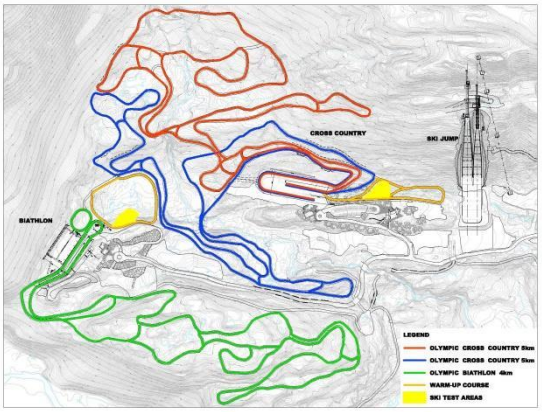
FIS Cross-Country Homologation Manual



FÉDÉRATION INTERNATIONALE DE SKI
INTERNATIONAL SKI FEDERATION
INTERNATIONALER SKI VERBAND

Contents

1 Introduction

This Homologation Manual is now in its ninth edition with updates on the process and fees for certificate renewal.

The experiences over the past years have proven that this manual and the Homologation process have become valuable assets that support the development of the sport. The requirements and recommendations described in this manual are recognized by coaches, athletes and organizers.

The overall objective for homologation of Cross-Country courses is:

- To create courses and stadiums that take care of the best traditions in Cross-Country skiing, are suited for all modern competition formats and techniques, and provide safe conditions and fair chances for all competitors

In order to obtain this objective, the involvement, the knowledge and the quality of the work performed by the Homologation Inspectors and course designers is of paramount importance.

This manual is intended to be a useful resource for the education and work of Homologation Inspectors, Cross-Country course designers and the organizers of FIS competitions. The content of the manual combined with the practical process of homologation inspector education should help to create an understanding of the requirements for good course and stadium design, and thus lead to the best possible courses for all levels of FIS competitions and skiers.

The FIS International Competition Rules (ICR) articles 310, 311, 312 and 321-327 list the requirements for homologated and certified FIS Cross-Country courses. This manual further describes these articles and provides recommendations for how to meet the requirements in the best possible way.

The development of this manual represents the collective experiences of many course designers, homologation inspectors, competitors and coaches. The development of these standards has been systematically ongoing since the Nordic World Ski Championships in Oberstdorf, 1987. The ongoing challenges for the Homologation process is to continue to address the needs of all competition formats, the increased emphasis on good TV production and promotion of our sport, and at the same time using and designing courses that maintain the original “soul of the sport”.

We hope that the National Ski Associations will continue to support the Homologation process in order to further improve the sport of Cross-Country skiing.

On behalf of the FIS Cross-Country Homologation Working Group,

Allan Serrano
Chair

2 Aspects and philosophy of Homologation

2.1 Responsibility

According to the ICR, all FIS Cross-Country competitions (with the exception of popular- and roller ski competitions) must be carried out on homologated and certified courses. For World Cup (WC) competitions, the courses should be homologated at least one year prior to the competition, such that the course can been tested in a lower level competition before being confirmed on the WC calendar. From the season 2018-2019 no Cross-Country competitions will be entered into the FIS Calendar unless the planned competition course has a valid homologation certificate.

For the highest-level competitions (level 1) - the Youth- and Olympic Winter Games (YOG and OWG), World Ski Championships (WSC), World Cup (WC) and U23/Junior World Ski Championships (JWSC) competitions - the FIS Nordic Office administration together with the Chair of the Homologation Working Group is responsible for the execution of the Homologation process. This includes:

- the appointment of the Homologation Inspector (HI)
- the review of the homologation reports
- the final acceptance and certification of the courses

A second level of inspection is additionally implemented for the final approval of the Olympic Games and World Championship courses.

For level 2 - Continental Cup and other lower level FIS competitions - the Regional Homologation Coordinators (see table in section 10) together with the National Ski Associations (NSA), are responsible for the appointment of the HIs and that final reports are sent to the FIS office. In order to have an even quality of the Cross-Country courses around the World, FIS-certified Homologation Inspectors should provide support to the NSAs and help design, inspect and approve courses in their region.

The FIS Nordic Office is also responsible for:

- Receiving and filing the documentation for each homologated course
- Issuing a certificate for each homologated course
- Keeping an updated on-line database of all homologated courses

2.2 Description of the Homologation Process

Homologation represents a “system of evaluation” that is designed to guide the development and/or the upgrade of Cross-Country competition courses. It is not just a set of numbers and standards but is a process towards certification that provides a forum for constructive discussion between Organizers, FIS and Inspectors.

The homologation evaluation includes more than just the course design. The stadium layout and the related infrastructure installations (including safe access roads and parking) are also part of the overall evaluation. The resulting certification and certificate represents a FIS stamp of approval indicating that the site is physically capable of accommodating international FIS competitions.

When an organizer applies or prepares for an international FIS competition or Championship, the existing courses, stadium and other facilities will normally need to be improved. These improvements should take place under supervision of a FIS appointed homologation inspector, and the organizer must apply to FIS for this through their National Ski Association (NSA).

For a brand-new venue or new course, the organizer first needs to employ a venue/course designer before applying for a FIS homologation inspector. It is important to distinguish between initial course design work and the resulting homologation inspection and certification process, especially in terms of cost and time commitment (see section 9 for more details).

It must also be emphasized that homologation should not be carried out in such a way that the courses marginally fit the rules. Some Cross-Country venues will not be capable of having a FIS homologated course if the physical characteristics of the terrain are below the requirements listed in the ICR (see section 3.2 for more details).

2.3 Preserving Cross Country Heritage

In the beginning of the ski history the trails used for cross country skiing were the same trails as used for transportation in the summer time, with limited grooming and no mechanical influence. Cross Country skiing was the mean of transportation in the wintertime. The layouts of the first competition courses were made in the same way: "The best possible trails given the possibilities of the natural terrain". Some competitions were also conducted on trails used daily for travel. With the increased use of heavy equipment used in today's trail construction there is a considerable risk that we will lose the "feeling for the natural terrain" that is in the soul of the Cross-Country skier. Even though we are designing courses for competition, it is extremely important that we take every opportunity to preserve the athlete's contact with the natural undulations of the terrain. This implies that course designers and inspectors have a responsibility to minimize the need to modify the terrain with machinery, but instead must find ways of using the natural terrain whenever possible. There have unfortunately been examples where a bulldozer has constructed an artificial "road" when the natural terrain was capable of providing a better skiing experience. The joy of skiing should be the ultimate goal.

2.4 Environmental Aspects

Society expects Cross-Country skiers to be close to nature. We therefore have an inherent responsibility to protect the natural resources. In order to preserve the relationship with nature, course designers must be aware of environmental factors and set a positive example. This includes the need to work with a variety of environmental organizations and landscape architects. The following lists some key areas of concern:

- Avoiding excessive side cuts
- Managing water flow and drainage
- Employing materials that blend into the natural surroundings
- Investigating rehabilitation/reforestation of the site, pre- and post-event
- Avoiding bridges where possible. They are expensive, can have an impact on nature, can be future obstacles, and make future changes more difficult

- Focusing on preservation of the snow (using north-facing slopes as much as possible, etc.) and optimising the conditions for artificial snow production

If the environmental restrictions of the terrain are such that very limited construction is possible, the courses could be designed with minimum width and be homologated for interval start competitions only.

2.5 Legal Aspects

It is the responsibility of the Organizer or Venue Owner to perform the necessary research into any legal aspects that affect the proposed site selection and its development, for example

- Land ownership
- Government authority regulations
- Environmental regulations

2.6 Course safety

The safety of the athletes under difficult and icy snow conditions has to be considered when the technical elements of the course are designed. Where necessary, permanent and protective fences should be included in the design. Such fences must be constructed in a way that they themselves do not cause safety hazards or obstruct TV cameras, and must be erected with smooth surfaces and without sharp corners that can injure the skier if hit.

The need for temporary protection and other special measures that the organiser must take into consideration under certain course conditions should also be mentioned in the Homologation report.

Separate spectators' and officials' access to and along the course must be considered, such that the competitors and the courses are not disturbed during the competition.

2.7 Course construction standard

The courses have to be constructed to a quality that allows for grooming and skiing in wintertime with a minimum of snow. This means that rocks, tree-stumps and trees on the course surface and in the skiers "fall-line" must be removed, that proper drainage ditches and pipes are constructed, and that a soft or smooth summer surface is planned.

2.8 Visibility

Over the past 15 - 20 years new competition formats have been introduced. Cross-Country Ski Cross-, sprint-, team sprint -, mass start-, pursuit and skiathlon competitions have been included in the FIS competition calendar, and we still observe that the sport is in constant development. The athletes

are developing new variations of the skiing techniques, continue to become stronger and faster, and we see that the skis, poles and waxing equipment improve yearly.

The challenge for organizers and venue owners is to design and maintain venues that meet these developments, and continue to display the sport of Cross-country skiing as modern events that attract spectators, TV audiences and other media, and ensures increased interest for the sport. This means creating stadium and course layouts where major parts of the course are visible for spectators. To provide for fair conditions the courses must be wide enough for the new formats, and the transitions between downhills into uphills must be laid out so congestion is avoided. However, the technical challenges must still be considered as important, and not be removed.

2.9 Cooperation with TV

Sport is today a big and competitive entertainment industry. In order to maintain and even improve the position of Cross Country skiing, cooperation with TV is very important.

Before any construction work on new Olympic, World Championship and World Cup courses is started, all aspects related to TV-production for future competitions must be reviewed. This includes planning for camera positions in the stadium and on the courses, as well as cable pathways, snowmobile routes and staging areas for TV-production trucks, etc. For WSC, OWG and WC sites this cooperation with the TV-experts should be initiated when the course design and homologation planning process start. The detailed course layout should be discussed with an experienced TV-producer, or a person with knowledge of the TV requirements. The objective is to create interesting TV-pictures showing all techniques of Cross Country skiing at the appropriate distances along the competition courses, and pictures of spectators enjoying themselves ("folk-fest") without disturbing the focus of the competitors. Even coaches are part of the TV production and "no-coaching" zones, feeding zones and ski-testing zones should be planned to avoid blocking of the camera shots or to enhance the TV production. Such zones should be displayed on the course maps, and reviewed at the Team Captains' Meetings.

Other important TV-considerations are:

- The more compact the whole course system is, the better for TV
- The courses for free and classic technique in Skiathlon or Relay should use the same paths as much as possible
- Wherever possible, especially in uphill sections, there should be an extra two meters width for a camera snowmobile, or a separate path close to the course for the snowmobile.
    - Occasional trees or bushes between the camera and the athletes is good and gives a better sense of the speed
- Long, arrow straight parts are not good for TV. A bit of variation is better, slight turns and ups and downs are better than dead straight and "flat". This applies for uphills, downhills and undulating parts
- The course lengths for interval start races should be minimum 5km for 10km race, and 5 km or ideally 7.5 km for 15 km race. These courses can consist of two 2.5km long and two 3.75km long courses respectively, as long as the courses are separate
- The courses should all have the same approach to the stadium
- The stadium should have one common entry and exit for all competition formats, and provide maximum visibility for the skiers before the finish
    - A horseshoe shape stadium is preferred

- The course design should, when possible, provide opportunity for unique images of the nature and the natural surroundings, old buildings or other interesting objects that make the TV-production more interesting, for example:
    - Showcasing the venue and its unique identity, for example the background view of the church in Seefeld, or the jumping tower in Holmenkollen


3 Competition Course Design Criteria

3.1 Terms

In this manual and in the International Competition Rulebook (ICR), the following terms are used. The definitions of these rules are:

3.1.1 A-climb

A = Major uphills = partial height difference (PHD) ≥ 30 m

For courses over 3.3 km, 20 – 55% of the total climb (TC) of the course should be from the partial total climb (PTC) of major uphills (A-climbs).

The gradient must be from 9 - 18 %, sometimes broken up with some short undulating sections less than 150 meters in length or a downhill that does not exceed 10 m partial height difference (PHD).

The average gradient of an A climb, including undulating terrain sections should be 6 - 14%.

The maximum PHD of an A climb should not exceed 80 m.

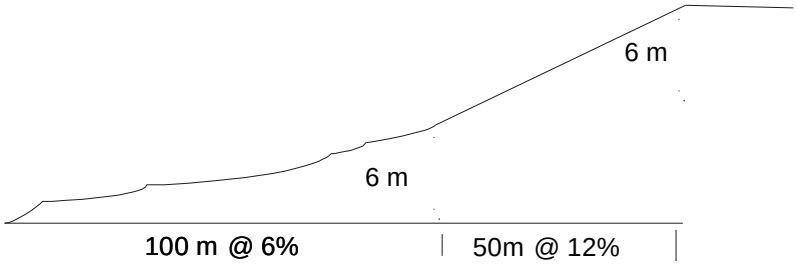
3.1.2 B-climb

B = Short uphills = 10 m ≤ PHD ≤ 29 m, gradient 9 - 18%

20 – 55% of the TC should be from the PTCs of short uphills (B-climbs).

B-climbs can also permit sections with gradients of less than 9% (undulating sections) providing that the B-climb includes some sections with a gradient ≥ 9% and the average gradient of the whole B climb is > 6%.

For example, the following will qualify as a B-climb:



3.1.3 C-climb

C = Steep uphills = 4m < PHD < 10m, gradient > 18%.

Climbs with < 4 m PHD will be included as undulating terrain or as part of an A- or B-climb.

For mass-start courses, C-hills should be avoided, or if possible, the hills must be widened (with space for three skiers side by side).

3.1.4 Undulating terrain (UT)

A combination of flat and rolling terrain including short steep climbs, flat sections and downhills. Terrain with gradient < 9 % and climbs < 10 m PHD with gradient ≥ 9 % can be included.

15 – 35 % of total climb (TC) should be from partial climbs (PC) on undulating terrain.

3.1.5 Maximum Climb (MC)

MC is the climb with the highest partial total climb or PTC (see 3.1.8), or in other terms, the biggest uphill section.

3.1.6 Total Climb (TC)

TC is the sum of all climbs on the course.

3.1.7 Partial Climb (PC)

Partial climb is a sub-section or distinct part of a climb that makes up an overall A climb or B climb.

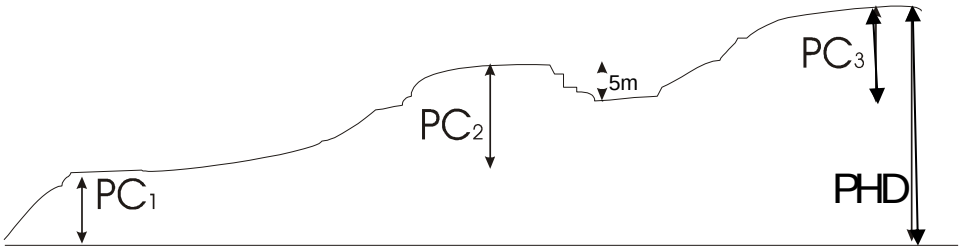
3.1.8 Partial Total Climb (PTC)

PTC (Partial Total Climb) is the sum of all partial climb sections (PC) of a climb that make up any A or B climb that has some varied gradients or short breaks in sections (see figure below where PTC = PC1 + PC2 + PC3). If an A or B uphill has no downhill parts then the PTC = PHD.

PTC is used to calculate the maximum and total climb.

3.1.9 Partial Height Difference (PHD)

PHD is used to calculate the average gradient of the climb (PHD x 100/distance)



$$PTC = PC_1 + PC_2 + PC_3$$

$$PHD = PTC - 5m$$

3.1.10 Height Difference (HD)

HD is the vertical distance from the lowest to the highest point on a cross-country course.

3.2 Requirements

All FIS Cross-Country competitions should be carried out on homologated courses. Exceptions are: popular competitions, roller skiing competitions, and substitute courses if approved by the TD. In competitions designed for special Cross-Country sport promotion ("Tours" or multi-stage TV events) it is also possible to use courses outside of the homologation standards providing they have been approved by the Sub-Committee for Rules and Control.

To meet the general homologation requirement the competition course and stadium must:

- Test the skier in a technical, tactical and physical manner
- Provide a degree of difficulty that matches the level of competition
- Be laid out as naturally as possible using the terrain in a balanced manner
- Be located to avoid wind exposed areas, and therefore woodland areas are preferred, however the spectators' viewing aspect has to be considered
- Be laid out in such a way that impact on nature and the environment is minimized
- Provide smooth transitions between the varying techniques of the skier
- Remain safe in marginal snow or icy conditions
- Have a distribution of the terrain of approximately
    - 1/3 uphills
    - 1/3 downhills and
    - 1/3 undulating terrain
- Be designed such that a large part of the uphills are located within the latter part of the course, and if possible, in view of the stadium
- Include space in and adjacent to the stadium for start/finish zones, mix zone, team preparation area, warm-up and ski testing

ICR Rules 311.2.5 and 311.2.6 specifically lists the required course design criteria that the Homologation Inspector must consider when evaluating the suitability of a FIS competition course.

ICR 311.2.5:

Course distance	Minimum climb * (in PHD)	HD	MC (in PTC m)	TC
Sprint F		max. 50 m	0 – 30 m	0 – 60 m
Sprint C	1 climb > 15 m	max. 50 m	15 – 40 m	20 – 60 m
2.5 km	1 climb > 25 m	max. 50 m	25 – 50 m	75 – 105 m
3.3 km	1 climb > 25 m	max. 65 m	25 – 65 m	100 – 140 m
3.75 km	1 climb > 30 m	max. 80 m	30 – 80 m	110 – 160 m
5 km	1 climb > 30 m	max. 100 m	30 – 80 m	150 – 210 m
7.5 km	2 climbs > 30 m	max. 125 m	30 – 80 m	200 – 315 m
8.3 km	3 climbs > 30 m	max. 125 m	30 – 80 m	210 – 330 m
10 km	3 climbs > 30 m	max. 125 m	30 – 80 m	250 – 420 m
longer than 10 km	Courses must follow the same principles			

* A “climb” is defined as an uphill with a gradient from 9 - 18 %. It may be broken up with short undulating sections less than 150 meters in length, or a downhill that does not exceed 10 m partial height difference (PHD). The average gradient of the climb, including undulating terrain and downhill sections should be 6 - 14%

ICR 311.2.6:

Category	**Minimum course width**			**Used for**
	Uphills	**Undulated terrain**	**Downhills**	
A	3 m	3 m	3 m	Interval start C
B	4 m	4 m	4 m	Interval start F Relay C
C	6 m	6 m	6 m	Mass start C Skiathlon C part Pursuit C Relay F Sprint C Team sprint C
D	9 m	7,5 m	6 m	Mass start F Skiathlon F part Pursuit F Sprint F Team sprint F
E	12 m	9 m	6 m	Skiathlon and Relay (when both techniques are used on the same course)

The requirement for width is based on measurements when the course is prepared for skiing and fenced off for the competition.

The remaining sections of ICR 311, sections 312 and 321 - 327 represent a mix of requirements and recommended guidelines to which the overall venue (course and stadium) design should adhere. The requirements include:

- Adhering to the tables in the ICR regarding stadium width and length for different competition formats (see ICR 321 – 327))
- Providing space in and adjacent to the stadium for start and finish zones, team preparation area, media etc. according to ICR 312
- Providing warm-up course and ski test areas according to ICR 312
- Considering on-course safety

The required length for a homologated Cross-Country course should not exceed the official course distance by more than 10% or must not be more than 5% shorter (meaning that a 5 km course should not be longer than 5.5 km or cannot be shorter than 4.75 km).

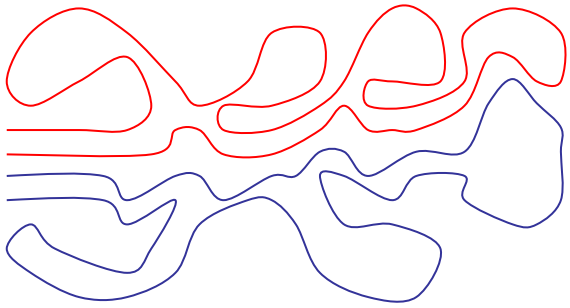
NOTE: Regardless of the percentages listed above, for a venue with both a 3.3 km and 3.75 km course, the 3.75 km must of course be longer than the 3.3 km course.

If it is necessary to vary the standards in one part of the course, this should be compensated in another part. For example, it is critical that the courses for mass start competitions provide enough width in all straight uphills and in the last part of the courses in order to provide for overtaking, fair and safe competitions. However, in other short and non-critical parts of the course where the required width will cause large construction costs, exceptions to ICR 311.2.6 should be possible.

3.3 Resource-saving considerations

The layout of a Cross-Country competition course should provide:

- Minimum impact on the nature and the environment
- Cost saving construction for the Organizer; bridges should be avoided etc
- Compact layout such that cost efficient TV-production is possible – one TV-bus can cover several camera positions on the course, with short cabling distances for cameras, timing, electrical power supply etc.
- Easy and separate access to different parts of the course for
    - Spectators
    - Media
    - Team support personnel
    - Organizer's officials



This is a principle layout of a course system that can accommodate all competition formats. It consists of two separate courses, one for each technique in the skiathlon competition and each 5 km long. Cut-offs can make courses of 2.5, 3.3 and 3-75 km length. Also sprint courses can be laid out inside this system. These two courses can be considered as one 10 km course, Another option is a transition from the red to the blue course outside the stadium in order to make a 7.5 km loop that is more suitable for interval start formats.

4 Course requirements for different competition formats

4.1 General

The current competition formats on the FIS competition calendar are: Relay, Interval start, Pursuit start, Mass Start, Sprint and Team Sprint, and Skiathlon (see below for special design considerations related to some of these formats). A new format, Cross-Country Ski Cross, has been tested out for younger skiers, but is not yet included in standard FIS competitions. Course design and homologation criteria for CC Ski Cross will be included in a future version of this homologation manual.

For Classical technique mass start/skiathlon competitions with large fields it is required that 4 tracks (or more) can be set throughout the course, while the requirement for free technique (sprint, mass start) is that 3 athletes can skate side by side, in all critical parts of the course, without interfering with each other (one skate lane is 3 m wide).

4.2 Relay

Relay courses should be designed using cut-offs from longer courses (see paragraph 3.3). Regarding the required width, see the table in section 3. Relay competitions are of great interest for spectators, and the course layout should therefore provide for good views of the competition. If both techniques are used on the same course, the course must be wide enough to accommodate the respective widths for each technique (see table in section 3).

4.3 Interval start competitions

Very few competition courses are designed just for interval start competitions. For competition courses where skiers are mostly skiing one by one, more technical elements (e.g. more curves and transitions) can be designed. An important thing to still consider is that overtaking and passing can take place, for example by including straight uphill sections.

4.4 Mass start competitions

These competition formats are also of great interest for spectators. The course layout should therefore provide for good view of the course from the stadium.

The start area must be wide and long enough to allow for starting up to 150 athletes at the same time. After the start and for the next 500 – 1000 m, depending on the terrain, three or more skiers should be easily able to ski side by side. Points of congestion must be avoided, and therefore sharp transitions from downhills into uphills, narrow sections and long and steep C-climbs must be avoided.

In downhill sections the following must be taken into consideration:

- Downhills should be laid out so that they provide technical challenges to the athletes, and avoid opportunities for drafting (e.g. very long and straight downhills)
- Consideration for the athletes' safety is very important, so corners must be sweeping and with a constant radius, especially at the bottom of downhills. There are formulas developed for how to design downhill corners based on the skier's estimated speed and the radius of the curve (see section 5.6 for details)
- Fast downhills must be wide such that skiers can get around other skiers in case of a crash
- Dangerous areas adjacent to the course must be fenced or protected (steep banks and ditches, trees, rocks)
- Avoid sections that create compressions such as a high speed downhill followed by an immediate steep uphill
- Avoid high speed "blind corners" where skiers cannot see the bottom of the hill or around the corner etc.

Approaching the finish, the course layout should focus on allowing for overtaking and passing. If possible, a final climb with opportunities for overtaking and passing should be located in view from the spectator stands. This is important in order to promote the excitement of these competition formats – which is so important for the future of the Cross-Country sport. The last 100 -150 m before the finish the course must be wide enough to allow for four corridors to the finish line, and should have a gentle climb with gradient between +2 and +4 %.

Narrow sections should be avoided on mass start courses. However, a narrower bridge or a tunnel can be accepted provided that this section is not located at a decisive part of the course. Decisive parts are immediate after start, just before the finish and in other parts where one athlete might block the others and affect the outcome of the competition in an unfair way. Such considerations

should be given special attention during homologation inspection and documented in the Homologation report.

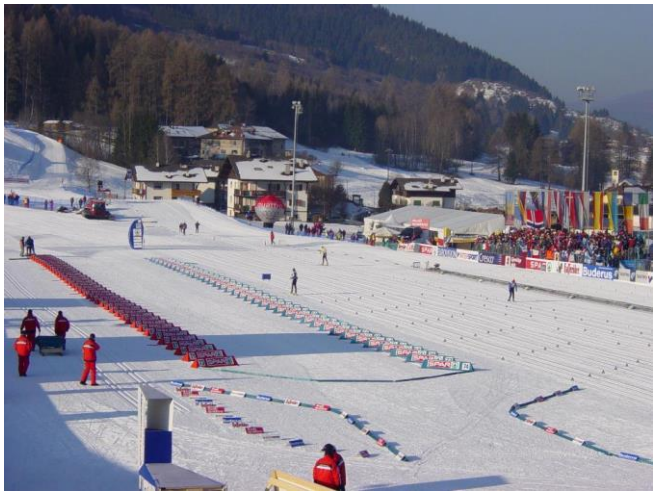
Extra space for feeding stations is an element that should be incorporated into course design. These are sections of the course that have extra width to accommodate large groups of coaches. Feeding locations are best located within undulating terrain, and on a straight section followed by a slight downhill. Optimally an extra 6 meters in width (30 meters long) is needed for a feeding station (feeding on both sides should be possible).

4.5 Skiathlon competitions

In addition to the recommendations mentioned for mass-start competitions, special attention must be given to the area for equipment exchange, which takes place in the stadium. About 1 - 1.25 m width per exchange box on a flat section as well as ski lanes into and out from the exchange boxes should be planned.

In order to show the excitement of this competition format, the athletes should come through the stadium as a minimum every 2.5/3.3/3.75/5 km. That means for the women7.5 km + 7.5 km, the laps could be 2.5 or 3.75 km. For the men's 15 km + 15 km, a 3.75 km or 5 km course should be used. If the course for the second part of the men's Skiathlon is too short (for example 2.5 km) overtaking might be a problem.

If a Skiathlon competition takes place as 5 + 5 km for women and as 10 + 10 km for men, the courses can be shortened to 2.5 km or 3.3 km loops.



4.6 Sprint Competitions

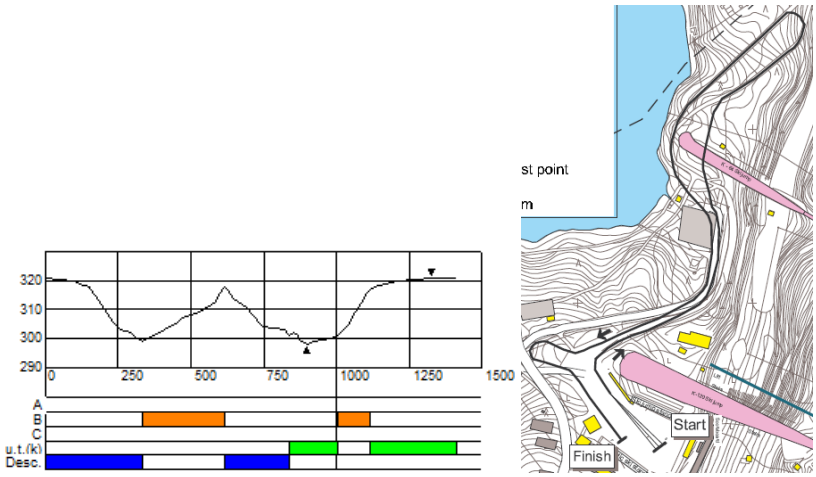
The overall goal when designing a classical technique sprint course is to make sure that the diagonal technique is used, which means hilly enough such that the skiers are applying kick wax under the skis and use diagonal stride technique.

The requirements below are valid for a men's level 1 (OWG, NWSC and WC) sprint course in classical technique (women's courses and level 2 courses (COC) may be less demanding):

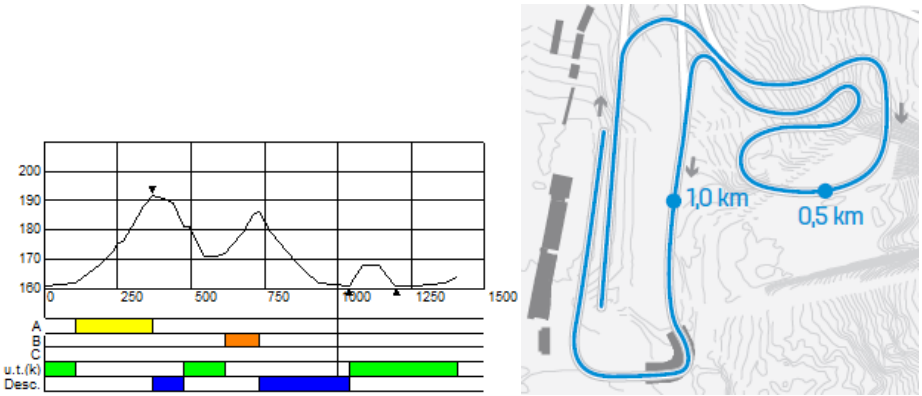
- Include minimum two uphills with gradients of 14 – 18%
- The PHD of one of the uphills should be minimum 15 m (preferably the last one)
- The PHD of the other uphill should be minimum 10 m
- At least one of the uphills should be suitable for a diagonal stride technique zone
- Both flat and uphill sections should include straight sections that allow for overtaking and passing. Too many curves on flat parts provide an advantage to those athletes using skating skis in classical technique competitions
- A slight uphill gradient towards the finish should be included
- Downhills with curves where several technical and tactical choices of best line is possible, is also recommended

NOTE: There are no uphill requirements for sprints in free technique. This is such that a sprint competition in free technique can be held on city streets or in a track & field stadium. It is however important that the requirements for width are upheld.

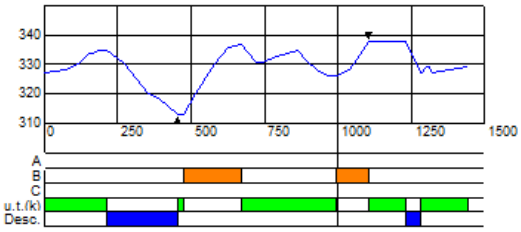
Examples of classical technique sprint courses:

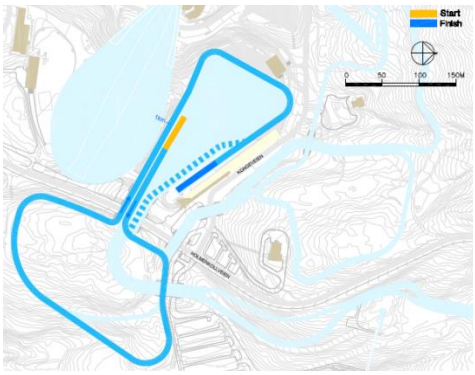


Kuusamo, Finland

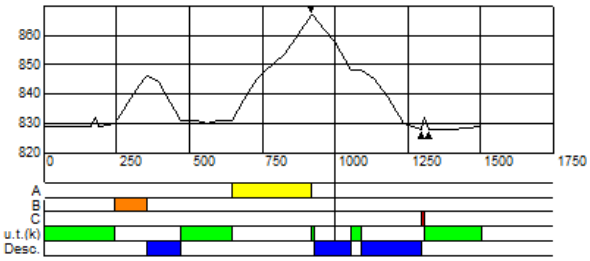


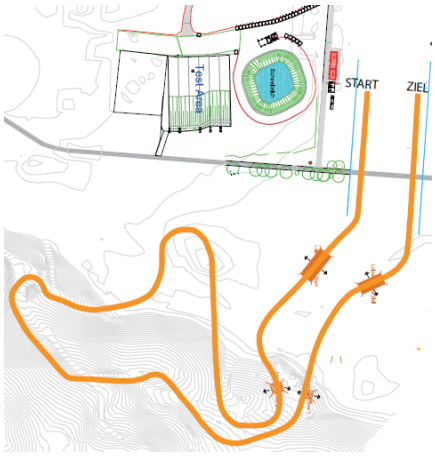
Falun, Sweden





Holmenkollen, Norway





Oberstdorf, Germany

4.7 Multi-stage competitions (Tour)

Tour de Ski (TdS) was introduced as part of the FIS World Cup program in 2007. The popular competition course from Cortina to Toblach was for a while included in the program, and the unique climb up Alpe Cermis has from the beginning been the trademark of the TdS. Both these competitions have been carried out on courses that are outside the homologation rules. The 2016 Tour de Canada included similar, non-compliant courses. Such courses still have to be inspected and approved by a HI.

The FIS subcommittee for Rules & Control and the Chair of the Homologation Working group have the discretion to approve World Cup multi-stage courses that are not in accordance with the homologation rules. These are usually special cases for the purpose of promoting the sport.

5 Design of Courses

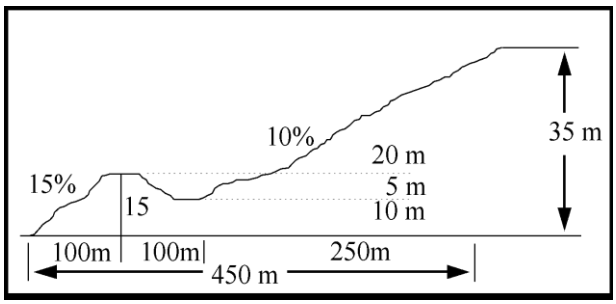
5.1 Uphill Terrain

Course designers and homologation inspectors must appreciate that there are many factors that can contribute to the difficulty of a climb. In designing a course, the possibilities for various types of climbs should be emphasized.

The steepest uphills are not necessarily the ones that separate the best skiers from the others, since the steepness often limits the speed regardless of technique and athlete's capacity. The best courses are those that include all kinds of uphills, with a variety of lengths and gradients. The ideal solution is for example one major uphill with an average gradient of 6%, another with 12%, and a third with 9%.

The following examples illustrate principles of uphill design:

This first example will homologate as a major climb:



Specific climb gradient = 15% & 10%

Average gradient of climb = 7,8%

Overall HD of climb = 35m

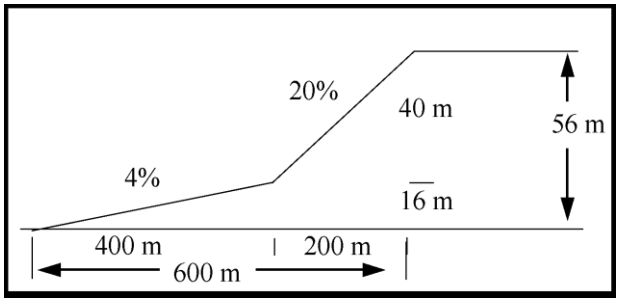
Added to TC from this climb = 40m.

(15 + 25m)

*Note: TC is the sum of all individual positive HDs.

The interruption consists of undulating terrain. Thus a small downhill with HD < 10m can be included.

This following example will not homologate as a major climb:



Specific climb gradient = 4% & 20%

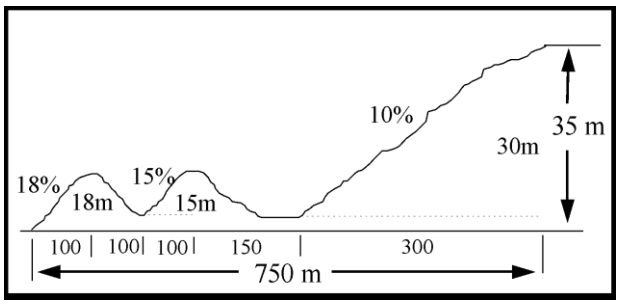
Average gradient of climb = 9.3%

Overall HD of climb = 56m

Added to TC from this climb = 56m (16 + 40m)

This example illustrates why the majority of the sections of climb in a major uphill belong in the range of 9 - 18% (ICR paragraph 311.1.2). Both these gradients of 4% and 20% are outside the range even though the average gradient is in the range of 6 - 14%. This would represent a poorly constructed uphill due to the long section at 20% for 200m. This is unacceptably long and must be broken up into shorter sections of varying slopes or eliminated altogether. Steep up hills, type "C" with gradient > 18% are not recommended to exceed 30m in length, with a single maximum HD of 10m. It is necessary to stress that these "C" climbs are kept short and not too steep so that the rhythm and tempo can be maintained while providing some technical and tactical features to the course. For mass start competitions in Classical technique any C climbs should be avoided.

The following example will not homologate as one single major climb:



Specific climb gradient = 18%, 15% and 10%

Average gradient of climb = 4.6%

Overall HD of climb = 33m

Added to TC from this climb = 63m (18 + 15 + 30m)

This is an example of two individual "B" climbs and one "A" climb. Lesser HDs (<10m) in this situation would re-define the B climbs to undulating terrain.

Undulating terrain (gradient < 9%) as part of a major climb

Major up hills are defined with a gradient of between 9% - 18%. The average gradient in a major uphill should be between 6% - 14%, thus an uphill can include undulating terrain. In fact, undulating terrain should normally be part of a major uphill. Such undulating sections can occur at the beginning, in the middle section or at the end of the major climb. This concept is also valid for a B-climb.

The acceptance of undulating sections within a major climb is based on their location and length. If an undulating section is accepted as part of a climb it counts as part of the uphills in the overall calculation of the terrain distribution.

When undulating sections occur in the middle of the climb it is a fairly simple situation. If they are less than 150 m in length or include a downhill of less than 10 m HD, the climb is not broken and the overall HD is used to determine the climb's average gradient. When they occur at the beginning or end of the climb, then the decision to allow them will depend on three basic principles:

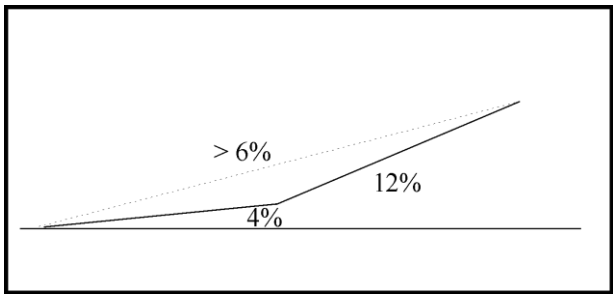
a) if the average gradient is between 6% - 14%, they are included

b) sections of uniform gradient must either be completely included or excluded

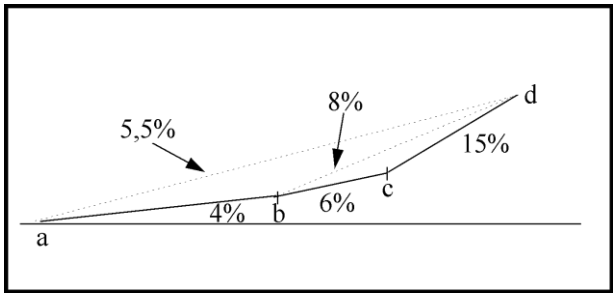
c) does the undulating section add sufficient physical demand to the skier (does it still feel like part of the climb, are they still working vs. resting)?

The last point is intended to be a judgement call on the part of the homologation inspector in cases where the average gradient borders on the limits of 6% or 14%.

Sample profiles



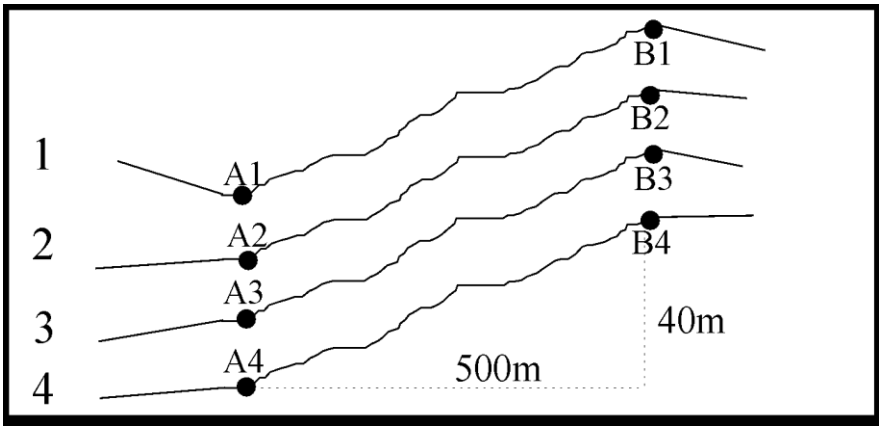
Normally accepted providing the 4% section is not excessively long.



Major climb is from B to D only. The HD from A to B is not included as part of this major climb. AB is an undulating part of the course, and the TC from this section is added to the TC of the course.

Effects of Surrounding Terrain on the Uphill

For course designers it must be appreciated that the following 4 examples represent sections that get progressively more difficult for the skier to ski, yet our homologation system would rate them all with average gradient of 8% with HD of 40m from A to B.



They would all be included as a good A climb in any course. The nature of terrain before and after the climb can add substantial physical demand without affecting the definition of the climb itself. One main purpose of Cross-Country course design is to create courses that separate the good skier from the less skilled one. A major climb like example 4 should be a part of every well-designed course. Even though the specifications are the same for all of the above examples it should be recognized that hill no. 4 is much more demanding to ski than the others because of the characteristics of the terrain before and after the uphill section.

Classical technique considerations

In the future, the challenge of preserving classical technique should be solved by other means than creating more and steeper uphills. Courses should no longer be built with uphills suitable only for the elite World Cup skiers.

Over the last year several Organizers and Juries have tested diagonal stride technique zones in classical technique competitions, both for sprint and distance competition, and both at a national and international (World Cup) level. The testing has been mostly successful, and it has shown that this is a better way to preserve classical technique than to require competition sites to build expensive "special" courses.

Regarding diagonal stride technique zones, the placement of these are the responsibility of the competition jury, and a well-designed course will normally include suitable sections. From experience, gradients from 14 – 18% are most suitable for zones, depending on the speed at the beginning of the uphill. Therefore, the course designer should try to include suitable 14 – 18% uphills in all courses, preferably moderately long (close to 100 m or more).

5.2 Recommendations for the number and location of A- and B-climbs

The ICR table 311.2.5 (see section 3) lists the minimum requirements for uphills as well as for Total Climb and Maximum Climb. To best obtain these requirements, the following table gives further guidelines for course designers:

Length of Loop	Major Uphills (A)		Short Uphills (B)	Steep Up-hills (C)
	Gradient 9 - 18 %		Gradient 9 - 18 %	Gradient >18 %;
	Avg gradient 6 - 14 % >=30 m PHD		10m<PHD<29m	4 m<10 m< PHD
	Qty	**PHD (m)**	**Qty**	**Qty**
Sprint Classic			1 - 2	0 – 1
2.5 km	1	25* - 50	1 - 3	0 – 1
3.3 km	1	25* - 65	2 - 3	0 – 1
3.75 km	1	30 - 80	3 - 4	0 – 1
5 km	1 - 2	30 - 80	3 - 5	0 – 1
7.5 km	2 - 3	30 - 80	4 - 6	0 - 2
8.3 km	3 - 4	30 - 80	4 - 7	0 - 2
10 km	3 - 4	30 - 80	5 - 7	0 - 3
12.5 km	1 - 2	51 - 80	6 - 9	0 - 3
	2 - 3	30 - 50		
15 km and	1 - 2	51 - 80	8 - 10	0 - 3
16,7 km	3 - 5	30 - 50		

*A hill of 25 – 29 m PHD is considered a B hill

NOTE: A Sprint Free course has no requirements for uphills

For courses longer than 3.3 km, the “A”climbs should represent between 20 % - 55% of the total climb (TC).

The location of the major climbs along the course is as critical as their total climb or elevation values, and together these factors determine the flow and balance of technique as well as where and when the maximum physical demands are placed on the skier. The location of the major climbs should be spread out along the course, and the course should optimally start with a shorter climb (B-climb). The most critical climb is towards the end of the course, where the strongest skier can “win the race”. The locations of the climbs will however in many cases be given by the natural terrain and the need to minimize the environmental impact.

The location of major climbs in the terrain is also a primary influence on where the stadium should be placed so that there is good access to the best terrain at appropriate distances along the course. If possible, the ideal solution is to place the stadium close to the middle between the highest and lowest point. The reason for this is that it gives flexibility for course design.

5.3 Requirements of Maximum Climb (MC) and Total Climb (TC)

ICR Paragraph 311.2.5 lists the table for required Maximum Climbs (MC) for different course lengths:

0.4 - 1.8 km sprint free	0 - 30 m
0.4 - 1.8 km sprint classical	15 - 40 m
2.5 km	25 - 50 m
3.3 km	25 - 65 m
3.75 km	30 - 80 m
5 km	30 - 80 m
7.5 km	30 - 80 m
8.3 km	30 - 80 m
10 km and over	30 - 80 m

ICR Paragraph 311.2.5 also includes the requirements for Total Climbs (TC). To achieve challenging courses, the TC for the different competition distances must be:

0.4 - 1.8 km sprint free	0 - 60 m
0.4 - 1.8 km sprint classic	20 - 60 m
2.5 km	75 - 105 m
3.3 km	100 - 140 m
3.75 km	110 – 160 m
5 km	150 - 210 m
7.5 km	200 - 315 m
8.3 km	210 – 330 m
10 km	250 - 420 m
Longer than 10 km	courses must follow the same principles

As an example, in a reasonably challenging 5 km loop (World Cup level) the TC should exceed 180 m and include two major uphills of a total of 80 – 90 m climb. This could be a combination of a 60 m hill and a 25 m hill, or a combination of two 40 m hills. This situation implies that, to be flexible in laying out the course, the available terrain should have a HD of up to 80 m.

If there is only one A-climb on a 5 km course, the PHD should exceed 45 m and could even be up to the maximum of 80 m. Another solution could be that the two A climbs follow each other. Such a design/course is suitable for a long-distance competition (30- or 50 km).

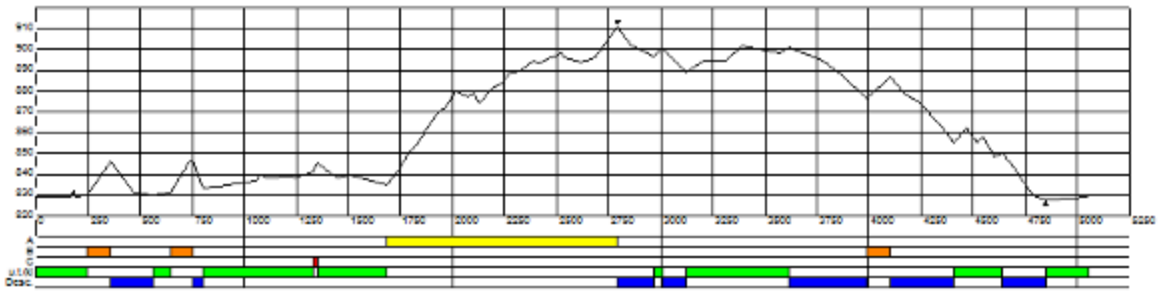
Exceptions

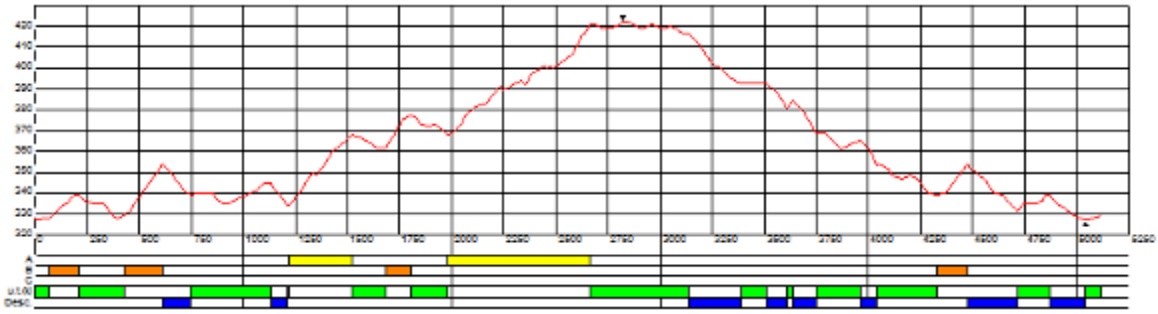
For Continental Cup (COC) venues above 1800 m elevation, the requirements listed and discussed here (TC and MC) can be reduced by 20%. This means, for example, that a TC of 120 m (which is 80% of 150 m) can be accepted on a 5 km course. In some cases, similar exceptions for regular COC level courses can be approved by the Regional Coordinator.

There are no altitude limitations for COC level competition courses.

Examples of homologated Championship courses:

The three examples below show that course profiles can be very different. The first profile can be used both for single and multiple lap competitions. The next two profiles should be used mainly for multiple lap competitions since the first part of the course is mainly uphill while the second part is mainly downhill.





5.4 Course length and use of shorter loops

The rules and guidelines provide many possibilities for variations in course design. The solution will be a judgement call on the part of the course designer and the homologation inspector.

When planning a competition course, the Total Climb (TC) for the whole competition distance has to be taken into account when TC for shorter loops are considered.

For example, a 5 km loop with a TC of 180 m is in the middle of the suggested range for a 5 km course, while the TC for a 50 km competition on the same loop (10 laps) will be 1800 m, which is

towards the *upper* level of the range (which is max. 2000 m). A challenging course that tests the skier's ability does not need to be at the maximum in order to be a good course. There are many combinations of factors that make the course a good one.

For competition distances using multiple laps, the course length should be measured from start to start, including lapping sections and excluding sections (finish) not skied during the laps. For horseshoe shaped stadiums, this means normally that the finishing straight is not included in the (one-lap) course length. The entire competition distance is then the length from start and back to start again multiplied by the number of laps plus (+) the length of the finishing straight.

For ski-through stadiums, such as Lillehammer, the final loop is normally shorter than the other loops. The calculation will then be the length from start and back to start again multiplied by the number of laps minus (-) the length of the lapping curve.

The length of the Cross-Country courses does not need to be exact (see section 3.2). However, for Nordic Combined and Biathlon courses, where two disciplines (jumping and skiing, or shooting and skiing) are elements of the same competition, the course distance should be quite exact to the competition distance.

On the FIS homologation certificate for the course, only the distance from start to finish is documented.

5.5 Design of Undulating Terrain

The definition of undulating terrain is found in ICR 311.1.2 and is best summed up with the words "rolling terrain" including short ups and downs interspersed with flat sections.

Rising terrain with less than 9% gradient will be considered undulating terrain. Short climbs (9 – 18% with HD less than 10m PHD, or >18% and less than 4 m PHD) are also included in the definition of undulating terrain. Short downhills with HD < 10m are parts of the undulating terrain as well. As indicated earlier in this manual, undulating terrain should be included as parts of a major climb.

The TC of a course includes (in addition to uphills) all positive elevation changes found in undulating terrain.

5.6 Design of downhills

Short downhills have an HD between 10 m and 30 m. Long downhills have an HD >30 m.

Undulating terrain can be included in a downhill. If those sections include small uphills, the elevation of these uphills also counts to the TC of the course.

Safety together with technical and tactical challenges for the skier should be taken into consideration when a downhill is designed. A good Cross-Country competition course includes various kinds of downhills, long and short, steep and slowly falling terrain.

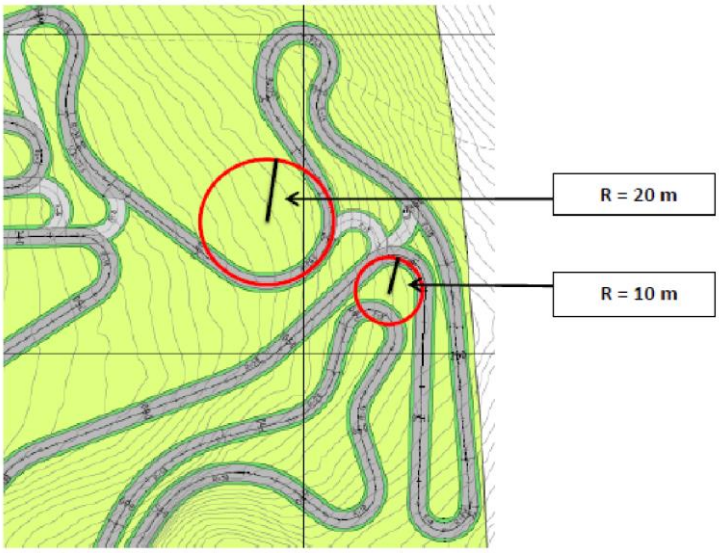
In fast downhill curves the need for proper radius and banking must be considered:

> The course designer must first consider the relationship between the radius R and the speed V in the curve. The ratio of **V^2/R** should be within the maximum values shown in the table below:

V^2/R maximum value	Interval start	Relay, Pursuit	Sprint, Team sprint	Masstart, Skiathlon
2	+	+	+	+
5	+	+	+	R
10	+	+	R	-
15	+	R	-	-
25	R	-	-	-

"+" means that the downhill and corner can be used
"-" means that the downhill and corner is not safe
"R" means that the HI/Jury should review

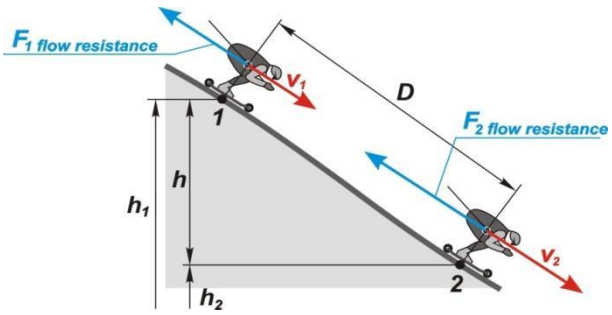
The radius can easily be measured from the course plans (see figure below):

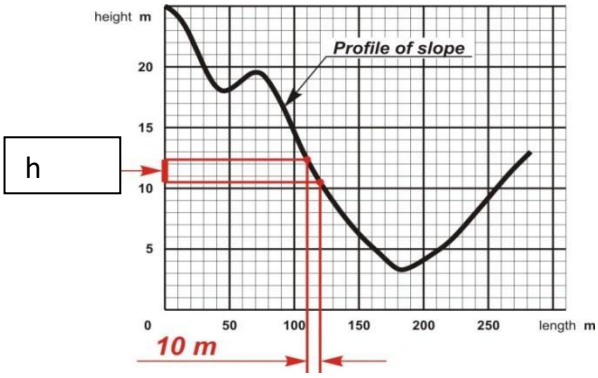


To calculate the theoretical speed is a bit more complicated, but it can be estimated by dividing the downhill into 10 m sections (the detailed profile of the planned course is required) and using the formula:

$$V_2 = \sqrt{0{,}95V_1^2 + 20h - 4}$$

where the variables V_1 and h are as shown on the drawings below.





The speed and speed/radius ratio are then calculated by entering the formula and data into an Excel spreadsheet:

Length	Part-length	HD	PHD	Calculated			
m	m	m	m	speed m/sec	km/hr	V2/R (R=15)	V2/R (R=30)
0				6	21.6	2.4	1.2
10	10	783	-2	8.3	29.8	4.6	2.3
20	10	781	-2	10.0	35.9	6.6	3.3
30	10	779	-2	11.3	40.8	8.6	4.3
40	10	777	-1	11.7	42.2	9.1	4.6
50	10	776	-1	12.1	43.4	9.7	4.9
60	10	775	-1	12.4	44.6	10.2	5.1
70	10	774	0	11.9	42.9	9.5	4.7
80	10	774	0	11.4	41.2	8.7	4.4
90	10	774	-1	11.8	42.6	9.3	4.7
100	10	773	0	11.4	40.9	8.6	4.3
110	10	773	0	10.9	39.2	7.9	4.0
120	10	773	0	10.4	37.5	7.3	3.6
130	10	773	-1	10.9	39.3	8.0	4.0
140	10	772	-1	11.4	40.9	8.6	4.3
150	10	771	-1.5	12.2	43.9	9.9	5.0
160	10	769.5	-1.5	12.9	46.6	11.2	5.6
170	10	768	-2	14.0	50.3	13.0	6.5
180	10	766	-2	14.9	53.6	14.8	7.4
190	10	764	-2	15.7	56.5	16.4	8.2
200	10	762	-1	15.8	56.9	16.7	8.3
210	10	761	-1.5	16.2	58.4	17.6	8.8
220	10	759.5	-1.5	16.6	59.8	18.4	9.2
230	10	758	0	16.1	57.9	17.2	8.6
240	10	758	0	15.5	55.9	16.1	8.1
250	10	758					

=SQRT(0.95*(POWER(E4,2)-20*D5-4))

5.7 Homologation of Multiple Lap Courses

The data from the table in ICR 311.2.5 is designed to represent single loop distances.

Sprint competitions should normally be carried out on single loop courses. If the same loop or part of the same loop is skied more than once, then the prologue must be able to be skied without a course crossing. Other competitions such as relay-, mass start- and skiathlon competitions should be carried out on multiple lap courses.

It is important to note that loops who serve several racing distances should have climbs designed so that the major climbs could be increased or decreased through the use of cut-offs or similar alternate routes.

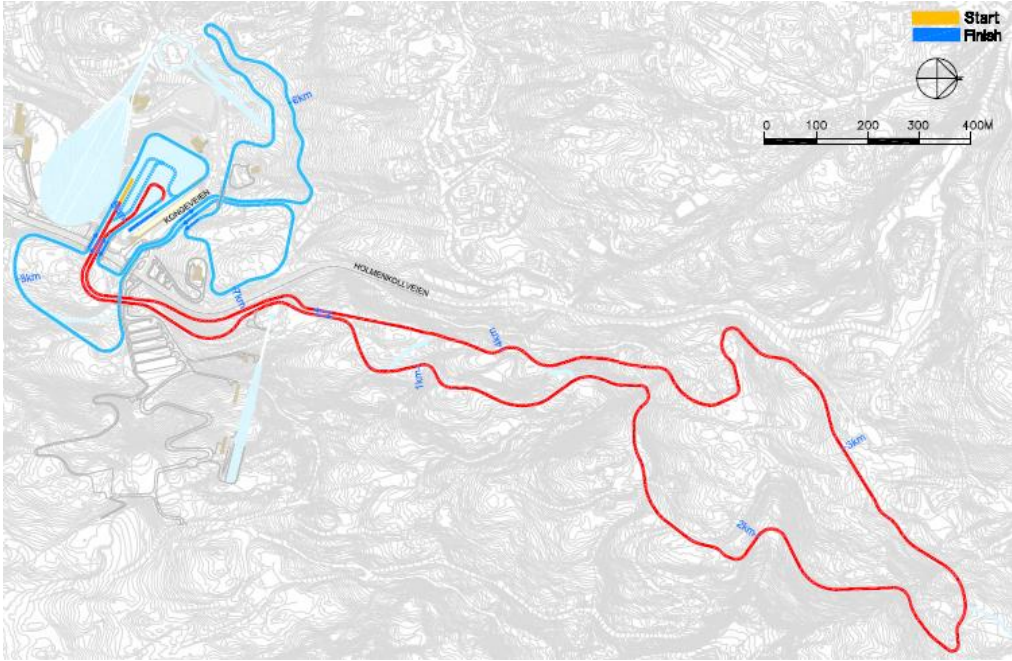
In the example below, from Sochi, we can see that the second 5 km (blue) loop by itself is not a great design, with a long downhill from the start. However, if the first 5 km (red) loop is skied first, followed by the blue (a 10 km loop) we see that the combination is a good course. We also achieve a good uphill climb towards the finish.

5.8 Standard naming and use of courses

Skiathlon competitions will normally require two different courses. In order to better inform athletes and coaches about the course system the Classical course should be marked red and the Free Technique course marked blue. The courses could then be named:

Red 1.4 km (or Sprint)	Blue 1.4 (or Sprint)
Red 2.5 km	Blue 2.5 km
Red 3.3 km	Blue 3.3 km
Red 3.75 km	Blue 3.75 km
Red 5 km	Blue 5 km

The longer courses (7.5 km, 8.3 km and 10 km) can then be a combination of the shorter red and blue courses.



Holmenkollen, Norway

5.9 Guidelines on Course Distances used in different Competition Formats

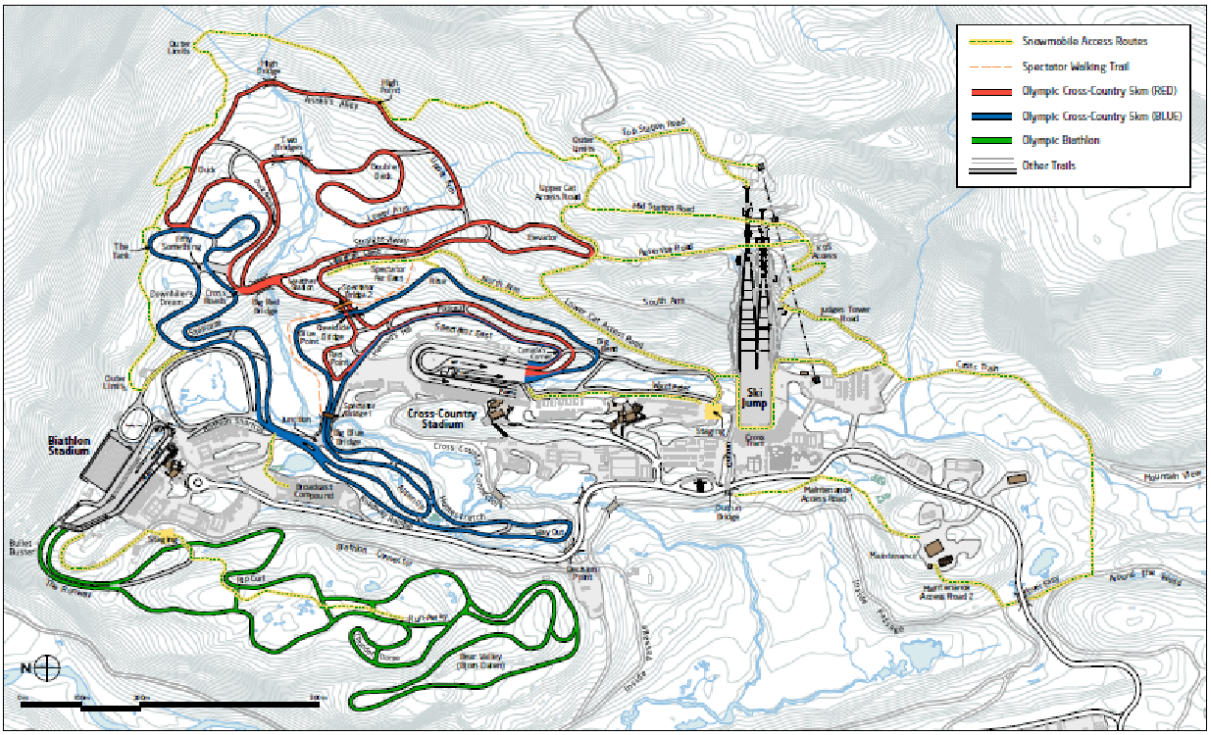
Competition courses Broadcast requirements for WC, WSC and Olympic Games			
Event	Minimum loop	Optimal loop	Comments
Interval start 10 km	3.3 km*	5 km	
Interval start 15 km	5 km	7.5 km or 10 + 5 km	Normally the intermediate timing positions are located after 1.5 - 2 km, then between 6 - 7 km, and finally between 12 - 13 km. These locations should all be within 1.2 km from the TV production van.
Interval start 30 km	5 km	7,5 km or 10 km	
Interval start 50 km	10 km*	12,5 km or 16,7 km	
Mass start 10 km	2,5 km	2,5 km or 3,3 km	
Mass start 15 km	2,5 km*	3,75 km or 5 km	
Mass start 30 km	3,75 km*	5 km, 7,5 km or 10 km	
Mass start 50 km	7,5 km	8.3 km or 10 km	Can use two different shorter loops if separate through stadium for example two different 5 km courses or a 3,3 km + 5 km
Skiathlon 5+5 km	2,5 km	2.5 km	Can use same course for both techniques if it is wide enough (12 m)
Skiathlon 7,5 + 7,5 km	2,5 km	2.5 km or 3.75 km	Can use same course for both techniques if it is wide enough (12 m)
Skiathlon 10 + 10 km	2,5 km	2.5 km or 3.3 km	Can use same course for both techniques if it is wide enough (12 m)
Skiathlon 15 + 15 km	3,75 km	3.75 km or 5 km	Can use same course for both techniques if it is wide enough (12 m)
Prologue 2,5 km, 3,3 km or 3,75 km	2,5 km	2.5 km, 3.3 km or 3.75 km	
Relay 4 x 5 km	2,5 km	2,5 km or 5 km	Can use same course for both techniques if it is wide enough (9 m)
Relay 4 x 10 km	2,5 km*	2,5 km, 3.3 km or 5 km	Can use same course for both techniques if it is wide enough (9 m)
Individual sprint	0,4 km	0,8 km up to 1.8 km	
Team sprint	0,4 km	0,8 km to 1.8 km	Two laps on a short loop can be used.
Special cases			Popular competitions or multi-stage competitions - to be dealt with individually
1. The minimum loops marked with an asterisk * - especially for interval start competitions – must only be used in unique situations. For example, no 10 km interval start competition should be planned to be held on a 3.3 km long course. Only in lack of snow should the shorter loop be an option.			
2. In all Championship competitions the TV Director must be involved at the earliest possible moment to evaluate which course would be best for TV for this particular event. The overall scheduling of the event (budgeting, other factors) might have an influence on this. For example – for practical reasons – it is better to do a skiathlon on the shorter loop even if the longer loop would give better TV pictures. This could be the case, especially in WC events, where the schedule can be very tight, and Nordic Combined or another competition needs to be taken into consideration.			
3. The stadium layouts should always be discussed with the TV director in advance. The stadium layouts should be standardised to the extent possible.			

5.10 Snowmobile paths

The homologation inspector for a level 1 venue must consider several elements in addition to the course and stadium layout. Events that are televised have special considerations for broadcast and marketing, and require extra pathways for access along the competition courses. Broadcast personnel with their equipment, marketing/sponsorship teams with their banner installations and security and medical persons all need to be transported to their positions the day of the competitions without damaging the groomed competition courses. In addition to the standard course design, the homologation inspector (together with the event organizer or venue owner) must therefore also plan separate layouts for snowmobile access paths. These paths can be narrow trails through uneven terrain but must be constructed such that a snowmobile with passenger and/or a trailer can travel safely.

Below is an example from the 2010 Olympic Games (the yellow line marks snowmobile paths).

Whistler Olympic Park Snowmobile Access Routes
2010 Olympic Winter Games



6 Homologation of courses for World Para Nordic skiing (skiers with impairments)

6.1 General

During Paralympic Winter Games, World Para Nordic Skiing (WPNS) will use the same stadium and parts of the competition course network used in the Olympic Winter Games and therefore need to be incorporated into the venue and course design. World Championship, World Cup and Continental Cup may also be used for WPNS competitions and therefore new cross-country venue developments should also consider WPNS homologation requirements.

In general, the philosophy for FIS homologation, and the requirements and recommendations for stadium and course design applies to WPNS as well.

However, since certain classes and categories have clear physical limitations, the courses must in general be made easier, with special attention to fast downhill sections, sharp curves, and steep or long up hills. Since WPNS athletes compete in both biathlon and cross-country competitions additional loop requirements and space for temporary WPNS 10 m shooting range and penalty loops could also be considered during stadium design.

The following sections will describe areas within homologation work that specifically should be considered when designing courses for Paralympic Nordic athletes.

6.2 Classification

Paralympic Nordic athletes are classified according to the following table:

Category	Class	Region Impairment	Main sport equipment and degree of impairment
Standing	LW2	Impairments in one lower limb (ex. above knee)	Skiing with 2 skis and 2 poles
	LW3	Impairments in both lower limbs	Skiing with 2 skis and 2 poles
	LW4	Impairments in one lower limb (ex. below knee)	Skiing with 2 skis and 2 poles
	LW5/7	Impairment in both upper limbs	Skiing with 2 skis and no poles
	LW6/8	Impairment in one upper limb	Skiing with 2 skis and 1 pole
	LW9	Impairment in one upper limb and one lower limb	Equipment of choice, but with 2 skis
Sit ski	LW10, 10.5	Impairments in both lower limbs (no sitting balance)	Using sit-ski
	LW11, 11.5	Impairments in both lower limbs (fair sitting balance)	Using sit-ski
	LW12	Impairments in both lower limbs (good sitting balance)	Using sit-ski
Visually Impaired	B1	Slight to no light perception in either eye	Must ski with a guide Must wear blackout glasses
	B2	Up to visual acuity of 2/60 and/or visual field of less than 5 degrees	May ski with a guide
	B3	Up to visual acuity of 6/60 and/or visual field of less than 20 degrees	May ski with a guide

6.3 WPNS Event Distances and recommended courses

The table below shows the standard event distances that are used at WPNS World Cup, World Championships and Paralympic Winter Games.

Courses: LW 10-12 800m, 2.0km, 2.5km, 3.0km

LW 2-9 / B1-3 1400m, 2.0km, 2.5km, 3.0km, 4.0/5.0km

6.3.1 Cross Country Skiing

	Competition	Class	Gender	Total Distance	Course		Loops
1	**CC Sprint**	LW 10-12	men	800m (+/-200m)	sit ski	800m (+/-200m)	1
	Qualification (all)	LW 10-12	women	800m (+/-200m)	sit ski	800m (+/-200m)	1
	Semifinal B1-3 (best 8)	LW 2-9	men	1200m (+/-400m)	standing	1200m (+/-400m)	1
	Semifinal LW (best 12)	B1-3	men	1200m (+/-400m)	standing	1200m (+/-400m)	1
	Final B1-3 (best 4)	LW 2-9	women	1200m (+/-400m)	standing	1200m (+/-400m)	1
	Final LW (best 6)	B 1-3	women	1200m (+/-400m)	standing	1200m (+/-400m)	1
2a	**CC Short**	LW 10-12	men	5km	sit ski	2.5km or 5km	2 or 1
		LW 10-12	women	2.5km	sit ski	2.5km	1
		LW 2-9	men	5km	standing	2.5km or 5km	2 or 1
		LW 10-12	men	5km	standing	2.5km or 5km	2 or 1
		LW 10-12	women	2.5km	standing	2.5km	1
		LW 10-12	women	2.5km	standing	2.5km	1
2b	**CC middle**	LW 10-12	men	10km	sit ski	2.5km	4
		LW 10-12	women	5km	sit ski	2.5km	2
		LW 2-9	men	10km	standing	2.5 or 5km	4 or 2
		B1-3	men	10km	standing	2.5 or 5km	4 or 2
		LW 2-9	women	5 km	standing	2.5 or 5km	2 or 1
		B 1-3	women	5 km	standing	2.5 or 5km	2 or 1
3a	**CC long**	LW 10-12	men	15km	sit ski	3.0km	5
	sit ski	LW 10-12	women	12km	sit ski	3.0km	4
3b	**CC long**	LW 2-9	men	20km	standing	4 or 5km	5 or 4
	standing	B1-3	men	20km	standing	4 or 5km	5 or 4
		LW 2-9	women	15km	standing	3 or 5km	5 or 3
		B 1-3	women	15km	standing	3 or 5km	5 or 3
4	**Relay**	mixed (330 %)	classic	5km	sit ski	2.5km	2
	2 x 2.5km classic +		free	5km	standing	2.5km	2
	2 x 2.5km free	open (370 %)	classic	5km	sit ski	2.5km	2
			free	5km	standing	2.5km	2

6.3.2 Biathlon

	Competition	Class	Gender	Total Distance	Course		Loops
6	**BT Sprint**	LW 10-12	men	7.5km	sit ski	2.5km	3
	Penalty loop	LW 10-12	women	6.0km	sit ski	2.0km	3
	150m	LW 2-9	men	7.5km	standing	2.5km	3
		B1-3	men	7.5km	standing	2.5km	3
	2 shootings	LW 2-9	women	6.0km	standing	2.0km	3
		B 1-3	women	6.0km	standing	2.0km	3
7a	**BT middle**	LW 10-12	men	12.5km	sit ski	2.5km	5
		LW 10-12	women	10km	sit ski	2.0km	5
	Penalty loop	LW 2-9	men	12.5km	standing	2.5km	5
	150m	B1-3	men	12.5km	standing	2.5km	5
	4 shootings	LW 2-9	women	10km	standing	2.0km	5
		B 1-3	women	10km	standing	2.0km	5
7b	**BT Pursuit**	LW 10-12	men	12.5km	sit ski	2.5km	5
	2 day Pursuit	LW 10-12	women	10km	sit ski	2.0km	5
	Penalty loop	LW 2-9	men	12.5km	standing	2.5km	5
	150m	B1-3	men	12.5km	standing	2.5km	5
	4 shootings	LW 2-9	women	10km	standing	2.0km	5
		B 1-3	women	10km	standing	2.0km	5
7c	**BT Sprint Pursuit**	LW 10-12	men	2.4 - 3.0km	sit ski	800m (+/-200m)	3
	Same day Pursuit	LW 10-12	women	2.4 - 3.0km	sit ski	800m (+/-200m)	3
	Qualification + Final	LW 2-9	men	3.6 - 4.8km	standing	1200m (+/-400m)	3
	Penalty loop 80m	B1-3	men	3.6 - 4.8km	standing	1200m (+/-400m)	3
	2 shootings	LW 2-9	women	3.6 - 4.8km	standing	1200m (+/-400m)	3
		B 1-3	women	3.6 - 4.8km	standing	1200m (+/-400m)	3
8	**BT Individual**	LW 10-12	men	15km	sit ski	3.0km	5
	Penalty	LW 10-12	women	12.5km	sit ski	2.5km	5
	1 minute	LW 2-9	men	15km	standing	3.0km	5
		B1-3	men	15km	standing	3.0km	5
	4 shootings	LW 2-9	women	12.5km	standing	2.5km	5
		B 1-3	women	12.5km	standing	2.5km	5

6.4 Course width categories

Course widths for particular competition formats should follow the following table:

Category	Minimum course width			Used for
	Uphills	Undulated terrain	Downhills	
sit ski	3 m	3 m	3 m	Sit ski only (2 tracks) Relay classical technique
sit ski	5 m	5 m	5 m	Sprint, Pursuit (3 tracks)
standing classical	3 m	3 m	3 m	Interval start (2 tracks)
standing classical	5 m	5 m	5 m	Sprint, Pursuit (3 tracks)
standing free	6 m	6 m	6 m	individual, standing only (1 track along the side of the entire course)
standing free	9 m	9 m	6 m	Sprint, Pursuit, standing only (1 track along the side of the entire course)
sit ski + standing classical	3m	3m	3m	Interval Start, Relay (2 tracks)
sit ski + standing classical	5 m	5m	5 m	Pursuit, Sprint (3 tracks)
sit ski + standing free	3m + 6 m	3m + 6m	3m + 6 m	Interval start (2 tracks for sit ski, 1 track for standing)
sit ski + standing free	3m + 9 m	3m + 9m	3m + 9 m	Pursuit, Sprint (2 tracks for sit ski, 1 track for standing)

6.5 Standing and Visually Impaired categories

In general, the Standing and Visually Impaired categories can ski on courses that are very close to FIS homologation standards. However, design considerations in the following areas should be considered:

- Fast down hills with curves and corners that can be difficult and unsafe for Visually Impaired skiers
- Use of shorter loops such that Visually Impaired skier more easily can become familiar with the course
- Reduction of A-climbs (should be replaced by B-climbs)
- Range for TC should in general be in the low range (for example 150 – 180 m for 5 km)

6.6 Norms for WPNS Cross-Country and Biathlon courses

6.6.1 Norms for LW 2-9 / B1-5 Cross-Country and Biathlon courses

The HD, TC and MC of the homologated competition courses should be within the following norms:

Course	TC	MC	HD	Hills
5.0 km	140 - 180	40	75	0-1 A hill, 4-6 B hills, 0-2 C-hills
4.0 km	100 - 150	40	60	0-1 A hill, 3-5 B hills, 0-1 C-hills
3.0 km	80 - 110	30	50	2-4 B hills, 0-1 C hill
2.5 km	75 - 90	30	50	2-3 B hills, 0-1 C hill
2.0 km	50 - 80	30	50	1-3 B hills, 0-1 C hill
1.4 km	0-60	35		
WC: In case the above-mentioned courses are not available, the following courses can also be used:				
3.3 km	90 - 130	30	50	3-5 B hills, 0-1 C hill
3.75km	100 - 135	40	50	0-1 A hill, 3-5 B hills, 0-1 C-hills
7.5 km	200 - 250	40	75	0-1 A hill, 6-10 B hills, 0-2 C hills
10 km	250 - 350	40	75	0-1 A hill, 8-12 B hills, 0-2 C hills

6.6.2 Norms for LW 10-12 Cross-Country and Biathlon courses.

The HD, TC and MC of the homologated competition courses should be within the following norms:

Course	TC	MC	HD	Hills
3.0 km	35-65	15	40	1 – 2 A hills, 2 – 4 B hills
2.5 km	30-60	15	40	0 – 1 A hills, 1 – 3 B hills
2.0 km	25-55	15	40	0 – 1 A hills, 1 – 3 B hills
800 m	0 - 30	15		
WC: In case the above mentioned courses aren't available, the following courses can also be used.				
5 km	60 - 120	15	50	1 - 2 A hills, 3 – 6 B hills
3.75	45-70	15	40	1 – 2 A hills, 2 – 4 B hills
3.33 km	35-70	15	40	1 – 2 A hills, 1 – 3 B hills

6.6.2.1 **<u>Courses for the sit-ski category can not follow FIS homologation rules</u>** due to the fact that sit-skiers have no use of their lower body, and push/pull themselves forward with poles from a sitting position (on their sledge). The categories for A, B and C hills are therefore:

A-hills 10 – 15 m PHD and gradient between 4 – 12 %

B-hills 4 – 9 m PHD and gradient between 4 – 12 %

C-hills 2 – 4 m PHD distance < 30 m long and gradient >12 %, maximum 16 %

Climbs with < 4m will be included as undulating terrain or as part of an A or B climb.

6.6.2.2 The following points should also be considered when designing courses for the sit-ski category:

- Sit ski courses should be placed on undulating terrain (not long flat courses) so that skiers chances to rest. The 1/3 up, 1/3 down, 1/3 UT criteria applies equally to sit ski courses.
- Uphills should in general not be steeper than **10 - 12 %** gradient
- A-hills should not be too long (**not over 200 m in length**)
- Down hills should have straight run-outs preferably with a slight uphill to break the speed, the hills should not be steeper than 12 – 14 % gradient
- Corners and turns should be placed where the speed is slow.
    - Corners on flat part of the course should optimally not be less than 90° angle (larger angle required for downhill corners). This applies in the stadium as well, for example for lapping or into the shooting range. (NOTE: If you as a standing skier are poling without using the legs, the skis should easily follow the track both in curves/bends in flat parts and also in down hills – if we have to "work" with the legs, a sledge will have problems).
    - Banking can help the skier make a sharp or a high-speed turn.
    - Sit ski turns of 180° can be made at the top of climbs where speed is very low.
    - **The minimum radius of a turn in a flat section or downhill section shall be 15m.**

6.7 WPNS Stadium layout

In contrast to the newest development of stadiums and course layouts for FIS competitions, it is less important to ski through the stadium often, since most WPNS competitions are interval start competitions. Since WPNS events are divided into 6 categories (3 for men and 3 for women), it is difficult for announcers and spectators to follow the event if several categories are starting, passing through the stadium or finishing at the same time. For competitions with small fields, this situation can however be solved by letting each category finish the competition before the next one starts.

A special consideration should be given to the transition and staging area for the sit-ski category. This should be provided with an easy and flat access to start & finish areas, with nearby covered and heated area for transition from wheelchair to sit-ski, as well as storage of wheelchairs.

6.8 WPNS biathlon Range

Since WPNS Competitions usually include both disciplines, stadium layout normally requires consideration of both biathlon and cross-country skiing formats. Venues with established biathlon ranges are ideal providing that the terrain and stadium access is suitable for sit ski courses and sufficient stadium space exists for cross-country formats. Cross-country skiing stadia may also be used where there is sufficient space to install the 10m WPNS Biathlon Range and 150m penalty loop. This requires a minimum of 27m x 62m for the World Cup range (10 LW 10 VI lanes) or 27m x 73m for World Championships and Paralympic Winter Games range (12 +12 lanes) **plus** space for a 150m penalty loop within 20m after the exit from the range.

NOTE: See also https://www.paralympic.org/nordic-skiing/rules-and-documents for updates to the ParaNordic homologation requirements.

7 Stadiums

7.1 Size, Location and Orientation

ICR articles 312 and 321-327 include the requirements that a stadium have to meet. The main objective is to design a stadium such that the athletes and spectators can experience an exciting atmosphere. This means that the stadium should not be larger than absolutely necessary, approximately 50 - 65 m wide and 150 - 200 m long (depending on if it is a horseshoe- or ski-through stadium). A good atmosphere between the competitors and the spectators can then be obtained.

When determining the location of the stadium, the movement, functionality and flow (ingress and egress) for all categories of personnel who have access to the stadium must be considered.

Ideally the stadium should be located within the terrain somewhere in the middle between the highest and lowest point on the course. This would improve the flexibility for course design by permitting access to a greater variety of terrain. Sufficient space must be found adjacent to the stadium in order to provide easy and secure access for the various services for media, team cabins, warm up, wax testing and the start.

Maximizing the benefit of exposure to the sun is important for a successful atmosphere. The stadium should be oriented in such a way that the main spectator area is in the sun, and that the athletes have the sun in their faces as they approach the finish line. For optimal TV exposure and atmosphere, it is usually preferable to have spectators on both sides of the stadium.

After the finish line, at World Cup and World Championship competitions, there must be enough space for the media mixed zone. A large mixed zone needs at least 30 m x 10 m but can be configured in different ways.

7.2 Functionality

7.2.1 General

To plan for the highest level of competitions, the access for all categories of people to their designated positions without interfering with each other is of paramount importance. For example, the competitors should be able to reach the following areas without being disturbed by other groups:

- the team preparation area (wax cabins)
- the ski testing area and the warm-up tracks
- ski-marking and equipment control
- the storage for warm-up clothing
- the start
- the through lap or relay exchange (with exit to the mixed zone)
- the finish
- the ski control after the finish line
- the immediate care area (tents for the exchange of clothes, refreshments etc.)
- the exit

There are several categories of traffic/people-flow that take place during a competition:

- Athletes, coaches, team leaders and service personnel
- Spectators
- Organisers' officials and volunteers
- TV and Media (press, photo)
- IOC or FIS officials

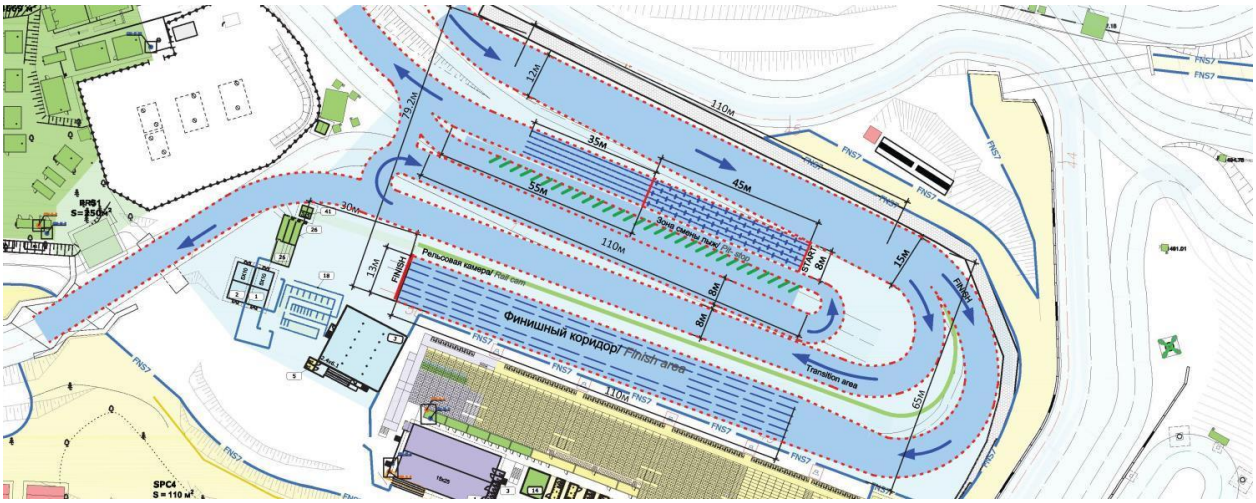
All these categories of traffic have to take place at the same time without interfering with each other. For lower level competitions (COC competitions), only the first three bullet points above apply.

7.2.2 For the athletes

The most important aspects of a stadium are:

- Easy and safe (non-slip) access between wax cabin service area, warm up track and start
- Provide fair start and finish conditions for all sorts of competitions (interval start 15 or 30 sec., skiathlon, sprints, regular mass start, mass start with ski exchange and relays)
- The Finish Zone should have a slight inclination 2-4% up to a length of 150 m. This can include some small natural undulations.
- A downhill leading into the finish zone should be avoided. If this is not possible, some speed-reducing measures, for example curves, should be implemented.
- Provide good conditions for clothing and feeding services at the start and after the finish.
- Sufficient space for coaches, competition equipment and final warm up
- Good visibility to the scoreboard and video screen
- Adequate space for lapping lane, pit stop for equipment change and relay exchange zone

The Skiathlon competition is the most demanding format for stadium design. It is because of the access to the start area, the transit for the classical course, the connections between the classical course and the ski exchange boxes, the connection between the pits into the free technique course, the transit for the free technique course, and finally to the finish. This should be laid out without course crossings that will require bridges. For mass start competitions where exchange of skis is allowed, the same considerations apply.



Skiathlon stadium (Sochi)

7.2.3 For TV and media

It is very important to provide opportunities for good coverage for TV and media in these following locations:

- Start Line
- Finish Line
- Finish Zone
- Equipment Change Zone
- Relay Exchange Zone.

To obtain good media conditions the following must be prepared:

- Good, unobstructed camera positions
- Facilities for photographers, writing journalists, radio and TV reporters. The detailed organization of these facilities should be done in cooperation with press people who will function in the start and finish area
- Rooms for press people and press conferences that are close to the start and finish area
- High quality and quantity of electrical power
- A parking area for TV buses
- Provide something that gives the stadium its own unique identity

7.2.4. In the Mixed Zone

The mixed zone must provide space and working conditions for many groups. The overall size of the mixed zone will depend on the level of the event, where the highest requirements are for the World Championship and the Olympic Games.
Space for the following groups must be considered:

- TV Host broadcaster
- TV Rights holders
- Radio
- Electronic network gathering (ENG) crew
- Photographers

- Writing press
- Ski racing/industry supplier (SRS) representatives
- Doping control personnel
- Ski patrol/medical (when needed)

Planning solutions for all of these different needs, while keeping the athletes as a primary focus, requires active input from all groups working in the stadium. Looking at previous models from other successful organizers is a very important first step.

Examples of mixed zones at successful venues are included in Section 15 in this manual.

8 Waxing Cabins, Ski Test area and Warm up course

8.1 Waxing cabins

For the teams, the wax cabins and waiting rooms are important. They have to be located so that the access to the Start/Finish area is unobstructed, safe (non-slip) and fenced off from spectators and media. The cabins can be located in halls, tents, trailers or permanent buildings. For high-level events, each participating team and FIS equipment supplier should have their own cabin that can be locked in order to store the material under safe conditions. The size of the cabins (or space) should as a minimum be in accordance with the World Cup rules (approximately 3 meter square per athlete). The FIS equipment suppliers will also have requirements for cabins.

In the cabins the installations should include

- Several electric outlets
- Adequate heating and ventilation
- Shelves
- Waste bins
- Security installations
- For wax trucks, special power is required and flat parking area is required, and the venue owner must be aware of this
- In addition to waxing cabins, separated changing rooms for women and men should be provided. In this area also a sufficient number of toilets must be installed.

8.2 Ski test area

Planning of ski test areas is a very important part of the Homologation process. A homologation inspector should look for suitable areas along the course where extra width can easily be added. If the course is wide enough, ski testing can take place on a separate lane (marked with V-boards or fences) adjacent to the competition lane as long as it does not interfere with the warm-up, competition or the TV pictures.

If two or more totally different snow conditions can be expected on the same course, multiple test areas along the course should be designed.

There is no longer need for a separate large ski test area, however ski depot areas adjacent to the ski test areas must be considered.

Ski Depot area

In the process of using the ski test areas along the course, the teams also need an area to stage the test skis. Therefore, a ski depot area should be planned adjacent to the course where the wax technicians can store the large number of different test skis without interfering with the flow of training athletes.

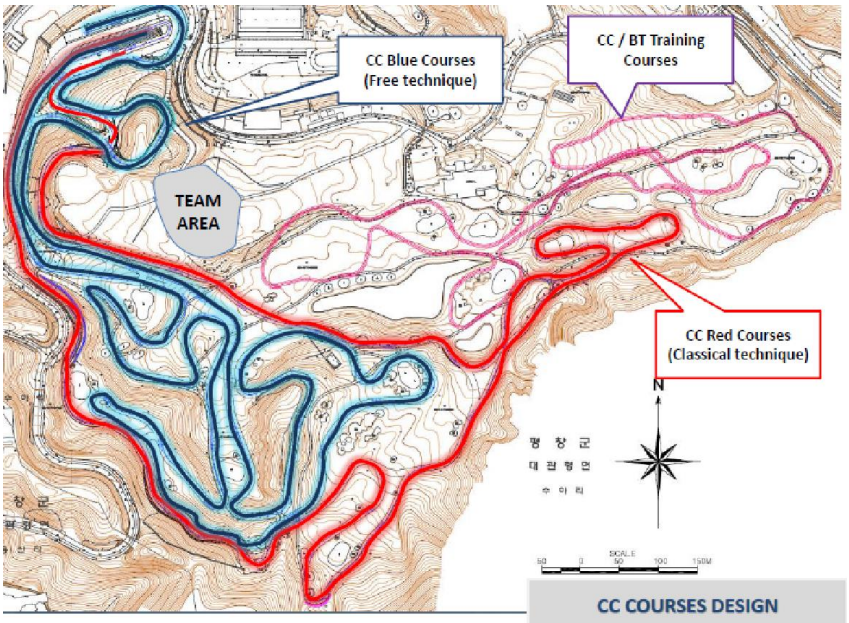
8.3 Warm up/training courses

The need for a separate warm up/training course is mostly related to the competition formats individual start and relay. In these two formats competing athletes are on the competition course while athletes who have not started need a separate warming up course. For mass-start competitions the skiers can often warm up on the competition course.

The warm up courses should be designed in a way that provides use of all cross-country skiing techniques. Since many skiers are expected to be on this course at the same time, safety precautions should be considered. Blind corners, steep down hills and narrow passages should be avoided. The length of warm up courses should be approximately 1 km. This course can also be the course that provides access from the wax test area to the competition courses.

Unused parts of the competition courses can be used for warm up purposes. Individual start formats in classical technique do normally not require the whole course width. Therefore, half of the width can be used for competing athletes while the other half can be used for athletes warming up.

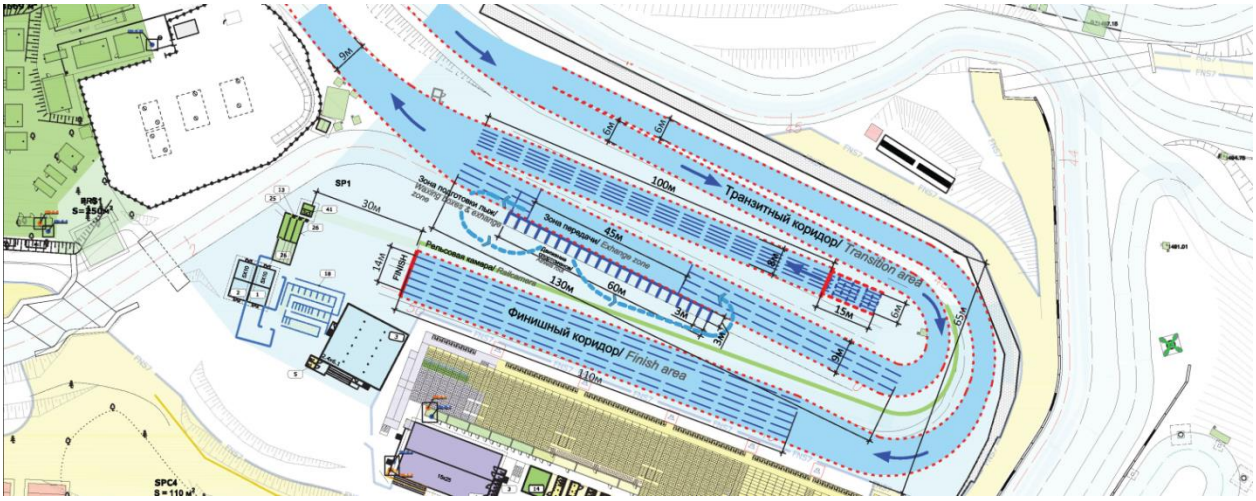
If a warm up course is used in both directions the course should be 10 m wide. The warm up course should provide for the same snow conditions as the competition courses, and special consideration should therefore be paid to the sun exposure. It has to be noted that for mass start competitions, where there is time for it, the warm up for the athletes can take place on the competition course.



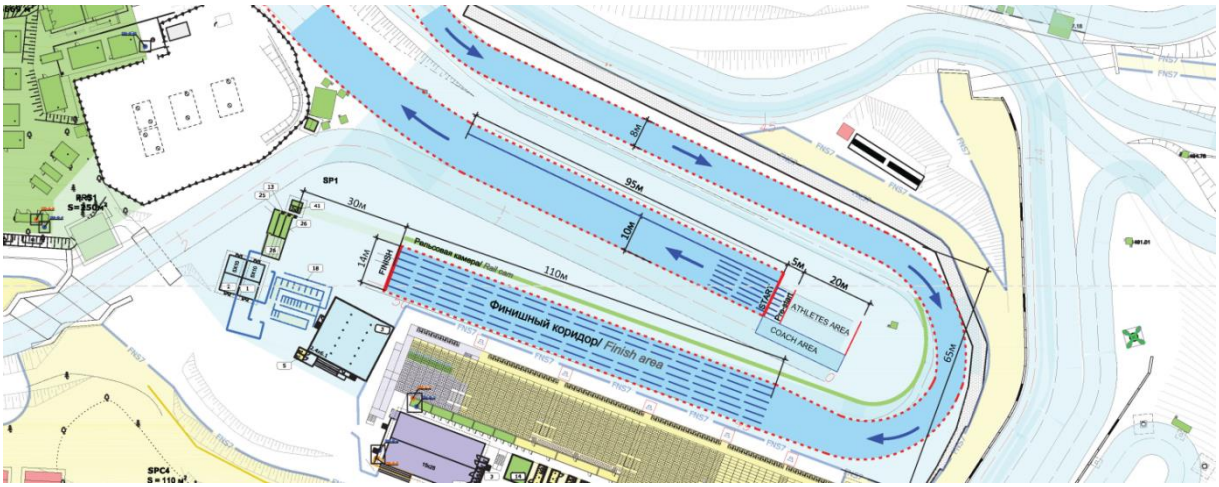
Venue showing competition courses and warm-up/training courses (Korea)

8.4 Examples of Stadium Configurations

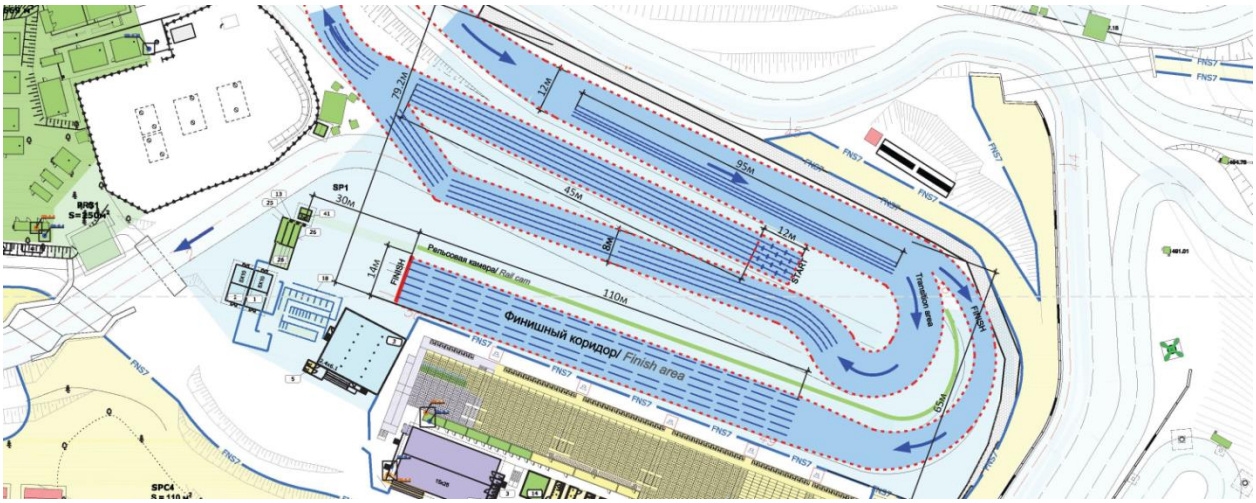
The pictures below (from Sochi and Falun) show stadium layouts for different competition formats. More examples are in Section 15.



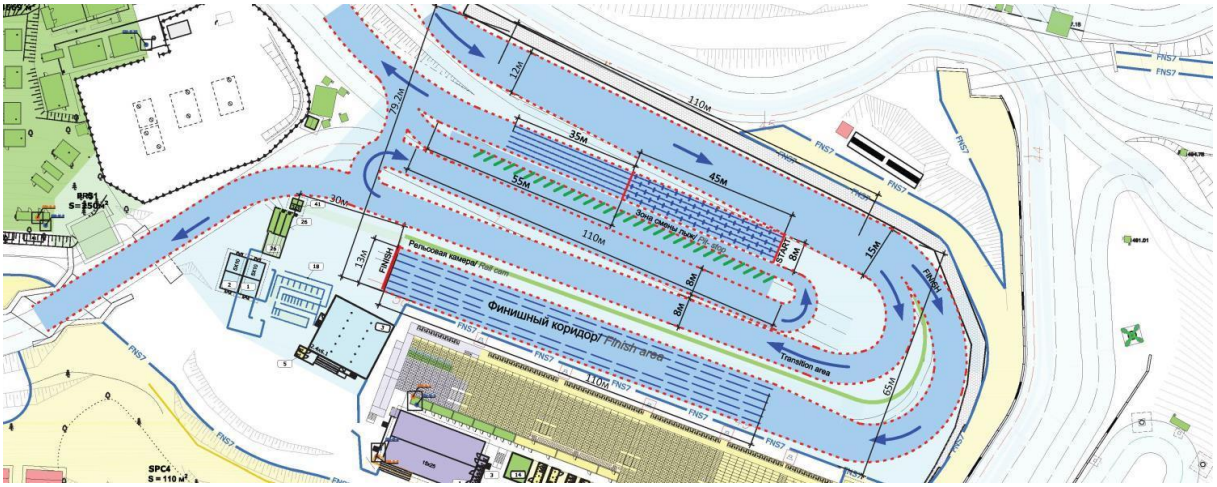
Team Sprint classic



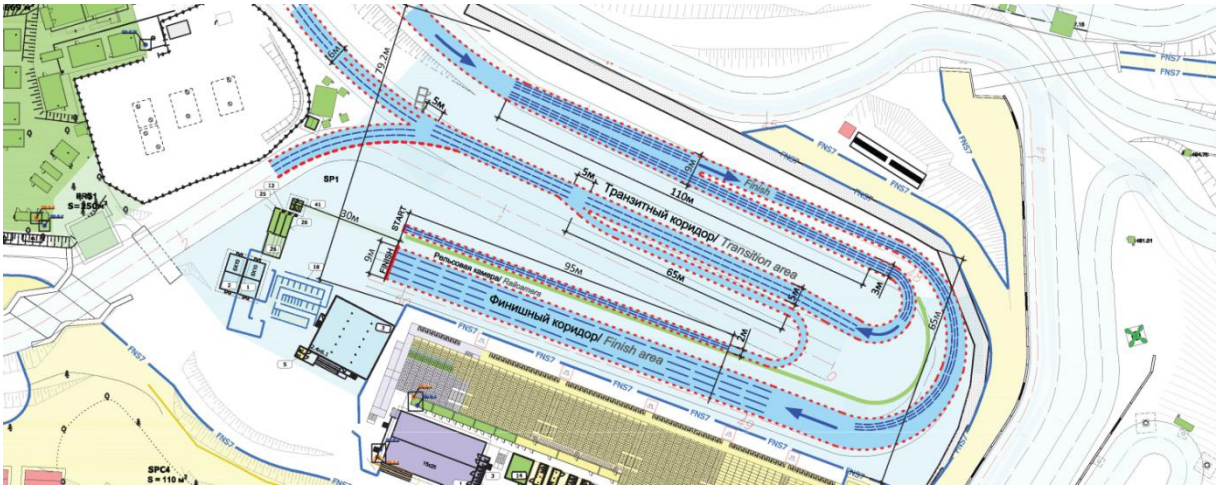
Sprint free



Relay



Mass-start free

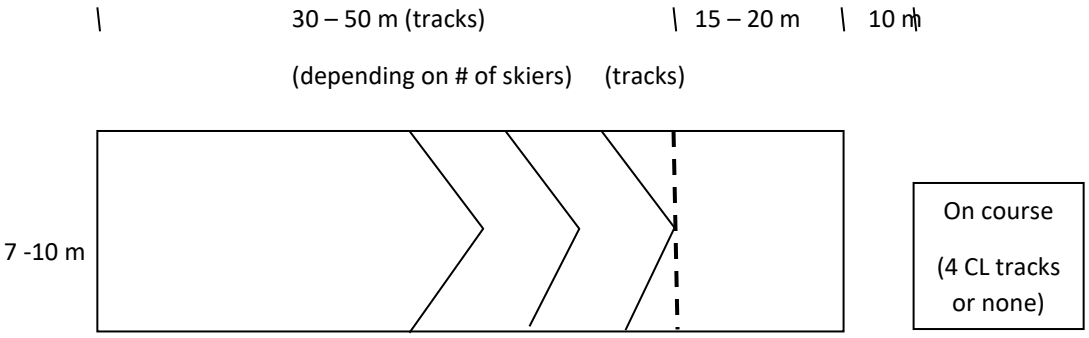


Interval start classic

Overview of Falun NWSC stadium (skiathlon setup)

Mass-start grid

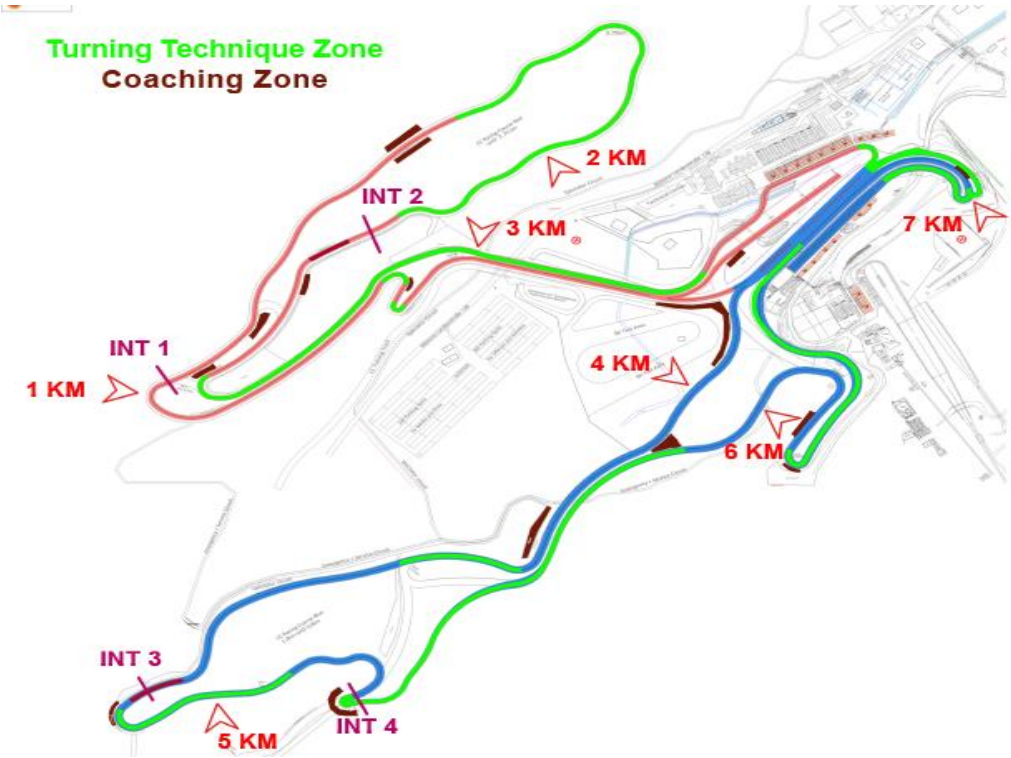
The following shows space requirements for a mass start (WC, WSC, OWG and JWSC):



For competitions in Classical technique the 5 or 7 start tracks should transition into 4 tracks on the course. The start tracks should be set 1.2 – 1.5 meters apart. For competitions in free technique the same 5 or 7 classical start tracks should transition into the free technique course.

Crossing of courses in the stadium

It is in general not advised to have courses where the skiers must cross each other's path during the competition. However, to avoid costly bridges this is sometimes possible in straight section with good view – for example inside stadiums. Below (see next page) is an example of the Seefeldt stadium where a crossing was possible during the long-distance competitions.



Situation:

Skiers could come from the red course and go over to the blue course while at the same time skiers could come from the blue course and go over to the red course for the second loop. It could happen that interference could take place since no bridge was build.

Solution: A a 50 m long zone was introduced where the two courses were parallel, see the 2 red lines on the stadium drawing, where the crossing should take place. For the crossing see the 2 black lines.

The WSC organizer saved money, and a bridge in the middle of the stadium would have been considered as a disturbance.

9 Practising Course design and Homologation

9.1 Designing and Homologating a Cross Country venue

It is important to distinguish between a new FIS course design process and a FIS homologation inspection.

Course design

A new COC or WC course design, in most cases, consists of several days of walking the terrain to find the best alignments and space for FIS competition courses and stadium. It further requires drawing course plans and obtaining course alignment- and elevation data for the course profile. The Venue Owner or OC is responsible for this process, and must do it themselves or employ or contract with a course designer for this work.

For COC level courses there are no restrictions in terms of who the course designer is, as long as a FIS Homologation Inspector is involved in the certification/homologation process (a homologation inspector/candidate can also be the course designer).

For WC courses only a small group of persons are approved to be a course designer:

Al Maddox	CAN
Markus Kohler	SUI
Dietmar Miklautsch	AUT
Hermod Björkestöl	NOR
Jakub Vodrazka	CZE
Janne Pylväs	FIN
John Aalberg	CAN
Karl-Heinz Lickert	GER
Uros Ponikvar	SLO

<u>Steps</u>

For new venues, this process or the Course designer's involvement and work normally consists of the following steps:

Step 1: Conducting a brief survey of the terrain to get an impression of the area

- Course map provided (by the OC) with scale 1:5000 with 1 or 2 m contour lines (5 m is also acceptable).
- Old courses to be visible on the maps
- Plan of stadium provided (by the OC) with scale 1:500

Step 2: Together with the venue owner, the NSA or the OC requesting the homologation, defining the initial sport masterplan that includes the following elements:

- Courses (with approximate distances)
- Stadium with location of buildings
- Access roads or paths
- Parking areas with location of waxing cabins/trailers

- TV compound
- Ski test and ski depot areas, and warm up course

Depending on the requirements for this initial plan, the venue owner/OC may need to bring in a mapping resource/expert.

Step 3: Providing input to the design and construction team (engineering company or OC) on the collection of preliminary course data and production of the following information:

- Professional stadium and course maps
- Exact measurements of the course alignments (length and elevation, width specifications for the different course sections)
- Extract profile data for courses (normally in Excel format)
    - Data points with distance and elevation at start and at every 20 m throughout the whole loop for each course (alternatively data at every point where the gradient changes)

Step 4: Importing the data points into the FIS homologation software program and producing course profiles to analyze whether the FIS standards are met (only Course designers that are FIS homologation inspectors and candidates have access to the FIS homologation software)

Step 5: For World Cup or OWG/Championship courses, the Course designer should involve a TV expert

Step 6: After agreeing on the course layout, the venue owner, OC or respective organization must start the legal and regulatory process. The legal process often consists of:

- Agreement with landowners (private or publicly owned land)
- Confirmation from local, regional and national authorities
- Identification of restricted areas - for example regional park status
- Surveys likely to be concluded are:
    - Area zoning review
    - Environmental review
    - Biological review
    - Archeological/cultural review
    - Special considerations – for example if native people have certain rights or requirements

Step 7: When the paper-plans are confirmed, a detailed assessment of the terrain must be done:

- The organizer takes part and if necessary, invites local authorities
- The plan is taken from the paper to the terrain
- Adjustments from the paper-plan are noted (trees etc. are marked)
- Necessary adjustments are made such that the best terrain options are selected:
    - Use depressions in the terrain where the snow is normally deeper
    - Avoid sun exposure

- Minimize sidecuts
- Consider water drainage

Step 8: Construction phase

- Site inspection visits for review and feedback by the course designer should be made at 50% and 90% of construction project completion

Step 9: When the construction work is completed, the final inspection takes place together with the Homologation Inspector (see below)

- Final measurements are done, and an update of the profile data is completed
- Corrected data must be entered into the homologation program

Homologation Inspection

A FIS homologation inspection, in most cases, takes place after a new course is designed or at an existing venue who applies to obtain FIS certification for its existing courses. A homologation inspection should be able to be accomplished on a one-day site visit and another day for developing the draft of the FIS certificates. For sites with existing courses, the venue owner, the National Ski Association, the course designer or its OC should provide the homologation inspector with maps of the courses and the profile data prior to an on-site visit.

Step 1: On-site visit to review the courses

Step 2: FIS certification paper work:

The following is required for making the FIS certificate:

- Course GPS alignments – one csv/gpx file for each course or one for all courses

(NOTE: The GPS data-values must be in the geographical coordinates (WGS84), also specified as EPSG:4326 or called “latitude/longitude”, and be in decimal format)

- Elevation data either in terms of detailed topographical maps or accurate electronic elevation models
- Stadium maps with drawings of configurations for the different competition formats, as well as map showing
    - Location of wax cabins/trailers
    - Ski test area
    - Warm up course

.

10 Process for FIS Certification of competition courses

The parties involved in the certification of FIS Cross-Country courses are:

- the venue owner or Organizing committee
- the National Ski Association
- the FIS Administrator
- the Regional Homologation Coordinators
- the appointed Homologation Inspectors/course designer
- a television expert (for level 1 venues)

Currently, the following persons have a Regional homologation coordination responsibility (updated to match the TD regional setup):

Coordinator	**email**	**Regional of Responsibility**
Chair of working group Allan Serrano, USA	allanjserrano@gmail.com	For World Cup courses, World-wide
Al Maddox, CAN (asst. Len Apedaile)	almaddox.tbay@gmail.com	for COC/FIS courses, Americas - with special responsibility for South America (Argentina, Chile, Brazil)
Tats Watanabe, JPN	tatskbth@osb.att.ne.jp	for COC /FIS courses, Far East Countries (Japan, Korea, China, Mongolia, Chinese Taipei, D.P.R. Korea)
Markus Kohler, SUI	markus@zeichnungswerkstatt.com	for COC/FIS courses, Western Europe (Andorra, Austria, Spain, France, Great Britain, Germany, Ireland, Italy, Lichtenstein, Slovenia, Switzerland, Czech)
Jakub Vodrážka, CZE (asst. Andrey Arseniev)	kbv@seznam.cz ars_a6@mail.ru	for COC/FIS courses, Central/Eastern Europe (Bosnia/Herzegovina, Bulgaria, Croatia, Greece, Makedonia, Poland, Romania, Serbia, Slovakia, Lebanon, Armenia, Belarus, Iran, India, Pakistan, Kazakhstan, Russia, Turkey, Ukraine, Uzbekistan)
Finn Marsland, AUS	finn.marsland@gmail.com	for COC /FIS courses, Oceania (Australia, New Zealand)
Hermod Björkestöl, NOR	hermod2012@gmail.com	for COC /FIS courses, Scandinavia/Baltics

Certification Process

Step 1 - application:

The National Ski Association (NSA) asks FIS for a homologation inspector for a competition site (through an email to the FIS administrative office person in charge of CC homologation).

For OWG/NWSC/World Cup competition sites the inspector must be from a different country, for all other competition sites (FIS/COC/JWSC/YOG/Universiade, etc. and for WC City sprints), the inspector can be from the same country

Step 2 – appointment:

The FIS (through a suggestion/confirmation from the National or Regional Coordinator) appoints a Homologation Inspector (HI) and sends out an email letter to the respective National Ski Federation and the appointed inspector (for World Cup competition sites the Chair of the Homologation working group will suggest a HI).

NOTE: For OWG/NWSC the FIS Sub-Committee for Rules and Control appoints the Homologation Inspector

Step 3 – compliance work:

The Homologation Inspector completes the compliance work (together with the National HI Coordinator if required) and submits (using the new FIS homologation software) a draft PDF report/certificate to the Regional Coordinator.

- The Regional Coordinator approves the work and the draft PDF certificate, and emails the electronic draft PDF certificate to the FIS office (to the FIS office administrative person in charge of homologation).
- For WC courses the draft PDF report/certificate is sent to the Chair of the FIS homologation working group who approves and emails to the FIS office administrative person.

Step 4 - certification:

- The FIS Office Administrative person adds all required dates, signatures, stamps and registration number for the certificate.
- The FIS Office Administrative person informs the respective NSA and Homologation Inspector that the certificate is completed
- The certificate is valid for 5 seasons (expires 30 June for Northern Hemisphere / 30 December for Southern Hemisphere)
- The certificate is uploaded to a database on-line
- The database is available for FIS members, OCs and NSAs
- The database can be searched using several criteria

Certificate Renewal

The FIS office will send a notice of expiring certificates to the respective NSA and Regional Coordinator no later than May 15 for the Northern Hemisphere and November 15 for the Southern Hemisphere.

If all of the following conditions have been met, the certificates can be renewed, with a new certificate number, for an additional five years:

- The course has been used in a FIS Competition, and,
- there have been no significant changes to the alignment, width, or elevation profile of the course, and,

- no negative comments in regard to the safety or functionality of the course have been recorded in a recent TD Report.

If the FIS office does not receive a response to the expiration notice by June 30 in the Northern Hemisphere or December 31 in the Southern Hemisphere, the certificates will expire.

Certificates may only be renewed one time. After ten years, courses are subject to a new homologation.

Provisional Certificate

A National Ski Association may request provisional homologation certificates for courses that have not yet met the final homologation. The Regional Coordinator is responsible for verifying that the following conditions are met before the certificates are issued:

- A Homologation Inspector* has been assigned and made at least one site visit, and,
- The Homologation Inspector* has verified that the elevation profile meets the ICR requirements, and,
- The course construction has been completed based on the feedback of the Homologation Inspector*.

*In the case where it is not possible for a Homologation Inspector to travel to the venue, a Course Designer, who is also a homologation inspector, may be substituted.

Requests for Provisional Certificates must be received no later than four weeks prior to the date the course is to be used for competition.

Provisional certificates expire on June 30 in the Northern Hemisphere or December 31 in the Southern Hemisphere following the season in which they are issued.

Certificate Fees

After signing of the final certificate, the FIS Office sends the certificate to the NSA.

The National Ski Association (NSA) is charged the cost of the certificate, and must itself invoice the OC if applicable. A homologation fee will be charged to the NSA by the FIS Office in order to complete the homologation process and receive the certificate. The fee will be calculated as follows:

- Basic application fee: CHF 100.-
- Homologation certificate fee: CHF 125.- for each new course certificate
- There is no cost for the first renewal
- Courses which are due to new homologation are subject to Certificate Fee, but not the Application Fee.

11 Guidelines for the organization, education and appointment of Homologation Inspectors (HI)

11.1 HI authority

The FIS HI is the representative of the FIS to the Organizer of the FIS Cross-Country course homologation. He/she guarantees that the homologated course meets the standards laid down in the FIS Rules and this manual. The HI will remain in charge of the homologation process until the final homologation report has been submitted. For OWG, WSC and other designated competitions the HI will serve as an expert for companies that are responsible for the total venue design.

11.2 HI organizational structure

The responsibility for all HI matters belongs to the FIS Sub-Committee for Rules and Control (SC R&C). A homologation working group prepares material and proposals on HI matters for each SC R&C meeting. Decisions of the SC R&C must be approved by the Cross–Country Committee.

The chair of the Homologation Working Group and the Regional Coordinators are appointed by the SC R&C to oversee homologation matters in their respective region:

- Western Europe
- Central/Eastern Europe
- Scandinavia / Baltic States
- Far East
- Americas (South and North)
- Oceania

The Regional Coordinator is involved in proposing and appointing a homologation inspector when a National Ski Association is applying for homologation. The Regional Coordinator is also assisting and coordinating the work of the different homologation inspectors in their region. Their main task is to assist the inspectors with course design issues and with completing the material and reports (using the homologation software) such that the final courses are ready to be given a FIS homologation certificate. They should also be active in course design themselves and be a homologation inspector.

The Regional Coordinators are approving the respective COC certificates. All World Cup certificates must be approved the chair of the CC Homologation working group.

<u>Current tasks for the Homologation working group</u>

Most of the work in between the meetings of the group is completed by the Chair (the meetings are normally held in during the FIS calendar/Congress meetings in the spring and/or the FIS meetings in Zurich in the fall).

The main tasks for the Chair are:

- Chair the meetings of the group
- Produce a yearly report for the FIS Spring Calendar/Congress meeting and an update for the FIS fall meeting (Zurich)
- Represent the group in the CC Sub-Committee for Rules and Control meetings
- Review and approve all FIS CC homologation certificates for WC

- Be the main contact person for FIS staff in homologation matters and questions
- Be the main author of the FIS Homologation Manual (assisted by members of the working group)
- Be a supervisor for and give feedback to the Regional Coordinators and other Homologation inspectors and candidates
- Be an active homologation inspector at World Cup, World Championship and OWG level
- Be responsible for nominating homologation inspectors for World Cup venues as soon as a venue is confirmed on the FIS World Cup calendar
- Be an expert and advisor for the FIS homologation software program

The chair will also work with the FIS staff and other members of the working group on other tasks:

- Together with FIS staff, be responsible for maintaining the overall list of currently certified CC venues and courses
- Together with FIS staff, be responsible for maintaining the list of current homologation inspectors and candidates
- Together with the FIS staff, be responsible for that World Cup venues have WC homologation certificates as soon as they are confirmed on the World Cup calendar
- Together with FIS staff, be responsible for the direction of the homologation process for the future
- Together with the working group, be responsible for organizing and creating material for the bi-annual international FIS homologation seminar

11.3 Selection Criteria for HI Candidates

HI candidates should be recruited from active members of the FIS or NSA. Ideal candidates are:

- Former competitors
- Team leaders
- Former coaches
- Chiefs of competition
- Chiefs of courses

The candidates' required qualifications are:

- Have some experience with course design on a national level
- Be able to ski all types of CC courses and by that knowing how to utilize the terrain in the best possible way during course design
- Understand the FIS ICR
- Be able to use of the Homologation software program
- Be able to communicate in English
- Be able to lead a meeting
- Be able to find solutions and make decisions

11.4 HI - Education

The Education Process provides the HI with the theoretical and practical knowledge necessary to carry out their assigned duties required to complete the FIS Homologation process. The training period is considered to take 2 or more years.

For a new HI candidate the process is normally the following:

- Selected as a HI candidate by the NSA after practicing or participating in course design or homologation seminars at a national level
- Proposed by the NSA to participate in the bi-annual international FIS HI seminar
- Being approved by the seminar leader; then taking part in the international seminar
- Perform course and homologation work under supervision of an experienced HI on a national or international level, and document the work through the homologation software program
- Have the final Homologation Report be approved by the Regional Coordinator

- After completion of the above tasks, the SCR&C will appoint the candidate as a HI

11.5 Homologation seminars

The FIS will organize an international Homologation Seminar every second year in late summer or early autumn. The seminar should alternate between being at a site with a Cross-Country course and stadium for a level 1 competition, and at a site used for COC competitions. The duration of the seminar should be three days, starting Friday afternoon and concluding Sunday early afternoon.

The goal for the seminar is through discussions and lectures contribute to developing venues in order to:

- Promote the Cross Country sport in the best way.
- Spread the knowledge to new countries
- Meet the needs from new competition formats
- Meet expectations from athletes, media and spectators
- Develop and educate HIs to learn the material described in this manual

The seminar sessions should include both theoretical and practical lessons, and refer to the latest standards and the most recognized venues. The lessons should include field work, lectures, and be partly organized in working groups. The seminar should aim for developing HIs to be able to understand, interpret and apply the FIS ICR, the Homologation Manual and other guidelines in order to develop the venues for the best promotion of the sport.

All written program and educational material prepared by the lecturers of the Seminar should be distributed after the seminar.

It is encouraged that NSAs or regions host additional course design and homologation seminars. Such seminars should be led by the national or the Regional Coordinator or an experienced FIS homologation inspector. These seminars are the natural entry point for persons wanting to become Course designers or Homologation Inspectors.

11.6 The HI License

The FIS Nordic Office keeps the record of the approved/licensed FIS Homologation Inspectors and candidates, and publishes the list on the FIS web site: http://www.fis-ski.com/en/inside-fis/document-library/cross-country-documents#36428ea9e24933781622b008

The license is valid for 4 years. To keep the license, a homologation inspector (HI) must attend a FIS International or Regional seminar at least once every 4 years.
To keep the license, the HI must also be practicing course design or homologation inspections.

11.7 Appointment of HI

- For OWG and WSC
  - The HI is proposed by the FIS SC R&C to the FIS Cross Country Committee
- For WC / JWSC
  - The HI is appointed by the Chair of the Working Group in cooperation with the working group members and the SC R&C
- For COC /FIS level
  - The HI is appointed by the FIS Administration in cooperation with NSA and the Regional Coordinator. The NSA may ask for a specific Inspector.

11.8 Compensation

For course design work, the NSA, venue owner or Organizing Committee must employ or contract with a course designer. The course design work, which is different than the Homologation Inspection work (see below), should be compensated at a rate equivalent to engineering consultants.

For the official FIS homologation inspection work and visits, the FIS HI has the right to reimbursement according to FIS rule 304.1.1 for their travel expenses, as well as free accommodation and meals during the assignment (train, first class; for longer distances air fare, tourist class; or payment of a per kilometre fee of 0.60€ or equivalent). In addition, a fixed daily rate of 100 CHF is added for the travel days to and from, as well as for each day on-site and for completing reports or the draft of the FIS Certificate. The maximum payment for personal vehicle transportation cannot exceed the equivalent cost of an airfare in economy class or car rental.

12 Homologation Software Program

12.1 Program

FIS has developed a new web-based program for the recorded part of the homologation process. When GPS data and correct elevation data for the course alignments are input into the program, the required documentation can be produced electronically.

FIS will regularly conduct educational seminars to teach how to use the new software program. A person from each region will be designated as an expert-user and become a resource for other Homologation Inspectors. Seminar education will also be followed up with training videos, a help file and an on-line discussion forum.

The new homologation software is now officially released, and all FIS homologation inspectors must use it.

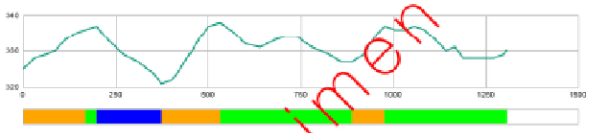
All Homologation Inspectors and candidates will get access (login) to the on-line Homologation software. The requirement for this is that the name of the FIS Homologation Inspector and candidate can be found on the list on the FIS web site (see link on page above). It is the responsibility of the Regional Coordinator to update this list with new candidates.

Appendix 1 Example of certificate reports

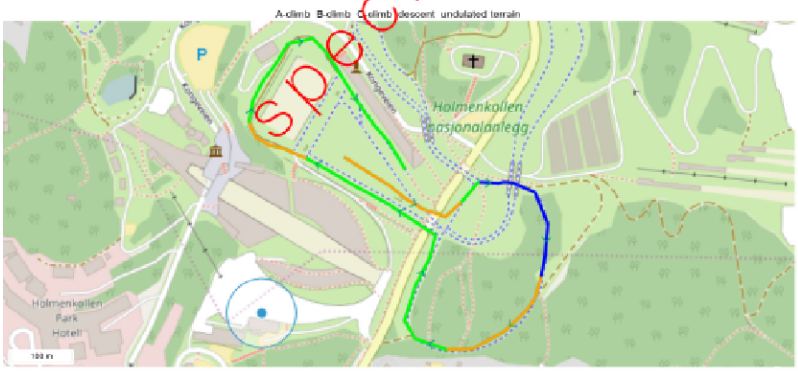
CERTIFICATE
OF FIS HOMOLOGATED CROSS-COUNTRY COURSE
FIS CROSS-COUNTRY COMMITTEE

(1) Registration number:	**17/50.06/1.3**
(2) Location of the competition site:	Holmenkollen, Oslo
(3) Organizer:	Holmenkollen Skifestival
(4) National ski association:	Norwegian Ski Federation
(5) Contact person in the organizing committee:	Anne Sandvold
(6) Homologation inspector:	John Aalberg
(7) Name of course:	Holmenkollen Sprint Women
(8) Competition level for course:	☐ OWG ☐ WCS ☑ WC ☐ JWCS ☐ COC ☐ FIS

Course length:	1,309m	Height difference (HD):	17m	Lowest point:	321m
Certification category:	D	Maximum climb (MC):	17m	Highest point:	338m
		Total climb (TC):	45m		

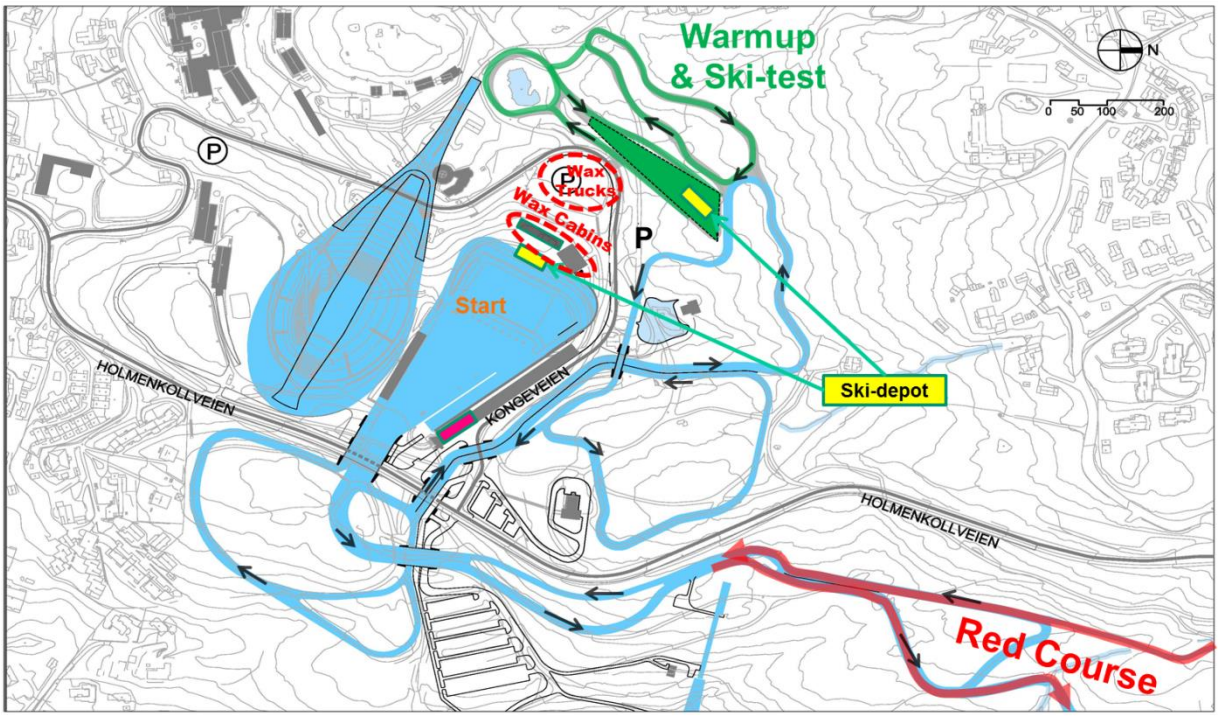


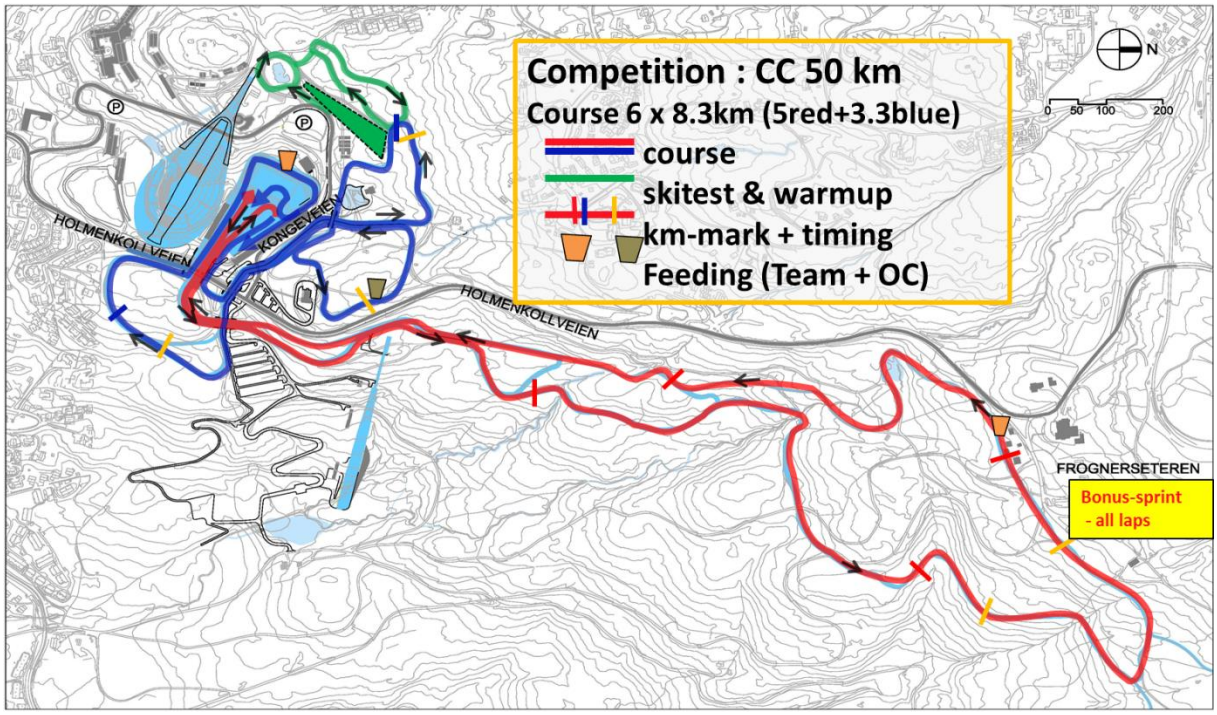
A-climb B-climb C-climb descent undulated terrain



FIS Office	FIS Stamp	FIS Homologation Responsible	Date of Issue
Ulf Seehase FIS Internation Ski Federation Blochstrasse 2 / Postfach CH - 3653 Oberhofen		Ulf Seehase	07.04.2017 Valid until 06.04.2022

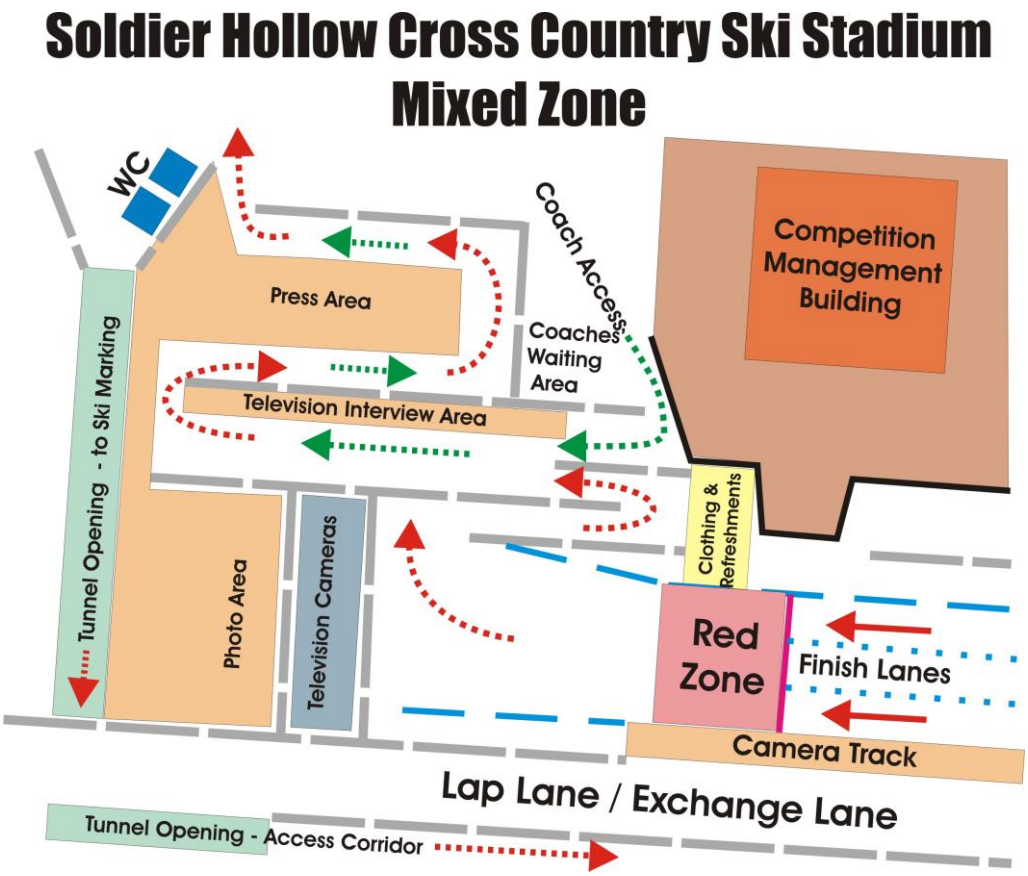
Overall venue view

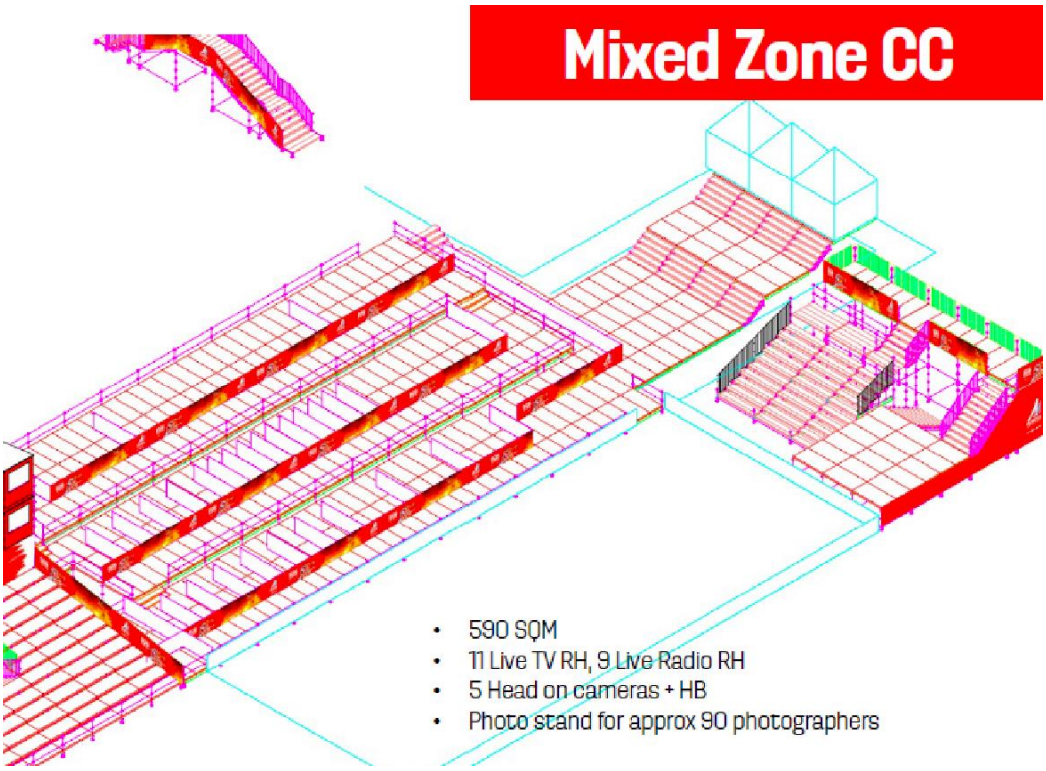




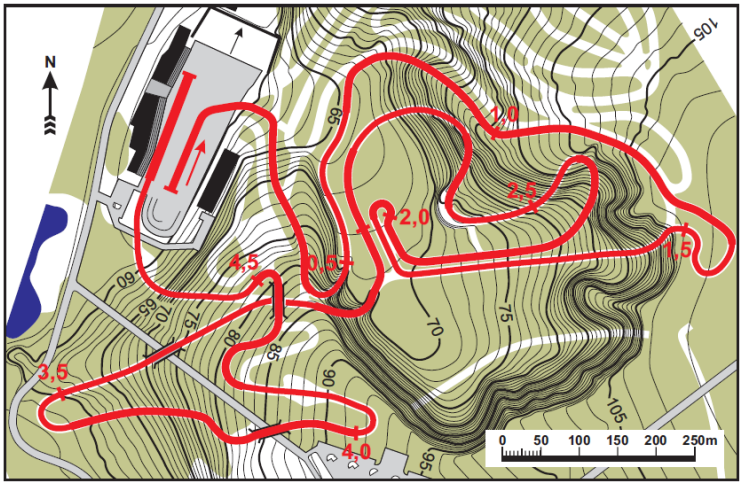
Holmenkollen, Norway

Mixed zone


Soldier Hollow Cross Country Ski Stadium
Mixed Zone
WC
Press Area
Coach Access
Coaches Waiting Area
Competition Management Building
Television Interview Area
Tunnel Opening - to Ski Marking
Photo Area
Television Cameras
Clothing & Refreshments
Red Zone
Finish Lanes
Camera Track
Lap Lane / Exchange Lane
Tunnel Opening - Access Corridor

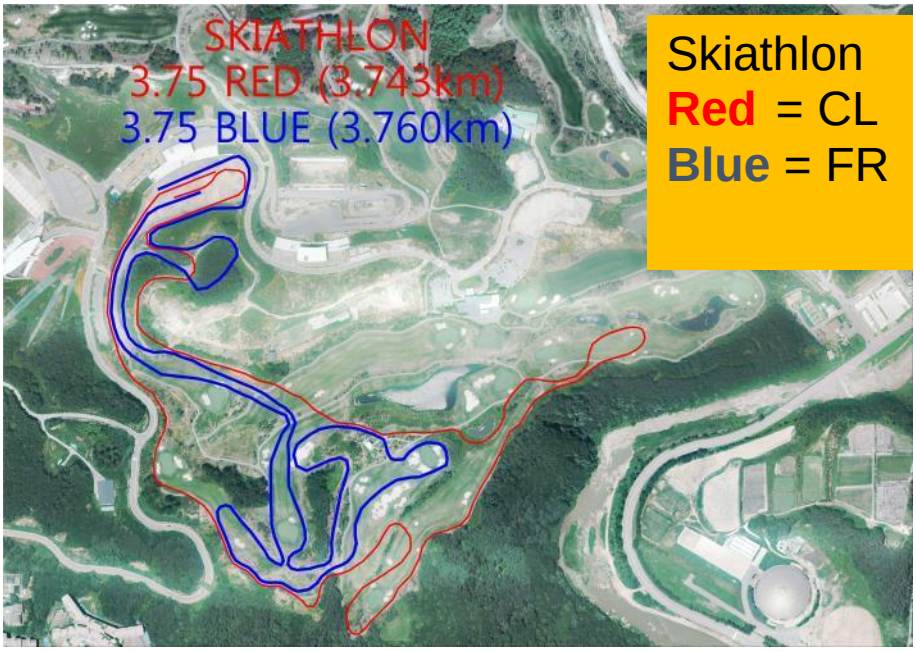

Mixed Zone CC
590 SQM
11 Live TV RH, 9 Live Radio RH
5 Head on cameras + HB
Photo stand for approx 90 photographers

Detailed course plans (with clear contour lines)



Tymen, Russia

Course plans on top of satellite photos



PyeongChang, Korea