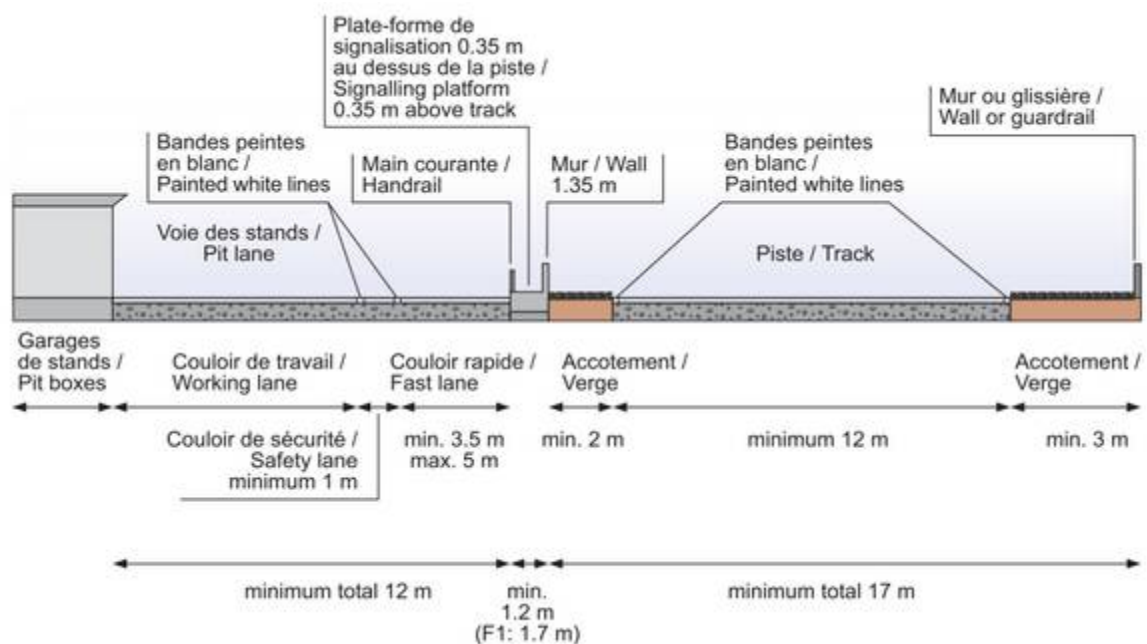


Figure A16.3 Pit Lane cross section example



Appendix 23 – Pit Garage Dimensions

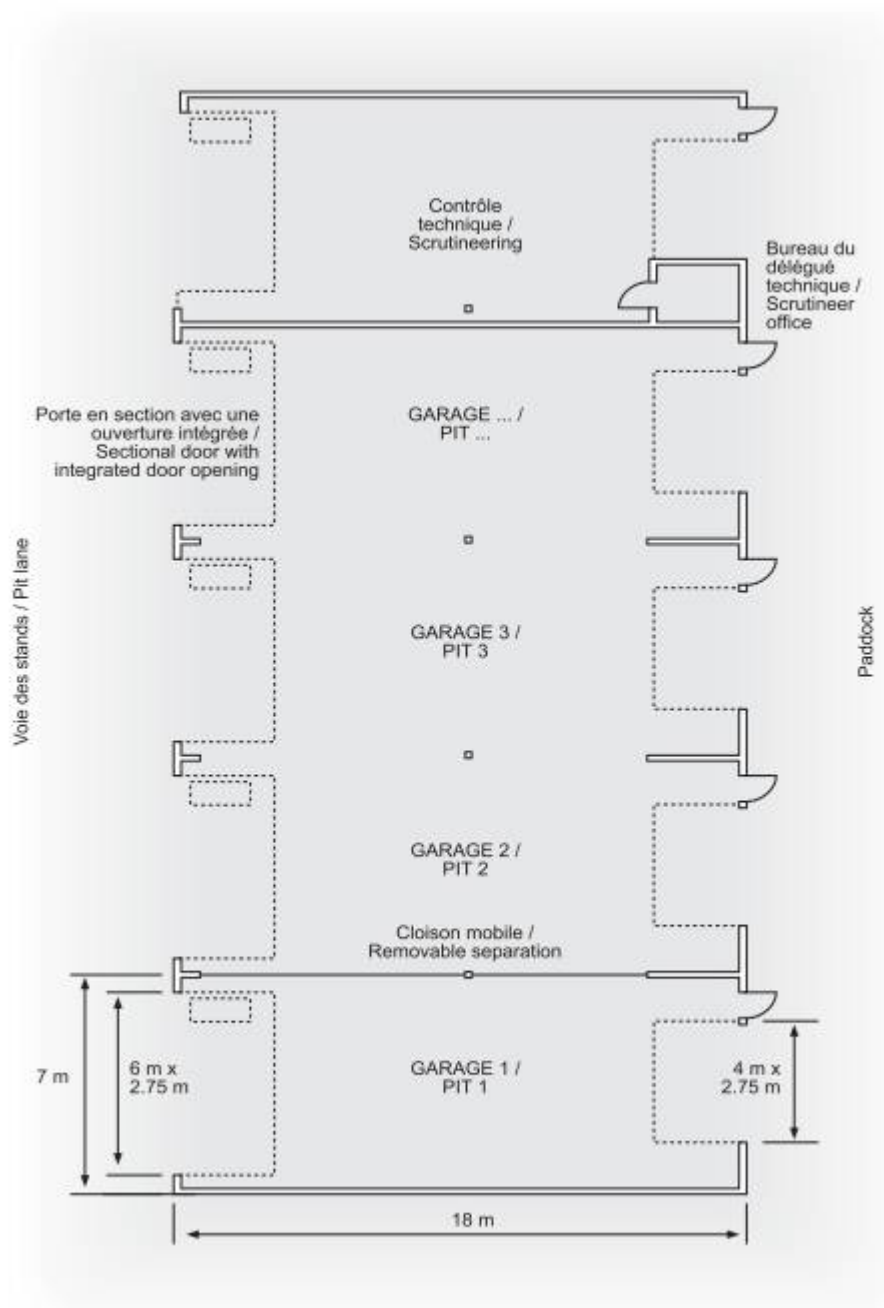


Figure A23.1 Suggested Pit garage layout.

Appendix 24 – Starting Grid Layout

A24.1 Compulsory Grid Layout for all National races held at Australian Race Circuits

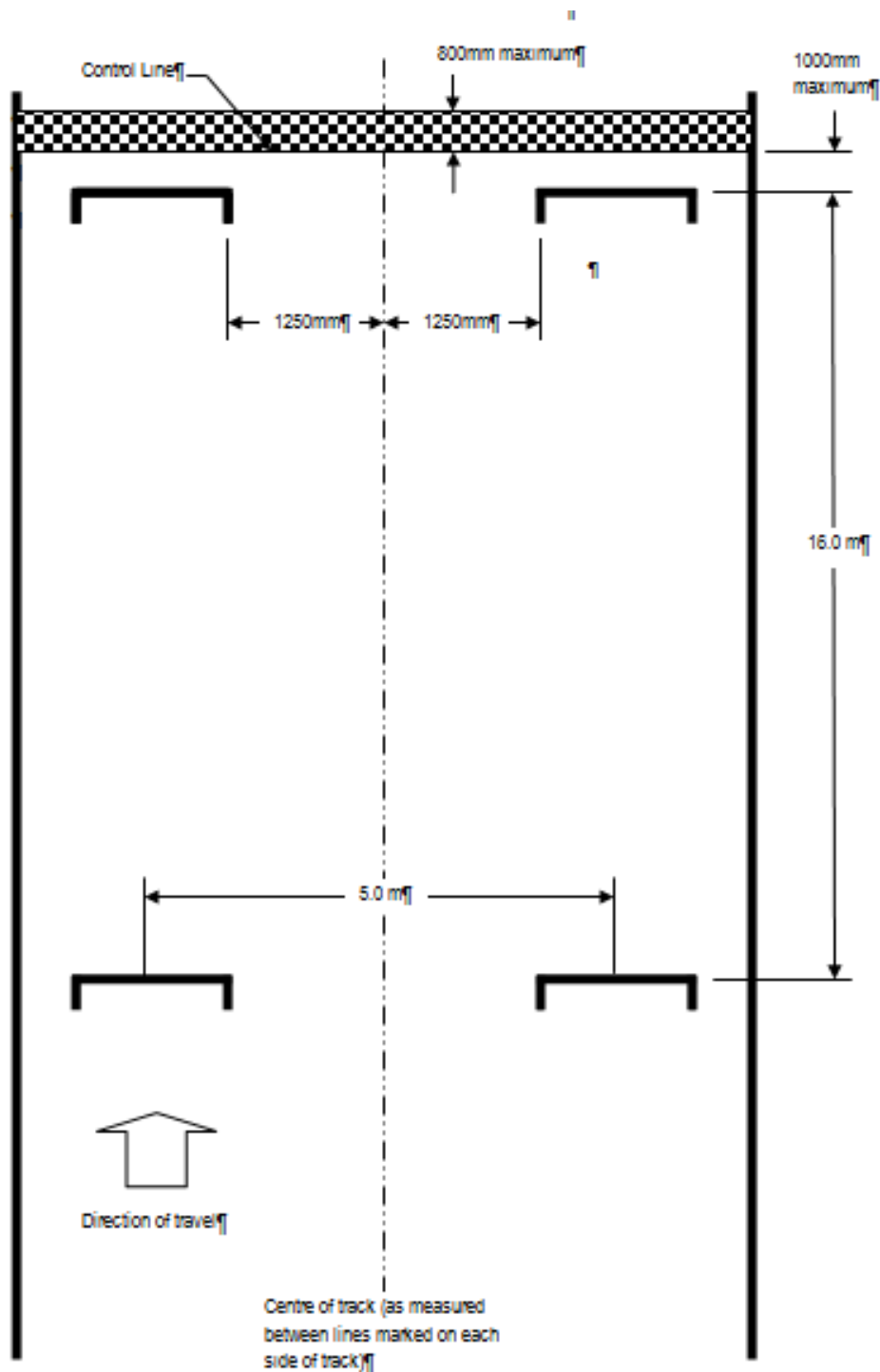


Figure A24.1 – Compulsory Grid layout for Australian races.

A24.2 FIA Grid layout

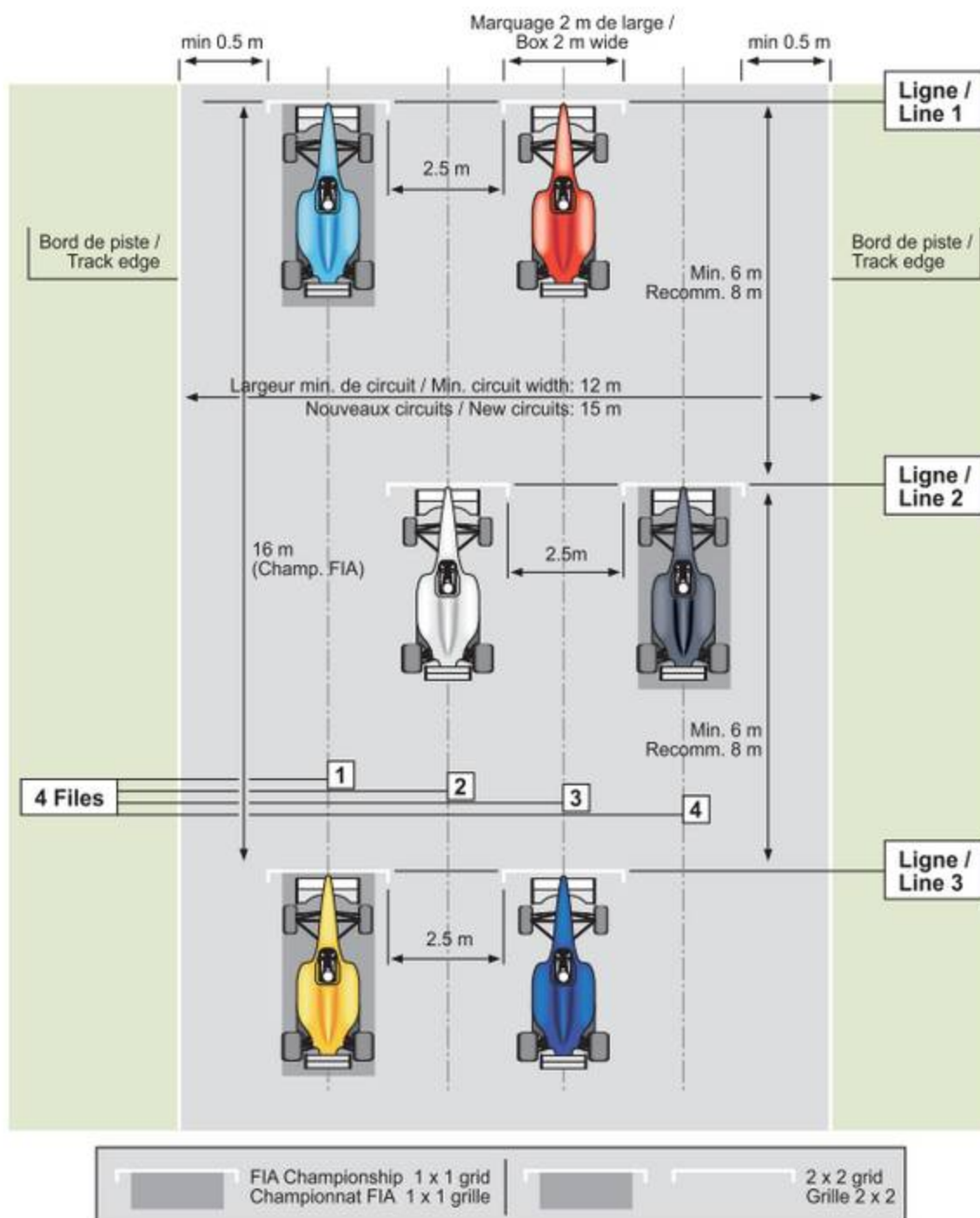


Figure A24.2 – combination FIA grid layout

Appendix 25 – Medical Centre layout

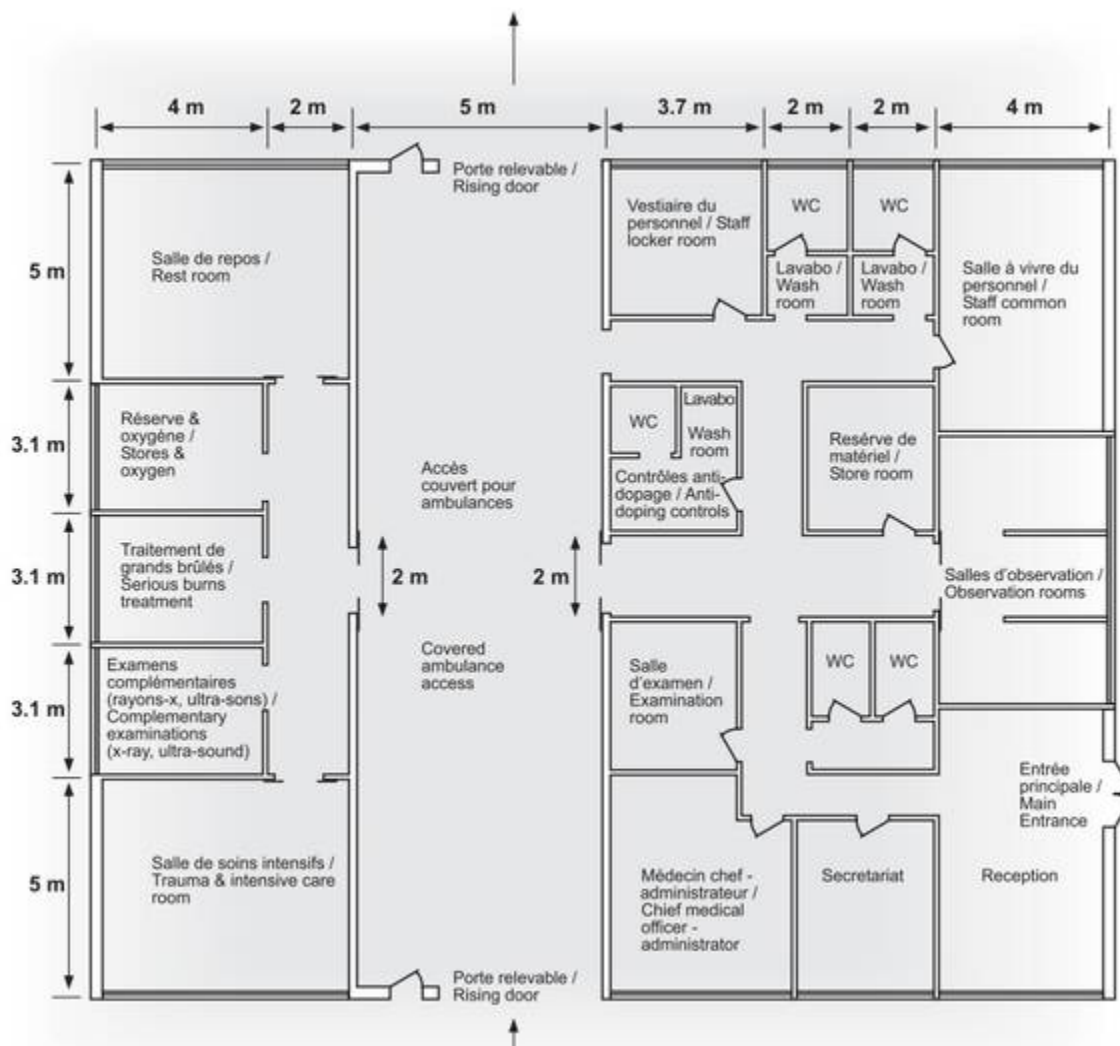


Figure A25.1 Suggested plan for Medical Centre for International Events

Appendix 28 – Track Density Formula

Track Density for races and for other activities at race circuits in Australia is based on the determination of a “base” number, which is then modified by the application of coefficients for various purposes.

The maximum base number (N) is calculated using the following formula:

$$N = 0.36 \times L \times W \times T \text{ (N to be rounded up to the next whole number which is divisible by 2).}$$

Where:

L= a coefficient depending on the length of the circuit, given in table 1 below;

W= a coefficient depending on the minimum width of the circuit, given in table 2 below;

T= a coefficient depending on the duration of the race, given in table 3 below;

To determine the Track Density for individual groupings the base number N is then multiplied by a further coefficient (G) depending on the group(s) of cars competing in the race, or other activity given in table 4 below.

Table 1) - Coefficient “L” [Length]

Length of circuit	Coefficient L
up to 1.6 km	Special case: see note below
from 1.6 km to 2.0 km	8
from 2.0 km up to 2.6 km	10
over 2.6 km up to 3.2 km	11
over 3.2 km up to 3.8 km	12
over 3.8 km up to 4.4 km	13
over 4.4 km up to 4.8 km	14
over 4.8 km up to 5.2 km	15
over 5.2 km up to 5.6 km	16
over 5.6 km up to 6.0 km	17
over 6.0 km up to 8.0 km	18
over 8.0 km	20

NOTE: For circuits up to 1.6 km, each case will be determined separately.

Table 2) - Coefficient “W” [Width]

*, in metres “W” (rounded off to the nearest whole number)

Reference width *	Coefficient W
8	9
9	9
10	10
11	10
12	10
13	11.5
14	12
15 (maximum)	12.5

* = reference width, in metres (rounded off to the nearest whole number) as appears on the track licence and is usually the mean minimum width of the track

Table 3) - Coefficient “T” [Time of race]

Duration of race in hours	Coefficient T
up to 1	1
over 1, up to 2 1	1.15
over 2, up to 4 1	1.25
over 4, up to 12	1.4
over 12	1.5

Table 4) - Coefficient "G"

Category or Class of Car	Coefficient G
Historic Regularity **	1.5
Modern regularity **	1.15
Endurance regularity **	1.0
Group 1	0.6
Group 2	0.8
Group 3	1.0
Group 4	1.15
Group 5	TBA
Supersprint **	0.5

** = Event type coefficient, irrespective of type of vehicles

Exceptions:

Superkarts – 15 karts per kilometre or part thereof, to an maximum of 45 karts.

Trucks – absolute maximum of 20 trucks.

In the case of a race with more than one category of cars, the lowest applicable coefficient will apply.

CAMS may require a reduction in the number of cars allowed to start, compared to the figure given by the formula.

For National Championship races, or races which require a pit stop to be made, the maximum number of cars will be equal to either the figure derived from the above formula, or the number of pit lane stopping spaces provided at the circuit, whichever is the lesser number.

Vehicle Groupings

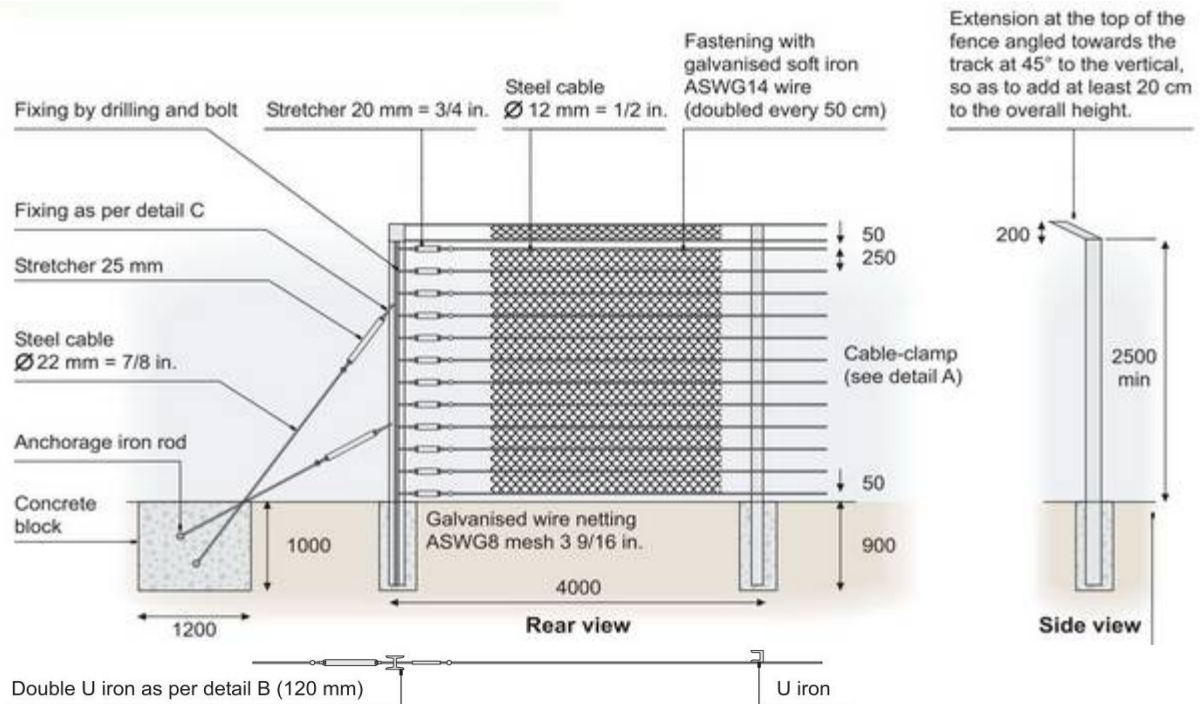
As of 1/1/1012, the following vehicle groupings apply.

Vehicle Class or Category Name	Group
Formula 4000	1
Historic – Formula 5000	1
Radical/Supersports	2
Group 6SR Sports Racer	2
Sports Sedans	2
Historic – Group O - Historic Racing and Sports Racing Cars	2
Historic – Group P - Historic Racing and Sports Racing Cars	2
Historic – Group R - Historic Racing and Sports Racing Cars	2
Historic – Group R – Sports 2000	2
Historic – Group U – Sports Sedans	2
Formula 3 post 2002	2
Formula 3 pre 2002	2
Australian Formula 2	2
Clubman Sports Cars	2
Group 2C Supersports	2
V8Supercars	3
V8 Utes	3
Improved Production Cars	3
Commodore Cup	3
Carrera Cup	3
Porsche GT3 Cup Challenge	3
Formula Ford	3
Road Registered Cars	3
Historic – Group A Touring Cars	3
Historic – Group C Touring Cars	3
Historic – Formula Ford Racing Cars, Fa, Fb, Fc	3

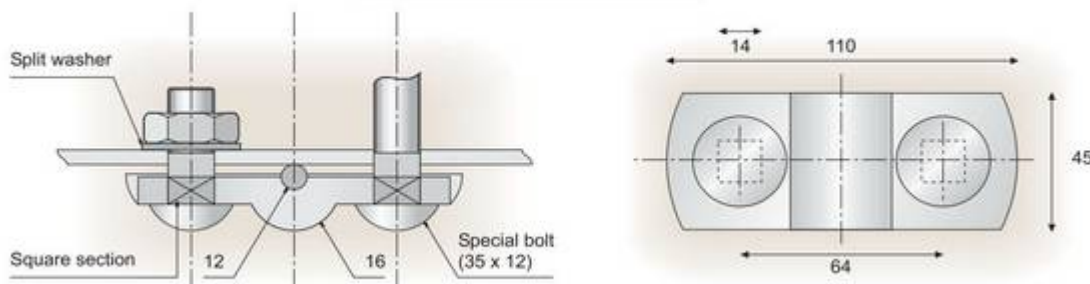
Vehicle Class or Category Name	Group
Historic – Group J – Vintage Cars	3
Historic – Group K – Post Vintage Thoroughbred Cars	3
Historic – Group Lb & Lc – Historic Sports and Racing Cars	3
Historic – Group M - Historic Racing and Sports Racing Cars	3
Historic – Group Na, Nb & Nc – Touring Cars	3
Historic – Group R – Formula Ford 2000	3
Historic – Group Sa, Sb & Sc – Production Sports Cars	3
Historic – Group T – Production Sports Cars	3
Historic – Group Va & Vb – Formula Vee Racing Cars	3
Australian GT	3
Sports Sedans under 2000cc	3
Formula Ford 1600	3
Mini Challenge	3
Suzuki Swift Cup	3
Targa Rally Racing Cars	3
Marque Sports Cars	3
Group 2F: Production Sports Cars	3
Formula Vee	4
Aussie Racing Cars	4
Generic Production Cars	4
Production One Make Formulae	4
Saloon Cars	4
HQ Holden	4

Appendix 29 – Second Line of Protection specification

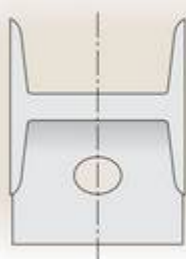
The following drawings provide a guide for the construction of a FIA Specification debris fence for use in areas where car speeds are up to 150km/h.



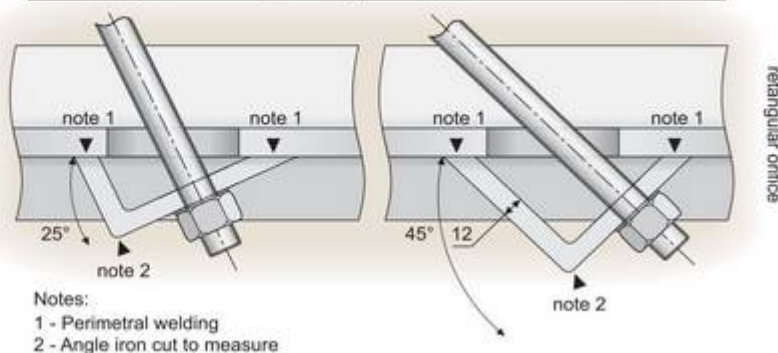
Detail A : Cable Clamp



Detail B : Double U iron (120 mm)



Detail C : Terminal attachment of reinforced wire fence (detail of fixing to stays)



The following drawings show the maximum size openings in debris fences recommended for flag marshal operations, access/egress to track for authorised personnel and unimpaired vision of the track for photographers

Figure 29.2 – Flagmarshal operations or access/egress to track for authorised personnel

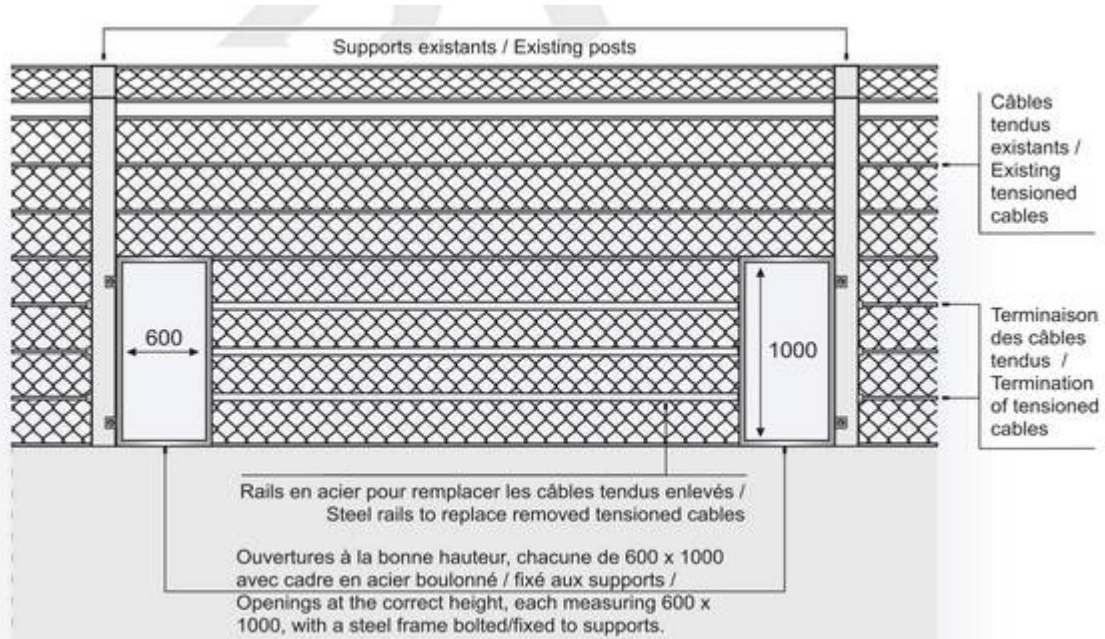


Figure 29.3 - Unimpaired vision of the track for photographers

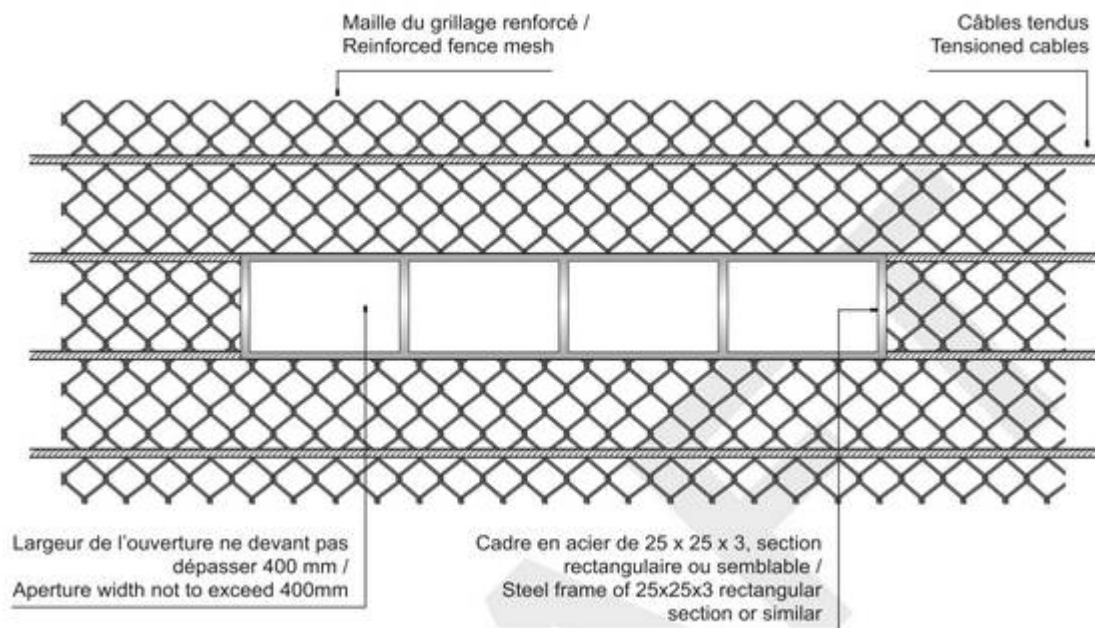


Photo A29.1 Debris Fences

Debris fence in braking area

Photo A29.2 Debris Fences

Shows compression strut use and use of multiple cable clamps.

Photo A29.3 Debris Fences



Rearview of debris fence at A1 Ring in Austria

Photo A29.4 Debris Fences



FIA specification debris fence at Criox-en-Ternois, France.

Photo A29.5 Pit Lane Debris protection



Pit Lane signaling panels

Photo A29.6 Debris Fences



Main straight at A1 Ring, Austria.

Photo A29.7 Debris Fences



FIA specification debris fence at Criox-en-Ternois, France.

Photo A29.8 Debris Fences



Debris Fence at A1 Ring, Austria

Photo A29.9 Debris Fences



Marshal post debris protection at A1 Ring, Austria

Photo A29.10 Debris Fences



2.5m Debris fence panels, Eastern Creek, Australia

Photo A29.11 Debris Fences



Debris Fence at Sandown, Australia. Photo taken in Marshal Zone.

Photo A29.12 Debris Fences



Debris Fence at Sandown, Australia. Note hooks for keeping cable in line

Photo A29.13 Debris Fences



Debris Fence at Sandown, Australia. Note hooks for keeping cable in line

Photo A29.14 Debris Fences



FIA specification debris fence at Criox-en-Ternois, France.

Photo A29.15 Debris Fences



Marshal point debris protection, Sepang, Malaysia

Photo A29.16 Debris Fences



Marshal point debris protection, Sepang, Malaysia

Photo A29.17 Debris Fences



Typical 2.5m height debris fence panel as used at Australian Temporary Race Circuits. Note orange identification of access location (see Article 11.2.10.3)

Photo A29.18 Debris Fences



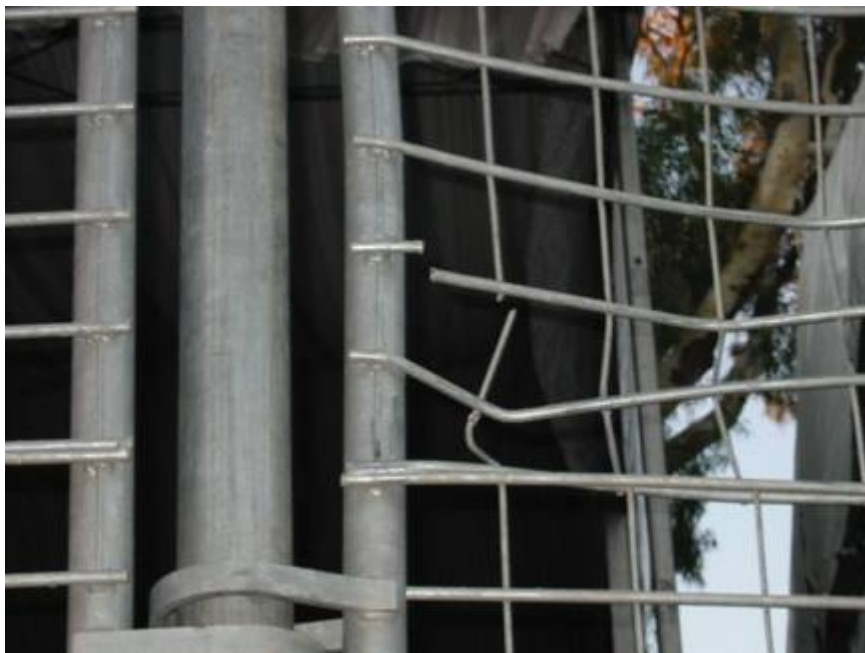
Additional height (3.5m) debris fence panel typical of that used at Australian Temporary Race Circuits

Photo A29.19 Debris Fence damage



Shows damage to debris fence panel after being hit by a car involved in a roll over. Height of impact is estimated at approx 2.3m above ground.

Photo A29.20 Debris Fence Damage



Close up of damaged caused to debris fence in incident. Replacement of panel was the only rectification required to restore the infrastructure to original condition.

Photo A29.21 Debris Fences



Debris fence panels at Mt Panorama, Australia.

Photo A29.22 Debris Fences



Mt Panorama, Australia. Note 500mm wide “gap” or “hole” in debris fence for flagging purposes is reinforced.

Photo A29.23 Debris Fences



Debris fence panels at Eastern Creek, Australia

Photo A29.24 Pit Lane Debris Protection



Pit Lane debris fence shield/panels at Yeongam Circuit, Korea

Photo A29.25 Pit Lane Debris Protection



Pit Lane debris fence shield/panels at Yeongam Circuit, Korea

Photo A29.26 Pit Lane Debris Protection



Pit Lane debris fence shield/Panels at Phillip Island Circuit, Australia

Photo A29.27 Pit Lane Debris Protection



Pit Lane debris fence shield/panels at Phillip Island Circuit, Australia

Photo A29.28 Pit Lane Debris Protection



Pit Lane debris fence shield/panels at Phillip Island Circuit, Australia

Photo A29.29 Pit Lane Debris Protection



Pit Lane debris fence shield/panels at Symmons Plains circuit, Australia

Photo A29.30 Pit Lane Debris Protection



Pit Lane debris fence shield/panels at Symmons Plains circuit, Australia

Photo A29.31 Pit Lane Debris Protection



Pit Lane debris fence shield/panels at Symmons Plains circuit, Australia

Photo A29.32 Pit Lane Debris Protection



Shows mounting of pit lane debris shield onto angled rear face on Pit Lane Signaling Wall at Symmons Plains circuit, Australia

Appendix 30 – Acknowledgements

In preparing this document, CAMS would like to acknowledge the assistance of:

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