Speed Skating Canada Long Track Crash Protection and Prevention - Specficiations and Guidelines

CANADA

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This document has been prepared as part of Speed Skating Canada's (SSC's) commitment to providing a safe field of play for both training and competition that is in keeping with True Sport and Long Term Participant and Athlete Development (LTPAD) principles. This document is the primary reference for establishing minimum crash protection standards for any long track speed skating context, including practices and competitions. It also provides guidance on how to exceed minimum standards.

At this point in time, the minimum crash protection standards are based upon the experience of experts in our sport. As SSC's sport injury surveillance system becomes highly functional, further modifications and enhancements to the standards will begin to be partly based on statistical evidence. Collaboration of all stakeholders in reporting incidents is imperative to improving the effectiveness of standards in the future. Please keep in mind that "adequately safe" does not mean "perfectly safe". No crash protection system will eliminate the risks of getting injured in long track speed skating. However, by following these specifications and guidelines, and by using safe skating behaviours, the probability and severity of the risks will be reduced. Members are always encouraged to exceed minimum standards so that we can provide more than just an "adequately safe" field of play.

Ultimately, to prevent injuries from crashes and/or reduce their severity; crash protection (including pads and/or snowbanks) is only part of the answer. If a long track speed skater falls and slides off the track, there are several ways in which injuries from the impact can be prevented/mitigated:

1) **Reduce Speed Prior to Impact** – The longer a skater slides on the ice, the slower the skater will be going when he/she does hit the pads/snowbanks. Ice should be prepared such that the non-track ice is "rough". The increased sliding friction will help reduce impact speeds into the pads/snowbanks.

2) **Hit the Pads/Snow Properly** – Skaters must be coached to fall "properly" into the pads/snowbanks i.e. NOT going in head-first or feet-first. Skaters should do whatever they can (that does not endanger other skaters) to achieve this result. Ideally, skaters should try to hit the pads/snowbanks with as much of their body surface area as possible, to distribute the impact forces. Also, skaters should brace (or stiffen themselves) for the impact. This will also help protect them from various injuries.

3) **The Thicker the Crash Protection the Better** – If skaters are going to slide off the track, we want pads/snowbanks between the skaters and any obstructions like trees or poles. As a sound general principle, the more padding/snow you have, the safer things will be. More material will absorb more impact energy instead of the skater absorbing that energy.

4) **Foam/Snow Type Matters** – There are many pad/snowbank details that subtly influence safety, but the last major consideration in crash protection is the compressibility of your crash protection. In general, use soft-medium compressibility pads, if you are using pads as they will become stiffer in cold environments. If you are using snow, make sure that you can compress the snow to some extent by pushing into it with one arm. Otherwise, it may be too hard to provide much energy dissipation on impact. The basic principle is that firmer crash protection

can handle higher energy impacts, but firmer crash protection can also increase the chance of injury if skaters hit the pads head or feet first. Softer crash protection, on the other hand, can be dangerous for high energy impacts if the soft protection is in front of hard, fixed objects. But soft crash protection will be safer for most types of low energy impacts.

Scope

These specifications and guidelines encompass:

- Crash protection in Canadian long track (LT) speed skating (333 m and 400 m long ovals),
- The use of foam pads or snowbanks,
- The use of an oval for training and competition,
- Skating on ice of any quality,
- Skaters of any age and skill level, and
- The risk of impacts into walls, pillars, posts or other dangerous obstructions.

These specifications and guidelines provide information on:

- Pad/snowbank dimensions,
- Foam density and stiffness,
- Pad venting/covers,
- Impact performance,
- Pad attachments/anchoring, and
- The placement of protection around the rink,

all with respect to skater speed and mass.

In all cases, the basis for establishing the relevant Specifications and guidelines during a given training or competition context depends primarily on the expected worst-case scenario during that training session or competition in terms of the following simple mathematical formula:

$$\textit{kinetic energy factor (KEF)} = \textit{(skater mass in kg)} / \textit{(fastest expected lap time in seconds)}^2$$

The heavier the mass in kg and/or the faster the lap time in seconds, the bigger this ratio will be. This formula is based on the amount of kinetic energy (KE) a skater possesses, which is proportional to skater mass x skater speed squared. Since knowing a skater's lap time is more common than knowing a skater's speed, lap times are used in the formula instead of speed. Since lap times decrease as skating speed increases, mass is divided by the lap time squared, not multiplied by it. To give an example, if a 70 kg (155 lb) skater is skating 40 second laps on a 400 m oval, their KEF is .04 but if they speed up and skate 30 second laps, then their KEF increases to .08. See Table 1 below, for more examples.

Please note that Table 1 is based on a 400 m oval. For 333m ovals, see Appendix 2. For all other track sizes and special configurations, Speed Skating Canada (safety@speedskating.ca) should be contacted to identify specific padding requirements.

In most cases, on 400 m ovals, elite long track KEF values will be at least .10 and the use of KEF values to specify padding/snowbank requirements referred to in this document are derived from the experience of speed skaters, coaches, officials and volunteers of all levels in Canada. We are not yet at the stage where the use of these values can be justified based on evidence gathered in a strictly controlled

environment with carefully calibrated instruments. As such, these values may not be perfect and should not be relied upon as if they were. They provide qualitative guidance. Judgement informed by experience should always be used in all circumstances, if one feels that the minimum standards are insufficient.

Table 1 – Long Track KEF Values for 400 m Ovals

		Lap Speeds (sec)									
		42.0	**40.0**	**38.0**	**36.0**	**34.0**	**32.0**	**30.0**	**28.0**	**26.0**	**24.0**
Skater Mass (kg)	**30**	0.017	0.019	0.021	0.023	0.026	0.029	0.033	0.038	0.044	0.052
	40	0.023	0.025	0.028	0.031	0.035	0.039	0.044	0.051	0.059	0.069
	50	0.028	0.031	0.035	0.039	0.043	0.049	0.056	0.064	0.074	0.087
	60	0.034	0.038	0.042	0.046	0.052	0.059	0.067	0.077	0.089	0.104
	70	0.040	0.044	0.048	0.054	0.061	0.068	0.078	0.089	0.104	0.122
	80	0.045	0.050	0.055	0.062	0.069	0.078	0.089	0.102	0.118	0.139
	90	0.051	0.056	0.062	0.069	0.078	0.088	0.100	0.115	0.133	0.156
	100	0.057	0.063	0.069	0.077	0.087	0.098	0.111	0.128	0.148	0.174
	110	0.062	0.069	0.076	0.085	0.095	0.107	0.122	0.140	0.163	0.191

Level 1 Level 2 Level 3 Level 4 Level 5

The focus of these specifications and guidelines for crash protection is primarily on safety. However, the minimum standards and guidance on padding/snow also take into account operational convenience, validation of material qualities, and compliance costs. In terms of crash protection, the primary objective is to decrease peak impact forces (and the associated Head Impact Criterion, or HIC) while the secondary objective is to decrease the degree to which skaters bounce back from the crash protection after impact. The desired effect is for "bounce back" to be minimal so as to prevent skaters from sliding back out into the path of oncoming skaters. The amount of crash protection that is required is proportional to the level of risk involved in the skating situation e.g. situations that involve top skaters in high-speed competition will require more or better crash protection than those that only involve slower, small skaters in relaxed training sessions. The overall objective of these specifications and guidelines is to offer guidance for coaches, club and event organizers and competition officials on how to provide an adequately safe field of play in Canadian speed skating that is both affordable and operationally practical, at all levels of the sport. Current practice is that the person in charge at/during competitions is the chief referee. In training sessions prior to major competitions it is the meet coordinator (or designate), and in general training sessions for a club it is the head coach. It is recommended that each Branch develop specific regulations based on these specifications and guidelines which are reflective of the size and speed of skaters participating in a given Branch sanctioned competition.

How to Use these Specifications and Guidelines

First note that most Canadian long track ovals are either 400 m or 333 m. If your oval has a different size, contact Speed Skating Canada (safety@speedskating.ca) for specific direction.

Second, to find out what minimum pad thickness you need on the various parts of your oval, you will need one other piece of information. Each skating group, training session or competition will have its

own unique padding needs. However, it's usually easiest in long track to set padding up for your fastest group and leave it for all groups to use. Use Table 2 below to determine your minimum padding needs for your biggest/fastest group of skaters. Do this by determining who on the ice has the greatest KEF value. You will base your padding needs on that person or group. Simply take their body mass and the fastest lap time that you expect they'll be skating in the practice or racing situation, and look up their KEF value on Table 1.

Now take that KEF value and look to Table 2. Find the column in the Table that applies to you, and read down that column to see what thickness of padding you need in the three zones around the rink, described in Appendix 1. Note the crash protection restrictions for Levels 4 and 5.

As well, all of the values in Table 2 refer to padding. If you are instead using snowbanks, add 50% to each non-zero value (measuring snowbank thickness at 25 cm above ice level).

A skater should not be able to slide off the ice and hit a fixed or mobile (i.e. unfixed and light) obstruction in this zone. If there is a mobile obstruction in harm's way, it should be moved. If it cannot be moved, it should be surrounded by protection (pads or snow) as per Table 2, on the sides of it that a skater can hit i.e. the side facing the oncoming skater, and the side facing the track. Likewise, if a fixed obstruction can be hit by a skater sliding off the ice into this zone, it should also be surrounded by protection as per Table 2, on the sides of it that a skater can hit.

Keep in mind that if you do not have enough crash protection (pads/snow) for your skating context, you can still hold practices. You'll simply have to get creative. In the end, you should only be holding skating activities that are consistent with the crash protection that you have available. Skating activities are possible with any amount of padding/snow but if you do not have enough crash protection of enough thickness to support the activity that you have planned, you will need to manage the speeds of skaters to operate within the KEF that your pads support i.e. conduct appropriately paced workouts etc.

Table 2 – Minimum Padding Specifications Chart for 400m Ovals in cm (inches)

	KEFs				
	Level 1 .020 to <.035	**Level 2 .035 to <.055**	**Level 3 .055 to <.080**	**Level 4 [1] .080 to <.115**	**Level 5 [2] .115+**
Zone					
RED	46(18)	56(22)	66(26)	76(30)	86(34)
YELLOW	0	30(12)	35(14)	41(16)	41(16)
GREEN	0	0	15(6)	15(6)	20(8)

[1] primary crash protection must be pads (not snow) [2] primary crash protection in the Red Zones must be free-standing pads

Skating Context

A further contextual consideration is the nature of the training activity on the ice. Sometimes, coaches have skaters practice turns on the infield ice of an oval (if it exists). If the skaters are moving fast enough to slide onto the main track if they fall, then crash protection should be put in place to prevent this from happening or training should not be occurring on the main track at that time.

Exceeding Minimum Specifications

If you have more than enough pads/snow for your skating context and you want to provide an even safer skating environment, look to the next column on the right in Table 2 and try and meet those specifications. Similarly, if you typically use more pads/snow than the minimum specification calls for, continue to do so.

Adequate Quality Padding, Snowbanks and Skid Zones

All long track pads should have venting on the top, end or side surface, covering an area equal to at least ¼ of the total top surface area. Pad height and length should be chosen so that pads weigh less than 30kg (66 lbs). In general, pads should be at least 4 feet (122 cm) tall. Pad covers should be waterproof, slippery and crack resistant to at least -40°C. They should be 16-20 ounce vinyl-coated polyester of 1000+ denier. Pads should be ruggedly connected to adjacent pads with Velcro (Hook #70 and Loop #71). Pads should be positioned and secured so that skaters do not tend to slide under the pads in case of a crash into them.

Open-cell foam, the type of foam which is used in crash pads, is often rated in terms of density and compressibility. In terms of density, the foam in the pads should generally be in the range of 1.3-1.8 lbs/ft^3 so that the pads are neither too light nor too heavy. In terms of compressibility, foam is tested in terms of weight required to compress a certain shaped piece of foam by 25%. If one has R42 foam, for example, it means that about 42 lbs is required to compress a certain piece of this foam 25%. If one has H26 foam, about 26 lbs are required etc. The test in question is called ASTM D3574, Test B1 – Indentation Force Deflection (IFD). If one puts out pads on a long track oval, the IFD value of the foam in the pads should ideally be in the range of 25-40. If one employs two layers of pads, then the layer that the skaters will hit should be softer than the layer farther away from the track. Pads used outdoors should be replaced at least every 7 to 10 years, and compressibility should be measured every two. Contact Speed Skating Canada (safety@speedskating.ca) for information on how to do this.

In general, it is suggested that pads should have ruggedly attached handles on each end and on the back face of the cover, to facilitate safe and convenient handling. Thin loop Velcro strips along the top and bottom of the fronts of the pads (97-100 cm apart) facilitate the attachment of standard advertising, as do eyelets attached to/near the tops of the pads. It is suggested that large, heavy-duty zippers (2 zipper pulls per track) should run up, along and down the back face of the pads to create a door through which the foams can be inserted and removed with ease. Velcro flaps and patches at the fronts of the pads are an easy way to connect adjacent pads, although there should be no more than 3" (8 cm) of overlap between the loop and hook Velcro strips to facilitate taking them apart. Velcro flaps and patches at the backs of the pads also help join adjacent pads.

Figure 1 - Sample Crash Pad (Back) Showing Zipper Tracks, Handles (side/back) and Velcro Flaps

The preceding details on padding cover "conventional" foam pads. There are other, creative designs that incorporate more elaborate arrangements of foam types, and air gaps. These need to be evaluated on a case-by-case basis for effectiveness. Contact Speed Skating Canada (safety@speedskating.ca) for more details.

With regards to snowbanks, they should be inspected and groomed before use, as needed. Ideal snowbanks consist of packed snow that is not crusted or hardened by ice formation. Ensure that rough and hard ice formations are not present at the foot of your snowbanks. If the snowbanks are short i.e. less than 1 m (3 ft) tall, pads may need to be placed behind the snowbanks to protect against impacts into obstructions. Conversely, if snowbanks are tall, hard, vertical walls, they may need to have pads placed in front of them (as if the snowbanks were fixed obstructions).

If your oval has skid zones (relatively flat ice or snow zones that skaters slide over to lose speed before hitting pads or snowbanks), make sure these zones do not have hardened icy protrusions sticking up that may injure skaters that are sliding over them. They should end in pads or snowbanks unless they are very long, and no obstacles lie beyond them (within sliding distance).

Safe Rink Conditions

Rink lighting should always be adequate enough to see dangers ahead in time to react to them i.e. clear visibility the length of the rink. Keep the ice on the outside of the racing track frosted (ungroomed) so that it is rough. This provides more sliding friction, reducing the impact energy when a skater hits pads.

It is recommended that rink entry points be located on the latter half of the straightaways for maximum visibility and reaction time, if this is possible. Skaters should not be allowed to rest in high risk areas such as the outer lanes of corners while other skaters are moving at significant speeds on any part of the track. Practice starts should typically be performed on the latter parts of the straightaways, on the outer lane. If the infield of the oval is also skatable ice, there should be some clear physical demarcation of the inner edge of the warm-up or training lane i.e. more than just lane paint, such as a raised ridge of snow or a string of lane markers.

It should also be made very clear to skaters as to where they should practice sprint skating i.e. the inner lane or the outer lane. Either case can work, and depending on the other features of the rink (e.g. whether rink access is from the infield), one may be a better choice than the other. One advantage of a sprint outer lane is that if skaters fall, they will not take any other skaters/people out. Another is that if skaters (esp. young skaters) can enter from the infield of the oval, then they will not be crossing sprint lanes to get onto their slower lanes. However, the sprinters will be close to the outer edge of the rink and they will experience a harder impact if they fall. Also, if skaters are entering/exiting the ice from the outside of the rink, they will have to cross this sprint lane to get into a slower lane. In such cases, a crossing-guard is advised for younger skaters. The advantage of sprinting on the inner lane is that if a skater falls, they will slow down quite a bit before they hit the snow banks or pads. If the ice quality is not high i.e. if top speeds are not very high, skaters can also experience greater lean in the inner corners. The significant disadvantages of sprinting in the inner lane include the possibility of taking out other skaters in the outer lanes if falls occur, and of hitting slow/young skaters that might access the skating lanes from the infield of the oval. These risks may be managed by regulating whether small/young skaters are even on the ice during advanced sprinting practices/competitions. There is no universal “best answer” to this issue of which lane is best for sprinting practice. It depends on your facility, your skaters, and your skating groups. Just be aware of the risks in each case, and provide guidance to skaters accordingly, both verbally and with signage.

Concluding Notes, Legal Disclaimer, Limit of Liability and Disclaimer of Warranty

Applying these specifications and guidelines requires care. It is up to club and/or competition organizers to provide adequate crash protection while referees at competitions will verify this adequacy using these specifications and guidelines. Please have experienced club and competition organizers help make such provisions.

No crash protection system will prevent all impact injuries. Remember the list of ways to reduce the chance of injuries due to sliding off the track (pages 1-2).

The contents of this document are provided to encourage consistency as well as the use of best practices in the approach to speed skating crash protection in Canada.

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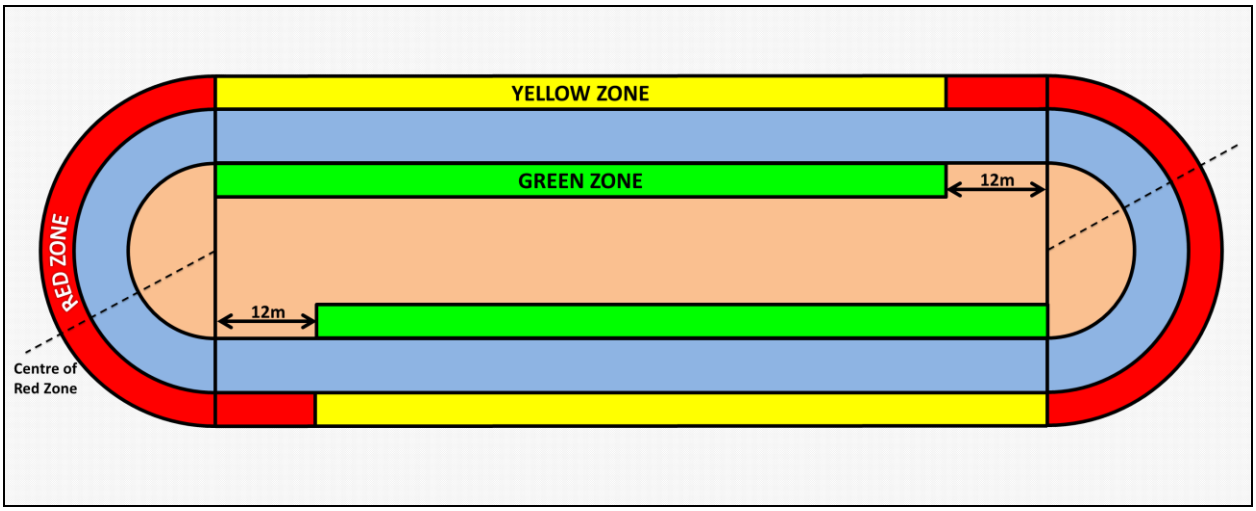
Any reliance you place on the publication is therefore strictly at your own risk and is your responsibility to perform due diligence before acting upon any of the information provided.

These specifications and guidelines are forever evolving. If you feel that you have a suggestion that will improve them, please contact the SSC National Office at safety@speedskating.ca. Feedback will be reviewed annually as this is a living document that will change from time to time, to maintain an adequate level of safety under evolving skating conditions and as new information and understandings come to light.

Glossary

Bounce Back (Rebond)	The degree to which a skater bounces off of a pad, back onto the track.
Braced Pads (Coussins amortisseurs fixe)	If they move at all, these pads have a fixed obstruction within their path and range of movement along the line of skater impact when struck by a skater who is skating counter-clockwise around the rink in a training or competitive context.
Corner Impact Zones (Zones de choc dans les virages)	The curved portions of the oval perimeter plus the 12 m of straightaway on corner exits.
Fixed Obstruction (Obstacle fixe)	A wall, post, pillar, platform, riser etc that does not move (much) when hit, that sits within one of the zones in the schematics shown on page 10.
Free-standing Pads (Coussins amortisseurs libres)	These pads move when hit, and they do not back up against a fixed obstruction along the path or range of the pad's movement when struck by a skater who is skating counter clockwise around the rink in a training or competitive context (otherwise they are "braced").
Hard Open-cell Foam (Mousse dure à alvéoles ouvertes)	Hard firmness open-cell foam is foam that is least easily compressed (a range of 40-50 on the Indentation Force Deflection [IFD] scale, the scale most commonly used by North American foam manufacturers).
KEF (FEK)	kinetic energy factor = (skater mass in kg) / (fastest lap time in seconds)^2
Medium Open-cell Foam (Mousse moyenne à alvéoles ouvertes)	Medium firmness open-cell foam spans an IFD range of 28-38.
Mobile Obstruction (Obstacle mobile)	A platform, post, bench, riser etc that does move when hit, that sits within one of the zones in the schematics shown on page 10.
Pad Venting (Orifice du coussins amortisseurs)	Mesh/porous material in a pad cover (usually on the top surface of the pad) that allows air to escape from the pad during impacts.
Peak Impact Forces (Orifice du coussins amortisseurs)	The maximum forces a skater's body experiences on impact.
Soft Open-cell Foam (Mousse douce à alvéoles ouvertes)	Soft firmness open-cell foam spans an IFD range of 16-26.
Track (Piste)	The practice and/or racing lanes on the skatable ice.
Rink/Oval (Patinoir)	The skatable ice surface.

Appendix 1 - Long Track Crash Protection Zones



Red Zone The Red Zone is the area along the outside of the corners, extending 12 m into the exit straightaway. This is the most common area for falls in long track, and the most dangerous as skaters hit the pads most directly in these areas. For Levels 1 and 2, if there are no obstructions present in the Red Zone within 2 or 3 meters, respectively, of the edge of the ice surface, crash protection is not required.

Yellow Zone The Yellow Zone is the area beside the straightaway, beyond the end of the Red Zone extending to the start of the next corner. No crash protection is required in this Zone for Level 1 but it is often required at the higher levels. However, if there are no obstructions of any sort, up to 2 m deep into the Yellow Zone for Level 2, or up to 3 m deep for Levels 3, 4 and 5, then no crash protection is required in this zone. Nevertheless, some is still suggested to prevent long slides on rough terrain.

Green Zone The Green Zone is in the infield along the ice, starting at 12m beyond the end of a corner (aligned with the end of the Red Zone) extending to the start of the next corner. For padding exemptions, it should be handled in the same way as the Yellow Zone (using a depth of 2 m for Level 3, 2.5 m for Level 4, and 3m for Level 5, while no padding is required for Levels 1 and 2).

Appendix 2 – KEF Values and Crash Protection requirements for 333m Tracks

Long Track KEF Values for 333 m Ovals

		Lap Speeds (sec)									
		37.5	**36.0**	**34.5**	**33.0**	**31.5**	**30.0**	**28.5**	**27.0**	**25.5**	**24.0**
Skater Mass (kg)	**30**	0.021	0.023	0.025	0.028	0.030	0.033	0.037	0.041	0.046	0.052
	40	0.028	0.031	0.034	0.037	0.040	0.044	0.049	0.055	0.062	0.069
	50	0.036	0.039	0.042	0.046	0.050	0.056	0.062	0.069	0.077	0.087
	60	0.043	0.046	0.050	0.055	0.060	0.067	0.074	0.082	0.092	0.104
	70	0.050	0.054	0.059	0.064	0.071	0.078	0.086	0.096	0.108	0.122
	80	0.057	0.062	0.067	0.073	0.081	0.089	0.098	0.110	0.123	0.139
	90	0.064	0.069	0.076	0.083	0.091	0.100	0.111	0.123	0.138	0.156
	100	0.071	0.077	0.084	0.092	0.101	0.111	0.123	0.137	0.154	0.174
	110	0.078	0.085	0.092	0.101	0.111	0.122	0.135	0.151	0.169	0.191

Level 1 Level 2 Level 3 Level 4 Level 5

Minimum Padding Specifications Chart for 333m Ovals (Inner Lane) in cm (inches)

	KEFs				
	Level 1 .030 to <.050	**Level 2 .050 to <.075**	**Level 3 .075 to <.110**	**Level 4 [1] .110 to <.155**	**Level 5 [2] .155+**
Zone					
RED	46(18)	56(22)	66(26)	76(30)	86(34)
YELLOW	0	25(10)	30(12)	36(14)	36(14)
GREEN	0	0	10(4)	15(6)	15(6)

[1] primary crash protection must be pads (not snow) [2] primary crash protection must be free-standing pads