TECHNICAL GUIDELINES
FOR
ELITE TRAIL ORIENTEERING

Timed control at WTOC 2004, Västerås, Sweden

IOF Trail Orienteering Commission

2009

Summary

The key to high quality of competition in elite international Trail-O is good terrain, good maps, good planning and good controlling. This document, issued by the IOF Trail Orienteering Commission, advises on each of these elements and specifies the IOF interpretations of the rules and established practice. These guidelines replace all previous issues of planning guidelines. They apply to all IOF events in trail orienteering and are recommended as a basis for any Trail-O event.

CONTENTS

1. INTRODUCTION

Trail orienteering is one of the four disciplines of international orienteering. Originally developed from the core discipline of foot-orienteering, it is a form of the sport in which contested physical performance has been eliminated to allow participation by competitors with impaired mobility, including those requiring the use of wheelchairs. Trail orienteering competition at all levels demands skills of map reading and terrain interpretation. At advanced level the competitors' speed of decision making is also tested.

The appeal of trail orienteering has extended to able-bodied orienteers over a wide range of experience, including world champion foot orienteers, all attracted to its technical challenge. The World Trail Orienteering Championships (WTOC) are open to all-comers, irrespective of age, gender or physical ability, in which those with mobility disabilities can compete with the able-bodied on equal terms. There is also a closed 'Paralympic' class restricted to those eligible and with medically-certified IOF approval.

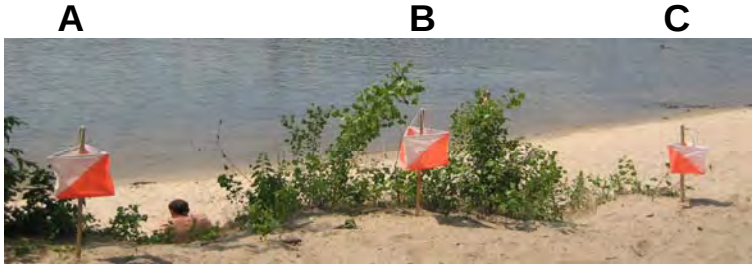
ESSENTIALS of ELITE TRAIL ORIENTEERING

In Trail-O the control sites, with a number of marker flags at each site, are out of bounds to the competitors. The flags are viewed from permitted access routes, usually tracks and paths, sometimes with wheelchair-friendly deviation off-path, the limits of which are marked in the terrain.

The competitors are required at each control location to determine whether the feature at the centre of the circle on the map and defined in the control description is marked by a flag in the terrain. Between one and five flags may be used at each site. At elite level there is a sixth option, no flag matching the centre of the circle and the control description, giving a zero answer.

In solving elite control problems, the competitors have to demonstrate advanced understanding of the relationship between map and terrain. The only permitted technical aid is a standard orienteering compass.

In viewing the controls the competitors may move (except at timed controls) up and down the permitted tracks or marked areas off-track. The flags are then identified from a decision point marked on the ground but not on the map. The coding used for recording the competitors' decisions is that the flags are referenced A to E, starting with the flag furthest to the left:



Currently the decision is recorded on a control card with six boxes for each control (A to E and zero) marked by a pin punch placed a short distance along the course from the decision point. Electronic forms of recording are being developed and IOF-licensed electronic punching systems are likely to become standard.

In addition to the main course, which has to be completed within a given overall time, there are a number of timed controls which test mental speed and accuracy. The times taken are used to distinguish between competitors who have the same total number of correct controls.

ELITE TRAIL-O and ELITE FOOT-O COMPARED

There is widespread agreement, both within the trail orienteering discipline and outside, that trail orienteering should follow the same practices as foot orienteering, *as far as is sensible and practicable*. Ideally, this means the same mapping, the same control feature selections and the same descriptions, as well as all the procedures for organising a competition and taking part in it.

However, this ideal cannot be fully met, because of three significant differences between the disciplines:

- trail orienteers do not enter the terrain;
- the use of multiple flags at a control in trail orienteering; and
- the greatly extended time for decision making at each trail orienteering control, which allows more information to be extracted from the map and more attention given to the exact placement of the control flag.

These differences produce constraints but also opportunities for trail orienteering to evolve beyond its starting point in foot orienteering. In particular, the expansion of the time available to examine the terrain (but not at the timed controls, where speed of decision is tested) has enabled the use additional position-fixing techniques to locate the feature at the centre of the circle matching the control description. Such techniques include sighting lines and precise compass bearings.

Also, in modern cartography and map production, the control circles are drawn and printed within the map, and this results in the centres of the circles being very precisely located. In earlier years this was not so, particularly with hand-copied master maps. Therefore, it was necessary to define the position of the control by a precise description, which had to be unique, in that it indicated a single identifiable point in the terrain. This convention remains in use for foot orienteering.

In trail orienteering the definition by means of unique description still applies to point features, which are not mapped to scale and the direction of placement of the control flag is only available from the description. However, for features large enough to be mapped to scale, a unique description is no

longer an essential requirement, as careful map reading can distinguish between flags which have the same description. This extends the range of different terrain recognition problems possible in elite trail orienteering and contributes to its being an extremely challenging and rewarding mental exercise.

Whilst trail orienteering undergoes natural and worthwhile evolution, those responsible for its development are conscious that it should retain the same ethos as foot orienteering, so that as many as possible of the features of the sport that foot orienteers find attractive, are replicated in trail orienteering.

THE PURPOSE OF THESE GUIDELINES

The basis of successful trail orienteering competition is careful control setting. The planning of testing but fair controls at elite level is particularly difficult and often underestimated by those who have not taken part in international competition at this level. Therefore, most of this document is about the practical issues of control selection and description.

Although prepared for providing technical guidance for elite trail orienteering, these guidelines can be useful at all levels as participants progress from the basic skills of introductory courses to the more precise and demanding techniques of national and international competition.

2. TERRAIN REQUIREMENTS for ELITE TRAIL-O

There are many similarities between the terrain requirements for elite events in foot orienteering and trail orienteering.

However, there are some important differences. Much more attention has to be given to the conditions of the surfaces over which the competitors are permitted to move. Also the terrain detail and visibility have more rigorous requirements.

Two questions have to be answered:

(i) Is the visible terrain suitable for Elite Trail Orienteering?

The best Trail-O terrain, visible from the tracks and permitted areas, has complex ground and contour detail, together with water and vegetation features, demanding skills of map interpretation.

Man-made features can play a part in elite Trail-O but are generally of secondary value, the best competition, as in Foot-O, being based upon natural detail.

Trying to judge from an existing Foot-O map, at 1:15000 or 1:10000 scale, whether the terrain is suitable for elite Trail-O is difficult because the Trail-O competition map, typically at 1:5000 scale, shows necessary detail which is often too fine to be included on the Foot-O map.

The sprint map at 1:5000 or 1:4000 is much more useful but, even so, the terrain ***must*** be visited to make sure there are enough sites of elite standard to support the competition.

(ii) Can a wheelchair competitor get round the course?

The IOF Rules for international trail orienteering events state:

"The terrain must be chosen so that the least mobile competitors, the person confined to and propelling a low fixed wheelchair and the person who walks slowly and with difficulty, can negotiate the course within the maximum time limit, using official assistance where provided." Rule14.2

There is also useful guidance in Appendix 1 – Principles of Course Planning for Trail Orienteering – attached to the Rules.

The wheelchair competitors need firm surfaces and room to turn. This last point is important, as competitors will often need to sight a problem from different positions before making a decision at the viewing point.

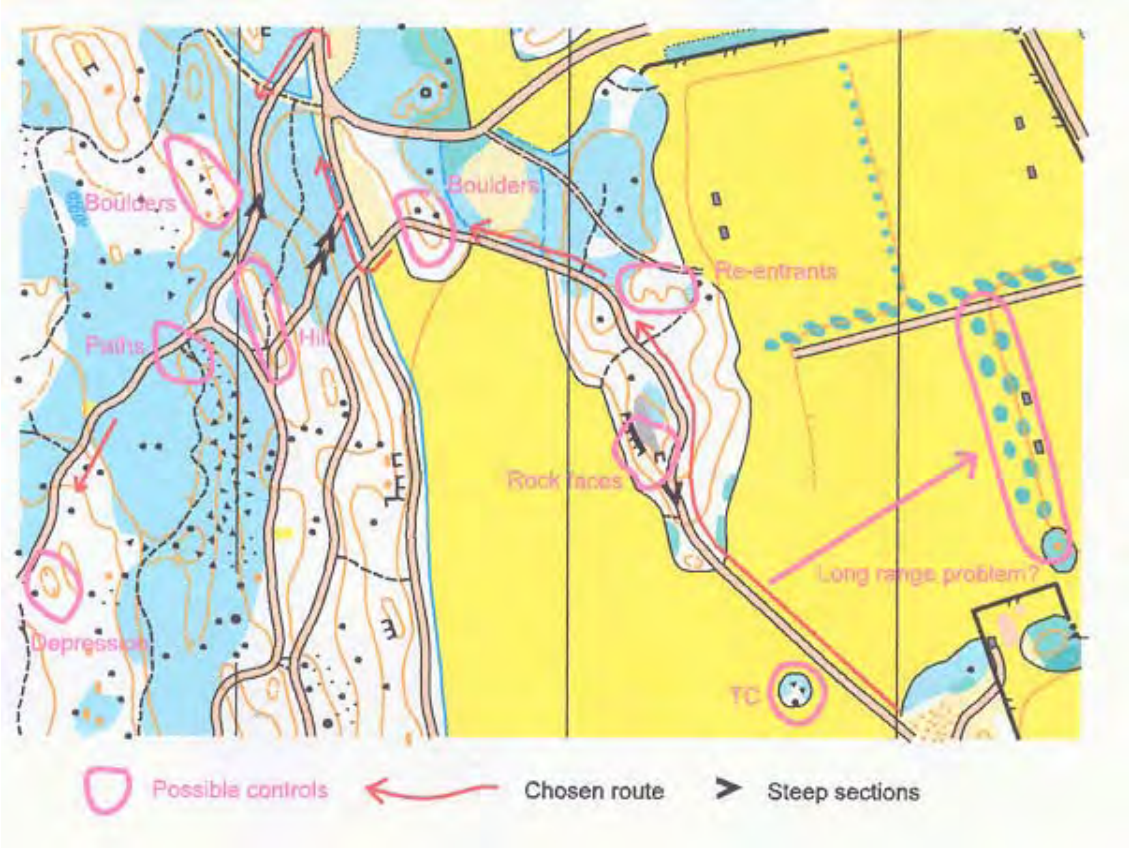
The firmness of the surface has to be carefully considered, particularly in softer ground that may become difficult in wet conditions. It may be necessary for sections of the tracks to be repaired for the competition or have temporary surfaces installed.

The gradients on the course may be critical. Appendix 1 of the IOF Trail-O Rules gives information about the limits to gradients for unassisted progress. Particular care should be taken concerning down slopes in wet conditions.

It is recommended that organisers seek on-site advice of those with practical knowledge of negotiating surfaces and slopes with wheelchairs.

Difficult sections will need physical assistance from helpers provided by the Organiser.

Here is an example of elite Trail-O terrain with good wheelchair access:



The notes on the map are from the early planning, outlining possible control sites. Some of these were used, others were not. Those rejected were unable to provide problems of the required elite standard.

If the two questions about terrain quality and wheelchair access can be satisfactorily answered, then an elite event is possible.

3. MAPPING for ELITE TRAIL-O

Reference: International Specification for Sprint Orienteering Maps (ISSOM), 2006.

The preparation and correction of Trail-O mapping is closely integrated with the planning process and is, therefore, included in detail in this document.

Maps for international trail orienteering are based on foot orienteering mapping specifications and are often modified versions of existing foot orienteering maps.

Since competitors in trail orienteering are forbidden to leave the tracks, paths and marked areas, there are a number of consequences for trail orienteering mapping. The competition area is that adjacent to the trails, generally within 50m, occasionally 100m or more when good visibility and contrast permits the placement of flags at longer distances.

Concentrating on this greatly reduced area, compared with foot orienteering competition, requires much more detailed terrain representation. This is achieved by means of an enlarged map scale, together with enlarged symbol size (for improved clarity), compared with the specification for 1:15000 maps. The following technical guideline ***(TG)*** applies:

Map specifications recommended for international trail orienteering:

- ***1:5000 or 1:4000 scale with symbol dimensions at 150% of conventional 1:15000 foot orienteering map symbols. (TG 1)***

These specifications match those in ISSOM for sprint foot orienteering.

The contour and form lines should give clear indication of the gradient and shape of the terrain. A contour interval of 2.5m is recommended but may be reduced for flatter terrain. The height of a contour line may be adjusted by up to 25% to improve the representation of a feature, provided relative height differences between closely adjacent features are maintained. If further representation is required, to indicate a definite change in gradient, for example, a form line may be used. The form line may be at any height between contours. Only one form line may be used between adjacent contours.

The map must fairly represent the terrain **as seen** from the trails and permitted access areas and, *in exceptional circumstances, non-visible features may be omitted*, if their inclusion would otherwise unacceptably distort the distances to and between features on the map.

The concept of runnability cannot apply in trail orienteering and is replaced by appearance and visibility. However, there is a close correlation between these representations and difficulties do not normally arise.

The precision with which a control flag is placed in trail orienteering may be to 1m or less. At a map scale of 1:5000 this is positioning the centre of the control circle to 0.2mm. This precision can be achieved with modern printing technology, provided the control circles are integral to the map. Therefore:

- **The control circles and courses should be integrated into the map prior to printing. Hand drawing of courses is not permitted. Overprinting of courses on already printed maps is not recommended.** ***(TG 2)***

A particular advantage of using the ISSOM map specification in trail orienteering (the example here is from WTOC 2004) is that the tracks and large paths are similarly marked. This allows the competitors to be instructed that, unless marked as no-go on the map and/or on the ground, all the brown routes may be used – **and no other path.**

If, under such arrangements, small paths form part of the course, the route is to be marked on the map with a dashed purple line in accordance with the mapping specification. The line may be interrupted where it obscures important map detail. The route is also to be marked on the ground at the path junctions and at intervals between them.

MODIFYING EXISTING MAPS

It is possible to survey and draw a new map specially for a Trail-O competition, but it is usual to modify an existing foot-O map. If an existing map is to be used for elite competition, it is essential that the detail at control sites is checked and, where necessary, modified. All maps are generalised, in that the mapped detail is a simpler, or smoother, version of the actual terrain. Foot-O maps are more generalised than those in Trail-O because the latter requires finer detail to be represented.

Many of the changes to the map will be made by the mapper without difficulty. These will be modifications to features already on the map, such as adjusting contours, removing tags from rock faces to improve clarity, and so on.

Some of the changes may be resisted by the mapper. This may occur when the changes conflict with the standard adopted across the map. For example, if the smallest boulder mapped is 1.5 m high because there are so many in the terrain, the mapper may be reluctant about specially mapping 1.0 m boulders at Trail-O control sites. The solution is to persuade the mapper that

this requirement is for is a one-off special version of the map for this competition only, and the map file can be deleted or archived after the competition.

NON-SPRINT MAPS IN TRAIL-O

Although the ISSOM 2006 specification is recommended for elite trail orienteering, maps drawn to the ISOM 2000 specification may be used provided the scale, symbol size and magnetic north line separation are changed in accordance with the guideline above ***(TG 1)***.

MAGNETIC NORTH

Since precision compass bearings (see Position Fixing in the next section) may potentially be taken at any control site, it is essential that the features at all sites are mapped so that their bearings are consistent with the magnetic north lines on the map.

Remember that quite small lateral distances in the position of an object or the point from which a bearing is taken can change the bearing by several degrees:

It is also important that magnetic north is generally correct across the rest of the map used for the course. If competitors notice significant magnetic discrepancies, they may lose confidence in the map, even though the control sites which demand precision compass use may have been carefully surveyed for that purpose.

The potential for general misalignment in magnetic north has increased in recent years due to the use of maps revised from old bases and also the greatly increased rate of change of magnetic variation now occurring.

Precision compass problems, if used in course planning, should only occur sparingly. Competitors should be advised that precision compass solutions should not be attempted unless a more precise method is not apparent.

Maps in this document
The map segments in the following pages are for illustrative purposes and are modified extracts from competition maps and solution sheets. The latter show individual flag positions and a decision point. Most are at a scale of approximately 1:2500.

4. POSITION FIXING TECHNIQUES

There are several position fixing techniques in elite trail orienteering. Some of these are 'classic' orienteering techniques and are labelled as such. The others are more recent developments.

Position at a mapped feature (Classic)

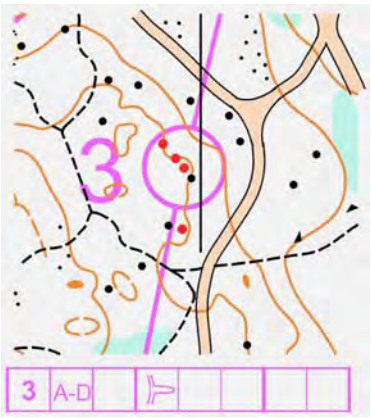
This is the basic form of precision fixing of a control position at or next to a mapped feature which can be identified in the terrain. At advanced level, identification may be more difficult due to complexity and variability of the features, in that some are mapped and some are not.

Example. A straightforward map reading exercise but complicated in the terrain by small unmapped features and visibility restricted by vegetation.

The red dots represent control flags.

Position by contouring (Classic)

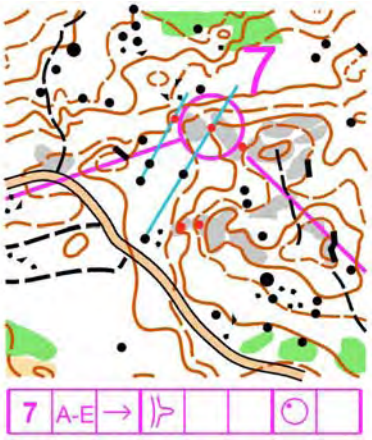
This is an advanced form of precision position-fixing which requires skill and practice. It is the tracing across the ground of a contour or form line from a selected reference point on the map. The reference point may be a feature at the same height as the contour or it may be between features at different heights. To position by contouring with accuracy needs a good sense of horizontal level in structured and sloping terrain.



Example. In this case, the contour line passes through the nearby boulder which, once identified, is a good reference point for tracing the contour across the ground. Of the two flags nearest to the boulder both were possible selections but the contour traced through one flag, with the correct flag being slightly higher up and on the centre line of the spur.

Position by sighting lines

This is an advanced form of precision fixing which can be very accurate. The technique is to identify two or more reference points on the map which line up with a feature on the map. Locating these 'leading marks' in the terrain and sighting along the line(s) between them leads to the feature. This may be the control point at the centre of the circle or another feature.



Example. The spur system lying across the control circle was stepped so that there were two separated spurs within the circle, giving the control description 'E spur, NW part'. Once the general area of the centre of the circle was identified, the boulders acting as leading marks were sighted across to identify the centre of the circle, which had a flag.

As a distractor an incorrect flag also had leading mark boulders.

Sighting lines which do not lead directly to a mapped feature can also be useful when they pass to one side of the feature. This can help with identification of the feature, aided by estimating the distance by which the line 'misses' the feature and transferring this distance to the terrain.

It is important that all features which could be reasonably used as leading marks are correctly positioned on the map.

Position by compass bearing

The standard orienteering protractor compass* may be used to transfer a direction from the map to the terrain. This is not as precise as the techniques listed above but can be useful for correctly planned control problems. It is important not to demand too high a precision, otherwise competitors would be unnecessarily encouraged to use sophisticated surveying compasses.

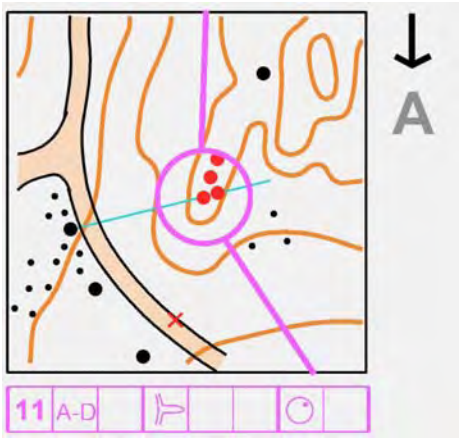
For precision compass problems, the following should be met:

Bearing estimation should not be required to better than 5^o. (TG 3)

When viewing flags from a suitable sighting point (not necessarily the same as the decision point), which can be accurately fixed on the map, the control point flag and adjacent flags shall not be less than 5^o apart in bearing.

* Wheelchair users concerned about the magnetic effect of their wheelchairs may prefer an eye-level sighting compass to take bearings.

For precision compass controls, the planner must check that the positional accuracy of features on the map must make it possible for the 5 degree requirement to be met:



Example. From the decision point (marked with x) the flags were less than 5° apart in bearing. The track junction, although at a good angle for maximising the angular separation of the flags, was too broad to act as a precise reference point. However, the nearby boulder, added as a map correction, was suitable. The bearing identified two flags but only one was on the centre line of the spur, as circled on the map.

Note. Although the competitors will take bearings using a standard compass, to minimise compound error the planner is advised to fix the flag positions using a surveying compass.

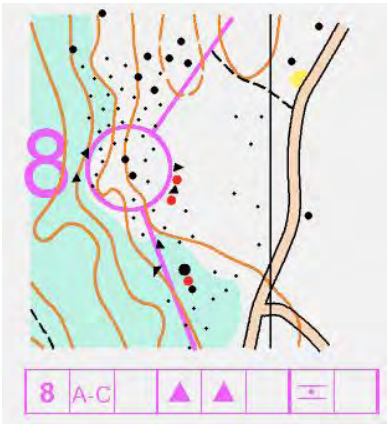
Position by distance estimation

1. Into the terrain (Classic)

The estimation of distance off the tracks into the terrain can be used in control problems to distinguish between features sufficiently separated in range. It is not a precision technique. The following rule should be observed:

Distance in range across the terrain estimated by competitors should not be required to an accuracy better than 25% (TG 4)

This figure includes any map error. For problems requiring range estimation, the map should be accurate to better than 10%.



Example. The two small, single symbols, boulder fields (ISOM 208) each contained a prominent boulder, which could be interpreted as the mapped pair with a flag between. The correct pair, unflagged, was further away at an additional distance more than 25% of the distance to the false control. The answer was 'zero'.

The range estimated answer was confirmed by reference to other features.

Estimation of distance from the observer (range) should be used with caution across ‘dead ground’. This is ground which falls out of sight for part of the distance.

2. Along the tracks

Estimation of distances across the field of view in the terrain can sometimes be achieved by measuring distance along the track and transferring this into the terrain. Distance along the tracks can be measured by pace counting or wheel turns, for those in wheel chairs, provided the track is reasonably flat and not too rough. In this case a better accuracy than by eye can be achieved. The guide is:

Distance estimation by pacing should not be required to better than 10%. (TG 5)

Example. This is a difficult contour problem solved by distance estimation. The feature was a long, low hill with its highest point offset from the centre. The length of the form line marking the upper part of the hill was measured on the map. This length was determined by pacing its distance along the track and then fitted to the hill.

The positional accuracy of features on the map must make it possible for these distance estimation requirements to be met.

Use of position-fixing problems in Planning

Whilst all the above position-fixing techniques are available to planners of elite competition, in areas of classic orienteering terrain it is expected that the ‘classic’ techniques will predominate, perhaps with some examples of the other plotting techniques to add variety and interest.

In areas with limited classic terrain detail elite competition can still be planned, but with the non-‘classic’ techniques predominating.

It is important for planners to note that competitors will consider several different (possibly all) fixing techniques in solving a control and these should

lead to the same answer. This is discussed further for planners and competitors in Section 6 *More ways than one to the solution.*

5. CONTROL SPECIFICATION

The key to all trail orienteering competition is accurately locating in the terrain the centre of the circle on the map, as described in the control description.

Since current mapping technology results in the circles on the maps being precisely located, the following IOF definitions apply:

- **The control position is defined by the centre of the circle on the map together with the control description.** ***(TG 6)***

- **The control description shall correctly describe the control position.** ***(TG 7)***

The control circles on the map are 6.0 mm in diameter. The circles are broken where essential detail would otherwise be obscured. They are also broken where adjacent control circles overlap.

If control sites are close together in very detailed areas and the above procedures give unacceptably fragmented course markings, then 4.0 mm diameter circles may be exceptionally used in the congested areas on the map. The pre-event details shall inform if this is so.

CONTROL SELECTION

At elite level the controls need to be both varied and of high quality. In general, this means the use of detailed terrain features of land form, rock, water and vegetation, as used in classic foot orienteering. Man-made features, such as buildings and fences, tend to be less acceptable, but may be used sparingly to add variety to the overall courses.

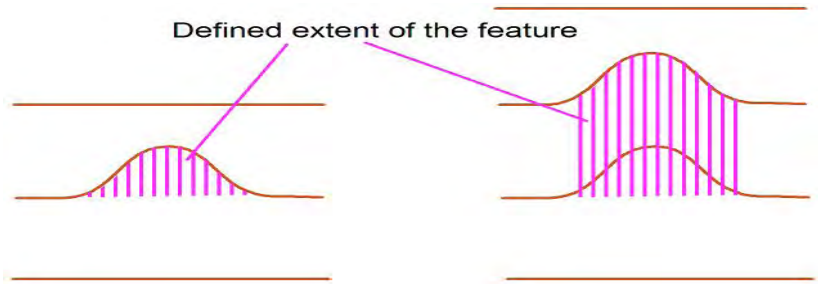
In principle, controls may be placed on, or in association with, any feature marked on the map, subject to certain constraints:

- **Given adequate visibility into the terrain, the controls may be set in accordance with accepted orienteering convention on any feature marked on the map, provided the centre of the circle can be determined by use of position-fixing techniques and the control feature can be correctly described.** ***(TG 8)***

Adequate visibility refers to being able to sight the control from the decision point and any other necessary viewing points, in particular from low level wheelchairs.

Accepted orienteering convention refers to procedures for selecting controls in trail orienteering, which are mostly derived from traditional foot orienteering convention, but with some differences. Where these conventions affect control position selection, it is necessary to understand the reasoning behind them.

The most important convention concerns contour line features, such as re-entrants and spurs. Where these are represented by a single contour the map cannot show the full extent of the feature so the convention in foot-O, accepted in Trail-O, is that the control is restricted to being within the curve of the contour. However, if the feature is represented on the map by more than one contour or form line, then there is better indication of its extent, so the area acceptable for control selection is greatly increased. These concepts are shown in the diagrams of two features, one small and the other larger:



Note that the two curved contours in the second diagram may represent two separate features, in which case the first diagram applies twice.

A convention in foot-O which does not apply in Trail-O is not using linear features that do not have a bend or corner to define position. A linear feature can be used in Trail-O because reference to other features may precisely locate a point on the linear feature. However, such problems are not often used at elite level, because higher quality problems are usually available. If not, a linear feature control can make an acceptable elite problem.

A further convention in foot-O, which does not apply in Trail-O, is, when selecting from a group of similar features, being restricted to the feature in the middle or furthermost in a specified direction. Since any one of a group may be precisely located by reference to other features in Trail-O, there is no need for such a restriction, provided the feature can be clearly identified.

CONTROL DESCRIPTION

Reference: International Specification for Control Descriptions, IOF 2004.

There are some differences in use and interpretation of control descriptions between federations. The conventions used for IOF events are as given below.
The control descriptions used in IOF trail orienteering are the same as those for foot orienteering, as given in the reference. In particular, compound

descriptions for the position of the control (Column G), which require more than one symbol are not permitted in current practice. Therefore:

- **The position of the control flag is described by a single symbol (or none) in Column G.** ***(TG 9)***

Since the development of accurate circle printing has made redundant the earlier practice of the description needing to be unique, it follows that:

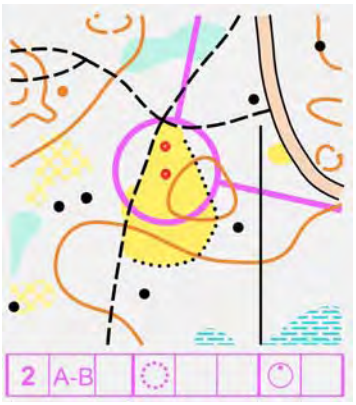
- **The control description may correctly apply to more than one flag.** ***(TG 10)***

Using precision position fixing, the control point, with or without a flag, is determined without the need for any modified interpretation of the description:

- **The convention for a direction description (such as NW part), where more than one flag fits the description, that the flag *furthermost* in that direction is the correct one does NOT apply in IOF competition.** ***(TG 11)***

Examples of the description correctly applying to more than one flag are:

1. Area feature

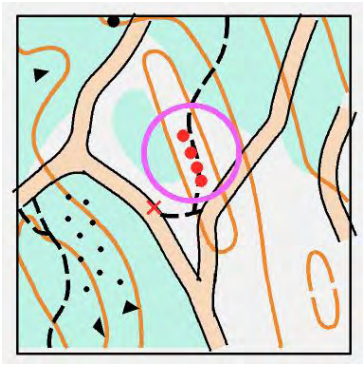


Description: '*Clearing N part*'.

The red dots show the position of the two flags. Both flags fit that description, but the circle is centred on the southern of the two, and fixed by reference to other features.

The low hill draws attention to the correct flag but it can be precisely fixed by sighting lines from two pairs of boulders.

2. Extended linear (or narrow area) feature



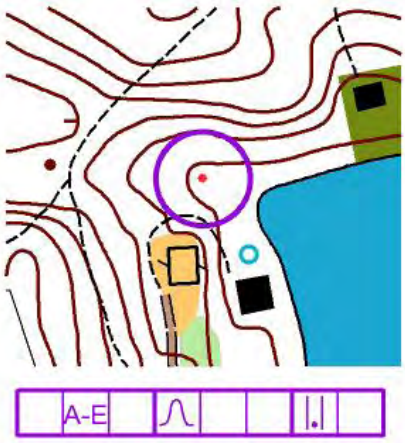
Description: '*Hill*'

At first sight the two middle flags fit the description, which is the centre of the hill. This could not be easily identified in the terrain because of restricted visibility. However, precision compass from the path junction to the west clearly indicated the required flag, confirmed by sighting along the hill as being on the W side of the path.
Difficulties can arise with describing control positions with respect to contour features (particularly re-entrants and spurs)

where the contour lines, as discussed above, do not represent the limits of the feature, although they may appear to do so on the map. The following procedure should be observed:

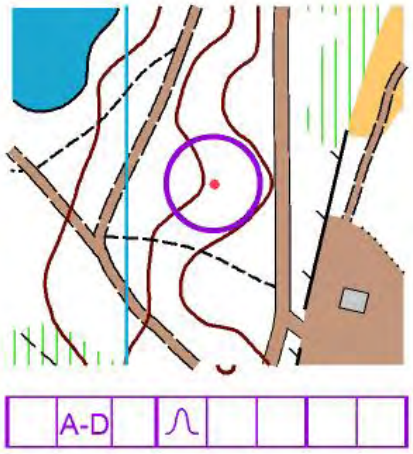
- **The description should take note of the visible extent of the feature in the terrain as well as its representation within the circle on the map.** ***(TG 12)***

This may be seen in the following examples:

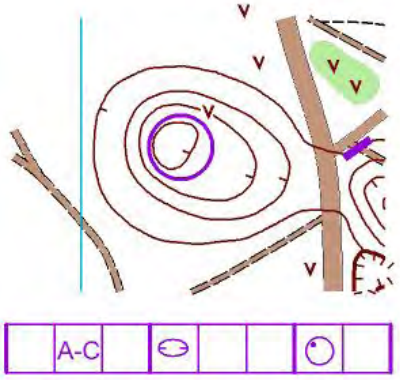


If the terrain shows, as the map suggests, a continuous single re-entrant, with no steps in the slope, extending across more than one contour line, although only one is within the circle, the correct description is ‘re-entrant, lower part’.

The direction description ‘eastern part’ does not apply in this example because the control is on the centre line of the re-entrant (See later detailed example)



In this second example, the control circle is centred above the contour line. However, if, as the map suggests, the re-entrant is continuous, extending further uphill, without steps, then the control position is valid and correctly described as ‘re-entrant’.



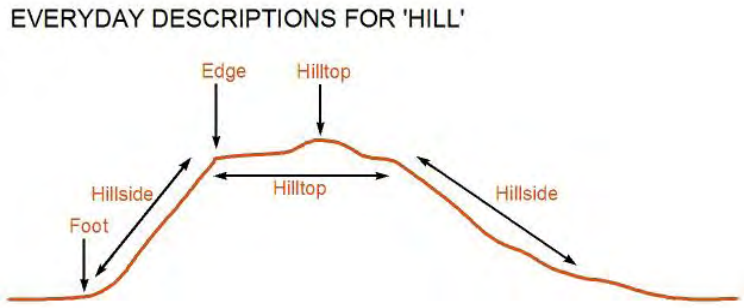
In this example of a very large and deep depression the control point is in the SE part of the ring contour within the circle. However, taking note of the full extent of the feature on the map and in the terrain, the correct description is ‘Large depression, NW part’.

Similar convention applies to hills with several contour rings.

THE POSITION OF THE FLAG (COLUMN G DESCRIPTION)

The placing of flags and the description of their positions has developed into a precise set of terms, which needs careful understanding to avoid confusion with the general, less precise usage in everyday English.

In particular, the differences between the everyday descriptions of hill features and orienteering terms could lead to confusion:



- In everyday English usage the ‘side’ of a hill is commonly understood to be all of the slope between top and bottom and the ‘edge’ of a hill, if existing, is considered to be a sharp change in gradient at the top part. Neither term is used for hill features in orienteering.

- Additionally a description also cannot be used in situations where it has two meanings. For example, the ‘top’ of a hill in everyday English can mean both the uppermost area of the hill and its highest point. The term ‘top’ is avoided for hills in orienteering.

- In the diagram above, the only orienteering description which agrees with everyday use is **foot**. Elsewhere on the hill the orienteering description **part** is used (except for no Column G description, which is the centre of the hill).

So we have the following conventions in trail orienteering:

DEFINITION OF DESCRIPTIONS USED IN COLUMN G

(**Blank/None**) – used for the middle of the feature. Additionally for rock faces, it means the foot.

SIDE – Used for features which rise up sharply from the ground (such as building, boulder, wall). The flag is positioned as close to the side of the feature as can be achieved.

FOOT – Used for the edges of features which rise less steeply from the ground (such as hill, knoll, spur). The flag is positioned, as best as can be judged, at the junction of the slope of the feature and the surrounding terrain.

EDGE – used for the edges of features at ground level (such as marsh, clearing) and those below ground level (such as depression). If the edge of a feature cannot be precisely fixed, the use of 'part' is preferred.

PART – used for any part of an area or linear feature which is not the centre or the edge or an end.

TOP – used for features where the normal flag position is at the base of the feature, e.g. rock face.

BETWEEN – used for the mid-point between the shortest distance between the edges of two features.

UPPER/LOWER – used for the upper and lower parts of the feature as existing in the terrain.

END – used to indicate the distinctive end of a linear feature. The orientation of the symbol, in one of the eight compass directions, indicates in plan view the orientation of the linear feature and its end.

BEND – used for a smooth change of direction of a linear feature.

CORNER (Inside & outside) – used for a sharp change of direction of a linear feature or the edge of an area feature. The angle enclosed by the directions each side of the corner is between 45^{o} and 135^{o}. The orientation of the symbol indicates the direction of the corner in plan view.

TIP (outside) - used for a very sharp change of direction of a linear feature or the edge of an area feature. The angle enclosed by the directions each side of the corner is less than 45^{o}. The orientation of the symbol indicates the direction of the tip in plan view.

More complete definitions of these descriptions are given in the *International Specification for Control Descriptions, IOF 2004.*

Use of these descriptions is illustrated in the following section and plan view diagrams.

EXAMPLES OF FLAG POSITION AND DESCRIPTION

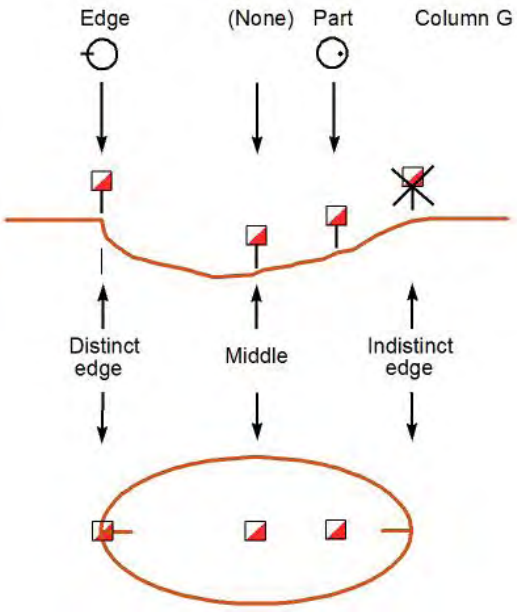
In the diagrams the sections are W to E, looking N. The plan views are conventional, with N at the top of the page. The flags indicate permitted control positions – for a zero control the flag would be absent.

Depression

If there is no description in Column G, the control flag is placed in the centre of the depression. Note that the lowest part is not necessarily the centre.

If the description is **part**, the control flag is placed sufficiently removed from the centre and the edge so as not to be confused with them, and also such that its direction can be distinguished from adjacent directions.

If there is a distinct edge, the control flag may be so placed and described as **edge.** Again, its direction must be clearly distinguishable from adjacent directions.



Pit

The same arrangements apply as for ‘depression’ above. Pits, having steeper sides than depressions, are more likely to have clear edges. For small pits, control flag positions are the centre and edge. For large pits the ‘part’ description may be used.

Erosion gully

A wide erosion gully can have a section across its width similar to that for a large pit and control flags may be placed across the gully in similar manner. A narrow gully, as with a narrow re-entrant (see below), has flag positions only along its centre line. However, flags may also be placed along its edge, if distinct.

Since gullies have longitudinal dimension, it is necessary to fix the control flag positions by reference to other features. Also, as gullies run down slopes, descriptions ‘upper part’ and ‘lower part’ may apply, in similar manner to re-entrants.

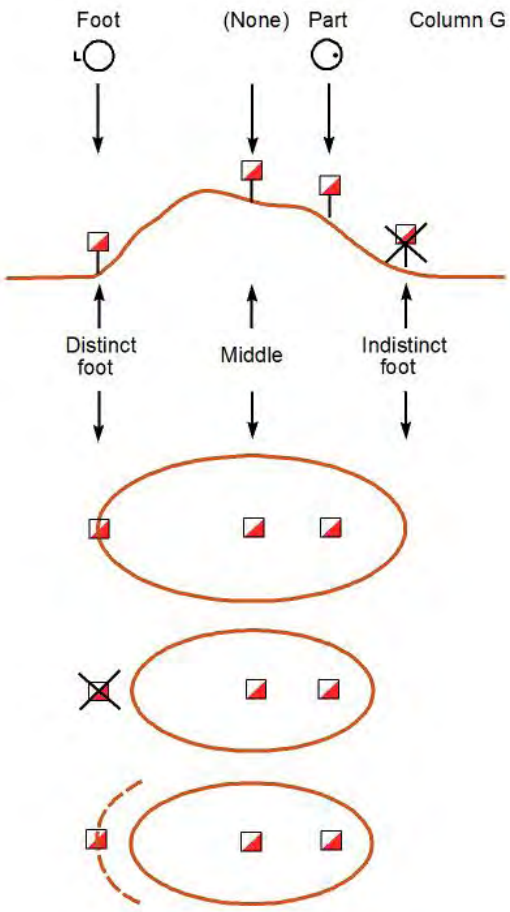
Hill

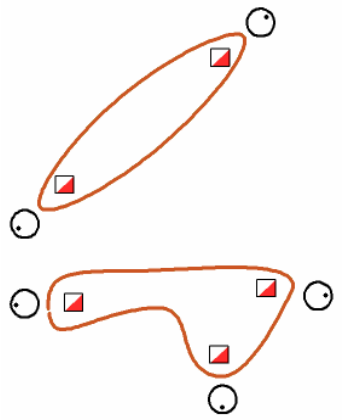
If there is no description in Column G, the control flag is placed at the centre of the hill. Note that the highest point is not necessarily at the centre. The description 'top' is not used.

If the description is **part**, the flag is placed sufficiently distant from the centre and the foot so as not to be confused with them, and also such that its direction is clear.

If the contour marks a distinct foot, the control point may be placed there and described as **foot,** with direction indication.

If the contour ring does not represent the base of the hill (as in the two lower plan views), a distinct foot may be some distance away and cannot be used as a control, unless a form line is added. The description is then either 'Hill, foot' or 'Spur, foot, depending on how the form line is drawn.





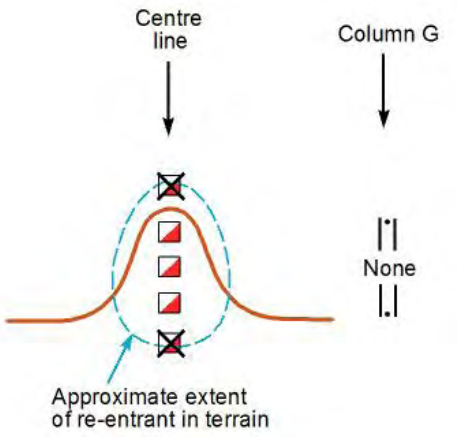
With some hill representations, such as the elongated form shown in the diagram, not all eight compass directions can be used to describe part. In this example only the NE and SW directions can be clearly identified.

In this second example of an irregularly shaped hill, the central point cannot be clearly identified. Attempting to place a flag at the central point (with no symbol in Column G) is not recommended. The description **part** may be used.

To help identify compass directions the 'tangent' method is suggested. This is bringing a line, set at 90 degrees to the required direction, towards the feature. The point at which first contact is made is the furthermost in that direction. With irregularly shaped hills, where the same part may have several direction descriptions from this method (NW, W and SW in the diagram), the description which relates best to the approximate centre of the hill (W) is to be preferred.

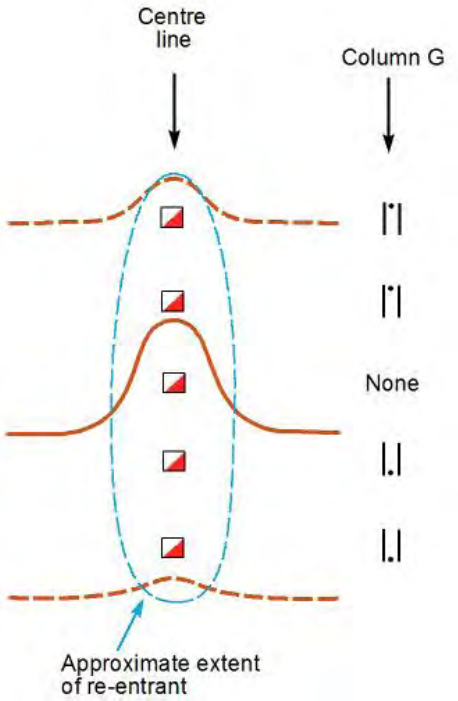
Re-entrant

The diagram shows a narrow re-entrant shown by a single contour line. Without any indication on the map of the extent of the re-entrant in the terrain, other than just this single contour, the convention is that the defined area of the re-entrant is within the curve of the contour.



Control positions may only be set within this defined area. In the first diagram the re-entrant extends little beyond the contour line and the upper and lower control positions are described as ‘Re-entrant, upper part’ and ‘Re-entrant, lower part’.

However, if the re-entrant in the terrain extends well beyond the limits of the contour line, these descriptions of the control positions within the defined area of the contour may not agree with those of the feature in the terrain.



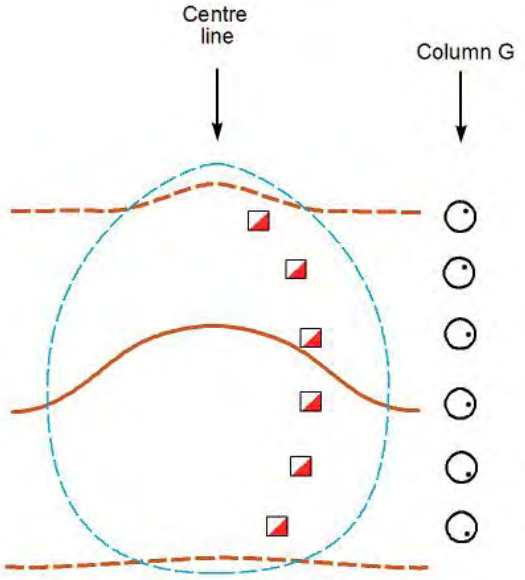
In such cases it is necessary for the extent of the re-entrant to be more fully shown on the map with more than one contour line or form lines. This allows its defined area to be greatly increased and all or most of its extent may be used for control positions and described appropriately.

The descriptions match the appearance of the feature in the terrain, not just that part within the control circle. The control description may correctly apply to more than one flag and the control point is located by reference to the contour/form lines and/or other features.

Narrow re-entrants approximate to linear features and control positions are down the centre line.

It is necessary when viewing in the terrain a re-entrant which is indicated on the map with more than one contour/form line, to determine whether the re-entrant is a single continuous feature or is stepped to give two or more separate re-entrants along the same line.

A wide re-entrant is an area feature and controls may be positioned off the centre line and given a direction description. The diagram shows control positions in the NE, E and SE parts of the re-entrant. Other positions in the NW, W and SW parts are also possible (and along the centre line).



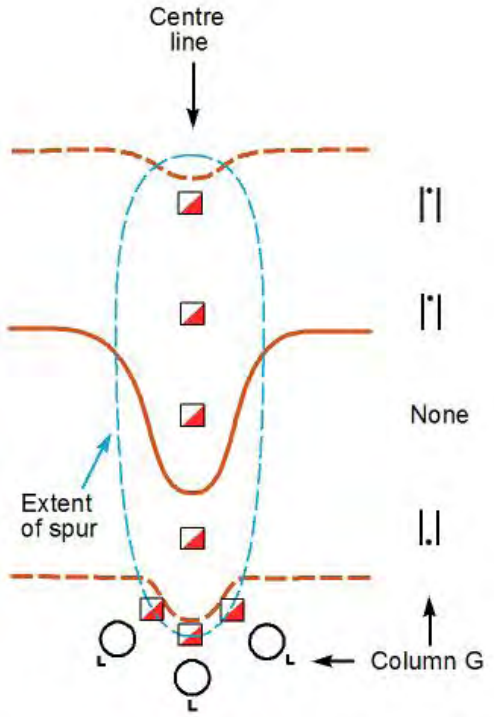
Any control position so described is permitted provided the flag is clearly within the defined extent of the re-entrant and sufficiently separated from the centre line to avoid confusion with centre line descriptions.

Again, selection of the correct flag among more than one with the same description is by reference to the contour line and/or other features.

Spur

Similar criteria apply to spurs as for re-entrants.

The diagram shows a continuous narrow spur depicted by a single contour line and two form lines. The extent of the spur in the terrain is shown by the broken blue line. The lower form line is at the foot of the spur in the terrain. The whole extent of the spur may be used for control positions, provided the form lines are on the map.



On a narrow spur the permitted control positions are down the centre line.

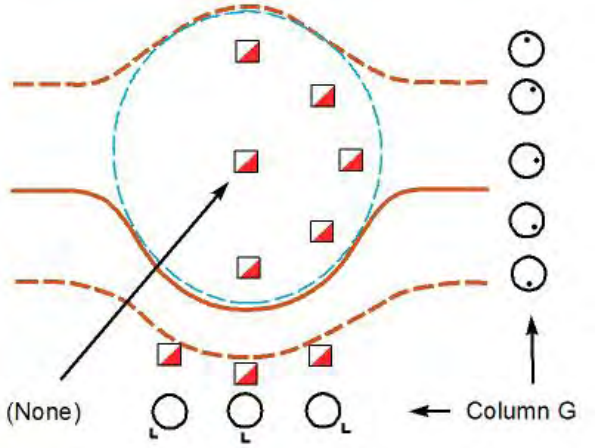
The foot of a spur refers to its furthest extension down the terrain and a number of control positions around the foot are permitted, as in the diagram. For wide spurs the same principles apply as for wide re-entrants and controls may be positioned off the centre line and given a direction description.

Since the control description may apply to more than one flag, the control point is located by reference to the contour line and/or other features.

Terrace

A terrace is an area of **flat** ground in sloping terrain. A common form arises from the excavation of material from the slope and bringing it forward to make a flat area for charcoal burning or other purposes.

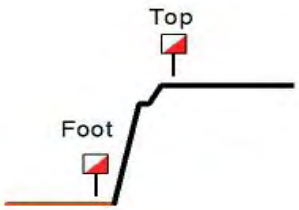
The diagram shows this form which may be regarded as a flat-topped wide spur. The lower form line shows the foot of the spur. The whole extent of the terrace may be used for control positions, provided the upper form line is on the map.



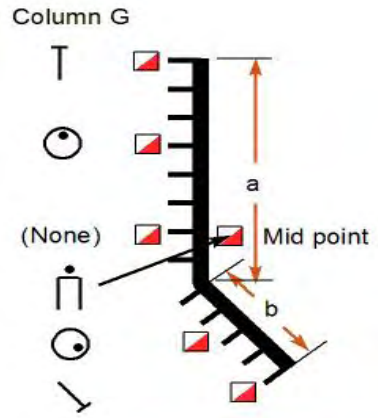
The diagram shows control flag positions in the N, NE, E, SE and S parts of the terrace. Other flag positions are possible. These have direction descriptions. The centre flag has no description.

The control flags at the foot of the spur are positioned at the foot in the terrain. This is separate from the contour line in this example which marks the edge of the flat area further up the slope. If used for a control, the foot must be marked with a form line.

Rock face



Flags at the foot of a cliff /rock face are placed as close to the foot as can be achieved. If there are difficulties in fixing the flag stakes, they may be set a short distance away from the foot but not so far as to raise the possibility of a zero answer.



The flag with no Column G description is placed at the mid-length foot. The length of the rock face includes bends and steps, if mapped. The length of the rock face in the diagram is (a + b). Minor steps and offsets, which are not mapped, are not included.

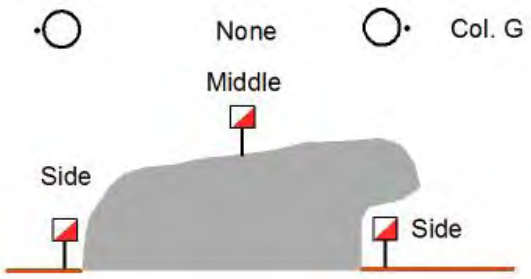
Flags may be positioned at other places along the rock face foot, and described as ‘part’ and ‘end’, provided the end is distinct.

A flag may be positioned at the rock face top at mid-length and described by the ‘top’ symbol. .

Note that, under current rules, no other flags are permitted along the top of the rock face, because double descriptions would be needed to identify them.

Boulder

Control flags placed around the boulder are positioned as close to the base of the boulder as possible and given a direction description.

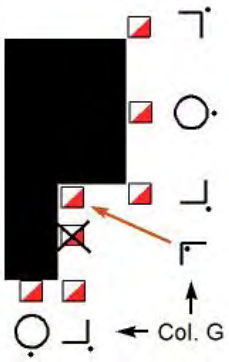


Flags are normally placed around a boulder but may be positioned on the boulder. A flag placed on a boulder in the middle position has no Column G description. For very large boulders the description ‘part’ may be used.

If the upper part of a boulder, above flag height, projects further than its base, the projecting part is ignored for ‘side’ controls.

Building

Control flags may be placed round the foot of a building at the mid-length of a projecting side (i.e. that which is furthest in a given direction) or at outside and inside corners. The descriptions are ‘side’ and ‘corner’.

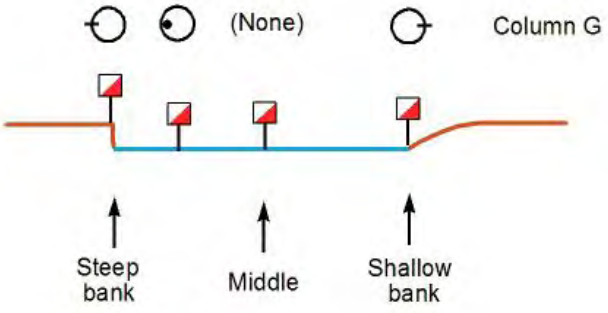


In the diagram the two faces of the building forming the inset cannot be described and therefore cannot be used, apart from the inner corner.

Where an upper part of a building projects further than its foot, the projecting part is ignored (as with boulder).

Watercourse

If Column G is blank, the control flag position is in the centre of the watercourse.



If the watercourse is wide, other flag positions within the watercourse are possible and the description ‘part’ in a given direction applies.

Control positions at the water edge are also possible. If the bank is at a shallow angle, the flag may be placed exactly at the water edge. If the bank is vertical so that the flag cannot be placed at the water edge, it may be placed at the top of the bank, as close as possible to the edge.

An advantage of using the top of a steep bank is that this flag position and description does not change if the water level rises and falls significantly.

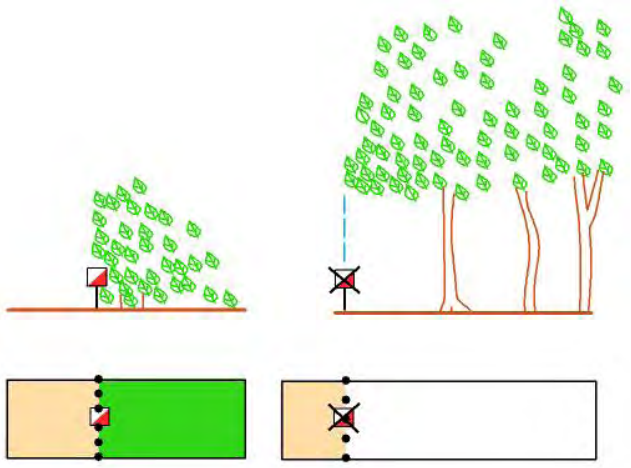
Since a watercourse has linear dimension, unless at a precisely positioned irregularity, the flag positions have to be determined by reference to other features.

Vegetation boundary

Care needs to be taken with vegetation boundaries. A distinct vegetation boundary, such as a forest edge adjacent to open land or an obvious change within the forest from broadleaf to coniferous trees, is mapped, according to IOF practice, in aerial plan view. The boundary at ground level is located directly under the edge or meeting of the canopy vegetation.

Use of such a vegetation boundary in elite trail orienteering is not recommended because of difficulties in fixing the line of the vegetation boundary on the ground, particularly with the high canopies of mature trees. Even if the canopy is low, as in the second diagram, it may not be possible for sufficient sighting possibilities along and across the boundary to fix the control position precisely. Exceptionally, if these possibilities do exist, such a vegetation boundary problem may be considered.

On the other hand, when the vegetation extends to the ground or almost to the ground, as in the first diagram, there is no difficulty.

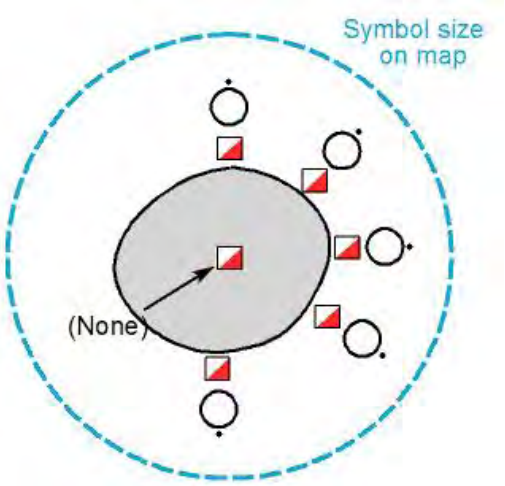


Since the vegetation boundary is a linear feature, unless placed at a bend or corner, the control position has to be fixed by reference to other features.

Point features

These are 'small' features where the size of the symbol on the map represents a greater area than the actual dimension of the feature in the terrain. Examples are boulders, knolls and small depressions/pits. Note that even the small distinct boulder symbol (ISOM 206) is equivalent to a diameter of 6 m on the ground!

Where there is no Column G description, the control flag is at the centre of the feature.

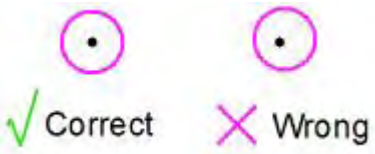


Otherwise the flags are positioned round the feature, as partly illustrated in the diagram, using direction descriptions as follows:

- Boulder - 'side'
- Knoll - 'foot'
- Pit - 'edge'

Since the map symbol is larger than the feature, positioning the centre of the circle on the control position cannot be precise. The convention in Trail-O is that, with point features, the circle is centred on the feature symbol and not offset in the direction of a flag which is on the side or edge of the feature.

Here is an example with a Boulder NE side control:



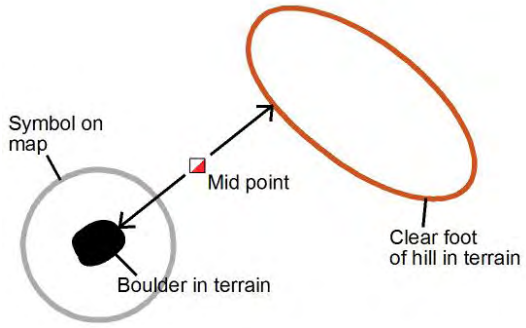
Between

The 'between' description refers to the mid point of the shortest imaginary line joining the 'edges' of two features (**not the centres**).

When setting 'between' problems using contour line and/or form line features, it is important to check that the contours and form lines on the map have been drawn to represent the actual edge and foot of the features. If necessary, form lines must be added to define the edges.

In the case of point features, such as boulders and knolls, whose map symbols are larger than the objects they are depicting, the actual edges of the features in the terrain are used in defining the separating distance.

Example: Between the boulder and hill:



Other positions along the line requiring two Column G symbols (such as 'Between, NE part') are not permitted at this time. However, controls may be sited at the ends of the line and described in association with the adjacent feature (e.g. Boulder, NE side).

DESCRIPTIONS – GOOD PRACTICE

In general, descriptions should not be more detailed than is necessary for the viewing of the problem from the decision point.

It is possible for some controls to have more than one valid description. Where one description is preferred, it should be used, but the others are acceptable and do not invalidate the control.

It is also reasonable practice to allow some latitude in descriptions, where this does not critically affect the identification of the correct flag. The essentials of good trail orienteering are skilful map reading and terrain interpretation, and not over-precision in control description.

Where misdescription of a control in competition is thought to be critical in the solution of a problem, this can be tested by the complaints and protest procedures. But, particularly, for features mapped to scale:

- **A control flag which is correctly placed in accordance with the centre of the circle on the map, but wrongly described, must NOT result in a zero answer.** ***(TG 13)***

For point features, the absence of a flag at the described position can give a valid zero answer.

6. OTHER TECHNICAL CONSIDERATIONS

Teamwork

The National Controller and IOF Event Adviser at WTOC (and similar officials at other elite events) need to work with the Planner(s) and Mapper to produce unambiguous control problems of high quality. The careful double-checking of every problem is essential for the success of the event.

Experience has shown that, if there is even a small mistake in the control setting or something that could be misinterpreted, several competitors will be misled and select the wrong answer. These competitors may then argue that the control be voided (see later in this section)

This section contains advice on how to avoid such difficulties.

How long is the course and what time is allowed?

The target time for elite competition is between 1½ and 2½ hours.

The time allowed depends on the number of controls and the length of the course. The Rules give a simple base formula for a course which is reasonably flat and well surfaced:

Time required = 3 min per control + 3 min per 100 m

If the course is considered to have additional climb over normal practice, an allowance of 3 minutes per 10 metres of additional climb may be added.

Example: 2 km course with 18 controls and 30m of additional climb

Time = (3 x 18) + (3 x 2000/100) + (3 x 30/10)

= 54 + 60 + 9 = 123 min

There may be other reasons for increasing the allowed time.

The Event Advisor has the authority to make such allowances.

The target time should be set to a rounded figure which facilitates the competitors' calculations of their remaining times. For example, the 123 min noted above should be rounded to 120 min.

More ways than one to the solution

Section 4 listed a number of position-fixing techniques. When a control problem is designed, there can be an intended best method of solution.

It may be that, of a number of alternative methods of solution, others have **equal or close merit**. It is important that the second or any other method of solution that is a valid way of arriving at the answer is checked for consistency with the intended method.

It is not realistic to expect maps in which every feature is perfectly represented in exactly its correct position with respect to all the other features. However, the main features which could be used for valid solutions of each problem must be correctly related to each other.

It is the responsibility of the planner to check that:

- **If there is more than one valid way to solve a control problem, all should give the same answer.** ***(TG 14)***

The competitor, when considering various methods of solution to a control problem, may not be aware that there is an intended best solution and will think about using all the methods. But they do not have equal importance in identifying the exact centre of the control circle in the terrain.

The most accurate position fixing is associated with those features on the map which in themselves, or combined with the description, lead to a precise point. These are the point features, the small features mapped to scale and precise parts of larger features. Examples are: boulder (with direction description), rock face (mid point foot) and forest corner.

Almost as accurate is position fixing by sighting lines. Although potentially very accurate, as when viewing across a pair of boulders, there are difficulties when using trees as leading marks and allowance has to be made for viewing to one side. The technique can also be sensitive to mapping errors. If the point to be identified is beyond the leading marks (extrapolation), then error in mapped position of the leading marks is increased. If the point is between the leading marks (interpolation), any such error is reduced. At any given control site there may be several possible sighting lines but none of these (unless the planner has so arranged it) might pass through the control point and in each case the offset has to be estimated from the map and judged on the ground. Also, not all sighting lines have the same merit, those which intersect a linear feature at a shallow angle being least accurate.

Less accurate but with potential for precise position fixing is the use of contouring. If the contour can be located in position and height by reference to mapped features then it may be traced with confidence. If not, or if there is some difficulty in viewing the terrain, the traced contour may be subject to error.

Precision compass, despite the name, is inherently less precise for position fixing than the above techniques. If used to select which of several identical features, it can lead indirectly to a very precise position. However, if used by itself to fix a position, that position is approximate.

Distance estimation across the direction of view can be reliably done if the range is not great and/or there are visual clues for size. Least accurate is using distance estimation in range. However, this technique can again be useful is distinguishing between features at different ranges.

Elite competitors will consider all techniques in solving a control problem and, particularly if they do not all agree with each other, give priority to those likely to have resulted in the most precise and accurate answer.

After the control position as described at the centre of the circle on the map has been identified in the terrain, either precisely or approximately, the competitor can then judge whether a flag is in that position, or so near that it cannot be considered a zero control.

Zero answers

The zero answer, no marker flag at the centre of the control circle on the map, is a feature of elite trail orienteering. Its use adds an extra dimension to control problem setting but also introduces increased difficulties with marker flag placement. This is because a minor misplacement, real or imagined, of the correct marker could be interpreted as a zero answer.

The solution is to ensure that zero answers are clear. Either the centre of the circle with no flag should be clearly identifiable or the flags can be located and shown to be in positions clearly not at the circle centre.

When planning zero answer problems, a flag should be placed at the zero position to assist with the correct placement of the nearby other flags. Once these other flag positions are set, the zero flag is removed.

Unmapped and part-mapped features

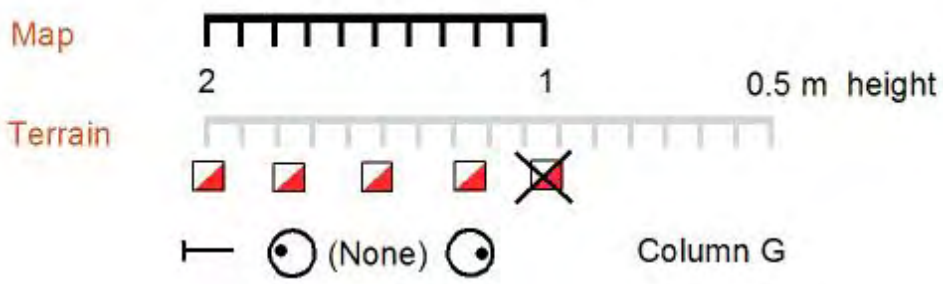
The mapping threshold for size of features for including them on the map can produce problems, especially for linear features. The minimum height or depth of features to be included on the map is given as 1m in the mapping specifications ISOM 2000 and ISSOM 2006. The mapper may choose, if the terrain has too many features for clear interpretation, to increase the threshold.

Terrain containing features where some are mapped and some are not, requires careful inspection to distinguish between them but, once this is done, there should not be too much difficulty for the competitor.

However, linear features which reduce in height can be much more problematic.

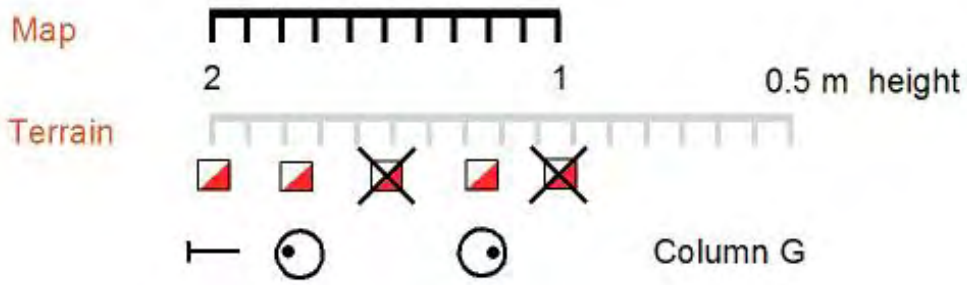
Consider the example of a rock face which is well above the mapping threshold of 1m at one end but reduces to below 1m at the other end. Only that part of the rock face which is 1m and above should be mapped. The planner needs to determine whether this is the case and confirm that a competitor viewing the rock face from a distance can correctly identify the mapped section (possibly by reference to the height of a control flag).

If the mapped end can be identified with reasonable certainty, then the following control positions are usable:



Even if the *mapped* end of the rock face is identified at 1m height, its use as a control point with the description 'end' is not recommended. However, the other flag positions, as in the diagram, are permitted. Note that the positional uncertainty of the mid-point of the mapped rock face is half that at the mapped end.

If the mapped end cannot be identified with reasonable certainty, then only the following control positions are usable:



All flags to have meaning

Do not add marker flags simply to increase numbers in order to reduce the chance of random selection being correct. At elite level flags which have no meaning are instantly rejected. Each flag used should be positioned so that it has some definite connection with the control description. The best incorrect flags are those which are right in several respects but wrong in one.

Decision point

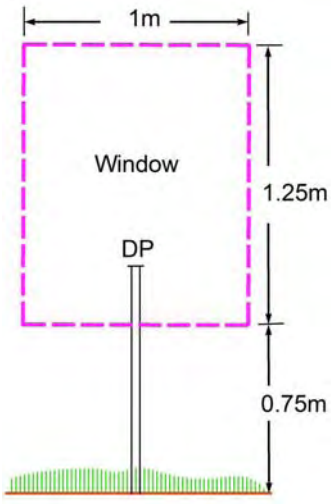
The *decision point* is the position from which all flags can be seen and the decision about which flag (A-E, or zero) marks the feature defined by the centre of the circle on the map and the control description is made. The decision point is marked with a prominent stake to be readily visible and is identified with the number of the control.

The decision point is not marked on the competition map. If there is possibility for doubt about its general location, the direction of view from the decision point towards the control may be given in Column H of the control description.

In the interests of wheelchair users, the decision point should not be located on a steep slope.

In addition to the decision point, there are other unmarked *viewing points* from which the flags can be seen and their relationship to the map and terrain determined.

The *recording point* (either a pin punch for marking a competitor's control card or electronic recorders) is sited a short distance from the decision point, and placed so that it does not interfere with the decision-making process. The recording point, which may be on either side of the track, is to be readily visible, if necessary by the addition of tapes, and numbered.



It is required to allow for several competitors, including wheelchair users, to be at the decision point at the same time. All must have reasonably equal opportunity to view the flags and the terrain, whether in a wheelchair or standing erect.

It is also required for the marker flags and decision point to be so positioned that a movement by the observer 0.5m either side of the decision point does not change the answer.

These requirements lead to a viewing window rather than a viewing point of the dimensions given in the diagram.

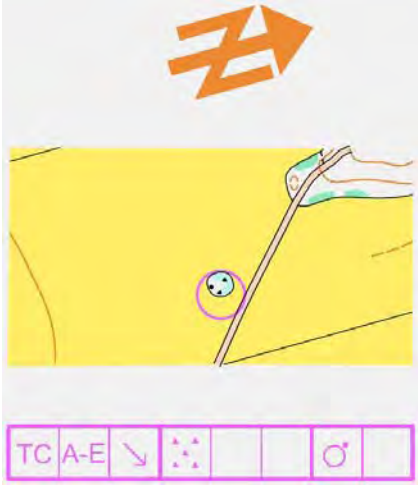
To accommodate two wheelchair competitors at the decision point at the same time, the conditions required for visibility of the flags and absence of parallax altering the flag sequence should also apply 2m back from the decision point stake.

Route choice

Most competitions are unable to offer route choice, but in those where more than one route is possible between a pair of controls, such an option could be considered by the Planner. This does not change the competitive nature of the courses but may add to their general quality.

Timed controls

For timed controls, the competitor stays in a fixed position.



The timed control map is a small segment of the competition map at the same scale, attached to a stiff board not less than A5 in size. The segment has the map circle in the lateral centre of the map and is oriented so that the direction of view to the flags is straight up the sheet. The example is from WTOC 2004. The map segment board may also carry, in suitably large size, the letters A-E.

The competitor has one minute only to give an answer, either by pointing to the chosen letter A-E or verbally using the international phonetic alphabet. A ten second warning is given at 50 seconds

The answer and times are recorded, the latter rounded back to nearest second for each of the two timing measurements.

To provide fair competition the problem should be capable of solution by all competitors in the time allowed. The best outcome for a timed control test is that all competitors give the right answer but the more skilled do so more quickly. Problems which are too difficult because of complexity or poor visibility result in guesswork and this distorts the results. Also, problems which are too easy and solved in less than 5 seconds by the fastest competitors can be subject to uncertainties in the timing procedure. The target time for the best competitors should be 10 - 15 seconds.

- **The zero answer option is not suitable for timed controls in classic trail orienteering competition.** ***(TG 15)***

Also not suitable for timed controls are those requiring precision compass.

There can be a problem with operating timed controls. This is variation of the time during which the flags at a timed control are visible to competitors before the timing starts, and this can lead to attempts to gain unfair advantage.

- The flags may be visible as the competitor moves from the call-up point to the viewing position. Screening should be considered.
- The flags are visible while the competitor is taking up position at the viewing point. The recommended action is to prevent this with a marshall standing in front of the competitor to block the view until the formal procedure begins.
- The recommended procedure is then for this marshall to step aside to reveal the flags, point out each one using the phonetic alphabet and then present the map to start timing. This procedure takes about 7 seconds.

When analysed on completion of the course the correct answer at a timed control is awarded one point and the time recorded is the average of the two measurements, to the nearest half or full second. An incorrect answer gains no point and a 60 second penalty is added to the time taken to answer.

Future development. The above procedures refer to manual timing. Currently (2009) electronic timing is being developed for trail orienteering. When approved for event use, new and revised procedures at timed controls will be issued.

Post-competition solution maps

Once the last competitor has finished and the course is closed, the solution sheets for all the controls, including time controls, may be issued. These consist either of map segments or the map of all of the competition area, at enlarged scale (usually twice competition scale) showing the decision points and positions of the flags at each control, which of the flags is correct or, for zero answers, the unflagged centre of the circle. Also included is the description for each control.

It is important that the solution sheet mapping agrees exactly with the competition map. Late changes to the competition map which are not replicated in the solution maps produce difficulties and invite dissension (see the next section).
A recommended procedure for mapping flag positions is to generate special symbols on the competition map, which can be used in the terrain at greatly

enlarged scale for fine tuning of the control and flag positions. On completion of the planning process the map segments are cut and pasted for making up the solution sheets. Before printing the competition map the special symbols are hidden.

Disagreements, Complaints and Protests

"Trail orienteering is a platform for dissent" (the late Peter Palmer)

Disagreement is a normal condition in trail orienteering. This is to be expected in a discipline, which uses subjective judgment and shades of meaning. To the credit of trail orienteers it is normal for differences to be settled by the opinion of the Event Advisor. Although complaints are submitted from time to time for consideration by the officials, it is rare for any to be raised to the level of protest.

Sometimes the validity of a control needs to be re-examined after it has been questioned by competitors or officials. If it is faulty, there is the option of advising the Organiser to void the control. Unlike in Foot-O this can be done without voiding the whole course.

However, the procedure for voiding a control should be undertaken with great care. If it is decided to void a control, on the grounds that the control is unfair, this decision and the reason for it must be announced to the competitors without delay, so that they or the team managers have the opportunity to make representations.

7. PLANNING LOGISTICS

Stage 1

The first stage of planning is, for each terrain area proposed, to identify possible routes of acceptable quality and length and to located within them a suitable number of potentially usable control sites. Outline proposals for assembly, start, finish and timed controls will also need to be considered at this time.

The first stage is best done when the visibility is good, not necessarily at the time of year of the competition. There is the possibility that seasonal vegetation can be cut, if necessary, to give acceptable visibility round the control sites. However, it should be confirmed, by visiting at the correct time of the year, that seasonal vegetation does not make the area unusable.

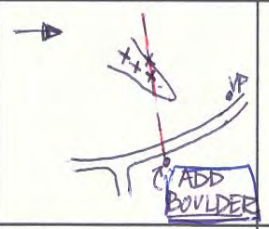
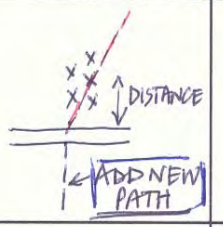
Stage 2

The second stage is to work on each proposed site in some detail, using flags, to develop a problem of good standard. The map needs to be sufficiently prepared to permit outline planning. The positions of the key flags and the viewing point are marked in the terrain.

This stage needs to be completed for the visit of the IOF Event Adviser(s) at **12 months before the event**. The purpose of this visit, within the competition terrain, is to approve the courses and the main details of the control sites (including reserve sites). At this time, map corrections which would be essential to the solution of the problem are identified.

The information relating to the control sites is marked on a planning/controlling sheet. An example of part of the IOF Event Adviser's notes at WTOC 2004 is:

WTOC 2004 PLANNING Competition ..... DAY 1 .....

No	A-?	Which feature	Feature	Sketch	Flag Posn	Notes	Ans
11	A-D		Spur			BEARINGS FROM NEW BOULDER (65°) 59° 54° GIVES 2 FLAGS BUT FURTHER FLAG OFF CENTRE OF SPUR	A
12	A-E					ALL FLAGS ON MARSH NW PART ONLY ONE ON BEARING AT RIGHT DISTANCE	D

Stage 3

The third stage is to revisit each control site for detailed final planning. For this, enlarged segments of the map are used to plot in the flag positions. The positions are marked in the terrain.

This stage is to be complete for the IOF EA visit at **3 months before the event**. The objective during this visit is to confirm and approve:

- the overall structure of each course, the distance and time allowed;
- the standard and range of problems set;

- the exact positioning of flags at each control site and on the map segments for solution sheets;
- the description of each control;
- the map content (subject to further corrections identified);
- timed control procedures;
- And other essentials.

For this stage, a more detailed control quality check sheet is useful:

Day __ Control ___		√
Part of competition map	**Map analysis around control** 1. All features on map identified in terrain 2. Features correctly positioned relative to each other 3. Features drawn with correct symbols 4. Map correction required?	
Part of solution sheet map	**Control analysis: position by** **Mapped feature** • Confirm correct feature • Confirm control flag position (including zero) **Contouring** • Confirm height (altitude) of control feature • Confirm reference point from which contour line can be traced **Leading lines** • Possible lines on map numbered and checked in terrain • All lines support right answer **Compass bearing** • All bearings numbered, checked and values recorded • Bearing separation guideline obeyed **Distance estimation** • All relevant distances numbered, checked and values recorded • Distance 25% guideline obeyed **Other flags** • All non-control flag positions sensible • All flag positions marked for efficient relocation	
Description	**Control description** 1. Conforms to rules and guidelines 2. Agrees with centre of circle 3. No better description possible	

A complete example of the use of this control quality check sheet is given in Appendix 2.

Stage 4

This is the final check, immediately before the event. Checking should begin not later than the number of days before the Model event equal to the number of days of competition, including the Model. With the format of one model, plus two days of championship competition, three days should be set aside for checking, This includes the competition map, the solution map, each control site with flags in position, and its decision point. The visibility of the flags and terrain from the decision point and any other essential viewing point needs to be confirmed as satisfactory for wheelchair contestants and any necessary vegetation cutting be carried out. Also confirmed at this time is the location and visibility of each punch, together with tapes within the course and the pre-start, post-finish and timed controls arrangements.

The reason for complete and careful checking of all aspects of each competition several days in advance is that experience has shown that errors or omissions are always found at this stage, despite very careful preparation. If found two days or so before the competition, there is time to put them right. With this schedule there is also time to defer the printing of the competition maps and solution sheets until the checking is complete, in case emergency changes have to be made, despite it being common knowledge that late changes can generate mistakes (such as differences between the competition map and the map segments on the solution sheets) and should be avoided.

For an international event the Planner will visit the terrain very many times, the Controller will visit many times. The IOF Event Advisor and/or the Assistant Advisor will normally visit three times, a preliminary visit to confirm the suitability of the terrain(s) and deliver any technical training necessary, and visits at one year and at three months before the event. At the one year visit the planning proposals should be complete so that the courses can be approved and map corrections identified. At the three months visit the final courses, the detailed flag positions and maps (including the solution sheets) are confirmed.

Mechanical aids for flag placement

The method of marking the positions of flags by tag or tape is commonly used but can lead to unnecessary difficulties. With multi-day events, such as the world championships, there are very many flags to be placed in position in a very short time. It is essential that the flags are installed in exactly the positions agreed in the final controlling session. This means locating each tag and searching for the hole made earlier. More often than not, the hole is not found and the flag stake/rod has to be driven in afresh. All this takes time.

A much improved method is to use plastic or metal tubing driven into the ground and left in position. With metal rods for holding the flags, these are dropped into the tubes, taking just a few seconds for each. The savings in time and the certainty that the flags are in the correct positions are invaluable.

A particularly useful version of this method with a tube flanged at one end and closed to a point at the other is used in Scandinavia.

8. DOCUMENTATION

This guideline documentation was prepared by Brian-Henry Parker (GBR) for the IOF Trail Orienteering Commission with input from members of the Trail Orienteering Commission, Rules Commission, Mapping Commission and other trail orienteers. In particular, the valued contribution of Owe Fredholm (SWE), Hannu Niemi (FIN) and Jari Turto (FIN) is readily acknowledged.

This document (V4-2, January 2009) is the first reissue of the original release of July 2008.

Much useful material is available from the IOF web site www.orienteering.org and the Trail-O web site www.trailo.org

From www.trailo.org can be accessed notes from technical clinics and much other valuable material, including the Nordic guidelines (in English).

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APPENDIX 1

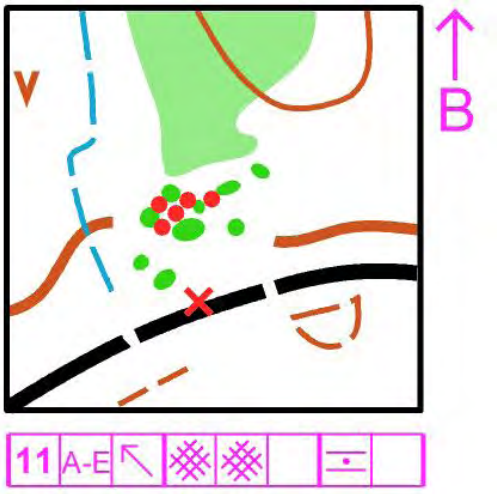
PLANNING EXAMPLES for ELITE TRAIL-O

There is a wide range of different problems, which can be set by Trail-O planners to give Elite Trail-O competitors the necessary variety and technical level of challenge.

The examples given here are from World Championship events and will be added to in due course. Submissions of good WTOC examples for possible inclusion in later editions of this Appendix are welcomed.

Between

The mid point may be easily determined between features with clear sides and, in such cases, the degree of difficulty of the 'between' problem is increased by setting it in a cluster of features, some mapped and some not.



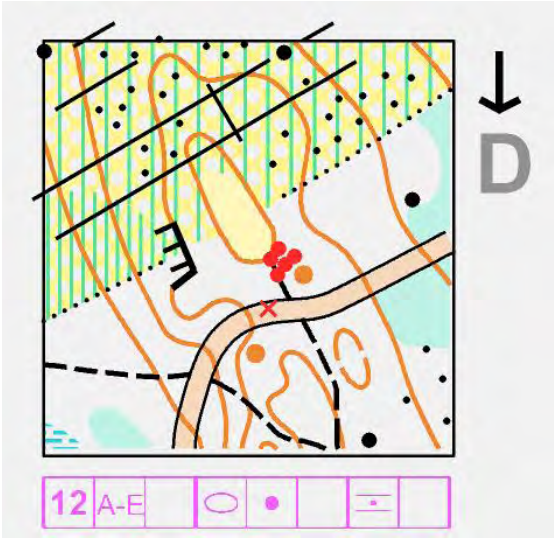
Example: WTOC 2005, Japan, Day 2-11.

Here there were a large number of small thickets. All the flags were set at mid points between pairs of thickets. The correct pair could be identified by the centre of the circle on the map and by the control description referring to the NW pair. Carefully checking which thicket was which led to the correct flag.

The 'between' problem is much more difficult with contour line features, as in this example.

Example: WTOC 2004, Sweden, Day 2-12.

The difficulty here is in identifying exactly where the contour line was with respect to the ground. In this case the contour coincided with the open yellow. This indistinct vegetation change helped to locate the contour line. The dot knoll had a reasonably clear foot so it was



possible to determine that flag D was at or very close to the mid point of the line from the knoll to the nearest part of the ring contour.

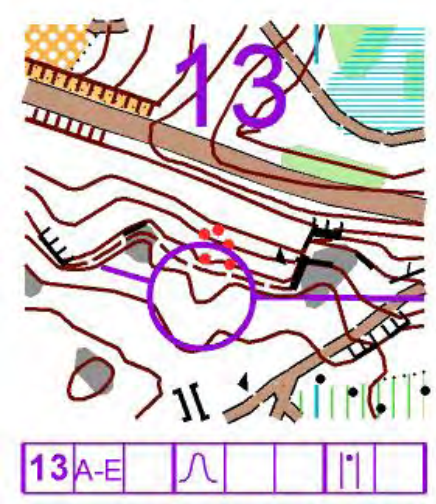
Invisible features

Features (such as pits) which cannot be seen from the viewing point or any other permitted position can be used in elite competition but with very great care. If nearby visible features can be used to locate the flags with the necessary precision, the problem may be acceptable.

A more straightforward option for using an invisible feature is the zero answer in which all the flags are clearly identifiable on other features, as with the following example:

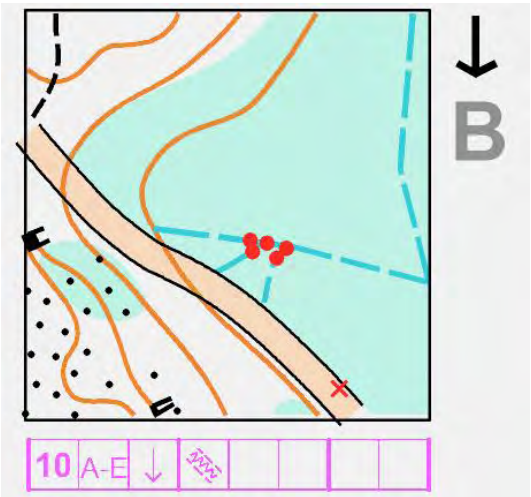
Example: WTOC 2006, Finland,
Day 2-13,

The re-entrant could not be seen from the road but, if its position was correctly judged, and not confused with the small, shallow re-entrant down slope, the existence of the five flags in incorrect positions leads to the zero answer.



Partly-invisible features

Features (such as ditches and paths) which cannot be seen from the viewing point but **are** visible from other points along the track can be used for legitimate and testing problems.



Example: WTOC 2004, Sweden
Day 2-10

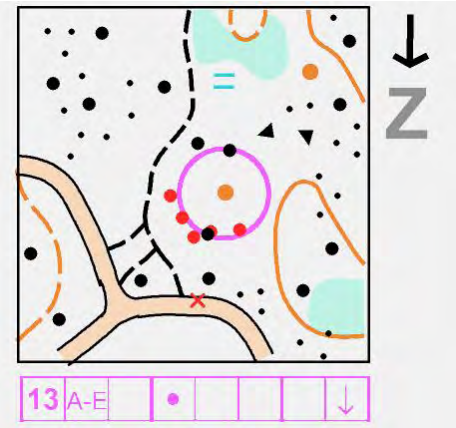
None of the ditches were visible from the viewing point. However, each ditch was visible when viewed along its length. By sighting along the three ditches in turn, it was seen that all flags were marking ditches and the correct flag, just east of the E ditch junction could be identified.

Unmapped features

The use of unmapped features can provide useful problems. These features are legitimately unmapped because they fall below the mapping threshold that the surveyor has set, but there is potential for confusion with similar features which are prominent enough to be mapped. Perhaps the most common, but usable feature, is the small boulder, but there are other possibilities.

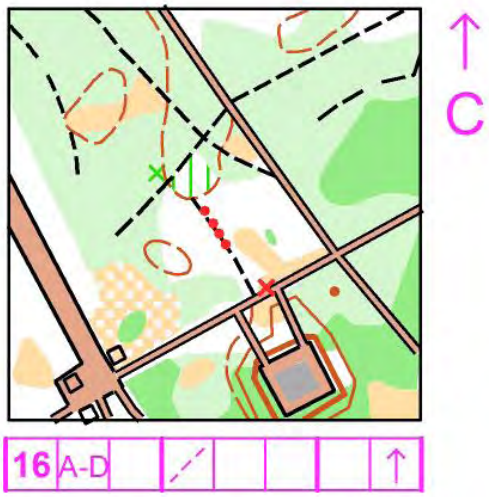
Example: WTOC 2004, Sweden
Day 2-13

This was a particularly testing control. Three flags were on unmapped knolls, one on a mapped boulder and another on an unmapped boulder. Visibility was restricted, even after some clearance work but a good line of sight from the viewing point with estimated bearing and distance showed a good knoll with no flag.



Sighting lines

A single sighting line can be used to fix a point on a linear feature and two such lines intersect to fix a point in an area feature. In both cases the intersecting angle should be sufficiently large to give accurate setting (90 degrees being the optimum). Shallower intersecting will need greater angular separation of the flags.



Example: WTOC 2007, Ukraine
Day 1-16

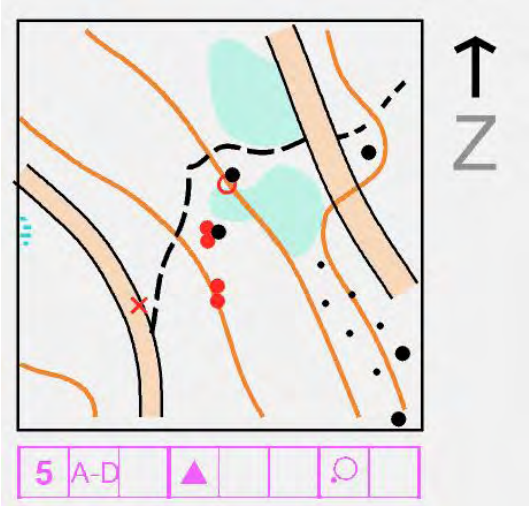
The flags along the path were too close in distance to estimate the position of the correct one. This was fixed by a sighting line from the first small path/ brown path junction north of the viewing point and the centre of the small hill.

Displaced similar features

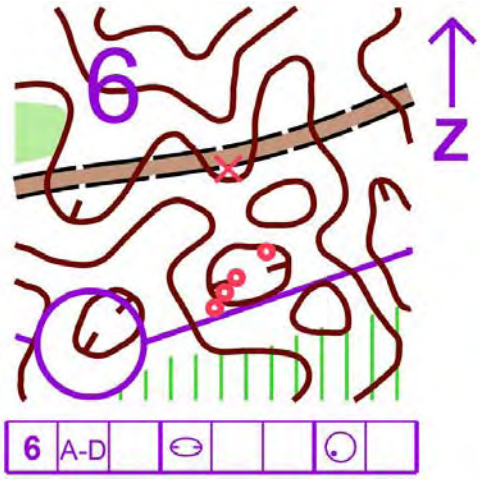
The existence of two or more displaced or **parallel** similar features can be used to set testing problems. The intention is invite misidentification of which feature is which. These normally are set to give a zero result, the correct feature being unmarked with the parallel feature(s) being flagged.

Example: WTOC 2004, Sweden, Day1-5,

The southern pair of flags was on an unmapped (undersize) boulder. The northern boulder was not visible from the viewing point, being hidden by the thicket, but could be seen from further along the track. Careful map reading of the thicket and small path confirmed the boulder to be at the centre of the circle and unflagged (marked o)



A much more difficult version of the parallel feature(s) problem is met when the general features along the track are broad and repetitive and do not permit easy location. In such circumstances it is easy to be misled by the false control, with flags set so as to appear as a problem requiring very careful analysis, as in the following example:



Example: WTOC 2006, Finland Day 1-6

The approach from the west had a number of repetitions of the re-entrant and spur combinations, all with pockets of denser vegetation on the north side of the track. The false depression was surrounded by higher ground which, at first sight, matched that mapped round the correct depression. This control needed careful back-checking along the track to confirm its true position.

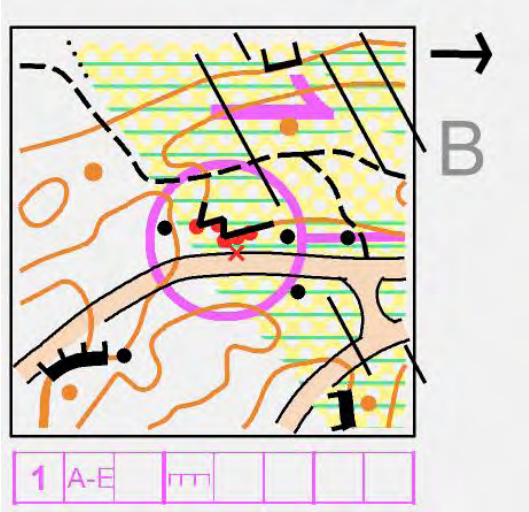
Irregular rock face

The mid point foot of a rock face is the middle of the actual **mapped** length, including changes of direction.

Example: WTOC 2004, Sweden
Day 1-1

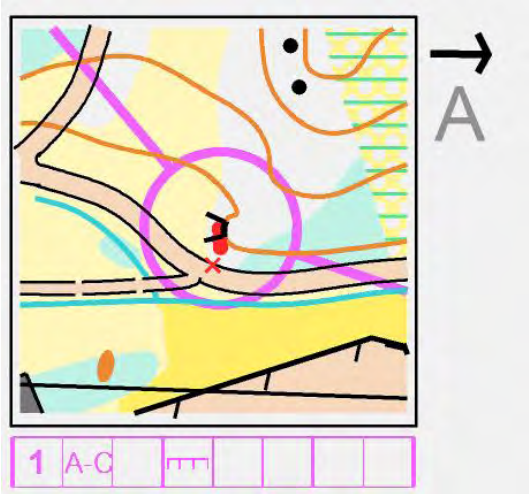
Since Column G has no description, the control is at the mid-point foot. The mid-point of the mapped feature is at the nearest SE corner. The centre of the circle precisely indicates this SE corner and eliminates the distractor flag E at the mid-point of the SE face.

This was set as an easy first control on the first day of the first world championships.

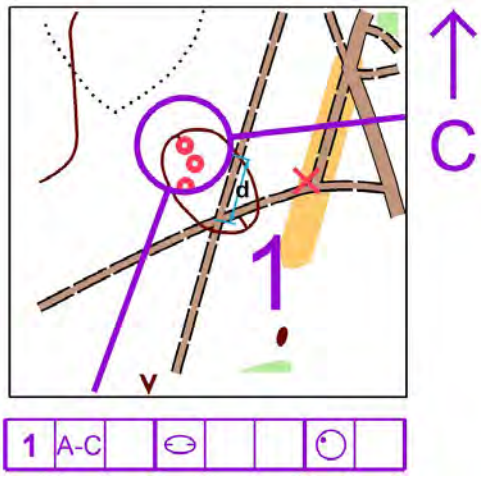


But the last control on the same day, D1-18, also a rock face, was much more difficult.

The mapped rock face was short and curved as indicated so that the western part was not visible from the viewing point, but visible on approach from the south. The rock face extended further east than as shown because this section was below the mapping threshold. Both of these character-istics gave competitors difficulty.



Contour following



Many elite problems have control positions set with respect to contour lines. These problems require the competitor to trace out a contour and relate it to the flags

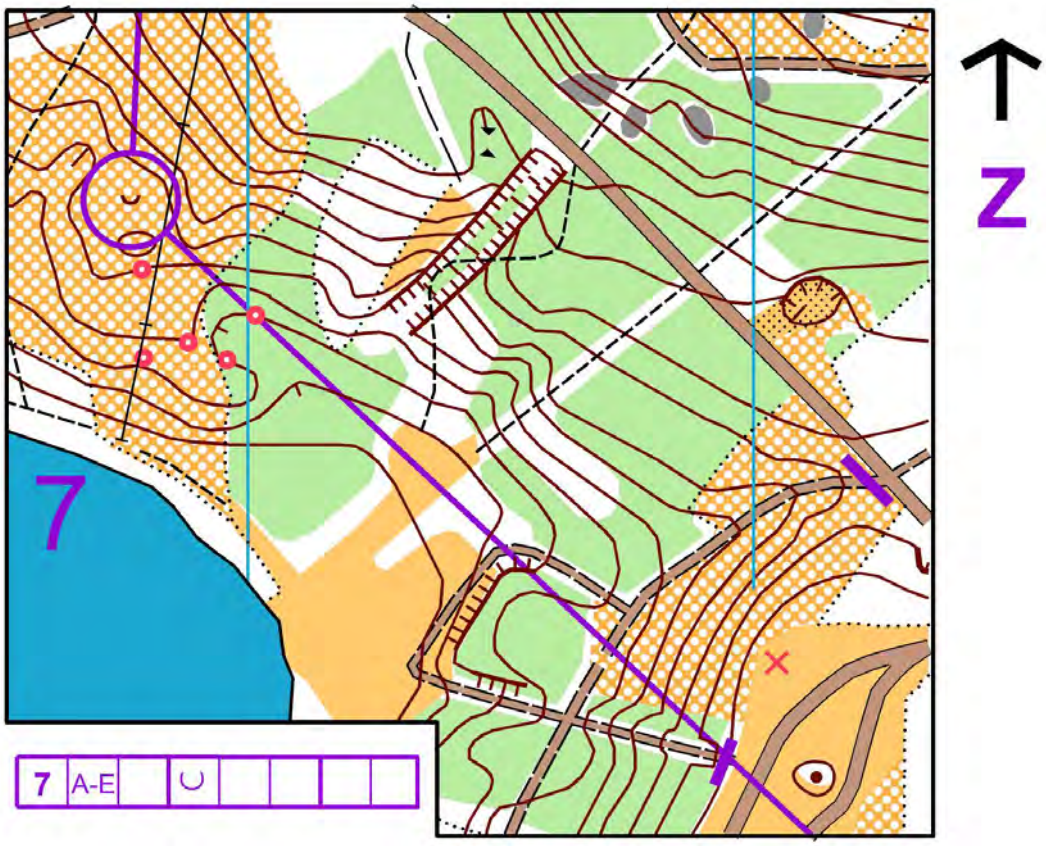
Example: WTOC 2006, Finland
Day 1-1

Compass bearings from the path crossing eliminated flag A. To determine which of the two remaining flags, or

neither, agreed with the centre of the circle, the contour had to be traced out. The point at which it crossed the northern path could be determined by judging or pacing the distance 'd'. The contour, so traced, showed flag C to be in the correct position

Long range control

These are acceptable for occasional use, provided the visibility and contrast is good (and there is no fog on the day). The following is an unusual example:



Example: WTOC 2006, Finland, Day 2 –7

This viewing distance, at 200m, was well beyond normal limits, but the viewing point was elevated, giving an overview of the distant terrain. There was good contrast so that the flags could be picked out against the rough open ground and the trees. The problem was relatively easily solved by the presumption that the small depression could not be identified at that range and, even if flagged, its position could not be confirmed with precision. Therefore the answer must be zero. This was verified by sighting the power line and noting that only one flag was beyond it, this flag being the wrong side of the hill.

Although this problem was only of moderate technical difficulty, it demonstrates that, with care, long range problems can be set up successfully.

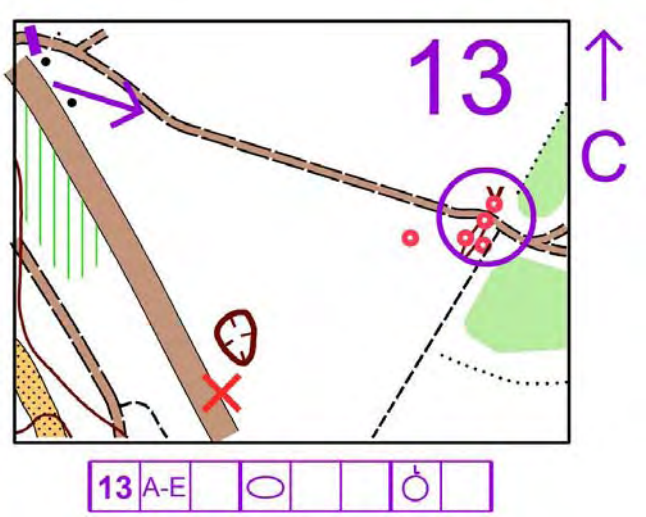
Parallax

Parallax is the 'apparent change in position of objects caused by change in position of the observer'.

This property is used in elite trail orienteering when the sighting point from which the correct flag is decided is distant from the staked viewing point and the relative sequence of the flags is different at the two points. It demands skills of identifying the same flag in the terrain when viewed from the different points, particularly when the correct flag cannot be viewed continuously when moving from the sighting point to the viewing point.

Example: WTOC 2006 Finland Day 1-13.

From the viewing point the precise positions of the two flags north of the knoll could not be seen. However, when viewed along the path (as shown by the arrow), it was possible to see that one flag was at the northern foot of the small hill. From this sighting point this was flag B. The same flag from the viewing point was flag C.



The principle of parallax can be also used to separate nearer and further features which are some distance away and tend to merge together. Viewing the features while moving along the track identifies those which are in front of the others.

Example: WTOC 2004, Sweden, Day 2-1.
This, at 125 m, was another long range control with good visibility and contrast. From a stationary position the copses merged and appeared to be at

the same distance. Moving along the track showed which were in front and which behind. Reference to the building identified the various copses.

Extrapolation

This is the extension of a linear feature, sometimes the other side of the track from control area, to fix the position of the required flag.

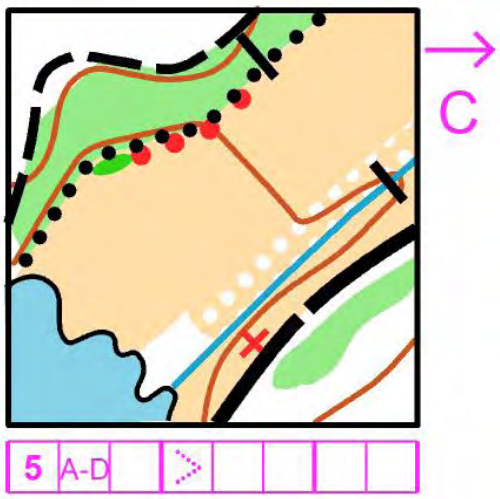
Example: WTOC 2007, Ukraine, Day 1-1.

The contour ring representing the hill had its NE end just intersecting the rough open. The remainder of the contour could then be traced at that height. This could be checked against the long diameter of the ring. The flag at the centre of the circle was just inside this contour, as required.

As a further check, the extrapolation of the line of the path on the other side of the track passes through the centre of the circle.

Precision distance estimation

Lateral distance across the terrain can be estimated accurately, provided there are mapped features at the same range that can act as a base line.

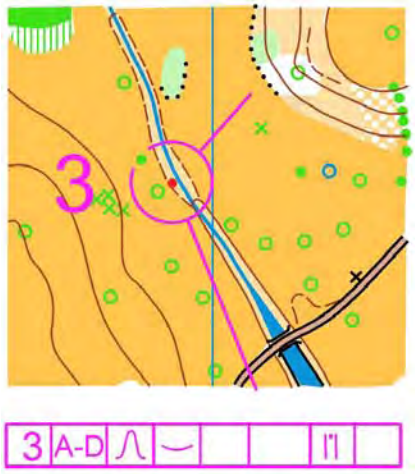


Example: WTOC 2005, Japan Day 2-5

This is a moderately easy example. The base line features across the field of view at the range of the flags are the northern end of the small thicket and the path/ vegetation boundary crossing. The control position was at the mid point between the two. A more testing problem would be use a ratio other than 50:50, perhaps 33:67.

'Linear' features

Area features defined by lines with very shallow curvature, as in the following example, may be considered as linear features.



Example: WTOC 2008, Czech Republic Day 1-3

Although the feature is a shallow re-entrant, the form line has little curvature and cannot be used to fix the centre of the circle. This was done by reference to the nearby tree and supported by a number of sighting lines passing through the circle.

Overlapping sites

This is intentional overlapping where one or more flags in adjacent control sites can be seen from the different viewing points and contribute to more than one flag grouping. It is arranged that not all of the flags are visible from each of the viewing points; the disappearance of flags and fresh ones appearing as the competitor moves from one viewing point to the next can add considerable interest.

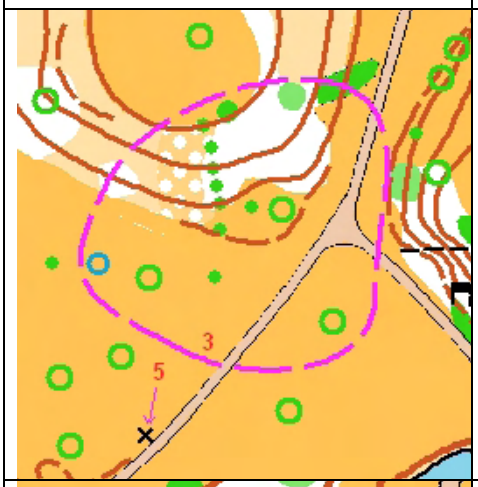
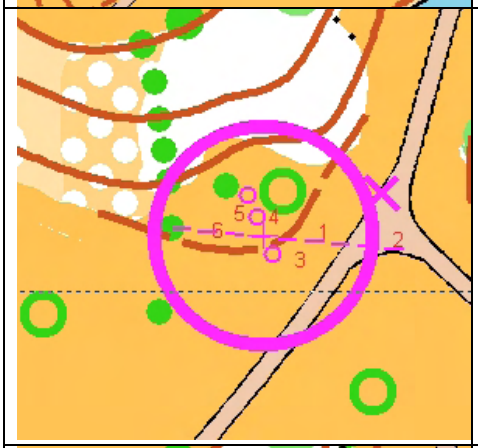
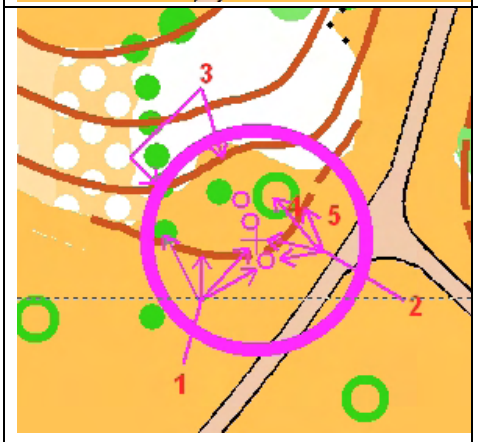
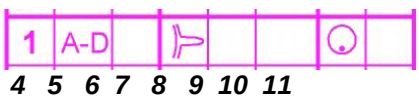
When overlapping is not intended and flags from other sites are visible and could confuse competitors, then boundary lines separating the sites may be drawn on the maps and/or separating tapes laid in the terrain and/or at the decision point.

Overlapping control sites have featured in World Cup Trail-O but not yet in WTOC events.

APPENDIX 2

EXAMPLE OF CONTROL QUALITY CHECK SHEET

This complete example is from WTOC 2008 Day 1 Control 1.

WTOC2008 Day 1 Control: 1		Date ___/__/__
	**Map analysis around control** 1) All features on map identified in terrain 2) Features correctly positioned relative each other 3) Features drawn with correct symbols 4) Map correction required 5) Special symbol –> bulletin, map	1 √ 2 √ 3 √ 4 √ 5 √ 6 7 8 9 10 11 12
	**Control analysis : position by** **Leading lines 1** • Possible lines numbered and checked in terrain. • All lines between all features support right answer **Compass bearing 2** • Bearings numbered, checked and recorded • Bearing separation guideline obeyed **Distance estimation 3,4,5,6** • Distances numbered, checked and recorded • Distance 25% guideline obeyed	1 √ 2 √ 280 3 √ 7m 4 √ 5m 5 √ 6m 6 √ 9m 7 8 9 10 11 12 13 14 15
	**Control analysis : position by** **Mapped feature 1,2** • Confirm correct feature • Confirm flag position on control feature (inc zero) **Contouring & altitude 1,2,3,4,5** • Confirm height (altitude) of control feature • Confirm reference point from which contour line can be traced **Other flags** • All other flag positions sensible 14 • All flag positions marked in terrain 15	1 √ 2 √ 3 √ 4 √ 3m 5 √ 5m 6 7 8 9 10 11 12 13 14 √ 15 √
	**Control description** 1) Conforms to rules and guidelines 2) Description agrees with centre of the circle 3) There is no better description	1 √ 2 √ 3 √ 4 √ 5 √ 4 6 √ 7 √ 8 √ 9 √ 10 √ ? 11 √