

# MAPPING STANDARD FOR SPRINT ORIENTEERING: STANDARDIZED COMPETITION MAPS FOR URBAN, PARK AND FOREST AREAS

**László Zentai**

Eötvös Loránd University, Department of Cartography and Geoinformatics, Budapest, Hungary, [laszlo.zentai@elte.hu](mailto:laszlo.zentai@elte.hu)

**Abstract:** Orienteering maps are one of the map products where the symbol set is standardized, no national deviations are allowed. Orienteering has developed a new form of competition which was originally held in parks or urban areas. This competition form is a very short and fast event where good media coverage is possible. The use of parks and urban areas has a significant advantage: it brings the sport into the midst of people and offers opportunities for increasing public and media awareness of orienteering. The international specification for traditional orienteering maps contains symbols for man-made features. However, the symbol set needed revision and extension in order to provide a clear and unambiguous interpretation of urban terrain required for fair competition in sprint orienteering. There are a number of reasons why the mapping of urban areas needs a modified approach compared to that used for the depiction of the 'classic' forested terrain.

## THE DISCIPLINES OF THE ORIENTEERING SPORT

The sprint is a new form of orienteering event. Originally orienteering had 4 different disciplines: foot-o (traditional orienteering), ski-o, mountain bike-o and trail-o (for handicapped people). Each discipline (excluding trail-o) has its own map specification.

When the International Orienteering Federation (IOF) was established (1961) there were no internationally accepted mapping standards for orienteering maps. Shortly after the foundation of the IOF an international expert group (the predecessor of the Map Commission) started to work on an international legend. In 1962, 79 orienteering maps were published in Norway, and the situation was similar in Finland and Sweden. But the most developed orienteering country of Central Europe (Switzerland) was far behind the Scandinavians. So for the first international discussion about orienteering maps mapmaking experiences of the Scandinavians were mostly used.

After organizing the first European Championships (1962, 1964) the first World Orienteering Championship was held in 1966. For these international events the organizers used the symbols of their topographic map series which could not assure fair conditions for foreign competitors.

After a long period of elaboration, the Map Commission of the IOF released the first official mapping standard (ISOM - International Specification on Orienteering Maps) in 1969. This issue was still not a "specification" but rather a "guideline", although it already contained quite concrete requirements. The most important specifications were the scales and the colours. The next ISOM (1975) was a compromise between the very different interests and requirements of the IOF member federations (at that time the IOF had 23 member countries). There were further releases in 1982, 1990 and 2000, but without any revolutionary changes.

The first Ski Orienteering World Championship was organized in 1975 using the existing foot-o mapping standards. The larger speed and the difficulties of map reading when skiing in winter conditions required special maps for ski-orienteering. The skiers are normally confined to using the track system, so a lot of irrelevant information could be omitted.

The mountain bike orienteering discipline has similar requirements to that of the ski-orienteering. The competitors are allowed to use the paths and track system only. The speed is also higher compared to foot-orienteering, so the map scale of ski-o and mtb-o is generally smaller (1:15 000, 1:20 000). The first Mountain Bike Orienteering World Championship was organized in 2002.

Trail Orienteering is a discipline of the sport designed for people with disabilities with the aim of having meaningful orienteering competitions. It completely eliminates the element of speed, but makes the map-interpretation element much harder. Able-bodied people can compete on equal terms with the disabled.

## HOW AND WHY SPRINT ORIENTEERING WAS STARTED?

Nowadays, most sports would like to be as media friendly as possible. The traditional orienteering sport has proven difficult to present on Television and Radio. The orienteering events are long in time and the competitors are hidden in the forest. The essence of the sport (navigation and route choice) is also difficult to present to the public. In order to be interesting to the media and spectators the athletes should be as visible as possible. The shorter time the event takes and the faster the competitors are running, the more dominant will the fight between the runners be, and the more attractive the event.

Park and city events have always been popular. For example, the public orienteering events in Venice (Italy) has a long tradition and has attracted more and more participants - in the past few years the number of competitors has reached 2-3000. In many countries the orienteers have organized such kinds of visible events for a number of years, and it has become evident that these events requires not only very fast running speed, but also extra safe and fast navigation techniques.

On the international arena, a series of park events, called the Park World Tour (PWT) have been staged annually since 1996. The PWT has attracted the elite, and has had a high media profile. It has therefore been a proof of concept for park/sprint orienteering, and must be considered the main reason why the sprint format made it into the WOC programme in 2001.

If the spectators do not want to go into the forest why not move the events into the cities? Every large city has parks, many of these parks are large enough for sprint events. Some urban parts of the cities are also more suitable for orienteering events than other, for instance old towns, building estates and garden suburbs etc. Forest areas are also suitable for this kind of special events, but the most challenging terrain for sprint orienteering is a mixture of different kind of areas.

The International Specification for Sprint Orienteering Maps (ISSOM) project started in 2001. It was a decision of the Extraordinary General Assembly of the IOF to integrate Sprint Orienteering into the World Orienteering Championships as a new discipline. This same year the sprint discipline was introduced into the World Orienteering Championships programme (Tampere, Finland) using the map specification of normal foot-o events (ISOM).

Sprint orienteering differs in some aspects from the classical formats of foot orienteering. While foot orienteering events are traditionally staged mainly in forested areas, sprint events can be staged in any type of terrain. The expansion from classical forested terrains into parks and urban terrain presented new challenges in orienteering cartography. The current international specification for orienteering maps (ISOM) already contains symbols that can form a basis for representing park and urban terrains. However, to ensure fair sprint orienteering competitions, the symbol set needed revision and extension in order to better accommodate parks and urban terrain. There are a number of reasons why the cartographic representation of terrain for sprint orienteering requires a different approach compared to what is used for representation of the 'classical' forested terrain. Such as:

- Many more restrictions affecting route choice have to be considered in parks and urban terrains, e.g. barriers, areas with forbidden access and multi-level structures.
- The amount of details in urban terrain, particularly in the centre of old towns is often higher than in a forested terrain.

The IOF Competition Rules defines the sprint discipline as follows:

*Sprint orienteering is a fast, visible, easy-to-understand format, allowing orienteering to be staged within areas of significant population. The sprint profile is high speed. Sprint is built on very high speed running in very runnable parks, streets or forests. The winning time, for both women and men, shall be 12-15 minutes, preferably the lower part of the interval.*

The IOF Map Commission was in a special situation:

- The sprint event immediately became a part of the IOF events (World Championships, World Cups etc.), and every organizer was waiting for a mapping standard for the new discipline.
- To establish a mapping standard for this new discipline proved to be much more complicated than for traditional orienteering in the forest, due to the inclusion of the urban environment, which is new to international orienteering.

Our main aim was to publish an intermediate standard, what we called Final draft 2003, before the next World Orienteering Championships in Rapperswil, Switzerland in 2003.

## **PRINCIPLES OF SPRINT MAPS**

### **Map legibility**

Map legibility depends on the map scale, a well-chosen set of symbols and signatures as well as the application of generalization rules. Depending on the chosen map scale, some symbols and signatures must represent features and be exaggerated in size, often far beyond the actual ground limits of the feature represented.

To ensure legible maps, the ISSOM symbol set was checked in many test prints to provide well-balanced symbols and signatures so that they would be clearly distinguishable in their size, line width, line type and colouring.

It is the mapmakers' task to produce precise and legible sprint orienteering maps by applying the specifications and generalization rules, such as selection, simplification and exaggeration.

The scales 1:5 000 and 1:4 000 are suitable for the sprint format. They allow course lengths up to 4.0 km with a handy map format. Scale 1:5 000 is suitable for most terrains. However, the level of detail in some urban terrains, particularly in the centre of old towns with lots of essential features may be better facilitated by a scale of 1:4 000.

The contour interval value should be either 2 m or 2.5 m for both 1:5 000 and 1:4 000. Contours are essential for the cartographic representation of a terrain and the only one which depicts relief forms geometrically. The subjective assessment of steepness is very important for route choice in orienteering. It is therefore important that the contour interval, contour line width and map scale is chosen in such a way that one obtains maps with about the same brownness for the same terrain using all foot orienteering map specifications. In this respect, the contour interval and contour line width chosen for the ISSOM corresponds to the contour interval of the ISOM.

### **Line width is used to show passability**

Barriers, such as high walls, fences and rock faces, are very important for route choice and shall be represented unambiguously. It was therefore determined that these features should all be marked with a prominent thick black line.

Obstacles which can be passed/crossed, such as low walls, fences and small rock faces are represented with a significantly thinner black line than the barrier features. Features which can be passed/crossed very easily, such as steps and edges of paved areas, are marked with a very thin black line.

This principle makes it impossible to use the black road and track symbols of ISOM 2000 in an unmodified form. Due to the large scale of sprint orienteering maps, roads, vehicle tracks and footpath should be represented in true shape with a light brown tone.

### **Barriers are forbidden to pass/cross**

To make sprint orienteering fair to all the competitors, it is important that competitors shall not be allowed to pass/cross features which are represented on the map as impassable, independently of their effective passability.

This rule is essential for two reasons:

- First, it is impossible to declare an exact height for when obstacles become impassable. Effective passability also depends on the physical characteristics of the individual competitor, such as body height and differing abilities. If features that are represented as barriers on the map are declared as forbidden to pass/cross, the conditions are the same for all.
- Secondly, many features are forbidden to pass by law in parks and urban terrain.

Running and navigation skills should be the success factors for competitors in a race, rather than the luck when it comes to climbing or jumping barriers or violating public law.

### **Traffic must be kept out of sprint orienteering areas**

Traffic that can influence the results can not be tolerated in a competition area for sprint orienteering, for fairness and safety reasons.

It is not possible to represent the variable characteristics of traffic volumes that affect the route choice of the competitor on an orienteering map. It is therefore not possible to guarantee fair conditions for all competitors with traffic in the terrain. Therefore, sprint orienteering events shall be staged only where traffic can be kept out.

## The main ‘running’ level of multilevel structures should be represented

It is common to find multilevel constructions such as bridges, canopies, underpasses or underground buildings in urban areas. The cartographic representation of more than one level is in general impossible. Hence, the main ‘running’ level should be represented on the map. However, under ground passages (e.g. underpasses, lighted tunnels) or overpasses (e.g. bridges), which are important for the competitors should be represented on the map.

## Collaboration between course planner and mapmaker is important

The restrictions and constraints of sprint orienteering must be taken seriously by the organizers and course planners. In particular: both mapmaker and course planner should consider all possible route choices.

The course planner should not encourage unfair actions from the competitors, such as passing/crossing barriers or areas with forbidden access. If it is unavoidable to set legs that cross or skirt areas with forbidden access (e. g. impassable walls and fences), then they have to be marked in the terrain.



Figure 1: The city base map, the fieldwork and the final sprint map (Basel)

## DIFFICULTIES OF SPRINT ORIENTEERING MAPPING

The number of symbols in the traditional foot-orienteeing map specification (ISOM2000) is 104. On a first look one can think that there is a need for more symbols to represent urban areas because of the special features of parks and urban areas. But some symbols can probably be left out. For instance, due to the large scale some of the ISOM point and linear features can be mapped as area features in true shape on sprint maps.

Comparing the number of symbols in the foot-o and sprint map specification:

Symbol category	Traditional (foot-o) map specification (ISOM)	Sprint orienteering map specification (ISSOM)
Land forms	18	15
Rock and boulders	12	11
Water and marsh	14	12
Vegetation	20	20
Man made features	40	30
Total	104	88

In the first three categories only a few symbols were left out or replaced by area symbols in the sprint map specification. The number of vegetation symbols is the same because most of the vegetation symbols are area symbols. The only change in this category was the removal of a superfluous symbol and the addition of a symbol for vegetation barrier. Apart from that there were no changes, neither in the meaning nor in the graphical representation of the symbols.

The largest reduction in the number of symbols can be found in the man made features category. This is the category where sprint maps differ the most from traditional orienteering maps due to the inclusion of urban terrains in sprint orienteering. It was decided to introduce some new symbols in this category (like stairs, canopy, tramway line and underpass), but over all the number of symbols was radically decreased due to the fact that less track and path symbols were needed (most of the roads and tracks are represented in plan shape). Symbols like firing range and ruin were deemed unnecessary because in the larger scale other symbols (like house, wall) could replace them.

An orienteering map is combination of a thematic map and a general topographic map. The most important theme of the orienteering map is runnability – which route between two controls is the fastest. Orienteering is also precise navigation, the competitor shall navigate along the chosen route and locate a control point, and this requires a very accurate and detailed topographic map. The mapping techniques of orienteering mapping are mainly the same as those used in cartography. The main difficulty of orienteering mapping is the generalization: which features are to be represented on the map and which are irrelevant to the competitors and can be left out. How do we emphasize the most important features of the terrain? How is it possible to illustrate the hierarchy among the different elements of the terrain to fit the competitors' perception while running?

There are areas which can be very interesting for sprint orienteering, but are impossible to map according to the sprint-o specification. In forest areas we have no multilevel problems (excluding exceptional cases), but in urban areas or in parks this situation is quite usual. The competitors' needs will always have to be taken into consideration: what is the primary level of the navigation:

- Features above or below the primary level are irrelevant for the competitors so mapmakers can simply leave out detail at those levels.
- Cases where several levels can be used are nearly impossible to map. Three dimensional structures are not possible to map in a way that the competitors can easily perceive at running speed. Some structures or areas are also so complicated that no expert can map it.

One of the main difficulties of mapping urban areas is the large number of features. The amount of detail in urban/park terrain, particularly in the centre of old towns is often much greater than in a forested terrain. During the process of creating a sprint map specification we have declared that “object smaller than 2 x 2m shall not be mapped unless they are very prominent”. In the final version we have removed this explicit sentence, but we have tried to make the mapmakers understand the importance of reducing the number of mapped features in complex areas. The mapmakers have to be aware of their responsibility: to represent the reality according to the sprint orienteering map specification. Some features are very high, but very small in plan shape (like map-post); other features are great in plan shape, but very small in height (concrete structures). And what about features like poles, junction boxes of cable television and telephone, benches, small sport fixtures, parking meters, trash cans, fire-hydrants, traffic signs, ticket machines, traffic lights? We can not give simple rules for all these features, we can use only one word as a limit of mapping: prominent. If the mapmaker sees the features as prominent he/she will have to make the decision about mapping it or not.

One of the most important experiences of the first sprint maps was the importance of emphasizing features which are forbidden for the competitors (forbidden, uncrossable or dangerous). From version to version we have increased the line thicknesses for forbidden features in order to make them more prominent, and thereby allow the competitors to easily perceive this essential information for the route choice. At the first glance, it must be very easy for the competitor to see which lines or areas are forbidden for them. As written previously, a decision was made, that all features that are mapped uncrossable are also forbidden to cross. It is suggested that the organisers mark these features on the terrain if it is not evident that they are uncrossable. Competitors run at very high speed and need all the help they can get to avoid unintentional crossing of features that they are not allowed to pass.

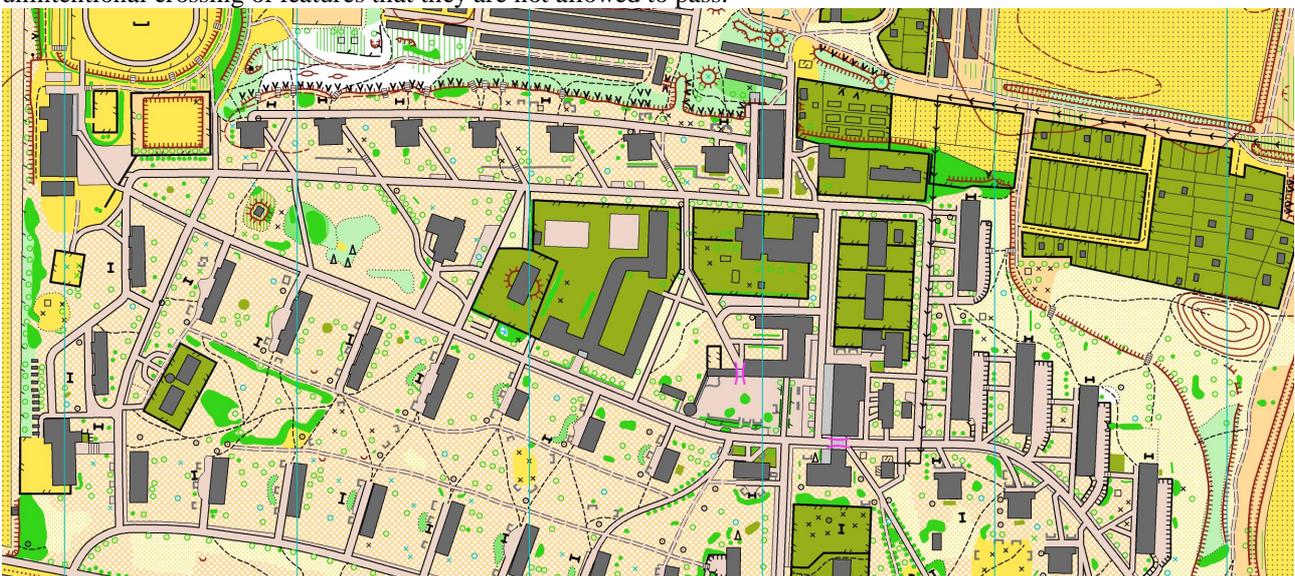


Figure 2: Mixed area on sprint-o map (Almásfüzitő, Hungary)

## THE ISSOM STANDARD

The final version of the ISSOM was officially released in April 2005. There were no big changes comparing to the 2004 version. A bit more freedom was given to the mapmakers to adjust the brown infill and the line width of paved areas (including unpaved footpaths) to achieve the best possible contrast in every situation (urban, park, forest or mixed area). The “visibility” of the brown shade is different if the dominant colour in the area is yellow (park area), white and green (forest area) or black, brown, grey and olive green (urban area).

In the first part of the ISSOM the main characteristics of the specification were summarized, as such:

- ISSOM is based on the ISOM2000, but competitors and mapmakers must understand that sprint maps are special maps.
- The most important difference is that thick black lines indicate barriers/uncrossable features. To ensure fairness it has been decided that features which are mapped uncrossable (e.g. walls, fences, cliffs) are also forbidden to cross. To achieve fairness, it is necessary for mapmakers and course planners to collaborate more closely than for other disciplines.
- The correct mapping of reduced running speed, both to degree and extent, is extremely important for sprint because of the short winning times.
- In urban areas it is not unusual to find multilevel areas. ISSOM allows for the representation of simple underpasses and overpasses. More complex multilevel areas which cannot be mapped clearly are not suitable for IOF events.

This new specification will be used for the trail-orienteering events also, and the results of the development will surely be used in the next update of the ISOM.

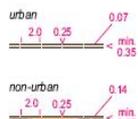
### 5.5 MAN-MADE FEATURES

#### 506.1 Unpaved footpath or track

An unpaved footpath or rough vehicle track is a way for passing mainly by foot, without a smooth, hard surface. The density of the brown fill-in shall be the same as the density chosen for paved area (529).

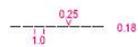
To improve the legibility of this symbol in non-urban parts of the map, the line width shall, in the non-urban parts of the map, be increased from 0.07 mm to 0.14 mm, and the brown fill-in shall, in the non-urban parts of the map, be drawn darker, so that if (x)% brown is used in urban parts of the map, (x+20)% brown shall be used in the non-urban parts of the map.

Colour: black, brown 0 (white), 10%, 20% or 30% (urban) / 20%, 30%, 40%, 50% (non-urban) (min. 60 lines/cm); the colour and the line width shall be the same as for 529/529.1.



#### 507 Small unpaved footpath or track

A small unpaved footpath or track. Not to be used in urban areas. Colour: black.



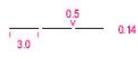
#### 508 Less distinct small path

A less distinct path or forestry extraction track. Not to be used in urban areas. Colour: black.



#### 509 Narrow ride

A distinct ride is a linear break in the forest (usually in a plantation), which does not have a distinct path along it. Where there is a path along a ride, the symbol small unpaved footpath or track (506.1) shall be used. Not to be used in urban areas. Colour: black.



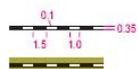
#### 512.1 Bridge

A bridge is a structure spanning and permitting passage over a river, chasm, road or the like. Colour: black.



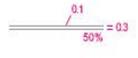
#### 515.1 Railway

A railway is a permanent track laid with rails on which locomotives, carriages or wagons can travel. If it is forbidden to pass or run along the railroad, the forbidden area around the railway shall be represented with symbol area with forbidden access (528.1). Colour: black.



#### 515.2 Tramway

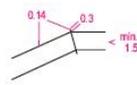
A tramway is a public vehicle running regularly along certain streets, usually on rails. The track can be easily passed by the competitor. Tramways are generally not represented. However, if they serve navigation or orientation, they can be represented. Colour: black 50%.



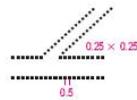
**516 Power line, cableway or skilift**  
Power line, cableway or skilift. The bars indicate the exact location of the pylons. Colour: black.



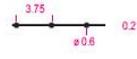
**517 Major power line**  
Major power lines should be drawn with a double line. The gap between the lines may indicate the extent of the powerline. Very large carrying masts, mostly complex poles, shall be represented in plane shape. In this case, the cable lines can be left out (the map shows only the pylons). Colour: black.



**518.1 Underpass or tunnel**  
An underpass or a tunnel is a passage running underneath the ground, especially a passage for pedestrians or vehicles, crossing under for instance a railroad or a road. Colour: black.  
*If underpasses or tunnels etc. are to be used in a competition, they shall be emphasized with symbol 70!*



**519 Passable stone wall**  
A stone wall or stone faced bank. This symbol shall be used only in non-urban areas. If such a wall is higher than 2.0 m, it shall be represented with the symbol impassable wall (521.1). Colour: black.



**519.1 Passable wall**  
A passable wall or retaining wall is a construction made of stone, brick, concrete etc., which can be passed. This symbol is suitable for urban areas. If such a wall is higher than 2.0 m, it shall be represented with the symbol impassable wall (521.1). Wide walls shall be drawn in plane shape. Colour: black 50%.



**521.1 Impassable wall (forbidden to pass)**  
An impassable wall or retaining wall is a wall, which fulfil the function of an enclosure or solid barrier. It shall not be passed, due to forbidden access or because it may constitute a danger to the competitor due to its height. Wider impassable walls shall be drawn in plane shape and represented with the symbol building (526.1). Colour: black.  
*It is forbidden to pass an impassable wall!  
Competitors violating this rule will be disqualified.*



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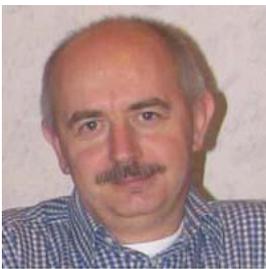
Figure 3: Sample pages from the official ISSOM (<http://lazarus.elte.hu/mc/specs/issom2005.pdf>)

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## BIOGRAPHY OF THE PRESENTING AUTHOR



László Zentai is an Associate Professor of the Department of Cartography and Geoinformatics at Eötvös Loránd University, Budapest, Hungary. He is also the Vice-dean of the Faculty of Informatics. László is the chairman of the Commission on Education and Training, International Cartographic Association and he is also the chairman of the Map Commission, International Orienteering Federation.

László Zentai has a Master of Cartography at the Eötvös University. His PhD research was related to Computer Cartography (presenting the digital facsimile edition of Atlas of Central Europe). He has managed such large map and atlas production projects like Atlas of leading and 'avoidable' causes of death in countries of Central and Eastern Europe; Administrative

Atlas of Hungary, 1914; Multimedia historical CD-ROM of the Hungarian and Finnish History.

His papers are dealing with computer cartography, cartographic education, topographic mapping, environmental protection and webcartography. He has also presented his research findings in Norway, Switzerland, Russia, Japan, China, Finland, South Africa, Lithuania, Slovenia.

László Zentai  
Associate Professor  
Department of Cartography and Geoinformatics  
Eötvös Loránd University  
Pázmány Péter sétány 1/A, H-1117 Budapest  
Tel +36 1 3722975, Fax +36 1 3722951  
[laszlo.zentai@elte.hu](mailto:laszlo.zentai@elte.hu)  
Homepage: <http://lazarus.elte.hu>