Speed Skating Canada Short Track Crash Protection and Prevention for Boarded Rinks - Specifications and Guidelines

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 padding standards for any short 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 padding 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 short 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, padding is only part of the answer. If a short track speed skater falls and slides into the boards, there are several ways in which injuries from the impact can be prevented and/or 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 boards. Ice should be prepared such that the non-track ice is "rough". The increased sliding friction will help reduce impact speeds into the boards.
2) **Hit the Boards Properly** – Skaters must be coached to fall "properly" into the boards 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 boards/mats 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 Pads the Better** – If skaters are going to hit the boards, we want pads between the skaters and the boards. As a sound general principle, the more padding you have, the safer things will be. More padding will absorb more impact energy instead of the skater absorbing that energy. You can achieve this by using thick pads or by doubling-up thinner pads.
4) **Foam Type Matters** – There are many pad details that subtly influence safety, but the last major consideration in crash protection is the compressibility of your pads. For pads along the ends of the straightaways, firmer foam is best because you want to bounce off those pads. For the rest of the rink, it's more complicated. If you only have one layer of pads (say up to 12" thick), they should either be of medium firmness or if you have two layers of foam within the 12" then the front layer should be softer than the back layer. The basic principle is that firmer foams can handle higher energy impacts, but they can also increase the chance of injury if skaters hit them

head or feet first. Softer foams, on the other hand, can be dangerous for high energy impacts but they will be safer for most types of low energy impacts. In general, try and have enough pad thickness that you can put softer foam in front and stiffer foam in back (either within one pad, or by using doubled-up pads of different firmnesses). A soft front with a stiffer middle and then a soft back can also be quite effective. Contact SSC (safety@speedskating.ca) if you wish to discuss your foam choices.

Scope

These specifications and guidelines encompass:

- Crash protection in Canadian short track (ST) speed skating (tracks up to 111.12 m long),
- The use of foam pads in boarded rinks,
- The use of a rink for training and competition,
- Skating on ice of any quality, and
- Skaters of any age and skill level.

These specifications and guidelines provide information on:

- Pad 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 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 10 second laps on a 111.12 m oval, their KEF is .70 but if they speed up and skate 9 second laps, then their KEF increases to .86. See Table 1 below, for more examples.

Please note that while Table 1 is based on a 111.12 m track, Table 1 should also be used in this document for 100m and shorter tracks. We do this for a couple of reasons. First of all, shorter tracks will be used with skaters in the first stages of development and/or with slower skaters. So the inaccuracy will not be that important in terms of creating significant changes in padding requirements. Also, this inaccuracy will always favour more padding, not less. So it will be a "safe" calculation error. For example, if a 50 kg (110 lb) skater skates a 10 second lap on a 111.12 m oval, there are certain padding requirements that arise from that skating situation (see Table 2, below). If another skater of

the same mass is skating 10 second laps on a 100m oval, they are likely skating a bit more slowly due to age or skill, although it may not be much more slowly if they skate a very wide track. As such, the padding specified in the first case (111.12 m track) will be adequate in the second case (100 m track).

In most cases, elite short track KEF values will be at least .75 and the use of KEF values to specify padding 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 – Short Track KEF Values

		Lap Times (sec)								
	(kg/lbs)	**12.0**	**11.5**	**11.0**	**10.5**	**10.0**	**9.5**	**9.0**	**8.5**	**8.0**
Skater Mass	**20/44**	0.14	0.15	0.17	0.18	0.20	0.22	0.25	0.28	0.31
	30/66	0.21	0.23	0.25	0.27	0.30	0.33	0.37	0.42	0.47
	40/88	0.28	0.30	0.33	0.36	0.40	0.44	0.49	0.55	0.63
	50/110	0.35	0.38	0.41	0.45	0.50	0.55	0.62	0.69	0.78
	60/133	0.42	0.45	0.50	0.54	0.60	0.66	0.74	0.83	0.94
	70/155	0.49	0.53	0.58	0.63	0.70	0.78	0.86	0.97	1.09
	80/177	0.56	0.60	0.66	0.73	0.80	0.89	0.99	1.11	1.25
	90/199	0.63	0.68	0.74	0.82	0.90	1.00	1.11	1.25	1.41
	100/221	0.69	0.76	0.83	0.91	1.00	1.11	1.23	1.38	1.56

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 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 pads 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 hockey rinks are either NHL size i.e. 85' (26 m) wide by 200' (61.0 m) long, or Olympic size i.e. 30 m (98' 5") wide by 60 m (196' 10") long. If your rink has different dimensions, simply note those for now.

To find out what minimum padding thickness you need on the various parts of your rink, you will need one other piece of information. Each skating group, training session or competition will have its own unique padding needs. Use Tables 2 and 3 below to determine your minimum padding needs for each practice session or competition that you host. Do this by determining who on the ice has the greatest KEF value (see Table 1). You will base your padding needs on that person(s). 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 or 3 (depending on whether your skating context is training or competition). 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 four zones around the rink. The zones are shown in Figure 2 on the last page of this document. Note the rink size/type restrictions for Levels 3, 4 and 5.

Keep in mind that if you do not have enough pads 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 padding that you have available. Skating activities are possible with <u>any</u> amount of padding but if you do not have enough pads 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 (Training)

	KEFs				
	Level 1 <.30	**Level 2 .30 to <.60**	**Level 3 [1] .60 to <.90**	**Level 4 [1,2] .90 to <1.15**	**Level 5 [3] 1.15+**
RED ZONE	20(8)	40.5(16)	50.5(20)	61(24)*	n/a
YELLOW ZONE	20(8)	20(8)	30.5(12)	40.5(16)	n/a
BLUE ZONE	0	20(8)	25(10)	30.5(12)	n/a
GREEN ZONE	0	0	0	0	n/a

[1] rink can be no shorter than 195' long (59.4 m) [2] rink can be no narrower than 92' wide (28 m)
[3] must use a boardless system * last pad in Red Zone should be tapered

Table 3 – Minimum Padding Specifications Chart (Competition)

	KEFs				
	Level 1 <.30	**Level 2 .30 to <.60**	**Level 3 [1,2] .60 to <.90**	**Level 4 [1,3] .90 to <1.15**	**Level 5 [4] 1.15+**
RED ZONE	20(8)	45.5(18)	56 (22)	70(28)*	n/a
YELLOW ZONE	20(8)	25(10)	35(14)	40.5(16)	n/a
BLUE ZONE	15(6)	20(8)	30.5(12)	30.5(12)	n/a
GREEN ZONE	0	0	15(6)	20(8)	n/a

[1] rink can be no shorter than 195' long (59.4 m) [2] rink can be no narrower than 85' wide (26 m) [3] rink can be no narrower than 92' wide (28 m)
[4] must use a boardless system * last pad in Red Zone should be tapered

Skating Context

A further contextual consideration is the nature of the training activity on the ice. Sometimes, coaches practice turns on the center face-off circle of the hockey rink (at any speed) or even in one of the four corner face-off circles (at slow-medium speeds). If the skaters are moving fast enough to slide to the boards if they fall, then the boards should have padding on them. In the case of the center face-off circle, there should be padding from blue line to blue line on both sides of the rink. In the case of the corner face-off circles, there should be padding from the blue line to the longitudinal center line of the rink that surrounds the given corner circle. In general, provide padding against any boards within 5 m (16') of the "course" that is being skated. As for how much padding, 6" (15 cm) is adequate for skaters under 50 kg (110 lbs) in any of the circles. At least 10" (25 cm) is adequate for skaters going at moderate speeds in the corner circles. And at least 12" (25 cm) is adequate for top skaters going all out (under control) in the center circle. Such high speed training should only be done in the center face-off circle.

Activities sometimes take place up and down the ice, not around the track. If such activities involve active skating to the icing lines, at least 8" of padding should be located at the ends of the rink.

Please note that if an electronic timing mechanism is attached to the boards at the finishing line, padding must extend right up to the mechanism to protect skaters from hitting the timing mechanism.

Pad Shape

The standard pad shape assumption in Tables 2 and 3 is a rectangular box/prism. If the pad instead has a sloping front face such that the bottom of the pad is thicker than the top of the pad, then the pad's thickness should be taken as the thickness of the pad 1' (30 cm) up from the ground. If a pad does have a sloping front face, the slope should not be more than 10° off the vertical.

Exceeding Minimum Specifications

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

Adequate Quality Padding

In general, short track pads should be at least 4' tall ± 1" (122 cm ± 2.5 cm) although an exception is described a couple of paragraphs below. All pads should have venting on the top surface, covering at least ¼ of the total top surface area. Pad length should be chosen so that pads weigh less than 30kg (66 lbs). Typically, pads should be 5-7' (1.52-2.13 m) long. Pad covers should be waterproof, slippery and crack resistant to at least -10°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) at both the fronts and backs of pads, and they may be attached to the boards (must be for competitions) as long as the attachment mechanisms (ropes/bungee cords) do not present a clear hazard in terms of catching arms and heads. Pads should be positioned and secured so that skaters do not tend to slide under the pads in case of a crash into them, and the weight of the pads must rest on the ice.

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 one layer of pads on a rink, the IFD value of the foam in the pads should ideally be in the range of 40-45. If one employs two layers of pads in, say, the RED zones, the front layer of pads (the layer that the skaters will hit) should have IFD values in the range of 32-42 while the pads nearest to the boards should have slightly higher values, in the range of 40-45. If one has three layers of pads (or foam), the pads closest to the boards should be in the 40-48 range, while the middle pads are in the 32-40 range, and the pads facing the skaters are in the 26-36 range. Alternatively, keep the soft layer at the front, put the stiffest layer in the middle, and put another soft layer at the back. In such a case, the 3rd layer of pads (the ones sitting directly against the boards) may be between 2' and 4' tall in the compressibility range of 20-30. If one has pads with 2 or more layers of foam inside them, take the weighted average (by thickness) of their compressibility to get a value for the pad that falls within the suggested ranges. Of special note is the GREEN zone. If you need to put pads in the GREEN zone, these pads should be relatively firm/stiff, not soft. Skaters typically hit these pads at acute angles and you want skaters to bounce off these ones.

As modifiers to consider when determining the compressibility of pad foam, keep in mind that cold makes foam feel stiffer. So if one's pads are rated at 40 lbs compressibility but training takes place at a usual air temperature of -10°C, then their effective compressibility would be in the high 40s.

Pads should be replaced at least every 15-20 years.

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.

The preceding details on padding assume "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 for more details by writing to safety@speedskating.ca

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

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.

The standard assumption for this document is that you will have five 111.12 m tracks marked on your rink. If your rink is less than 195' (59.4 m) long, you should only use the middle three 111.12 m tracks and may want to consider closer spacing between tracks.

It is also 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, or even practice starts, in high risk areas such as the exits of corners while other skaters are moving at significant speeds on any part of the track. Practice starts should typically be performed within the interior of the track when the track is being used for training or warm-ups.

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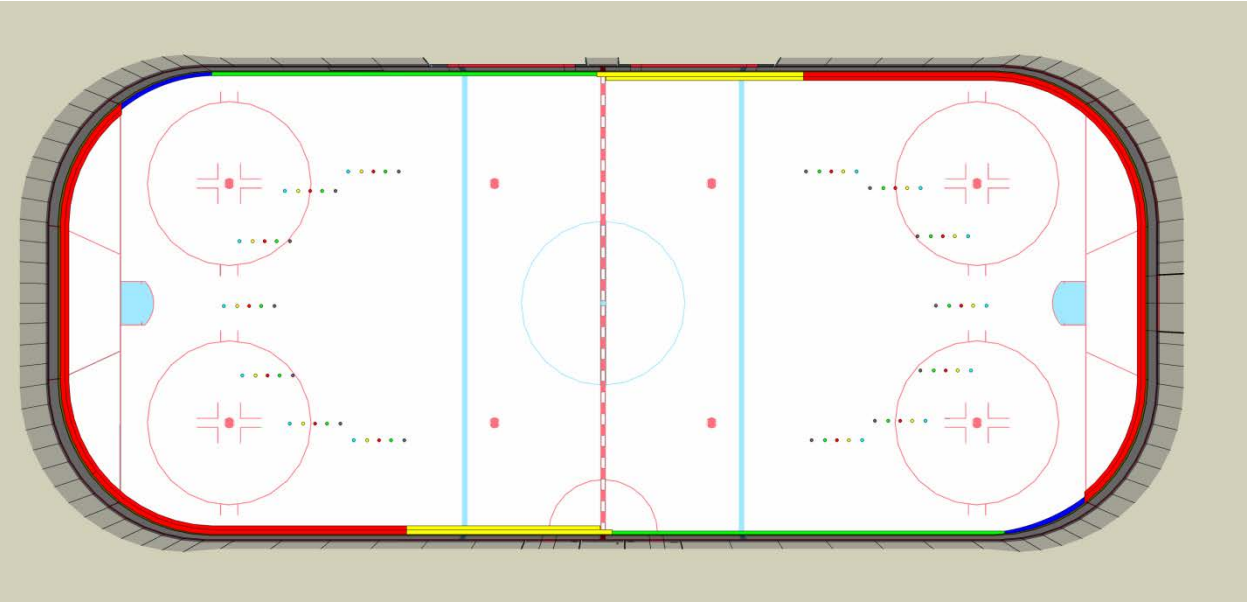
Any reliance you place on the publication is therefore strictly at your own risk and is your responsibility to perform due diligence before acting upon any of the information provided.

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 of Terms

Bounce Back (Rebond)	The degree to which a skater bounces off of a pad, back onto the track.
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.
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 (Patinoire)	The ice surface enclosed by the boards.

Appendix 1 - Short Track Crash Protection Zones



Red Zone	The red zone shall extend from the icing line (or 1m from the end of the rink if there is no icing line) through to the track marker closest to the rink's centre line.
Yellow Zone	The yellow zone shall extend from the track marker closest to the rink's centre line (end of the red zone) to the rink's centre line.
Blue Zone	The blue zone shall extend from the end of the green zone to the beginning of the red zone.
Green Zone	The green zone shall extend from the rink's centre line to the beginning of the curvature of the corner boards.