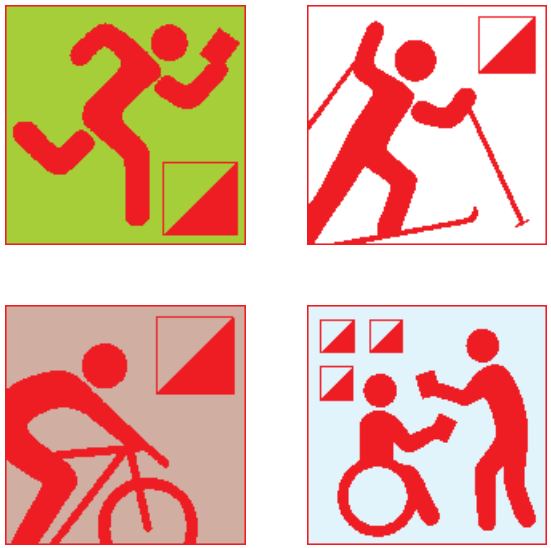
International Specification for Orienteering Maps



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MAP COMMITTEE

International Specification for Orienteering Maps

1 INTRODUCTION

Orienteering is a worldwide sport. A common approach to the interpretation and drawing of orienteering maps is essential for fair competition and for the future growth of the sport.

It is the aim of the International Specification for Orienteering Maps (ISOM) to provide a map specification which can accomodate the many different types of terrain around the world and the many ways of doing orienteering. These specifications should be read in conjunction with the rules for International Orienteering Federation (IOF) orienteering events. For IOF events deviations are permissable only with the sanction of the IOF Map Committee (IOF MC). For other events such sanction must be given by the national federation. In addition, there are supplementary specifications for other orienteering disciplines on the basis of the specification for foot orienteering maps.

2 GENERAL REQUIREMENTS

2.1 Orienteering and the map

Orienteering is a sport in which the orienteer completes a course of control points in the shortest possible time, aided only by map and compass. As in all forms of sport, it is necessary to ensure that the conditions of competition are the same for all competitors. The more accurate the map, the better this can be done, and the greater the opportunity for the course planner to set a good and fair course.

From the competitors' point of view, an accurate and legible map is a reliable guide for choice of route, and it enables them to navigate along a route chosen to suit their navigational skill and physical ability. However, skill in route choice loses all meaning if the map is not a true picture of the ground—if it is inaccurate, out-of-date or of poor legibility.

Anything which bars progress is essential information: cliffs, water, dense thickets. The path and track network shows where the going and navigation is easiest. A detailed classification of the degrees of hindrance or good going helps the competitor to make the right decisions. Orienteering is first of all to navigate by map reading. An accurate map is therefore necessary for a good and effective route choice. In the ideal case no competitor should gain an advantage or suffer a disadvantage because of faults on the map.

The aim of the course planner is a course where the deciding factor in the results will be navigational skill. This can be achieved only if the map is sufficiently accurate, complete and reliable, and is also clear and legible under competition conditions. The better the map the course planner has, the greater the chance he has of setting good, fair courses, whether for the elite or for the novice.

Controls are the most important building blocks of a course. Choice of sites, placing of the markers, checking their positions, and locating controls in competition, all put definite demands on the map. The map must give a complete, accurate and detailed picture of the terrain. For an international event, it must be up-to-date in all parts which could affect the end result of the competition. If it is not up-to-date it must be improved.

For the mapper, the task is knowing which features to map and how to represent them. A continuing involvement in the sport is important for a basic understanding of the requirements for the orienteering map: its content, the need for accuracy, the level of detail and above all the need for legibility.

2.2 Content

An orienteering map is a detailed topographic map. The map must contain the features which are obvious on the ground to a competitor at speed. It must show every feature which could influence map reading or route choice: land forms, rock features, ground surface, rate of progress through the vegetation (known in foot-o as runnability), main land uses, hydrography, settlements and individual buildings, the path and track network, other lines of communication and features useful from the point of view of navigation.

The shape of the ground is one of the most important aspects of an orienteering map. The correct use of contours to show a three dimensional picture of the ground—shape and height difference—cannot be overemphasized.

The degree to which a feature is recognizable, the openness of the forest and runnability of the terrain should be taken into consideration at the survey stage.

Boundaries between different types of ground surface provide valuable reference points for the map reader. It is important that the map shows these.

An orienteer´s speed and choice of route through the terrain is affected by many factors. Information on all of these factors must therefore be shown on the map by classifying paths and tracks, by indicating whether marshes, water features, rock faces and vegetation are passable, and by showing the characteristics of the ground surface and the presence of open areas. Clearly visible vegetation boundaries should also appear since they are useful for map reading.

The map must show the features which are obvious on the ground and which are of value from the point of view of map reading. An attempt must be made when surveying to maintain the clarity and legibility of the map, i.e. the minimum dimensions designed for normal sight must not be forgotten when choosing the degree of generalization.

The map must contain magnetic north lines and may additionally contain some place names and peripheral text to help the competitor to orientate the map to north. This text should be written from west to east. Text within the map should be placed to avoid obscuring important features and the style of lettering should be simple.

The sides of the map should be parallel to the magnetic north lines. Arrowheads may be used to show magnetic north.

2.3 Accuracy

The general rule should be that competitors shall not perceive any inaccuracy in the map. The accuracy of the map as a whole depends upon the accuracy of measurement (position, height and shape) and the accuracy of drawing. Accuracy of position on an orienteering map must be consistent with that obtained by compass and pacing. A feature must be positioned with sufficient accuracy to ensure that a competitor using compass and pacing will perceive no discrepancy between map and ground. In general if the distance between neighbouring features deviates less than 5% this will satisfy accuracy requirements.

Absolute height accuracy is of little significance on an orienteering map. On the other hand, it is important that the map shows as correctly as possible the relative height difference between neighbouring features.

Accurate representation of shape is of great importance for the orienteer, because a correct, detailed and sometimes exaggerated picture of the land form is an essential precondition for map reading. However, the inclusion of a lot of small detail must not disguise the overall shapes. Drawing accuracy is of primary importance to any map user because it is closely connected with the reliability of the final map.

Absolute accuracy is important if an orienteering map is to be used with a positioning system or together with geographical data sets from other sources. In such cases it must also be possible to transform the map to a well known geographical reference system.

2.4 Generalization and legibility

Good orienteering terrain contains a large number and a great variety of features. Those which are most essential for the runner in competition must be selected and presented on the orienteering map. To achieve this, in such a way that the map is legible and easy to interpret, cartographic generalization must be employed. There are two phases of generalization—selective generalization and graphic generalization.

Selective generalization is the decision as to which details and features should be presented on the map. Two important considerations contribute to this decision—the importance of the feature from the runners' point of view and its influence on the legibility of the map. These two considerations will sometimes be incompatible, but the demand for legibility must never be relaxed in order to present an excess of small details and features on the map. Therefore it will be necessary at the survey stage to adopt minimum sizes for many types of detail. These minimum sizes may vary somewhat from one map to another according to the amount of detail in question. However, consistency is one of the most important qualities of the orienteering map.

Graphic generalization can greatly affect the clarity of the map. Simplification, displacement and exaggeration are used to this end.

Legibility requires that the size of symbols, line thicknesses and spacing between lines be based on the perception of normal sight in daylight. In devising symbols, all factors except the distance between neighbouring symbols are considered.

The size of the smallest feature which will appear on the map depends partly on the graphic qualities of the symbol (shape, format and colour) and partly on the position of neighbouring symbols. With immediately neighbouring features, which take up more space on the map than on the ground, it is essential that the correct relationships between these and other nearby features are also maintained.

3 MAP SPECIFICATION FOR FOOT-ORIENTEERING

3.1 Scale

The scale for an orienteering map is 1:15 000. Terrain that cannot be fieldworked at a scale of 1:7 500 and legibly presented at a scale of 1:15 000, is not suitable for international foot-orienteering.

Maps at 1:10 000 may be produced for relay and short distance competitions. The scale 1:10 000 is recommended for older age groups (age classes 45 and above) where reading fine lines and small symbols may cause problems or for younger age groups (age classes 16 and below) where the capacity of reading complex maps is not fully developed.

Maps at 1:10 000 must be drawn with lines, line screens and symbol dimensions 50% greater than those used for 1:15 000 maps.

Where practical the same dot screens as used at 1:15 000 will give the most legible map and are therefore to be preferred.

In education there is usually a progression of scales from 1:2 500 to 1:5 000 to 1:10 000. Maps at very large scales such as 1:2 500 will clearly contain additional detail such as playground equipment. Line dimensions for these maps should also be enlarged by 50%.

Other scales may be produced for other forms of orienteering.

For practical reasons a map should not be larger than is necessary for the orienteering competition. Maps larger than A3 should be avoided.

3.2 Contour interval

The contour interval for an orienteering map is 5 m. In flat terrain a contour interval of 2.5 m may be used. It is not permissable to use different intervals on the same map.

3.3 Dimensions of map symbols

No deviations from the given dimensions within these specifications are permitted. It is however accepted that due to limitations in printing technology the final map symbol dimensions may vary up to +/- 5%.

Dimensions in this book are given at the printed scale of 1:15 000.

All line widths and symbol dimensions must be kept strictly to their specified value. Certain minimum dimensions must also be observed. These are based on both printing technology and the need for legibility.

MINIMUM DIMENSIONS of 1:15 000

- The gap between two fine lines of the same colour, in brown or black: 0.15 mm
- The smallest gap between two blue lines: 0.25 mm
- Shortest dotted line: at least two dots
- Shortest dashed line: at least two dashes
- Smallest area enclosed by a dotted line: 1.5 mm (diameter) with 5 dots
- Smallest area of colour
  - Blue, green, grey or yellow full colour: 0.5 mm^2
  - Black dot screen: 0.5 mm^2
  - Blue, green or yellow dot screen: 1.0 mm^2

All features smaller than the dimensions above must be either exaggerated or omitted, depending on whether or not they are of significance to the orienteer. When a feature is enlarged, neighbouring features must be displaced so that the correct relative positions are maintained.

SCREENS

Vegetation, open areas, marshes, etc. are shown with dot or line screens. The following table lists the permissible combinations of screens.

	117	210	309	310	311	401	402	403	404	406	407	408	409	410
117 Broken ground				●	●	●	●	●	●	●	●	●	●	●
210 Stony ground				●	●	●	●	●	●	●	●	●	●	●
309 Uncrossable marsh								●	●	●	●	●	●	●
310 Marsh	●	●				●	●	●	●	●	●	●	●	●
311 Indistinct marsh	●	●				●	●	●	●	●	●	●	●	●
401 Open land	●	●		●	●						●	●	●	●
402 Open land with scattered trees	●	●		●	●						●	●	●	●
403 Rough open land	●	●	●	●	●						●	●	●	●
404 Rough open land with scattered trees	●	●	●	●	●						●	●	●	●
406 Forest: slow running	●	●		●	●							●	●	●
407 Undergrowth: slow running	●	●		●	●			●	●				●	●
408 Forest: difficult to run	●	●		●	●									●
409 Undergrowth: difficult to run	●	●		●	●			●	●					●
410 Vegetation: impassable	●	●		●	●									

● Permitted combinations

3.4 Enlargement of maps

Where a map is enlarged to a scale of 1:10 000 or greater, all lines and symbols must be enlarged to 150%. Area screens made with fine dot percentage tints should not be enlarged wherever possible, i.e. screens at 60 l/cm.

3.5 Printing

An orienteering map must be printed on good, possibly water resistant, paper (weight 80-120 g/m^2).

Spot colour printing is recommended for IOF events. Other printing methods may be used, if colours and line width have the same quality as printing with spot colours.

Legibility depends on the correct choice of colours.

3.5.1 Spot colour printing

Spot colour printing uses pure colour inks. Each spot colour ink is made by mixing a number of stock inks in specific proportions to produce the desired colour. The colours specified for use for orienteering maps are defined by the Pantone Matching System (PMS).

The map may be in up to 6 colours (excluding overprinting).

The following recommendations for spot colours are intended to standardize maps as much as possible:

Colour	PMS number
Black	Process black
Brown	471
Yellow	136
Blue	299
Green	361
Grey	428
Violet	Purple

The appearance of colours is dependent on the printing order.
In spot colour printing, order should always be:

1. yellow
2. green
3. grey
4. brown
5. blue
6. black
7. purple

3.5.2 Four colour offset printing

Four-colour printing is the traditional way of printing most colour work, maps have been one of the main exceptions due to the fine line requirements.

The four colour printing method uses the three basic colours of the subtractve colour model: cyan, magenta and yellow. In theory a mix of 100% of cyan, magenta and yellow produces black colour, but in reality it will be more of a dark brown. Therefore black is normally printed as a separate colour. After these four colours the model is often referred to as CMYK.

Although four-colour printing requires fewer and standardized inks, the main advantage of using this process is that it allows the inclusion of colour photographs and full colour advertisements at no extra cost.

The use of digital techniques to produce four colour separations has now made it possible to make high quality orienteering maps using four colour printing. This is not the suggested method of printing orienteering maps, it is an alternative. This method will only be acceptable when line quality, legibility and colour appearance are of the same quality as the traditional spot colour printed map.

However, the mapmaker has to take into consideration the limitations and potential errors of this method. The reproduction of very thin lines (contours) requires special attention.

Colours

The following table lists the CMYK combinations for the equivalent PMS colours recommended for orienteering maps:

Colour	PMS colour	Cyan	Magenta	Yellow	Black
Black	Process black				100%
Brown	PMS 471		56%	100%	18%
Yellow	PMS 136		27%	79%	
Blue	PMS 299	87%	18%		
Green	PMS 361	76%		91%	
Grey	PMS 428				23%
Violet	Purple		100%		

Screens

The colour mixture can be done either with traditional printing screens or special printing screens with randomly distributed dots called stochastic screens. The latter screens will improve legibility and make fine lines such as contours more readable, and is therefore highly recommended.

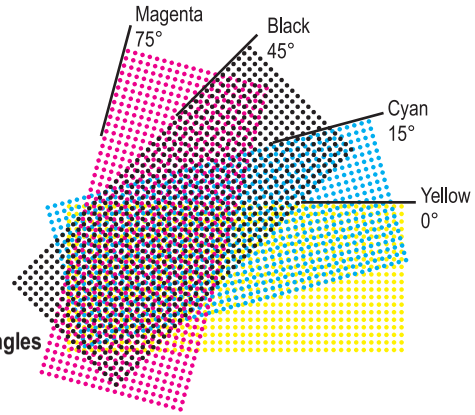
Screen frequency

Traditional screens should have a screen frequency of at least 60 lines/cm. For stochastic screens the frequency will vary randomly.

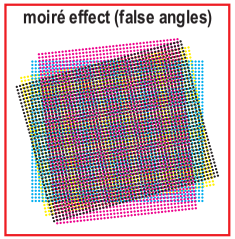
Angles

To avoid the unwanted moiré effects with traditional printing screens 4-color orienteering maps should always use the recommended angle set. In proper stochastic screens the dots are placed randomly, so angles are irrelevant and unwanted moiré effects will not appear.

Colour	Angle
Cyan	15°
Magenta	75°
Yellow	0°
Black	45°



Recommended angles



Printing order

The appearance of colours is dependent on the printing order. In 4-colour orienteering map offset printing the printing order should always be:

1. Yellow
2. Cyan
3. Magenta
4. Black

Overprinting
With traditional spot colour printing inks are physically printed on top of each other. It is possible to simulate the same with four-colour printing technique, and this optimises legibility and gives a colour appearance as close to traditional spot colour printing as possible. To achieve this effect in four-colour offset printing, information underlying (in the spot colour printing order described in 3.5.1) a specific spot colour should not be blocked out (erased / printed white) completely, but should be blended in to produce a new colour for printing.

The use of overprinting effect with 4-color offset printing is recommended for the following solid colors:

- 100 % Violet
- 100 % Black
- 100 % Brown
- 100 % Blue
- 100 % Green

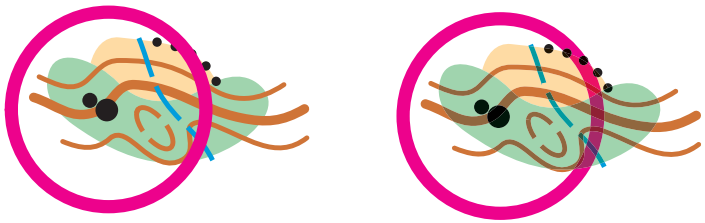


Illustration: Contours in dense vegetation printed in 4-colours. Overprinting effect in the right illustration.

3.5.3 Alternative printing methods

Colour copiers, printers and other digital printing equipment are not yet suitable for printing orienteering maps for high level competitions. It is very difficult to achieve the line quality, legibility and colour appearance of traditional spot colour printed maps using this kind of equipment.

It is expected that the continuing development of computer technology will lead to the possibility of using alternative printing methods with quality suitable for large competitions.

Most printing devices use a 4-color technique (CMYK). For such devices the same colour settings as recommended for 4-color offset printing may be suitable, but the colour appearance will vary slightly from one device to another and from one paper quality to another.

Extensive experimentation with different colour and halftone settings, different paper qualities and other variables will be necessary to achieve a quality as close to offset printing as possible. Such experimentation has to be done for a whole range of devices. This specification can therefore not give any general recommendations for the use of such alternative printing methods.

4 EXPLANATION OF SYMBOLS (FOOT-O)

Definitions of map features and specifications for the drawing of symbols are given in the following sections. Symbols are classified into 7 categories:

Land forms	(brown)
Rock and boulders	(black+grey)
Water and marsh	(blue)
Vegetation	(green+yellow)
Man-made features	(black)
Technical symbols	(black+blue)
Course symbols	(purple)

Note: dimensions are specified in mm at the scale of 1:15 000.
All drawings are at 1:7 500 for clarity only.

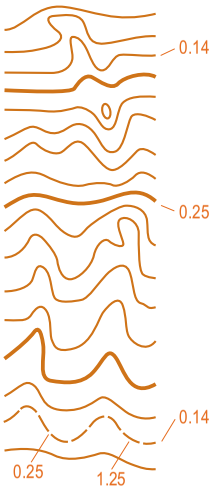
< gap or infill between two lines
– line thickness
– distance from centre to centre or length of line
ø diameter
symbol orientated to north

4.1 Land forms

The shape of land is shown by means of very detailed contours, aided by the special symbols for small knolls, depressions, etc. This is complemented in black by the symbols for rock and cliffs. Orienteering terrain is normally best represented with a 5 m contour interval.

Excessive use of form lines should be avoided as this will complicate the map and give a wrong impression of height differences. If the representation of an area needs a large number of form lines, a smaller contour interval provides a more legible alternative.

The relative height difference between neighbouring features must be represented on the map as accurately as possible. Absolute height accuracy is of less importance. It is permissible to alter the height of a contour slightly if this will improve the representation of a feature. This deviation should not exceed 25% of the contour interval and attention must be paid to neighbouring features.



101 Contour
A line joining points of equal height. The standard vertical interval between contours is 5 metres. The smallest bend in a contour is 0.25 mm from centre to centre of the lines.
Colour: brown.

102 Index contour
Every fifth contour shall be drawn with a thicker line. This is an aid to the quick assessment of height difference and the overall shape of the terrain surface. Where an index contour coincides with an area of much detail, it may be shown with a normal contour line.
Colour: brown.

103 Form line
An intermediate contour line. Form lines are used where more information can be given about the shape of the ground. They are used only where representation is not possible with ordinary contours. Only one form line may be used between neighbouring contours.
Colour: brown.

104 Slope line
Slope lines may be drawn on the lower side of a contour line, e.g. along the line of a re-entrant or in a depression. They are used only where it is necessary to clarify the direction of slope.
Colour: brown.

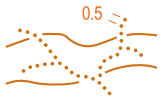
105 Contour value
Contour values may be included to aid assessment of large height differences. They are inserted in the index contours in positions where other detail is not obscured. The figures should be orientated so that the top of the figure is on the higher side of the contour.
Colour: brown.

106 Earth bank
A steep earth bank is an abrupt change in ground level which can be clearly distinguished from its surroundings, e.g. gravel or sand pits, road and railway cuttings or embankments. The tags should show the full extent of the slope, but may be omitted if two banks are close together. Impassable banks should be drawn with symbol 201 (impassable cliff). The line width of very high earth banks may be 0.25 mm.
Colour: brown.

107 Earth wall
Distinct earth wall. Minimum height is 1 m.
Colour: brown.

108 Small earth wall
A small or partly ruined earth wall shall be shown with a dashed line. Minimum height is 0.5 m.
Colour: brown.

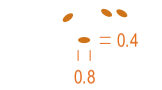
109 Erosion gully
An erosion gully or trench which is too small to be shown by symbol 106 is shown by a single line. The line width reflects the size of the gully. Minimum depth 1 m. The end of the line is pointed.
Colour: brown.



110 Small erosion gully
A small erosion gully or trench. Minimum depth 0.5 m.
Colour: brown.

111 Knoll
Knolls are shown with contour lines. A prominent knoll falling between contour lines may still be represented by a contour line if the deviation from the actual contour level is less than 25%. Smaller or flatter knolls should be shown with form lines.
Colour: brown.

112 Small knoll
A small obvious mound or rocky knoll which cannot be drawn to scale with a contour (diameter of mound less than ca. 5 m). The height of the knoll should be a minimum of 1 m from the surrounding ground. The symbol may not touch a contour line.
Colour: brown.



113 Elongated knoll
A small obvious elongated knoll which cannot be drawn to scale with a contour (length less than 12 m and width less than 4 m). The height of the knoll should be a minimum of 1 m from the surrounding ground. Knolls larger than this must be shown by contours. The symbol may not be drawn in free form or such that two elongated knoll

114 Depression
Depressions are shown with contours or form lines and slope lines. Prominent depressions falling between contour lines may be represented by a contour line if the deviation from the actual contour level is less than 25%. Smaller or shallower depressions should be shown by form lines.
Colour: brown.

115 Small depression
Small shallow natural depressions and hollows (minimum diameter 2 m) which cannot be shown to scale by contours are represented by a semicircle. Minimum depth from the surrounding ground should be 1 m. Location is the centre of gravity of the symbol, which is orientated to north. Symbol 116 is used for man-made pits.
Colour: brown.

116 Pit
Pits and holes with distinct steep sides which cannot be shown to scale by symbol 106 (minimum diameter 2 m). Minimum depth from the surrounding ground should be 1 m. Location is the centre of gravity of the symbol which is orientated to north.
Colour: brown.

117 Broken ground
An area of pits or knolls which is too intricate to be shown in detail. The density of randomly placed dots may vary according to the detail on the ground.
Colour: brown.

118 Special land form feature
This symbol can be used for a special small land form feature. The definition of the symbol must be given in the map legend.
Colour: brown.

4.2 Rock and boulders

Note: dimensions are specified in mm at the scale of 1:15 000.
All drawings are at 1:7 500 for clarity only.

Rock is a special category of land form. The inclusion of rock gives useful information about danger and runnability, as well as providing features for map reading and control points. Rock is shown in black to distinguish it from other land forms features. Care must be taken to make sure that rock features such as cliffs agree with the shape and fall of the ground shown by contours or form lines.

201 Impassable cliff
An impassable cliff, quarry or earth bank (see 106) is shown with a 0.35 mm line and downward tags showing its full extent from the top line to the foot. For vertical rock faces the tags may be omitted if space is short, e.g. narrow passages between cliffs (the passage should be drawn with a width of at least 0.3 mm). The tags may extend over an area symbol representing detail immediately below the rock face. When a rock face drops straight into water making it impossible to pass under the cliff along the water's edge, the bank line is omitted or the tags should clearly extend over the bank line.
Colour: black.

202 Rock pillars/cliffs
In the case of unusual features such as rock pillars or massive cliffs or gigantic boulders, the rocks shall be shown in plan shape without tags.
Colour: black.

203 Passable rock face
A small vertical rock face (minimum height 1 m) may be shown without tags. If the direction of fall of the rock face is not apparent from the contours or to improve legibility, short tags should be drawn in the direction of the fall. For passable rock faces shown without tags the ends of the line may be rounded to improve legibility.
Colour: black.

204 Rocky pit
Rocky pits, holes or mineshafts which may constitute a danger to the runner. Location is the centre of gravity of the symbol, which is orientated to north.
Colour: black.

205 Cave
A cave is represented by the same symbol as a rocky pit. In this case the symbol should be orientated to point up the slope as indicated opposite. The centre of gravity of the symbol marks the opening.
Colour: black.

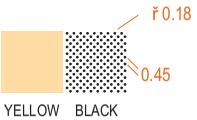
206 Boulder
A small distinct boulder (minimum height 1 m). Every boulder marked on the map should be immediately identifiable on the ground. To be able to show the distinction between boulders with significant difference in size it is permitted to enlarge this symbol by 20% (diameter 0.5 mm).
Colour: black.

207 Large boulder
A particularly large and distinct boulder. For gigantic boulders symbol 202 should be used.
Colour: black.

208 Boulder field
An area which is covered with so many blocks of stone that they cannot be marked individually is shown with randomly orientated solid triangles with sides of ratio 8:6:5. A minimum of two triangles should be used. The going is indicated by the density of the triangles. To be able to show the distinction between boulder fields with a significant difference in boulder size it is permitted to enlarge the triangles by 20%.
Colour: black.

209 Boulder cluster
A small distinct group of boulders so closely clustered together that they cannot be marked individually. The symbol is an equilateral triangle orientated to the north. To be able to show the distinction between boulder clusters with significant difference in size it is permitted to enlarge this symbol by 25% (1.0 mm).
Colour: black.

210 Stony ground
Stony or rocky ground which affects going should be shown on the map. The dots should be randomly distributed with density according to the amount of rock. A minimum of three dots should be used.
Colour: black.



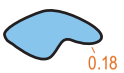
211 Open sandy ground
An area of soft sandy ground or gravel with no vegetation and where running is slow. Where an area of sandy ground is open but running is good, it is shown as open land (401/402).
Colour: black 12.5% (22 lines/cm) and yellow 50% (see 403).

212 Bare rock
A runnable area of rock without earth or vegetation is shown as bare rock. An area of rock covered with grass, moss or other low vegetation is shown as open land (401/402).
Colour: black 30% (60 lines/cm) or grey.

4.3 Water and marsh

Note: dimensions are specified in mm at the scale of 1:15 000. All drawings are at 1:7 500 for clarity only.

This group includes both open water and special types of vegetation caused by the presence of water (marsh). The classification is important because it indicates the degree of hindrance to the runner and provide features for map reading and control points. A black line around a water feature indicates that it cannot be crossed under normal weather conditions. In dry areas the features listed in this section may only contain water in some seasons.



301 Lake
Large areas of water are shown with dot screen. Small areas of water should be shown with full colour. A black bank line indicates that the feature cannot be crossed.
Colour: blue 50% (60 lines/cm), black.

302 Pond
Where the lake or pond is smaller than 1mm^2 on the printed map, the bank line is omitted.
Colour: blue.

303 Waterhole
A water-filled pit or an area of water which is too small to be shown to scale. Location is the centre of gravity of the symbol, which is orientated to north.
Colour: blue.

304 Uncrossable river
An uncrossable river or canal is drawn with black bank lines. The bank lines are broken at a ford.
Colour: blue 50% (60 lines/cm), black.

305 Crossable watercourse
A crossable watercourse, minimum 2 m wide. The width of watercourses over 5 m wide should be shown to scale.
Colour: blue.